Chapter 5

Financial Stability and Credit Risk in Turkish Participation Banks: A Comparative Analysis[1]

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Abstract

This paper delves into the evolving landscape of Islamic finance in Türkiye, where Participation Banks (PBs) adhere to Islamic law and ethical principles, setting them apart from Conventional Banks (CBs). The unique nature of PBs demands tailored assessments of their financial health. The primary objective is to evaluate the financial stability and credit risk of Türkiye's PBs through a comparative analysis with CBs. The study employs the Non-Performing Loans (NPL) ratio in conjunction with the Emerging Market (EM) Score model—a modified version of Altman's Z-Score which is widely used in predicting the bankruptcy of firms including banks. The combination provides a comprehensive evaluation and a deeper understanding of financial stability.

Focused on six major PBs—Kuveyt Türk, Albaraka Türk, Türkiye Finans, Ziraat, Vakıf, and Türkiye Emlak—the methodology entails collecting and analyzing financial data from official sources, including the Participant Banks Association of Turkey (TKBB) and the Banking Regulation and Supervision Agency (BRSA).

Anticipated outcomes include enhanced decision-making and the development of robust risk management strategies for Turkish PBs, reinforcing their financial stability. The comparative analysis with CBs aims to unveil competitive advantages and unique challenges, offering valuable insights for policymakers, regulators, and stakeholders in the Turkish banking sector.

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1. INTRODUCTION

The financial sector plays a crucial role in the broader finance industry. Within this sector, banks perform a range of essential functions. They engage in financial intermediation, promote savings, facilitate national and international trade for businesses and individuals, finance projects that significantly contribute to the economy, and provide liquidity to depositors and lending institutions. However, during times of financial crisis, banks often find themselves at the epicenter of such crises due to their numerous responsibilities (Hasman & Samartín, 2023). Therefore, the strength and stability of banks become crucial for maintaining and fostering the economic growth of any country.

The banking industry has undergone significant changes, crises, and developments in recent years. These financial crises have heightened the demand for alternative financial systems, and the importance of financial stability has become paramount for the resilience of financial institutions. This discussion brings our attention to a specific area of growing prominence, which is Islamic finance (Routledge, 2023). Islamic banks (IBs), also known as participation banks (PBs) in Türkiye, are the most crucial instruments within the realm of Islamic finance. They play a central role in facilitating financial activities under Islamic law, which prohibits interest-based transactions and promotes ethical financial practices, including profit and loss sharing. Their unique characteristics and adherence to these principles set them apart from conventional counterparts, offering an appealing alternative financial system for economies.

Financial stability refers to the condition where a financial system, including banks and other financial institutions, is resilient and able to withstand shocks and disruptions while efficiently performing its functions. It involves maintaining the soundness, strength, and smooth functioning of the financial system, thereby fostering economic growth, and minimizing the risk of financial crises (Alam, Hussain, & Saqib, 2023).

On the other hand, credit risk pertains to the potential loss faced by banks due to borrowers' failure to fulfill their repayment obligations. It encompasses the risk of non-payment or delayed payment of interest or principal on loans and credit instruments (Dell'Atti, Tommaso, & Pacelli, 2023).

Given the unique characteristics of PBs and the evolving dynamics of the financial landscape, it is essential to assess the financial stability of Turkish PBs to gauge their resilience and ability to navigate potential

challenges. Moreover, mitigating credit risk is essential for PBs to protect their depositors, maintain liquidity, and foster stability in the Islamic finance industry, ultimately contributing to the financial stability of economies.

In this study, I will utilize the Emerging Market (EM) Score model to measure the financial stability of Turkish participation banks. The EM Score is a developed version of the Altman Z-Score model that is widely used by scholars and researchers to assess the performance of companies and predict their financial distress, including banks. Furthermore, I will employ the Non-Performing Loan (NPL) Ratio as a proxy for evaluating the credit risk portfolio of Turkish PBs. Additionally, I will conduct a comparative analysis of PBs and CBs by using both sector average data. This research paper aims to investigate the financial health and stability of Turkish PBs while contributing to a broader understanding of the banking industry.

1.1. Research Objectives and Research Questions

This study focuses on analyzing the financial stability and credit risk of Turkish PBs with the following specific objectives:

- ✓ Measure the financial stability of Turkish PBs and compare it with their CBs counterparts.
- ✓ Evaluate the credit risk of Turkish PBs in comparison to CBs.
- ✓ Investigate the correlation between the financial stability and credit risk of Turkish PBs and CBs.

To address these objectives, the research will address the following key questions:

- ✓ How does the financial stability of Turkish PBs compare to those of CBs?
- ✓ How does the credit risk indicator for Turkish PBs change over time, and what differences exist in the credit risk between PBs and CBs?
- ✓ Is there any relationship between financial stability and credit risk indicators in Turkish PBs and CBs?

1.2 Significance of Study

Understanding the financial stability and credit risk of Turkish PBs and comparison of PBs and CBs hold significant importance for various stakeholders. Firstly, PBs themselves can benefit from a comprehensive analysis of their financial stability indicators and examine their NPL ratio to establish better credit risk management practices.

Furthermore, the research outcomes can guide regulatory initiatives aimed at maintaining a healthy banking environment and mitigating systemic risks. Hence, policymakers and regulators can utilize the findings of this study to develop targeted regulations and policies.

Lastly, it can contribute to the existing knowledge by expanding the literature on the banking sector and providing empirical evidence in the context of Turkish PBs and CBs. Therefore, the academic community and researchers in the field of banking and finance can benefit from this study for further research and exploration of financial stability and credit risk soundness in the banking sector.

2. LITERATURE REVIEW

2.1 Introduction

Today, Islamic finance stands as one of the fastest-growing sectors in the global financial industry, with its financial institutions, models, and services. Within a few years, it has rapidly grown from a niche industry to a globally recognized and important sector (Refinitiv, 2023). According to S&P Global Ratings (2023), despite a forecasted economic slowdown, the global Islamic finance industry is expected to grow by around 10% in 2023-2024, after expanding by a similar number in 2022. Hasan et al. (2020) highlighted that the developments in the field of Islamic finance enable Muslims to engage in savings and investments while adhering to their religious and ethical beliefs and obtaining financing. The industry's growing popularity goes beyond its initial purpose. Islamic finance now serves as a viable alternative to the conventional financial system, providing an appealing option for everyone.

Islamic financial institutions (IFIs), although initially developed to meet the needs of Muslims, have seen substantial growth and expansion (Farahani & Dastan, 2013). The industry's appeal is partly due to the principles that govern it, and it is gradually gaining recognition in non-Muslim countries as well.

Hussain et al. (2016) state that in alignment with Islamic principles, IFIs encompass several prohibitions, which include:

- ✓ Interest (Riba) is forbidden. Islamic finance opts for profit and loss sharing (PLS) methods, like mudarabah and musharakah, where both lender and borrower share project profits and losses.
- ✓ Transactions with excessive uncertainty or risk (Gharar) are prohibited. Islamic finance mandates contracts based on tangible assets and shared risk.

- ✓ Gambling or speculation (Maisir) is not allowed, resulting in the exclusion of derivatives and speculative financial instruments.
- ✓ Financing activities deemed haram, such as alcohol, pork, tobacco, and businesses that promote unethical behaviors, is prohibited. Instead, Islamic finance focuses on investing in halal, socially beneficial activities.

Moreover, other rules include the requirement that the subject of the transaction should not be harmful or damaging, contract freedom, consideration of public interest, prohibition of price control and manipulation, provision of accurate and equal information, fair pricing, fostering brotherhood, and so on. All these principles, prohibitions, and rules are derived from the two main sources of Islam, the Holy Quran, and Hadiths.

Growing in popularity, Islamic banking currently constitutes about 70% of the entire Islamic finance industry, primarily encompassing a larger share of deposits and financing instruments. Another area of activity in this market is the Islamic Capital Market, which includes funds, equity, real estate investment trusts (REITs), investment funds, venture capital, structured capital, and Sukuk. Sukuk, also known as Islamic bonds, are financial instruments that comply with Islamic principles and are used to raise capital in a Sharia-compliant manner (Refinitiv, 2023). Unlike conventional bonds that represent debt obligations and generate interest payments, sukuk represents ownership in underlying assets, businesses, or projects. The structure of sukuk allows investors to earn returns from the underlying assets or projects instead of receiving interest. The total share of the Islamic capital market in the sector is approximately 25%. Sukuk itself represents nearly 95% of this share (TKBB, 2023). The two relatively smaller areas are the Commodity Market which includes the trading of physical goods or raw materials, metals, and energy resources with Islamic finance instruments like the commodity Murabaha, and the Takaful which is a type of insurance within Islamic principles. In recent times, in addition to these services, some Islamic Wealth Planning services have also emerged.

Due to its reliance on various principles and rules that differentiate it from the traditional finance and banking system, the sector has developed many specialized financing instruments, including commercial and investment banks, asset management, insurance, and leasing companies. Although it presents itself with different variations and applications, some of the main instruments include Murabaha, Mudarabah, Musharakah, Ijarah, Tawarruq, Wakalah, Takaful, Istisna, Salam, Sukuk, and Karz Hasan.

2.2 Conceptual Framework of Financial Stability and Credit Risk Management in Islamic Banks

2.2.1 Financial Stability for IBs

Financial stability refers to the state of a financial system where it can efficiently perform its functions and withstand external shocks without any disruptions. In the context of the banking industry, financial stability is of utmost importance as it ensures the smooth functioning of financial institutions, maintains public confidence, and supports sustainable economic growth. When the financial system is stable, it facilitates the allocation of funds, promotes investment, and enables efficient risk management (Washeka, Anjom, & Faruq, 2023).

Financial instability can have severe implications for the economy, including systematic risks, bank failures, and economic downturns. Systematic risks arise when disruptions in the financial system have far-reaching consequences that can spread across institutions and markets. Bank failures can have detrimental effects on depositors, investors, and the overall economy. Economic downturns, such as recessions or financial crises, can result from financial instability, leading to reduced economic activity, unemployment, and negative impacts on individuals and businesses (The World Bank, 2023). Therefore, financial stability is critically important for any kind of bank, including PBs.

To assess financial stability, various indicators and measures have been used. These include capital adequacy ratios, which assess the adequacy of banks' capital buffers to absorb potential losses. Asset quality indicators evaluate the quality and performance of banks' loan portfolios. Liquidity ratios measure a bank's ability to meet short-term obligations. Profitability ratios assess the bank's ability to generate sustainable earnings. Solvency ratios examine the long-term viability and financial strength of banks (Schinasi, 2004). There are however some methods of mixing and using some of these financial ratios. Altman Z-Score model, which has been used in this thesis, is one of the most used examples of it.

While their adherence to Shariah principles and emphasis on ethical practices contribute to their stability, there are certain characteristics unique to Islamic banking, such as profit and loss sharing and liquidity management challenges, that need to be effectively managed (Al-Binali, 2023).

