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Liquidity Dynamics in Bangladesh: Investigating the Impact of Selected Macroeconomic Indicators Using an ARDL-ECM Method

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Abstract*: The study scrutinizes the influence of the selected macroeconomic forces on the liquidity of Bangladesh during the period 1986-2021. The ratio of excess reserve and total deposit liability is used to represent the liquidity of Bangladesh while total domestic credit, lending rate, consumer price index (CPI) and exchange rate are selected as the macroeconomic forces. As the data become stationary at both level and intercept, the ARDL bounds testing approach has been used to investigate the long-run linkage among the variables. Through the ARDL bounds test, it has been confirmed that there exists a long-run impact of consumer price index, domestic credit and exchange rate on liquidity. In both the long-run and short-run, domestic credit has a statistically significant impact on liquidity whereas lending rate have poor prediction of liquidity in both the long-run and short-run. From the result of the lag order selection criteria, the maximum lag of the series is one. From the stability test and diagnostic test, it has been found that the model seems stable in predicting the behaviour of the variables. The use of the ARDL approach in examining the short-run and long-run effects of selected macroeconomic variables makes the present study unique. There are limited studies on analysing the liquidity dynamics of Bangladesh using the ARDL approach.*

JEL Classification: *B22, C32, C82, P44.*

Keywords: *Macroeconomic variables, Time series models, Liquidity, Bangladesh, Econometrics.*

1.0 Introduction

In banking, liquidity is a term that indicates having cash investment in marketable securities issued by the government to fulfil regulatory requirements which are easily convertible into cash without incurring substantial loss. However regulatory requirement like cash reserve ratio (CRR) and statutory

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liquidity ratio (SLR) set by the central bank of a country is not considered as the part of excess liquidity. Currently, Bangladeshi commercial banks are obligated to keep 4% as CRR and 13% as SLR of their total deposits in Bangladesh Bank (2017), the central bank of Bangladesh in cash and non-cash form respectively. According to Ahmed (2021), 60 commercial banks are operating in Bangladesh, among those conventional banks 48, Islamic banks 9 and specialized banks 3 to serve a particular objective for the economy. In compliance with the Basel Accord, Bangladesh Bank has executed the Basel Accord III to alleviate the liquidity shockwaves and reinforce the capital base to face adverse outcomes of investments.

Banks run the business by collecting deposits or by borrowing from the money markets. Banks accumulate funds from different surplus units of the economy like individuals, businesses, financial institutions, and governments. Then banks use the collected funds to provide loans and advances to different deficit units of the economy like real estate, commercial and industrial units. Historically economic development starts in all places with the help of the banking system and its contribution to the financial growth of a country like Bangladesh is the highest in the early stage (Chowdhury, 2021). Ahmad et al. (2022) studied the correlation between bank stability and excess liquidity of conventional and Islamic banks and found excess liquidity decreases banks' stability rather than improves. Their findings also revealed that Islamic banks unveil greater elasticity to the adverse outcomes of excess liquidity than conventional banks.

In Bangladesh, the banking sector is under great pressure because of its unusually high liquidity which already crosses 1 lac crore. To minimize cost, commercial banks deploy most of the excess funds in treasury securities and it brings a huge problem for both legislators and practitioners. On May 17, 2017, the excess liquidity was 11% of the overall market compared to 13% in 2016. The liquidity position of the banking sector of Bangladesh showed a rising trend from 2010 to 2013, a stable trend from 2013 to 2015, and then a declining trend (Bangladesh Bank, Jul-Dec 2017). Ansari and Sensarma (2022) investigated the Indian banking industry with a span of 2005 to 2020 and found some factors like required reserves have a negative effect, private sector credit have a positive effect and government securities have negative effects on the excess liquidity, respectively. Other issues like inter-bank call rate and exchange rate have fluctuating effects at different levels.

At the end of June 2022, Bangladesh Bank reported that the idle funds in the banking sector of Bangladesh rose to Tk. 203,435. The amount of idle funds crossed Tk. 2 lakh crore in April 2021, which created a record of taka 2.31 lakh crore in August 2021 during the driving of money by Bangladesh bank through the COVID-19 incentive package. But, due to severe scarcity of dollars in banks,

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the amount fell below Tk. 2 lakh crore in March 2022 (The Business Standard, 13 August 2022). It is very vital to have a healthy level of liquidity for the smooth running of the economy of a country. Balanced liquidity is an integral part of the economy to ensure a stable financial sector (Nwakanma & Mgbataogu, 2014).

