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## Article

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## Determinants of liquidity in commercial banks: evidence from the Turkish banking sector

Ahmet KARAKAŞ\*, Melek ACAR\*\*

### Abstract

*Liquidity management has an important place in the asset and liability management of banks. The aim of this study is to empirically investigate the intra-bank and macroeconomic factors that affect liquidity in 20 Turkish commercial banks. Financial data of commercial banks operating in the 2002-2022 period and macroeconomic data for the same period are taken into account. In the panel data analysis where liquidity ratios liquid asset ratio (LAR), acid-test ratio (ATR) and current ratio (CR) were taken as dependent variables, a negative relationship between liquidity ratios and deposits to liabilities ratio (DR), financial asset ratio (FAR), fixed asset ratio (FIXR), economic growth rate (gross domestic products - GDP), central bank interest rate (INT), loans to assets ratio (LR), net interest margin (NIM), non-performing loans ratio (NPL); a positive correlation with liquidity ratios and equity ratio (equities to assets ratio, CAP), inflation rate (INF), natural logarithm of asset size (TA), foreign exchange rate (XR) was found. In the study, no statistically significant relationship was found between foreign exchange liquidity ratio (FXLR) and liquidity ratios. Despite its profitability-reducing effect, banks need to manage their liquidity sensitively and effectively in order to maintain the trust of customers and market, especially during crisis periods.*

**Keywords:** commercial banking, liquidity, Turkey

### Introduction

Commercial banks are among the most important actors of the financial system. With an asset size of 6.4 Trillion Turkish Liras (TL) as of 2021, banks constitute 82% of the total 7.8 Trillion TL financial system in Turkey (BAT, 2021a, p. 31). Credit customers, savings deposit customers, stakeholders, creditors, partners, national treasury and central bank generally expect multi-partnered and publicly traded banks to operate on the basis of profitability and efficiency.

While continuing their activities, banks may encounter sector-specific risks as well as macro risks affecting the economy such as market interest rates, inflation rate, and financial crisis. Liquidity

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risk based on maturity mismatch has been among the most important structural problems of the Turkish banking sector for a long time. In addition, credit risk, market risk and operational risks stand out among sectoral risks. The liquidity risk lies at the root of the crisis experienced in Turkey in 2000-2001 and the financial crisis experienced in the USA in 2008 and its effects spread all over the world. With this study, it is aimed to contribute to the academic literature by empirically determining the intra-bank and macroeconomic factors that determine liquidity and to present it to the benefit of the banking sector. For this purpose, firstly, the conceptual framework on the subject was drawn, the relevant literature was examined, information was given about the methodology, the data set and variables were introduced, the method was explained and the findings were evaluated in comparison with the literature.

## **1. Literature Review**

Numerous studies have been conducted on the determinants of liquidity in banks in the national and international literature. Especially the financial crisis in 2008 and the international regulations made in this context have made the liquidity issue an important field of study in the literature. In researches they were taken into account as independent variables such as equity ratio, asset size, capital adequacy ratio, non-performing loans ratio, interest income to total assets ratio, economic growth rate (GDP), inflation rate, foreign exchange rate, interest rate, loans to assets ratio, deposits to liabilities ratio, fixed assets ratio, coverage ratio of foreign exchange assets to foreign exchange liabilities, loans to deposits ratio, consumer loans to total loans ratio, return on assets ratio (ROA), return on equities ratio (ROE), net interest margin (NIM), loans received, deposits growth rate, loans growth rate, deposit and loan interest rates, oil prices, insured deposits to total deposits ratio, off-balance sheet loans, financial crisis, operating expenses to total assets ratio, interest cost to assets ratio, interest income to assets ratio, reserves, public expenditures, public debt, debt to equity ratio, loans to GDP ratio, foreign direct investment ratio, financial leverage ratio, money in circulation (M3), budget deficit, unemployment rate, financial deficit ratio (loans-deposits), operating expenses to total deposits ratio, cost to income ratio, bank ownership structure, interbank interest rates, non-interest income to non-interest expense ratio, cost of liabilities and market capitalization ratio. Below are the researches carried out on the topic in recent years (Table 1).

**Table 1. Studies on the relationship between liquidity and intra-bank financial ratios and macroeconomic ratios**

Authors and publication years	Research period	Research method	Research content	Findings
Berger and Bouwman (2009)	1993-2000	Panel Data	Banks in the USA	While the liquidity creation effect of capital size is positive in large-scale banks and negative in small-scale banks, it is insignificant in medium-scale banks. Liquidity increases the market value of banks.
Vodova (2011a)	2001-2009	Panel Data	Banks in Czech Republic	There is a negative relationship between LAR and financial crisis, inflation rate, a positive relationship with equity ratio, NPL, loan interest rates. There is a negative interaction between the ATR and the inflation rate, a positive interaction between the equity ratio and the loan interest rate. There is no significant relationship between liquidity and ROE, net interest income, monetary policy interest rate, interbank interest rate and unemployment rate.
Vodova (2011b)	2001-2010	Panel Data	Banks in Slovakia	There is a negative relationship between LAR and financial crisis, ROE, asset size, equity ratio. There is a negative relationship between ATR and financial crisis, ROE, equity ratio. GDP, inflation rate, unemployment rate, monetary policy interest rate, interbank interest rate and NPL does not have a significant effect on liquidity.
Vodova (2011c)	2001-2010	Panel Data	Banks in Poland	There is a negative relationship between LAR and asset size, net interest income, GDP, unemployment rate, financial crises and a positive relationship between equity ratio and inflation rate. There is a negative relationship between ATR and ROE, loan interest rate and a positive relationship with equity ratio. Monetary policy interest rate does not have a significant effect on liquidity.
Deléchat <i>et al.</i> (2012)	2006-2010	Panel Data	96 commercial banks in Central America	There is a positive relationship between ATR and asset size, liquid asset ratio and a negative relationship between NIM, capitalization, NPL.
Munteanu (2012)	2002-2010	Panel Data	27 commercial banks in Romania	There is a positive interaction between ATR and capital adequacy ratio (CAR), NPL, interest expenses, unemployment rate and a negative interaction with the market interest rate.

Tesfaye (2012)	2000-2011	Panel Data	Commercial banks in Ethiopia	There is a positive relationship between LAR and CAR, asset size, NPL, net interest income, inflation rate. There is no significant relationship between LAR and GDP, loan growth rate, short-term interest rates.
Bonfim and Kim (2012)	2002-2009	Panel Data	500 banks in Canada, France, Germany, USA, Russia, Netherland, Italia, Great Britain	There is a negative interaction between ATR and ROA, loans to assets ratio and a positive interaction between loans to deposits ratio, loans to assets ratio.
Cucinelli (2013)		Panel Data	1080 banks in Euro zone	Large-scale banks are exposed to more liquidity risk. There is a linear relationship between banks' capital size and liquidity. Asset quality has an impact on short-term liquidity. In times of crisis, only short-term liquidity becomes important.
Ferrouhi and Lehadiri (2013)	2001-2012	Panel Data	8 banks in Morocco	There is a positive interaction between LAR and asset size, equity ratio, foreign direct investments and a negative interaction with GDP. There is a positive relationship between ATR and GDP, foreign direct investments.
Vodova (2013)	2001-2010	Panel Data	18 banks in Hungary	LAR is negatively related to asset size and positively related to equity ratio, GDP. ATR is interact negatively to interbank interest rate, monetary policy interest rate, net interest income, interact to equity ratio, loan interest rate. Inflation rate, unemployment rate, financial crisis, ROE and NPL have no significant effect on liquidity.
Ayaydın and Karaaslan (2014),	2003-2011	Panel Data	23 banks in Turkey	There is a positive relationship between LAR and equity ratio, asset size, and a negative relationship between ROA, ROE, net interest income, foreign capital, public capital and GDP.
Ben Moussa (2015)	2000-2010	Panel Data	18 commercial banks in Tunisia	There is a negative relationship between LAR and ROA, NIM, equity ratio, operating expenses, inflation rate, and a positive relationship between ROE and GDP.
Berhanu (2015)	2002-2014	Panel Data	8 commercial banks in Ethiopia	There is a negative interaction between LAR and asset size, loan growth rate, a positive interaction between GDP, loan interest rates, policy interest rates, NPL, short-term interest rates, reserve rates.
Ogilo and Mugenyah (2015)	2010-2014	Panel Data	43 bank in Kenya	There is a positive relationship between LDR and CAP, and a negative relationship with financial leverage ratio. There is no significant relationship between liquidity ratio, bank ownership structure, asset size and liquidity.