IBs employ several strategies to enhance financial stability within their operations. Here are some common strategies taken by IBs (Radzi & Lonik, 2016):

- ✓ *Compliance with Islamic Principles:* Ensuring compliance with Sharia principles is vital for maintaining the integrity and stability of IBs. Therefore, Each IB has a Sharia Supervisory Board comprising Islamic scholars (muftis) who provide guidance and ensure that the bank's operations adhere to these principles. IBs use Sharia-compliant contracts to ensure compliance with these principles. Moreover, regulatory bodies and supervisory authorities play a significant role in overseeing and enforcing compliance with these principles.
- ✓ *Governance and Risk Management*: Effective governance and robust risk management practices are essential for financial stability in IBs. Setting a well-defined governance framework can ensure proper oversight, accountability, and transparency in decision-making processes. Additionally, strong risk management practices help identify, assess, and mitigate various risks, including credit risk, liquidity risk, market risk, and operational risk. A well-organized Shariah governance committee which is a necessary body for IBs can play a crucial role in ensuring compliance with Islamic principles and mitigating potential risks.
- ✓ *Asset Quality and Profitability*: The quality of assets is necessary for IBs, and it is a tical determinant of their financial stability. IBs need to ensure that the assets are high quality to minimize credit risk and potential losses. Furthermore, maintaining profitability is essential for the financial sustainability and stability of IBs, as it enables them to build capital buffers and absorb potential shocks.
- ✓ *Diversification of Portfolio*: IBs also prioritize the diversification of their financing portfolio. By extending financing to various sectors and industries, they reduce concentration risk and minimize the impact of downturns in specific sectors. Diversification enhances stability by spreading risks across different segments of the economy.
- ✓ *Liquidity Management*: IBs face unique challenges in liquidity management. Some of these challenges result from a lack of interest-based borrowing and lending from other banks, dependency on profit-sharing investment accounts, asset-based financing focus, shari'ah compliance considerations, limited access to the interbank market, and the possibility of asset-liability mismatching (Warninda, 2022). Some strategies adhere to IBs to manage liquidity risk, such as Sukuk and engaging in Shariah-compliant interbank transactions, like Wakalah and Murabahah. They rely on asset-backed financing based on Shariah-compliant contracts, emphasizing risk-sharing over interest-

based lending. In some jurisdictions, IBs have access to Shariah-compliant central bank facilities during liquidity stress. IBs may use these assets as collateral and implement Shariah-compliant cash management practices (Dolgun & Ng, 2019). Overall, there should be such facilities for IBs to maintain banks' obligations, respond to unexpected liquidity needs, and contribute to better financial stability (Sutrisno, Hakim, & Panuntun, 2023).

- ✓ *Transparency:* Transparency in financial reporting and communication builds trust and enhances stability by fostering confidence among stakeholders. IBs prioritize transparency in their operations as a necessity of Islamic principles.
- ✓ *Market Perception and Confidence*: The perception and confidence of stakeholders, including customers, investors, and regulators, play a significant role in maintaining financial stability for IBs. Building trust through transparent operations and effective communication fosters confidence in the integrity and stability of IBs. Therefore, providing clear and reliable information about the financial performance and risk profile of IBs enhances market perception and confidence.
- ✓ *Regulatory Compliance:* IBs adhere to relevant regulatory frameworks and standards. They comply with prudential regulations, capital adequacy requirements, and Shariah governance guidelines. Adhering to regulatory requirements ensures sound and responsible financial practices, contributing to stability (Susanto & Walyoto, 2023).

By considering these principles and implementing appropriate strategies, IBs enhance their financial stability, mitigate risks, and contribute to the overall stability of the financial system.

On the other hand, according to the report of IMF (2017), Islamic banking needs strong financial safety networks that follow its principles and global best practices. Therefore, international guidance is necessary for creating resolution frameworks, specifying institutions, legal rules, creditor priorities, and cross-border issues. The establishment of an international standard for Islamic banking deposit insurance schemes is also necessary to solve deposit challenges, manage funds, and ensure resolution funding.

2.2.2 Credit Risk Management for IBs

Credit risk refers to the chance that the other party might not fulfill its obligations. Credit risk is one of the most significant risks faced by banks and requires dedicated attention due to its potential impact on financial stability

(Salem, 2013). As debts make up over 70% of assets in banks' financial records, it's understandable that credit risk stands as the primary cause for banks facing financial collapse (Greuning & Bratanovic, 2020).

Unlike CBs that primarily rely on interest income, IBs share profits and losses with their customers. This means that they assume a greater degree of risk for themselves. To ensure the profitability and sustainability of their financing arrangements, IBs must employ effective risk assessment, monitoring, and control mechanisms (Zahra & Miranti, 2023). Following the discussion of general risks, the specific risks that are unique to IBs will be presented in this title. Then, the focus will be on credit risk. Moreover, credit risk identification, assessment techniques, mitigation strategies, and monitoring and control measures employed in Islamic banking will be discussed.

Type of Risk for Banking Industry

Banks face certain risks. These risks can either originate from internal factors or external factors. These risks can be classified as systemic, systematic, and nonsystematic risks. Systemic risk is different from systematic risk. Systemic risk is the risk that a specific event can cause a major shock to the system. An example of systemic risk is the 2008 financial crisis, which was caused by the collapse of the housing market and the mortgage industry (Allen & Carletti, 2013). In contrast, systematic risk refers to the possibility of a disruption or failure within a financial system that can have widespread and severe adverse effects on the overall economy (Nistor & Ongena, 2023). Price shocks, interest rate risks, inflation risks, and recessions are some examples of systematic risks, and they affect all market actors. Systemic and systematic risks extend beyond individual institutions.

On the other hand, non-systematic risks, also known as unsystematic risks or specific risks, are the kinds of risks that are specific to a particular company, industry, or asset and are not directly related to broader market or systemic factors. The non-systematic risks can be listed as management risk, operational risk, financial risk, reputational risk, etc. These risks are unique to the individual entity and can be mitigated through diversification (Oliver, 2015). Therefore, it can be prevented before they occur with the measures to be taken by companies, including banks and they can be reduced after they occur.

Banks need to identify, assess, and manage both systemic and nonsystematic risks effectively to maintain stability, protect their stakeholders, and ensure

the overall health of the banking sector. Here are the main types of risks encountered in the banking sector (Kakaç, 2019):

- ✓ *Credit Risk:* Credit risk refers to the potential for borrowers to default on their loan obligations, causing financial loss to the bank as we mentioned above. Credit risk arises when a financial institution anticipates receiving a payment that has been mutually agreed upon with another party, but the obligors fail to fulfill their obligations, commonly known as default. Furthermore, credit risk is also triggered by changes or underestimations in the counterparty's rating.
- ✓ *Operational Risk:* Operational risk is the risk of loss resulting from inadequate or failed internal processes, people, and systems, or from external events. It includes risks associated with technology failures, fraud, human error, legal and regulatory compliance, and business disruptions. Fiduciary risk is also part of operational risk, where it emerges from the bank not fulfilling its contractual commitments.
- ✓ *Market Risk:* Market risk is the potential for financial loss due to adverse changes in market conditions. It includes risks arising from fluctuations in interest rates, foreign exchange rates, equity prices, commodity prices, and other market variables. Banks with trading activities are particularly exposed to market risk (Tzouvanas, 2023).
- ✓ *Liquidity Risk:* Liquidity risk is the risk of not being able to meet financial obligations as they become due without incurring excessive costs. It arises when a bank has insufficient liquid assets to fund its operations or faces difficulty in accessing funding sources.
- ✓ *Interest Rate Risk:* Interest rate risk is the potential for financial loss due to changes in interest rates. Banks, especially those with significant exposure to fixed-rate assets and liabilities, face interest rate risk. Changes in interest rates can affect the bank's net interest income, the value of its fixed-income securities, and the cost of funding.
- ✓ *Foreign Exchange Risk:* Foreign exchange risk arises from fluctuations in foreign currency exchange rates. Banks engaged in international operations or exposed to foreign currency transactions face this risk. Adverse movements in exchange rates can impact the bank's profits, balance sheet valuation, and cash flows.
- ✓ *Strategic Risk:* Strategic risk refers to the potential for financial loss resulting from inadequate business decisions, ineffective strategic planning, or failure to adapt to changing market conditions. It includes

risks associated with entering new markets, mergers and acquisitions, product diversification, and competitive pressures.

- ✓ *Country Risk:* Country risk refers to the potential for financial loss due to adverse political, economic, or social events in a specific country or region. It includes risks associated with currency convertibility, government regulations, legal systems, and geopolitical instability.
- ✓ *Compliance and Regulatory Risk:* Compliance and regulatory risk relates to the potential for penalties, fines, reputational damage, and legal consequences arising from non-compliance with laws, regulations, and industry standards. Banks must comply with a wide range of regulations governing their operations, such as capital adequacy requirements, anti-money laundering laws, and consumer protection regulations.
- ✓ *Reputational Risk:* Reputational risk is the potential for negative public perception or loss of trust and confidence in the bank's integrity and business practices. It can arise from poor customer service, ethical misconduct, data breaches, or involvement in controversial activities (Syadali, Segaf, & Parmujianto, 2023).

Each of these risks requires effective risk management practices and mitigation strategies to ensure the stability and sustainability of the bank's operations (Washington Bankers Association, 2023).

Risks Specific to IBs

Although IBs include these all risks except for interest rate risk. However, some risks are specific to Islamic or PBs due to their unique operational and Sharia-compliant nature (Shah, Sukmana, & Fianto, 2021). These are:

- ✓ *Sharia Compliance Risk:* IBs must adhere to Sharia principles, which prohibit interest (Riba) and certain economic activities. Sharia compliance risk arises from non-compliance with these principles.
- ✓ *Profit-Sharing Investment Risk:* IBs engage in profit-sharing investment contracts (e.g., Mudarabah) with customers, where the bank shares profits and losses. The risk arises from potential losses in these investment activities.
- ✓ *Asset Quality Risk:* IBs must ensure that their assets are Sharia-compliant and of high quality as we mentioned before. The risk involves assessing the authenticity and value of the assets held.

- ✓ *Equity Investment Risk:* IBs often engage in equity-based investments (e.g., Musharakah and Sukuk). The risk lies in the volatility and potential losses associated with equity markets.
- ✓ *Commodity Price Risk:* IBs involved in commodity financing face price risk due to fluctuations in commodity prices, as they often engage in Murabahah (cost-plus financing) transactions.
- ✓ *Transparency risk:* Emerging from the lack of standardized accounting and reporting in Islamic banking.

Credit risk management is of utmost importance for IBs, as they engage in financing activities without charging interest (Riba) and rely heavily on profit-sharing and equity-based financing (Alkhawaja & Görmüş, 2019). By focusing on credit risk in this thesis, complexities of credit risk and specific challenges can be observed.

Credit Risk Management for IBs

Both CBs and IBs encounter credit risk and employ some common strategies to address it. Nevertheless, distinctions arise in their approaches due to the distinct focus of IBs. This focus includes activities like lending in Murabaha, leasing in Ijarah, taking on delivery or purchase commitments in Istisna and Salam, and investing based on business performance in Musharakah and Murabaha contracts (Khandelwal, 2008).

I mentioned earlier some strategies for ensuring financial stability. Within the boarder framework of these strategies, specific strategies are designed by IBs to manage credit risk and enhance the overall stability of their operations (Ahmed & Khan, 2007). These are:

- ✓ *Shariah Compliance:* IBs must ensure that their credit risk management practices comply with Shariah principles. This involves conducting thorough due diligence on the financing transactions to ensure they adhere to the principles of fairness, transparency, and ethical conduct. Shariah scholars and committees guide the permissibility and compliance of financing activities, ensuring that the credit risk management framework aligns with Islamic principles.
- ✓ *Risk Identification and Assessment:* IBs need to identify and assess credit risks associated with their financing activities. This involves evaluating the creditworthiness and financial strength of potential borrowers, as well as analyzing the risk characteristics of the financing contracts. IBs use various tools, such as financial statement analysis, cash flow

projections, and risk scoring models, to assess the creditworthiness of customers seeking financing (Grassa, Moumen, & Hussainey, 2020).

