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Macro-Prudential Liquidity Management and Financial Distress Resolution in the Nigerian Banking Industry: An ARDL Approach

Adolphus J. Toby& Jibaniya K.Danjuma
Department of Banking and Finance Rivers State University, Nigeria

Abstract
This paper investigates the impact of liquidity management on financial distress resolution in the Nigerian banking industry within the ARDL framework using aggregated time series data.Liquidity management is measured by minimum liquidity ratio, loan to deposit ratio and cash reserve ratio, while financial distress resolution is measured in terms of ratio of distressed bank. The data used consist of annual time series observations from 1986 to 2018 obtained from different versions of Central Bank of Nigeria (CBN) and National Deposit Insurance Corporation (NDIC) as well as the factbook of the Nigerian Stock Exchange (NSE). The plausible ARDL specification is determined using the Schwarz information criterion. We find that macroprudential liquidity measures collectively have a significant effect at 5% level on financial distress resolution, although, individually, their effects are mixed both in terms of sign and interms of significance.
Key words*: Financial distress resolution, liquidity management, ARDL*

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I. Introduction

The banking industry plays a significant role in the Nigerian financial sector. The industry is a key driver of the economy serving as the supplier of oxygen for proper combustion. Besides intermediation role, the industry provides a good channel for the transmission of government economic policies. In their intermediation function, banks take deposits of short maturity and channel same to investors for a long maturity to pay. This maturity mismatch exposes the banks to transformation and asset risks which if not properly managed may create shocks capable of triggering panics that could lead to distress (Toby, 2006). The fragility of the financial sector makes banks susceptible to systemic risk contagion. A shock from a single bank when not promptly and adequately checked could be propagated to other banks as externality and may result in systemic risks with capability of causing runs. One potential trigger for deposit-runs is fear that a bank may be insolvent.

The effectiveness of macroprudential measures in managing financial distressat banks has continued to attract scholarly attention especially since the recent global financial crisis. According to Perotti and Suarez (2009), macroprudentialpolicies are measures that are aimed at discouraging banks from adopting strategies that would cause systemic risk and negative externality on the entire financial system. Also, Alade (2012) contends that adopting a separate macroprudential objective is more important tomitigate the systemic risk generated by the collective actions of banks which threatens the overall stability of the financial system than concentratingon the safety of the individual banks.

One dimension of macroprudentialpolicies is bank liquidity management. Liquidity is the ability of the bank to meetup all its financial contractual obligations as required. For example, it includes investment commitments, lending, deposit withdrawals and liability maturities in the normal course of business. According to Bank for International Settlements (BIS), liquidity is the ability of bank to fund increases in assets and meet obligations as they fall due, without incurring undesirable losses. A liquid bank stores sufficient liquid assets and cash, couple with the ability to raise fund quickly from other sources for the purpose of meeting its payment obligations and financial commitment timely. Liquid asset means cash transferable assets. It also involves investment in securities that are easily realizable at a short notice and with little or no risk to the bank. Expectedly, banks are required to keep certain percentage of their deposits as primary reserves in an account with the Central Bank, which primarily is used to manage interbank indebtedness and as depositor's insurance.

A bank is illiquid when its financial obligations to other partners mature faster than the financial obligation from others. This results to asset/liabilities mismatch, also as gaps between its receipt and payment. When illiquidity occurs, it means that the bank can no longer withstand decreases in deposit or meet its obligations. As a result, the affected bank would not be able to succeed and would be compelled to acquire additional liabilities under negative market conditions at extremely high rates and in severe cases resulting to

fire sale of assets. This would worsen the already illiquid position of the affected banks and may result in solvency.

The purpose of this study is to examine the impact of macroprudential liquidity management on bank financial distress in Nigeria from 1986 to 2018 using the ARDL framework. The study contributes to the growing literature by using the Newey-West estimation approach, which adjusts the standard error process so that robust empirical results can be obtained even when serial correlation or heteroskedasticity or both are present in the data. This estimation procedure is novel in the Nigerian literature in this area of scientific inquiry.