# Determinants of liquidity in commercial banks: evidence from the Turkish banking sector

Azimova (2016)	2007-2015	Panel Data	Banks of Azerbaijan	There is a positive relationship between liquidity and asset size, ROA, deposit interest rates, NPL, deposit rate, oil prices. The ratio of insured deposits to total deposits, CAR, ROE, NIM, off-balance sheet loans, loan interest rates, policy interest rates and exchange rates do not have a significant effect on liquidity.
Mohamad (2016)	2006-2013	Panel Data	21 banks in Turkey	There is a positive relationship between ATR and equity ratio, NPL, and a negative relationship with asset size. There is a negative relationship between LAR and ROE, financial crisis factor, and a positive relationship with equity ratio. GDP and inflation rate do not have a statistically significant effect on liquidity.
Sheefeni and Nyambe (2016)	2001-2014	Panel Data	Commercial banks in Namibia	There is a positive interaction between liquidity (loans to assets ratio) and GDP, policy interest rate, and a negative interaction with inflation rate.
Sukmana and Suryaningtyas (2016)	2010-2014	Panel Data	8 Islamic and 5 commercial banks in Indonesia	There is a positive relationship between LAR and CAR in Islamic banks, a negative relationship between LAR and ROA, a positive relationship between LAR and ROA, NPL in commercial banks, a negative relationship between LAR and CAR.
Zengin and Yüksel (2016)	2005-2014	Logit Regression	10 commercial banks in Turkey	There is a negative interaction between CR and CAR, and a positive interaction with NIM.
Ahmad and Rasool (2017)	2005-2014	Panel Data	31 commercial banks in Pakistan	There is a positive relationship between LAR and equity ratio, GDP, a negative relationship between asset size and NPL. ROE and inflation do not have a significant effect on liquidity.
Altan (2017)	2009-2014	Panel Data	28 commercial banks in Turkey	There is a positive relationship between LAR and lagged liquidity, deposits to liabilities ratio, loans, ROA, and a negative relationship between asset size and liquidity. There is no significant relationship between bank capital, NPL, ROE, non-interest income, net interest income and liquidity.
Berger and Bouwman (2017)	1984-2008	Panel Data	Banks in the USA	While the need for liquidity in small-scale banks decreases during periods of monetary tightening in the economy during non-crisis periods, it increases during periods of easing. This effect is not seen in medium and large scale banks. In times of financial crisis, the effect of monetary policy on banks' liquidity is weaker. The increase in the level of liquidity creation of banks before the financial crises can be perceived as a sign of the upcoming crisis.

Hasanovic and Latic (2017)	2006-2015	Panel Data	19 commercial banks in Bosnia-Herzegovina	There is a positive interaction between liquidity (available reserves) and NPL, asset size, and a negative interaction with loans to assets ratio, inflation, and market interest rate. ROE, equity ratio and GDP do not have a significant relationship with liquidity.
Kaur and Sharma (2017)	2006-2016	Panel Data	8 banks in India	There is a negative relationship between LAR and ROA, interest expenses, operating expenses to total deposit ratio, and a positive relationship between asset size, equity ratio, acid test ratio, cost income ratio and deposit ratio.
Nguyen and Diep (2017)	2009-2016	Panel Data	32 commercial banks in Vietnam	There is a positive relationship between LAR and asset size, and a negative relationship with loans to deposits ratio and equity ratio. ROA has no significant effect on liquidity.
Bayz (2018)	1999-2017	Panel Data	12 banks in the USA	There is a negative relationship between LAR and ATR, equity ratio, GDP, and a positive relationship with asset size. ROA and NPL have no statistically significant effect on liquidity.
Hailemarim (2018)	2000-2016	Panel Data	7 banks in Ethiopia	There is a positive relationship between ATR and CAR, ROA, and a negative relationship between asset size, loan growth, market interest rate, and net interest income. There is a negative relationship between LAR and asset size, loan growth, net interest income, market interest rate, and a positive relationship with ROA.
Luvuno (2018)	2006-2016	Panel Data	18 commercial banks in the South Africa Republic	There is a negative relationship between LAR and loan growth rate, CAR, NPL, asset size, and a positive relationship with GDP. There is a negative relationship between ATR and loan growth, NPL, and a positive relationship between CAR and asset size. Inflation rate has no statistically significant effect on liquidity.
Ojha (2018)	2010-2017	Panel Data	Commercial banks in Nepal	There is a negative relationship between LAR and ROA, ROE, NPL, interbank interest rates, and a positive relationship between CAR and GDP.
Sayedahmed (2018)	2007-2016	Panel Data	15 Palestinian banks	There is a negative relationship between LAR and CAR, loans to assets ratio, deposits to liabilities ratio, and a positive relationship with bank loans. There is a negative relationship between ATR and CAR, loans to assets ratio, a positive relationship with bank loans, and a negative relationship between loans to deposits ratio, CAR, deposits to liabilities ratio, and a positive relationship with loans to assets ratio.
Sopan and Dutta (2018)	2005-2016	Panel Data	45 banks in India	There is a negative relationship between LAR and asset size, ROA, NPL, funding cost, and a positive relationship with deposits to liabilities ratio, capitalization rate. There is no statistically significant relationship between GDP and inflation rate and liquidity.
Al-Homaidi <i>et al.</i> (2019)	2008-2017	Panel Data	37 commercial banks in India	There is a positive relationship between LAR and asset size, equity ratio, deposits to liabilities ratio, ROA, operating expenses, and a negative relationship between loans to assets ratio, interest income, ROE, NIM.



