

DETERMINANTS OF LIQUIDITY ADEQUACY RATIO: AN EMPIRICAL STUDY ON TURKISH BANKS

A Thesis

by

Osman Serhan Çokaklı

Submitted to the
Graduate School of Sciences and Engineering
In Partial Fulfilment of the Requirements for the
Degree of

Master of Science

In the

Department of Financial Engineering

Özyeğin University
May 2022

Copyright © 2022 by Osman Serhan Çokaklı

DETERMINANTS OF LIQUIDITY ADEQUACY RATIO: AN EMPIRICAL STUDY ON TURKISH BANKS

Approved by:

Assistant Professor Emrah Ahi,
Advisor,
Department of International Finance
Özyeğin University

Assistant Professor Levent Guntay,
Department of International Finance
Özyeğin University

Assistant Professor Gamze Öztürk
Danışman,
Department of International Trade
and Finance
Kadir Has University

Date Approved: 27 May 2022

ABSTRACT

Liquidity and liquidity risk is a phenomenon that has important consequences in the management of banks. In addition, liquidity risk has an important role in banking crises. The deterioration in their financial strength of many financial institutions after the 2008 Global Crisis, has increased the importance of liquidity risk management.

Liquidity management has an important role in the balance sheet management of banks. Liquidity management, especially the state of being liquid or illiquid of banks, affects banks' costs and returns. Liquidity risk management helps financial institutions to balance the cost of sufficient liquidity. As a result, the bank is exposed to liquidity risk. Theoretically, liquidity risk is defined as the inability of a bank to have sufficient liquidity to meet its obligations on time.

With the direction of new regulations created, liquidity indicators are considered in the evaluations of the banking sector and the financial strength of the banks.

This study investigates the variables affecting the liquidity risk of the Turkish banking sector. As a result of the analysis using simple linear regression, I find that the factors affecting the liquidity management in the Turkish banking sector are cash to total assets ratio, demand deposit to total deposits ratio, funds from repo transactions to total liabilities ratio, non-performing loans to cash loans ratio, although their effectiveness changes periodically.

ÖZETÇE

Likidite ve likidite riski bankaların yönetiminde önemli sonuçlar doğuran bir olgudur. Buna ek olarak likidite riskinin bankacılık krizlerinde önemli bir rolü bulunmaktadır. 2008 Küresel Kriz sonrasında birçok finansal kurumun finansal pozisyonlarındaki bozulma likidite risk yönetiminin önemi artırmıştır.

Likidite riski yönetimi, bankaların bilanço yönetiminde önemli bir yere sahiptir. Likidite yönetimi özellikle bankaların likit olma veya likit olmama durumu, banka maliyetlerini ve getirilerini etkilemektedir. Likidite riski yönetimi finansal kurumların yeterli likidite maliyetini dengelemelerine yardım eder. Bunun sonucunda da banka likidite riskine maruz kalmaktadır. Teorik olarak likidite riski, bir bankanın yükümlülüklerini zamanında karşılamasında yeterli likiditeye sahip olamama durumu olarak tanımlanmaktadır

Oluşturulan yeni regülasyonlar ile Bankacılık sektörü ve bankaların finansal olarak güçlülüğü değerlendirmelerinde likidite göstergeleri dikkate alınmaktadır.

Bu çalışma, Türk bankacılık sektörünün likidite riskini etkileyen değişkenleri incelemektedir. Basit doğrusal regresyon kullanılan analiz sonucunda Türk bankacılık sektöründe likidite yönetimini etkileyen faktörler dönemsel olarak etkinlikleri değişmekle birlikte nakit değerlerin toplam aktiflere oranı, vadesiz mevduatların toplam mevduatlara oranı, takipteki alacakların toplam nakit kredilere oranı ve repo işlemlerinden kaynaklanan fonlama tutarlarının toplam pasiflere oranı olduğu bulunmuştur.

ACKNOWLEDGMENTS

I would like to express my sincere gratitude to my supervisor, Assistant Professor Emrah Ahi, whose valuable feedbacks, encouragement and patience have helped me throughout this study. He has offered us stimulating comments and suggestions with his rich research experience.

I would also like to give my special thanks to Assistant Professor Levent Guntay for his valuable feedbacks, support of the project.

TABLE OF CONTENTS

ABSTRACT	III
ÖZETÇE.....	IV
ACKNOWLEDGMENTS	V
TABLE OF CONTENTS.....	VI
LIST OF TABLES.....	VIII
LIST OF ABBREVIATIONS.....	X
INTRODUCTION	11
DEFINITION OF LIQUIDITY AND LIQUIDITY RISK	14
2.1 Definition of liquidity	14
2.1.1 Market Liquidity	16
2.1.2 Funding Liquidity	17
2.1.3 Central Bank Liquidity	18
2.2 Relationships Between Liquidity Risk Types.....	20
2.3 Liquidity measurement.....	20
2.3.1 Short Term Liquidity	21
2.3.2 Cash flow ladder	21
2.3.3 Liquidity coverage ratio (LCR)	22
2.4 Long term balance.....	22
2.4.1 Structural funding - Net stable funding ratio (NFSR).....	22
CHAPTER 3.....	24
DATA SECTION.....	24
3.1 Data Construction	24
3.2 Variables used in the analysis	26

THE DETERMINANTS OF BANK LIQUIDITY ADEQUACY RATIO ...	32
4.1 Contemporaneous analysis.....	34
4.2 Predictive analysis.....	36
4.3 2018 Financial crisis effects to liquidity adequacy ratio	38
4.3.1 Contemporaneous analysis before June 2018	39
4.3.2 Contemporaneous analysis after June 2018	40
4.3.3 Predictive analysis before June 2018	43
4.3.4 Predictive analysis after June 2018	44
CONCLUSION.....	46
BIBLIOGRAPHY	48
VITA	50

LIST OF TABLES

1	Definition of Liquidity and Liquidity Risk.....	15
2	Summary statistics of balance sheet item ratios	25
3	Summary statistics of macroeconomic variables.....	25
4	Regulatory Maturity Buckets for Measuring Liquidity Adequacy	32
5	Contemporaneous analysis VIF test results, variables with possible multicollinearity availability.....	34
6	Contemporaneous analysis re-calculated VIF test results, variables with multicollinearity availability	35
7	Contemporaneous analysis stepwise regression methods comparison	35
8	Contemporaneous analysis predictor candidates according to forward stepwise regression	36
9	Contemporaneous analysis regression results.....	36
10	Predictive analysis VIF test results, variables with possible multicollinearity availability	37
11	Predictive analysis re-calculated VIF test results, variables with multicollinearity availability	37
12	Predictive analysis stepwise regression methods comparison.....	38
13	Predictive analysis predictor candidates according to forward stepwise regression	38
14	Predictive analysis regression results	38
15	Contemporaneous analysis before June 2018, VIF test results, variables with possible multicollinearity availability	39
16	Contemporaneous analysis before June 2018, stepwise regression methods comparison.....	40
17	Contemporaneous analysis before June 2018, predictor candidates according to forward stepwise regression.....	40
18	Regression results	40
19	Contemporaneous analysis after June 2018 VIF test results, variables with possible multicollinearity availability	41
20	Contemporaneous analysis after June 2018 the variables eliminated from dataset according to VIF test results	41
21	Contemporaneous analysis after June 2018 stepwise regression methods comparison.....	41
22	Contemporaneous analysis after June 2018 predictor candidates according to forward stepwise regression.....	42
23	Contemporaneous analysis after June 2018 regression results.....	42
24	Predictive analysis before June 2018 VIF test results, variables with possible multicollinearity availability	43
25	Predictive analysis before June 2018 stepwise regression methods comparison	43