- ✓ *Risk Mitigation Strategies:* IBs employ a range of risk mitigation strategies to manage credit risk. These strategies include collateralization, where assets are pledged as security for the financing, providing a form of risk protection in case of default (Aldoseri & Worthington, 2022). Qard diversification is also important, spreading credit exposure across different sectors and customers to reduce concentration risk. IBs may employ risk transfer mechanisms, such as Takaful (Islamic insurance), to manage credit risk. Takaful protects against potential losses arising from defaults or other credit-related risks. IBs can participate in Takaful schemes to mitigate their exposure to credit risk (Tapsir & Talib, 2012).
- ✓ *Profit and Loss Sharing:* IBs share profit and loss with their customers due to the absence of interest-based transactions. This unique feature introduces a different dimension to credit risk management. IBs need to assess the creditworthiness and viability of financing projects or ventures, as they bear the risk of potential losses along with the customers (Malim, 2015).
- ✓ *Monitoring and Control:* IBs establish robust monitoring and control mechanisms to track the performance of financed projects and manage credit risk. Regular monitoring of customers' financial conditions, cash flows, and compliance with contractual obligations is essential. In case of any signs of financial distress or non-compliance, appropriate remedial actions are taken to mitigate credit risk. Additionally, strong internal controls, risk management committees, and reporting mechanisms support effective credit risk management (Islam & Barghouthi, 2017).
- ✓ *Regulatory and Supervisory Framework:* Regulatory and supervisory authorities play a significant role in establishing and enforcing the credit risk management framework for IBs. They set prudential standards, guidelines, and reporting requirements specific to Islamic finance to ensure the soundness and stability of the banking system. Regular assessments, audits, and inspections are conducted to monitor compliance and the effectiveness of credit risk management practices. One of the good examples of such regulatory and supervisory institutions is AAOIFI.

These strategies and measures help mitigate the potential impact of credit defaults and enhance the overall stability of the banks. IBs can effectively identify, assess, and manage the risks inherent in their operations (Akram & Rahman, 2018).

2.3 Previous Research Related to the Financial Stability of Banks

Previous research related to financial stability has been a critical area of study in economics and finance. Numerous studies have delved into various aspects of financial stability, including the identification of early warning indicators, the measurement and assessment of systemic risk, the impact of macroeconomic factors on financial stability, and the effectiveness of regulatory frameworks in ensuring stability, etc.

There have been many models developed to measure the financial stability or instability of companies. For the first time in 1966, Beaver tried to explore the predictive ability of financial ratios. He built discriminant models, which have five different ratios namely, cash flow to total debt, total debt to total assets, net income to total assets, working capital to total assets, and current ratio (Beaver, 1966). Then, the Z-score was applied first time in 1968 by Edward Altman to measure financial performance and predict the bankruptcy of firms. In his first study, he took a sample of 33 companies that are financially successful manufacturing companies that are also open to the public and 33 of the same companies that filed for bankruptcy (Altman E. I., 1968). Later the model was adjusted and modified several times by him and several other researchers. Altman et al. (1977) noticed the fact that model accuracy reaches about 94%, especially in a year before business failure and it is about 72% before two years. According to Chieng (2013), the Z-Score model has demonstrated its reliability as a predictor of Eurozone bank failures occurring within five years before bankruptcy. The study revealed that the Z-Score model successfully predicted the occurrence of all banking failures during the five years leading up to their eventual demise.

In their research Altman et al. (1977) the adjusted model divided the calculation of corporate bankruptcy into 3 model equations, those are:

1. If the company is a public firm, the following equation should be used:

$Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + .999X5$

X1: Net Working Capital / Total Assets

X2: Retained Earnings / Total Assets

X3: Earnings before Interest and Taxes (EBIT) / Total Assets

X4: Market Value of Equity / Total Liabilities

X5: Net Sales / Total Assets

Altman established reference intervals for evaluating the obtained Z-Score using the above equation as follows:

Z > 2.99 indicates financial success.

1.8 < Z < 2.99 indicates a grey zone.

Z < 1.8 indicates financial failure.

2. If the company is a private firm, the following equation will be used:

$$Z = 0.717\,X1 + 0.847\,X2 + 3.107\,X3 + 0.420\,X4 + 0.998\,X5$$

X1: Net Working Capital / Total Assets

X2: Retained Earnings / Total Assets

X3: Earnings before Interest and Taxes (EBIT) / Total Assets

X4: Book Value of Equity / Total Liabilities

X5: Net Sales / Total Assets

With this new function, the coefficients have changed, and the effects of X1 and X4 ratios on the Z-Score value have decreased. Unlike the first function, the book value of equity is used instead of market value. The evaluation of the obtained Z-Score is similar to the previous model. However, the discriminant regions to consider have been changed as follows:

Z' > 2.90 indicates financial success.

1.23 < Z' < 2.90 represents the gray zone.

Z' < 1.23 indicates financial failure.

3. If the company is in the service sector, the following equation will be used:

$$Z = 6.56\,X1 + 3.26\,X2 + 6.72\,X3 + 1.05\,X4$$

X1: Net Working Capital / Total Assets

X2: Retained Earnings / Total Assets

X3: Earnings before Interest and Taxes (EBIT) / Total Assets

X4: Book Value of Equity / Total Liabilities

The discriminant regions determined for the results obtained from the third function Z"-Score are as follows:

Z" > 2.6 indicates financial success.

1.1 < Z" < 2.6 represents the gray zone.

Z" < 1.1 indicates financial failure.

Altman et al. (2014) demonstrated that the Z-Score model's effectiveness extends beyond its original application in an international context. The model showcased its robustness and reliability in predicting bankruptcy and identifying distressed firms across a wide range of firms from different European and non-European countries. However, for greater efficiency, country-specific models can be derived for both European and non-European countries by incorporating additional background variables along with the original four variables. While a general international model works reasonably well, classification accuracy can be improved by using country-specific estimation in most cases. Even simple additional variables in a country-specific model can significantly enhance classification accuracy (Paolone & Rangone, 2015). The practical examinations in this research validate that both the initial Z-Score Model and its modified version, including the four variables from Altman's (1983) investigation and coefficients recalibrated using an extensive dataset from Europe, consistently demonstrate strong international performance and are simple to apply and understand.

Altman et al. (1998) introduced a modified version of Altman's method, known as the Emerging Market (EM) Score, which was specifically designed for both manufacturing and non-manufacturing companies operating in developing markets. To do this, Altman and others suggested adding a constant variable (+3.25) to standardize the results and consider scores equal to or below zero as the default condition. They conducted a study using a sample of Mexican companies to validate the EM Score. The method utilized the same variables as the revised Z-Score but with the inclusion of a constant variable (+3.25) to filter out potential distortions associated with the sector and country (Paolone & Rangone, 2015).

More than five decades after the first version of Z-score bankruptcy models was introduced, it has emerged as the predominant approach for offering advance alerts about bankruptcy or financial challenges in numerous research studies conducted by scholars and professionals worldwide (Hasan, Hadi, & Jasim, 2021).

When compared to other sectors or countries, there is a noticeable lack of studies regarding the implementation or utilization of Z-Score in the banking sector of Türkiye. First, some of these existing studies and then global study examples will be chronically presented in this section.

A comparison of CBs and PBs by applying the Z-Score model in Türkiye indicated that major IBs exhibit lower financial stability when compared to prominent CBs. However, both large IBs and CBs demonstrate greater financial strength when compared to their smaller counterparts (Elbadri & Bektaş, 2017).

Aksoy and Göker (2018) applied the Z-Score model and the Bankometer model to a sample of commercial banks listed on Borsa Istanbul from 2012 to 2016. The results from the Bankometer model showed that all commercial banks had high debt-paying capacity and low financial risk levels. However, the results from the Z-Score model revealed the opposite, indicating that all commercial banks had a high level of financial risk. The discrepancy in results was attributed to the usage of parameters in the Z-Score model, particularly the X1 variable (Net Working Capital/Total Assets), which had a consistently negative and low value across all banks and years. This was due to the mismatch between the maturity of deposits and loans in the Turkish banking sector. According to the authors, this situation demonstrates that the Z-Score model has weakened its status as an applicable model in the Turkish banking sector.

The financial soundness and debt repayment capacity of five PBs in Türkiye (three private and two state-owned) were empirically analyzed again by using the Z-Score and Bankometer methods by Çalış et al. (2022). The results indicate that both private and state-owned PBs have a significant potential for bankruptcy according to the Z-Score method commonly used for predicting bankruptcy risk. According to the study, the Z-Score results for both bank groups were below 1.1, indicating a high potential for bankruptcy.

Kınalı and Karasioglu (2022) undertook an analysis of financial data from 34 companies listed on Borsa Istanbul between 2014 and 2019, employing the Z-Score model to scrutinize their financial performance. Their findings revealed that out of the 34 companies, 12 were classified as risky, 16 as uncertain, and 6 as low risk. This classification provides valuable insights into the financial health and risk levels of these companies in the market.

Only application of the EM Score with original Z-Score and Springate in the Turkish banking sector was conducted by Tekin and Gör (2022). The findings of this study, based on Altman Z-Score and Springate results, suggest that the Z-Score alone may not be a suitable predictor of financial failure in the Turkish banking sector. However, incorporating a constant of

+3.25 in Z-Score calculations improves its effectiveness, resulting in most banks being classified as financially sound and successful.

There are many global studies about the Altman Z-Score model for IBs. Some of them are comparative studies between countries or between CBs and IBs. Now, IB-related studies will be reviewed.

The first cross-country comparative empirical analysis of CBs and IBs that focused on implementing the Z-Score was conducted by Čihák & Hesse (2010) to assess the financial stability of IBs. They analyzed financial data from 77 IBs across multiple countries including Bahrain, Bangladesh, Iran, Yemen, UAE, Saudi Arabia, Kuwait, Qatar, Jordan, Malaysia, and Sudan from 1993 to 2004. The results of the study represent that smaller IBs are financially more robust than smaller commercial banks, while larger commercial banks tend to be financially stronger than larger IBs. It's noteworthy that smaller IBs display higher stability compared to larger IBs as well. According to the authors, this could be because of challenges in adapting their credit risk monitoring system as they expand, difficulties in standardizing credit risk management, and growing issues linked to making safe choices and managing behavior when dealing with larger operations.

Arshed (2020) employed the Z-Score and Springate models. Through a comparison of these models and an assessment of companies' financial conditions from 2013 to 2019, the research findings suggested that the Z-Score model surpasses the Springate model in its ability to predict company bankruptcy. The researcher concluded that the approach alerts companies and underscores the importance of improving their performance.

By utilizing Z-Score, Qasim (2020) demonstrated that among the three banks in Jordan, one bank displayed the highest Z-score, signifying a stable financial position. Jordanian IBs have exhibited overall improvement since 2013. The study affirmed the validity of the Z-Score model in assessing performance. The ratios employed for Z-Score calculations were considered effective indicators and were also utilized by Jordanian IBs for funding both short-term and long-term projects. The study recommends combining the Z-score with other financial analysis techniques to establish industry benchmarks.

Majumder and Moonmoon (2020) indicated a variation in the Z-score of financial distress, suggesting that the Z-Score model for emerging economies is effective in predicting financial distress within the Islamic banking industry of Bangladesh.

Rahman et al. (2020) applied the Z-Score model to evaluate the risk of bankruptcy of Non-Bank Financial Institutions (NBFIs) in Bangladesh. The outcomes revealed that 90% of NBFIs were in financial distress in 2018.