# Determinants of liquidity in commercial banks: evidence from the Turkish banking sector

Assfaw (2019)	2011-2017	Panel Data	8 commercial banks in Ethiopia	There is a negative relationship between liquidity (liquid assets to deposits ratio and loans to deposits ratio) and asset size, loan growth, deposits to liabilities ratio, and a positive relationship between net interest income, GDP, inflation rate.
El-Chaarani (2019)	2014-2016	Panel Data	183 banks in the Middle East	There is a negative relationship between liquidity (loans to assets ratio and loans to deposits ratio) and asset size, GDP, and a positive relationship with asset quality.
Gockov and Hristovski (2019)		Panel Data	14 commercial banks in Northern Macedonia Republic	There is a positive relationship between LAR and ROA, equity ratio, NPL, policy interest rate, and a negative relationship with asset size.
Gümüş (2019)	2010-2018	Panel Data	7 banks in Turkey	There is a negative relationship between liquidity (loans to deposits ratio) and LAR, and a positive relationship between deposits to liabilities ratio, ROA, NIM.
Gürsoy (2019)	2002-2015	Panel Quantile	9 Turkish banks	There is a negative relationship between liquidity (financial deficit ratio) and LAR, and a positive relationship between asset size and loans received.
Khanal (2019)	2007-2017	Panel Data	10 commercial banks in Nepal	There is a positive relationship between liquidity (loans to deposits ratio) and ROA, and a negative relationship between ROE, assets size, GDP, CAR, inflation rate. NPL has no statistically significant effect on liquidity.
Şimşek (2019)	2002-2017	Panel Data	23 commercial banks in Turkey	There is a positive relationship between LAR and the loans received, CAR, and a negative relationship between NPL, loans to deposits ratio. There is a positive relationship between ATR and loans received, and a negative relationship between NPL, loans to deposits ratio.
Ahi (2020)	2008-2018	Panel Data	18 commercial banks in Turkey	There is a positive relationship between ATR and CAR, and a negative relationship between deposits to liabilities ratio, FX assets to total assets ratio, loans to deposits ratio, consumer loans, ROA, ROE, interest incomes, interest expenses.
Al-Qudah (2020)	2011-2018	Panel Data	13 commercial banks in Jordan	There is a positive relationship between LAR and equity ratio, deposit growth rate, inflation rate, and a negative relationship with GDP, assets size and NPL. There is no statistically significant relationship between liquidity and ROA.
Bista and Basnet (2020)	2004-2015	Time Series	Commercial banks in Nepal	There is a positive relationship between LAR and deposits to liabilities ratio, and a negative relationship between CAR and asset size. Inflation rate, public expenditures and public debt do not have a statistically significant effect on liquidity.
Menteşoğlu (2020)	2006-2019	Panel Data	20 commercial banks in Turkey	There is a negative relationship between LAR and asset size, savings deposits, GDP, and a positive relationship with CAR, NPL. ROA, NIM, inflation rate, interest rates and financial crises do not have a significant effect on liquidity.



## 2. Data Set and Variables

### 2.1. Data Set

In the study, 20 Turkish commercial banks operating in the 2002-2022 period were taken into account, and their list is given in Table A1 (Appendix). In the research, the data for the period from the last quarter of 2002 (Q4) to the first quarter of 2022 (Q1) were compiled from the BAT (the Banks Association of Türkiye) data system, in which the quarterly financial data of banks are reported (BAT, 2021b), websites of banks operating in Turkey and national and international academic studies have also been used. Macroeconomic data was compiled and arranged from the CBRT (The Central Bank of the Republic of Turkey) and TURKSTAT (Turkish Statistical Institute) systems (CBRT, 2021a, b; TURKSTAT, 2021). The data have been prepared by considering quarterly periods. Stata and Eviews packet data programs were used in the analysis.

### 2.2. Variables

In the research, liquid assets ratio (LAR), acid-test ratio (ATR) and current ratio (CR) were taken as dependent variables, which are generally accepted liquidity ratios in banking and related literature. From intra-bank financial data asset size (TA), equity ratio (CAP), FX liquidity ratio (FXLR), deposit ratio (DR), loan ratio (LR), non-performing loans ratio (NPL), fixed assets ratio (FIXR), financial assets ratio (FAR), net interest margin (NIM) were taken as the independent variables. From macroeconomic (external) factors economic growth rate (GDP), consumer price index (INF), value of Turkish Lira against basket exchange (XR), CBRT overnight lending rate (INT) were also taken as the independent variables. Variables and their calculation methods are given in Table A2 (Appendix).

#### 2.2.1. Dependent variables - measuring liquidity

##### *Liquid Assets Ratio*

This ratio is calculated with Liquid Assets / Total Assets formula. It shows the share of assets and assets that can be converted into cash in the short term, in the balance sheet shows the ability of banks to easily meet their due liabilities. It is also called liquid asset ratio (IMF, 2019, p. 6), cash

ratio, cash asset ratio and liquidity ratio in the finance literature (The Free Dictionary by Farlex; Pradhan and Shrestha, 2017).

#### *Acid-test Ratio*

This ratio, which shows the short-term debt coverage ratio of current assets excluding inventories and prepaid expenses in real sector businesses, is calculated with the formula Liquid Assets / Short-Term Liabilities (CBRT, 2020). It is also called acid-test ratio and quick ratio in the finance literature. The ratio shows the ratio of assets to cover liabilities that will mature within one year. Considering that 61 of the 78 periods within the scope of this study are in 2017 and before, in accordance with BAT's 2017 and earlier reporting, liquid assets are taken into account as "Cash + Deposits in CBRT and Banks + Receivables from Money Markets + Financial Assets at Fair Value Through Profit and Loss + For Sale Available Financial Assets" (BAT, 2021).

#### *Current Ratio*

In the international finance literature, the current ratio, which shows the assets to meet the liabilities within a one-year maturity ([www.investopedia.com](http://www.investopedia.com)) and is calculated with the formula of Short-Term Assets to Short-Term Liabilities. It is similar to the liquidity adequacy ratio in the BRSA's regulations (Banking Regulation and Supervision Agency), except term definition. Liquidity adequacy ratio shows that assets with maturity of up to one month meet liabilities with maturity of up to one month (BRSA, 2006). In this research, the ability of assets to meet liabilities with a maturity of up to one month is called the current ratio (CR) similar to the international literature (except term criterion). In the literature, loans to deposits ratio, loans to total assets ratio and deposits to total liabilities ratio are also considered as liquidity (risk) criteria.

### **2.2.2. Explanatory variables**

#### *Equity Ratio*

Paid-in capital, reserves, past and current period profits are the most important equity elements of banks. The equity ratio, which shows the share of equity in total capital, is also the focus of the profitability expected by the shareholders from the bank. Regulatory and supervisory institutions related to banks determine and supervise the minimum equity ratio in order to prevent the savers from

being harmed, to give confidence to the financial markets, and to prevent the assets of banks from being endangered (Schargrodsky and Sturzenegger, 1998, p. 8; Kim and Santomero, 1988, p. 1219). It is among the ratios frequently used together with the capital adequacy ratio in researches on the factors affecting the liquidity of banks. It is predicted that liquidity ratios and equity ratio are positively related (Hypothesis 1).

#### *Deposit Ratio*

While it is possible for banks to obtain funds through different instruments such as borrowing from the central bank and the interbank market and issuing bonds, deposits remain the most important source of funds. While the share of deposits in liabilities in commercial banks in Turkey is 58%, its average maturity is approximately 80 days (BAT, 2021a, pp. 35-39). The maturity mismatch of assets and liabilities is one of the leading risk factors that should be carefully managed by banks. The deposit ratio, which shows the share of deposits in total liabilities, is among the variables frequently used together with the loan ratio in studies on liquidity. It is predicted that liquidity ratios and deposit ratio are positively related (Hypothesis 2).

#### *Financial Assets Ratio*

Securities held in the portfolio by banks to earn trading income or interest income are among the items that affect profitability and liquidity. It is predicted that liquidity ratios and financial assets ratio are negatively related (Hypothesis 3).

#### *Fixed Assets Ratio*

Assets held for sale, partnership investments, tangible and intangible fixed assets are included in the category of non-income or low-income assets and affect the profitability and liquidity of banks. It is predicted that liquidity ratios and fixed assets ratio are negatively related (Hypothesis 4).