26	Predictive analysis before June 2018 predictor candidates according to forward stepwise regression	43
27	Predictive analysis before June 2018 regression results	44
28	Predictive analysis after June 2018 VIF test results, variables with possible multicollinearity availability	44
29	Predictive analysis after June 2018 the variables eliminated from dataset according to VIF test results	44
30	Predictive analysis after June 2018 stepwise regression methods comparison ..	45
31	Predictive analysis after June 2018 predictor candidates according to forward stepwise regression	45
32	Predictive analysis after June 2018 regression results	45



LIST OF ABBREVIATIONS

ASF:	Available Stable Funds
BCBS:	The Basel Committee on Banking Supervision
BRSA:	Banking Regulation and Supervision Agency
ECB:	European Central Bank
HQLA:	High Quality Liquid Asset
IFC:	The International Finance Corporation
LCR:	Liquidity Coverage Ratio
LAR:	Liquidity Adequacy Ratio
NSFR:	Net Stable Funding Ratio
RSF:	Required Stable Funding
CAR:	Capital Adequacy Ratio
OBS:	Off-Balance Sheet
LOLR:	Lender-of-last-resort
CBRT:	The Central Bank of the Republic of Turkey

CHAPTER 1

INTRODUCTION

Creating liquidity and allocating risk to different financial areas are the two fundamental functions of banks in the financial system. The importance of fulfilling these two functions was once understood in the global economic crisis that started in 2007 and its effects are still ongoing. The bankruptcy of Lehman Brothers in September 2008, nationalization of Fannie Mae and Freddie Mac in the USA, AIG's almost went bankruptcy, sale of Fortis, collapse of Iceland's largest commercial bank, some events, such as the fact that many countries gave serious support to their banks, showed that adequate measures were not taken adequately for crisis situations and the current system contains serious deficiencies.

The global financial crises experienced and the resulting effects have brought liquidity risk and risk management to a prominent position in bank management.

In 2007, the Greek financial crisis was the first remarkable event in the European financial crisis, triggered by the preliminary problems arising from Ireland, Portugal, which caused long discussions in European financial authorities, about the way to reduce the Greek governments' rating and solve very difficult liquidity problems. All this happened one year after the Lehman crisis. Then expectations of contagion spread, affecting the Italian financial system, one of the world's largest debt issuers, and soon after the effects reached Spain financial system, resulting with receiving financial aid from Europe, for Bankia, the fourth largest bank in Spain and the Spanish banking sector.

Many governments have faced exorbitantly high refinancing costs, unemployment rates and falling growth rates.

In August 2012, the European Central Bank (ECB) guidance and promise of unlimited the support given to the financial sectors in Euro area members, became a game changer point in solving the problems caused by lack of liquidity in the banking sector [1].

With the lessons learned from the crises experienced, new regulations defined. Attempts to establish global rules for financial strength of banks with Basel I and Basel II regulations have made remarkable progress.

These regulations have identified capital adequacy as one of the most important tools of risk management. However, in the financial system, becoming increasingly complex with the 21st century, capital is not the only solution for all kinds of financial risk management.

Basel III requirements cover key issues such as better capital adequacy, redesigned and improved risk weight approach, higher capital ratios, new leverage and liquidity ratios. New rules regarding liquidity have been introduced under the Basel III accord, and two different liquidity standards have been announced, namely the short-term Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSF). These standards have been determined as the main indicators in the management of liquidity risk in the banking sector.

In this study, I examined the factors affecting the Liquidity Adequacy Ratio (LAR), which represents the LCR, which is a short-term liquidity indicator, but includes longer data in terms of historical data. I identified 25 independent variables from both balance sheet items and macro-economic indicators likely to affect the LAR and analysed

their effects. The study covers mainly Banking Regulation and Supervision of Agency (BRSA) sector data, and the period after 2007, due to availability of LAR until end of 2021. I used multiple linear regression analysis in order to find the factors effecting LAR.

Based on the analysis, the implications of this study is, only balance sheet items, either increases the assets or decreases the liabilities effects LAR, no significant relationship between macro-economic variables and liquidity adequacy ratio of commercial banks found.



CHAPTER 2

DEFINITION OF LIQUIDITY AND LIQUIDITY RISK

2.1 Definition of liquidity

Liquidity risk is defined as the risk of loss due to the inability to meet payment obligations on time or at a reasonable cost. In other words, Liquidity can be defined as the primary resource that allows a company to meet its obligations, fulfil its contractual obligations and raise funds when needed at a reasonable price.

Failure to meet expected or unexpected payments on time is likely to have serious consequences. In particular, when an organization is unable to meet its financial obligations, its access to external sources of finance may be compromised and it may be forced to sell its assets at inappropriate prices. It can also tarnish its reputation in the market, create unrest among investors and creditors, and cause unwanted scrutiny by regulators.

Liquidity is also necessary to finance the growth of the organization. While capital is necessary for long-term investment, carefully managed and planned liquid resources allow periodic payments, necessary for growth and development. Since the corporate value creation depends on financial growth, the ability for organizations to properly finance such development is essential.

Table 1: Definition of Liquidity and Liquidity Risk

American Academy of Actuaries (USA) Liquidity is the ability to meet expected and unexpected cash demands. The ability of the entity to meet the cash needs of its contractual obligations with little or no loss. A business's liquidity profile is a function of its assets and liabilities. Liquidity risk is a natural part of the activities of financial institutions and it is of great importance to understand, monitor and measure it. (AAA, 2000, p. 4)
Bank for International Settlements (Supranational) A liquid market is a financial market in which operating organizations can execute large-scale transactions quickly and with minimal impact on prices. (BIS, 2000, p. 5)
Canadian Institute of Actuaries (Canada) Liquidity risk is the inability to meet financial liabilities with current cash flows or sales of assets at reasonable prices. (CIA, 1996, p. 4)
Federal Deposit Insurance Corporation (USA) Liquidity is when a bank manages a decrease in deposits and other liabilities with increases in assets with the minimum loss. A bank's ability to obtain adequate funding in a timely manner and at a reasonable cost demonstrates sufficient liquidity potential. (FDIC, 1998, p. 1)
Financial Services Authority (UK) Liquidity risk is when an organization does not have sufficient financial resources to meet its obligations or it has to bear serious costs to meet them. (FSA, 2003, p. 3)
HM Treasury (UK) Liquidity is the ability to exchange one financial claim for another with acceptance by third parties. (HM Treasury, 1999)
International Association of Insurance Supervisors (Supranational) Liquidity risk is the inability of the insurance company to fulfil its liabilities with its assets. (IAIS, 2000)
International Organization of Securities Commissioners (Supranational) Efficiency in liquid form is the ability of an organization to meet its liabilities in a timely and cost-effective manner while holding assets and engaging in new and profitable activities due to its cost-effective resources. (IOSCO, 2002, p. 3)
Office of the Comptroller of the Currency (USA) Liquidity risk is the inability of a bank to meet its liabilities with the revenues and capital to experience unacceptable losses while meeting it. (OCC, 2001, p.1)
Office of the Superintendent of Financial Institutions (Canada) Liquidity is the ability of an institution to meet its due obligations with its own cash or cash generated at a reasonable cost.(OSFI, 1995, p. 2)
Federal Reserve Bank of San Francisco (US) Liquidity is generally defined as the ability of a financial organization to meet its debt obligations without having unacceptable losses. (FRBSF, 2008, p.1)
Bank for International Settlements (Supranational) Liquidity is the ability of a bank to fund increases in assets and meet obligations as they come due, without incurring unacceptable losses. (BIS, 2008, p.1.)