Agénor & Aynaoui (2010) found some structural and cyclical dynamics which are liable for excess liquidity. Structural issues consist of risk aversion and financial development. They also found that banks and other interested parties in the countries, where financial sectors are least developed, try to ensure a greater level of liquidity. A high-risk aversion tendency would lead to greater risk premium and less demand for credit. The degree of risk aversion may have a direct correlation with prolonged macroeconomic volatility, and it may clarify a progressive, long-lasting association amid high inflation and excess liquidity. The global financial crisis (GFC) has increased their consideration in understanding the connection between financial solidity and financial connectivity. When there are excessive funds in the economy, it may create systemic catastrophe by expediting undesirable spillover effects all over the world through cross-border possessions, as detected in the recent GFC (Demir & Önder, 2019).

If an economy runs with more liquid funds than its necessity, the economy will face the problem of excess liquidity. The liquidity position of a country is generally measured by the money supply index compared with nominal GDP. If the nominal GDP seems less than the money supply, the economy will face excess liquidity. From the beginning of the 21st century, the expansionary monetary policy taken by the advanced nations, the continual rise of oil prices and the increase in the trade surplus of Asian countries have steered to an outcome of excess liquidity throughout the globe (Tu et al., 2012).

Excess liquidity generates numerous abnormalities in the banking sector. It reduces banks' asset utilization capacity and overall competitiveness. It also creates inconsistencies in the transmission of effective monetary policy and the expansion of the financial market. The existence of short-term Sukuk in the economy creates a statistically significant negative effect on excess liquidity (Ali et al., 2019).

Liquid assets are the lifeblood of an economy. However excess or less liquidity can create hazards to the economy. So, it is important to maintain a healthy level of liquidity to have a stable economic condition. Through investigating macroeconomic variables, policymakers can forecast the future liquidity condition of an economy and formulate policy consequently. Bangladesh is a developing country and its economy is growing rapidly. This study is trying to find out the impact of macroeconomic variables like CPI, lending rate, domestic

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credit, exchange rate, GDP, money supply etc. on the liquidity position of Bangladesh.

2.0 Literature Review

Though there remains significant doubt about the precise nature of the link and the direction, historical experience implies a somewhat substantial association between surplus liquidity and asset values. If excess liquidity is prevalent and a fixed supply of assets is present, there may be an inflation in asset values. Next, if both result from better economic prospects, asset values may rise concurrently with an increase in liquidity. For instance, a cyclical upturn may also be accompanied by higher stock prices, stronger company profitability forecasts, and more money demand.

Liquidity has numerous theoretical definitions and is frequently employed in a variety of circumstances. In brief, (Ross et al., 2015) noted liquidity refers to how quickly assets can be changed to cash with minimum value loss. Another scholar Jordan et al. (2020) mentioned that liquidity is a condition in which an asset can be converted quickly without price concession. Agbada and Osuji (2013) defined liquidity in the banking context as the bank's ability to keep sufficient money to pay for maturing liabilities. Although liquidity is a desirable phenomenon, it becomes an issue when it is in excess in the financial system. The definitions in the preceding sections provide an intuitive understanding of liquidity. Many research on excess liquidity, however, provides an empirical computation of excess liquidity.

Although liquidity is a favourable circumstance, it poses concerns when it surpasses the required levels. In their findings of the effect of surplus cash on monetary policy, Bathaluddin et al. (2012) found that surplus money decreases the rate of success of monetary policy by affecting the demand side and thereby encouraging inflation.

According to Saxegaard (2006), A study of surplus money and the success of monetary policy in the African Sub-Saharan area found that the amount of funds placed with the regulatory bank by financial institutions, plus cash kept in vaults that exceeds what is needed or statutory numbers. He added that excess reserves may be cautious or involuntary, with precautionary excess reserves held consciously by banks to meet prudential requirements or liquidity needs, and involuntary excess reserves because of structural impediments in the financial system. In the research, they conducted on the surplus money in a free economy and its proper utilization, TU et al. (2012) identified surplus liquidity as the phenomenon whereby an economy's governable currency exceeds the necessary amount.

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Gray (2006) defined excess liquidity from the standpoint of the central bank, indicating that a liquidity surplus happens when the central bank has net currency-related obligations versus the banking industry as a whole. Although being defined from surplus money is said what bank holds more than the desirable or required levels from various views or approaches. The question remains as to why banks would keep surplus reserves. The section that follows attempts to answer this question.

Banks hold a specific percentage of reserves as insurance against unexpected withdrawals, often known as precautionary reserves. Khemraj (2006) gathered the findings of research initiatives conducted in the latter part of the 20th century for his study on Guyana. These research projects along with studies done by Agénor et al. (2004) tested the theory that banks select reserve funds that maximize earnings or minimize losses. These studies found that (i) banks want more reserves when adjustment costs increase, (ii) necessary bank reserves grow or decrease depending on the statutory liquidity ratio and (iii) the level of reserves increase as uncertainty increases.