#### *Net Balance Sheet Position and Foreign Exchange Liquidity Ratio*

These ratios show the liquidity in FX at banks. FX liquidity management gains importance in banks, which have an important place in their financial assets and liabilities in their balance sheets. It is predicted that liquidity ratios and foreign exchange liquidity ratio are positively related (Hypothesis 5).

### *Gross Domestic Products*

Economic growth rate is one of the factors affecting the liquidity of banks. Economic growth or contraction is a factor in the investment decisions of companies and the increase or decrease in their financing needs. Likewise, it is also effective in saving tendencies of firms and individuals. This situation also affects the tendency and possibilities of banks to extend loans. While banks that do not have difficulty in obtaining funds and do not have liquidity problems during the growth periods of the economy tend to provide more loans to companies and individuals, they reduce their loan disbursements during periods of contraction in the economy (Güneş, 2014, p. 62). On the other hand, businesses that use loans during growth and prosperity periods may have difficulty in repayment of loans during the economic contraction period and the bank's credit facilities may narrow. It is predicted that liquidity ratios and gross domestic products are negatively related (Hypothesis 6).

### *Inflation Rate*

Considering the pricing and maturity structure of banks' assets and liabilities, inflation expectations they need to do. Inflation is among the factors that directly affect the liquidity risk of banks, especially in markets such as the Turkish banking sector, where the liquidity risk arising from the maturity mismatch between assets and liabilities is high. Due to this effect, the inflation rate has been taken into account in many studies on liquidity. It is predicted that liquidity ratios and inflation rate are positively related (Hypothesis 7).

### *Benchmark Interest Rate*

Interest risk of banks among the risks faced. Short-term interest rates fluctuations affect earnings and costs associated with assets and liabilities (Van Greuning and Bratanovic, 2003, p. 249). The high risk of maturity mismatch between assets and liabilities causes increases or decreases in interest rates to directly affect the profitability of banks. It is not possible for banks to reflect the interest changes in the market to all their assets and liabilities in a short time. It is predicted that liquidity ratios and interest rate are positively related (Hypothesis 8).

### *Loan Ratio*

Loans and deposits are among the primary tools used by banks to fulfill their intermediary function. At the beginning of the assets that banks evaluate the funds are loans. The share of loans in assets in commercial banks is 56% and the average maturity is about two years in Turkey (BAT, 2021a, p. 35; BAT, 2021b). The loan ratio, which shows the share of loans in total assets, is one of the important variables used in studies on liquidity. It is predicted that liquidity ratios and loan ratio are negatively related (Hypothesis 9).

### *Net Interest Margin*

Net interest margin, which is calculated with the formula  $(\text{Total Interest Income} - \text{Total Interest Expenses}) / \text{Income Generating Assets}$ , is one of the leading profitability indicators in banking. The interest margin is a fundamental result of the banks' function of transferring funds from investors with surplus funds to individuals and institutions in need of funds. The margin between the interest income of banks from the assets and the funding cost forms the basis of profitability. Financial assets other than cash and the similar, loans and other financial assets measured at amortized cost have been taken into account in the calculations of income generating assets in the research. Net interest margin is among the important variables included in the research considering its potential to affect the liquidity of banks. It is predicted that liquidity ratios and net interest margin are negatively related (Hypothesis 10).

### *Non-performing Loans Ratio*

Non-performing loans ratio shows the share of non-performing loans in total loans. There is a risk of non-repayment of loans at maturity. For this reason, banks take risks that may occur during the evaluation of loan requests. Banks try to minimize that risk. Accurate lending will ensure more efficient use of funds. Otherwise, non-payment of the credits on due date and problematic is inevitable. The increase in non-performing loans will affect the profitability and liquidity of banks. It is predicted that liquidity ratios and non-performing loans ratio are negatively related (Hypothesis 11).

### *Asset Size*

Asset size may affect the competitiveness of banks in the market in terms of providing funds and extending loans. The scale effect is among the positive factors for banks to reach liquidity more

easily. Therefore, it is predicted that liquidity ratios and asset size are positively related (Hypothesis 12).

### *Exchange rate*

Banks' foreign exchange based assets and liabilities have an impact on liquidity and profitability depending on the exchange rate risk. If liabilities of banks in foreign exchange is more than its assets in foreign exchange (open position), short-term increases or decreases in exchange rates will increase the exchange rate risk. This situation will positively or negatively affect the liquidity of the bank, depending on its position, while increasing or decreasing its profitability. The size of the open position of the banks may even cause the bank to fall into insolvency. It is predicted that liquidity ratios and exchange rate are positively related (Hypothesis 13).

While liquidity ratios protect the reputation and trust of banks in the eyes of customers and other stakeholders, especially in times of crisis, they also have an impact on profitability. On the other hand, liquidity ratios are affected by macroeconomic factors as well as the ratios related to the bank's financial structure. As a matter of fact, as stated in the literature summary section, many studies have been conducted to determine the factors affecting the liquidity ratios, and in these studies, results have been reached regarding the interaction of liquidity ratios with intrabank and macroeconomic factors. In this study, it was predicted that there was a negative relationship between liquidity ratios and FAR, FIXR, GDP, LR, NIM, NPL; there was a positive relationship between CAP, DR, FXLR, INF, INT, TA, XR and these hypotheses were investigated.

### **3. Methodology and preestimation tests**

Three types of data are generally used in econometric analysis. These are time series data, cross-section data, and panel data, which deals with time series data and cross-sectional data. Panel data is formed by bringing together the cross-sectional observations of units such as individuals, countries, businesses, households in a certain period and consists of the combination of time series and cross-section data (Güriş, 2018, p. 3; Yerdelen Tatoğlu, 2020, p. 10).

In the study, the determinants of liquidity were investigated by panel data analysis. Data for 78 periods from the fourth quarter of 2002 to the first quarter of 2022 from 20 banks within the scope of the research were used. The descriptive statistics of the dependent and independent variables (Mean,

Median, Maximum, Minimum, Standard Deviation, Skewness, Kurtosis, Jarque-Bera and Observation) are given in Table A3 (Appendix).

The values of the cross-section units of the data in Table A3 shows the maximum, minimum, mean, standard deviation, skewness and kurtosis coefficients and the distribution of the coefficients (Jarque-Bera value). Since the skewness coefficient of the variables is mostly different from 0 and the kurtosis coefficient is different from 3, the Jarque-Bera values are high (for example, this figure is 598973.50 for the CAP) and this situation indicates that the distribution of the coefficients of the mentioned variables is not normal (heterogeneous) is clearly indicated. The correlation matrices of the cross-section units included in the analysis are given in Table A4 (Appendix).

When Table A4 is examined, it is seen that the correlation coefficients between the variables are below 50%. However, correlation coefficient and descriptive statistics are not sufficient criteria to explain the relationship between variables. In addition to these values, cross-section dependency, stationarity (unit root) and autocorrelation tests are also needed.

One of the problems encountered in panel data analysis is that a shock affecting any of the cross-section units also affects other cross-section units. At the beginning of the analysis, this problem, called cross-section dependency, needs to be tested. In this study, the Breusch-Pagan (1980) LM test, which was developed to determine whether the error terms are dependent across the cross-sectional units, and which gives consistent results, was used by Pesaran *et al.* (2007) LM test was applied (Hoyos and Sarafidis, 2006, pp. 482-496); as well as Pesaran (2004), Baltagi *et al.* (2012) and Pesaran (2004) CD tests were also used (Pesaran, 2004, pp. 1-42; Breusch-Pagan, 1980, pp. 239-253; Baltagi *et al.*, 2012, pp. 1-41; Pesaran (2004) and Pesaran *et al.* (2007). The results are given in Table A5 (Appendix). The test results in Table A5 show that there is a cross-sectional dependency at the 1% significance level in all series and models.