* Erik Banks- Liquidity Risk-Managing Funding and Asset Risk -Palgrave Macmillan UK (2014) [2]

2.1.1 Market Liquidity

Market liquidity is defined as the ability to buy and sell an asset at the lowest cost and without significant decreases in price in the short term. Market liquidity risk is the risk that an asset cannot be quickly converted into cash at its fair value in the market, and this risk constitutes the systematic and non-diversifiable side of liquidity risk [3].

The concept of market liquidity is more easily understood with its dimensions. In the literature, the dimensions of market liquidity are defined as tightness, depth and elasticity, and these dimensions are commonly measured by the best bid-ask range and illiquidity ratio [4],[5].

Tightness is the size of the liquidity premium that market makers deem necessary to hold financial assets and measured by bid-ask spread or relative bid-ask spread. In an illiquid market, market makers keep the bid-ask spread high to compensate for the liquidity risk. The reason for this is the risk of not being able to sell the assets in their portfolios [4],[5].

Depth is the power of trading transactions to affect asset prices. It is the change in prices when a certain amount of buying and selling is done in the market. When relatively low-volume transaction creates high price changes, this fact shows that this market is not deep enough. Rate of illiquidity ratio is widely used in the measurement of the depth. In this ratio, the numerator is the absolute value of the percent change in price, while the denominator is the turnover rate. What is aimed to be measured with turnover rate ratio is, how many of the assets that can potentially be traded, are traded. An increase in rate of illiquidity ratio means a decrease in market liquidity [4].

Elasticity is defined as how quickly prices return to equilibrium. In the study of the International Monetary Fund (IMF), it was stated that it is difficult to measure the elasticity. The market efficiency coefficient (MEC) has been proposed for measurement. The MEC is calculated by dividing the five-day return variance to five times the daily return variance and is based on the assumption that price movements are more continuous in liquid markets. A ratio close to 1 indicates that the market is [4],[5].

2.1.2 Funding Liquidity

According to the definition of The Basel Committee on Banking Supervision (BCBS); funding liquidity is the ability of banks to meet their due obligations on time and without any delay. Similarly, IMF defines funding liquidity as the timely fulfilment of the agreed payments by the organizations.

According to the definitions above, the main liquidity sources of banks are the deposits they collect, the asset market that they can sell, the interbank market and finally the funds they obtain directly from the central banks. Banks can obtain liquidity through instruments such as asset sales, securitization, syndication or can evaluate liquidity in these markets [6].

If debt facilities are not adequately accessed, the organization may experience funding losses; When this is combined with liquidity risk issues, more serious instances of financial distress can develop. Access to finance can be affected by internal or external factors. For example, from an internal perspective, a firm may not be able to obtain the necessary unsecured financing if its overall financial performance deteriorates rapidly or if its credit rating is very poor. From an external perspective, a serious deterioration in overall market conditions as a result of systemic instabilities could jeopardize appropriate access for the funding resources.

Unexpected demand for cash is at the heart of funding liquidity risk and difficult to manage into a risk management plan, but some contingent financing can be created to manage "surprises". Whether this amount will ultimately be sufficient cannot be determined in advance but performing a plausible scenario analysis can provide appropriate guidance. Unexpected liquidity demand can come from a variety of sources [7].

- unpredictable cash flows
- change in legal or regulatory judgments
- mismanagement
- negative perceptions/market actions

Unexpected demand for liquidity that exceeds the capacity of an unsecured funding capacity to cover obligations, requires action on the asset side of the balance sheet, such as; post assets as collateral at unreasonably large discounts, or can only sell its asset portfolio at distressed prices in order to supplement the cash position, then the very sources that impact funding risk will feed directly into asset liquidity problems [2].

2.1.3 Central Bank Liquidity

Central bank liquidity is defined as "the ability of the central bank to provide the liquidity required by the financial system" according to [3].

A central bank's "liquidity management" is the set of tools and rules the central bank uses to manage the amount of bank reserves to control prices (i.e., short-term interest rates) in a manner consistent with its ultimate goals (e.g., price stability).

Central bank liquidity refers to the ability of central banks to provide liquidity to the financial system, in case of need, via direct and indirect tools in accordance with

monetary policy. Direct tools are tools for which central banks apply the money policy with legal regulations such as interest rate controls, bank loan limitations, liquidity rates, disponibility rates and specialized loans. Some of the indirect tolls are required reserves, open market operations, currency swaps, issuance of central bank notes[8].

By definition, it is known that central banks will never have a liquidity problem due to their power to create a monetary base. Central banks only experience liquidity problems during periods of hyperinflation or exchange rate crises where local currency is not in demand [3]. The power to create money, directs the financial system to the fundamental nature of central banks' lender-of-last-resort (LOLR) function in case of liquidity shortage in the market. But there has been debate about how to implement this function. The "classical" doctrine of the LOLR is, such lending should be extended freely without limit, but only to solvent institutions at penalty rates and against good collateral. For most banks, this almost certainly means that there are significant doubts about the Banks's ultimate solvency. The proposition that central banks only lend against good collateral is also undermined by the fact that, a bank which is unable to raise funds in the market, would have problem to access to good security for collateralized loans. In addition, the usage of a penalty rate has been criticized since such a policy could compound the problem if it imposes a substantial burden on the troubled bank. On the other hand, some argue that in an advanced financial system, LOLR should be exclusively through open market operations. As long as systemwide changes in demand for liquidity are met through such operations, the market can direct reserves to those most in need, thereby avoiding the mispricing that administrative mechanisms might create. Another opinion is, LOLR may require direct lending, not open market operations, as the market

may fail to deliver liquidity to distressed banks whose failure threatens the financial system.

2.2 Relationships Between Liquidity Risk Types

According to [3], the relationships between different liquidity risks are evaluated in normal periods when the liquidity risk is relatively low and during the periods when the economy is volatile and liquidity risk is high. Under normal economic conditions, liquidity easily moves between all three liquidity types. In these cases, central banks give a certain amount of liquidity to the market, and this liquidity is transferred by the banks to the segments in need of liquidity through the interbank and tradable asset markets. The liquidity injected into the market by the central bank will be distributed and reabsorbed in the market, and an effective distribution to economic units will be ensured with the funding liquidity.

The strong links between liquidity risks continue in fluctuating periods, but in these cases, fluctuation in financial markets create unbalanced results in the financial system through their risk-increasing effects. In these cases, central bank intervention and an effective regulation and supervision structure are deemed necessary in order to bring the market back into balance.

2.3 Liquidity measurement

Liquidity risk measurement can be split into two components: the short-term one for refinancing contractual obligations up to one year and which is focused on the most immediate of those – overnight, one week or 30 days, or two or three months. The long-term liquidity risk must consider and measure the sustainability of a bank over a longer

time frame of five to ten years, thus giving consideration and actions a more strategic stance.

