

“The Effects of Liquidity Risk Management on the Profitability of the Banking System in the Republic of North Macedonia”

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Abstract

The financial crisis highlighted the damage that an entire economy can suffer from the insecurity of banks, which clearly demonstrates the importance of the liquidity of banks in particular and the banking system in general. Banking systems around the world have suffered major financial crises as a result of mismanagement of liquidity risk, and based on this, banks have always made continuous efforts to avoid, through various strategies and instruments, the decline of banking liquidity below the mandatory levels set by the National Bank, without negatively affecting their profitability.

The realization of this scientific research aims to describe, analyze and compare the effects of liquidity risk management on the profitability of the banking system in the Republic of North Macedonia, through the measurement of indicators related to liquidity and profitability.

Through the analysis and assessment of the banking system, through the annual and quarterly reports of the BPRMV, the financial situation of this system has emerged, from which it can be concluded that banks in our country have a stable level of liquidity, as a result of the interventions of the Central Bank through its monetary policy, namely the required reserve ratio.

Keywords: Liquidity Risk, Financial Performance, banking system in the Republic of North Macedonia

1. Introduction

The financial crisis highlighted the damage that a country's economy can suffer from insufficient bank liquidity, and the importance of liquidity risk management in the financial health of the banking sector.

The importance of liquidity is clearly seen in banks that have weak liquidity, such banks tend to refinance their liabilities, but even when they manage to do so, they do so at a higher rate than the market rate and in these circumstances banks can only survive for a certain period of time

until they reach the point where they completely lose their liquidity and this manifests itself with negative results in their performance that lead the bank to bankruptcy. A bank will have serious problems if it is not able to maintain its liquidity at a satisfactory level by not being able to repay its liabilities on time. Therefore, liquidity risk management and efforts to eliminate its negative effects are of particular importance for financial institutions, namely banking activity.

1.1. Reasons and problems of the research

Adequate liquidity risk management consists of reducing the probability of serious risks to banks in particular and the banking sector in general, because mismanagement of liquidity risk of a single financial institution can negatively reflect on the entire financial system.

The markets that suffer the most from a lack of liquidity are those markets where there is a high inflation rate, unstable exchange rate and many other macroeconomic policy factors.

To avoid liquidity problems, a bank must hold liquid assets. However, increased liquidity has a cost. There is a reciprocal relationship between liquidity and profitability, the more liquid the asset, the lower the percentage of income. Instead of holding liquid funds, a bank can create more profitable loans.

Despite the costs, holding liquid assets is necessary because it:

- signals to the market that the bank is prudent and well managed;
- avoids the forced sale of the bank's assets;
- avoids the need to pay excessive borrowing costs in the interbank markets;
- avoids borrowing from the central bank.

The banking system represents the most important part of the financial system of the Republic of North Macedonia, considering that banks account for approximately 90% of the total assets of the financial system in the RMN. By describing, analyzing and evaluating the banking system, through the annual and quarterly reports of the BPRMV, we have shown the financial condition of this system, from which it can be concluded that banks in our country have a stable level of liquidity, as a result of the interventions of the Central Bank through its monetary policy, namely the required reserve ratio.

1.2 Research goals and tasks

Given the importance of liquidity risk management of financial institutions, namely the banking system, especially after the 2007 financial crisis, the purpose of the research is to describe, analyze and compare the effects of liquidity risk management on the profitability of the banking system in the Republic of North Macedonia.

Among the research objectives, the following can be highlighted:

- Analysis of the RMV banking system and its liquidity
- Analysis of the performance of liquidity and profitability indicators of the banking system in the Republic of North Macedonia
- Measurement of the impact of liquidity risk on the profitability of the RMV banking system
- Analysis of the theoretical and empirical relationship between liquidity and profitability of second-tier banks.

Through the research of the RMV banking system, it has been possible to measure financial indicators that serve as indicators of liquidity risk, such as: Loan/Deposit ratio and Required reserves, and as indicators of profitability, the following have been used: Return on average assets (ROAA), Return on average equity (ROAE).

The dependence and relationship between variables will be tested through regression analysis, while to see what impact liquidity risk management has on the profitability of second-tier banks in the RMV, the Granger Causality test will be used.

1.3. Research hypotheses

Through the hypotheses presented, the research work is defined and what is planned to be achieved through the research carried out is determined.

The hypotheses raised are testable and are based on the research objectives, i.e. they derive from the research questions.

The hypotheses stated:

H1: There is a significant relationship between the loan/deposit ratio and return on assets (ROAA) in the banking system of the Republic of North Macedonia.

H2: There is a significant relationship between the loan/deposit ratio and return on equity (ROAE) in the banking system of the Republic of North Macedonia.

H3: There is a significant relationship between liquidity and profitability in the banking system of the Republic of North Macedonia.

1.4. Scientific research methodology

Since this research analyzes the effects of liquidity management on the profitability of the banking system in the Republic of Macedonia, a deductive approach was used, which allows testing the hypotheses raised in previous research on the causal relationship between variables in relation to reality, based on several assumptions.

The quantitative method used in this research is a very efficient method that has also been used in other research related to the liquidity of the banking system, which provides more opportunities for analyzing large amounts of data obtained through the use of descriptive

statistics, which is used to establish causal relationships between variables and produce models for these variables.

The data used to test the hypotheses raised on the impact of liquidity risk management on the profitability of the banking system are secondary data, which are provided by the quarterly reports of the Central Bank of the Republic of Macedonia for the banking system in, these data analyzed through the Stata-16 software, reaching the expected results for the interpretation of their significance and reliability. As empirical data for testing the hypotheses, the ratios that have emerged from the calculation of various variables related to the liquidity and profitability indicators of the country's banks were used. In this paper we discuss the research methodology, the definition of research variables, the methods and techniques of data processing, etc. It also discusses liquidity estimators such as Loans to Deposits and Required Reserves and profitability estimators such as ROAA and ROAE, which are presented graphically through quarterly data provided by the Central Bank of the Republic of North Macedonia. Through the application of the Augmented Dickey-Fuller and Phillips-Perron tests, the stationarity of the time series was tested. After the Johansen-Jusselius test was applied, whose results were not sufficient to prove the cause-effect relationship, the Granger Causality test was also applied to test the hypotheses raised, to see the causal relationship between the research variables.