Determining whether some features of the time series data created for a variable are stable in the process comes first in econometric analysis (Acar Boyacıoğlu *et al.*, 2010, p. 202). If all or some of the units in the panel are not stationary, the regression to be established between the panel data will be misleading (fake) (Nargeleçekenler, 2009, p. 3; Acar Boyacıoğlu *et al.*, 2010, p. 202; Uçan ve Koçak, 2014, p. 56). Tests that take into account the correlation between units in panel data are classified as second generation (Şak, 2018, p. 262). In case of cross-section dependency, second generation unit root tests should be used to test whether the series are stationary. In this study, the Pesaran (2007) CIPS test was preferred (Pesaran, 2007), and the test results are given in Table A6 (Appendix). The critical values for the panel are 1%, 5% and 10%, respectively.



Considering that it is -2.70, -2.57 and -2.51, it is understood that all variables are stationary at the level [I(0)] (Pesaran, 2007).

The correlation of the error term for each cross-sectional unit with the error term in the following period is called autocorrelation. The tests used to investigate this problem are Baltagi-Wu (1999) Locally Best Invariant (LBI) test and Bhargava *et al.* (1982) Durbin-Watson test.

One of the main problems encountered in panel data analysis is that the variances of the error terms are not constant (heteroskedasticity). Since the standard errors obtained in the analyses without considering this problem will be biased, it is necessary to derive the robust standard errors. The modified Wald test (Ün, 2018, p. 75; Yerdelen Tatoğlu, 2020, pp. 228-229), gives effective results in determining the problem of heteroskedasticity.

Table A7 shows the Pesaran-Yamagata (2008) test, modified Wald test (Greene, 2003), Baltagi-Wu (1999) LBI and Bhargava *et al.* (1982) Durbin-Watson test, Breusch-Pagan (1980) LM test, Chow test and Hausman test (1978) results (Appendix). The Pesaran-Yamagata (2008) test results show that the slope parameters for all variables are heterogeneous with a probability of 0.000 (test values; 36.12 / 4.58 / 14.37). The modified Wald test results show that variance of the error terms are not fixed (heteroskedasticity problem) with a probability of 0.000 (test values; 229.03 / 82180.26 / 918.76). Bhargava *et al.* (1982), Durbin Watson test and Baltagi-Wu (1999) LBI test results show autocorrelation between error terms in LAR, ATR and CR models (BFN test values; 0.34 / 1.90 and 1.32, BW test values; 0, 39 / 1.93 / 1.41). Breusch-Pagan LM test indicates that error terms with a probability of 0.000 are correlated between units, and that the common effect estimation model is not suitable for estimation (test values; 1905.72 / 1379.46 / 1473, 19). Chow test results show that the common effect estimation model is not suitable with a probability of 0.000 (test values; 33.29 / 8.82 / 44.97). Hausman test results show fixed effect estimation model are suitable for LAR, ATR and CR (test values; 27.95 / 54.65 / 20.85).

The linear relationship between the independent variables (multicollinearity) in the regression model reduces the estimation efficiency. While the Variance Inflation Factor (VIF) calculated with the formula  $1 / (1 - R_i^2)$  is lower than 1.33, it indicates that there is no multicollinearity. While values above 1.33 indicate that there is a multicollinearity (Uçan and Şahin, 2021, p. 242). Variance inflation factor (VIF) values were found to be 5,39 in this study.

#### 4. Results and Discussions

The ordinary least squares method (OLS) used in panel data analysis assumes that the distribution of error terms is normal, the variance of the error terms is constant at each level of the

explanatory variable (homoscedasticity), the error terms is not correlated between cross-section units and in consecutive periods, and there is no multicollinearity between the explanatory variables. In the presence of at least one of the heteroskedasticity, cross-section dependency and autocorrelation, the estimations will be ineffective even if they are consistent. In the presence of these problems, it is necessary to use robust standard errors without touching the parameter estimations or to make estimations with methods that take these problems into account (Yerdelen Tatoğlu, 2020, p. 303). In the tests results in Table A6 varying variance, autocorrelation and correlation problems were detected, analysis was performed with the Driscoll-Kraay method, which is one of the estimators producing robust standard errors with OLS methods (Güriş, 2018, p. 96; Yerdelen Tatoğlu, 2020, p. 335). Estimation results are given in Table 2.

**Table 2. Estimation results in relationship of LAR, ATR and CR with intra-bank factors and macroeconomic variables**

<i>Variable</i>	Liquid Asset Ratio (LAR)		Acid-Test Ratio (ATR)		Current Ratio (CR)	
	<i>Coefficient</i>	<i>p-value</i>	<i>Coefficient</i>	<i>p-value</i>	<i>Coefficient</i>	<i>p-value</i>
Equity Ratio-Equities to Assets Ratio (CAP)	0,31	0,006	-1,20	0,660	0,77	0,150
Deposits Ratio-Deposits to Liabilities Ratio (DR)	0,01	0,709	-1,03	0,059	-0,04	0,777
Financial Asset Ratio (FAR)	-0,62	0,000	-1,17	0,043	-1,09	0,000
Fixed Asset Ratio (FIXR)	-0,80	0,000	-0,31	0,779	-1,32	0,000
Foreign Exchange Liquidity Ratio (FXLR)	0,01	0,494	0,05	0,707	0,01	0,898
Gross Domestic Products (GDP)	0,00	0,977	0,00	0,994	-0,23	0,048
Consumer Prices Index-Inflation Rate (INF)	-0,09	0,308	0,58	0,484	0,43	0,083
Central Bank Interests Rate (INT)	-0,24	0,000	-0,79	0,269	-0,17	0,205
Loans Ratio-Loans to Assets Ratio (LR)	-0,97	0,000	-1,99	0,000	-0,87	0,000
Net Interest Margin (NIM)	-0,51	0,000	9,68	0,116	0,04	0,935
Non-performing Loans Ratio (NPL)	-0,32	0,000	0,66	0,254	0,15	0,103
Asset Size-Natural Logarithm of Asset Size (TA)	1,82	0,017	-2,30	0,454	3,87	0,479
Foreign Exchange Rate (XR)	0,08	0,002	-0,61	0,121	0,13	0,297
Constant	91,86	0,000	259,88	0,018	100,1	0,008
Estimator	Driscoll-Kraay		Driscoll-Kraay		Driscoll-Kraay	
Number of Banks	20		20		20	
Time Span	2002-2022		2002-2022		2002-2022	
Observations	1560		1560		1560	
R <sup>2</sup>	0,660		0,273		0,381	

