

SHORT-TERM VS. LONG-TERM ANALYSIS OF LOAN
VOLUME AND NON-PERFORMING LOANS: TURKISH
BANKING SECTOR PERSPECTIVE

A THESIS
SUBMITTED TO ABDULLAH GÜL UNIVERSITY
SOCIAL SCIENCES INSTITUTE
IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF MASTER OF ARTS

By
Mehmet Kemal YILDIZ
May, 2025
Kayseri, Türkiye

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YILDIZ

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SCIENTIFIC ETHICS COMPLIANCE

I hereby declare that all information in this document has been obtained in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all materials and results that are not original to this work.

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REGULATORY COMPLIANCE

M.A. thesis titled Short-Term Vs. Long-Term Analysis Of Loan Volume And Non-Performing Loans: Turkish Banking Sector Perspective has been prepared in accordance with the Graduate Thesis Preparation Guidelines of the Abdullah Gül University, Social Sciences Institute.

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ABSTRACT

This thesis investigates the dynamic relationship between loan volume and NPLs in the Turkish banking sector, focusing on both short-term and long-term perspectives. Using weekly data from January 2014 to May 2024 and employing the DCC model, this study explores how credit growth and economic shocks influence NPLs. The findings reveal a significant correlation between loan volumes and NPLs in the long term. On the other hand, the thesis also shows notable fluctuations during financial instability, such as the 2018 currency crisis and the COVID-19 pandemic. The cross-correlation analysis further highlights the effects of loan growth on NPLs following the importance of proactive risk management. The research provides actionable insights for policymakers, emphasizing the need for balanced credit growth, enhanced regulatory frameworks, and dynamic risk assessment tools. These findings contribute to the literature by offering a nuanced understanding of the relationship between credit dynamics and financial stability in an emerging market context. The study also aligns with Sustainable Development Goals (SDGs) 8, 10, and 17, supporting inclusive economic growth and reduced financial inequalities and partnership through improved banking practices.

Keywords: Non-Performing Loans, Loan Volume, Banking Sector

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ÖZET

Bu tez, Türkiye bankacılık sektöründe kredi hacmi ile takipteki krediler (TK) arasındaki dinamik ilişkiyi hem kısa hem de uzun vadeli perspektiflerden incelemektedir. 2014'ün Ocak ayından 2024'ün Mart ayına kadar olan veriler kullanılarak, Dinamik Koşullu Korelasyon (DCC) modeli aracılığıyla kredi büyümesi ve ekonomik şokların TK'lere nasıl etki ettiği araştırılmaktadır. Bulgular, uzun vadede kredi hacmi ile TK'ler arasında anlamlı bir ilişki olduğunu ortaya koymaktadır. Öte yandan, 2018 döviz krizi ve COVID-19 pandemisi gibi finansal istikrarsızlık dönemlerinde kayda değer dalgalanmalar yaşandığı da tespit edilmiştir. Çapraz korelasyon analizi, kredi büyümesinin TK'ler üzerindeki etkilerini daha da vurgulayarak, proaktif risk yönetiminin önemini göstermektedir. Araştırma, dengeli kredi büyümesi, geliştirilmiş düzenleyici çerçeveler ve dinamik risk değerlendirme araçlarının önemini vurgulayarak politika yapıcılar için uygulanabilir öneriler sunmaktadır. Bu bulgular, kredi dinamikleri ile finansal istikrar arasındaki ilişkiye dair daha detaylı bir anlayış sunarak literatüre katkı sağlamaktadır. Çalışma ayrıca, bankacılık uygulamalarının iyileştirilmesi yoluyla kapsayıcı ekonomik büyümeyi ve finansal eşitsizliklerin azaltılmasını destekleyen Sürdürülebilir Kalkınma Amaçları'ndan (SKA) 8, 10 ve 17 ile uyum göstermektedir.

Anahtar Kelimeler: Takipteki Alacaklar, Kredi Hacmi, Bankacılık Sektörü

TABLE OF CONTENTS

ABSTRACT.....	1
ÖZET.....	2
TABLE OF CONTENTS.....	3
LIST OF ABBREVIATIONS.....	5
LIST OF GRAPHS.....	6
1. INTRODUCTION.....	7
2. LITERATURE REVIEW.....	10
3. METHODOLOGY	24
3.1 Data Collection and Sources	24
3.2 Model Selection.....	25
3.2.1 Core Concepts	28
3.2.2 Advantages of the DCC Model	31
3.3 Software Tools	32
4. RESULTS.....	33