2. Literature Review / Theoretical Framework

This chapter demonstrates knowledge and understanding of the economic literature related to the banking system, and aims to provide a general overview of the knowledge related to the liquidity and profitability of the banking system and their interconnection. The scientific literature used is reliable literature, reviewed by professionals in the relevant field, which serves to summarize previous knowledge that will contribute to the realization of this scientific research.

2.1. Definition and importance of liquidity

In simple terms, liquidity means the ease with which assets are converted into cash whenever we need them, while cash represents the highest level of liquidity because it is stable and easily convertible into other assets. Cash also serves as a measure of the liquidity of other assets, any asset that can be easily converted into cash is called a liquid asset. The Basel Committee defines liquidity as the ability to finance the growth of the asset and the repayment of liabilities when they arrive. (Basel Committee on Banking Supervision, 2000). One of the definitions of liquidity is that liquidity represents the bank's ability to meet all anticipated and unforeseen obligations of its customers, and to provide sources of additional funds, i.e. it must be able to provide additional funds in the short term, without high costs, through increasing liabilities, securitization, sale of assets or in any other way. (Živko, Kandžija, 2014).

A bank has sufficient liquidity potential when it can obtain the necessary funds at reasonable prices. All liquidity is determined by market conditions and the market's perception of the riskiness of the borrowing institution. (Greuning, Brajovic, Bratanovic, 2006, p.167)

We can also define banking liquidity as the ability that commercial banks must possess to balance the ratio between revenues and liabilities, namely the ability of the bank to fulfill its obligations to its creditors at a given time.

Bank liquidity is the main indicator of the strength of the business and the ability of the bank, as well as the main indicator of the trust of the subjects towards the bank. (Pojatina, 2000, p.246)

Given the importance of liquidity in the functioning of banks, especially after the global financial crisis of 2007, the Basel Committee, with the aim of strengthening the stability of the banking sector, proposed two new indicators for determining the level of liquidity of banks:

- In the short term, to ensure that banks have high quality liquid assets to withstand an scenario lasting one month.
- In the long term, to increase incentives for bank financing, using more stable sources on a structural basis. Furthermore, it includes a series of tools for the ongoing supervision of exposure to liquidity risk and the exchange of information between supervisors.

Liquidity in the banking system is a key factor because a bank must ensure that it holds enough cash or other liquid assets to meet its obligations to depositors and to satisfy the demands of credit consumers.

2.2.Characteristics and elements of liquidity

The description of the characteristics and elements of liquidity is of particular importance, due to the fact that it enables us to clearly understand the complexity of liquidity issues and its importance in the financial stability of the banking sector.

2.2.1. Liquidity risk

In the economic literature we encounter many categories of risk that require supervision by the bank's management. Some of these categories are: credit risk, interest rate risk, price risk, liquidity risk, compliance risk, operational risk, strategic risk and reputation risk.

In modern banking, liquidity plays a key role, therefore, in the group of the largest risks of the banking system, a very important factor is liquidity risk, which represents a fundamental condition for the activity of financial institutions, namely banks.

2.2.2. Types of liquidity risk

In the economic literature we encounter different divisions regarding the types of liquidity risk. Some authors speak of financing liquidity risk and market liquidity risk, some other authors distinguish four types of liquidity risk, where in addition to financing liquidity risk and market liquidity risk, they also add revocation risk and maturity liquidity risk.

According to B.Casu, C. Girardone and P. Molyneux they speak of two other types of liquidity risk.

- Daily liquidity risk concerns daily withdrawals. This is usually predictable (normal), because only a small percentage of a bank's deposits will be withdrawn on any given day. Very few institutions actually run out of cash because it is relatively easy for banks to cover any cash shortage by borrowing funds from other banks in the interbank markets.
- A liquidity crisis occurs when depositors demand larger than normal withdrawals. In this situation, banks are forced to borrow funds at a higher interest rate, higher than the market rate that other banks pay for similar loans. This is usually unpredictable and can be due to either a lack of confidence in individual banks, or an unexpected need for cash.

2.2.3 Liquidity risk management

Liquidity management is one of the main banking tasks and is an integral part of asset and liability management. Most banking assets depend on a bank's ability to provide liquidity to its customers, and banks need liquidity to offset expected and unexpected fluctuations in their balance sheets and to provide funds for growth. Adequate liquidity provision has an impact on the bank's profitability. (Rose, 2003., p.350)

Risk management is a complex and sophisticated task, and it is more difficult if we consider that banks every day enter into new business relationships with securities or derivative instruments, speculative operations, bank insurance and a number of new businesses that are far from the classic concept of banking. The expansion of the business field exposes banks increasingly to new risks. More precisely, banks today have become "producers" of risks, they assume, transform and incorporate them into their products and services. This is why timely risk management is one of the most important comparative advantages that a bank can have. (Prga, Šverko, 2005, pp. 153-162).

Bank liquidity management has developed, changed and improved throughout its history in line with the development of the financial market and the emergence of various financial instruments, but also by changing the view on the place, role and way of doing business of the bank (Saunders, 2011, p.110)

The changing environment in which banks operate is a fundamental challenge for them, but at the same time it contains complex and changing risks that represent traditional approaches to bank management. This is why banks must rapidly adopt financial risk management capabilities to survive in a market-oriented environment, maintain competition from foreign banks and support private sector economic growth (Greuning, Brajovic Bratanovic, 2006, p. 15.)

2.2.4. Liquidity risk measurement

The process of measuring a bank's liquidity risk should be commensurate with its size, complexity and liquidity risk profile. Similar to the limits and objectives of a bank's policy, liquidity measurement should be comprehensive and prospective.

A comprehensive liquidity measurement should include all cash flows and liquidity implications from all material assets, liabilities, off-balance sheet positions and other activities, including potential options placed on the bank's assets and liabilities.

