Monetary Policy and Banking Sector Stability in Nigeria

Chizoba E. Didigu[1,2] , Nsikak J. Joshua[2], Joel I. Okon[2], Annette O. Eze[2], Jurbe Y. Gopar[2], Charles N. Oraemesi[2], Blessing-Oxford U. Udofia[2], Daniel N. Yisa[2], Jude C. Ejinkonye[2], and Victoria E. Ette[2]

This study investigates the impact of monetary policy on banking sector stability in Nigeria, utilizing quarterly data for the period 2007Q1 to 2021Q4. The study employs the autoregressive distributed lag (ARDL) bounds testing approach to cointegration. Results show that a long run relationship exist between banking sector stability and monetary policy in Nigeria. Furthermore, monetary policy rate, liquidity ratio, and cash reserve ratio are found to enhance banking sector stability. The study recommends, among others, that cash reserve and liquidity ratios should be kept at levels that will prevent excess liquidity in the system.

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1. Introduction

In recent time, there has been intense debate on the efficacy of monetary policy in ensuring financial system stability. This is because, prior to the 2007 to 2009 global financial crises, the overarching objective of monetary policy in almost all countries of the world was that of price stability. The rationale behind the focus of monetary policy on price stability was that its achievement could ensure macroeconomic stability (Mordi *et al.,* 2007). It was a common belief that achieving price stability would lead to achievement of financial stability. In this regard, monetary policy mandate of price, and financial stability were best considered as being complementary to each other (Padoa-Schioppa, 2002; Issing, 2003). However, the collapse of some of the world's renowned financial systems brought about by the global financial crisis tend to underscore the fact that monetary policy aimed at price stability seemed not to have guaranteed financial system stability after all, thereby reigniting the debate

[1]Corresponding Author: cedidigu2@cbn.gov.ng
[2]Authors are staff of the Statistics Deaprtment, Central Bank of Nigeria. The views expressed in this paper are those of the authors and do not in any way represent the position of the Central Bank of Nigeria.

on the role of central banks in ensuring financial sector stability through monetary policy both in normal and crisis periods (Gameiro *et al.,* 2011). As a result, there have been arguments that central banks need to pursue their mandates beyond price stability to incorporate financial system stability as one of the mandates of monetary policy (International Monetary Fund [IMF, 2015]).

The 2007 Central Bank of Nigeria (CBN) Act mandates the apex bank as one of its objectives to promote financial system stability. The CBN ensures the safety and soundness of the financial system in Nigeria through banking sector reforms, improved access to finance, adequate institutional capacity building and implementation of good corporate governance practices (CBN, 2010). Ensuring financial and banking system stability is important because the failure of financial institutions, particularly banks, is capable of undermining public confidence, precipitate unanticipated contraction in money supply, reduce savings and investments, and induce payment system collapse with adverse effects on the real economy (Oboh, 2014). More so, the stability of the financial system is very imperative since its achievement ensures effective monetary policy transmission mechanism. As such, ensuring financial system stability will help monetary authorities in achieving the primary objective of price stability (Oboh, 2014).

To achieve financial and banking system stability, the CBN at different times had instituted various reforms aimed at ensuring effective performance of the banking sector. The liberalization of the financial system in 1986 as one of the major components of the Structural Adjustment Programme (SAP) marked a major effort at ensuring the stability of the financial system in Nigeria. Under the SAP initiative, the major reform in the financial sector was the deregulation of interest and exchange rates, implementation of market-based monetary policy, strengthening of regulatory and supervisory institutions, establishment of the Nigeria Deposit Insurance Corporation (NDIC) and granting of licenses to more banks (Ogujiuba & Obiechina, 2011). The interest rates deregulation mechanism, which was meant to stimulate savings and ensure efficient allocation of resources could not achieve its objectives as it rather led to increased lending rates and decreased savings deposit rate, resulting in a widened interest rate spread. With the persistent exchange rate volatility, coupled

with public sector deficit financed by the CBN, there was soaring inflation (Ogujiuba & Obiechina, 2011). During the liberalization era, the country witnessed episodes of banking crises and instability in the financial system. For instance, between 1989 and 1996, there was severe illiquidity and systemic distress in the banking sector, which led to an increase in the number of distressed banks from 8 to 52 (Iyede *et al.*, 2018; Chete, 2001; Adeyemi, 2011). The situation worsened in the early 2000s as the banking sector was characterized by structural and operational weaknesses, persistent illiquidity, financial distress, and gross insider abuses, resulting in huge non-performing loans, poor asset base, weak management, and poor corporate governance (Soludo, 2004). The CBN embarked on the recapitalization policy which strengthened and increased the capital base of the banks in the system through mergers and acquisitions.

In 2008, the Nigerian banking system was rocked by another financial crisis, caused by the effect of the global financial crisis of 2007 to 2009 (Echekoba *et al.*, 2017). The crisis witnessed during this period affected the performance of the Nigerian banking system as the share of non-performing loans to total loans rose from 7.19% in 2008 to 36.25% in 2009. The CBN came to the rescue of 8 banks by injecting liquidity to restore sanity and confidence in the banking sector. In 2010, the Asset Management Corporation of Nigeria (AMCON) was established to tackle the issue of non-performing loan assets of commercial banks (CBN, 2014).

