



Gönderiliş Tarihi: 30/11/2022  
Kabul Tarihi: 01/12/2022  
ORCID 0000-0003-1300-2112

## BANKACILIK SEKTÖRÜNDE KREDİ, KUR, FAİZ VE LİKİDİTE RİSKLERİNİN İÇSEL BELİRLEYİCİLERİ

Bilal AKKAYNAK<sup>1</sup>

### ÖZ

*Bankacılık sektörü finansal piyasaların en önemli aracı kurumlarından biridir. Birçok sektör ile ilişkili olması, finansal piyasaların ulusal ve uluslararası ölçekte olması, finansal piyasaların oldukça hassas bir yapıda olması gibi başlıca sebeplerden ötürü sistematik ve sistematik olmayan birçok riske maruz kurumlardır. Bu çalışmanın amacı bankacılık sektörünün maruz kaldığı likidite, kur, faiz ve kredi risklerinin içsel belirleyicilerinin Türk mevduat bankacılığı örneğinde incelenmesidir. Bu amaç doğrultusunda 2009 ve 2021 yılları arasında düzenli olarak verilerine ulaşılabilen 28 mevduat bankasının bilgileri derlenmiştir. Derlenen bilgiler panel veri analizi yöntemi ile analiz edilmiştir. Likidite, kur, faiz ve kredi riski değişkenleri bağımlı değişken olarak kullanılmıştır. Sermaye yeterlilik oranı, sermaye yapısı, varlık yapısı, ROA, ROE, faiz gelirleri, faiz dışı gelirler, sektör payı, personel giderleri, gelir gider dengesi ve mevduat oranı değişkenleri bağımsız değişken olarak kullanılmıştır. Analiz sonucunda değişkenlerin bağımlı değişkenler üzerinde farklı etkilerinin bulunduğu gözlemlenmiştir.*

**Anahtar Kelimeler:** Bankacılık Sektörü, Finansal Risk, Panel Veri Analizi

**Jel Kodu:** C4, G21, G32

## INTERNAL DETERMINANTS of CREDIT, EXCHANGE, INTEREST and LIQUIDITY RISKS in the BANKING SECTOR

### ABSTRACT

*The banking sector is one of the most important intermediary institutions in financial markets. They are institutions that are exposed to many systematic and non-systematic risks due to the main reasons such as being related to many sectors, the national and international scale of financial markets, and the very sensitive structure of financial markets. The aim of this study is to examine the internal determinants of liquidity, exchange rate, interest and credit risks that the banking sector is exposed to in the Turkish deposit banking sample. For this purpose, the information of 28 deposit banks whose data can be accessed regularly between 2009 and 2021 was compiled. The collected information was analysed by the panel data analysis method. Liquidity, exchange rate, interest and credit risk variables were used as dependent variables. Capital adequacy ratio, capital structure, asset structure, ROA, ROE, interest income, non-interest income, sector share, personnel expenses, income expense balance and deposit ratio variables were used as independent variables. As a result of the analysis, it was observed that the variables had different effects on the dependent variables.*

**Keywords:** Banking Sector, Financial Risk, Panel Data Analysis

**Jel Codes:** C4, G21, G32

<sup>1</sup> Dr. Öğretim Üyesi, Erzincan Binali Yıldırım Üniversitesi, İİBF İşletme Bölümü, bakkaynak@erzincan.edu.tr

## **1. INTRODUCTION**

The banking sector is one of the most important institutions that realize the flow of funds between fund demanders and fund suppliers in all economies. Intermediary institutions, especially commercial deposit banks, which fulfil the most basic function of the financial system with fund transfer, may be exposed to various risks in this process. These risks that banks are exposed to are grouped as systematic and unsystematic risks. Systematic risks can also be expressed as external risks. In this risk group, the institution cannot be affected by making any intervention. Unsystematic risks, on the other hand, are those that the institution can be affected by intervening.

Another distinction that can be made regarding the risks that banks may be exposed to in the banking sector is the risks realized as a result of transactions and the risks arising from the human factor. Risks arising from the human factor can be listed as non-compliance risk against legal regulations, transaction risk, environmental risk, political risk, technology risk, system risk and reputation risk. Also, risks arising from transactions can be listed as currency risk, interest rate risk, credit risk, commodity risk, liquidity risk, operational risks and stock price risks. Between these two risk groups; risks arising from transactions are more measurable and preventable than risks arising from human resources (Koç: 2013: 277).

The fact that the banking sector is very important for all sectors, the financial system and the country's economy prompts the institutions that are legally responsible for the process to act more carefully and meticulously and also attracts the attention of researchers interested in the subject. Goyal (2010) lists the risks that the banking sector is most exposed to as credit risks, market risk, operational risk, exchange rate risk, interest risk and liquidity risk.

Credit risk can be expressed as the probability that households or institutions in need of funds are not able to fulfil their obligations arising from the loans they have used to meet their financing needs. The most basic financial source of commercial deposit banks is the deposits they obtain from savers. They offer these deposits as loans to the parties in need of funds. In this process, the transformation of the loans they have extended into doubtful, that is, non-performing loans, creates the obligation to meet the deposit, which is the origin of this loan, with different resources by the bank. Such a situation undoubtedly reduces the financial performance of the bank. Credit risk is not a type of risk that can be completely eliminated by the bank, but it can be minimized with an effective management approach. In this process, in order for the bank to minimize the credit risk, it is necessary to supervise the loan requesters with a more effective observation and research. The most important indicator of credit risk is non-performing loans with doubtful collections. Banks that want to fight credit risk should take initiatives to reduce non-performing loans (Misman and Bhatti: 2020: 4).