The research conducted on 50 firms in the construction sector in Indonesia used three bankruptcy prediction models: the Z-Score model, the EM Score, and the S-Score model. The results of the model's predictions for the years 2014 and 2018 indicate that different presidency periods in Indonesia influenced the models' outcomes. Changes in political and economic policies under different presidents can impact the performance of bankruptcy prediction models. The study also highlights the importance of the debt-to-equity ratio (DFL) variable in the Z-Score model and the significant influence of independent and control variables in the EM Score method (Ar-Rasyid & Gandakusuma, 2020).

An assessment of Pakistan's banking sector's financial condition was carried out using the Z-Score test. The findings indicated that local banks demonstrated stability, while foreign banks faced distress. Moreover, the study deduced that the Z-Score model is accurate and valuable for predicting financial stability in the context of Pakistan's banking sector (Ullah, Wang, & Abbas, 2021).

The EM Score utilized by Hasan et al. (2021) evaluates the stability of Iraqi banks and assesses their dependability within the Iraqi business environment. Nevertheless, the research discovered that the outcomes produced by the model were challenging to interpret. Regarding the banks that experienced failure, the model suggested that they did not face substantial difficulties initially but eventually led to failure.

Based on the implementation of the Z-Score model to IBs in Indonesia, most of these banks were financially sound between 2017 and 2019, except one bank in a cautious financial position. Several banks demonstrated improvements in their financial performance, while others experienced a decline (Swissa, 2021).

According to the Z-Score model, all IBs were placed in the safe zone. Only one firm was flagged as distressed, and another landed in the inconclusive zone out of the total of twenty firms examined. The results regarding IBs in Pakistan were quite encouraging (Ahmad & Hussain, 2021).

Tran (2021) examined the EM Score and six financial ratios to predict financial distress in Vietnam. The EM Score showed impressive capability in accurately anticipating financial troubles in the Vietnamese market. The model achieved an accuracy rate of 91.58% for one year and 83.77% for five

years. What's noteworthy is that the model could foresee financial distress up to 4 years before a company got delisted.

When assessing the level of financial distress using the Z-Score method to 4 Foreign Exchange Sharia Banks and 4 Non-Foreign Exchange Sharia Banks from 2014 to 2018, results concluded that there is no significant difference between the Z-Score value of the two groups. Both types of banks exhibit similar scores, indicating a relatively healthy state (Safitri & Sholikha, 2022).

After implementing Z-Score, Asmadi et al. (2023) found three companies with potential bankruptcy with values below 1.1. Additionally, three other companies were identified as prone to bankruptcy, with values falling between 1.1 and 2.6. In contrast, 24 companies were categorized as healthy, primarily owing to their substantial total assets and manageable debt. The study affirmed the effectiveness of the Z-Score method in evaluating performance, predicting bankruptcy, and assessing the financial health of Indonesian companies.

The effect of COVID-19 on the financial stability of IBs in Indonesia was analyzed by the implementation of Z-Score. The results showed that IBs are stable during the pandemic for the short term, however, the long-term impact requires more observations (Amaroh, 2023).

According to Hamid et al. (2023), the financial health of most Iraqi banks is inconsistent, positioning them within the third risk category, signifying a heightened risk of bankruptcy due to their Z-Score results. Hence, the researchers recommended to use of alternative bankruptcy prediction models in conjunction with Z-Score.

The effect of corporate governance on the health of Indonesian banks was examined by the utilization of Z-Score. The findings revealed a positive relationship between the frequency of board meetings and the financial health of these banks, indicating that more frequent meetings enhance managerial monitoring and contribute to better financial health. However, other variables, including the board of commissioners, independent board of commissioners, and educational background, showed no significant influence on bank health (Susanto & Walyoto, 2023).

Hussein and Idris (2023) applied the EM Score to forecast financial distress in manufacturing companies that had gone bankrupt and were listed on the Amman Stock Exchange from 2003 to 2019. The results highlight the EM Score value's proficiency in recognizing potential financial challenges

within otherwise stable industrial firms, demonstrating its capacity to identify vulnerabilities before they escalate into distress.

The Z-Score model and its various improved versions have been extensively studied in the field of financial analysis. These studies have produced diverse and sometimes conflicting results, indicating a lack of correlation in their findings. Notably, when focusing on emerging markets and economies, the research outcomes tend to exhibit a predominance of negative results or inconsistent findings regarding the application of the original Z-Score model.

However, it is important to note that a modified version of the Z-Score model, specifically designed for emerging markets and known as the EM Score, has shown consistency in its results (Altman, Hartzell, & Peck, 1998) and has been utilized by many researchers on emerging markets. This modified model takes into account the unique characteristics and challenges faced by emerging markets, providing a more accurate assessment of financial stability within these contexts. Therefore, to get a more accurate assessment and study results for the Tuekish market, this model will be used.

2.4 Previous Research Related to the Credit Risk Management of Banks

NPL ratio is a method that is commonly used as a proxy for credit risk (Kabir & Worthington, 2017) and provides insights into a bank's asset quality and potential vulnerability to financial distress (Christaria & Kurnia, 2016). The NPL ratio reflects the proportion of loans not being serviced according to their scheduled payments, typically defined as loans with payments overdue by 90 days or more (Karapappas, 2023). For IBs, which employ non-interest-based financing methods, a loan is considered non-performing when the borrower fails to repay the full debt amount on time. Additionally, in certain Islamic contracts like mudarabah and musharakah, a loan is classified as non-performing if the counterparty fails to pay the bank's share (Elgari, 2018).

An increasing number of non-serviced loans and a higher NPL ratio can indicate declining asset quality and potential financial instability (Özçim & Kaya, 2021). Therefore, it could elevate the likelihood of the bank facing bankruptcy (Kabir & Worthington, 2017).

This section will provide a chronological overview of previous domestic and global studies on risk management in the banking sector, with a specific focus on NPL and NPL ratio studies. Reviewing these studies will contribute to a better understanding of credit risk management practices and underscore

the significance of NPL ratios in the assessment and management of credit risk, particularly in the context of Islamic banking.

Yağcılar and Demir (2015) focused on determining the factors influencing NPL ratios in both macroeconomic and bank-related contexts. The findings indicated that macroeconomic factors such as economic growth and interest rates significantly affect NPL ratios in banks. Specifically, a negative relationship was observed between economic growth and NPL ratios, suggesting that a decline in economic activity leads to an increase in NPL Additionally, it was found that higher interest rates exacerbate the risk of non-repayment. Moreover, the study revealed that banks listed on the stock exchange tend to have lower NPL ratios, indicating that capital markets play a role in managing risks and enhancing bank profitability. Banks with high liquidity and asset profitability were also found to have lower NPL ratios, highlighting the importance of credit management. Furthermore, foreign banks exhibited higher credit risk compared to domestic banks, and strong capital structures were associated with more aggressive lending practices and higher NPL ratios.

Selimler (2015) emphasizes that NPL poses significant challenges to the Turkish banking sector. The elevated NPL ratio and the need to allocate special provisions indicate the potential negative impact on banks' profitability. NPL impacts the balance sheet, income statement, profitability, liquidity, capital adequacy, and asset quality ratios of banks, both in terms of their amount and the ratios they are included in. However, the inability to eliminate NPL necessitates a focus on slowing down the transfer of loans and improving the collection process.

Büyükkara (2015) examined the loan default rates of companies that received loans from PBs and CBs in Türkiye using analysis techniques. The data covered the period from January 2011 to December 2012. The results suggest that loans from PBs are more likely to default, even after considering factors like borrower details, loan terms, and bank characteristics. Interestingly, loans exclusively from PBs have a lower chance of default compared to loans from both PBs and CBs. For firms borrowing from both types of banks, the default rate of PBs' loans was found to be higher than that of CBs' loans.

Özkan and Işıl (2016) analyzed data from four active banks in Türkiye covering the period from 2006 to 2014. They utilized an analytical approach to identify factors affecting the NPL ratio. The results indicated that as banks allocate a larger proportion of their overall funds to potential loan losses, the

NPL ratio increases. In contrast, larger banks with a smaller percentage of their funds allocated to loans tend to experience a decrease in the NPL ratio.

The factors influencing NPL in the Turkish banking sector after the global crisis were examined by Us (2016). The findings indicated that before the crisis, NPLs in Turkish banks were primarily influenced by bank-specific variables such as capital adequacy, lending, inefficiency, and bank size. Inflation and exchange rate were the only macroeconomic indicators affecting the NPL ratio during this period. However, after the crisis, the influence of bank-specific factors diminished, with lending being the only significant variable. The effectiveness of macroeconomic and policy-related factors also varied, with real Gross Domestic Product (GDP) growth, inflation, and exchange rate playing a role in shaping NPL dynamics. Additionally, the persistence of the NPL ratio emerged as a crucial factor, as evidenced by the significance of the dependent variable.

Yüksel (2017) investigated the factors influencing credit risk in developing nations, specifically examining the Turkish banking sector in the aftermath of the 2001 crisis. Utilizing annual data from 23 Turkish deposit banks spanning 2004 to 2014, the study employed a statistical model. The NPL ratio was identified as the dependent variable, and the research revealed that the industry production index played a significant role in affecting NPL. A negative correlation was demonstrated, implying that a decrease in the industry production index results in an increase in NPL. This suggests that economic downturns could lead to higher NPL ratios as companies grapple with financial challenges and job losses that impact their ability to repay loans.

Alkhawaja and Görmüş (2019) focused on investigating credit problems in Turkish banks, especially in IBs, and how they differ from regular banks. They analyzed data from three IBs over a decade, comparing their findings with research on regular banks. They used NPL as a measure of credit risk. Their results showed that in IBs, increasing reserves for possible loan issues Loan Loss Provision (LLP), and Provision for Possible Losses (PPL) raised the credit risk, while having more money for loans (PLA) lowered it. Factors like bank size and loan earnings had less impact. For regular banks, the outcomes were somehow different. The study revealed that higher reserves for loan problems (LLP), how much they earn from loans (NIM), and how much money they have compared to loans increased the credit risk. However, setting aside money for fewer loans (PLD and PLA) or having a larger bank reduced the credit risk. The research highlighted that Islamic and regular banks were largely similar concerning LLP and PLA.

Kakaç (2019) focused on assessing credit risk in Turkish banks by examining NPLs with two models which are Logit and Probit. The analysis included both public and private capital deposit banks over the period from 2007 to 2017. In the Logit model, banks were categorized based on their NPL, and the results revealed a 90.91% correct classification rate. The probit model considered credits and receivables accounts, showing an 84.30% correct classification rate.

İncekara and Çetinkaya (2019) presented a comparative analysis of banking characteristics for CBs and PBs in Türkiye. The study examined the factors influencing liquidity risk in Islamic and CBs in Türkiye between 2014 and 2018. The results showed that NPL and liquid assets were significant factors in both banking types. Increasing NPL decreased liquidity risk in conventional banking but increased it in Islamic banking. Additionally, higher liquid assets reduced liquidity risk in both types of banks. Return on equity (ROE), return on assets (ROA), gross domestic product (GDP), and inflation were not significant factors.

Özçim and Kaya (2021) focused on analyzing the relationship between credit risk in PBs and macroeconomic variables. From the perspective of the consumption sector, changes in private consumption expenditure affect the NPL of PBs. Considering that changes in GDP are larger and longer, it can be said that there is a stronger interaction between NPL and the production sector of the macroeconomy. The study concluded that the majority of loans provided by PBs are evaluated in the production sector.