Theoretically, the role of monetary policy in ensuring financial stability could be found in the leaning against the wind theory. According to the theory, monetary policy could play a proactive role in curtailing financial instability. Specifically, a more proactive monetary policy action through an active interest rate policy has the capability to mitigate bust and prevent crisis in the financial system (Cecchetti *et al.*, 2002). The theory further identified the risk-taking monetary transmission channel as the major route through which monetary policy could have real influence on the stability/instability of the financial system (White, 2009). This means that a well-implemented interest rate policy has the ability to streamline instability and crisis in the financial system. On empirical ground, several studies have investigated the link between monetary policy and financial and banking system stability in Nigeria

(Ajisafe *et al.*, 2021; Oparah & James, 2020; and Hamilton *et al.* , 2020). This study differs from the previous studies by further examining the impact of monetary policy on banking stability from the angle of banking soundness, using an aggregate Z-score in a more extensive manner to capture banking stability. As such, all four indicators of banking soundness (capital adequacy ratio (CAR), asset quality (ASQ), liquidity (LQD) and returns on asset (ROA)) were used in the construction of the Z-score for this study. This study also differs from the previous ones in Nigeria by using a high frequency time series data on quarterly basis from 2007Q1 to 2021Q4. Furthermore, the study employed the autoregressive distributed lag (ARDL) technique for its estimation. The ARDL is adopted because it could be applied even if the variables are integrated of mixed orders. The ARDL technique is also suitable for studies with small sample size (Latif *et al.*, 2015).

The objective of this study is to investigate the impact of monetary policy on banking system stability in Nigeria. Findings from this study would be beneficial to the monetary authority as they would help in policy formulation to curtail instability in the banking sector in Nigeria. This study also contributes to the body of existing literature on the impact of monetary policy on banking system stability as well as banking soundness in Nigeria.

The rest of this study is structured as follows: Section 2 presents theoretical and empirical literature review; data and methodology of the study are discussed in Section 3; Section 4 presents results and discussion; and Conclusion and policy recommendations are presented in Section 5.

2. Literature Review

2.1 Theoretical Literature

This section reviews three theories linking monetary policy to financial stability, namely Benign neglect theory, monetary transmission mechanism theory and leaning against the wind theory. The *'Benign neglect'* theory was developed by Bernanke and Gertler (1999 & 2001) and further elaborated by Greenspan (2002). The theory states that monetary policy should focus primarily on price stability rather than on financial stability because achievement of price stability would automatically lead to financial sector stability. In this regard, the theory states that monetary policy

should play a reactive role in the event of financial crisis. This means that monetary authorities should activate monetary policy actions only when there is crisis in the financial system but not to adjust monetary policy in a pre-emptive manner (Bordo & Jeanne, 2002; Gameiro *et al.* 2011). Thus, central banks need not take actions directly when there is financial instability such as asset boom-bust or credit boom but should adopt a laissez-faire approach and work indirectly in addressing financial instability through the primary goal of price stability (Greenspan, 2002).

The leaning against the wind theory was developed by Cecchetti *et al.*, (2002) and states that monetary policy should play a proactive rather than a reactive role in curtailing financial instability. According to the theory, monetary authorities should implement monetary policy that would mitigate financial crisis proactively rather than instituting policy actions that will clean up the mess after financial crisis might have occurred (IMF, 2015). The proponents of this theory argued that leaning is not only about preventing financial crisis but promoting financial stability, even when there is a possibility of financial instability occurring at the remote level (Borio & Lowe, 2002; Bank of International Settlement [BIS, 2016]; and Juselius *et al.,* 2016). The theory further contends that a more proactive monetary policy action through an active interest rate policy has the capability to mitigate bust and prevent crisis in the financial system. Thus, monetary policy tightening even in the face of market bubbling could limit the build-up of significant price misalignment, which results in financial instability (Borio & White, 2004). The theory then identified the risk-taking monetary transmission channel as the major route through which monetary policy could have real influence on the stability of the financial system through boom-bust cycles in asset prices (White, 2009).

The monetary transmission mechanism theory identified channels through which monetary policy is transmitted to affect the decisions of firms, households, financial intermediaries, investors and ultimately economic activities and prices (Kuttner, 2003). Kuttner (2003) spelt out four channels through which monetary policy transcends into the economy, namely: interest rate, credit, exchange rate, and risk-taking channels. The interest rate channel is the primary transmission channel in the monetary policy-financial stability nexus. The theory suggests that an increase in monetary

policy rate leads to an increase in interest (lending) rate by the banks. An increase in the cost of borrowing increases the probability of loan default, leading to high ratio of non-performing loans and vice versa. The credit channel is dependent on a well-functioning financial system and involves the impact of monetary policy action on the balance sheet of banks and their supply of credit (Gameiro *et al.,* 2011). For instance, an expansionary monetary policy through contraction in bank reserves would lead to increase in the amount of bank loans. On the other hand, a tight monetary policy through expansion in bank reserves reduces bank lending with its attendant negative effect on the performance of the banks. The exchange rate channel works through the uncovered interest rate parity condition. According to the theory an increase in domestic interest rate relative to foreign interest rate will result in currency appreciation and reduction in net export earnings by firms that borrowed funds from the banks. This could result in loan default with negative impact on the performance of banks, particularly if such loans were foreign currency denominated. Lastly, the risk-taking channel has effect on banks' balance sheet and lending ability of the banks. A decrease in interest rate leads banks to grant loans to riskier borrowers and those with bad credit history, resulting in financial instability and vice versa (Gameiro *et al.,* 2011).

This study is anchored on the leaning against the wind theory based on the forward-looking and proactive nature of monetary policy decisions by Nigeria's monetary authority. In the event of perceived financial distress, the CBN puts certain policy actions in place to mitigate against bust and prevent crisis in the financial system.

2.2 Empirical Literature

Several studies exist outside Nigeria on the effect of monetary policy on financial stability. Applying the structural vector autoregressive (SVAR) technique, Cocriş and Nucu (2013) carried out a study on the impact of monetary policy on financial stability in Eastern and Central Europe, using monthly data from 2003 to 2012. Result of their study showed that monetary policy through money market interest rate has short term effect on financial stability in Czech Republic, Hungary, Poland and Romania, while money market interest rate did not enhance financial stability in Bulgaria and Lithuania. Using the structural vector autoregressive (SVAR) model,

Ouhibi and Hammami (2015) investigated the linkage between monetary policy and financial stability among six (6) Southern Mediterranean countries (Tunisia, Egypt, Morocco, Turkey, Lebanon and Jordan), utilizing monthly data from 2006 to 2013. The result indicated that for countries that executed flexible exchange rate (such as Turkey, Tunisia, Egypt and Morocco), monetary policy strategy through short term interest rate influenced financial stability.