4.1 Cross-Correlation Analysis of Loan Volume and NPLs	34
4.2 Analysis of DCC Model Results.....	36
4.3 Analysis of DCC and Its Implications.....	49
5. CONCLUSION	53
5.1 Policy and Practical Implications	54
5.1.1 Strengthening Risk Management Practices.....	54
5.1.2 Regulatory Framework Enhancements.....	54
5.1.3 Promoting Financial Inclusion and Diversification	55
5.1.4 Leveraging Technology and Data Analytics.....	56
5.1.5 Policy Coordination and Collaboration.....	56
6. REFERENCES	62

LIST OF ABBREVIATIONS

BIS	Bank for International Settlements
BRSA	Banking Regulation and Supervision Agency of Türkiye
CBRT	Central Bank of the Republic of Türkiye
DCC	Dynamic Conditional Correlation
NPL	Non-Performing Loan
OECD	Organization for Economic Co-operation and Development
SDG	Sustainable Development Goals
TL	Turkish Lira

LIST OF GRAPHS

Graph 4.1.1 Cross-Correlation Analysis.....	34
Graph 4.2.1 Trends in Loan Volume and Non-Performing Loans	39
Graph 4.2.2 Loan Volume and Non-Performing Loans in 2018.....	40
Graph 4.2.3 Loan Volume and Non-Performing Loans in 2020.....	41
Graph 4.2.4 Loan Volume and Non-Performing Loans in 2022-2024.....	43
Graph 4.2.5 Loan Volume and Non-Performing Loans Adjusted Inflation.....	46
Graph 4.2.6 Loan Volume And Non-Performing Loans DCC Results.....	48
Graph 4.3.1 Analysis of Dynamic Conditional Correlation in 2018.....	50
Graph 4.3.2 Analysis of Dynamic Conditional Correlation in 2020.....	51
Graph 4.3.3 Analysis of Dynamic Conditional Correlation in 2022 and 2024.....	52

1. INTRODUCTION

The banking sector plays a crucial role in the stability and growth of any economy (Komolov, 2015). The connection between economic growth and banking has led to the development of the entire economy and is associated with the banking industry's health (Dsouza & Jain, 2022). The financial quality of the banking system is of great importance not only for the robustness of the banking sector but also for other fundamental components of the economy (Çolak et al., 2024). Therefore, the relationship between loan volumes and non-performing loans is significant for the Turkish state and private banks as it directly affects the economic health and stability of banks and the overall economy (Klein, 2013). This study has important implications for the Turkish banking sector and provides policy insights into risk management practices and regulatory policies.

The financial quality of the banking system is of great importance not only for the robustness of the banking sector but also for other fundamental components of the economy (Levine, 2005). The crisis and economic challenges have highlighted the importance of effective risk management and regulatory oversight in the banking sector (Leaven&Valencia, 2013). NPLs are essential because they reflect the credit quality of banks' loan portfolios and, collectively, the credit quality of the banking sector's loan portfolio in a country (Ozili, 2019). Understanding the factors that affect NPL levels is vital to banks' risk management function and financial stability (Ozili, 2019). According to the BRSA, NPLs are classified as loans and other receivables overdue for 90 days and above due to the borrower's deteriorating financial condition. Institutions such as the CBRT and BIS regularly monitor non-performing loan data and publish the relevant data in their reports. The BIS report (2017), which was written by Baudino and Yun, underscores that high NPL ratios can undermine financial intermediation and economic growth, particularly in economies with elevated credit exposure. In this context, understanding the determinants and dynamics of NPL has become increasingly important for policymakers, regulators, and market participants.

This study investigates the period from January 2014 to March 2024, a critical window for understanding the interaction between loan growth and NPLs in Türkiye's banking sector. Applying the DCC model, it explores the time-varying relationship between the variables and examines how economic shocks, regulatory changes, and credit conditions influence this dynamic in the Turkish Banking Sector.

Specifically, the purpose of this research is:

Examine the long-term and short-term relationship between non-performing loans and loan volume in the Turkish banking sector. This relationship is significant due to the Turkish government's economic approach to interest rates, which will yield substantial results on managing risks based on loan growth. This BRSA defines NPLs as loans that default due to missed payments or payment delays beyond 90 days. Loan volume is the total amount of loans banks provide to customers for a given period. Previous studies have explored various aspects of the banking sector's performance, but this thesis aims to fill a significant gap in the literature by investigating the dynamic relationship between loan volumes and NPLs, particularly in the Turkish context.

It is essential to note that this study has certain limitations:

Temporal Limitations: The data used in this study spans from January 2014 to March 2024. While this period provides a substantial scope, significant economic events or regulatory changes outside this timeframe may still need to be captured.

Data Quality: The accuracy and reliability of the data sourced from various financial institutions and regulatory bodies could affect the study's outcomes. Inconsistent data reporting practices or gaps in historical data can introduce biases.