Kayhan and İslamoğlu (2022) aimed to assess the impact of bank-specific variables on loans granted to Small and Medium Enterprises (SMEs) in Türkiye. The findings reveal that an increase in the overall loans-to-assets ratio has a positive effect on the ratio of SME cash loans to total loans. However, an increase in the NPL ratio leads to a decrease in the SME cash loans ratio.

Özel (2022) suggested that vulnerabilities in the banking sector, including factors specific to banks and macroeconomic variables, have a significant impact on NPL. The study emphasizes that adverse developments in the banking sector can have negative consequences not only for the sector itself but also for the entire financial system and the overall economy. It highlighted the importance of maintaining the continuity of credit flow from the financial system to the economy and the need for timely and adequate credit repayments. Furthermore, the study suggested that models considering both NPL and loans under close monitoring can provide a more comprehensive understanding of credit risk. The findings emphasized the

interplay between NPL, bank-specific factors, and macroeconomic variables and underscored the significance of implementing appropriate policies to ensure a sustainable credit system and financial stability.

The profitability of five Turkish PBs has been examined by Dağılgan (2023) for the period between 2016 and 2021, focusing on bank-specific determinants. ROA and ROE are taken as dependent variables, while bank-specific variables such as capital adequacy, asset quality, and NPL ratio are considered independent variables. From the findings, it is observed that an increase in the total loan amount positively affects asset profitability but does not significantly impact equity profitability. The continuous growth of the loan portfolio for PBs implies an increase in overall profitability. However, an increase in NPL has a negative effect on equity profitability, reducing it. Lower levels of NPL lead to higher equity profitability. Therefore, managing and reducing the level of NPL should be a priority for Turkish PBs to enhance their equity profitability.

Thus far, I have provided illustrative instances of research from Türkiye. Now, I am going to present some global studies in the field of banking, with a particular focus on IBs. Those are:

Rezina et al. (2020) aimed to determine internal bank variables that influence NPL ratios. They deduced that while internal bank variables do have an impact on the NPL ratio, they may not be as substantial as anticipated, partly due to the limited sample size. Interestingly, IBs appear to be more dependent on these variables compared to CBs on the other hand, but further analysis is needed.

According to Mdaghri (2022), there is a significant negative impact of bank liquidity on NPL in both the short and long term which means that when banks engage in activities that generate liquidity, both on and off the balance sheet, it leads to a decrease in NPL. These findings support the perspective that increased liquidity creation has a positive effect on the economy. Additionally, the study conducted a regression analysis to examine whether this relationship holds for both IBs and CBs. The results indicated that liquidity creation contributes to the reduction of NPL in both types of banks, implying that the positive effect of liquidity creation on NPL applies to IBs as well as CBs.

Badawi et al. (2022) focused on analyzing the factors that influence the financial performance of IBs, with a specific emphasis on the role of competitive advantage. The findings revealed that the Non-Operating Income Margin (NOM) and NPL variables do not have a significant effect,

while the Operating Expense to Operating Income Ratio (BOPO) variable has a significant negative effect on financial performance. However, the competitive advantage variable does not moderate the effects of NOM, NPL, and BOPO on ROA. The conclusions indicated that NPF and NOM do not significantly affect the ROA of IBs, and the competitive advantage variable does not moderate the effects of NPF and NOM on ROA.

Safarda et al. (2023) directed their attention to financial performance indicators of IBs and CBs during the COVID-19 pandemic. Their findings suggested that there are no significant disparities in indicators such as CAR, FDR, and NPL/NPFs. Nevertheless, substantial variations are noted in indicators like ROA, ROE, and Operating Profit to Operating Income (OP/OI).

The COVID-19 period is related to another example held by Asykarulloh and Sultoni (2023) compares the performance of IBs and CBs during the COVID-19 pandemic. The results indicated significant differences in the CAR and BOPO performance between the two types of banks, with IBs having higher scores. However, the NPL/NPF, ROE, and LDR/FDR ratios didn't show significant differences.

Bhuiya et al. (2023) examined the impact of credit risk on the profitability of commercial banks in Bangladesh. The findings indicated that the NPL ratio has a significant negative effect on both ROE and ROA. Additionally, factors such as LLP, Loan-to-Asset (LATD), PPL, and GDP also influence profitability. The study highlighted the importance of managing credit risk and suggested measures such as regulations, employee training, and credit rating systems to ensure financial soundness.

Chowdhury et al. (2023) explored the impact of bank-specific and macroeconomic variables on the NPL of IBs in Bangladesh. The results uncovered that factors such as loans, loan-to-assets (LOTA) ratio, and net interest margin (NIM) have a significant and negative effect on NPL, while the CAR exhibits a positive relationship with NPL. On the macroeconomic front, GDP exhibits a positive correlation, while inflation has a negative association with NPL. Improving net interest margins and considering the growth of GDP can also help reduce NPL. The impact of the capital adequacy ratio on NPL is not significant, suggesting the need for additional information such as reserves for NPL.

3. METHODOLOGY

An overview of the methodology employed in this study to examine the financial stability and the credit risk of PBs and CBs. The research design and approach incorporate two crucial models: the EM Score and NPL ratios.

3.1 Research Design and Approach

To achieve our research objectives of analyzing the financial stability and credit risk soundness of Turkish PBs, I adopted a mixed-model research design. This design allowed us to combine quantitative approaches from both models to provide a comprehensive understanding of the subject matter.

3.1.1. Emerging Market (EM) Score Method

The EM Score is a Multiple Discriminant Analysis (MDA) model, which is a statistical method utilized to categorize an observation into specific pre-defined groups based on the individual characteristics of the observation. It is primarily employed for classification and prediction purposes in situations where the dependent variable is qualitative, such as bankrupt or non-bankrupt firms or other binary characteristics (Ndiege, 2017).

The EM Score produced by Altman et al. (1998) is an improved and modified version of the statistically proven Z-Score model. This model can be applied to manufacturers and non-manufacturers and is suitable for both listed and privately owned companies. That means the EM Score offers an advantage over the original Z-Score as it can be applied to non-traded companies and is not limited to manufacturing companies alone.

This modified method includes the special characteristics of firms for developing markets. The model was initially applied in Mexico and then applied to many developing market companies in different countries, and the model has proven its effectiveness and success in non-American environments (Hussein & Idris, 2023).

The EM Score takes a specific form with the formula:

"EM Score = 6.56 * X1+3.26 * X2+ 6.72 * X3 + 1.05 * X4 + 3.25"

EM Score =A1X1+A2X2...ANXN,

Where EM Score = Overall Score

A1... AN = Discriminant Coefficients

X1...XN = Discriminant Variables

A5 (+3.25) = Constant Variable

The definitions of the formula variables will be given with details as follows:

X1: Net Working Capital / Total Assets

X2: Undistributed (Retained Earnings) / Total Assets

X3: Earnings Before Interest and Tax / Total Assets

X4: Book Value of Equity / Total Liabilities

A5: Constant Variable (+3.25)

X1: Working Capital / Total Assets

In the Z-Score or EM Score method, the initial factor is the ratio of working capital to total assets. This ratio assesses the bank's capacity to meet its short-term obligations and represents the proportion of the firm's liquid assets to its overall capitalization. A rising liquidity value indicates a favorable indication, while a declining value implies increased liabilities and potential distress for the bank (Tran, 2021).

X2: Retained Earnings / Total Assets

The second variable of the model measures the bank's capability to generate earnings through its assets. A higher ratio is preferred, as it indicates the bank's ability to accumulate profits. However, typically a young firm like Türkiye Emlak PB in our study will exhibit a low ratio of retained earnings to total assets because it has not had sufficient time to accumulate substantial profits. Therefore, Altman (1968) emphasized that the likelihood of failure is considerably higher during the early years of a firm.

X3: Earnings before Interest and Taxes / Total Assets

The ratio of earnings before interest and tax (EBIT) to total assets reflects the relationship between a company's profitability and its assets. It measures the efficiency of the firm's assets without considering tax or leverage factors.

X4: Book Value Equity / Total Liabilities

The fourth variable represents financial leverage, which is the proportion of equity in the firm's total assets. This measure indicates how much the firm's assets can decline in value before the liabilities exceed the assets, resulting in insolvency. A higher value of this ratio suggests that the firm is more aggressive in financing its growth through debt (Chieng, 2013).

X5: Constant Variable

Where the first four variables are still without a format change, the last numerical constant variable (+3.25) was added by Altman et al (1998) to standardize the model.

The zones of discrimination depend on the formula result from the EM Score arranged as below:

If the EM-Score > 2.6 it means the firm is in the "Safe" zone

If the EM-Score is between 1.1 and 2.6 it's called the "Grey" zone (1.1 ≤ Z-score ≤ 2.6)

Lastly, if EM-Score < 1.1 it's in the zone called the "Distress" zone.

These zones categorize the financial stability of firms based on their EM Score values. If it is above 2.6 indicates a safe financial position, while a score between 1.1 and 2.6 represents a grey area where the firm's financial stability is less certain. An EM Score below 1.1 indicates a distress situation, suggesting potential financial difficulties for the firm.

On the other hand, once the EM Score has been calculated, it can be used to determine a bond rating equivalent for the company. The bond equivalent rating table is derived from an analysis of financial statements (Altman, Hartzell, & Peck, 1998; Coelho, 2014). The table provides a concise and clear representation of bond ratings corresponding to different ranges of the Emerging Market System (EMS). In the table, the bond ratings are categorized from the highest credit quality "AAA" to the lowest "D". Companies with an EMS above 8.15 are classified as "AAA," indicating a very low risk of default. On the other end, companies with an EMS below 1.75 receive a rating of "D," indicating a high risk of default.

The decision to employ the EM Score in our study is based on several factors. Firstly, the inconsistent findings observed in previous studies using the traditional Z-Score model highlight the need for a more tailored approach in the context of emerging markets. Secondly, utilizing the EM Score has demonstrated improved consistency in assessing financial stability within emerging markets according to previous studies. Furthermore, its application accounts for the specific dynamics, risk profiles, and structural characteristics of such developing economies, providing a more nuanced understanding of their financial landscape. By employing the EM Score, I aim to enhance the reliability and relevance of the study and contribute to the existing body of knowledge regarding the financial stability of Turkish PBs and CBs.

3.1.2. Non-Performing Loans (NPL) Ratio

The second measure I examine to assess banking stability is the NPL ratio, which serves as an indicator of asset quality and risk soundness issues within banks. This ratio is derived from accounting data and is calculated by dividing the non-performing loans by the total value of loans (NPL/TL) in which the borrower has not made scheduled payments for at least 90 days (Karapappas, 2023).

In other words, the NPL ratio indicates the percentage of loans that are at risk of not being repaid by borrowers, either due to overdue payments or default. These loans are considered non-performing because they are not generating the expected income for the bank (Rahman & Jahan, 2018). A higher NPL ratio indicates a higher level of credit risk and potential financial distress for the bank.

With the abundance of various models and approaches in credit risk management, I focused on analyzing the NPL ratio as a key indicator and making it a proxy for the financial stability of Turkish PBs. By narrowing our focus, I aimed to gain deeper insights into the credit risk dynamics and challenges faced by those banks. Also, I aimed to deliver relevant and targeted findings that could offer practical implications for credit risk soundness and management strategies for the Turkish banking sector.

NPL ratio can be easily found by formula $= \frac{\text{Non-Performing Loans}}{\text{Total Loans}} \text{X } 100$ %

There are some general criteria that researchers, analysts, and regulators often use to assess the health of a bank based on its NPL ratio (Saleh & Winarso, 2021). These are:

If the NPL ratio is < 5%, it means the firm is healthy.