Risk measurement can be done in several ways. The first way to measure a bank's exposure to liquidity risk is to compare key balance sheet ratios and characteristics, such as loans and deposits, borrowed funds versus total assets, etc.

Another tool for measuring liquidity risk is liquidity gaps. When analyzing liquidity risk, a given bank may monitor various ratios, and some of the most important are:

- loan-to-deposit ratio - represents one of the most traditional liquidity ratios. The basic logic was to compare loans (which are essentially illiquid instruments) and deposits (as potential liabilities). The lower the loan-to-deposit ratio, the better the liquidity position of the bank. However, it should be noted that this ratio is adequate for relatively less developed financial markets (where loans are not securitized or sold). In developed markets, this ratio is no longer interesting. That is, in these markets, some loans are already quite liquid instruments, so drawing conclusions based on this ratio may be insufficient.
- liquid assets to total liabilities ratio - among liquid assets, liquidity reserves are most often observed, which include: cash and cash equivalents (in the amount above the required reserve), marketable securities and funds that can be borrowed in the money market.
- the ratio of short-term assets to short-term liabilities - which should essentially be above 1, i.e. short-term assets should be higher than short-term liabilities.

2.3 *Definition and importance of profitability*

As for any economic entity, also for banks, the main motive of their functioning is the realization of profit.

The determination of the determinants of bank profitability aims to highlight the factors that have the greatest impact on the total profitability of banks and, moreover, the knowledge of these factors would help to more easily overcome possible negative shocks in the future and to maintain the financial stability of the entire system. As Golin (2001) says, adequate profits are necessary for banks to maintain their solvency, survive and improve the competitive environment.

Profit also has an impact on the cost of raising additional capital, not only because of its direct contribution to capital growth, but also because of the assessment of external investors of the financial strength of the bank. The better the profit, the better the prospects for raising additional capital, as investors have more confidence in its financial strength (Bobakova, 2003).

Profitability is important for banks as well as for all other business entities, however, compared to other business entities, the profitability of banks has a much broader social and economic significance, mainly due to the various positive and negative externalities of their activity. In addition, banks themselves are unique compared to other non-financial companies in terms of their regulatory environment and the nature of the service they provide (Kundid, 2012).

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2.4. Measuring profitability

Measuring bank profitability is important because of several differences, in addition to the fact that it is a fundamental indicator of the success of their operations. That is, as profitability increases, banks are rightfully allowed to generate more funds for the purpose of approving a larger number of loans in an economy. That is, when bank profitability decreases, lending decreases to protect the ability to meet capital requirements and vice versa. The consequence of the reduction in lending will lead to a negative effect on consumption and investment in the economy (Pejic Bach et al, 2009, pp.82-83).

Initial analyses of bank profitability argued that the main determinants were the structure of financial markets and barriers to entry. Both were classified as external forces with the greatest impact on profits. Moreover, the analyses began to develop in two directions, distinguishing between internal factors and environmental (external) factors. Now, the structure of financial markets began to be treated as one of the most external influences affecting profitability, including economic growth, inflation, market interest rates and ownership. Internal factors arise from the functioning of the bank itself and can be best seen from balance sheets and reports and are therefore often called micro factors, i.e. factors specific to the specific bank. On the other hand, external factors represent variables that are not directly related to the functioning of the bank's management, but are a reflection of the economic-legal conditions in which the bank operates and that affect its achievements and operations. (Athanasoglou et al. 2005)

Traditional measurement

The assessment of the economic performance of banks is a complex process that involves the interaction between the environment, internal operations and external activities. In principle, several indicators are used to present their functioning and the data for their calculation are taken from the financial reports of the banks. Thus, among the most used indicators are: Return on Assets (ROA), Return on Equity (ROE), and Net Interest Margin (NIM).

The first measure of profitability (ROA) shows the profit earned per unit of assets and is a reflection of the ability of management to use the financial and real investment resources of the bank to realize a profit (Hassan & Bashir 2003). For each bank, this indicator depends on management decisions, bank policy, as well as factors over which they have no control, which are related to economic and state regulation. Banks are not the same size as each other, so comparing the profitability of banks is difficult. ROA is a fundamental indicator of profitability that takes into account the size of the bank, and is obtained by dividing the bank's profit by the amount of its assets.

The second measure (ROE) shows how effectively the bank's management uses the funds made available by shareholders and is an indicator of the return they realize as compensation for their capital investments in the specific bank. What bank shareholders are most interested in is how much the bank earns on their capital, and this is measured by Return on Equity (ROE), which is obtained from the ratio of net profit to invested capital.

Another important indicator of a bank's success is the Net Interest Margin (NIM), which represents the difference between interest income and interest expenses as a percentage of total assets. The net interest margin is determined by the balance sheet structure and the interest rates applied to individual asset and liability items. The impact on profit reduction is more pronounced when non-earning assets generate income financed by interest-bearing liabilities and the opposite occurs when non-interest-bearing liabilities increase profits if they finance high-interest assets. (Pakovic,2004, fq.183).¹

Economic measurement

The economic measurement of profitability takes into account the development of shareholder value creation and aims to assess, for each given fiscal year, the economic results generated by a company, from its economic assets (as part of its balance sheet). These measures mainly focus on efficiency as a central element of performance, but generally have high levels of information requirements.

Two groups of indicators can then be identified among the economic performance measures:

¹Irijana Knezevic, "Odnos profitabilnosti i velicine banke u Republici Hrvatskoj", Pula, 2019. Fq.7-8.
<https://repositorij.unipu.hr/islandora/object/unipu:5255/datastream/PDF/view>

1) Indicators related to the total return on an investment, based on the concept of an opportunity cost, the most common is economic value added (EVA).

$EVA = \text{return on invested funds} - (\text{weighted average cost of capital} * \text{invested capital})$
 $- (\text{weighted average cost} * \text{net debt})$

1) Indicators related to the underlying level of risk associated with the banks' activities. PAROC (risk-adjusted return on capital, i.e. the expected return on economic capital) allows banks to allocate capital to individual business units according to their individual business risk. As a performance assessment tool, it then allocates capital to business units based on their expected economic value added.