When the results in Table 2 were examined, it was seen that there was a negative and significant relationship between LAR and FAR, FIXR, INT, LR, NIM and NPL, and a positive and significant relationship with CAP, TA and XR. There was no statistically significant relationship between LAR

and DR, FXLR, GDP, INF. While slope parameters are significant and the effects of other variables are constant, 0.62% in FAR, 0.80% in FIXR, 0.24% in INT, 0.97% in LR, 0.51% in NIM, a 0.32% decrease in NPL resulted in a 1% increase in LAR. It was observed that an increase of 0.31% in CAP, 1.82% in TA and 0.08% in XR caused a 1% increase in LAR. There is a negative and significant relationship between ATR and DR, FAR, LR. There is no statistically significant relationship between ATR and CAP, FIXR, FXLR, GDP, INF, INT, NIM, NPL, TA, XR. While the slope parameters are significant and the effects of other variables are constant, a decrease of 1.03% in DR, 1.17% in FAR and 1.99% in LR leads to a 1% increase in ATR. It was determined that an increase of 2.43% in CAP caused an increase of 1% in ATR. There was a negative and significant relationship between CR and FAR, FIXR, GDP, INF, LR. There was a positive and significant relationship between CR and INF. There was no statistically significant relationship between CAP, DR, FXLR, INT, NIM, NPL, TA, XR and CR. While slope parameters are significant and the effects of other variables are constant, a decrease of 1.09% in FAR, 1.32% in FIXR, 0.23% in GDP and 0.87% in LR leads to a 1% increase in CR. It was observed that an increase of 0.43% in INF caused an increase of 1% in CR. Finally, when the results in Table 2 were evaluated, it was seen that the hypotheses H<sub>1</sub>, H<sub>3</sub>, H<sub>4</sub>, H<sub>6</sub>, H<sub>7</sub>, H<sub>9</sub>, H<sub>10</sub>, H<sub>11</sub>, H<sub>12</sub> and H<sub>13</sub> were confirmed, whereas hypotheses H<sub>2</sub>, H<sub>5</sub> and H<sub>8</sub> and were rejected.

When the findings of the study are compared with the literature, positive relationship between LAR and CAP is same with Vodova (2011a), Vodova (2011c), Ferrouhi and Lehadiri (2013), Vodova (2013) Ayaydın and Karaaslan (2014), Mohamad (2016), Ahmad and Rasool (2017), Gockov and Hristovski (2019), Al- Homaidi *et al.* (2019), Al-Qudah (2020), different with Vodova (2011b), Ben Moussa (2015), Nguyen and Diep (2017), Bayz (2018). Negative relationship with LAR and INT is same with Hailemarim (2018), Ojha (2018), different with Berhanu (2015), Gockov and Hristovski (2019). Negative relationship with LAR and LR is same with Sayedahmed (2018) and Al-Homaidi *et al.* (2019). Negative relationship with LAR and NIM is same Ben Moussa (2015) and Al-Homaidi *et al.* (2019). Negative relationship with LAR and NPL is same with Ahmad and Rasool (2017), Luvuno (2018), Ojha (2018), Sopan and Dutta (2018), Şimşek (2019) and Al-Qudah (2020), different with Vodova (2011a), Tesfaye (2012), Berhanu (2015), Sukmana and Suryaningtyas (2016), Gockov and Hristovski (2019), Nazarli (2019). Positive relationship with LAR and TA is same Tesfaye (2012), Ferrouhi and Lehadiri (2013), Ayaydın and Karaaslan (2014), Al-Homaidi *et al.* (2019), Çanakcı (2017), Kaur and Sharma (2017), Nguyen and Diep (2017), different with Vodova (2011b), Vodova (2011c), Vodova (2013), Berhanu (2015), Ahmad and Rasool (2017), Altan (2017), Bista and Bisnet (2020), Luvuno (2018), Hailemarim (2018), Gockov and Hristovski (2019), Al-Qudah (2020), Sopan and Dutta (2018).

The findings of the study are related to the relationship between liquidity, bank-specific internal factors and macroeconomic factors in the literature. It differs according to country, time period, data set and method. For example, while Vodova found a negative relationship between GDP and liquidity in her study on Polish banks, and a positive relationship in her study on Hungarian banks, in her study on Slovakia banks, she found that there was no significant relationship between GDP and liquidity (Vodova, 2011b, 2011c and 2013). Vodova has obtained findings that differ according to countries in the relationships between NPL and interest rates and liquidity in their studies (Vodova, 2011a, b, c, 2013).

When the findings obtained as a result of the study are evaluated together, it is significant that loan disbursements (LR) reduce liquidity. It is understood that the negative relationship between deposits (DR) and liquidity is due to the average maturity of deposits being approximately 80 days. In addition to the liquidity-increasing effect of the inflation rate (INF), the lowering effect of the Central bank interest rate (INT) should be evaluated together. The use of public expenditures and increase in emissions as an economic growth policy tool increases inflation rates and leads banks to act cautiously. However, it is understood that the fall in the policy interest rates, especially in periods when interest rates are weak in parallel with inflation, prompted banks to act prudently and encouraged the policy of increasing liquidity. It is natural for banks to increase their capital (CAP) capacity, increasing the liquid asset ratio. Fixed assets (FIXR) and financial assets (FAR) have a negative relationship with liquidity due to their low income generation capacity compared to other assets. The declining effect of non-performing loans (NPL) on asset quality is one of the factors that increase liquidity needs. However, the positive effect of collecting non-performing loans on interest income should not be overlooked. It is also significant that the increase in the interest margin (NIM) lowers the liquidity prudence. It is understood that the increase in asset size (TA) also increases liquidity due to economies of scale. The lack of a significant relationship between the FX liquidity ratio (FXLR) and liquidity can be explained by the fact that banks are cautious against exchange rate risk due to the volatility of the exchange rate. The negative relationship between the economic growth rate (GDP) and the current ratio can be explained by the fact that banks do not have difficulty in extending their liabilities during growth periods. The positive relationship between the value of TL against the exchange basket (XR) and the LAR ratio is significant. As the value of TL decreases, liquidity also decreases, and in the opposite case, it increases.

## Conclusions

Generally, publicly traded banks are expected to operate as profitable and efficient as other commercial enterprises, in line with the expectations of their stakeholders. The ability of banks to manage the risks they face during their activities is of critical importance in achieving their goals. Liquidity risk is among the most important of these risks. The financial crises experienced in Turkey in 2000 and 2001, and in the USA in 2008, which also affected other countries, drew the attention of the financial world to the liquidity risk. The maturity mismatch of liabilities and assets is one of the leading risk factors that put banks in a difficult situation, especially in times of crisis. Micro and macro variables affecting the liquidity of banks have been the subject of many academic studies. It is thought that this study, which investigates 78 quarters of 20 deposit banks operating in the Turkish banking sector with panel data analysis, will contribute to the literature. Considering that the detailed reports of BAT on banks started to be published in the last quarter of 2002, the last quarter of 2002 was taken as the beginning of the research and 78 quarterly data, including the first quarter of 2022, were included in the scope of the study. Twenty commercial banks including three state-owned, eight domestic capital and nine foreign capital operating in the 2002-2022 period were included in the research. Banks operating only in the field of corporate banking, which did not have a widespread branch network, which terminated their operations for various reasons during this period, and banks that started their operations during the research period, as well as development and investment banks were not included in the scope of the study.

In this study, which was carried out using the intra-bank ratios of 20 Turkish commercial banks for the period 2002-2022 and the macroeconomic data of the same period, it was determined that there was a negative relationship between liquidity ratios (liquid assets ratio, acid-test ratio and current ratio) and deposits to liabilities ratio (DR), financial asset ratio (FAR), fixed asset ratio (FIXR), economic growth rate (gross domestic products - GDP), central bank interest rate (INT), loans to assets ratio (LR), net interest margin (NIM), non-performing loans ratio (NPL); a positive relationship between equity ratio (equities to assets ratio, CAP), inflation rate (INF), natural logarithm of asset size (TA), foreign exchange rate (XR). In the study, no statistically significant relationship was found between foreign exchange liquidity ratio (FXLR) and liquidity ratios.