Market risk is a change in the values of the assets in the balance sheets of banks depending on a phenomenon in the market. A sudden and large change that may occur in factors such as interest rate, unemployment rate, consumption or production-induced inflation can directly or indirectly affect the bank. In some cases, this effect can manifest itself as a credit risk due to the possibility of borrowers not being able to pay their loans, as a currency risk due to the increase in interest rates after a fund is extended, or as an exposure of a bank with a short foreign exchange position to currency risk due to currency fluctuations.

Operational risk arises from internal decision-makers and practitioners. Operational risk is the bank's management or personnel's attempts to harm the bank, either due to lack of knowledge or intentionally. Operational risks that the bank may be exposed to if a reckless officer injures the institution during fund management or if a systemic problem originating from information technologies harms the bank and its related parties. The fact that an imprudent official injures the institution during fund management or a systemic problem originating from information technologies harms the bank and related parties could be seen as the operational risks that the bank may be exposed to (Naseem, 2021:2).

Exchange rate risk refers to the risks that banks may be exposed to due to their on-balance sheet or off-balance sheet foreign exchange positions depending on the devaluation of the country's currency against other currencies in national and international markets. A bank cannot completely eliminate this type of risk, but can reduce it with effective risk management techniques. The most obvious indicator of the

exchange rate risk that the bank may be exposed to is the records on the on-balance sheet and off-balance sheet net foreign currency position (Yüksel et al. 2016:85).

Interest rate risk is expressed as a change in market interest rates causing loss to the lending institution. Since the increase in market interest rates after the loan is extended also increases the interest costs of the bank during the collection of new deposits, it creates the possibility that the loan will not be able to cover the cost of the deposit interests. This situation arises as a result of the institution’s holding assets with shorter maturities in its balance sheet compared to its interest liabilities and can also be expressed as reinvestment risk. In such a case, the return from the reinvested funds may be lower than the cost of the old fund. Another interest rate risk that the bank may be exposed to is that the average maturity of loans and receivables is longer than the average maturity of deposits. The realization of such a risk will result in the bank being exposed to liquidity risk. Interest rate risk is not a type of risk that the institution can completely eliminate (Koç: 2013: 279).

Liquidity risk is a type of risk that banks may be exposed to as a result of their inability to meet their financial obligations. The main reasons for the bank’s inability to meet its obligations can be listed as follows: failure to perform an effective receivables management, doubtful and non-performing loans and receivables, the bank’s inability to collect new deposits, insufficient attention to the securities issued by the bank, the increased demand for money by depositors from the bank, and the bank’s difficulty in finding new funds (Leykun, 2016:47).

In this study, it is aimed to examine the in-bank determinants of credit, exchange rate, interest rate and liquidity risks that deposit banks operating in Turkey may be exposed to. In the following parts of the study, primarily a literature review will be included, and then the findings obtained as a result of the method and analysis will be mentioned. In the conclusion part, the findings will be interpreted.

## 2. LITERATURE REVIEW

The main risks that the banking sector is exposed to are listed as liquidity risk, interest rate risk, credit risk and currency risk. When the relevant literature is examined, no study has been found that examines all risks together. The researchers considered the risks separately. Application is carried out on the banking sector in all of the examined studies. In addition, the panel data analysis is the most preferred analysis method.

The findings obtained as a result of the literature review are shown in Table 1.

*Table 1. Literature Review*

| Researcher           | Date | Research Subject | Dependent Variables   | Independent Variables                      | Result |
|----------------------|------|------------------|---|--|--------|
| Lucchetta            | 2007 | Liquidity Risk   | Loans on Total Assets, Liquid Assets/Consumer and ST Fundings | Loan Loss Provisions /Net Interest Revenue | -      |
|                      |      |                  |   | Capital Structure                          | -      |
|                      |      |                  |   | Size                                       | -      |
|                      |      |                  |   | ROA  | -      |
|                      |      |                  |   | Deposits on Total Assets                   | -      |
| Mugenyah             | 2009 | Liquidity Risk   | Total Loans/Total Deposits                                    | Capital Adequacy Ratio                     | +      |
|                      |      |                  |   | Liquid Assets /Total Assets                | 0      |
|                      |      |                  |   | Ownership                                  | 0      |
|                      |      |                  |   | Capital Structure                          | -      |
|                      |      |                  |   | Size                                       | 0      |
| Ayaydın ve Karaaslan | 2014 | Liquidity Risk   | Liquid Assets /Total Deposits, Liquid Assets /Total Assets    | Capital Adequacy Ratio                     | +      |
|                      |      |                  |   | Size                                       | +      |
|                      |      |                  |   | ROA  | -      |