2.3.1 Short Term Liquidity

Short-term liquidity risk of up to one year and mostly focusing on three months will deal with the immediate necessity of raising funds to meet contractual obligations maturing in such limited time available. Cash flows are therefore crucial to control and manage short term liquidity risk. Contractual maturity mismatch identifies the gaps between the contractual inflows and outflows of liquidity for given time buckets. The maturity gaps indicate how much liquidity a bank would have to ensure in each of these time bands if all outflows occurred at the earliest possible date

2.3.2 Cash flow ladder

Cash flows are up most important to control and manage short term liquidity risk. Contractual maturity mismatch identifies the gaps between the contractual inflows and outflows of liquidity for given time buckets. The maturity gaps indicate how much liquidity a bank would have to keep in each of these time buckets if all outflows occurred at the earliest possible date.

Some indications of the ladder components are provided in the regulatory documents mentioning;

- Contractual obligations, in and out cash flows, considering maturity.
- Rules for mapping flows on the maturity ladder.
- Flows without contractual certainty.

2.3.3 Liquidity coverage ratio (LCR)

The LCR encourages the short-term durability of a bank's liquidity strength, ensuring that the bank has sufficient high-quality liquid resources to survive the stress scenario identified over a one-month period. Specifically, the LCR states that a bank must have “an adequate stock of high-quality tradable liquid assets (HQLA) that can be easily and immediately converted into cash in financial markets to meet its liquidity needs for 30 calendar days of liquidity.”

Liquidity adequacy within the 30-day period are calculated by multiplying outstanding balances of various liability and off-balance sheet items by the rates at which they are expected to be reduced in a stress scenario, and are netted (a cap is defined) with expected liquidity inflows over the same period to calculate net liquidity outflows.

2.4 Long term balance

The long-term liquidity risk must consider and measure the sustainability of a bank over a longer time frame of five to ten years, thus giving consideration and actions a more strategic stance.

2.4.1 Structural funding - Net stable funding ratio (NSFR)

The NSFR objective is complementary to the LCR in that it aims to ensure funding resilience over a longer time horizon, requiring banks to fund long-term assets with long-term liabilities and thus limit the degree of maturity mismatch. Specifically, the NSFR requires that banks' available stable funding over a one-year horizon is at least as large as the required stable funding over the same horizon, where available stable funding and

required stable funding are defined as weighted fractions of liabilities and assets respectively, as well as off-balance sheet items.

The NSFR aims to prevent banks from excessively financing long-term assets with short-term liabilities and thus seeks to mitigate the potential for future funding stress.



CHAPTER 3

DATA SECTION

Liquidity adequacy ratio, which is the first regulation for the assessment of banks' liquidity risk, were implemented at the end of 2006. Basically, with the regulation, it is aimed that banks' assets will operate with sufficient total and foreign currency liquidity level to meet their liabilities.

The most basic methods used in the liquidity analysis of the banking sector are the analysis of assets and liabilities by maturities, the calculation of liquidity deficit and phases by maturities, and the liquidity analysis according to the time remaining to maturity.

In this section, the relation between liquidity adequacy ratio and various variables effecting the ratio, both balance sheets items and macro-economic indicators, is discussed.

Throughout the analysis, the relation between liquidity adequacy ratio and the various balance sheet items as well as macro-economic variables will be examined. Then, the effect of 2018 financial turmoil to the liquidity adequacy ratio would be analysed.

3.1 Data Construction

I obtain the data from Turkish Banking Regulation and Supervision Agency (BRSA) web site. I cross checked some of the data with the Banks Association of Turkey (BAT), Data Query System web site.

I retrieve the macroeconomic data from Bloomberg Data Vendor and Central Bank of Turkey (CBRT), Electronic Data Delivery System (EVDS) web site.

The data covers the period between April 2007 and December 2021 with monthly statements. I select this period because the regulatory Liquidity Adequacy Ratio (LAR) available starting from April 2007 and the period covers the effects of 2018 financial turmoil on LAR.

I selected LAR variable to investigate the effects of balance sheet items as well as macroeconomic ones.

Table 2: Summary statistics of balance sheet item ratios

Variable	Number of observations	Mean	Min	Max	Std. Dev.	Pctl. 25	Pctl. 75
Funds from repo transactions to total liabilities	177	0.0410	0.0130	0.0750	0.0130	0.0330	0.0510
Non-performing loans to cash loans	177	0.0352	0.0266	0.0541	0.0076	0.0292	0.0402
Periodic net profit to total equity	177	0.0887	0.0072	0.2477	0.0005	0.0419	0.1239
Fee, commission banking service income to total income	177	0.1213	0.0881	0.1529	0.0148	0.1117	0.1319
Demand deposit to total deposit	177	0.1992	0.1275	0.3868	0.0554	0.1607	0.2123
Non-performing loans to total assets	177	0.0210	0.0150	0.0340	0.0040	0.0180	0.0230
Loans to total assets	177	0.5750	0.4570	0.6540	0.0550	0.5260	0.6190
Total deposits to total liabilities	177	0.5930	0.5270	0.6530	0.0320	0.5620	0.6270
Cash to total assets	177	0.0800	0.0360	0.1510	0.0230	0.0560	0.0950
Required Reserves to total assets ratio	177	0.0160	0.0070	0.0220	0.0040	0.0110	0.0190
Loans to deposits	177	0.9770	0.7110	1.1750	0.1410	0.8390	1.1110

Table 3: Summary statistics of macroeconomic variables

Variable	Number of observations	Mean	Min	Max	Std. Dev.	Pctl. 25	Pctl. 75
5 year Turkey CDS premium	177	267.01	117.81	592.29	110.16	184.99	309.17
CBRT net funding amount	177	75,218.28	-	354,456.70	84,018.45	-	108,378.70
USD-TRY Mid Rate	177	3.23	1.17	10.53	2.19	1.58	3.88
CBRT weighted average funding cost	177	8.42	-	25.50	6.75	-	11.97
CBRT current deficit amount Mio USD	177	(2,832.79)	(9,407.00)	3,768.00	2,367.47	(4,300.00)	(1,478.00)
CBRT official reserve amount Mio USD	177	100,286.66	67,638.00	134,576.00	19,551.06	83,750.00	117,784.00
1 Month EUR deposit rates	177	1.48	0.09	4.31	0.93	0.95	1.81
1 Month TRY deposit rates	177	11.24	5.26	22.85	4.40	7.84	15.54
1 Month USD deposit rates	177	2.02	0.46	4.62	0.94	1.41	2.44
Monthly Consumer Price Index	177	0.92	(1.44)	13.58	1.34	0.31	1.36
Emerging Markets Credit Spread	177	344.25	165.76	753.09	92.90	291.48	365.54
Volatility Index (VIX)	177	20.32	9.51	59.89	8.81	14.04	23.70
US Government 10 years security interest rate	177	2.45	0.53	5.03	0.92	1.80	2.99

3.2 Variables used in the analysis

The variables considered in the study are as follows,

Liquidity adequacy ratio: Ratio of Turkish lira and foreign currency assets to Turkish lira and foreign currency liabilities by maturity brackets.

Funds from repo transactions to total liabilities ratio: A repurchase agreement (repo) is a short-term agreement that one party sells securities to another and agrees to repurchase those securities later at a higher price. The securities serve as collateral and assumed that the transaction is secured. This type of securitization makes transactions relatively cheaper compared to unsecured transactions like money market or deposits. Although it is advantageous in terms of profit and loss, it is more costly in terms of liquidity management and capital adequacy ratios. For example, in the liquidity-related ratio analysis, the coefficients of repo transactions were determined higher, which in turn increases the amount of liabilities and decreases the liquidity ratio in liquidity ratios that are generally calculated as total assets to total liabilities.