If the NPL ratio is between 5 and 10, it means a moderate zone (5 % ≤ NPL ratio ≤ 10%).

If the NPL ratio is > 10%, it means the firm is in an unhealthy status.

The NPL ratio below 5% is generally considered low and indicates a healthy loan portfolio. Banks with NPL ratio below this threshold are often viewed positively in terms of asset quality and risk management. The NPL ratio between 5% and 10% is considered moderate. It suggests that a bank has a certain level of NPL, but it might still be able to manage the credit risk effectively. Lastly, the NPL ratio exceeding 10% is generally seen as high and raises concerns about the bank's asset quality. A high NPL ratio indicates a

significant portion of NPL, which may impact the bank's profitability and capital adequacy.

However, regulations and industry standards may also play a role in defining what is considered a healthy NPL ratio. Therefore, regulators in different countries might set specific guidelines or thresholds to monitor and control credit risk in banks.

3.2 Scope of the Study

The scope of this thesis extends to a comprehensive examination of both the financial stability and credit risk soundness of Turkish PBs. I focused on the period from 2016 to 2022, covering 7 years, to gain an understanding of the banks' performance over time. Also, I aimed to compare the financial stability and credit risk profiles of Turkish PBs with those of CBs in Türkiye, considering a wider range of variables. Additionally, the study investigates the relationship between financial stability and credit risk within the framework of the banking sector. The research also involves a comprehensive examination of the methodology, including the application of the EM Score and the analysis of NPL ratios.

3.3 Data

I have gathered secondary data from reliable sources, such as the TKBB and BRSA official websites, to ensure data credibility. This data comprises financial information of Turkish PBs and CBs from audited financial reports. These reports are prepared by external auditors and adhere to accounting standards.

The financial data includes key statements like income statements, balance sheets, and cash flow statements for each of the PBs, covering the years 2016 to 2022. To compare PBs and CBs, I utilized annual average data for each sector spanning from 2005 to 2022.

For assessing financial stability, I collected the necessary financial ratios and indicators for calculating the EM Score. To analyze credit risk, I obtained data on NPL ratios for each PB and the annual sector data. I conducted the analysis using the Stata statistical software developed by StataCorp.

4. FINDINGS AND RESULTS

In this chapter, results and discussions of the EM Score and NPL of Turkish PBs and a comparison of PBs and CBs for both models will be presented.

4.1 Descriptive Statistics Regarding EM Score for PBs

Table 4.1 provides the descriptive statistics of EM Score between 2016 and 2022 for each bank, as well as an average across these variables. Appendix Table A.1 provides detailed information about each variable of the overall EM Score for each PB in each year between 2016 and 2022.

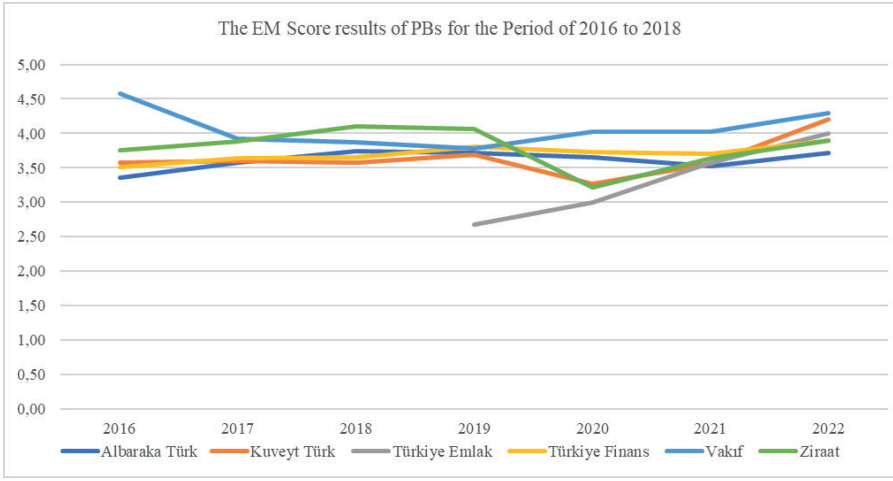
Table 4.1 Descriptive Statistics based on the EM Score results of PBs from 2016 to 2022.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Albaraka Türk	7	3.61	.14	3.36	3.74
Kuveyt Türk	7	3.64	.28	3.27	4.2
Türkiye Emlak	4	3.31	.59	2.68	4.0
Türkiye Finans	7	3.70	.13	3.51	3.9
Vakıf	7	4.07	.28	3.78	4.58
Ziraat	7	3.79	.30	3.21	4.1
Average	7	3.72	.16	3.48	4.00

According to Table 4.1, the mean EM Scores for these banks show some variation, ranging from 3.31 for Türkiye Emlak PB to 4.07 for Vakıf PB. On average, the EM Score for all the PBs is 3.72, indicating a reasonably stable level of financial health. The minimum EM Score is 2.68 for Türkiye Emlak PB, and the maximum is 4.58 for Vakıf PB. While there are minor variations over the years, most of these Turkish PBs seem to maintain a stable financial position during the specified time frame. In terms of standard deviation, Türkiye Finans PB exhibits the lowest variability with a value of 0.13, meaning their EM Score results are tightly clustered around the mean. In contrast, Türkiye Emlak PB has a relatively high standard deviation of 0.59, suggesting that their scores are more spread out over a wider range.

To gain a deeper understanding of the factors influencing the EM Score results, it's essential to conduct a trend analysis over time for these PBs.

Figure 4.1 The EM Score results of PBs from 2016 to 2022.



Source: Calculated by the author based on the Participant Banks Association of Türkiye (TKBB) reports accessed July 31, 2023, from https://tkbb.org.tr/sayfa/sektor-bilgileri/denetim-raporlari

The EM Score results of Turkish PBs for the period of 2016 to 2022 are given in Figure 4.1. Among the observed banks, Albaraka Türk PB consistently demonstrated financial success, evidenced by positive trends in key metrics, reflecting robust liquidity, retained earnings, high profitability, and sound financial structure by remaining over 2.6. Kuveyt Türk PB maintained a resilient financial performance during the same period. Even though a slight decline emerged in 2020, the bank's financial stance remained robust in subsequent years. Notably, the EM Score consistently exceeded 2.6, reaching 4.2 in 2022, reinforcing the bank's resilience. Türkiye Emlak PB doesn't have data for the period of 2016 to 2018 as its operations started in 2019. However, the bank overcame initial challenges, demonstrating significant financial improvement. EM Score consistently surpassed 2.6, reaching a reassuring 3.99 in 2022, showcasing the bank's resilience. Türkiye Finans PB displayed a consistent positive financial trajectory from 2016 to 2022, as signified by a cumulative score of 3.90 in 2022, further emphasizing the bank's stability. Vakıf PB consistently demonstrated favorable financial performance throughout the observed period, sustaining a strong financial stance. Although minor fluctuations were observed, the bank consistently maintained positive values across variables, solidifying its financial stability.

EM Score consistently exceeded the 2.6 threshold, reaching an impressive 4.30 in 2022, reaffirming the bank's sound health and minimal distress risk. Lastly, Ziraat PB exhibited variable financial performance over the entire span, marked by fluctuations. Even though the score decreased in 2020, subsequent years witnessed positive variable trends, leading to a consistently strong EM Score exceeding 2.6, underscoring the bank's sturdy financial position and low risk of distress.

Overall, from 2016 to 2022, the six PBs showcased generally positive financial performance based on the EM Score results. Across the years, the Score consistently remained above the threshold of 2.6, indicating that all banks maintained a stable financial position with a low enough risk of distress.

4.2 Descriptive Statistics Regarding the EM Score of PBs vs. CBs

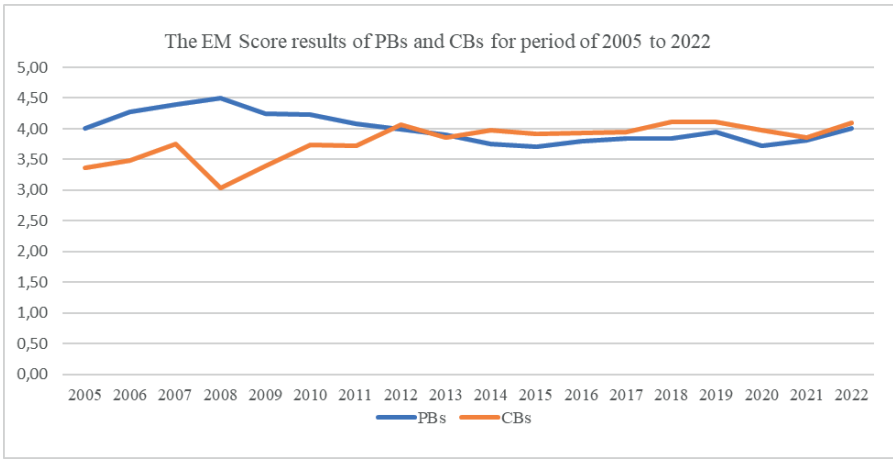
Descriptive statistics and results of EM Scores for PBs and CBs are given in Table 4.2.

Table 4.2 Descriptive Statistics of the EM Score results of PBs and CBs from 2005 to 2022.

Variable	Obs.	Mean	Std. Dev.	Min	Max
PBs	18	4.00	.23	3.71	4.50
CBs	18	3.80	.30	3.03	4.11

For CBs the average EM Score is 3.80, showcasing a moderate level of financial health. The standard deviation of 0.30 indicates that the EM Score for CBs has some variability around this mean. The scores range from 3.03 to 4.11, suggesting diversity in financial health levels within this category. PBs present a higher average EM Score of 4.00, indicating a comparatively stronger financial health status. The standard deviation of 0.23 points toward a more consistent distribution of scores around the mean. The range of scores spans from 3.71 to 4.50, showcasing relatively stable financial health levels among PBs.

Figure 4.2 The EM Score results of PBs and CBs from 2005 to 2022.



Source: Calculated by the author based on the BRSA website annual data accessed July 31, 2023, from http://www.bddk.org.tr/BultenAylik/

According to Figure 4.2, both sectors generally maintained positive financial performance and stability over the period from 2005 to 2022. Throughout the years, CBs showcased impressive improvement, steadily increasing their EM Score, reaching a peak of 4.11 in 2018. This growth demonstrates their ability to navigate through economic crises and adapt to changing market conditions. On the other hand, Turkish PBs demonstrated consistent financial stability, with EM Score remaining above 3.80 throughout the years. While their growth trajectory was more modest compared to CBs, their stable performance reflects their resilience in the face of economic challenges. Moreover, both sectors had almost intersection points in 2012, 2013, and 2021. Overall, they consistently maintained an EM Score above 2.6, indicating financial stability and a lower risk of distress.

4.3 Descriptive Statistics and Comparison of NPL among PBs

Table 4.3 shows the descriptive statistics and NPL ratios of PBs from 2016 to 2022.