|                    |      |                    |  |                                   |   |
|--------------------|------|--------------------|--|-----------------------------------|---|
|                    |      |                    |  | ROE                               | - |
|                    |      |                    |  | Net Interest Margin               | - |
|                    |      |                    |  | Foreign Banks                     | - |
|                    |      |                    |  | Domestic Banks                    | - |
| Woicik ve Marek    | 2015 | Liquidity Risk     | Total Loans/Total Deposits, Liquid Assets  | Capital Structure                 | + |
|                    |      |                    |  | Net Interest Margin               | + |
|                    |      |                    |  | ROA                               | - |
|                    |      |                    |  | Non-Performing Loans/Total Loans  | - |
|                    |      |                    |  | Size                              | + |
| Ghasemi ve Rostami | 2016 | Interest Rate Risk | Interest Spreading Rate  | Non-Interest Income               | - |
|                    |      |                    |  | Interest Income                   | - |
|                    |      |                    |  | Demand Deposits/Deposits          | + |
|                    |      |                    |  | Capital Adequacy Ratio            | - |
|                    |      |                    |  | ROA                               | + |
|                    |      |                    |  | Non-Performing Loans/Total Loans  | - |
| Leykun             | 2016 | Liquidity Risk     | Liquid Assets /Total Deposits  | Loans/Total Asstes                | 0 |
|                    |      |                    |  | Capital Adequacy Ratio            | 0 |
|                    |      |                    |  | Total Deposits/Total Assets       | - |
| Yüksel vd.         | 2016 | Currency Risk      | (On Balance Sheet Foreign Currency Position + Off Balance Sheet Foreign Currency Position) /Total Equity | ROE                               | 0 |
|                    |      |                    |  | Size                              | + |
|                    |      |                    |  | Total Loans/Total Deposits        | 0 |
|                    |      |                    |  | Derivatives/Total Loans           | 0 |
| Işık ve Belke      | 2017 | Liquidity Risk     | Total Loans/Total Assets   | Size                              | + |
|                    |      |                    |  | ROE                               | - |
|                    |      |                    |  | Net Interest Margin               | 0 |
|                    |      |                    |  | Capital Structure                 | - |
|                    |      |                    |  | Deposits Growth Rate              | - |
|                    |      |                    |  | Loan Loss Provision/Total Loans   | - |
| Akkaya ve Azimli   | 2018 | Liquidity Risk     | (Total Deposits-Liquid Assets) /Total Assets   | ROE                               | - |
|                    |      |                    |  | Deposits/Total Assets             | + |
|                    |      |                    |  | ROA                               | + |
|                    |      |                    |  | Total Loans/Total Deposits        | + |
|                    |      |                    |  | Interest Income/Interest Expenses | + |
| Korkmaz            | 2018 | Interest Rate Risk | Interest Rate Coefficient of Variation   | Capital Structure                 | + |
|                    |      |                    |  | Total Loans/Deposits              | + |
|                    |      |                    |  | Liquid Assets /Tootal Assets      | + |
|                    |      |                    |  | Non-Performing Loans/Total Loans  | + |
| Aydın              | 2019 |                    | Non-Performing Loan  | Capital Adequacy Ratio            | - |

|                     |      |                    |   |   |   |
|---------------------|------|--------------------|---|---|---|
|                     |      |                    |   | Special Provisions                        | + |
|                     |      |                    |   | Non-Interest Income                       | - |
|                     |      |                    |   | 1/( Liquid Assets /Total Assets)          | - |
|                     |      |                    |   | Other Operatin Charges/Total Assets       | + |
|                     |      |                    |   | Size                                      | 0 |
|                     |      |                    |   | ROA                                       | - |
| Çelik               | 2019 | Currency Risk      | Beta of Interest Rates  | Total Loans/Total Assets                  | + |
|                     |      |                    |   | Capital Adequacy Ratio                    | + |
|                     |      |                    |   | Foreign Exchange Assets/Total Assets      | + |
|                     |      |                    |   | Foreign Exchange Liabilities/Total Assets | - |
|                     |      |                    |   | ROA                                       | - |
| Navruz              | 2019 | Interest Rate Risk | Deposit Interest Rate   | Sector Share                              | - |
|                     |      |                    |   | ROA                                       | - |
|                     |      |                    |   | Non-Performing Loans/Total Loans          | + |
|                     |      |                    |   | Avarage Expiriy of Deposits               | + |
|                     |      |                    |   | FC Deposits/Total Deposits                | - |
| Tran vd.            | 2019 | Liquidity Risk     | Total Loans/Short Term Liabilities, Liquid Assets/Total Assets, Liquid Assets / Short Term Liabilities, Deposits/Total Assets | Size                                      | 0 |
|                     |      |                    |   | Capital Structure                         | + |
|                     |      |                    |   | ROA                                       | 0 |
|                     |      |                    |   | ROE                                       | 0 |
|                     |      |                    |   | Total Loans/Equity                        | + |
|                     |      |                    |   | Non-Performing Loans/Total Loans          | + |
| Huan vd.            | 2020 | Credit Risk        | Non-Performing Loans/Total Loans  | Size                                      | - |
|                     |      |                    |   | ROA                                       | 0 |
|                     |      |                    |   | Capital Structure                         | - |
|                     |      |                    |   | Total Revenue/Total Expenses              | 0 |
|                     |      |                    |   | Rate of Return                            | 0 |
| Misman ve Bhatti    | 2020 | Credit Risk        | Non-Performing Loans/Total Loans  | Financial Assets/Total Assets             | 0 |
|                     |      |                    |   | Loan Loss Provision/Total Assets          | + |
|                     |      |                    |   | Capital Structure                         | 0 |
|                     |      |                    |   | Capital Adequacy Ratio                    | 0 |
|                     |      |                    |   | Net Interest Margin                       | 0 |
|                     |      |                    |   | Total Earning Assets to Total Assets      | - |
|                     |      |                    |   | Size                                      | - |
| Yağcılar ve Kalaycı | 2020 | Interest Margin    | (Interest Income-Interest Expenses) /Total Assets   | Size                                      | 0 |
|                     |      |                    |   | Cash Assets/Total Assets                  | 0 |
|                     |      |                    |   | Off Balance Sheet Items/Total Assets      | 0 |