Non-performing loans to cash loans ratio: A nonperforming loan (NPL) is a bank loan, which will not be repaid by the borrower in full or is subject to late repayment. The terms of a non-performing status can vary, but “no payment” is usually defined as zero payment of either interest or principal. The specified period of the non-performing loans also varies, depending on the type of loan. Usually, the period ranges from 90 to 180 days. In the banking sector, a commercial loan is considered as non-performing if the borrower is 90 days past due. A non-performing loan is considered in default, but if the debtor resumes payment again, the loan becomes reperforming.

An NPL ratio is used to measure the level of the bank's credit risk and quality of outstanding loans. A high ratio means the bank bears a greater risk of loss if it fails to recover the owed amounts, while a low ratio means that the outstanding loans pose a low risk to the bank [9].

Periodic net profit to total equity ratio: Return on equity (ROE) is a financial ratio that shows how much profit a public company earns in comparison to the shareholders' equity. ROE is very useful for comparing the performance of similar companies in the same industry and one of the most effective profitability metrics for investors.

Fee, commission banking service income to total income ratio: Net fee and commission income to total net operating income is a measure of profitability for banks.

Demand deposit to total deposit ratio: A demand deposit is cash left in a bank account that the depositor can withdraw at any time, without giving prior notice to the bank. Normally demand deposit is relatively cheap and preferable liability for the banks. In liquidity analysis, like other non-maturity products, the maturity structure is defined and expanded to various maturity buckets, based on various models. In liquidity adequacy ratio calculations, it is separated to a specific bucket and not directly effecting monthly liquidity adequacy ratio.

Non-performing loans to total assets ratio: As mentioned above, an NPL ratio is used to measure the level of the bank's credit risk and quality of outstanding loans. A high ratio means the bank bears a greater risk of loss if it fails to recover the owed amounts, while a low ratio means that the outstanding loans pose a low risk to the bank. The NPL to total assets ratio considers not only loans as mentioned above, but also other assets.

Loans to total assets ratio: The loans to assets ratio measures the total loans outstanding as a percentage of total assets. The higher this ratio indicates a bank is loaned up and its liquidity is low. The higher the ratio, the riskier a bank may be to higher defaults.

Total deposits to total liabilities ratio: Total debt to total assets is a leverage ratio that defines the total amount of debt relative to assets. This metric is very useful for comparing the performance of similar companies in the same industry. This information can reflect how financially stable a company is. The higher the ratio, the higher the degree of leverage and, consequently, the higher the risk of investing in that company.

Derivatives to total assets: Derivative transactions are useful for hedging credit exposure as well as utilizing funding resources into an appropriate source for the company needs. Banks use these transactions for liquidity management purposes, for instance, by hedging a cash outflow. Depending on the position in the balance sheet, such transactions sometimes have a positive and sometimes negative effect on the liquidity ratio. These transactions are used for the purpose of regulating the liquidity composition rather than improving the ratio in terms of liquidity. Therefore, it was excluded from the variables used in this study.

Cash to total assets ratio: Cash accounts is an active account in which Turkish lira banknotes, coins and foreign currencies are in circulation in our country. It is short term with 100% coefficient asset that supports total assets and liquidity adequacy ratio.

Required Reserves to total assets ratio: Deposit-based reserve requirements to total assets ratio shows the deposit structure and the capability of using deposits as funding resources.

Loans to deposits ratio: Loan-to-deposit ratio (LDR) is a key indicator monitored to gauge banks' structural liquidity positions. It is a ratio simply showing how much of the banks' key assets, loans, are funded by key stable funding resources, namely deposits. Therefore, presumably, the lower the LDR of a bank, the lower is the likelihood of that bank facing liquidity stress. There is no universally accepted optimum value for the ratio and the indicator displays a wide variation across countries [6], [10].

5-year Turkey CDS premium: CDS is a financial derivative that provides "insurance" for the credit quality of any reference entity, such as a government or corporate firm. In financial markets, the price of a CDS is quoted in premium terms called "spread", and CDS spread is considered to be an indicator of the market perception of the credit quality of any single reference entity. 5 years Turkey CDS premium is the price of Turkish Government credibility in 5 years' time.

CBRT net funding amount: The amount of liquidity that CBRT landed to financial market in order to stabilize the markets for liquidity shortages.

USD-TRY Mid-Rate and EUR- TRY Mid-Rate: Average of bid-ask prices of USD-TRY and EUR-TRY currency parities.

CBRT weighted average funding cost: Cost of funding in terms of interest rate provided by CBRT to the market participants.

CBRT current deficit amount: One of the components of a country's balance of payments, the current account balance covers the imports and exports of goods and services. The current account balance helps a country evaluate its competitive strengths and weaknesses and forecast the strength of its currency.

CBRT official reserve amount: The official reserve account, a subdivision of the capital account, is the foreign currency and securities held by the government, usually by its central bank, and is used to balance the payments from year to year

1 Month EUR, TRY, USD deposit rates: The annualized rate of interest that a bank will charge for lending or pay for borrowing a currency for one month tenor. When entering a deposit contract both the seller and the buyer will agree upon the currency, principle amount, day count convention, maturity, and interest rate. The deposits are alternative sources of Banks funding.

Monthly Consumer Price Index (CPI): The consumer price index, or CPI for short, is a measure of the average changes in the prices of a particular group of products and services purchased by a typical consumer. It is used to measure the change in the annual inflation value. CPI causes uncertainty in the financial markets.

Emerging Markets Credit Spread: Credit spreads indicate the credit risk perceived by market participants/investors and are dynamic reflecting real-time market conditions, unlike credit ratings which are revised (upgraded or downgraded) with some lag. The spread of JP Morgan EMBI Global Core Spread is the value commonly used by investors and general public as measure of emerging market risk. This spread is the difference between the weighted average emerging market external debt securities yields and the US Treasury securities yields with similar maturity.

Chicago Board Options Exchange (CBOE) Volatility Index (VIX): The VIX Index is a calculation designed to produce a measure of constant, 30-day expected volatility of the U.S. stock market, derived from real-time, mid-quote prices of S&P 500 Index (SPXSM) call and put options. On a global basis, it is one of the most recognized measures of

volatility, widely monitored by financial markets and closely followed by a variety of market participants as a daily market indicator.

US Government 10 years security interest rate: The 10 Year Treasury Rate is the yield received for investing in a US government issued treasury security that has a maturity of 10 years.



CHAPTER 4

THE DETERMINANTS OF BANK LIQUIDITY ADEQUACY RATIO

The first regulation on liquidity in the Turkish Banking System based on Banking Law No. 5411 is the “Regulation on the Measurement and Assessment of Liquidity Adequacy of Banks” published in the Official Gazette dated November 1, 2006 and numbered 26333. The purpose of the regulation is defined as regulating the procedures and principles for banks to provide and maintain sufficient liquidity level to meet their liabilities. The maturity buckets to be taken as a basis in the calculation of the total liquidity adequacy ratio and the foreign currency liquidity adequacy ratio are given in the table below.

Table 4: Regulatory Maturity Buckets for Measuring Liquidity Adequacy

Time Bucket	Days To Maturity
First time bucket	Up to 7 Days
Second time bucket	Up to 1 Month
Third time bucket	Up to 3 Months
Fourth time bucket	Up to 12 Months
Fifth time bucket	Total

Within the scope of this regulation, the sectoral basis liquidity adequacy ratio required to be prepared from banks is calculated and published by the BRSA on a monthly basis since April 2007. The report includes the weighting of selected balance sheet items with the coefficients determined by the regulator and their separation based on the time periods specified in Table 2.