The remainder of this study has the following structure: The next section focuses on both theoretical and empirical review, section 3 discusses the data, variables and empirical strategy, section 4 contains the empirical analysis and discussion, and section 5 concludes the study.

II. Literature Review

2.1 Theoretical Considerations

Friedman and Schwartz (1963) argue that massive withdrawal of deposits by depositors, illiquidity of assets and the inability of monetary authority to inject liquidity into the financial system can lead to banking crisis and the collapse of financial institutions. Banks encountered difficulty in converting their assets to liquid form; hence, they were unable to meet depositors' withdrawal demands. In support of this theory, Bernanke (2012) acknowledged Fed's role in creating the 1930's Great Depression, and that Fed's 2008 response with massive liquidity injection during the Global Financial Crisis is a pointer that Fed learned a lesson from the Great Depression. Coleman (2019) in support of the Friedman-Schwartz's Illiquidity Hypothesis confirms that liquidity provides the lubrication to markets and transactions that we need for smooth functioning economy. When liquidity starts to disappear the usefulness of bank deposits also disappears.

According to Richardson (2007), scholarly debate now revolves around the two competing theories. The traditional scholarship argue that underlying causes of the Great Depression were withdrawals of deposits, illiquidity of assets and the Fed Reserve's reluctance to act, a "contagion of fear," a flight to cash holdings and large withdrawals drained deposits from banks and pushed financial institution towards collapse. They argue that Federal Reserve's mistakes exacerbated the credit crunch (Friedman & Schwartz, 1963; Wicker, 2000). The contending school contends that banks fail because the economy contracted. Asset prices fell, loan defaults rates rose, and banks became insolvent. These fundamental forces accentuated a process of bank liquidation and that began during the 1920s (Calomiris& Mason, 2007; Temin, 1976;White, 1984).

2.2 Empirical Review

Toby (2008) investigates the effects of bank liquidity practices (monetary policy outcomes) and effects of capital adequacy of selected Deposit Money Banks in Nigeria using 8 multiple regression equations. The result indicated that minimum liquidity ratio is irrelevant in controlling industry nonperforming loans in the banking industry as a whole and the distressed banks in particular.

In Iran, Salehi and Abedini(2009) use the multiple regression to examine the predictive power of financial ratios for financial distress focusing on listed companies. The financial ratios considered are liquidity, working capital, profitability, leverage, and sales ratios. Their sample comprises 60 companies, which are divided into two groups: namely companies with financial distress and companies with no record of financial distress. The reported findings indicate that the included financial ratios jointly predicted about 70% of financial distress.

Olagunju, David and Samuel (2012) use the Pearson correlation method to examine the relationship between liquidity management and bank profitability in Nigeria. The evidence obtained from the analysis of survey data shows that liquidity and bank profitability showthat liquidity and profitability are significantly related.

Chiaramonte and Casu (2017) using pooled logistic regression model examined the effect of BASEL III structural liquidity and capital ratios on the probability of banks' failure in 28-member states of the European Union for a period ten years from 2004 to 2013. The sample utilized comprises 513 banks, with 1,982 bank-year panel observations. The study finds that the probability of banks' failure and distress is negatively associated with banks' liquidity holdings, while the effect of capital ratios is more pronounced only for large banks.

Edem(2017) examines the impact of liquidity management on bank performance in Nigeria from 1986 to 2011 using multiple linear regression analysis. The study finds evidence suggesting that liquidity management has a significant effect onthe performance of deposit money banks in Nigeria. It is also reported that during the financial crisis, many banks became illiquidity, while some raise funds at a large discount in order to meet up with high pressure of demand for urgent cash. The study advocates that financial and nonfinancial institutions revisit their corporate governance policies to accommodate market liquidity risk exposures.

Altunbas, Binici and Gambacorta (2018) adopting the dynamic panel general methods of moments (GMM) estimated the impact of macroprudential policies on bank risk. They use a large panel dataset comprising 20870 bank-date observations for 3177 banks headquartered in 61 emerging and advanced countries for the period from 1990 to 2012. They find that macroprudential polices have a significant effect on bank risk, and that holding bank-specific characteristics constant, macroprudential policies have more impact in a tightening than in an easing episode. Their findings also indicate that there are differences in banks' responses to changes in macroprudential policies, with small and weakly capitalized banks with a higher share of wholesale funding responding more strongly to macroprudential policy changes.