|                   |      |                |                                  |  |   |
|-------------------|------|----------------|----------------------------------|--|---|
|                   |      |                |                                  | Interest Sensitive Assets/Interest Sensitive Liabilities | 0 |
|                   |      |                |                                  | (FC Assets-FC Liabilities) /Total Assets                 | 0 |
|                   |      |                |                                  | Total Loans/Total Assets                                 | + |
|                   |      |                |                                  | Non-Interest Income                                      | 0 |
|                   |      |                |                                  | Non-Performing Loans/Total Loans                         | + |
|                   |      |                |                                  | Total Operating Costs/Total Assets                       | + |
|                   |      |                |                                  | Capital Structure  | 0 |
|                   |      |                |                                  | ROA  | + |
|                   |      |                |                                  | Deposits on Total Assets                                 | - |
|                   |      |                |                                  | Total loans/Deposits                                     | - |
| Ahamed            | 2021 | Liquidity Risk | Total Loans/Deposits             | Size   | - |
|                   |      |                |                                  | ROE  | 0 |
|                   |      |                |                                  | Capital Adequacy Ratio                                   | + |
|                   |      |                |                                  | Total Loans/Total Assets                                 | 0 |
| Naseem            | 2021 | Liquidity Risk | Total Loans/Deposits             | Capital Structure  | - |
|                   |      |                |                                  | Non-Performing Loans/Total Loans                         | 0 |
|                   |      |                |                                  | Capital Adequacy Ratio                                   | 0 |
|                   |      |                |                                  | Size   | - |
|                   |      |                |                                  | Liquid Assets/Total Assets                               | - |
| Tunay ve Akhisar  | 2021 | Credit Risk    | Non-Performing Loans/Total Loans | Loan Loss Provision/Non Performing Loans                 | + |
|                   |      |                |                                  | Capital Structure  | - |
|                   |      |                |                                  | Liquid Assets/Total Assets                               | + |
|                   |      |                |                                  | Non-Interest Income                                      | - |
|                   |      |                |                                  | ROE  | + |
|                   |      |                |                                  | Sector Share   | - |
| Naili ve Lahrichi | 2022 | Credit Risk    | Non-Performing Loans/Total Loans | Size   | - |
|                   |      |                |                                  | Capital Adequacy Ratio                                   | + |
|                   |      |                |                                  | ROE  | - |
|                   |      |                |                                  | Total Revenue/Total Expenses                             | - |
|                   |      |                |                                  | Ownership  | + |
|                   |      |                |                                  | Non-Interest Income                                      | - |

In this article, the determinants of liquidity, exchange rate, interest and credit risks that the banking sector is exposed to will be examined together. The fact that the subject is discussed in detail in terms of dependent variable reveals the originality of the study compared to other studies.

### 3. DATASET and METHOD

In this study, it is aimed to examine the internal determinants of currency, credit, liquidity and interest risks that deposit banks operating in Turkey are exposed to. Among the 51 banks operating in Turkey,

the information of 28 banks whose regular data can be accessed between 2009 and 2021 has been compiled. The financial statements are obtained from the internet address of the Banks Association of Turkey.

Currency risk, credit risk, liquidity risk and interest rate risk variables were used as dependent variables in the study. Return on assets (ROA), return on equity (ROE), interest income, non-interest income, sector share, income-expense balance, asset structure, capital structure and capital adequacy ratio variables were used as independent variables.

The dependent and independent variables used in the article are shown in Table 2 with their references.

*Table 2. Dependent and Independent Variables*

| <b>Dependent Variables</b>   |   | <b>References</b>  |
|------------------------------|---|--|
| Currency Risk                | On Balance Sheet Foreign Currency Position/Total Equity | Yağcılar ve Kalaycı (2020), Arıçay ve Akgöz (2014)   |
| Credit Risk                  | Non-Performing Loans/Total Loans                        | Tran vd. (2019), Naseem (2021), Wojcik ve Marek (2015), Huan vd. (2020), Ghasemi ve Rostami (2016)                     |
| Liquidity Risk               | Liquid Assets/Short Term Liabilities                    | Tran vd. (2019), Mugenyah (2009)   |
| Interest Rate Risk           | Interest Incomes/ Interest Expenses                     | Ayaydın ve Karaaslan (2014), Akkaya ve Azimli (2018)   |
| <b>Independent Variables</b> |   | <b>References</b>  |
| Capital Adequacy Ratio (CAR) | Capital/Risk Weighted Assets                            | Mugenyah (2009), Ghasemi ve Rostami (2016), Leykun (2016), Ahamed (2021), Naseem (2021)                                |
| Capital Structure (CS)       | Equity/Total Assets                                     | Tran vd. (2019), Mugenyah (2009), Misman ve Bhatti (2020), Yağcılar ve Kalaycı (2020), Naseem (2021)                   |
| Asset Structure (AS)         | Financial Assets/Total Assets                           | Misman ve Bhatti (2020)  |
| ROA                          | Average Return on Assets                                | Lucchetta (2007), Wojcik ve Marek (2015), Akkaya ve Azimli (2018), Navruz (2019), Tran vd. (2019)                      |
| ROE                          | Average Return on Equity                                | Akkaya ve Azimli (2018), Tran vd. (2019), Ahamed (2021)  |
| Interest Income (IN)         | Interest Income /Total Assets                           | Ghasemi ve Rostami (2016), Işık ve Belke (2017), Akkaya ve Azimli (2018)   |
| Non-Interest Income (NII)    | Non-Interest Income/Total Assets                        | Ghasemi ve Rostami (2016), Aydın (2019), Yağcılar ve Kalaycı (2020), Tunay ve Akhisar (2021), Naili ve Lahrichi (2022) |
| Sector Share (SS)            | Total Assets/Total Assets of the Sector                 | Navruz (2019), Tunay ve Akhisar (2021)   |
| Income Expense Balance (IEB) | Total Revenue/Total Expenses                            | Huan vd. (2020), Naili ve Lahrichi (2022)  |
| Deposit Ratio (DR)           | Deposits on Total Assets                                | Lucchetta (2007), Leykun (2016), Akkaya ve Azimli (2018), Tran vd. (2019), Yağcılar ve Kalaycı (2020)                  |