2.5. Liquidity management strategies

To manage liquidity, banks draft a plan that provides for policies and procedures to be followed by the bank in cases of unusual withdrawals of funds by depositors, as well as mechanisms to provide funds that would help the bank overcome unforeseen risks.

Sound liquidity management should be preceded by permanent supervision of all incoming and outgoing cash flows, diversification of income flows and investment portfolios to include highly liquid assets, and accurate, permanent and detailed planning of liquidity financing.

The primary source of funds in the RMV banking system are deposits of non-financial entities, which are divided into demand deposits, short-term deposits and long-term deposits by maturity.

3. Scientific research methodology

This part of the article discusses the research methodology, the definition of research variables, data processing methods and techniques, etc. It also discusses liquidity estimators such as Loans to Deposits and Required Reserves and profitability estimators such as ROAA and ROAE, which are presented through quarterly data provided by the Central Bank of the Republic of North Macedonia.

3.1. Description of the research methodology used

The research methodology includes data collection, their division into dependent and independent variables, as well as the theoretical and empirical description of the variables. Also, the description of the econometric model that has been applied, the linear regression analysis and through the results achieved, the testing of the research hypotheses is enabled and as a result the commentary on the results that emerge from the testing of the hypotheses as well as the impact of these results on the banking system of the Republic of North Macedonia is made through descriptive statistics, and the same have been analyzed through the Stata.16 software, and the expected results have been achieved, the interpretation of their significance and reliability.

3.2. Definition of research variables

Dependent variables

The dependent variable in this research is the profitability of banks, for the measurement of which indicators such as Return on Average Assets (ROAA) and Return on Average Equity (ROAE) were used. The variables were tested separately against liquidity indicators, to find any existing relationship with profitability indicators. The research contains a total of two dependent variables.

Independent Variables

As independent variables in this research, various liquidity indicators such as Loans to Deposits and Required Reserves have been taken. The aforementioned indicators show an overview of the liquidity level of a business entity by measuring indicators from the balance sheet, income statement and cash flow statement, aiming to measure the adequacy of resources.

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4.1. Statistika deskriptive

Descriptive statistics consist of a variety of methods for summarizing and describing the main characteristics of a data set. Examples include measures of central tendency such as the mean, median, and mode, which provide information about the typical value of the data set. Measures of variability, such as variance and standard deviation, describe the spread of the data. Descriptive statistics also include graphical methods such as histograms and graphs, to present data visually. Table 3. Variables used in empirical analysis

1.	RKD Loan/Deposit Ratio	It is an indicator of banking liquidity that shows that the higher the loan-to-deposit ratio, the more likely it is that banks will finance loans with borrowed funds
2.	RD Required Reserves	One of the main instruments of monetary policy, determined by the Central Bank for managing the money supply, regulating activity in the interbank market, reducing the structural excess of liquidity, etc.
3.	ROAA Return on Average Assets	It is an indicator used by banks and other financial institutions to assess their financial performance, i.e. it shows how efficiently a company uses assets to generate profits
4.	ROAE Return on Average Equity	It refers to the financial ratio that measures the profitability of banks, based on average capital during a financial year

Table 4. Descriptive statistics of variables

		Summarize	TDep	TCre	RKD	ROAA	ROAE	
Variable	Obs	Mean	Std. Dev.	Min	Max	skewness	kurtosis	p50
TDep	52	322249.5	84874.92	192250	493955	.357901	1.948288	305975.5
TCre	52	280631.4	67964.06	176161	422522	.2974235	2.073799	277529
RKD	52	0.875585	03.613049	0.818	0.923	.1943679	2.429391	0.125
RD	52	60701.15	13251.79	42223.46	88178.33	.6906446	2.21521	54390.62
ROAA	52	1.122115	.7557241	-.3	3.1	.1879307	2.409375	11.2
ROAE	52	10.13462	6.807461	-2.5	28	-.5799397	2.716251	87.9

Table 4 contains descriptive statistics that provide a comprehensive description and presentation of the data used in this research. The table includes independent variables such as the loan-to-deposit ratio and the required reserve ratio and dependent variables such as return on average assets and return on average capital. For all variables used in this research, the mean, standard deviation, minimum, maximum, skewness, kurtosis and median (p50) were calculated, which allow for a comparison of the distribution of the data collected and the normal distribution of the data. Skewness essentially characterizes the asymmetry of a data distribution, where if the skewness is negative, this means that most of the numerical data for a given variable are distributed and clustered to the right with a long tail at the top, and vice versa when the skewness is positive. Kurtosis determines the importance of the tails of the distribution, where if kurtosis is positive, this means that the distribution is peaked, while when kurtosis is negative, then the distribution is flat. When we have a normal distribution, the skewness has the value 0, while kurtosis 3.

The Loan to Deposit Ratio has an average of 0.875 and ranges from a minimum of 0.818 to a maximum of 0.923, with a standard deviation of 0.3613 and a median of 0.125. The skewness of the CDR is positive (0.1943679), which means that the data are skewed to the left, and the skewness is 2.429, indicating a flatter distribution than normal.

Required reserves have an average value of 60701.15, a median of 54390.62 and a standard deviation of 13251.79, the minimum value is 42223.46, and the maximum is 88178.33. The skewness of the required rays is positive (0.6906446) which means that the data is stacked to the left and the skewness is 2.21521 and indicates a distribution flatter than normal.

ROAA has a mean value of 1.122115, a median of 11.2 and a standard deviation of 0.7557241, the minimum value is -0.3, while the maximum is 3.1. The skewness of ROAA is positive (0.1879307) which means that the data is stacked to the left and the skewness is 2.409375 and indicates a distribution flatter than normal.

ROAE has a mean value of 10.13462, a median of 87.9, and a standard deviation of 6.807461, the minimum value is -2.5, while the maximum is 28. The skewness of ROAE is negative (-0.5799397), which means that the data is skewed to the right, and the kurtosis is 2.716251, indicating a flatter distribution than normal.