Masdupi, Tasman and Davista (2018) empirically investigate the effects of liquidity, leverage and profitability on financial distress in Indonesia using the Logistic regression approach. The study focuses on 118 listed companies covering from 2012 to 2016. They find that controlling for firm size,all the three explanatory variables have a negative and statistically significant effect on financial distress.

Also, in Indonesia, Susanti, Latifa and Sunarsi (2020) examine the importance of profitability, liquidity and leverage in the process of financial distress using the Random effects empirical framework. The study focuses on 21 listed companies from 2014 to 2018. The results show that the explanatory variables all play a significant role in financial distress both individually and collectively. However, while both profitability (return on assets) and financial leverage (debt to assets ratio) exert a positive effect, the beta capturing the effect of liquidity (current ratio) is found to be negatively signed.

III. Research Methodology

3.1 Data and Variables

Our data consist of yearly aggregate time series observations from 1986 to 2018. The data obtained from different versions of Central Bank of Nigeria, National Deposit Insurance Corporationand the factbook of the Nigerian Stock Exchange. For reliable empirical analysis, we remove data extremes and outliers through log-transformation. The data analysis is aided by EViews 11.

The study variables are defined as follows:

Ratio of Distressed Banks (RDB): This is the number of distressed banks to healthy banks in the financial system. A bank is distressed when the ratio of its non-performing loans to total loans falls above the acceptable standard and has one of the highest deciles of the industry using a three (3) year moving average.

Minimum Liquidity Ratio (MLQR): This is the minimum liquid assets Deposit Money Banks are expected to hold to ensure they meet their current liabilities and settle outstanding obligations as they fall due. It is measured as a ratio of liquid assets to current liabilities and means a company's ability to pay debt obligations and its margin of safety through the calculation of metrics including the current ratio, quick ratio and operating cash flow ratio.

Loan to Deposit Ratio (LTDR): This is the ratio of loans made to customers to customer's deposits. This ratio expresses whether the bank is creating enough interest-bearing assets or not. When the ratio is too low it means the bank is under-employing the deposits. It is equally risky when it is too high because of the fear that in times of economic downturn, the asset quality may deteriorate.

Cash Reserve Ratio (CRR): Thisrefers to a certain percentage of total deposits the banks are required to maintain in the form of cash reserve with the Central bank of Nigeria to meet the need of depositors. It is a specified minimum fraction of customer's deposit required of Deposit Money Banks to be held as reserves, either in cash or with the central bank.

Table 1 shows the descriptive summaries of the variables while their time series plots is shown in Figure 1.

Table 1: Descriptive Statistics for RDB, MLQR, LTDR and CRR

Variable	$\bar{x}$	σ	S	k
RDB	19.95	19.64	1.85	5.00
MLQR	11.65	1.29	0.12	2.40
LTDR	65.89	12.29	-0.60	2.69
CRR	31.61	16.96	0.15	1.66