Adalid and Detken (2007) use credit growth and structural money shocks to assess excess liquidity, which is obtained by VAR estimation using a larger set of endogenous variables. Since the 1970s, quarterly data from 18 OECD nations have been collected using a panel regression model, and the authors have discovered that excessive liquidity only influences real estate prices during surge times. However, under typical circumstances, the surplus liquidity's predictive power tends to switch from asset price inflation to consumer price inflation.

Saxegaard (2006) splits bank demand for surplus cash into two categories: precautionary and involuntary; based on his research in the Central African countries. Involuntary liquidity is influenced by demand forces, whereas defensive excess reserve is somehow determinable. Spontaneous funds would increase if requirement conditions were adverse for a variety of reasons, such as economic and political instability. So is for adverse global conditions. Moreover, reason is more likely to result in inflation if demand conditions improve, but precautionary surplus reserves do not alter the composition of bank portfolios, making them less inflationary.

Using the model of Agénor et al. (2004), Saxegaard (2006) identified the relevant elements that contribute to the accumulation of spontaneous liquidity: (i) international aid donation by the rest of the world (ii) newly discovered oil earnings, (iii) increased government deposits in banks; (iv) sluggish private sector loan demand. More factors impacting surplus liquidity were discovered by Khemraj (2006); which are: (i) a huge underground economy generating bank deposits, (ii) inbound remittances, and (iii) government involvement in the foreign exchange market.

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Empirical studies by Nwakanma and Mgbataogu (2014) reveal top three factors are; money supply level, monetization of foreign exchange, and surplus liquidity lagged as the prime elements of surplus liquidity in Nigeria. They also suggest that a proper amount of fund availability is possible by ensuring efficient foreign exchange management.

In a study by Aikaeli (2006) titled "Determinants of Excess Liquidity in Tanzanian Commercial Banks" to reveal the reasons for the surplus fund, the autoregressive distributed lag model was used. The unpredictability of depositors' cash preference, higher lending risk, increasing cost of funds, and finally mandatory reserves requirement rate directed to build up of funds in excess of requirements was the prime outcome.

The empirical analysis was done by Hasanovic and Latic (2017) on 19 commercial banks in Bosnia and Herzegovina based on the generalized method of moments (GMM) methodology for the 2006-2015 time period. By using dynamic panel analysis, they tried to determine the relationship between surplus fund and selected key variables. The outcome was bank size, NPL, total outstanding loans as well as consumer price index are the noteworthy indicators.

Similar kinds of studies were done by Moussa (2015) in Tunisia on 18 banks for 10 years (2001-2010) time frame. Results of the study indicate that financial results, invested capital, debt to assets ratio, operating expenses to total assets ratios, GDP growth rate and CPI rises have a remarkable influence on available funds in Banks.

Some other distinguished scholars also found the same result as those who mentioned the challenges created by a surplus of liquidity in economies including Caprio and Honohan (1990), Aryeety and Nissanke (2005), Agénor et al. (2004), and Bathaluddin et al. (2012). According to Agenor and El Aynaoui (2010), excess liquidity in the financial system provides an important hurdle to central bank policymaking and the economy in general. The researchers acknowledge that too much liquidity hinders the efficiency of the implementation of monetary policy mechanisms. As a consequence, the fulfilment of macroeconomic goals like full employment, greater GDP rates, price stability, and so on is jeopardized.

Lag of Additional Liquidity, Money Supply lag, and the surplus funds of financial institutions as further sources of excess liquidity in the country's economy Bathaluddin et al. (2012). According to findings, in a general price-increasing condition, unplanned surplus cash will be distributed rapidly as the financial system's general demand becomes higher.

A Study was done (Trenca et al., 2015) to find the macroeconomic factor's effects on bank liquidity for the countries that have lately experienced unfavourable financial and economic conditions. They discovered that the

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macroeconomic parameters that affect liquidity levels include the rate of inflation, the public deficit, the unemployment rate, the GDP, and the liquidity ratio, among others. Of these, the effects on liquidity and inflation were greatest, while those on the GDP were least. While Dinger (2009) demonstrated the opposite association between GDP growth rate and bank liquidity, (Bunda & Desquilbet, 2008) study indicated a positive influence of GDP rate on liquidity in financial institutions. Furthermore, the research by (Horvath et al., 2012) demonstrated that while the unemployment rate hurt bank liquidity and that high unemployment rates reduce loan demand, which affects bank liquidity, inflation rates did not affect bank liquidity. Tasnova (2022) examined how macroeconomic and bank-specific factors affected the liquidity of 29 Bangladeshi commercial banks that were listed. Bank funds availability was inversely impacted by the business cycle and the interest rate of the monetary policy. In contrast, nonperforming loans, capital adequacy, profitability, and interest rate spread are all positively correlated with bank liquidity.