On the other hand, countries that executed a regime of fixed exchange rate (such as Lebanon and Jordan), monetary policy through short term interest rate did not have positive effect on financial stability. Tabak *et al.,* (2013) investigated the role of monetary policy in ensuring financial stability in Brazil, using monthly data from 2003 to 2009. The fixed effect panel technique of estimation was used. Result showed a positive relationship between monetary policy and financial stability in Brazil. Khataybeh and Al-Tarawneh (2016) empirically estimated the association between monetary policy and financial stability in Jordan, using monthly data from September, 1993 to December, 2012 and employing the vector autoregressive (VAR) technique. Results showed that changes in excess reserves and changes in domestic credit have positive effect on financial stability. Result of the granger causality test indicated that excess reserves and credit granger caused financial system stability. Ayomi *et al.* (2021) investigated the impact of monetary policy and bank competition on banking default in Indonesia from 2009 to 2019, adopting the generalized method of moment (GMM) technique. Result revealed that monetary policy through benchmark rate impacted positively on risk of banking stability, while credit interest rate impacted negatively on risk of banking stability.

In Nigeria, several studies have been carried out on the impact of monetary policy on financial stability. Oparah and James (2020) investigated the impact of monetary policy on financial stability of the banking sector in Nigeria, using quarterly data from 2008Q1 to 2016Q2 and employing the error correction model (ECM) technique. Result showed that monetary policy enhanced financial stability through open market operations and exchange rate. Hamilton *et al.* (2020) undertook a study on the effect of monetary policy on banking system distress in Nigeria from 1989 to 2018, employing the error correction model (ECM) technique. Results showed that mon-

etary policy, represented by monetary policy rate exerted negative effect on banking distress in the long run and positive effect on banking distress in the short run. Also, exchange rate exerted positive effect on banking distress in Nigeria. Ajisafe *et al.* (2021) examined the effect of monetary policy on financial stability in Nigeria from 1986 to 2017, employing vector error correction method. Result showed that monetary policy has significant effect on financial stability in Nigeria, particularly through exchange rate.

Atoi (2018) investigated the drivers of non-performing loans and its effect on banking stability in Nigeria, from 2014Q2 to 2017Q2, employing the general method of moment (GMM) technique. The result showed that lending rate, exchange rate and liquidity ratio were drivers of non-performing loans and banking stability responded negatively to shocks in non-performing loans.

The review of empirical studies showed that several studies exist for Nigeria, investigating the impact of monetary policy on financial/banking stability. For instance, Hamilton *et al.* (2020) and Ajisafe *et al.* (2021) used annual time series data for their analysis, while Oparah and James (2020) employed quarterly time series on a relatively short time frame from 2008Q1 to 2016Q2. This study differs from Oparah and James (2020) by utilizing quarterly data on a longer scale (2007Q1 to 2021Q4). Also, unlike Oparah and James (2020) and Hamilton *et al.* (2020) that employed the error correction model (ECM) technique, this study employed the autoregressive distributed lag (ARDL) bounds testing approach to cointegration. The rationale behind the application of the ARDL technique is that it could be applied for a mixture of I(0) and I(1) time series.

3. Data and Methodology

3.1 Data

Data for this study were obtained from secondary sources such as Statistical Bulletins, Annual Reports and Statement of Accounts, and Financial Stability Reports of the CBN and were collected on quarterly basis from 2007Q1 to 2021Q4. The description of variables and measurement of data are presented in Table 1.

Table 1: Description of variables and measurement

S/N	Variables	Description and measurement
1.	Financial (banking) stability index	Banking stability index is captured by the Z-score. The Z-score captures the probability of default of a country's commercial banking system. The Z-score is constructed using four broad banking soundness indicators (capital adequacy ratio, asset quality, liquidity level and profitability level).
2.	Monetary policy rate	The monetary policy rate is the interest rate set by the Central Bank of Nigeria to serve as an indicative rate for transactions in the interbank money market. It is measured in percentage.
3.	Treasury bills rate	Treasury bills are are short-term securities issued by the CBN on behalf of the Federal government at a discount for a tenor ranging from 91 to 364 days. It is an instrument of open market operation. It is measured in percentage.
4.	Liquidity ratio	Liquidity ratio is the proportion of the deposit money banks' liquid assets which is kept with the Central Bank. It is measured in percentage.
5.	Cash reserve ratio	This is a percentage of the total deposits the CBN requires deposit money banks to keep with it. It is measured in percentage.
6.	Exchange rate	This is the units of the domestic currency per unit of the foreign currency. This is measured by units of naira per US dollar.

3.2 Model Specification

Empirical equation for this study is anchored on the "leaning against the wind" theory. Based on the theoretical anchor, the equation for this study was built and specified. The dependent variable is banking sector stability, represented by the banking stability index which was constructed using the Z-score. The independent variable is monetary policy, captured by quantitative policy instruments such as monetary policy rate, open market operation, represented by treasury bills rate, liquidity ratio, cash reserve ratio and exchange rate. Monetary policy variables were derived from the leaning against the wind theory. The empirical model for this study as abstracted from previous studies such as Atoi (2018), Hamilton et *al.* (2020), Oparah and James (2020), Ayomi *et al.* (2021) and Ajisafe *et al.* (2021) can be specified functionally as follows:

$$BSI = f(MPR, TBR, LQR, CRR, EXR) \tag{1}$$

where: BSI = banking stability index, MPR = monetary policy rate, TBR = treasury bills rate, LQR = liquidity ratio, CRR = cash reserve ratio and EXR = exchange rate. The econometric specification of equation (1) can be expressed in its explicit form as follows:

$$BSI = \omega_0 + \omega_1 MPR + \omega_2 TBR + \omega_3 LQR + \omega_4 CRR + \omega_5 EXR + U_t \tag{2}$$

where: $\omega_0, \ldots, \omega$, are the parameters to be estimated and U_t is the stochastic error term, assumed to be normally distributed. The theoretical expectations about the coefficients of the regressors are stated as follows: $\omega_1 > 0$, $\omega_2 > 0$, $\omega_3 > 0$, $\omega_4 > 0$, $\omega_5 > 0$ Measuring banking system stability posed difficulty since there is no known aggregate indicator used by central banks to measure financial stability. As such, the process of constructing aggregate financial stability index is still ongoing and in experimental state (Geršl & Hermánek, 2008; Sere-Ejembi, *et al.,* 2014). The banking stability index for this study is constructed using Z-score for the four main variables of banking soundness indicators, namely capital adequacy ratio, asset quality, liquidity level and profitability level. The Z-score is purely an idiosyncratic measure of banking stability based on simple statistical principle, calculated using the formula:

$$Z = \frac{X - \mu}{\sigma} \tag{3}$$

where: $Z =$ the $Z - score$ (that is, banking stability index), $X =$ a particular banking stability/soundness indicator (capital adequacy ratio, asset quality, liquidity and returns on asset), $\mu =$ mean value of a particular banking stability/soundness indicator (capital adequacy ratio, asset quality, liquidity and profitability), and $\sigma =$ standard deviation of a particular banking stability/soundness indicator (capital adequacy ratio, asset quality, liquidity and returns on asset). Thus, the banking stability (soundness) index based on the Z-score is computed as follows:

$$BSI = Z_1 CAR + Z_2 ASQ + Z_3 LQD + Z_4 ROA \tag{4}$$

3.3 Estimation Procedures

The study adopted the ARDL technique based on the bounds testing approach to

cointegration, developed by Pesaran *et al.* (2001). One major advantage of this technique is the fact that it can be applied in the estimation process irrespective of whether the series is either purely I(0) or I(1) or mutually integrated, and suitable for studies with small sample size (Latif *et al.*, 2015). The ARDL method usually proceeds in two stages. In the first stage, the cointegration test (bounds test) is carried out. The second stage involves the estimation of the long-run and the short-run coefficients of the specified equations (Pesaran *et al.*, 2001; Narayan, 2005).

3.3.1 Bounds Test for Cointegration

The ARDL model isspecified as follows:

$$\begin{aligned}\Delta BSI_t = \omega_0 + \omega_1 BSI_{t-1} + \omega_2 MPR_{t-1} + \omega_3 TBR_{t-1} + \omega_4 LQR_{t-1} + \omega_5 CRR_{t-1} \\ + \omega_6 EXR_{t-1} + \sum_{i=1}^{k} \omega_{7i} \Delta BSI_{t-i} + \sum_{i=0}^{k} \omega_{8i} \Delta MPR_{t-i} + \sum_{i=0}^{k} \omega_{9i} \Delta TBR_{t-i} + \\ \sum_{i=0}^{k} \omega_{10i} \Delta LQR_{t-i} + \sum_{i=0}^{k} \omega_{11i} \Delta CRR_{t-i} + \sum_{i=0}^{k} \omega_{12i} \Delta EXR_{t-i} + U_t \quad (5)\end{aligned}$$

where: ω_0 to ω_{12} are the parameters to be estimated and U_t is the error term. To test for the existence of a long run relationship among the variables, the null hypothesis and alternative hypothesis were set up from the bounds test equation in (5) as follows:

Null hypothesis (H_0): $\omega_1 = \omega_2 = \ldots = \omega_6 = 0$ (no long run relationship).

Alternative hypothesis (H_a): $\omega_1 \neq \omega_2 \neq \ldots \neq \omega_6 \neq 0$ (there is long run relationship).

For an acceptable conclusion to be reached, the computed F-statistic is compared to the critical bounds values. If the computed F-statistic is greater than the upper critical bound value, then a long run relationship exists among the variables. On the other hand, if the computed F-statistic is less than the lower critical bound value, then there is no long run relationship among the variables. However, if the F-statistic lies in-between the lower and the upper critical bound values, then the results are inconclusive.

3.3.2 ARDL Error Correction Model

From Pesaran *et al.* (2001) specification, the unrestricted error correction model

(UECM) based on (1) can be specified as:

$$\Delta BSI_t = \omega_0 + \sum_{i=1}^{j} \omega_{1i}\Delta BSI_{t-i} + \sum_{i=0}^{j} \omega_{2i}\Delta MPR_{t-i} + \sum_{i=0}^{j} \omega_{3i}\Delta TBR_{t-i} + \sum_{i=0}^{j} \omega_{4i}\Delta LQR_{t-i} + \sum_{i=0}^{j} \omega_{5i}\Delta CRR_{t-i} + \sum_{i=0}^{j} \omega_{6i}\Delta EXR_{t-i} + \pi ECM_{t-i} + U_t \quad (6)$$

where: U_t is the error term, and π is the error correction factor, indicating speed of adjustment from short run disequilibrium to long run equilibrium.

3.4 Post Estimation/Diagnostic Checks

The study conducted several post-estimation/diagnostic tests to ascertain the reliability and adequacy of the estimated equation. The cumulative sum of recursive residuals (CUSUM) and the Ramsey RESET tests were employed to check for the stability of the model. The Breusch-Godfrey serial correlation Lagrange multiplier (LM) was used to test for autocorrelation. The Breusch-Pagan-Godfrey autoregressive conditional heteroscedastcity (ARCH) test was conducted to check for heteroscedasticity, and the Jarque-Bera test was used to determine the normality of the estimated equation.