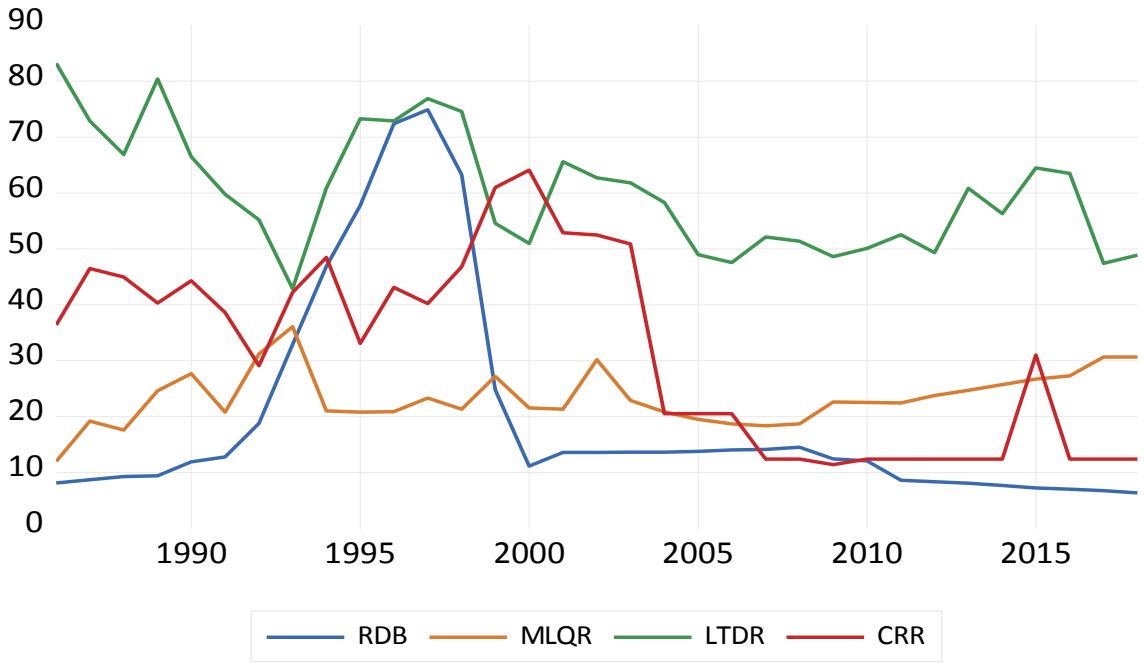

Figure 1: Time series Plot for RDB, MLQR, LTDR and CRR

From Table 1, we can see that over the sampled period (1986 – 2018), the ratio of distressed banks averaged 19.95% with a standard deviation at 19.64. The minimum liquidity ratio and cash reserve ratio have mean values of 11.65% and 31.61%, respectively, while loan to deposit ratio has a mean value of 65.89%. Further, while loan to deposit ratio ($\sigma = 12.29$) and cash reserve ratio ($\sigma = 16.96$) recorded high variability, the data on minimum liquidity ratio($\sigma = 1.29$) are lowly dispersed. Further, while ratio of distressed banks, minimum liquidity ratio ($S = 0.12$) and cash reserve ratio ($S = 0.15$) have a positive skewness coefficient, loan to deposit ratio ($S = -0.60$) has a negative skewness coefficient. The coefficient of Kurtosis ($K < 3$) below three for all variables, except for RDB ($K = 5$). This implies that none of the variables may have a normally distributed series.

From Figure 1, we can see that all the three variables exhibited a trending behaviour, suggesting that they are not a stationary series. However, these movements are characterized by significant breaks and shocks, hence there is good reason to log-transform the series for quality empirical analysis.

3.2 Methods and Models

To analyze the impact of macroprudential liquidity management on financial distress resolution, we employ the ARDL (Autoregressive Distributive Lag) framework. This framework is employed partly because of its dynamic nature and partly because of its known advantage of allowing time series variables with mixed integration in a single empirical model.

The simple ARDL parameterizations of the above models are given as follows:

$$RDB_t = \alpha_0 + \alpha_1 RDB_{t-1} + \alpha_2 MLQR_t + \alpha_3 MLQR_{t-1} + \alpha_4 LTDR_t + \alpha_5 LTDR_{t-1} + \alpha_6 CRR_t + \alpha_7 CRR_{t-1} + \epsilon_t \quad (1)$$

Where;α_0 is the intercept term, α_1 is the autoregressive coefficient which captures the effect of lagged ratio of distressed banks, andϵ_t is the error term. Also, while α_2, α_4 and α_6 are the contemporaneous coefficients for the main explanatory variables, α_3, α_5 and α_7 are their distributive or lagged coefficients.

Although, our specification includes one lagged term for both the dependent variable and each of the explanatory variables, it is conventional to determine the appropriate lag order empirically. To this end, we employ the popular Schwarz information criterion (SIC) for optimum lag specification.