It is more significant to consider the expected impacts of surplus funds on important macroeconomic indicators when deciding on monetary policy. The availability of money in the financial market may result in a drop in interest rates, which would increase loanable funds for people and private businesses if all other factors remained constant. Imports would be impacted by the rise in total demand. If export growth is not accompanied by an increase in imports, current account imbalances and trade deficits will arise, which will have an impact on the foreign currency conversation rate and rising prices.

3.0 Objective of the study

The aim of the study is to scrutinise the effect of inflation, domestic credit, lending rate, and exchange rate (in dollar terms) on the liquidity of Bangladesh. The study purposes at discovering the fluctuation of liquidity for these selected macroeconomic variables.

4.0 Data and Variable Definition

To meet the objective of this study, yearly data for the period 1986 to 2021 has been collected. The timeframe has been chosen resolutely since the economy of Bangladesh has faced many fluctuations during this period like capital market developments, trade liberalisation, etc. Analysing the association between liquidity and macroeconomic variables during this period will be helpful for the upcoming periods for predicting the abrupt swing in liquidity. It will also help the analysts to predict the changes in the liquidity of the country due to changes in any of the macroeconomic variables. Firstly, the data on liquidity has been taken from the website of Bangladesh Bank. Then, five macroeconomic variables have been chosen including the domestic credit (DC), lending rate (LR), exchange rate (Exchange), and consumer index price (CPI, base year 2010). Data on liquidity

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(LLQ), domestic credit (DC) and exchange rate (Exchange) have been collected from the Bangladesh Bank website whereas (Bangladesh Bank, n.d.) lending rate (LR) and consumer index price (CPI) have been collected from the data bank of the World Bank Statistics (World Bank Open Data, n.d).

Table 1: Sources of Data

Variable	Concept	Description	Units	Data Source	Literature
LLQ	Natural logarithm of the amount of liquidity	Excess reserve/ total deposit liability	The ratio of the total amount of excess reserve and total deposit liability (in crore)	Bangladesh bank website	Ross et al., 2015 Jordan et al. (2020) Agbada and Osuji (2013) Kuwornu and Owusu-Nantwi, (2011), Nwakanma and Mgbataogu (2014)
LDC	Natural logarithm of yearly domestic credit	Credit/loan given to the public and private sector within the national boundary	Yearly amount in crores	Bangladesh bank website	Adalid and Detken (2007) Gozgor, (2014) Agenor et al. (2004) Hasanovi´c and Lati´c (2017)
LLR	Natural logarithm of the Lending rate	Monthly average call money market rates (weighted average)	Average yearly percentage	World Bank data statistics	Matemilola et al. (2015). Gupta and Modise (2013) Aikaeli (2006)
LCPI	Natural logarithm of consumer price index	Changes in the Consumer Price Index (CPI). Base year:2010	Yearly percentage	World Bank data statistics	Bathaluddin et al. (2012) Bryan and Cecchetti (1993) Adalid and Detken (2007) Hasanovi´c and Lati´c (2017)
LExchange	Natural logarithm of exchange rate	The average buying and selling rate of US dollar (The rate of Bangladesh bank)	Average yearly rate against US dollar	World Bank data statistics	Williamson (1983), Dornbusch (1982), Agenor et al. (2004), Khemraj (2006), Nwakanma and Mgbataogu (2014)

5.0 Methodology

The aim of the study is to examine the association between macroeconomic factors and liquidity in Bangladesh.

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The hypothesized model for the paper is as follows:

$$\ln \mathrm{LQ}_t = \beta_0 + \beta_1 \ln CPI_t + \beta_2 \ln DC_t + \beta_3 \ln LR_t + \beta_4 \ln EXCHANGE_t + \varepsilon_t$$

Where LQ=Excess liquidity/Deposit Liability; Exchange= Exchange Rate; LR = Lending rate; DC = Total Domestic Credit; CPI= Consumer Index Price; ε_t = The standard error term, and β_0 is the constant and, β_1 β_2 β_3 β_4 and represent the respective parameters. The paper uses the ARDL approach proposed by Pesaran et al. (2001) because the ARDL approach has some advantages over the other cointegration approaches like the Engle-Granger (Engle & Granger, 1987) and Johansen cointegration test (JJCA). These traditional cointegration approaches need all the variables to be integrated into the same order. However, the ARDL test effectively processes the data, whether the variables are integrated/stationary at the level I(0) or at the first difference I(1) or mutually co-integrated (Pesaran et al., 2001). Because of having a small number of observations and various order of integration, the study variables make ARDL the most appropriate method for this study.