4.2. Econometric model

To assess the relationship between liquidity and profitability, a linear regression model was used, which in this case shows the impact of liquidity indicators on the profitability of second-tier banks, where profitability as a dependent variable is represented by ROAA and ROAE, α represents a constant while liquidity indicators are in the quality of independent variables.

Time series analysis serves to understand trends and changes over time, and is usually used in stationary processes, while by stationary process we mean a process that is essentially the same at any given point in time, namely the series is called stationary when the means and variances of the series are not dependent on time. A non-stationary series is calculated as a series that does not meet the condition of independence in time. The method by which stationarity is tested is the URT (Unit Root Test) method or in other words the unit root test. Econometric programs apply two groups of tests for URT processing, and they are the Augmented Dickey-Fuller (ADF-Test) and the Phillips-Perron (PP) test.

4.2.1. Stationarity testing

Stationarity is an important process for time series data, which in a general sense means that the statistical properties of a process that generates a time series do not change over time.

Stationary processes are a subclass of a wider family of possible models of reality, which are easier to analyze.

In many cases, simple models can be useful, either as building blocks of more advanced models, or as approximations of more complex models, so due to the aforementioned properties, stationarity has become a common recommendation for many practices and tools in time series analysis. Among others, these include trend estimation and causal prediction and inference.

The variables used in this research vary in time, so they represent time series and as such it is necessary to test for stationarity. In cases where the series are non-stationary, they must be transformed into stationary series, as first differences, second differences, and so on.

When the joint distribution of a part of the series ($y_{t1}, y_{t2}, \dots, y_{tk}$) is the same as the distribution of any other part of the series ($y_{t1+\tau}, y_{t2+\tau}, \dots, y_{tk+\tau}$), where τ can be an integer, then the time series y_1, y_2, y_3, \dots , represent stationary time series. If the time series are shifted by an amount τ , then this should not affect the joint distribution, and this is true for any value of k . Second-order stationarity represents another definition of stationarity, which does not consist in the joint distribution of the random responses y_1, y_2, y_3, \dots , except that the mean is constant: $E[y_t] = \mu$, while the covariance between observations y_t and y_{t+k} depends on the lag k between the two observations and not on the point t in the time series: $\gamma(k) = \text{cov}(y_t, y_{t+k})$.

The covariance between two random variables, or y_t and y_{t+k} , represents the average value of the product $(y_t - \mu_t)(y_{t+k} - \mu_{t+k})$: for a stationary process and $k=0$ it follows that:

$E[y_t] = \mu$ dhe $\text{var}[y_t] = \sigma^2$ for any value of t , in other words, the mean and variance of the time series are the same at every point in time. In the case of taking $k=2$, stationarity consists in the fact that the joint distribution of y_{t1} and y_{t2} depends on the difference $t_2 - t_1 = \tau$, which is called the lag or time delay. When the equation is: $Y_t = \mu + \rho * y_{t-1} + \epsilon_t$

The stationarity hypotheses are:

$H_0: \rho=0$

$H_a: \rho < 1$

To perform the Augmented Dickey-Fuller and Phillips-Perron tests, it is very important to determine the optimal time lag. In order for the test results to be more relevant, a more accurate decision on the optimal number of time lags is needed, which is preceded by 4 information selection criteria that we used, which are:

FPE – Final prediction error

AIC – Akaike information criterion

HQIC – Hannan-Quinn Information Criterion

SBIC – Bayesian information criterion (BIC)

Table 5. Information selection criteria and decision on the optimal number of time delays

Variables	Maximum lag	Lag selection criteria				
		FPE	AIC	HQIC	SBIC	decision
TDep	8	4	4	4	4a	4
TCre	8	4	4	4	3	4
RKD	8	3	3	3	2	3
RD	8	3	2	3	3	3
ROAA	8	2	2	2	2	2
ROAE	8	2	2	2	2	2

From Table 5 it is understood that 8 maximum time lags have been determined and from the results of the four information selection criteria we have made the decision on the number of time lags that is most preferred by the criteria for each variable used, at the basic level as well as in the first and second difference.

After the time lags have been determined, the Augmented Dickey-Fuller (ADF-Test) and the Phillips-Perron (PP) test have been applied to see if the variables are stationary or not. Through Tables 6 and 7 the results of both tests are presented from which it can be seen that the variables at the level are non-stationary, in which case there is a need to differentiate them.

From the Phillips-Perron test it is seen that after the first differentiation in both the trend and the non-trend variant, the variables are stationary.

Table 6. Results of test Augmented Dickey Fuller (ADF) dhe Phillips Perron / Unit Root Test

Variabels	Level I (0)		First difference I (1)		Second difference I (2)		decision	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
RKD	-2,938 (-1,794)	-3,499 (-2,958)	-2,950** (-6,353)	-2,930** (-2,729)			I (1) 0	I (1) 0
RD	-2,938 (-1,586)	-2,947 (-1,698)	2,950** (-5,454)	-2,930** (-3,729)			I (1) 0	I (1) 0
ROA	-2,938 (-1,137)	-3,499 (-3,525)	-2,936** (-5,658)	-3,500** (-9,753)			I (1) 0	I (1) 0
ROE	-2,938 (-1,198)	-3,512 (-2,452)	-2,930** (-9,837)	-3,499** (-3,404)			I (1) 0	I (1) 0

Note: ** critical value at 5% significance level.

The number in parentheses is the (t) statistical value

Table 7. Results of test Augmented Dickey Fuller (ADF) dhe Phillips Perron / Unit Root Test

Variabels	Level I (0)		First difference I (1)		Second difference I (2)		decision	
	ADF	PP	ADF	PP	ADF	PP	ADF	PP
RKD	-3,512 (-2,412)	-3,499 (-2,958)	-3.528** (-6.469)	- 3.500** (-7.077)			I (1) 0	I (1) 0
RD	-3.512 (-2.227)	-3.524 (-1.517)	-3.528** (-5.557)	- 2.930** (-3.729)			I (1) 0	I (1) 0
ROA	-3,512 (-2,443)	-3,524 (-2,701)	-1,950** (-5,571)	- 3,500** (-9,740)			I (1) 0	I (1) 0
ROE	-3,512 (-2,452)	-3,500 (-2,521)	-2,936** (-5,658)	- 2,936** (-5,470)			I (1) 0	I (1) 0

Note: ** critical value at 5% significance level.