IV. Empirical Results and Discussion

4.1 Results

Tables 2 and 3 present the regression results and diagnostic tests for the effects ofmacroprudential liquidity management variables on ratio distressed banks. While the Schwarz Information Criterion (SIC) is used to select the optimum lag order (which selects the model that corresponds to its minimum value), the estimation is based on Newey and West's (1987) robust standard errors which are consistent in the presence of unknown heteroskedasticity and serial correlation. Figure 2 presents the SIC model selection results. Figure 3 presents the graph of the regression residuals.

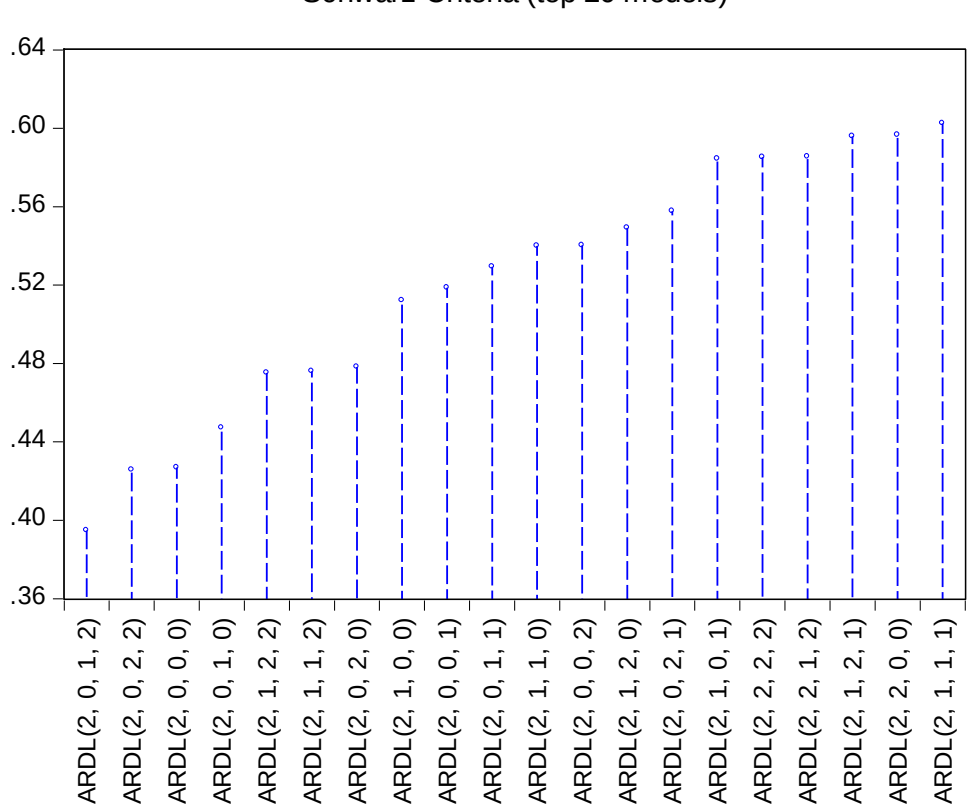

Figure 2: SIC model selection results

Table 2: Regression Results; DV = RDB_t

Variable	Coefficient	P-value
RDB(-1)	1.4163	0.0000
RDB(-2)	-0.5543	0.0018
MLQR	0.5754	0.1337
LTDR	0.6296	0.3748
LTDR(-1)	-0.8292	0.0741
CRR	-0.0439	0.6621
CRR(-1)	-0.1175	0.4195
CRR(-2)	0.3709	0.0756
Intercept Term	-0.9224	0.5915
Wald (Joint)	12.748	0.0472

Table 3: Model Diagnostics Tests

Statistic	Value
R^2	0.9375
$\bar{R}^2$	0.9148
F-statistic	41.289
Prob(F-statistic)	0.0000
Durbin-Watson	2.3982

From Figure 2, we can see that for the relationships in our empirical model, the Schwarz information criterion prefers an ARDL (2,0,1,2) specification, which implies a model with two lagged values of the dependent variable, one lagged value of loan to deposit ratio and two lagged values of cash reserve ratio as additional explanatory variables. Thus, these additional regressors are important explanatory factors in our empirical model and must be accounted for if reliable empirical results are desired.