4. Results and Discussion

4.1 Pre-estimation Results

The descriptive statistics are presented in Table 2. The banking stability index has an average value of -0.004% during the evaluation period, with the maximum value of 4.11% and the minimum value of -4.66%. The low standard deviation of the banking stability index of about 1.92 showed that there was low variability between the mean and the median values of the banking stability index during the period of analysis. This means that there was prevalence of banking stability and less of instability in the banking system during the period of evaluation. Monetary policy rate has an average value of 11.23%, with maximum value of 14.00% and minimum value of 6.00%. Its low standard deviation of value of 2.46 showed that there was low variability between the average and the median values of the monetary policy rate. This means that monetary policy rate did not deviate far from its average value of 11.23% during the evaluation period.

Table 2: Descriptive statistics

	BSI	MPR	TBR	LQR	CRR	EXR
Mean	-0.004	11.229	8.748	30.417	14.650	219.682
Median	-0.325	12.000	9.840	30.000	15.000	157.670
Maximum	4.110	14.000	14.490	40.000	31.000	412.440
Minimum	-4.660	6.000	0.030	25.000	1.000	117.740
Std. Dev.	1.917	2.467	3.754	3.599	10.005	91.857
Skewness	0.319	-0.836	-0.514	1.526	-0.133	0.671
Kurtosis	2.697	2.638	2.409	5.813	1.456	1.966
Jarque-Bera	1.246	7.309	3.510	43.066	6.133	7.183
Probability	0.536	0.026	0.173	0.000	0.047	0.028
Sum	-0.210	673.750	524.890	1825.000	879.000	13180.890
Sum Sq. Dev.	216.813	359.037	831.617	764.583	5905.650	497827.700
Observations	60	60	60	60	60	60

Note: BSI, MPR, TBR, LQR, CRR, and EXR denote banking stability index, monetary policy rate, treasury bill rate, liquidity ratio, cash reserve ratio, and exchange rate, respectively.

The average value of treasury bills rate during the period of analysis was about 8.75%, while its maximum and minimum values were 14.49% and 0.03%, respectively. The standard deviation value of 3.75 showed that there was low variability between the mean and the median values of the treasury bills rate. This implies that there was no wide deviation of the treasury bills rate from its average value. Liquidity ratio has an average value of about 30.42% and its maximum and minimum values were 40.00% and 25.00%, respectively. The low standard deviation of 3.59 showed that there was low variability between the mean and the median values of the treasury ills rate. The average value of the cash reserve ratio was about 14.65%, while its maximum and minimum values were 31.00% and 1.00%, respectively, with the standard deviation of about 10.01. The low value of the standard deviation means that cash reserve ratio values clustered around its average value. Lastly, exchange rate has an average value of ₦219.68:$1, with its maximum value of ₦412.44:$1 and minimum value of ₦117:$1. The high standard deviation value of about 91.86 showed that there was high variability in the exchange rate during the evaluation period.

Analysis of skewness showed that the distributions for banking stability index, liquid-

ity ratio and exchange rate were rightly skewed or tailed, given the positive skewness values taken by the variables. This revealed the asymmetric nature of the distributions. On the other hand, the distributions for monetary policy rate, treasury bills rate and cash reserve ratio were skewed to the left, given the negative skewness values exhibited by the variables. Analysis of kurtosis showed that the distribution for liquidity ratio was leptokurtic, given that its kurtosis value was at least 3. The distribution for banking stability index, monetary policy rate, treasury bills rate, cash reserve ratio and exchange rate were platykurtic, given that their kurtosis values were less than 3.

The results of the unit root tests based on the augmented Dickey-Fuller (ADF) and the Phillips-Perron (PP) tests are reported in Table 3.

Table 3: Unit root tests

Variable	ADF statistic			PP statistic		
	Level	1st diff.	Remarks	Level	1st diff.	Remarks
BSI	-2.348	-8.459***	I(1)	-2.120	-8.936***	I(1)
MPR	-1.283	-6.632***	I(1)	-1.463	-6.666***	I(1)
TBR	-1.776	-7.199***	I(1)	-1.905	-7.296***	I(1)
LQR	-1.497	-9.757***	I(1)	-2.924**	-	I(0)
CRR	-0.748	-9.263***	I(1)	-0.748	-9.286***	I(1)
EXR	-0.253	-6.406***	I(1)	-0.187	-6.315***	I(1)

Note: BSI, MPR, TBR, LQR, CRR, and EXR denote banking stability index, monetary policy rate, treasury bill rate, liquidity ratio, cash reserve ratio, and exchange rate, respectively. diff. = difference. ***, ** and * denote significance at 1%, 5% and 10%, respectively.

The result of the Augmented Dickey-Fuller (ADF) test showed that no variable was stationary at the level but were stationary after their first differences. The Phillips-Perron (PP) tests showed that one variable (liquidity ratio) was stationary at level, while the remaining variables were stationary after first difference. Since the variables are mutually integrated [that is, the variables were either I(0) or I(1)], the ARDL bounds testing procedure was employed in ascertaining the existence of cointegration among the variables.

Table 4 presented the correlation matrix for the correlations among the variables in the estimated equations.

Table 4: Correlation analysis

	BSI	MPR	TBR	LQR	CRR	EXR
BSI	1.000					
MPR	-0.246	1.000				
TBR	-0.080	0.307	1.000			
LQR	0.397	0.094	-0.048	1.000		
CRR	-0.317	0.803	-0.135	-0.099	1.000	
EXR	-0.266	0.563	-0.309	-0.171	0.841	1.000

Note: BSI, MPR, TBR, LQR, CRR, and EXR denote banking stability index, monetary policy rate, treasury bill rate, liquidity ratio, cash reserve ratio, and exchange rate, respectively.