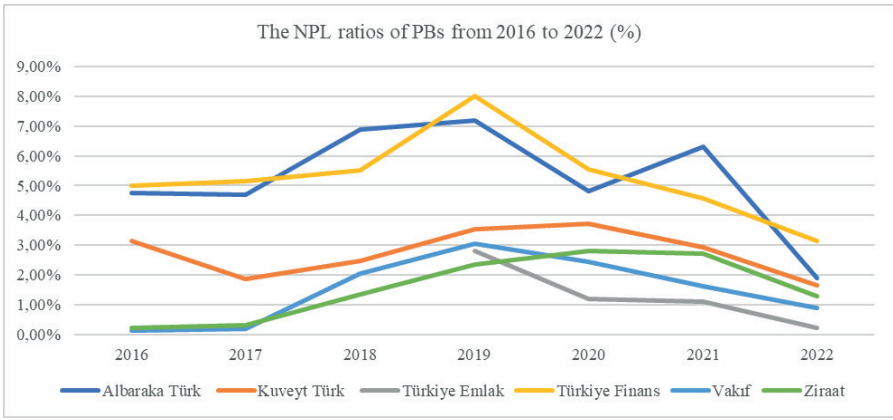
Table 4.3 Descriptive Statistics of the NPL ratios of PBs from 2016 to 2022.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Albaraka Türk	7	5.22	1.81	1.90	7.20
Kuveyt Türk	7	2.75	.80	1.64	3.71
Türkiye Emlak	4	1.33	1.08	.21	2.80
Türkiye Finans	7	5.28	1.46	3.15	8.01
Vakıf	7	1.48	1.12	.14	3.04
Ziraat	7	1.57	1.08	.21	2.80
Average	7	3.05	.96	1.51	4.47

The average NPL ratio of Albaraka Türk PB stands at 5.22, demonstrating a significant portion of the NPL ratio within the bank's portfolio. The standard deviation of 1.81 indicates variability in the NPL ratio around this mean. The scores vary from 1.90 to 7.20, signifying diverse levels of NPL ratio. On the other hand, Kuveyt Türk PB exhibits a lower average NPL ratio of 2.75, reflecting a relatively healthier loan portfolio. The standard deviation of 0.80 suggests a moderate level of variability around the mean. The NPL ratios range from 1.64 to 3.71, indicating a narrower spread compared to Albaraka Türk PB. Türkiye Emlak PB has a smaller sample size (Obs. 4), with an average NPL ratio of 1.33. The standard deviation of 1.08 reveals higher dispersion around the mean, while the NPL ratios range from 0.21 to 2.80, indicating a wide range of NPL ratios. Türkiye Finans PB shows a relatively high average NPL ratio of 5.28, accompanied by a standard deviation of 1.46. The NPL ratios range from 3.15 to 8.01, suggesting a considerable variability in the NPL ratio. Both Vakıf and Ziraat PBs have average NPL ratios of 1.48 and 1.57, respectively, with standard deviations of 1.12 and 1.08. The NPL ratios span from 0.14 to 3.04, reflecting varying degrees of NPL within these banks.

The overall average for all banks is 3.05, with a standard deviation of 0.96. This indicates an average level of NPL ratio across the combined dataset. The minimum and maximum NPL ratios are 1.51 and 4.47, respectively, providing a range of NPL ratio levels within the considered banks over the specified period.

Figure 4.3 The NPL ratios of PBs from 2016 to 2022 (%)



Source: Calculated by the author based on the Participant Banks Association of Türkiye (TKBB) reports accessed July 31, 2023, from https://tkbb.org.tr/sayfa/sektor-bilgileri/denetim-raporlari

According to Figure 4.3, starting with Albaraka Türk PB, the NPL ratio fluctuated over the years. It increased from 4.75% in 2016 to 7.20% in 2019, suggesting credit quality concerns possibly due to economic challenges or sector-specific factors affecting borrowers' ability to repay loans. However, the bank demonstrated resilience by decreasing the NPL ratio to 4.80% in 2020, possibly a result of proactive credit risk management measures even during the COVID-19 pandemic. The ratio increased again to 6.30% in 2021 before significantly declining to 1.90% in 2022, indicating successful efforts in managing credit risk and enhancing asset quality in the last year. Kuveyt Türk PB maintained relatively stable NPL ratios ranging from 1.85% to 3.71% over the years. The slight upward trend in recent years might be attributed to economic challenges, including the effects of the COVID-19 pandemic. However, the bank's NPL ratios remained at manageable levels, reflecting sound credit risk management practices. Türkiye Emlak PB stood out with remarkable NPL performance, maintaining low NPL ratios and making them lower each year throughout its life. This indicates excellent credit risk management and minimal NPAs, reflecting the bank's focused approach and prudent lending. Türkiye Finans PB witnessed fluctuations in its NPL ratio, with a peak of 8.01% in 2019 over the sector. The bank managed to improve its NPL ratio in subsequent years, possibly through enhanced credit risk management and loan restructuring efforts during the pandemic's economic impact. Vakıf PB displayed consistently strong credit risk management, maintaining NPL ratios ranging from 0.14% to 0.90%.

Exceptionally low NPL ratios indicate effective risk management and a healthy asset portfolio, further solidified by the bank's conservative financial structure and prudent lending practices. Ziraat PB maintained relatively stable NPL ratios between 0.21% and 2.80%. The bank's conservative approach and diverse customer base likely contributed to its stable performance and effective credit risk management.

Overall, most of the PBs maintained relatively low NPL ratios, suggesting their ability to manage credit risks effectively and maintain financial stability. Vakıf and Türkiye Emlak PBs showcased exceptional performance with the lowest NPL ratios, reflecting their credit risk management practices. While the NPL ratios for Albaraka and Türkiye Finans PBs surpassed the 5% threshold for a couple of years, they signified a good credit risk management portfolio in 2022. The analysis also indicates that the COVID-19 pandemic might have influenced NPL ratios for some banks, but overall, the banks demonstrated resilience and effective risk management.

4.4 Descriptive Statistics and Comparison of NPL between PBs and CBs

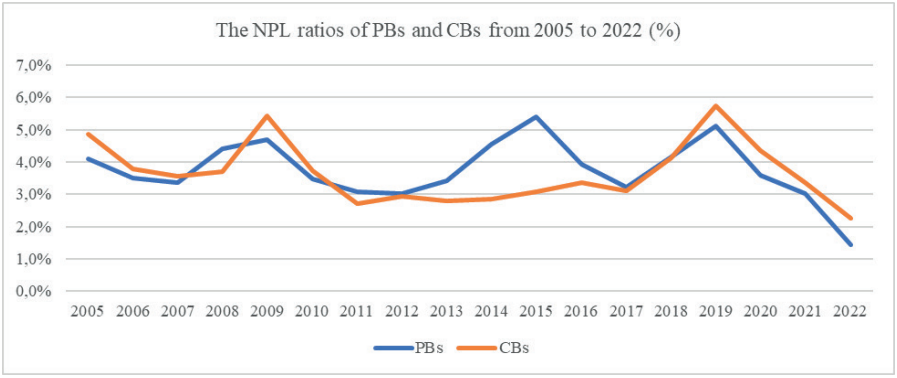
Examination of the descriptive statistics and outcomes of the NPL ratio for PBs and CBs are presented in Table 4.4.

Table 4.4 Descriptive Statistics of the NPL ratios of PBs and CBs from 2005 to 2022.

Variable	Obs.	Mean	Std. Dev.	Min	Max
PBs	18	3.75	.92	1.43	5.40
CBs	18	3.65	.95	2.25	5.74

For the CBs, the data indicates an average NPL ratio of 3.65, signifying a moderate level of NPL within their loan portfolios. The standard deviation of 0.95 suggests some variability around this mean, while the NPL ratios range from 2.25 to 5.74, indicating diverse levels of NPL across these banks. Conversely, PBs display a slightly higher average NPL ratio of 3.75, reflecting a comparable degree of NPL ratio within their portfolios. The standard deviation of 0.92 suggests a relatively consistent distribution of NPL ratios around this mean. The NPL ratios span from 1.43 to 5.40, demonstrating varying levels of NPL among the participating banks.

Figure 4.4 The NPL ratios of PBs and CBs from 2005 to 2022 (%)



Source: Prepared by the author based on the BRSA website annual data accessed July 31, 2023, from http://www.bddk.org.tr/BultenAylik/

Based on Figure 4.4, between 2005 and 2008, both PBs and CBs experienced relatively stable NPL ratios. PBs consistently maintained slightly lower ratios compared to CBs during this period. In 2008, the NPL ratio for PBs rose to 4.40%, indicating a notable impact on their loan quality and a higher risk of loan defaults. On the other hand, CBs showed a relatively modest increase in their NPL ratio, which reached 3.71% in the same year.

From 2009 to 2014, the NPL ratios for both PBs and CBs fluctuated. In 2009, PBs' NPL ratio increased to 4.70%, while CBs' ratio increased to 5.42%. This year has the potential to show the effects of the global 2008 economic crisis considering to NPL ratio Hence, the NPL ratios of CBs have increased more than the NPL ratio of PBs in the year 2009. However, both sectors gradually reduced their NPL ratios over time.

In 2015, both PBs and CBs experienced an increase in their NPL ratios, with PBs reaching 5.40%, having more value than CBs' NPL ratio may show the possibility of economic challenges during this period. In 2016 and 2017, both PBs and CBs experienced a decline in their NPL ratios. This improvement in asset quality suggests a relatively stable economic environment during these years. In 2018, both PBs and CBs saw a slight increase in their NPL ratios, which may have been influenced by global economic challenges or specific economic events in the respective regions. In 2019, both sectors witnessed a more significant increase in their NPL ratios. This rise could be attributed to global economic uncertainties and challenges during this period. CBs had a higher NPL ratio of 5.74% compared to PBs' 5.13%.

In 2020, PBs and CBs showed resilience by managing to reduce their NPL ratio, possibly due to proactive risk management and conservative lending practices. Again in 2021, both PBs and CBs maintained relatively low NPL ratios compared to previous years, showing their adaptability to the pandemic-induced economic uncertainties. In 2022, PBs demonstrated a remarkable improvement in their credit risk management, achieving a low NPL ratio of 1.43%. CBs also improved but had a slightly higher NPL ratio of 2.25%. For the last five years, however, the NPL ratio of CBs has been higher than the NPL ratio of PBs.

Overall, PBs demonstrated more resilience during economic crises and the COVID-19 pandemic, maintaining relatively lower NPL ratios compared to CBs. However, both sectors showed improvements in managing credit risks over the years.

4.5 Statistical Analysis Using the Wilcoxon Signed-Rank Test

The Wilcoxon signed-rank test is a non-parametric statistical test used to assess whether there is a significant difference between paired observations within a dataset (Oyeka & Ebuh, 2012). Because of the interdependencies between banks due to systematic risk (the performance of one bank has an unavoidable impact on the performance of other banks), the Wilcoxon signed rank is selected. I will employ this test to determine whether there are statistically significant variations in EM Scores and NPL ratios between the two bank types from 2005 to 2022.

✓ For the EM Score, our hypothesis is:

H0: $\mu_{PB} = \mu_{CB}$ *EM Score of PBs is equal to the EM Score of CBs.*

Ha: $\mu_{PB} \neq \mu_{CB}$ *EM Score of PBs is not equal to the EM Score of CBs.*

The Wilcoxon Signed Rank Test Z statistic is -0.893 (p value:0.37)

Number of the observations is 18. From those observations, 10 of them have positive sign values and 8 have negative signs. There are no observations that have the same sign which results in have zero value. The p-value is 0.3720 and the test yielded a test statistic (z) of -0.893. This test statistic does not suggest that there could be meaningful differences in EM Score values between the two bank types.

✓ For NPL ratios, our hypothesis is:

H0: $\mu_{PB} = \mu_{CB}$ *NPL ratio of PBs is equal to the NPL ratio of CBs.*

Ha: $\mu_{PB} \neq \mu_{CB}$ *NPL ratio of PBs is not equal to the NPL ratio of CBs.*

The Wilcoxon Signed Rank Test Z statistic is -0.196 (p value:0.84)

Number of the observations is 18. From those observations, 9 of them have a positive sign value and 9 have a negative sign. There are no observations that have the same sign which results in have zero value. The p-value is 0.8446 and the test yielded a test statistic (z) of -0.196. This test statistic does not suggest that there could be meaningful differences in EM Score values between the two bank types.