#### 4. ANALYSIS and FINDINGS

In this article, the variables determining the exchange rate, credit, liquidity and interest risks that banks operating in Turkey are exposed to are examined by the panel data analysis method. Panel data analysis is accepted as a more powerful analysis method than time series in terms of adding unit sections to time sections and allowing more data to be analysed. Panel data analysis is an analysis method performed under the assumption that error terms and independent variables are not correlated.

Model 1:

$$(\text{Currency Risk})_{i,t} = \alpha + \beta_1 \text{CAR}_{i,t} + \beta_2 \text{CS}_{i,t} + \beta_3 \text{AS}_{i,t} + \beta_4 \text{IN}_{i,t} + \beta_5 \text{NII}_{i,t} + \beta_6 \text{SS}_{i,t} + \beta_7 \text{ROA}_{i,t} + \beta_8 \text{ROE}_{i,t} + \beta_9 \text{IEB}_{i,t} + \beta_{10} \text{DR}_{i,t} + u_{i,t}$$

Model 2:

$$(\text{Credit Risk})_{i,t} = \alpha + \beta_1 \text{CAR}_{i,t} + \beta_2 \text{CS}_{i,t} + \beta_3 \text{AS}_{i,t} + \beta_4 \text{IN}_{i,t} + \beta_5 \text{NII}_{i,t} + \beta_6 \text{SS}_{i,t} + \beta_7 \text{ROA}_{i,t} + \beta_8 \text{ROE}_{i,t} + \beta_9 \text{IEB}_{i,t} + \beta_{10} \text{DR}_{i,t} + u_{i,t}$$

Model 3:

$$(\text{Liquidity Risk})_{i,t} = \alpha + \beta_1 \text{CAR}_{i,t} + \beta_2 \text{CS}_{i,t} + \beta_3 \text{AS}_{i,t} + \beta_4 \text{IN}_{i,t} + \beta_5 \text{NII}_{i,t} + \beta_6 \text{SS}_{i,t} + \beta_7 \text{ROA}_{i,t} + \beta_8 \text{ROE}_{i,t} + \beta_9 \text{IEB}_{i,t} + \beta_{10} \text{DR}_{i,t} + u_{i,t}$$

Model 4:

$$(\text{Interest Rate Risk})_{i,t} = \alpha + \beta_1 \text{CAR}_{i,t} + \beta_2 \text{CS}_{i,t} + \beta_3 \text{AS}_{i,t} + \beta_4 \text{IN}_{i,t} + \beta_5 \text{NII}_{i,t} + \beta_6 \text{SS}_{i,t} + \beta_7 \text{ROA}_{i,t} + \beta_8 \text{ROE}_{i,t} + \beta_9 \text{IEB}_{i,t} + \beta_{10} \text{DR}_{i,t} + u_{i,t}$$

The solution of econometric models first starts with the homogeneity test. After the homogeneity test, the cross-sectional dependence of the variables should be performed. These two tests are important in terms of choosing the unit root test to be applied. If the cross-section dependency tests of the variables are found to be statistically significant, the unit root test to be applied should be preferred among the second-generation unit root tests. Second-generation unit root tests can yield results if the variables are both homogeneous and heterogeneous. If the cross-section dependency tests of the variables are found to be statistically insignificant, then the unit root test to be applied should be preferred among the first-generation unit root tests. Some of the first-generation tests give results on the assumption of homogeneity and some of them under the assumption of heterogeneity.

In this article, Swammy S homogeneity test, Pesaran CDIm cross-section dependency test and Harris Tvazalis unit root tests were used. Table 3 shows the test results applied.

Table 3. Swammy S, Cross Sectional Dependence and Unit Root Tests

| Değişkenler            | Swammy S  | CDIm (For Variables) | HT Unit Root Test |
|------------------------|-----------|----------------------|-------------------|
| Currency Risk          | 1197.95*  | 2.60*                | 0.4071*           |
| Credit Risk            | 2533.07*  | 19.58*               | 0.6079*           |
| Liquidity Risk         | 392.49*   | 20.30*               | 0.3821*           |
| Interest Rate Risk     | 379.81*   | 18.38*               | 0.0647*           |
| Capital Adequacy Ratio | 311.73*   | 18.17*               | 0.6676*           |
| Capital Structure      | 498.93*   | 20.96*               | 0.6362*           |
| Asset Structure        | 90.98*    | 39.13*               | 0.6311*           |
| ROA                    | 881.39*   | 9.69*                | 0.3687*           |
| ROE                    | 1008.97*  | 7.86*                | 0.2272*           |
| Interest Income        | 228.74*   | 22.08*               | 0.2248*           |
| Non-Interest Income    | 130.53*   | 8.11*                | 0.2589*           |
| Sector Share           | 19870.62* | 1.34                 | 0.0927*           |
| Income Expense Balance | 372.62*   | 25.09*               | -0.3125*          |
| Deposit Ratio          | 615.99*   | 6.58*                | 0.4038*           |

Note: Statistical significance is represented as “\*” if  $p < 0.01$ , “\*\*” if  $0.1 \leq p < 0.05$ , and “\*\*\*” if  $0.5 \leq p < 0.1$ .