Exclusion of Other Variables: The study primarily focuses on the relationship between loan volumes and NPLs. The analysis does not include other macroeconomic variables, such as GDP growth, inflation, or interest rates, which could influence the relationship.

Regulatory Changes: Frequent regulatory frameworks and banking policy changes can significantly impact the dynamics between loan volumes and NPLs.

In conducting this research, several ethical considerations have been observed to maintain the confidentiality and integrity of the data. The aim of this research is to contribute valuable information to the banking sector, create more effective risk management strategies, and help develop regulatory policies and decision-making processes.

The three selected SDGs for this study are Decent Work and Economic Growth, Reduced Inequalities, and Partnerships for the Goals. This research investigates short-term and long-term trends in loan volume and NPLs to provide insights into the financial stability of the Turkish banking sector. The study aims to contribute to a sustainable and inclusive economic environment by linking these financial indicators to the specified SDGs. Ensuring sustainable growth and improved credit quality in the banking sector is critical not only for financial stability but also for enhancing social welfare. Sassi and Goaid (2011) emphasize that financial inclusion and responsible lending contribute

directly to poverty reduction and economic stability, aligning with the objectives of SDG 8 and 10.

The SDG on Decent Work and Economic Growth strongly emphasizes the role of the financial sector in promoting sustainable, inclusive, and sustainable economic growth (United Nations, 2015). This study aims to contribute to the financial sector's risk management by examining the long-term and short-term relationship between NPL and loan volume.

The goal of reducing inequalities highlights the urgent need to address income inequality in the financial sector (United Nations, 2015). This research offers recommendations for creating a more equitable financial system.

Partnerships for the Goals emphasize the critical role of collaborative efforts in achieving sustainable development (United Nations, 2015). This thesis examines the relationship between financial institutions, regulatory bodies, and other stakeholders to increase the effectiveness of policies and practices to attain the identified SDGs.

2. LITERATURE REVIEW

The banking sector is a vital component of a nation's economy, representing a significant portion of its capital. Within a bank's total assets, the loan portfolio holds particular importance as it generates substantial interest income, a crucial indicator of its financial performance and stability (Vatansever & Hepşen, 2013). Consequently, the NPL ratio is a critical measure of a bank's performance. Recent research has underscored the

growing recognition of the relationship between macroeconomic indicators such as bank-level factors, and the NPL ratio.

Yun and Moon (2014) investigate systemic risk in the Korean banking sector using Marginal Expected Shortfall (MES) and CoVaR as key measures computed via Engle's DCC model. Their study highlights the characteristics of Korea's bank-dominated financial system and contrasts it with the US and Europe's market-based systems. Yun and Moon (2014) find that MES and CoVaR yield qualitatively similar results in cross-sectional evaluations of systemic risk contributions, though the two measures provide differing insights during periods of financial instability. In their empirical analysis, the authors emphasize the importance of bank-specific characteristics such as size, leverage ratio, and VaR in determining systemic risk contributions. They identify a significant positive relationship between systemic risk contributions and bank size and VaR in both cross-sectional and time-series dimensions. Moreover, leverage ratios show weak correlations in cross-sectional analysis but emerge as significant contributors to systemic risk over time. This divergence underscores the dynamic nature of systemic risk and highlights the limitations of static measures in risk management. In summary, the study by Yun and Moon (2014) enriches the literature on systemic risk measurement by adapting MES and CoVaR to a bank-dominated financial system and proposing the aggregate MES as a practical tool for systemic risk monitoring. These contributions are instrumental in bridging theoretical models with policy-oriented applications, particularly in emerging markets.

Shi (2022) conducted an empirical investigation into the interconnectedness of the Chinese stock market and its Asia-Pacific counterparts in the aftermath of the Global Financial Crisis. Employing the Dynamic Conditional Correlation–Mixed Data Sampling (DCC-MIDAS) model, the study differentiated between short- and long-term comovements to assess how key economic shocks—such as the Shanghai stock market collapse, the escalation of the US-China trade conflict, and the COVID-19 outbreak—

altered regional financial linkages. The results indicated a notable amplification in contagion effects among these markets during major events. Furthermore, bilateral trade relations and market structural similarities were identified as influential factors in shaping the degree of synchronization between China and both developed and emerging markets in the region. Shi's work adds to the financial integration literature by offering quantitative insights into the evolving nature of stock market interdependence in Asia-Pacific economies, emphasizing the relevance of both country-specific and global determinants.