Although Liquidity Coverage Ratio (LCR) is the major liquidity measurement ratio after Basel III regulations, it is officially come into force in Marc 2014 and published quarterly by the regulator.

In the study, it was decided to use liquidity adequacy ratio as a good proxy for LCR, since both rations include balance sheet items with maturity up to 1 month moving in a similar direction. But in any case, there are not the same in terms of regulatory coefficients, and the distribution of balance sheet items. For instance there is no distinction in deposits in liquidity adequacy ratio (LAR) but different treatment is available in retail and corporate/commercial deposits in LCR.

In addition to the basic data from the balance sheet items subject to the regulatory report, macroeconomic data gathered from local and global financial markets are included, and the effects of such time series of data on the LAR are analysed.

The selected time period is in the monthly period from April 2007, the first date for which regulatory LAR data are available, to the end of 2021.

The selected maturity bucket was not total but, up to one month in accordance with the LCR report format.

In the analysis, contemporaneous and predictive (considering endogeneity) analysis was studied. For the predictive method, the dependent variable was kept constant and the independent variables were shifted back one period.

In both dataset, the stationary of the data was checked via Augmented Dickey Fuller test (ADF). ADF is a systematic test that investigates the existence of a unit root in a series. ADF Test is a common statistical test used to test whether a given time series

is stationary or not. It is one of the most commonly used statistical test when it comes to analysing the stationarity of a series.

The Variance Inflation Factor (VIF) test was used to identify whether there is multicorreality among the independent variables or not. VIF quantifies how much the variance of the estimated coefficients are inflated when multicollinearity exists. A variance inflation factor exists for each of the predictors in a multiple regression model. The general rule of thumb is that, a VIF of 1 means that there is no correlation among the calculated predictor and the remaining predictor variables, whereas VIFs exceeding 4 warrant further investigation, while VIFs exceeding 10 are signs of serious multicollinearity requiring correction .

4.1 Contemporaneous analysis

Initially, the stationarity of the data was checked. As mentioned above, ADF test was used for this purpose, According to the ADF test results, the p-values of the variables are calculated smaller than required p-value which ensures stationarity.

Then, the multicollinearity among the variables were tested via VIF test

Table 5: Contemporaneous analysis VIF test results, variables with possible multicollinearity availability

Non-performing Loans to Total Cash Loans	Non-performing Loans to Total Assets	Loans to Total Assets	Total Deposits to Total Assets	Loans to Deposits
99.929	112.886	52.572	36.701	47.435

Considering the VIF test results, both Non-performing Loans to Cash Loans and Loans to Deposits variables are eliminated from the dataset and re-run the VIF test.

Table 6: Contemporaneous analysis re-calculated VIF test results, variables with multicollinearity availability

USD-TRY Mid	EUR-TRY Mid
4.751423	4.172821

Other than two variables shown above (USD-TRY Mid and EUR-TRY Mid), VIF test results are turned to around 2.00. The correlation between these two variables are calculated for further investigation. The correlation is calculated as 0.8396373 and EUR-TRY Mid variable is also eliminated from the data set. Finally, all variables' VIF results turned to around 2.00.

To find a set of independent variables that significantly influence the dependent variable, a stepwise regression analysis is calculated. Stepwise regression can be used as a hypothesis generating tool, giving an indication of how many variables may be useful, and identifying variables that are strong candidates for prediction models.

In the analysis, forward selection, backward elimination and both forward and backward selection methods are used. The forward selection method is preferred since the method calculates maximum R-Squared (R^2) among them.

Table 7: Contemporaneous analysis stepwise regression methods comparison

Stepwise Method	Number of possible predictors	R squared	Adj. R squared
Backward	5	10.24%	7.60%
Forward	7	11.70%	8.00%
Both	2	6.60%	5.50%

Table 8: Contemporaneous analysis predictor candidates according to forward stepwise regression

Total deposits to total liabilities
Cash to total assest
Required Reserves to total assets
Periodic net profit to total equity
Funds from Repo Transactions to total liabilities
Non-performing loans to total assets
Loans to total assets

Table 9: Contemporaneous analysis regression results

	Estimate	Std.Error	t Value	Pr(> t)
Funds from Repo Transactions to total liabilities	(101.87)	62.92	(1.62)	0.11
Total deposits to total liabilities	114.53	72.47	1.58	0.12
Cash to total assest	221.89	81.35	2.73	0.01 **
Required Reserves to total assets	512.50	425.75	1.20	0.23
Periodic net profit to total equity	0.14	0.08	1.77	0.08 .
Non-performing loans to total assets	729.73	549.62	1.33	0.19
Loans to total assets	(75.16)	66.55	(1.13)	0.26

As a result of the regression, the change in the ratio of cash values to total assets had a positive significant effect on the change in the Liquidity Adequacy Ratio. The regulatory coefficient for the cash is 100%, meaning that the whole notional amount is included for the ratio calculation. The other remarkable issue is that no macro-economic variable is contributing to the ratio.

4.2 Predictive analysis

As mentioned above, the dependent variable was kept constant and the independent variables were shifted back one period for the predictive analysis.

The steps followed in the contemporaneous analysis were repeated. The stationarity of the data series were checked via ADF test. According to the ADF test results, the p-values of the variables are calculated smaller than required p-value which

showed stationarity. Then, the multicollinearity among the variables were tested via VIF test.

Table 10: Predictive analysis VIF test results, variables with possible multicollinearity availability

Non-performing Loans to Total Cash Loans	Non-performing Loans to Total Assets	Loans to Total Assets	Total Deposits to Total Liabilities	Loans to Deposits
99.971	113	52.623	36.718	47.525

It is seen that, VIF test results are almost the same with contemporaneous analysis VIF results. One period lag in predictive analysis has no effect on multicollinearity availability since the same time series are used.

In order to make both analyses comparable, preserving the same data set, as much as possible, prioritized. In this respect, both Non-performing Loans to Cash Loans and Loans to Deposits variables are eliminated from the dataset and re-run the VIF test as applied in contemporaneous analysis.

Table 11: Predictive analysis re-calculated VIF test results, variables with multicollinearity availability

USD-TRY Mid	EUR-TRY Mid
4.539	3.921

Same as contemporaneous analysis, other than two variables shown above (USD-TRY Mid and EUR-TRY Mid), VIF test results are turned to around 2.00. Depending on the correlation between these two variables EUR-TRY Mid variable is also eliminated from the data set. Finally, all variables' VIF results turned to around 2.00.

Then, three methods of stepwise regression analysis has been performed. As shown in Table.9, R squared figures are decreased dramatically. The models in predictive analysis are not explanatory as contemporaneous analysis.

Table 12: Predictive analysis stepwise regression methods comparison

Stepwise Method	Number of possible predictors	R squared	Adj. R squared
Backward	3	4.78%	3.11%
Forward	5	6.10%	3.30%
Both	1	3.20%	2.60%

Table 13: Predictive analysis predictor candidates according to forward stepwise regression

Demand deposit to total deposit
Funds from Repo Transactions to total liabilities
Non-performing loans to total assets
Loans to total assets
US Government 10 Years Traesury Yield

Funds from Repo transactions to total liabilities, Loans to total assets and non-performing loans to total assets ratio variables were determined as covariates in both analyses. Although it is calculated insignificant in the regression analysis, US Government 10 years Treasury Yield is determined as a candidate for the model different than contemporaneous analysis executed above. R squared (R^2) figure is decreased from 11.68% to 6.10%.