The number in parentheses is the (t) statistical value

The results of the Phillips Perron test are largely in favor of the fact that the time series are integrated in the first difference and can be used to estimate the cointegration models of the series.

5.2.2. Cointegration and Johansen-Jusselius test results

Since the first difference resulted in the variables being stationary, this enabled the Johansen-Jusselius test to be applied, where:

H0: There is no cointegrating vector

Hα: There is a cointegrating vector

Tables 8 and 9 show the results of the cointegration test for the model that has been defined, these results based on the Trace test statistic in the upper part and the Maximum eigenvalue statistic in the lower part. If the test value results to be lower than the critical value, then both tests accept the null hypothesis.

Tabel 8 Johansen tests for cointegrationvecrank RKD RD ROAA, trend(constant) max

Hypothesized Number of Co integrating Equations	Eigen value	Trace Statistic	5% Critical Value
None	-	40.4462	29.68
At most 1	0.50711	5.0731*	15.414
At most 2	0.07070	1.4068	3.76
At most 3	0.02774		

Hypothesized Number of Co integrating Equations	Eigen value	Max Statistic	5% Critical Value
None	-	35.3731	20.97
At most 1	0.50711	3.6663*	14.07
At most 2	0.07070	1.4068	3.76
At most 3	0.02774		

In the Trace test results we see that the null hypothesis, according to which there is no cointegration vector, is not accepted because the test value is 40.4462, greater than the critical value 29.68 with a probability of 5%. Next we see that the null hypothesis that there is at most 1 integration vector is accepted because the Trace test statistic value (5.0731) is less than the critical value (15.414) and a probability of 5%.

In the Eigen value test results we see that the null hypothesis that there is no cointegration vector is not accepted because the test value is 35.3731, greater than the critical value 20.97 with a probability of 5%. Next we see that the null hypothesis that there is at most 1 integration vector is accepted because the Max test statistic value (3.6663) is less than the critical value (14.07) and a probability of 5%. According to the test results, it is accepted that there is a cointegration vector between the variables.

Tabela 9 Johansen tests for cointegration vecrank RKD RD ROEA, trend(constant) max

Hypothesized Number of Co integrating Equations	Eigen value	Trace Statistic	5% Critical Value
None	-	40.6789	29.68
At most 1	0.51109	4.9004*	15.41
At most 2	0.06607	1.4826	3.76
At most 3	0.02922		

Hypothesized Number of Co integrating Equations	Eigen value	Max Statistic	5% Critical Value
None	-	35.7785	20.97
At most 1	0.51109	3.4177*	14.07
At most 2	0.06607	1.4826	3.76
At most 3	0.02922		

In the Trace test results we see that the null hypothesis, according to which there is no cointegration vector, is not accepted because the test value is 40.6789, greater than the critical value 29.68 with a probability of 5%. Next we see that the null hypothesis that there is at most 1 integration vector is accepted because the Trace test statistic value (4.9004) is less than the critical value (15.41) and a probability of 5%.

In the Eigen value test results we see that the null hypothesis that there is no cointegration vector is not accepted because the test value is 35.7785, greater than the critical value 20.97 with a probability of 5%. Next we see that the null hypothesis that there is at most 1 integration vector is accepted because the Max test statistic value (3.4177) is less than the critical value (14.07) and a probability of 5%. According to the test results, it is accepted that there is a cointegration vector between the variables.

Although the results of the Johansen-Jusselius test show that there are up to two integrated vectors, this is not enough to prove the existence of a cause-and-effect relationship, and for this reason another statistical test called the Granger-Causality test has been developed, which serves to tell us whether a given time series serves to predict another time series.

Test of kauzalitetit – Granger

After the Johansen-Jusselius Test, the conclusion was that there is a short-term relationship between the variables, because there are at least two integrated vectors and this proves the existence of a short-term integrative relationship between the variables and we can use the “vector auto regression method” (VAR) and not the Vector Error Correction Method (VECM).

The VAR “vector autoregression” model represents a statistical instrument that can easily be used to interpret time series. The VAR time series model promises and provides a reliable and coherent approach to describing time series.

In recent decades, this model has become increasingly popular because it provides empirical evidence for the response to various exogenous impulses of financial variables in order to distinguish alternative models. In the VAR model, we have used the Granger Causality test to test the hypotheses included in this paper.

In the Granger Causality test, the basic idea is that if the prediction of a time series is improved by incorporating knowledge of a second time series, then the latter has a causal effect on the first series. Through linear regression, Granger improved this idea where two autoregressive models are equipped with the first time series with and without the second time series as well as improving the variance of the error terms. So Granger used the double factor of VAR to find the causal relationship between the variables.

In this master's thesis, three research hypotheses have been put forward in order to fulfill the research goal and solve the research problem. The hypotheses put forward are presented below and that is:

H1: There is a significant relationship between the loan/deposit ratio and return on assets (ROAA) in the banking system of the Republic of North Macedonia.

Table 10 shows the results of the Granger Causality Test and the testing of the hypotheses raised in this research. The application of the Granger-Causality test served to test the hypotheses that were put forward at the beginning of the research, in order to find the causal relationship between the research variables, at a confidence level of 95%. After the Johansen-Jusselius Test, the conclusion was that there is a short-term relationship between the variables, because there are at least two integrated vectors and this proves the existence of a short-term integrative relationship between the variables and we can use the “vector auto regression method” (VAR) and not the Vector Error Correction Method (VECM).

The VAR “vector autoregression” model represents a statistical instrument that can easily be used to interpret time series. The VAR time series model promises and provides a reliable and coherent approach to describing time series.

In recent decades, this model has become increasingly popular because it provides empirical evidence for the response to various exogenous impulses of financial variables in order to distinguish alternative models. In the VAR model, we have used the Granger Causality test to test the hypotheses included in this paper.