From Table 2, the coefficients on RDB(-1) and RDB(-2) are estimated at 1.4163 and -0.5543 with attached p-values of 0.0000 and 0.0018 respectively, indicating that the two lagged dependent variables have mixed signs and are highly statistically significant. The estimated autoregressive coefficientsshow that, ceteris paribus, a 1% increase in ratio of distressed banks in the current year would, on average, lead to approximately 1.42% increase in the ratio of distressed banks in the next one year, and approximately 0.55% decrease in the ratio of distressed banks two years after. Thus, the net own effect of a 1% increase in non-performing loan ratio after two years is 0.8620 (= 1.4163 – 0.5543) which is positive and considerably large. This suggests that bank

distress is persistent, hence, a bank that is weak or unable to meet its set goals and targets in the current period will also be unable to meet its goals and targets in the next two years, but the magnitude of the distress would be much lower in the second year.

Further, the regression results show that while the relationship between ratio of distressed banks and minimum liquidity ratio is only contemporaneous, the relationship between ratio of distressed banks and loan to deposit ratio, and between ratio of distressed banks and cash reserve ratio, both have lagged effects. First, the coefficient of 0.5754 shows that, holding other explanatory factors constant, a 1% increase in minimum liquidity ratio would, on average, lead to approximately 0.58% increase in ratio of distressed banks. Although, the size of this coefficient is reasonably large, the associated p-value of 0.1337 shows that the effect of minimum liquidity ratio is not statistically significant. Second, the coefficients of 0.6296 and -0.8282 show that holding other explanatory factors constant, if loan to deposit ratio increases by 1%, ratio of distressed banks would, on average, increase by approximately 0.63% in the same period, but would decrease by approximately 0.83% one year after. Hence, the net effect of a 1% increase in loan to deposit ratio after one year is approximately -0.20% (0.63% - 0.83%). Although, these coefficients are sizable, the accompanying p-values of 0.3748 and 0.0741 indicate that only the lagged effect of loan to deposit ratio is statistically significant at 10% level. Third, the coefficients of -0.0439, -0.1175 and 0.3709 show that, ceteris paribus, if cash reserve ratio increases by 1%, ratio of distressed banks would, on average, concurrently decrease by about 0.04%, and by approximately 0.12% one year after, while it would increase by approximately 0.37% two years after. Hence, the net effect of a 1% increase in cash reserve ratio after two years is roughly 0.21% (-0.0439 – 0.1175 + 0.3709). However, the attached p-values of 0.6621, 0.4195 and 0.0756 indicate that only the second period lagged effect is statistically significant at 10% level.

Furthermore, the Wald statistic in Table 2 is associated with a p-value of 0.0472, indicating that the joint test is statistically significant at 5% level. Thus, minimum liquidity ratio, loan to deposit ratio and cash reserve ratio jointly have a significant effect on ratio of distressed banks.

From Table 3, we can see that our optimum ARDL regression model is highly fitted ($\bar{R}^2 = 0.9148$) to our time series data, with the explanatory factors accounting for approximately 91% of the observed variation in ratio distressed banks. The F-statistic has almost zero probability, hence, the estimated model is also highly significant. Although, the value of Durbin-Watson statistic (DW = 2.398) is greater than 2, which may indicate the presence of negative serial correlation, we argue that our results are consistent and free from any specification issue since our estimation follows the Newey-West error adjustment procedure. The reliability of our results is also confirmed by the residual plot in Figure 3 which shows that the fitted line is very much close to the actual, and the estimated errors are stationary.