Table 14: Predictive analysis regression results

	Estimate	Std.Error	t Value	Pr(> t)
Demand deposit to total deposit	(1.05)	0.51	(2.05)	0.04 *
Funds from Repo Transactions to total liabilities	70.64	57.97	1.22	0.22
Non-performing loans to total assets	782.71	533.54	1.47	0.14
Loans to total assets	(76.64)	64.93	(1.18)	0.24
US Government 10 Years Traesury Yield	1.70	1.53	1.11	0.27

4.3 2018 Financial crisis effects to liquidity adequacy ratio

Decline in global economic growth, expansion of central banks' balance sheets, China-United States trade war, partial United States Federal Government shutdown, and concerns about the corporate earnings caused a dramatic volatility in financial markets

(e.g. Dow Jones Industrial Average has lost about 10 percent of its value, as did the S&P 500. The Nasdaq dropped roughly 8 percent).

Increasing risk perceptions in global markets, the tendency to exit developing countries, the increase in oil prices and the US sanctions against Turkey were the external factors that supported the negative developments in the domestic markets. Before the elections, the Central Bank Monetary Policy Committee, which convened extraordinarily in the face of the sudden increase in the exchange rate on May 23, increased interest rates. The sudden rise in the exchange rate also affected the economic balances, and inflation rose above 20 percent for the first time in years. Furthermore a currency crisis also triggered. To analyse the 2018 financial crisis impact in liquidity adequacy ratio, similar regression analyses were repeated by splitting the dataset into two parts, before and after May 2018.

4.3.1 Contemporaneous analysis before June 2018

The stationarity of the data series is not checked via ADF test since the same time series used, but the multicollinearity among the variables were tested via VIF test for possible correlation change among data series.

Table 15: Contemporaneous analysis before June 2018, VIF test results, variables with possible multicollinearity availability

Non-performing Loans to Total Cash Loans	Non-performing Loans to Total Assets	Loans to Total Assets	Total Deposits to Total Liabilities	Loans to Deposits
101.24993	95.119457	34.508581	34.608359	35.025276

As shown in Table 15, VIF test results were calculated almost the same as the results obtained when all data were used. In this context, the analysis continued in parallel with the analysis made with all data.

Table 16: Contemporaneous analysis before June 2018, stepwise regression methods comparison

Stepwise Method	Number of possible predictors	R squared	Adj. R squared
Backward	2	5.19%	3.73%
Forward	4	7.40%	4.50%
Both	2	5.20%	3.70%

Table 17: Contemporaneous analysis before June 2018, predictor candidates according to forward stepwise regression

Demand deposit to total deposit
Cash to total assest
Periodic net profit to total equity
1 Month EUR Deposit Rate

The number of possible predictor candidates are decreased to 4 comparing to the total data set in both contemporaneous and predictive analysis.

As shown in Table 17, two of four the explanatory variables are different than the analysis covering all data.

Table 18: Regression results

	Estimate	Std.Error	t Value	Pr(> t)	
Demand deposit to total deposit	173.37	79.28	2.19	0.03	*
Cash to total assest	200.10	102.38	1.95	0.05	.
Periodic net profit to total equity	0.15	0.10	1.52	0.13	
1 Month EUR Deposit Rate	(3.71)	3.24	(1.15)		

although the data is contemporaneous the model outputs only demand deposit to total deposit ratio as positively significant, same as total data predictive analysis with a little increase in R squared (7,44%).

4.3.2 Contemporaneous analysis after June 2018

The same process covering the multicollinearity among the variables were tested. According to VIF test results, multicollinearity among the variables increased dramatically comparing to analysis executed before (number of 12 over 25 variables calculated with more than 5 VIF test score). Sample of the variables with multicollinearity shown in Table 19.

Table 19: Contemporaneous analysis after June 2018 VIF test results, variables with possible multicollinearity availability

Non-performing Loans to Total Cash Loans	Non-performing Loans to Total Assets	Loans to Total Assets	Total Deposits to Total Liabilities	Loans to Deposits
773.81125	1,013.88	437.988473	217.464616	319.771071

The variables with high VIF score were eliminated from the data set gradually and re-run VIF test after each elimination step controlling the new test results. Table 17 shows the variables eliminated from dataset in order to have acceptable VIF test results, lower than 5 VIF score.

Table 20: Contemporaneous analysis after June 2018 the variables eliminated from dataset according to VIF test results

Non-performing Loans to Total Assets
Loans to Total Assets
EURTRY Mid
1 Month USD Deposit Rate
1 Month EUR Deposit Rate
TURKEY 5Y CDS Premium
1 Month TRY Deposit Rate

Table 21: Contemporaneous analysis after June 2018 stepwise regression methods comparison

Stepwise Method	Number of possible predictors	R squared	Adj. R squared
Backward	4	50.89%	45.72%
Forward	5	51.30%	44.70%
Both	4	50.90%	45.70%

Table 22: Contemporaneous analysis after June 2018 predictor candidates according to forward stepwise regression

Funds from Repo Transactions to total liabilities
Required Reserves to total assets
Cash to total assest
Non-performing loans to cash loans
CBTR Current Deficit

Table 23: Contemporaneous analysis after June 2018 regression results

	Estimate	Std.Error	t Value	Pr(> t)	
Funds from Repo Transactions to total liabilities	(162.54)	41.25	(3.94)	0.00	***
Required Reserves to total assets	259.86	493.43	0.53	0.60	
Cash to total assest	258.38	75.72	3.41	0.00	**
Non-performing loans to cash loans	6.51	2.60	2.51	0.02	*
CBTR Current Deficit	0.10	0.05	1.97	0.06	.

The analysis results shows that, funds from repo transactions has strong negative effect on liquidity adequacy ratio. Considering the repo rates relatively cost effective comparing to money market borrowings or deposits, it would be profitable but regulatory coefficients for repo transactions are 100% whereas e.g. demand deposits 20%, time deposits 30%. Increase in repo transactions to total liabilities results in decrease in other items in total liabilities such as deposits which causes increase in liabilities and decrease in liquidity adequacy ratio.

Cash to total assets ratio is positively significant, which allows Banks to manage liquidity more comfortable manner.

Non-performing loans to total cash loans ratio is also positively significant since it indirectly reduces the duration of loan portfolio and supports up to 1 month assets amount.

4.3.3 Predictive analysis before June 2018

The same process, the multicollinearity among the variables were tested since 1 period lag is executed in predictive analysis. As expected, the VIF test results are almost same comparing to contemporaneous analysis results.

Table 24: Predictive analysis before June 2018 VIF test results, variables with possible multicollinearity availability

Non-performing Loans to Total Cash Loans	Non-performing Loans to Total Assets	Loans to Total Assets	Total Deposits to Total Liabilities	Loans to Deposits
101.808	94.757	35.622	34.857	37.023

Since VIF results are similar, same data elimination process has run. In this respect, Non-performing Loans to Cash Loans, Loans to Deposits variables are eliminated from dataset. All VIF test scores turn out to be acceptable, around 2.00.