The equation of an ARDL model can be specified as follows:

$$\Delta \ln \mathrm{LQ}_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta \ln LQ_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta \ln CPI_{t-i} + \sum_{i=1}^{p} \beta_{3i} \Delta \ln DC_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta \ln EXCHANGE_{t-i}$$

$$+ \sum_{i=1}^{p} \beta_{5i} \Delta \ln LQ_{t-i} + \beta_6 \ln LQ_{t-1} + \beta_7 \ln CPI_{t-1} + \beta_8 \ln DC_{t-1} + \beta_9 \ln EXCHANGE_{t-1} + \beta_{10} \ln LQ_{t-1} + \varepsilon_t$$

Where Δ stands for the difference operator. The test includes the F-test of the joint significance of the coefficient of lagged variables to verify that there exists a long-term relationship among the variables. The Pesaran (2001) test has been followed to validate the null hypothesis of having no long-term relation exits among the variables (H_0: β_6= β_7= β_8= β_9= β_{10}=0). The decision of the null hypothesis (H_0) being rejected or accepted is generally based on the following conditions: if the value of the F-test is greater than the value of the upper critical bound (UCB), the null hypothesis will be rejected which means the variables of the study are co-integrated. On the other hand, if the value of the F-test statistic is less than the lower critical bound (LCB), the null hypothesis is accepted which means that the study variables are not co-integrated. Lastly, the decision will be inconclusive if the F-test value is greater than or equal to the lower critical bound (LCB) and less than or equal to the upper critical bound (UCB).The error correction model (ECM) for the estimation of the short-run association can be stated as follows:

$$\Delta \ln LQ_t = \beta_0 + \sum_{i=1}^{p} \beta_{1i} \Delta \ln LQ_{t-i} + \sum_{i=1}^{p} \beta_{2i} \Delta \ln CPI_{t-i} + \sum_{i=1}^{p} \beta_{3i} \Delta \ln DC_{t-i} + \sum_{i=1}^{p} \beta_{4i} \Delta \ln EXCHANGE_{t-i}$$

$$+ \sum_{i=1}^{p} \beta_{5i} \Delta \ln LQ_{t-i} + \alpha_1 ECT_{t-1} + \varepsilon_t$$

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If the ECM_{t-1} coefficient (α_1) has a negative sign and is statistically significant, the model implies that any long-run disequilibrium among the dependent variables and a number of independent variables will converge back to the long-term equilibrium association.

6.0 Results and Discussions

6.1 Descriptive statistics and correlation analysis

The descriptive statistics table presented the mean, median, standard deviation, maximum and minimum values over the period from 1886 to 2021. From the table, the average log value of the consumer price index, domestic credit, exchange rate liquidity and lending rate shows 4.2, 9.2, 4.0, -4.4, and 2.5 representing average values of 1708019.81, 4343884542, 1048576, 2719736.09, 9536.74 respectively. The descriptive analysis table also represents the pair-wise correlation analysis among the variables.

Table 2: Descriptive Statistics

	LLQ	LEXCHANGE	LDC	LCPI	LLR
Mean	-4.407240	4.007914	9.177006	4.231459	2.508006
Median	-4.144758	4.062966	9.163149	4.131661	2.560227
Maximum	-2.428220	4.440370	14.18008	5.300500	2.697711
Minimum	-8.334363	3.410157	6.697382	3.189653	1.991179
Std. Dev.	1.317184	0.347468	1.612287	0.634875	0.166831
Skewness	-1.038248	-0.371064	0.591830	0.143848	-1.327871
Kurtosis	3.835634	1.732908	3.759614	1.780617	4.395156
Jarque-Bera	7.515180	3.234411	2.967097	2.354496	13.49913
Probability	0.023340	0.198452	0.226831	0.308126	0.001171
Sum	-158.6606	144.2849	330.3722	152.3325	90.28823
Sum Sq. Dev.	60.72406	4.225696	90.98142	14.10734	0.974146
Observations	36	36	36	36	36
LLQ	1.000000				
LEXCHANGE	-0.373871	1.000000			
LDC	0.472514	-0.336392	1.000000		
LCPI	-0.336160	0.967092	-0.169992	1.000000	
LLR	-0.002312	-0.670072	-0.082972	-0.733082	1.000000

Source: Researcher's own calculation

The coefficient measures of the correlation analysis have pointed out that exchange rate and consumer price index lending rate are negatively correlated

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with liquidity where only domestic credit is positively associated. The consumer price index is positively correlated with the exchange rate and both domestic credit and lending rate are negatively related. In the case of domestic credit consumer price index and lending rate, both are negatively correlated with domestic credit. A negative correlation exists between the consumer price index and lending rate.