As shown on Table 4, monetary policy rate (MPR) exhibited negative relationship with banking stability index (BSI), given its negative correlation coefficients of -0.246. Similarly, treasury bills rate (TBR) exhibited negative correlation with banking stability index (BSI), given its negative correlation coefficient of -0.080. Meanwhile, liquidity ratio (LQR) has a positive relationship with banking stability index (BSI), with its negative correlation coefficient of 0.397. Lastly, cash reserve ratio (CRR) and exchange rate (EXR) exhibited negative correlation with banking stability index (BSI), given their correlation coefficients of -0.317 and -0.266, respectively. Examination of the correlation matrix showed that there were low pair-wise correlation coefficients among the majority of the independent variables. Therefore, we can conclude that there is no serious problem of multicollinearity among the independent variables in the estimated equations. Hence, the variables could be utilized for the estimation in this study.

4.2 Estimation Results

The results of the co-integration test based on the ARDL bounds testing procedure is presented in Table 5. The F-statistic (7.73) is greater than the upper critical bound (3.79) at the 5% level of significance. This outcome showed that there is long run equilibrium relationship among the variables. The long run results are presented in Table 6.

Table 5: Bounds test for cointegration

Test Statistic	Value	Signif.	I(0)	I1
F-statistic	7.732	10%	2.26	3.35
K	5	5%	2.62	3.79
		2.5%	2.96	4.18
		1%	3.41	4.68

Table 6: Long run estimates of the banking stability index equation

Dependent Variable: D(BSI)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
MPR	1.495	0.369	4.048	0.000
TBR	0.760	0.144	5.256	0.000
LQR	0.706	0.126	5.585	0.000
CRR	0.267	0.082	3.254	0.003
EXR	0.009	0.005	1.830	0.081

Note:MPR, TBR, LQR, CRR, and EXR denote monetary policy rate, treasury bill rate, liquidity ratio, cash reserve ratio, and exchange rate, respectively.

The results showed that monetary policy rate positively and significantly impacted on banking stability index in Nigeria at 5% level of significance. This means that monetary policy tightening through the monetary policy anchor rate helps to mob up excess liquidity in the banking system and enhance banking sector stability in Nigeria. In line with a priori expectation, treasury bills rate exerted positive and significant effect on banking stability index in the long run at 5% level of significance. This means that monetary policy decision through open market operations enhanced the stability of the banking system in Nigeria in the long run. Furthermore, liquidity ratio impacted positively and significantly on banking stability in Nigeria at the 5% level of significance. This means that monetary policy decision through maintenance of adequate level of liquidity in the banking system enhanced banking system stability in Nigeria. Meanwhile, cash reserve ratio exhibited significant positive long run impact on bank stability index at 5% level of significance. This means that raising the level of cash reserve ratio limits the ability of banks to amass excess liquidity in the banking system and ensure banking system stability in Nigeria. Lastly, the impact of exchange rate on banking stability is weak as it became significant only at 10% level.

Before the ARDL error correction model was estimated, a model selection test was carried out to determine the best model for the study. The ARDL model selection criteria was based on the Akaike information criteria. The test evaluated 20 top possible models. The best model is one with the least AIC value. The result of the model selection criteria is presented in Figure 1. As indicated in the figure, the selected model based on the Akaike information criteria (AIC) was given as: ARDL (5,5,5,5,5,3).

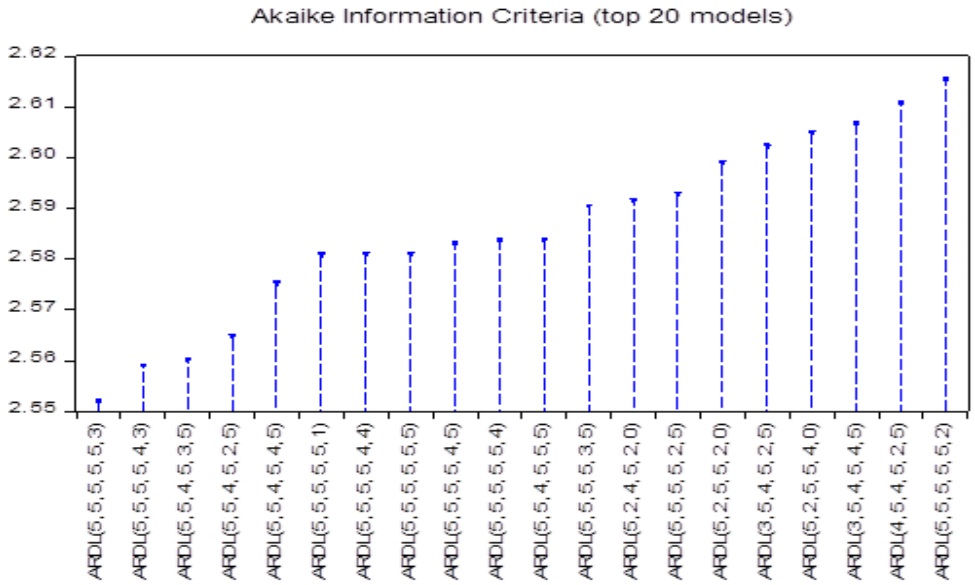

Figure 1: Graphical representation of model selection criteria

Results of the short run dynamics of banking system stability are presented in Table 7. The result showed that the error correction factor has a negative sign and is statistically significant in line with expectation. Its coefficient of 0.907 showed that about 91% of the discrepancy between the actual and the expected banking stability index was corrected within a quarter, indicating a fast speed of adjustment. The adjusted R-squared of 0.636 showed that about 64% of the total variation in the banking stability index was accounted for by its determinants. The model thus has a moderately high explanatory power. The Durbin-Watson value of 1.937 showed that there is no problem of serial correlation in the model.