Table 25: Predictive analysis before June 2018 stepwise regression methods comparison

Stepwise Method	Number of possible predictors	R squared	Adj. R squared
Backward	1	4.23%	3.50%
Forward	1	4.20%	4.70%
Both	1	3.50%	3.50%

Table 26: Predictive analysis before June 2018 predictor candidates according to forward stepwise regression

Demand deposit to total deposit
Non-performing loans to total assets
Periodic net profit to total equity
1 Month USD Deposit Rate
US Government 10 Years Treasury Yield

Table 27: Predictive analysis before June 2018 regression results

	Estimate	Std.Error	t Value	Pr(> t)	
Demand deposit to total deposit	1.49	0.67	(2.23)	0.03	*
Non-performing loans to total assets	1,474.58	892.94	1.65	0.10	
Periodic net profit to total equity	0.06	0.10	0.54	0.59	
1 Month USD Deposit Rate	3.27	2.56	1.28	0.20	
US Government 10 Years Treasury Yield	2.36	1.87	1.26	0.21	

Same as predictive analysis for all data, only Demand deposit to total deposit ratio is calculated negatively significant. It is consistent since the time series representing before 2018 financial turmoil, is same in both analyses.

4.3.4 Predictive analysis after June 2018

The same process covering the multicollinearity among the variables were tested. It is seen that, VIF scores increased dramatically.

Table 28: Predictive analysis after June 2018 VIF test results, variables with possible multicollinearity availability

Non-performing Loans to Total Cash Loans	Non-performing Loans to Total Assets	Loans to Total Assets	Total Deposits to Total Liabilities	Loans to Deposits
855.613	1,128.25	302.296	177.033	212.081

Number of 8 variables with high VIF scores are eliminated from the dataset.

Table 29: Predictive analysis after June 2018 the variables eliminated from dataset according to VIF test results

Non-performing Loans to Total Cash Loans
Loans to Total Assets
EUR-TRY Mid
1 Month USD Deposit Rate
1 Month EUR Deposit Rate
1 Month TRY Deposit Rate
TURKEY 5Y CDS Premium
Fee, commission banking service income to total income

Same analysis process repeated followed by stepwise regression and possible explanatory variables defined.

Table 30: Predictive analysis after June 2018 stepwise regression methods comparison

Stepwise Method	Number of possible predictors	R squared	Adj. R squared
Backward	3	22.70%	16.76%
Forward	6	28.20%	18.50%
Both	3	22.70%	16.80%

Like all other analysis, forward selection stepwise regression analysis outputs the maximum R^2 and number of predictor candidates

Table 31: Predictive analysis after June 2018 predictor candidates according to forward stepwise regression

Funds from Repo Transactions to total liabilities
Periodic net profit to total equity
Cash to total assest
CBTR net funding
US Government 10 Years Traesury Yield
Emerging Markets 5 Years Credit Spread

Table 32: Predictive analysis after June 2018 regression results

	Estimate	Std.Error	t Value	Pr(> t)	
Funds from Repo Transactions to total liabilities	(115.06)	53.16	2.16	0.04	*
Periodic net profit to total equity	0.24	0.13	1.87	0.07	.
Cash to total assest	(44.28)	93.88	(0.47)	0.64	
CBTR net funding	(1.67)	0.87	(1.91)	0.06	.
US Government 10 Years Traesury Yield	3.45	2.33	1.48	0.15	
Emerging Markets 5 Years Credit Spread	0.01	0.01	1.09	0.28	

The only significant variable is Funds from Repo transactions to liabilities ratio same as the regression analysis covering after 2018 data series.

CHAPTER 5

CONCLUSION

The purpose of this study was to determine the relationship between both balance sheet items and macro-economic indicators and the liquidity adequacy ratio of banking sector in Turkey.

The data set used in the study is analysed in two parts. Firstly, dependent, and independent variables are kept contemporaneous as first data series and independent variables shifted for one period as the second data series. Then both data series divided into two parts: before and after 2008 financial turmoil which allowed six different analyses to be made.

In all analyses of this study, only four variables (funds from deposits and repo transactions in liability side, cash, and non-performing loans to cash loans in asset side) either increases the assets or decreases the liabilities found significant. Regression analysis found no significant relationship between macro-economic variables and liquidity adequacy ratio of commercial banks.

Since the dependent variable is derived from balance sheet items with maturities up to 30 days, the balance sheet items which helps reducing the duration has positive effect on the ratio, for instance, not increase in deposits to liabilities ratio but increase in demand deposits to total deposits ratio has positive effect since demand deposits are placed in the first time-bucket (up to seven days) and causes decrease in deposit duration.

Another effective factor is the regulatory coefficients which defines the weights of the balance sheet items in the liquidity adequacy ratio calculation. For instance, repo transactions have more weight (100%) compared to deposits (20% for demand, 30% for time deposits). Funding with repo transactions would increase the liability side and cause decrease in the liquidity ratio.

This study concludes that macro-economic variables does not significantly affect the liquidity adequacy ratio of financial sector in Turkey.



BIBLIOGRAPHY

- [1] Soprano Aldo, “Liquidity Management A Funding Risk Handbook,” Wiley UK, 2015.
- [2] Banks Erik, “Liquidity Risk - Managing Funding and Asset Risk,” Second Edition, Palgrave Macmillan UK, 2014.
- [3] Nikolaou Kleopatra, “Liquidity Risk Concepts Definitions And Interactions”, European Central Bank Working Paper Series No:1008, February 2009.
- [4] Sar Abdourrahmane, Lybek Tonny, “Measuring Liquidity in Financial Markets,” IMF Working Paper, WP/02/232, 2002.
- [5] Yıldırım Burcu Deniz, “Piyasa Likiditesinin Ölçümü Ve Anlamı,” Uzmanlık Yeterlilik Tezi, Türkiye Cumhuriyet Merkez Bankası Bankacılık ve Finansal Kuruluslar Genel Müdürlüğü Ankara, Eylül 2009.
- [6] Drehmann Mathias, Nikolaou Kleopatra, “Funding Liquidity Risk Definition And Measurement,” European Central Bank Working Paper Series No:1024, March 2009.
- [7] Gülhan Ozan, “Bankacılıkta Likidite Riski ve Likidite Düzenlemeleri Türk Bankacılık Sektörü Üzerine Uygulamalar,” Doktora Tezi, Ankara, Ocak 2018.
- [8] Cecchetti Stephen, Disyatat Piti, “Central Bank Tools and Liquidity Shortages,” Federal Reserve Bank of New York Economic Policy Review, August 2010.

- [9] Risna Waty Sitepu, “Factors Affecting Liquidity Coverege Ratio (LCR) As Implementation of Basel III in The Banking Sector,” Universitas Sumatera Utara, January 2020.
- [10] Alper Koray, Çapacıoğlu Tanju, “The Dynamics of Loan-To-Deposit Ratio In Turkey,” TCMB Blog Financial Markets, November 2018.



VITA

After graduating from Civil Engineering at Yıldız Teknik University in 1996, he started his career at Sümerbank within Management Trainee Program. Then he transferred to Treasury Department. Almost 4 years improving himself, he decided to fulfil his military obligation. Afterwards, he continued his career at Anadolu Bank Treasury Department. He decided to widen his viewpoint in finance and continued his career in risk management and moved to Yapı ve Kredi Bankası, one of the largest privately owned banks in Turkey. Throughout his years at Yapı ve Kredi Bankası, he learned technical background of financial instruments and their valuation methods, how to meet business needs, successfully managed various market risk management projects. Currently, he continues to his career at the same bank, and managing counterparty credit risk, daily margining of derivatives portfolio, independent price verification and models used in market risk management.