6.2 Lag length selection criteria

It is necessary to ensure the order of integration among the variables for model estimation. And so the unit root test is the primary requirement for time series analysis for the presence of stationarity of the variables. To confirm the order of integration, Perron (1997) and Dickey & Fuller (1979) developed unit root test and the test was directed for all the variables having structural breaks. The test results show the values for both the intercept and time trend. The test statistics with a greater value than the critical value indicate the rejection of the null hypothesis which assumes the presence of unit root and vice versa. If the value show that the data have unit root, then the researchers suggest to have the first difference. The aim of the test is to make the data stationary at the first difference. In this paper time trend is being used to make the data stationary. Results of the ADF test for unit root explicate that at the first difference without trend LLQ, LCPI, LDC, LLR and Lexchange become stationary at the significance level of 1%. Simultaneously, at the first difference with trend and intercept, only domestic credit (LDC) becomes stationary at 5% significance level and other variables like exchange rate, lending rate, excess reserve, consumer price index and liquidity become stationary at the first difference with significance level of 1%. Phillip Perron (PP) test also be used to make the data set stationary. From PP test results, it is found that, at first difference, without trend and intercept, LCPI, LDC and LLR become stationary at the significance level of 1% where LLQ become stationary at level with the significance level of 1% critical value level and Lexchange become stationary at level with 5% significance level. In the case with trend LDC and LLR become stationary at the first difference with the significance level of 5 % critical value and all other variables like LLQ, LCPI, and Lexchange become stationary at the first difference with the significance level of 1% critical value. The ARDL approach is the valid approach if the data series becomes stationary both at level and at interval or with mixed order. One of the most important assumptions of ARDL approach is to have the data integrated at level or intercept and if the data becomes stationary at second difference, the F-test will be invalid to access the long-term association among the variables. Table 3 reveals the unit root test of the variables and it can be inferred that the data become stationary at level or intercept. So, ARDL approach will give the prediction of the variables in the long run.

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Table 3: Unit root test

Variables	ADF test				PP test			
	Without trend		With trend		Without trend		With trend	
	Level	1st difference	Level	1st difference	Level	1st difference	Level	1st difference
LLQ	-2.732*	-7.441***	-2.849	-7.360***	-2.739*	-7.559***	-2.892	-7.487***
LCPI	0.293	-4.381***	-2.272	-4.411***	0.206	-4.339***	-1.452	-4.421***
LDC	-1.012	-3.925***	-0.420	-4.067**	-1.072	-3.925***	-0.420	-4.0564**
LLR	1.181	-4.123***	-0.987	-4.276***	0.704	-4.073***	-0.591	-4.218**
Lexchange	-1.467	-5.029***	-1.062	-5.064***	-3.114**	-4.962***	-0.831	-8.359***

Source: Researchers' Own Calculation

6.3 Lag length selection criteria

According to Chaudhuri and Smiles (2004), To choose the measurement of the co-integration model, the number of lags is required to find out before applying the ARDL bounds test. For selecting the lag, several criteria are required to test such as Akaike information criteria, Likelihood Ratio, Schwarz information criterion, Final Prediction Error and Hannan-Quinn Information Criterion (HQIC). Based on all these criteria, one is the maximum lag that has been selected. Inappropriate lag can predict biased results and will not be accepted for policy analysis. Among all the criteria, in this paper, Akaike information criteria (AIC) is given the highest priority over the other lag length selection criteria because AIC provides more robust results to explain the lag length.

The study tools, being used to calculate the optimum lag length, suggest the lag of one. It will be a great mistake to select no lags in the study as most of the tools suggest selecting one lag. The result of the VAR lag order selection criteria is supported by all of the criteria like AIC, FPE, HQ and SBIC that the maximum lag of the series is one. Khan and Yousuf (2013) have selected the optimum five lag length according to AIC. Naik and Padhi (2012) showed that lag of one has been selected from VAR lag order selection criteria in their respective similar paper.

Table 4: Lag selection criterion

Endogenous variables: LCPI LDC LEXCHANGE LLQ LLR						
lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-70.681	NA	5.90e-05	4.451837	4.676	4.528
1	119.277	312.873*	3.67e-09*	-5.251637*	-3.904848*	-4.792*
2	132.679	18.131	8.05e-09	-4.569340	-2.100228	-3.727

* Indicates lag order selected by the criterion
* Source: Researchers' Own Calculation
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SIC: Schwarz information criterion

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6.4 Eigenvalue stability condition

For the stability test, roots of characteristic polynomial is essential to check whether the VAR model is stable for predicting the long-run relationship with the variables. Hamilton (1994) and Lutkepohl (2005) suggested that if the VAR model needs to be stable the modulus value of the eigenvalue must be less than one and that should be within the circle. Based on the analysis of the paper we can conclude that the VAR model used in the paper is stable as all the modulus values are less than one and stay within the eigenvalue circle.