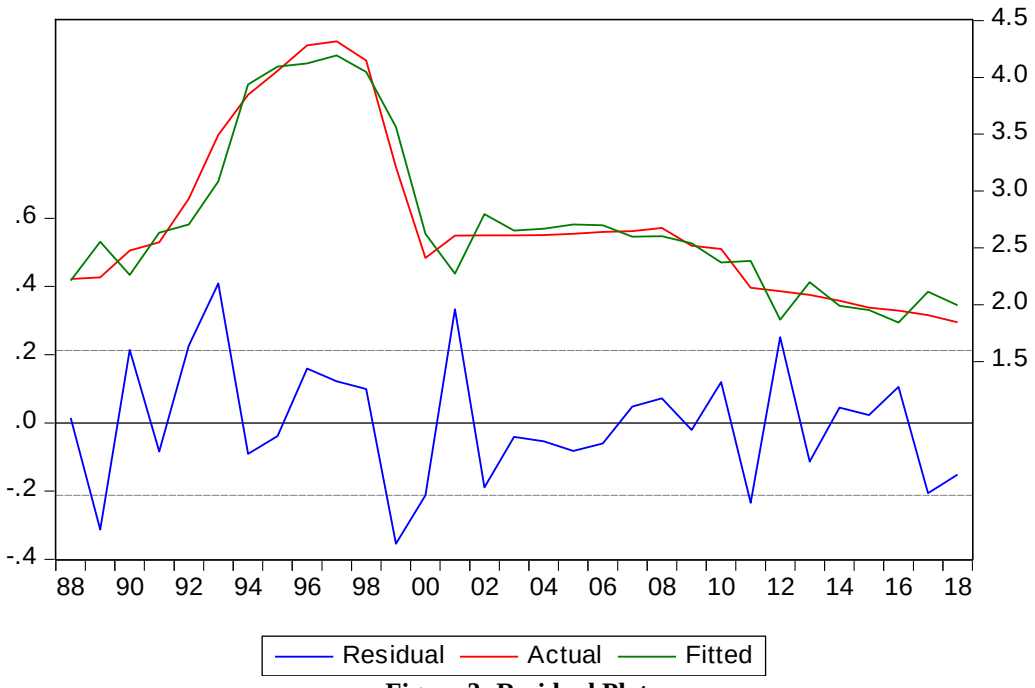

Figure 3: Residual Plot

4.2 Discussion of Findings

Our main objective is to examine the impact of macro-prudential liquidity management on ratio of distressed banks in Nigeria. Here, macro-prudential liquidity management is measured by the joint significance

of monetary lending rate, loan to total deposit ratio and cash reserve ratio. According to Galati and Moessner (2013), macro-prudential management focuses on limiting or preventing risks and costs of systemic crises to the economy. This implies macro-prudential management can significantly affect ratio of distressed banks. Thus, our *apriori*expectation is that the Wald statistic, which tests the joint significance of monetary lending rate, loan to total deposit ratio and cash reserve ratio, is statistically significant.

Consistent with our expectation *apriori*, we find that controlling for two lagged values of ratio of distressed banks,macro-prudential management has a statistically significant effect on ratio of distressed banks. This implies that macroprudential measures such as minimum lending rate, loan to total deposit ratio and cash reserve ratio contain relevant information for predicting bank distress in Nigeria. This evidence, which also suggests that financial distress is related to systemic or macroeconomic shocks, agrees with Galati and Moessner (2013) and the general view that macroprudential measures can effectively reduce risk and costs of financial distress to the economy. This finding is also consistent with the finding by Altunbas, Binici and Gambacorta (2018) that macroprudential polices have a significant effect on bank risk.

An implication of this finding is that banks' distress is more related to system-wide financial risk or contagion risk created by interconnectedness and herding behaviour of banks, hence implementing macro-level policies aimed at strengthening the entire financial system would effectively reduce the probability of bank failure or financial distress. This finding can also be interpreted in the context of the argument by Goodhart (2015) that prudential measures aimed at achieving macro-level stability in financial institutions and financial markets are more important for the economy as a whole.

V. Conclusion

The main conclusion of this study is that macroprudential liquidity measures: namely, minimum liquidity ratio, loan to deposit ratio and cash reserve ratio, collectively play a significant role in financial distress resolution, although, both the sign and significance of their individual effects are mixed.

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