According to the homogeneity and cross-section dependency test results in Table 3, all other variables were suitable for analysis with the second-generation unit root test, except for the sector share variable. In this context, the variables that should be tested with the second-generation unit root test were tested with the Harris Tvazalis unit root test, and the sector share variable was tested with the first generation version of the Harris Tvazalis unit root test. According to the results obtained, it was determined that all variables were stationary at the level. In order to choose the appropriate estimator after the unit root test, the models should be tested with F, LM and Hausman tests. Table 4 contains the results of the tests.

Table 4. F, LM ve Hausman Tests

| Modeller           | F Testi | LM Testi | Hausman Testi | Karar          |
|--------------------|---------|----------|---------------|----------------|
| Currency Risk      | 6.77*   | 108.90*  | 15.45         | Random Effects |
| Credit Risk        | 5.60*   | 43.94*   | 102.00*       | Fixed Effects  |
| Liquidity Risk     | 5.05*   | 0.000    |               | Fixed Effects  |
| Interest Rate Risk | 5.53*   | 0.000    |               | Fixed Effects  |

Note: Statistical significance is represented as “\*” if  $p < 0.01$ , “\*\*” if  $0.1 \leq p < 0.05$ , and “\*\*\*” if  $0.5 \leq p < 0.1$ .

According to the results in Table 4, it was determined that it was appropriate to analyse the model in which the determinants of exchange rate risk were analysed with the random effects model. Further, it was specified that it was appropriate to analyse the models in which the determinants of credit, liquidity and interest risk were analysed with fixed effects.

After determining the appropriate estimator, it should be tested whether heteroskedasticity, autocorrelation and cross-section dependence exist in the established econometric models. The horizontal cross-section dependence realized at this stage was applied to the model. In this respect, it differs from the cross-section dependence in Table 3.

The test results of heteroskedasticity, autocorrelation and cross-section dependence are given in Table 5.

Table 5. Heteroskedasticity, Autocorrelation ve Cross Sectional Dependence Tests

| Modeller           | Heteroskedastite | Otokorelasyon |            | Cross Sec. Dep. (For Model) |
|--------------------|------------------|---------------|------------|-----------------------------|
|                    |                  | Durbin Watson | Baltagi Wu | Pesaran                     |
| Currency Risk      | Wo: 3.9450*;     |               |            |                             |
|                    | W50: 2.7727*;    | 1.2206        | 1.5305     | 2.634*                      |
|                    | W10: 3.7398*     |               |            |                             |
| Credit Risk        | 88456.82*        | 1.3336        | 1.5321     | 7.796*                      |
| Liquidity Risk     | 4831.24*         | 1.6532        | 1.7423     | 6.619*                      |
| Interest Rate Risk | 17169.89*        | 1.1083        | 1.2298     | 10.709*                     |

Note: Statistical significance is represented as “\*” if  $p < 0.01$ , “\*\*” if  $0.1 \leq p < 0.05$ , and “\*\*\*” if  $0.5 \leq p < 0.1$ .

According to the results in Table 5, heteroskedasticity and autocorrelation were found in all models in which the determinants of the exchange rate, credit, liquidity and interest risk were examined. It was also observed that all models were cross-section dependent. At this stage, the existence of these three effects should be separated in the models or an appropriate estimator should be preferred, taking into account the existence of these three effects.

In this article, the Driscoll Kraay estimator, which estimates heteroskedasticity by taking into account the presence of autocorrelation and cross-section, is used.

The regression results of the models are given in Table 6.

Table 6. Regression Results

| Independence Variables | Dependence Variables |             |                |                    |
|------------------------|----------------------|-------------|----------------|--------------------|
|                        | Currency Risk        | Credit Risk | Liquidity Risk | Interest Rate Risk |

|                        |             |            |           |             |
|------------------------|-------------|------------|-----------|-------------|
| Capital Adequacy Ratio | 2.0078*     | 0.5252*    | 0.3875    | -6.0363     |
| Capital Structure      | -4.2625*    | -0.2149    | 2.4516*   | 66.2614*    |
| Asset Structure        | -1.1342*    | 0.0475     | -0.5120   | -1.5147     |
| ROA                    | 0.7593      | 98772*     | -14.4195* | -53.2297    |
| ROE                    | -0.3926     | -0.7905*   | 0.9245    | 11.8619     |
| Interest Income        | -2.8221     | -18819**   | 4.6213    | -189.708**  |
| Non-Interest Income    | -13.1614*** | -18140**   | 4.9552    | -218.2524** |
| Sector Share           | 0.1256      | -0.3116*** | 2.5500    | 45.5726*    |
| Income Expense Balance | 0.0373***   | -0.0468*   | -0.0511** | 5.7340*     |
| Deposit Ratio          | -0.2028     | 0.0973     | 0.1225    | -0.3013     |
| F Statistics           | 2353.50*    | 301.08*    | 1312.83*  | 611.54*     |
| R <sup>2</sup>         | 0.2867      | 0.4828     | 0.2733    | 0.6998      |

Note: Statistical significance is represented as “\*” if  $p < 0.01$ , “\*\*” if  $0.1 \leq p < 0.05$ , and “\*\*\*” if  $0.5 \leq p < 0.1$ .