Despite the negative impact of liquidity on profitability due to the fact that liquid assets are interest-free or low-yielding, having sufficient liquid assets is very important for banks to maintain their reputation with the market and customers, especially during crisis periods. The issue of liquidity management has been the focus of academic studies. It is thought that empirical analyzes with

different variables in different markets will contribute to the literature and the banking sector by classifying small, medium and large-scale banks, or banks with public and private capital, or banks with domestic and foreign capital.

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## APPENDIX

Table A1. Banks included in the analysis

State Owned Banks	Domestic Capital Banks	Foreign Capital Banks
T.C. Ziraat Bankası A.Ş.	Akbank T.A.Ş.	Alternatif Bank A.Ş.
T. Halk Bankası A.Ş.	Anadolubank A.Ş.	Burgan Bank A.Ş.
T. Vakıflar Bankası T.A.O.	Fibabanka A.Ş.	DenizBank A.Ş.
	Şekerbank T.A.Ş.	HSBC Bank A.Ş.
	Turkish Bank A.Ş.	ICBC Turkey Bank A.Ş.
	Türkiye Ekonomi Bankası A.Ş.	ING Bank Türkiye A.Ş.
	T. İş Bankası A.Ş.	QNB Finansbank A.Ş.
	Yapı Kredi Bankası A.Ş.	Turkland Bank A.Ş.
		T. Garanti Bankası A.Ş.

Table A2. Variable description

Dependent Variables	Definition	Explanation
LAR	Liquid Assets Ratio (Liquid Assets / Total Assets Ratio)	(Cash + Deposits in the CBRT and Banks + Receivables from Money Markets) / Total Assets
ATR	Acid-test Ratio (Liquid Assets / Current Liabilities ratio)	(Cash + Deposits in the CBRT and Banks + Receivables from Money Markets) / Liabilities due up to one month
CR	Current Ratio (Liquidity Adequacy Ratio)	Assets due up to one month / Liabilities due up to one month
Independent Variables	Definition	Explanation
CAP	Equity Ratio	Equity / Total assets
DR	Deposit Ratio	Total deposits / Total liabilities
FAR	Financial Asset Ratio	Financial assets / Total assets
FIXR	Fixed Asset Ratio	Fixed assets / Total assets
FXLR	Foreign Exchange Liquidity Ratio	FX Assets / FX Liabilities ratio
GDP	Gross Domestic Products	Change in GDP compared to the previous year
INF	Annual Inflation Rate	Change in consumer price index compared to the previous year
INT	CBRT Interest Rate	CBRT overnight lending rate
LR	Loan Ratio	Total loans / Total assets ratio
NIM	Net Interest Margin	The ratio of the last four quarters net interest income to the last four quarters income generating assets average
NPL	Non-performing Loans Ratio	Non-performing loans and receivables / Total assets
TA	Asset Size	Natural logarithm of asset size
XR	Foreign Exchange Rate	Value of Turkish Lira against basket exchange (0,5 Euro + 0,5 Usd)



**Table A3. Descriptive statistics**

Variable	Mean	Median	Max.	Min.	Std. Dev.	Skewness	Kurtosis	Jarque-Bera	Obs.
LAR	28,34	26,09	85,28	2,90	11,45	1,47	6,68	1441,90	1560
ATR	53,98	46,55	2749,40	4,81	73,25	32,11	1176,9	89843209	1560
CR	53,91	48,77	304,13	5,92	27,59	2,75	18,97	18537,96	1560
CAP	11,65	11,08	91,61	2,88	4,76	6,85	98,01	598973,5	1560
DR	63,01	62,12	87,53	1,15	9,06	-0,42	6,47	830,16	1560
FAR	20,35	17,20	77,38	0,61	12,52	1,43	5,45	919,63	1560
FIXR	4,21	3,24	51,60	0,45	3,57	4,63	39,75	93387,79	1560
FXLR	79,96	83,54	156,73	12,53	17,05	-0,82	3,97	234,48	1560
GDP	5,62	6,41	21,89	-14,54	5,17	-1,09	6,68	1191,91	1560
INF	11,07	8,81	29,88	6,00	5,46	2,08	6,81	2069,48	1560
INT	16,56	12,75	51,00	6,50	9,18	1,79	6,87	1801,01	1560
LR	57,26	61,76	87,84	0,08	15,12	-1,23	4,26	498,72	1560
NIM	4,96	4,84	56,82	-8,32	3,34	6,08	85,22	448981,8	1560
NPL	5,24	3,81	94,62	0,00	6,95	6,20	56,21	194032,8	1560
TA	4,34	4,40	6,18	1,39	0,85	-0,29	2,47	39,45	1560
XR	43,13	48,30	69,39	6,46	19,40	-0,38	1,79	132,76	1560

**Table A4. Correlation matrix**

	ATR	CAP	CR	DR	FAR	FIXR	FXLR	GDP	INF	INT	LAR	LR	NIM	NPL	TA	XR
ATR	1.00	0.26	0.21	-0.20	0.04	0.15	0.09	0.02	0.11	0.14	0.25	-0.26	0.41	0.12	-0.14	0.08
CAP	0.26	1.00	0.29	-0.22	-0.07	0.50	0.02	0.01	0.06	0.17	0.19	-0.23	0.57	0.09	-0.39	0.28
CR	0.21	0.29	1.00	-0.12	-0.33	0.02	-0.04	-0.04	0.08	0.06	0.26	-0.05	0.10	0.03	-0.41	0.02
DR	-0.20	-0.22	-0.12	1.00	0.20	-0.04	0.05	0.02	0.14	0.15	-0.04	-0.11	-0.19	0.16	-0.05	0.06
FAR	0.04	-0.07	-0.33	0.20	1.00	0.09	0.23	0.06	0.12	0.32	0.13	-0.70	0.11	0.30	0.14	0.39
FIXR	0.15	0.50	0.02	-0.04	0.09	1.00	0.14	0.08	0.27	0.41	0.07	-0.37	0.24	0.18	-0.23	0.22
FXLR	0.09	0.02	-0.04	0.05	0.23	0.14	1.00	0.02	0.21	0.15	0.27	-0.36	-0.08	0.10	0.24	-0.14
GDP	0.02	0.01	-0.04	0.02	0.06	0.08	0.02	1.00	-0.07	0.05	0.08	-0.11	0.04	-0.01	-0.06	0.10
INF	0.11	0.06	0.08	0.14	0.12	0.27	0.21	-0.07	1.00	0.71	-0.03	-0.30	0.00	0.32	0.01	-0.24
INT	0.14	0.17	0.06	0.15	0.32	0.41	0.15	0.05	0.71	1.00	0.10	-0.55	0.23	0.30	-0.28	0.28
LAR	0.25	0.19	0.26	-0.04	0.13	0.07	0.27	0.08	-0.03	0.10	1.00	-0.57	0.06	-0.13	-0.21	0.26
LR	-0.26	-0.23	-0.05	-0.11	-0.70	-0.37	-0.36	-0.11	-0.30	-0.55	-0.57	1.00	-0.24	-0.30	0.24	-0.45
NIM	0.41	0.57	0.10	-0.19	0.11	0.24	-0.08	0.04	0.00	0.23	0.06	-0.24	1.00	0.08	-0.30	0.44
NPL	0.12	0.09	0.03	0.16	0.30	0.18	0.10	-0.01	0.32	0.30	-0.13	-0.30	0.08	1.00	-0.07	-0.02
TA	-0.14	-0.39	-0.41	-0.05	0.14	-0.23	0.24	-0.06	0.01	-0.28	-0.21	0.24	-0.30	-0.07	1.00	-0.50
XR	0.08	0.28	0.02	0.06	0.39	0.22	-0.14	0.10	-0.24	0.28	0.26	-0.45	0.44	-0.02	-0.50	1.00