Table 7: ARDL error correction estimates of banking stability index equation

Dependent Variable: D(BSI)				
Selected Model: ARDL(5, 5, 5, 5, 5, 3)				
Variable	Coefficien	Std. Error	t-Statistic	Prob.
C	-16.672	2.139	-7.794	0.000
D(BSI(-1))	0.189	0.122	1.543	0.137
D(BSI(-2))	0.116	0.125	0.927	0.364
D(BSI(-3))	-0.269	0.110	-2.444	0.023
D(BSI(-4))	-0.460	0.126	-3.632	0.001
D(MPR)	-0.359	0.265	-1.356	0.189
D(MPR(-1))	0.864	0.214	4.033	0.000
D(MPR(-2))	-0.534	0.195	-2.737	0.012
D(MPR(-3))	-0.227	0.200	-1.132	0.270
D(MPR(-4))	-0.553	0.171	-3.225	0.004
D(TBR)	0.118	0.076	1.551	0.135
D(TBR(-1))	-0.330	0.080	-4.114	0.000
D(TBR(-2))	-0.103	0.080	-1.292	0.210
D(TBR(-3))	-0.150	0.064	-2.317	0.030
D(TBR(-4))	0.193	0.067	2.872	0.009
D(LQR)	-0.009	0.072	-0.128	0.899
D(LQR(-1))	-0.777	0.104	-7.416	0.000
D(LQR(-2))	-0.582	0.108	-5.380	0.000
D(LQR(-3))	-0.765	0.117	-6.498	0.000
D(LQR(-4))	-0.306	0.108	-2.821	0.010
D(CRR)	0.193	0.051	3.724	0.001
D(CRR(-1))	-0.069	0.051	-1.362	0.187
D(CRR(-2))	0.036	0.056	0.645	0.525
D(CRR(-3))	0.223	0.063	3.519	0.002
D(CRR(-4))	0.152	0.067	2.269	0.033
D(EXR)	0.042	0.010	3.885	0.000
D(EXR(-1))	0.001	0.009	0.214	0.832
D(EXR(-2))	0.019	0.008	2.377	0.027
CointEq(-1)*	-0.907	0.119	-7.579	0.000
R-squared	0.825	Adjusted R-squared		0.636
F-statistic	4.383	Durbin-Watson stat		1.937
Prob(F-statistic)	0.000			

Given the conflicting signs of the estimated coefficients of the variables (as a result of their lag structures), it is difficult to isolate clearly the specific effect of the monetary policy variables on the banking stability index in Nigeria. To overcome this difficulty, the Wald Test was conducted on the coefficients of each of the independent variables to determine the net effect of the particular variable on the dependent variable. The result of the transformed short run model is presented in Table 8.

Table 8: ARDL transformed short run estimate equation

Dependent Variable: D(BSI)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-16.67	2.139	-7.794	0.000
$D(BSI_{t-i})$	-0.189	0.212	-0.889	0.383
D(MPR)	1.909	0.692	2.756	0.011
D(TBR)	1.092	0.350	3.113	0.005
D(LQR)	0.209	0.172	1.211	0.239
D(CRR)	0.755	0.266	2.833	0.009
D(EXR)	0.222	0.107	2.073	0.050

Note: BSI, MPR, TBR, LQR, CRR, and EXR denote banking stability index, monetary policy rate, treasury bill rate, liquidity ratio, cash reserve ratio, and exchange rate, respectively. D is difference operator.

The results showed that monetary policy rate has positive and significant effect on banking stability index in Nigeria at the 5% level of significance. This means that monetary policy decision employing monetary policy rate enhanced banking system stability in Nigeria. Since monetary policy rate is an anchor rate, increasing it also affects other interest rates such as lending rate and reduces the ability of banks to grant excessive and risky loans with high probability of default with its attendant stability effect in the banking system. In real term, a 1% increase in monetary policy rate brought about a 1.91% increase in banking stability index. This outcome is in line with finding obtained by Hamilton, *et al.* (2020) and Cocriş and Nucu (2013).

Treasury bills rate has a positive and significant influence on banking stability index in Nigeria at the 1% level of significance. This means that monetary policy decision using open market operation enhanced banking stability in Nigeria. By buying and selling of securities in an open market, the Central Bank of Nigeria (CBN) can influence the level of liquidity as well as ability of deposit money banks to create excess

and risky loans with high probability of default and ensures the stability of the banking system in Nigeria. In real term, a 1% increase in treasury bills rate resulted in an increase in banking stability index by about 1.09%. This outcome is in agreement with a study carried out by Oparah and James (2020).

Liquidity ratio exerted a positive effect on banking stability in Nigeria in line with a priori expectation. This implied that monetary policy decision using the liquidity ratio instrument enhanced banking stability in Nigeria. The CBN by tinkling with the liquidity ratio helps to maintain the required level of liquidity that enhances banking sector stability in Nigeria. The result in real term showed that an increase in liquidity ratio by 1% resulted in an increase in banking stability index by about 0.21%. This outcome is consistent with Atoi (2018).

Furthermore, cash reserve ratio has positive and significant impact on banking stability in Nigeria at the 1% level of significance. This implied that monetary policy through changes in cash reserve helps to check the ability of banks to grant excessive and risky loans with high default probability and enables stability to be achieved in the banking system. In real term, a 1% increase in cash reserve ratio brought about a 0.76% increase in banking stability index. This result supported the finding obtained by Khataybeh and Al-Tarawneh (2016), who found that changes in excess reserves had positive effect on financial stability.

Lastly, exchange rate has a positive and significant effect on banking stability in Nigeria at the 5% level of significance. This means that an appreciation in the value of the naira against foreign currencies has a stability effect on the banking system in Nigeria. The implication is that a stronger exchange rate is capable of preventing capital flight as well as attracts foreign investment in the domestic financial system. An increase in investment in the banking sector could enhance the performance and hence the stability of the banking system in Nigeria. In real term, a 1% appreciation in exchange rate brought about a 0.22% increase in banking stability index. This result agreed with Atoi (2018) and Ajisafe, *et al*. (2021).