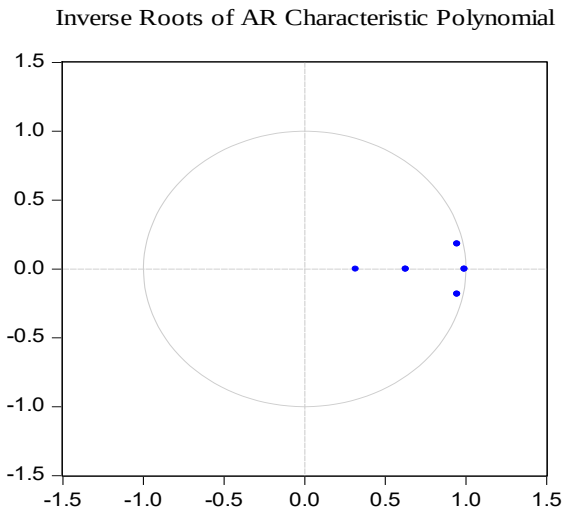

Figure 1: Optimal lag selection criteria under VAR model in polynomial graph

Source: Researchers' Own Calculation

As the VAR model shows the stability in the model, it can be stated that the estimations would be appropriate to the model.

6.5 Bound Test Approach

Following the approach proposed by Pesaran et al. (2001) and Narayan and Narayan (2005), this paper used the AIC criteria for selecting the optimum lag length for ARDL approach. Table 5 reveals the results of the cointegration test based on ARDL bounds test and it has been found that the value of the f-statistic is 4.46 which is greater than the UCB (upper critical bound) at 1 and 5 percent of significance level where consumer price index, lending rate, exchange rate and domestic credit are dependent variables.

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Table 5: Bounds Test Results

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	**Value**	**Significance**	**I(0)**	**I(1)**
F-statistic	4.461169	10%	2.2	3.09
k	4	5%	2.56	3.49
		1%	3.29	4.37

Source: Researcher's own calculation

Based on the result, it can be concluded that the null hypothesis of having no levels relationship is rejected and there exists long-term association among the variables.

6.6 Long run and short run analysis

From the ARDL bound test, it has been confirmed that there exists long-run cointegration among the dependent and independent variables. Table 6 exhibits the long-run and short-run elasticities of the variables. In the long-run, the consumer price index, exchange rate and domestic credit, negatively and significantly affect the liquidity whereas the lending rate has negative impact on liquidity with no significance. A 1 percent increase in liquidity will have an 8 percent positive change in the exchange rate. Similarly, a 1 percent change in liquidity will result in an 0.55 percent change in domestic credit in the same direction.

In case of the consumer price index, 1 percent change in the liquidity will result in a 4.91 percent change in the opposite direction. The lending rate seems insignificant in explaining the liquidity in the long run. In the short-run, the result demonstrates that only domestic credit has positive and significant impact on liquidity. A 1 percent change in the liquidity will have 0.65 percent change in the domestic credit in the same direction. The value of R2 and adjusted R2 confirm that there exists no spurious regression and have indicated a strongly good fitted model. The criteria of good fitted model have also been confirmed by the f-statistic with less than 0.05 probability value. Error correction model with a negative and statistically significant value indicates that the disequilibrium and any prior shock in the exploratory variables can be adjusted with higher speed in the long run.

Table 6: Results of long-run and short-run coefficients applying the ARDL approach

Dependent variable is LLQ: ARDL (4, 4, 1, 4, 3) selected based on AIC				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
Panel A: Long run estimation				
LEXCHANGE	8.367341	3.080562	2.716174	0.0201
LDC	0.550232	0.137991	3.987455	0.0021

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Dependent variable is LLQ: ARDL (4, 4, 1, 4, 3) selected based on AIC				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
LCPI	-4.915303	1.726894	-2.846325	0.0159
LLR	-0.333066	1.498908	-0.222205	0.8282
C	-17.58923	8.047291	-2.185733	0.0513
Panel B: Short-run estimation				
D(LEXCHANGE)	8.331197	5.668072	1.469847	0.1696
D(LDC)	0.651444	0.229641	2.836792	0.0162
D(LCPI)	-19.56889	12.69728	-1.541187	0.1515
D(LLR)	-3.296680	6.330726	-0.520743	0.6129
ECM	-1.793932	0.302367	-5.932958	0.0001
EC = LLQ - (-4.9153*LCPI + 0.5502*LDC + 8.3673*LEXCHANGE -0.3331 *LLR -17.5892)				
Panel C: residual diagnostic tests				

R squared	0.805364
Adjusted R squared	0.597753
Durbin Watson stat	2.541438
F statistic	3.879193
Prob(F-statistic)	0.026645

Source: Researcher's own calculation

In previous studies, to specify the model fit, (Narayan and Narayan, 2005; Qamruzzaman & Jianguo, 2017) some of the diagnostic tests have been done and so in this paper for ensuring the stability of the model, normality test of the model, LM serial correlation test, Ramsey Reset test, Breusch-Pagan-Godfrey heteroscedasticity test have been carried out. The results of the diagnostic test have been presented in Table 7. The normality test result shows that the study variables are normally distributed, as indicated by Jarque-Bera statistics. Based on the result of the serial correlation LM test, heteroscedasticity test and Ramsey RESET test, it can be inferred that the ARDL model has confirmed all the diagnostic tests successfully meaning that there exists no serial correlation among the variables and no heteroscedasticity.