In the Granger Causality test, the basic idea is that if the prediction of a time series is improved by incorporating knowledge of a second time series, then the latter has a causal effect on the first series. Through linear regression, Granger improved this idea where two autoregressive models are equipped with the first time series with and without the second time series as well as improving the variance of the error terms. So Granger used the double factor of VAR to find the causal relationship between the variables.

In this master's thesis, three research hypotheses have been put forward in order to fulfill the research goal and solve the research problem. The hypotheses put forward are presented below and that is:

H1: There is a significant relationship between the loan/deposit ratio and return on assets (ROAA) in the banking system of the Republic of North Macedonia.

Table 10 shows the results of the Granger Causality Test and the testing of the hypotheses raised in this research. The application of the Granger-Causality test served to test the hypotheses that were put forward at the beginning of the research, in order to find the causal relationship between the research variables, at a confidence level of 95%.

Table 10. Results of the Granger Causality Test Return on Assets ROAA

Null Hypothesis	Obs	Lag	z	P > z	Decision
D_RKD does not Granger Cause D_ROAA	47	3	0.04	0.967	H ₀ is accepted.
D_RD does not Granger Cause D_ROAA		3	-2.41	0.016	H ₀ is rejected.
All variables does not Granger Cause D_ROAA		4	1.59	0.111	H ₀ is accepted
D_ROAA does not Granger Cause D_RKD	47	4	3.32	0.001	H ₀ is rejected.
D_RD does not Granger Cause D_RKD		4	2.48	0.013	H ₀ is rejected.
All variables does not Granger Cause D_RKD		4	-2.05	0.041	H ₀ is rejected.
D_ROAA does not Granger Cause D_RD	47	3	-0.76	0.448	H ₀ is accepted
D_RKD does not Granger Cause D_RD		1	-3.25	0.001	H ₀ is

All variables does not Granger Cause D_RD		4	0.84	0.402	accepted H ₀ is accepted
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The decisions made based on the results of the tests conducted according to the Granger Causality Test procedure are:

- a. From the results of the Granger Causality Test presented in Table 10, it is decided to accept the hypothesis H₀ ($p = 0.967$) which states that the Loan/Deposit Ratio (LDR) does not Granger cause Return on Assets (ROAA) in the banking system of the Republic of North Macedonia,
- b. From the results of the Granger Causality Test presented in Table 10, it is decided not to accept the hypothesis H₀ ($p = 0.016$) which states that the RD Granger do not Granger cause Return on Assets (ROAA) in the banking system of the Republic of North Macedonia, instead, the Alternative Hypothesis H₁ is accepted which states that there is a significant relationship between Required Reserves (RD) and Return on Assets (ROAA) in the banking system of the Republic of North Macedonia, with a reliability of 95%.
- c. From the results of the Granger Causality Test presented in Table 10, it is decided not to accept the hypothesis H₀ ($p = 0.001$) which states that Return on Assets ROAA Granger does not cause the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, instead the Alternative Hypothesis H₁ is accepted which states that there is a significant relationship between Return on Assets (ROAA) and Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a reliability of 95%.
- d. From the results of the Granger Causality Test presented in Table 10, it is decided not to accept the hypothesis H₀ ($p = 0.013$) which states that the Reserve Requirements (RR) Granger does not cause the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, instead, the Alternative Hypothesis H₁ is accepted which states that there is a significant relationship between the Reserve Requirements (RR) and the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a reliability of 95%.
- e. From the results of the Granger Causality Test presented in Table 10, it is decided to accept the hypothesis H₀ ($p = 0.448$) which states that the Return on Assets (ROAA) Granger does not cause the Reserve Requirements (RR) in the banking system of the Republic of North Macedonia.
- f. From the results of the Granger Causality Test presented in Table 10, it is decided not to accept the hypothesis H₀ ($p = 0.001$) which states that the Reserve Requirements (RR) Granger does not cause the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, instead the Alternative Hypothesis H₁ is accepted which states that there is a significant relationship between the Reserve Requirements (RR) and the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a reliability of 95%.

H₂: There is a significant relationship between the loan/deposit ratio and return on equity (ROAE) in the banking system of the Republic of North Macedonia.

Tabel 11. Results of Test of Granger Causality ROAE

Null Hypothesis	Obs	Lag	z	P > z	Decision
D_RKD does not Granger Cause D_ROAE	47	2	0.05	0.957	H ₀ is accepted.
D_RD does not Granger Cause D_ROEA		3	-2.27	0.023	H ₀ is rejected.
All variables does not Granger Cause D_ROEA		4	1.43	0.152	H ₀ is accepted.
D_ROAE does not Granger Cause D_RKD	47	4	3.51	0.000	H ₀ is rejected.
D_RD does not Granger Cause D_RKD		4	2.56	0.010	H ₀ is rejected
All variables does not Granger Cause D_RKD		4	-2.16	0.031	H ₀ is rejected
D_ROAE does not Granger Cause D_RD	47	2	0.20	0.838	H ₀ is accepted.
D_RKD does not Granger Cause D_RD		1	-3.30	0.001	H ₀ is accepted.
All variables does not Granger Cause D_RD		4	0.82	0.411	H ₀ is accepted.

The decisions made based on the results of the tests conducted according to the Granger Causality Test procedure are:

- a. From the results of the Granger Causality Test presented in Table 11, a decision is made to accept the hypothesis H₀ (p = 0.957) which states that the Loan/Deposit Ratio (LDR) does not Granger the Return on Equity (ROAE) in the banking system of the Republic of North Macedonia,
- b. From the results of the Granger Causality Test presented in Table 11, a decision is made not to accept the hypothesis H₀ (p = 0.023) which states that the RD Granger does not Granger the Return on Equity (ROAE) in the banking system of the Republic of North Macedonia, instead, the Alternative Hypothesis H₂ is accepted which states that there is a significant relationship between the Required Reserves (RD) and the Return on Equity (ROAE) in the banking system of the Republic of North Macedonia, with a reliability of 95%.
- d. From the results of the Granger Causality Test presented in Table 11, it is decided not to accept the hypothesis H₀ (p = 0.001) which states that Return on Equity (ROAE) does not Granger cause the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, instead the Alternative Hypothesis H₂ is accepted which states that there is a significant relationship between Return on Equity (ROAE) and Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a reliability of 95%.
- e. From the results of the Granger Causality Test presented in Table 11, it is decided not to accept the hypothesis H₀ (p = 0.010) which states that the Reserve Requirements (RR) Granger does not cause the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, instead, the Alternative Hypothesis H₁ is accepted which states that there is a significant relationship between the Reserve Requirements (RR) and the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a reliability of 95%.
- f. From the results of the Granger Causality Test presented in Table 11, it is decided to accept the hypothesis H₀ (p = 0.838) which states that the Return on Equity (ROAA) Granger does not

cause the Reserve Requirements (RR) in the banking system of the Republic of North Macedonia