Table 6 shows the regression results of four econometric models on which the variables of currency risk, credit risk, liquidity risk and interest risk were dependent and on which exchange rate CAR, equity/total assets, asset structure, ROA, ROE, interest income, non-interest income, sector share, personnel expenses, income/expense and deposit/total assets variables were independent variables

In the model on which the currency risk was dependent and the determinants of the currency risk were investigated, the capital adequacy ratio, capital structure, asset structure and personnel expenses were found to be statistically significant at the 1% significance level, while the non-interest income and income/expense variables were found to be statistically significant at the 10% significance level. As a result of the analysis, it was concluded that the capital adequacy ratio, personnel expenses and total income/total expense variables were positively related to the exchange rate risk, while the capital structure, asset structure and non-interest income variables were negatively related to the currency risk. The F statistic, which tests the overall significance of the model, was found to be significant at the 1% significance level, and the R<sup>2</sup> value, which expresses the explanatory power of the model, was found to be 28.67%.

In the model in which credit risk was the dependent variable and the determinants of credit risk were investigated, capital adequacy ratio, ROA, ROE and total income/total expense variables were at 1% significance level, interest income and non-interest income variables at 5% significance level, and sector share variable at 10% significance level. They were all statistically significant. As a result of the analysis, it was found that the capital adequacy ratio, ROA, and personnel expense variables were positively related to the credit risk, while the ROE, interest income, non-interest income, sector share and total income/total expense variables were negatively related to the credit risk. The F statistic, which tests the overall significance of the model, was found to be significant at the 1% significance level, and the R<sup>2</sup> value, which expresses the explanatory power of the model, was found to be 48.28%.

In the model on which the liquidity risk was dependent and the determinants of the liquidity risk were investigated, the capital structure, ROA and personnel expenses variables were found to be statistically significant at the 1% significance level, and the total income/total expenses variable at the 5% significance level. As a result of the analysis, it was inferred that the capital structure variable was positively related to the liquidity risk, while the ROA, personnel expenses and total expense/total income variables were negatively related to the liquidity risk. The F statistic, which tests the overall significance of the model, was found to be significant at the 1% significance level, and the R<sup>2</sup> value, which expresses the explanatory power of the model, was found to be 27.33%.

In the model on which the interest risk was dependent and the determinants of the interest risk were investigated, the capital structure and total income/total expense variables were found to be statistically significant at the 1% significance level, the interest income and non-interest income variables at the 5% significance level, and the personnel expense variable at the 10% significance level. As a result of the analysis, it was concluded that capital structure, sector share, personnel expenses and total income/total

expense variables were positively related to interest risk, while interest income and non-interest income variables were negatively related to interest risk. The F statistic, which tests the overall significance of the model, was found to be significant at the 1% significance level, and the R<sup>2</sup> value, which expresses the explanatory power of the model, was found to be 69.98%.

## **CONCLUSION**

Financial markets have a very complex structure. Deposit banks, one of the leading actors of these markets, may be exposed to a high level of risk as they are related to many sectors, because risk transfer is at the core of financial markets. The banking sector for all national economies is sensitive in this respect. For this reason, in this study, it is aimed to examine the internal determinants of credit, liquidity, exchange rate and interest risk that the banking sector is exposed to.

The ratio variable of the on-balance sheet foreign currency position to total assets is used to represent the exchange rate risk. When the results of the analysis were examined, it was concluded that the low level of own funds in total capital increased the exchange rate risk. The low amount of financial assets in total assets increased the exchange rate risk similarly. When we look at income items, the decrease in non-interest incomes increased the exchange rate risk, while the increase in total incomes compared to expenses increased the exchange rate risk similarly. This is thought to be due to the fact that banks' foreign exchange income is less than their TL-denominated income.

In the study, the variable obtained by the ratio of doubtful non-performing loans to total loans was used to represent the credit risk. As a result of the analysis, it was found that banks with low return on assets were less exposed to credit risk. This situation is thought to be caused by the passive credit policy. Considering other results regarding income items, it is observed that the credit risk is lower in banks with high-interest and non-interest incomes. Accordingly, banks with high incomes can follow a calmer attitude in loan sales. As a result, they can reduce the probability of bad debts by making the funds available to parties with high creditworthiness. It is an expected result that the credit risk is high in banks with a lower sector share. Similarly, the credit risk is high in banks that have lower income compared to their total expenses because banks with small scales and low income-expense balances can follow more aggressive loan policies. At this point, banks are advised not to be overly aggressive in their growth-oriented attitudes since uncollectible loans push banks to be responsible for deposits with their own resources. This situation may lead to results reducing equity profitability. The ratio of liquid assets to short-term liabilities is used to represent the liquidity risk. As a result of the analysis, it is inferred that banks with lower return on assets and lower income compared to their total expenses are more likely to be exposed to liquidity risk. This is an expected result because the low profitability and income weaken the bank's ability to meet its short-term liabilities. Considering the model in which interest rate risk is the dependent variable, it is concluded that banks with low interest and non-interest income are also more likely to take interest risk. It is thought that the reason for this situation may be the bank's inability to convert deposits into loans.

In general, banks are advised to increase their equity, reasonably reduce personnel expenses, and diversify their income in foreign currency. Banks are advised to follow more effective credit policies. In addition, it is suggested that they diversify their non-interest incomes, considering that non-interest income items increase financial performance. Finally, banks are advised to follow effective credit policies, but not to be aggressive in this regard.