Table 7: Diagnostic Tests

Diagnostic test(s)	**Statistic(s)**	**Test statistic**	**p value**
Normality	Jarque-Bera	0.198	0.91
Breusch-Godfrey serial correlation LM	F-statistic	4.024372	0.0522
Breusch-Pagan-Godfrey heteroskedasticity	F-statistic	1.882303	0.1319
Ramsey RESET	F-statistic	0.467387	0.5083

Source: Researcher's own calculation

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Based on the diagnostic test, the model has passed all the standards. Meanwhile, in this paper, two stability tests have been conducted such as CUSUM and CUSUMSQ for analysing the stability of long-run and short-run parameters. The graph of the stability tests presented in Figures 2 and 3 have identified that the plots for stability test are within the critical thresholds at the significance level of 5 percent.

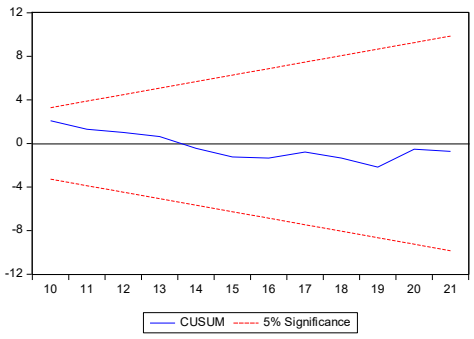

Figure 2: Plot of cumulative sum of recursive residuals

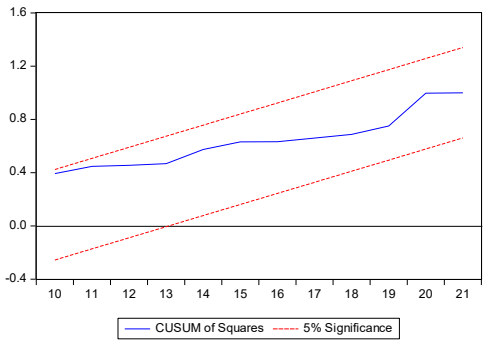

Figure 3: Plot of cumulative sum of squares of recursive residuals

The findings have confirmed the accuracy of long-run and short-run parameters which have an impact on the liquidity over the period 1986-2021.

7.0 Conclusion

The study examines the long-term co-integrating relationship between the liquidity of the country and selected macroeconomic variables using the ARDL approach proposed by Pesaran et al. (2001). The stationarity test reveals that the data become stationary at both level and intercept and so the paper followed the ARDL approach to investigate the long-run impact of the macroeconomic variables on liquidity. ARDL bound test results predicted that there exists long-run relation between liquidity and selected macroeconomic variables as the value of f-statistic is greater than the upper critical bound at 1 and 5 percent significance level. It is also tried to find out the predictability of changes in liquidity due to the changes in selected macroeconomic variables. From the results, it can be concluded that, in the long run, consumer price index, exchange rate and domestic credit can predict liquidity with significance but lending rate have poor predictability of liquidity. In the short-run, only domestic credit has a significant influence over liquidity. In addition, the correction intensity of liquidity value has been analyzed to find out. Error correction term shows that the disequilibrium will be corrected significantly in the long-run. From the result of the VAR lag order selection criteria, it is supported by both AIC and SBIC that the maximum lag of the series is one. From the stability test and diagnostic test, it has been found that the model seems stable in predicting the behaviour of the variables. Economic policymakers will be able to predict the behaviour of the

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selected macroeconomic variable when any change is observed in liquidity and vice versa. Belke and Keil (2016) found that financial integration drives the prices of the commodity. They also find that the break between financial flow and dynamics of the commodity prices is corrected by the global liquidity managed by central bank. Qehaja et al. (2022) investigated the relationship between macroeconomic variables and liquidity of the banks where they found that per capita GDP and unemployment rate have positive effect inflation have negative impact on the bank liquidity. Analyzing the previous similar studies, it is evident that the macroeconomic forces have significant impact on the liquidity of the banking sector but the direction of the effect varies from country to country and market to market. As the liquidity is associated with exchange rate, consumer price index and domestic credit, policy makers should be very careful about the amount of the liquidity to meet the economic crisis. Acharya and Kulkarni (2012) suggested banking sector to maintain high level of liquidity to absorb any economic shock. For the future study, researchers can investigate the impact of a large number of macroeconomic variables on liquidity as in this paper only four of the macroeconomic variables have been included.

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