4.6 Correlation Assessment between Results of EM Score and Results of NPL

Correlation analyses were conducted for the EM Score and the NPL ratio of both PBs and CBs over the period from 2005 to 2022 to see if there is any significant correlation between the EM Score value and the NPL ratio of each type of bank. As a higher EM Score represents better financial stability and a higher NPL ratio represents more credit risk, I expect to observe a negative correlation between the EM Score and NPL ratio of each group.

Table 4.5 Correlation Analysis of the EM Score and the NPL ratios of PBs and CBs from 2005 to 2022.

PBS	**EM-S**	**NPL**	**CBS**	**EM-S**	**NPL**
EM-S	1.0000		**EM-S**	1.0000	
NPL	-0.0813	1.0000	**NPL**	-0.2806	1.0000

The correlation coefficient between the EM Score of PBs and the NPL of PBs is -0.0813. This coefficient suggests a weak negative correlation between the two variables. This means that as the EM Score of PBs increases, the NPL ratio tends to decrease. However, the correlation is close to zero, indicating that there is very little linear relationship between them.

The correlation coefficient is -0.2806 between the EM Score and NPL of CBs suggesting a moderate negative correlation. This suggests that there is a more noticeable relationship between the EM Score and the NPL ratio for CBs. This is in line with our negative relationship expectations. This means that as financial stability (EM Score) improves, credit risk (NPL ratio) tends to decrease. This is consistent with the idea that well-managed banks with better financial stability are generally at lower risk of non-performing loans.

5. DISCUSSION

5.1 Interpretation of the Results

Within the realm of PBs, variations in financial health and credit risk management were noted. When considering the average EM Score of the PBs, Vakıf PB leads with the highest EM Score of 4.07, indicating significant financial stability within a relatively narrow range. Ziraat PB follows closely with an EM Score of 3.79, signifying a moderate level of financial stability. Türkiye Finans, Kuveyt Türk, and Albaraka Türk PBs showcase relatively similar trends in EM Score values, all ranging from around 3.60 to 3.70, suggesting comparable levels of financial stability. In this context, Türkiye Emlak PB demonstrates a relatively stable financial position with an EM Score of 3.31, reflecting prudent financial stability. On average, the EM Score for all banks stands at 3.72, collectively displaying a moderate level of financial stability. Importantly, all these scores are comfortably above 2.60, indicating that they are well within the safe zone for financial health.

On the NPL front, among the PBs, Türkiye Emlak PB stood out with the most effective credit risk management, boasting consistently low NPL with an average NPL ratio of 1.33, showcasing the best credit portfolio performance. Vakıf PB showcased a relatively stable credit risk profile with an average NPL ratio of 1.48, ranking third. Ziraat PB ranked fourth, displaying varying credit risk levels within its portfolio with an average NPL ratio of 1.57. which means Public PBs have comparatively less credit risk and credit default. Following closely to public PBs, Kuveyt Türk PB demonstrated a resilient loan portfolio with relatively lower NPL ratios, averaging 2.75. Albaraka Türk PB ranked fifth, presenting potential fluctuations in credit risk with an average NPL ratio of 5.22, while Türkiye Finans PB ranked sixth, exhibiting relatively higher NPL with an average NPL ratio of 5.28, indicating a diverse range of credit risk levels within their respective portfolios. The average NPL ratio for all banks is 3.05, with a standard deviation of 0.96, signifying moderate NPL levels across the dataset. Indeed, while there were instances when Albaraka Türk and Türkiye Finans PBs exceeded the 5% threshold in some years, their overall performance indicates a sound credit risk portfolio. The majority of their NPL ratio levels are below 5%, aligning with a prudent credit risk portfolio.

A notable comparison emerged between PBs, and CBs based on their average EM Scores. CBs recorded an average EM Score of 3.80, while PBs exhibited a higher average EM Score of 4.00, suggesting a relatively stronger financial position. In terms of NPL ratio, PBs and CBs showcased

comparable stable, and resilient NPL ratios. Even though PBs have a slightly higher NPL ratio of 3.75, since 2019 they have had less NPL ratio than their conventional counterparts.

The Wilcoxon signed-rank test was conducted to assess significant variations in EM Score and NPL ratio between PBs and CBs from 2005 to 2022. The test results revealed that there are no meaningful differences in EM Score values between the two bank types. The NPL ratios did not show statistically significant differentiation between PBs and CBs as well.

The correlation analysis reveals that there is a correlation between the EM Score and the NPL ratio, although the strength of this relationship varies between PBs and CBs. For PBs, the correlation is weak, indicating that there is very little linear relationship between financial stability, as measured by the EM Score, and credit risk, as represented by the NPL ratio. In contrast, for CBs, the correlation is more pronounced, suggesting that changes in the EM Score have a stronger likelihood of being associated with changes in the NPL ratio. Overall, the analysis suggests a connection between financial stability and credit risk within the dataset, with a moderate correlation observed for CBs and a weak correlation noted for PBs. This suggests that there is a noticeable but not very strong connection between these essential financial indicators.

5.2 Implications of the Study

Our findings have several implications for the banking sector. These are:

The comparative analysis of the EM Score highlights variations among different banks. This means that when examining the EM Scores of various banks, we observe differences in the levels of financial stability. These variations could stem from a range of factors, including differences in management practices, risk exposure, asset quality, or economic conditions in the regions where these banks operate.

The variability in the NPL ratio among different banks indicates differences in their approaches to credit risk management. Some banks consistently maintain a low NPL ratio, while others demonstrate greater fluctuations in this measure. However, overall, most of these banks appear to have a convenient level of NPL ratio.

The comparison between PBs and CBs highlights that PBs tend to have higher EM Score values, reflecting better financial stability. However, both PBs and CBs exhibit similar NPL ratios. For both bank categories, financial stability, and credit risk portfolio are in a reasonable and convenient level.

The correlation analysis reveals a low degree of negative correlation between EM Score and NPL ratios, indicating that there may be some other factor that affects our correlation.

These implications aim to guide banks towards maintaining a healthy financial position while effectively managing their credit risk.

5.3 Limitations of the Study

While our study offers valuable insights, it is important to acknowledge its limitations. These are:

The most important limitation observed during calculating the EM Score. One of the variables with one of the two biggest coefficients of the overall equation is X1, which represents the ratio of net working capital to total assets. This variable has been found to have consistently negative and very low values across all years and banks as deposits tend to be short-term, while granted credits are largely long-term. More importantly, it's very difficult to calculate Net Working Capital (NWC) for banks as they have different balance sheets than regular firms. Since NWC represents current assets / short-term liabilities, there are no such categories for the bank's balance sheet. Even if they may follow their short-term liabilities in some other ways, there will be no current asset or short-term and long-term liability categories in the bank's balance sheet when I check their financial statements and reports. Therefore, it is very difficult to figure out the overall NWC ratio. As a result, this either negative or missing value of net working capital impacts the X1 variable, which in turn affects the overall Z-Score value in the discriminant analysis.

Our analysis is confined to a specific timeframe, potentially missing broader trends and variations. Some influence of external factors, such as global economic events, may not be fully captured in our study.

Financial data alone may not capture all relevant risk factors, such as operational risks or market conditions, limiting the study's scope.

6. CONCLUSION AND POLICY RECOMMENDATION

6.1 Conclusion

This study delved into the intricate landscape of Turkish PBs and CBs. The analysis of EM Score and NPL ratios provided a deep understanding of the financial stability and risk resilience of these banks. The study revealed that PBs demonstrated commendable financial performance with EM Score consistently exceeding the threshold of 2.6. This stability was maintained

even during periods of economic turbulence, such as the global financial crisis and the COVID-19 pandemic. Comparing PBs with CBs, even PBs exhibited a higher average EM Score, but statistically, it does not make any meaningful difference. Both sectors have an acceptable value of EM Score.

Based on NPL findings, even though there are some fluctuations and diverse values among PBs, overall performance indicates a sound credit risk portfolio. In terms of comparison, PBs and CBs showcased comparable stable and resilient NPL ratios on average. Even though PBs have slightly higher NPL ratios, since 2019 they have had less NPL ratio than their conventional counterparts.

The Wilcoxon Signed-Rank Test did not suggest any meaningful differences between both bank categories regarding the EM Score and NPL ratio. On the other hand, the correlation analysis showcases a moderate negative correlation between the EM Score and the NPL ratio.

These findings hold significant implications for the Turkish banking industry, regulators, and policymakers. The study underscores the capacity of PBs and CBs to navigate economic downturns while maintaining financial stability. The research contributes valuable insights to decision-making processes, fostering a more stable and resilient banking ecosystem in Türkiye. As the financial landscape continues to evolve, these findings offer a guiding light for the industry's future endeavors, promoting sustained growth and risk mitigation.

6.2 Policy Recommendations

I have some recommendations to enhance credit risk management practices, strengthen financial stability, and improve overall risk resilience within the Turkish PBs. These are:

Banks, particularly PBs, can utilize EM Score results to evaluate their financial stability position and should prioritize strengthening their financial stability measures accordingly. This could involve optimizing capital structures, liquidity management, and asset quality to improve overall financial health as the dependent variable of the EM Score based on these elements.

Banks with relatively higher NPL variability should consider diversifying their loan portfolios to mitigate credit risk concentration.

Banks should align their asset allocation strategies with their financial stability goals. This involves balancing higher-return assets with lower-

risk assets to optimize financial stability and credit risk management simultaneously.

The low negative correlation between EM Score and NPL ratios underscores the need for a holistic approach that integrates financial stability and credit risk to see the other factors that may affect this correlation. Moreover, banks should perform regular economic scenario analyses to assess the potential impact of macroeconomic changes on both financial stability and credit risk. This helps in preparing proactive strategies to navigate uncertainties effectively.

Banks should strike a balance between financial stability and credit risk as these two have significant importance for sustainable growth and resilience. They should establish a robust monitoring and analysis system to continuously assess their financial health and credit risk management performance.

As proactive identification and management of potential vulnerabilities can enhance overall stability, regular monitoring of EM Score value and NPL ratios is essential. These regular reviews can help identify trends, areas for improvement, and potential early warning signals.

Finally, investment in continuous training for bank staff involved in credit risk assessment and management can be very useful. A well-trained team can contribute to effective risk identification, mitigation, and management strategies.

6.3 Suggestion for Future Research

To contribute to a deeper understanding of financial stability and credit risk, I propose the following areas for future research:

Exploring alternative methods for analyzing the financial stability of banks, taking into account the challenges associated with computing the net working capital ratio for banks. It may be worthwhile to investigate adaptations or modifications of the formula that can accurately represent the financial health of banks while accommodating their unique balance sheet structures.

Conducting a longitudinal study over an extended period to capture long-term financial trends and dynamics with a comprehensive perspective will be more beneficial.

It's a good idea to undertake a cross-border comparative study involving international banks to offer a broader and more global view of financial stability and credit risk.

Recognizing that financial data alone may not encompass all relevant risk factors affecting banks, future studies could benefit from a multi-dimensional approach, which includes incorporating non-financial risk factors such as operational risks, regulatory changes, and market conditions. This approach might involve qualitative data analysis, sentiment analysis of industry reports, or seeking expert opinions to complement quantitative analysis.

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