## **REFERENCES**

- Ahamed, F. (2021). Determinants of Liquidity Risk in the Commercial Banks in Bangladesh. *European Journal of Business and Management Research*, 6(1), 164-169.
- Akkaya, M., ve Azimli, T. (2018). Türk Bankacılık Sektöründe Likidite Riski Yönetimi. *Finans Politik ve Ekonomik Yorumlar*, (638), 35-57.
- Ayrıçay, Y., ve Akgöz, E. (2014). Ticari Bankaların Finansal Oranlar Yardımıyla Sınıflandırılması: Kümeleme Analizi Yaklaşımı. *Journal of Social and Humanities Sciences Research*, 1(1), 1-23.

- Ayaydın, H., ve Karaaslan, İ. (2014). Likidite Riski Yönetimi: Türk Bankacılık Sektörü Üzerine Bir Araştırma. *Gümüşhane Üniversitesi Sosyal Bilimler Enstitüsü Elektronik Dergisi*, 5(11), 237-256.
- Aydın, Y. (2019). Türk Bankacılık Sektöründe Kredi Riskinin İçsel Belirleyicileri. *SOBİDER*, 6(35), 193-210.
- Çelik, İ. E. (2019). Evaluating the Determinants of Market, Exchange Rate and Interest Rate Risks in the Pre-and Post Financial Crisis for The Turkish Banking Industry. *International Journal of Management Economics & Business/Uluslararası Yönetim İktisat ve İşletme Dergisi*, 15(3).
- Ghasemi, A., and Rostami, M. (2015). Determinants of Interest Rate Spread in Banking Industry. *International Journal of Applied Research*, 1(9), 338-346.
- Goyal, K. A., and Agrawal, S. (2010). Risk management in Indian banks: some emerging issues. *Int. Eco. J. Res*, 1(1), 102-109.
- Huan, K. S., Ramasamy, S., Yen, Y. Y., and Pillay, S. D. (2020). Determinants of Credit Risk in Conventional Banks: An Empirical Study in Malaysia. *European Journal of Molecular & Clinical Medicine*, 7(08), 2020.
- Işık, Ö. ve Belke, M. (2017). Likidite Riskinin Belirleyicileri: Borsa İstanbul'a Kote Mevduat Bankalarından Kanıtlar. *Ekonomi Politika ve Finans Araştırmaları Dergisi*, 2(2), 113-126.
- Koç, S. (2013). Bankaların Karşılaştıkları Riskleri Yönetmedeki Etkinliği: Türkiye ölçeği. *Maliye Dergisi*, (165), 275-297.
- Korkmaz, A., ve Yılmaz, S. (2018). Bankacılık Sektöründe Faiz Oranı Riski ve Belirleyicileri: BIST Bankalarına Yönelik Bir Uygulama. İstanbul Üniversitesi SBE İktisat ABD Yayınlanmamış Doktora Tezi.
- Leykun, F. (2016). Determinants of Commercial Banks' Liquidity risk: Evidence from Ethiopia. *Research journal of finance and accounting*, 7(15), 47-61.
- Lucchetta, M. (2007). What Do Data Say About Monetary Policy, Bank Liquidity and Bank Risk Taking?. *Economic Notes*, 36(2), 189-203.
- Misman, F. N., and Bhatti, M. I. (2020). The Determinants of Credit Risk: An Evidence from ASEAN and GCC Islamic Banks. *Journal of Risk and Financial Management*, 13(5), 89.
- Mugenyah, L. O. (2015). *Determinants of Liquidity Risk of Commercial Banks in Kenya* (Doctoral dissertation, University of Nairobi).
- Naili, M., and Lahrichi, Y. (2022). Banks' Credit Risk Systematic Determinants and Specific Factors: Recent Evidence from Emerging Markets. *Heliyon*, 8(2), e08960.
- Naseem, H. I. (2021). Determinants of Liquidity Risk: A Study Of Commercial Banks in Pakistan. *Archives of Business Research*, 9(4).
- Navruz, B. (2019). Bankacılıkta Sistemik Risk Sorunu ve Pigovian Çözüm Yaklaşımı: Türk Bankacılık Sektörü Açısından Bir Değerlendirme. *İstanbul: TBB Yayınları*.
- Tran, T. T., Nguyen, Y. T., and Long, T. (2019). The Determinants of Liquidity Risk of Commercial Banks in Vietnam. *Banks and Bank Systems*, 14(1), 94.
- Tunay, B.K. and Akhisar, İ (2021). Determinants of Credit Risk in the Turkish Banking Sector: New Findings. *International Journal of Insurance and Finance*. 1(2), 39-49
- Yağcılar, G. G., ve Kalaycı, Ş. (2020). Türk Bankacılık Sektöründe Net Faiz Marjının Mikro-Belirleyicileri: Küresel Mali Krizin Etkileri. *Karadeniz Teknik Üniversitesi Sosyal Bilimler Enstitüsü Sosyal Bilimler Dergisi*, 10(19), 7-34.
- Yüksel, S., Özsarı, M., ve Canöz, İ. (2016). Influencing Factors of Currency Risk of Deposit Banks in Turkey by Using Probit Method. *International Journal of Commerce and Finance*, 2(2), 85-95.
- Wojcik-Mazur, A., and Szajt, M. (2015). Determinants of liquidity risk in commercial banks in the European Union. *Argumenta Oeconomica*, 2(35), 25-48.