4.3 Diagnostic Tests

Several diagnostic tests were conducted to investigate the adequacy of the estimated

model. The cumulative sum of recursive residuals (CUSUM) and the Ramsey RESET tests were employed to check the stability of the model. The Breusch-Godfrey serial correlation LM test, the ARCH test and the Jarque-Bera test were conducted to check for the existence of the normality of the estimated model. The inferences of these tests are summarized in Table 9 and in Figure 2.

Table 9: Diagnostic test

Test statistic	Value (prob.)
Breusch-Godfrey Serial Correlation LM Test	0.024 (0.975)
Breusch-Pagan-Godfrey Heteroscedasticity Test	1.484 (0.172)
Jarque-Bera Test	1.277 (0.527)
Ramsey RESET Test	1.748 (0.201)

The Breusch-Godfrey LM test statistic (0.024) with a high p-value of 0.975 depicted the absence of autocorrelation. The Breusch-Pagan-Godfrey ARCH test statistic (1.484) with a high p-value of 0.172 depicted the absence of heteroscedasticity. The Jarque-Bera test statistic (1.277) with a high p-value of 0.527 depicted the normality of the estimated model. The result of the CUSUM is presented in Figure 2.

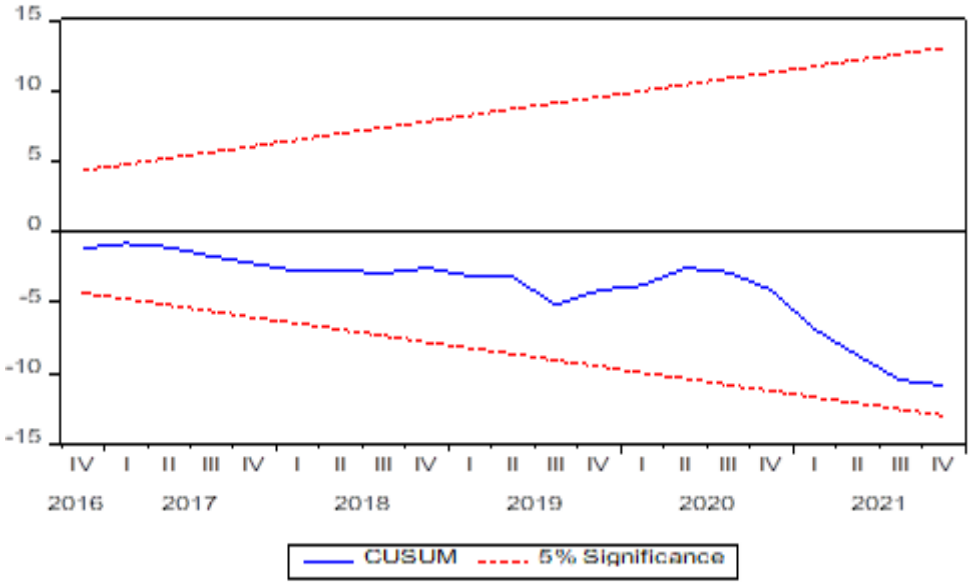

Figure 2: Cumulative sum of recursive residuals (CUSUM) test

An examination of the plot of CUSUM graph showed that the plotted lines wandered within 95% confidence interval which indicated the stability of the model. Similarly,

the Ramsey RESET test statistic 1.748 with a high p-value of 0.201 also depicted the stability of the estimated model. Based on the inferences from the various tests, conclusion could be drawn that the model is adequate.

5. Conclusion and Policy Recommendations

The impact of monetary policy on financial system stability in general and banking stability has generated a lot of arguments. This is because, despite the prudent implementation of monetary policy, there are still some concern on the stability of Nigerian banks. This has led to debates on the effect of monetary policy decision on the stability of the Nigerian financial system with particular emphasis on the banking system. On this premise, this study attempted to investigate the impact of monetary policy on financial sector stability, with reference to banking sector stability in Nigeria, using the ARDL technique and bounds testing approach to cointegration.

Results of the long run estimates showed that exchange rate and monetary policy through instruments such as monetary policy rate, treasury bills rate (open market operations), liquidity ratio, and cash reserve ratio exerted long run positive and significant impact on banking stability index in Nigeria. Results of the short run estimates show that monetary policy rate, treasury bills rate, cash reserve ratio and exchange rate exerted positive and significant impact on banking stability, while liquidity ratio has positive and insignificant effect on banking stability index in Nigeria. The overall conclusion drawn from this study is that monetary policy enhanced banking stability in Nigeria during the period of evaluation. Thus, monetary policy rate, treasury bills rate, and cash reserve ratio are effective instruments of monetary policy decision that could bring significant stability in the banking sector in Nigeria. Similarly, exchange rate is also a significant determinant of banking sector stability.

Based on the results, the study recommended that the monetary authority should keep monetary policy rate at a moderate level that would not generate instability in the banking system. Moderating the monetary policy rate will also moderate the lending rate and reduces the burden of loan repayment and probability of loan default, which could impact significantly on banking stability. The monetary authority should also enahance its use of the open market operations to help regulate the level of liquidity and credit creation in the banking system. The use of open market operation will

help stem the tide of excess liquidity that could bring about instability in the banking sector in Nigeria.

Since excess liquidity could cause banking system instability, the CBN should always ensure cash reserve ratio and liquidity ratio are maintained at conformable levels to ensure stability of the banking system. Lastly, foreign exchange demand side pressure should be minimized through appropriate exchange rate policies such as the imposition of high import tariff on ostentatious imports to ease demand-side pressure of the exchange rate. As such, the harmonization of the various exchange rates and abolition of black and parallel market activities in the foreign exchange market is key in achieving banking stability in Nigeria.

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