- g. From the results of the Granger Causality Test presented in Table 11, it is decided not to accept the hypothesis H0 ($p = 0.001$) which states that the Reserve Requirements (RR) do not Granger cause the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, instead the Alternative Hypothesis H1 is accepted which states that there is a significant relationship between the Reserve Requirements (RR) and the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a reliability of 95%.

H3: There is a significant relationship between liquidity and profitability in the banking system of the Republic of North Macedonia.

From the results of the Granger Causality Test presented in Tables 12 and 13, a decision is made to accept the hypothesis H3, which states that there is a significant relationship between liquidity and profitability in the banking system of the Republic of North Macedonia with a reliability of 95% for the reasons presented in the following tables as a result of the analysis carried out by the empirical procedure of the Granger Causality Test:

Table 12. Relationship of variables in ROAA research (dependent variable)

Linking variables	P	The connection is	Decision on the Hypothesis
RKD → ROAA	0.967	Not significant	H0
RD → ROAA	0.016	Significant	H1.1
ROAA → RKD	0.001	Significant	H1.2
RD → RKD	0.013	Significant	H1.3
ROAA → RD	0.448	Not significant	H0
RKD → RD	0.001	Significant	H1.4

- a. Alternative hypothesis H1.1 which states that there is a significant relationship between Reserve Requirements (RR) and Return on Assets (ROAA) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.
- b. Alternative hypothesis H1.2 which states that there is a significant relationship between Return on Assets (ROAA) and Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.
- c. Alternative hypothesis H1.3 which states that there is a significant relationship between Reserve Requirements (RR) and Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.
- d. Alternative hypothesis H1.4 which states that there is a significant relationship between Reserve Requirements (RR) and Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.

Table 13. Relationship of variables in ROAE research (dependent variable)

Linking variables	P	The connection is	Decision on the Hypothesis
RKD → ROAE	0.957	Not significant	H0
RD → ROAE	0.023	Significant	H1.5
ROAE → RKD	0.000	Significant	H1.6
RD → RKD	0.001	Significant	H1.7
ROAE → RD	0.838	Not significant	H0
RKD → RD	0.001	Significant	H1.8

- a. Alternative hypothesis H1.5 which states that there is a significant relationship between Reserve Requirements (RR) and Return on Equity (ROAE) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.
- b. Alternative hypothesis H1.6 which states that there is a significant relationship between Return on Equity (ROAE) and Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a confidence level of 95%. Hipoteza alternative H1.7 that states that there is a significant relationship between Reserve Requirements (RR) and the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.
- d. Alternative Hypothesis H1.8 which states that there is a significant relationship between Reserve Requirements (RR) and the Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.

6. Conclusion

The banking system represents the most important part of the financial system of the Republic of North Macedonia, considering that banks account for approximately 90% of the total assets of the financial system in the RMN. Through the description, analysis and assessment of the banking system, through the annual and quarterly reports of the BPRMV the financial condition of this system has been revealed, from which it can be concluded that banks in our country have a stable level of liquidity, as a result of the interventions of the Central Bank through its monetary policy, namely the required reserve ratio.

Liquidity risk management represents an important function of banking work, through which long-term stability and achievement of set objectives are achieved, with an acceptable level of risk exposure.

An irreplaceable contribution to liquidity risk management is made by a financial body such as the Basel Committee on Banking Supervision, which requires banks to maintain a satisfactory level of liquid assets, to be able to meet their obligations, and at the same time to be profitable to be stable, therefore the main challenge of liquidity management is finding the balance between liquidity and profitability.

Given the importance of liquidity risk management of financial institutions, namely the banking system, especially after the 2007 financial crisis, the purpose of the research is to describe, analyze and compare the effects of liquidity risk management on the profitability of the banking system in the Republic of North Macedonia.

Through the research of the banking system of the Republic of Macedonia, it has been possible to measure financial indicators that serve as indicators of liquidity risk, such as: the Loan/Deposit ratio and Required Reserves, and as indicators of profitability, the following were used: Return on Average Assets (ROAA), Return on Average Equity (ROAE).

Through empirical analysis, through the application of statistical cointegration tests such as Johansen-Jusselius and the Granger Causality test, the hypotheses raised in this scientific research have been tested. Although the results of the Johansen-Jusselius test show that between the independent variables (RKD, RD) and the dependent variables (ROAA, ROAE), there are up to two integrated vectors, this is not enough to prove the existence of a cause-and-effect relationship, and for this reason another statistical test called Granger-Causality test was developed which serves to test the first main hypothesis, which states: There is a significant relationship between the loan/deposit ratio and return on assets (ROAA) in the banking system of the Republic of North Macedonia.

From the results of the Granger Causality Test, a decision is made to accept the hypothesis H1 which states that there is a significant relationship between the Return on Assets (ROAA) and the Loan/Deposit Ratio (RKD) in the banking system of the Republic of North Macedonia, with a reliability of 95%.

From the results of the Granger Causality Test, a decision is made to accept the hypothesis H2, which states that there is a significant relationship between Return on Equity (ROAE) and Loan/Deposit Ratio (LDR) in the banking system of the Republic of North Macedonia, with a confidence level of 95%.

From the results of the Granger Causality Test, a decision is made to accept the hypothesis H3, which states that there is a significant relationship between liquidity and profitability in the banking system of the Republic of North Macedonia, with a confidence level of 95%.

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