Table A5. Cross-section dependency test results

Variables	Breusch-Pagan LM test	Stats	Pesaran scaled LM test	Stats	Pesaran CD test	Stats	Bias-corrected scaled LM test	Stats	Pesaran-Ullah-Yamagata (PUY) test	Stats
ATR	1591,00	0,000***	71,87	0,000***	20,59	0,000***	71,74	0,000***		
ATR MOD	1379,46	0,000***	61,02	0,000***	15,83	0,000***			466,60	0,000***
CAP	2469,21	0,000***	116,92	0,000***	27,01	0,000***	116,79	0,000***		
CR	1530,00	0,000***	68,74	0,000***	25,65	0,000***	68,61	0,000***		
CR MODEL	1473,19	0,000***	65,83	0,000***	25,22	0,000***			490,00	0,000***
DR	2232,68	0,000***	104,79	0,000***	16,35	0,000***	104,66	0,000***		
FAR	4527,08	0,000***	222,49	0,000***	52,03	0,000***	222,36	0,000***		
FIXR	4817,33	0,000***	237,38	0,000***	50,96	0,000***	237,25	0,000***		
FXLR	2626,64	0,000***	125,00	0,000***	9,46	0,000***	124,87	0,000***		
GDP	14820,00	0,000***	750,50	0,000***	121,74	0,000***	750,37	0,000***		
NIM	5518,15	0,000***	273,33	0,000***	60,60	0,000***	273,20	0,000***		
INF	14820,00	0,000***	750,50	0,000***	121,74	0,000***	750,37	0,000***		
INT	14820,00	0,000***	750,50	0,000***	121,74	0,000***	750,37	0,000***		
LAR	2427,43	0,000***	114,78	0,000***	10,84	0,000***	114,65	0,000***		
LAR MOD	1798,96	0,000***	82,54	0,000***	8,49	0,000***			152,10	0,000***
LR	7446,95	0,000***	372,27	0,000***	77,43	0,000***	372,14	0,000***		
NPL	3477,52	0,000***	168,65	0,000***	33,16	0,000***	168,52	0,000***		
TA	13792,07	0,000***	697,77	0,000***	117,37	0,000***	697,64	0,000***		
XR	14820,00	0,000***	750,50	0,000***	121,74	0,000***	750,37	0,000***		

\*\*\* Statistically significant at the 1% level.

**Table A6. CIPS unit root test results**

<i>Variables</i>	<i>CIPS</i>		<i>P Value Critical Values</i>		
			<i>1%</i>	<i>5%</i>	<i>10%</i>
	<i>(Intercept, Trend)</i>				
ATR	-5,22	***	-2,70	-2,57	-2,51
CAP	-3,33	***	-2,70	-2,57	-2,51
CR	-5,15	***	-2,70	-2,57	-2,51
DR	-3,37	***	-2,70	-2,57	-2,51
FAR	-3,23	***	-2,70	-2,57	-2,51
FIXR	-3,15	***	-2,70	-2,57	-2,51
FXLR	-3,62	***	-2,70	-2,57	-2,51
GDP	2,61	**	-2,70	-2,57	-2,51
NIM	-2,89	***	-2,70	-2,57	-2,51
INF	2,61	**	-2,70	-2,57	-2,51
INT	2,61	**	-2,70	-2,57	-2,51
LAR	-3,30	***	-2,70	-2,57	-2,51
LR	-2,95	***	-2,70	-2,57	-2,51
NIM	-2,89	***	-2,70	-2,57	-2,51
NPL	-2,94	***	-2,70	-2,57	-2,51
TA	-2,58	**	-2,70	-2,57	-2,51
XR	2,61	**	-2,70	-2,57	-2,51

\*\*\* and \*\* are statistically significant at the 1% and 5% level, respectively.

**Table A7. Correlation, autocorrelation and varying variance test results**

Dependent variables	Independent variables	Test	P Value	Test Statistics	Conclusion
<b>LAR</b>	CAP, DR, FAR, FIXR, FXLR, GDP, INF, INT, LR, NIM, NPL, TA, XR	Pesaran-Yamagata (2008) test	0,000***	36,12	H0 is rejected. The slope parameters are heterogeneous.
		Modified Wald test	0,000***	229,03	H0 is rejected. Error terms variance are variable by units.
		Bhargava <i>et al.</i> (1982) Durbin Watson test and Baltagi-Wu (1999) LBI test	0,002**	BFN=0,34 BW= 0,39	H0 is rejected because the test statistic results are much smaller than 2 and the p value is less than 0.05. There is autocorrelation between the error terms.
		Breusch-Pagan (1980) LM test	0,000***	1905,72	1) H0 is rejected. Error terms are correlated between units. 2) H0 is rejected. The common effect model is not suitable.
		Chow test	0,000***	33,29	H0 is rejected. The common effect model is not suitable.
		Hausman test	0,006*	27,95	H0 is rejected. The fixed effects method is suitable.
		Pesaran-Yamagata (2008) test	0,000***	4,58	H0 rejected. The slope parameters are heterogeneous.
<b>ATR</b>	CAP, DR, FAR, FIXR, FXLR, GDP, INF, INT, LR, NIM, NPL, TA, XR	Modified Wald test	0,000***	82180,26	H0 is rejected, error terms variance are variable by units.
		Bhargava <i>et al.</i> (1982) Durbin Watson test and Baltagi-Wu (1999) LBI test	0,002**	BFN= 1,90 BW = 1,93	H0 is rejected because the test statistic results are smaller than 2 and the p value is less than 0,05. There is autocorrelation between the error terms.
		Breusch-Pagan LM test	0,000***	1379,46	1) H0 is rejected. Error terms are correlated between units. 2) H0 is rejected. The common effect model is not suitable.
		Chow test	0,000***	8,82	H0 is rejected. The common effect model is not suitable.
		Hausman test	0,000***	54,65	H0 is rejected. The fixed effects method is suitable.
		Pesaran-Yamagata (2008) test	0,000***	14,37	H0 rejected. The slope parameters are heterogeneous.
		Modified Wald test	0,000***	918,76	H0 is rejected. Error terms variance are variable by units.
<b>CR</b>	CAP, DR, FAR, FIXR, FXLR, GDP, INF, INT, LR, NIM, NPL, TA, XR	Bhargava <i>et al.</i> (1982) Durbin Watson test and Baltagi-Wu (1999) LBI test	0,000***	BFN= 1,32 BW= 1,41	H0 is rejected because the test statistic results are much smaller than 2 and the p value is less than 0,05. There is autocorrelation between the error terms.
		Breusch-Pagan LM test	0,000***	1473,19	1) H0 is rejected. Error terms are correlated between units. 2) H0 is rejected. The common effect model is not suitable.
		Chow test	0,000***	44,97	H0 is rejected. The common effect model is not suitable.
		Hausman test	0,053	20,85	H0 is rejected. The fixed effects method is suitable.

\*\*\*, \*\* and \* are statistically significant at the 1%, 5% and 10% levels, respectively.