Virk and Javed (2017) explore European equity market integration by analyzing the co-movement of seven leading European stock markets from 1990 to 2013 using the Dynamic Conditional Correlation-Mixed Data Sampling (DCC-MIDAS) model. This methodology allows the integration of daily stock market data with monthly macroeconomic variables, providing a nuanced understanding of short- and long-term correlations. The study reveals a distinct divergence between large and small equity markets, with smaller markets showing higher short-run European convergence than larger markets. The results also highlight the significant impact of the European debt crisis, particularly the Greek crisis, on market correlations. The findings underscore the importance of geographical proximity and monetary integration in driving financial market interdependencies, providing valuable insights into the dynamic nature of European equity market integration. This research contributes to the literature by demonstrating the utility of the DCC-MIDAS model in capturing the nuanced impacts of macroeconomic conditions on financial market correlations.

The study by Fiszeder, Faldziński, and Molnár (2019) presents an advanced application of the DCC model by incorporating high and low prices into the framework to enhance covariance and Value-at-Risk (VaR) forecasting. The authors argue that traditional DCC models relying solely on closing prices are less effective in capturing market volatility compared to those leveraging high and low prices. Using datasets from currency pairs, commodity exchange-traded funds (ETFs), and stocks over the 2008–2016

period, they demonstrate that the DCC-RGARCH model significantly outperforms standard DCC and DCC-CARR models in forecasting covariance and Value-at-Risk (VaR). The study highlights that range-based models respond more effectively to abrupt market changes, addressing a critical limitation of return-based GARCH models. However, the findings also show that the model's performance is contingent on the type of asset class, with mixed results in stock data due to extreme outliers. By utilizing statistical tests like the Diebold–Mariano test and log-likelihood comparisons, the authors establish the superiority of their model for most financial instruments. Despite its strengths, the study does not account for asymmetric effects in volatility or longer-term structural changes in financial markets, which could limit its applicability in certain contexts.

The study by Al-Nassar et al. (2022) investigates the hedging and safe-haven properties of gold, Bitcoin, oil, and the oil price volatility index (OVX) during the COVID-19 pandemic. Using the DCC-GARCH model, the research analyzes the time-varying correlations between these alternative investments and the Saudi stock market. The findings reveal that gold and OVX exhibited strong hedging capabilities and served as weak safe havens during the early stages of the pandemic. In contrast, Bitcoin and oil, while demonstrating some hedging potential, were primarily diversifiers rather than safe havens. The study underscores the critical role of gold as a flight-to-safety asset, particularly during periods of heightened market uncertainty, and highlights the importance of OVX-based products in managing portfolio risks in oil-exporting countries. The research highlights the importance of gold and OVX in mitigating risks in oil-exporting economies and suggests future exploration into non-traditional hedging tools, broader market samples, and the inclusion of geopolitical variables for comprehensive risk analysis.

Shah, Bhanja, and Dar's (2023) study explores the diversification potential of gold and the US dollar in managing global sectoral risk, utilizing connectedness and DCC

measures. The study employs the Diebold-Yilmaz (2012) connectedness framework and the DCC-GARCH model to measure sectoral spillovers and the risk-reduction potential of safe assets like gold and the US dollar. Their findings reveal that global stock markets exhibit high sectoral connectedness, with the industrial and financial sectors particularly crucial in transmitting global sectoral shocks. Moreover, the study highlights the asymmetric nature of this connectedness, which intensifies during crisis periods such as the European debt crisis, Brexit, the US-China trade war, and the COVID-19 pandemic. The study demonstrates that including gold and the US dollar in investment portfolios effectively reduces sectoral risk, particularly during turbulent periods. This research contributes to the literature by emphasizing the importance of safe-haven assets in global risk management and comprehensively analyzing sectoral connectedness dynamics (Shah et al., 2023).

In their 2017 study, Bala and Takimoto explore how volatility spillovers behave between emerging markets (EMs) and developed markets (DMs) throughout periods of financial turbulence. Utilizing a suite of multivariate GARCH (MGARCH) models—particularly emphasizing the DCC framework with a skewed-t distribution—they examine data spanning from 1994 to 2016. The research addresses non-normal characteristics of financial returns, such as asymmetry and fat tails, by applying advanced modeling techniques including DCC-MGARCH and BEKK-MGARCH, with crisis-specific dummy variables to capture temporal effects. The analysis reveals that financial markets in developed economies tend to exhibit stronger and more persistent correlations compared to those in emerging economies, although both groups demonstrate a pronounced rise in interdependence during major crises, notably the Global Financial Crisis (2007–2009). Moreover, volatility in EMs appears to be predominantly self-contained, with minimal spillover effects from other markets. By integrating the skewed-t distribution into the DCC model, the authors enhance the robustness of volatility forecasts, offering methodological improvements over conventional specifications. This contribution underscores the necessity of incorporating distributional asymmetries and

crisis-sensitive modeling approaches when assessing volatility transmission across global financial markets.

The study by Zhang et al. (2023) examines systemic risk spillovers among various financial sectors and the stock market in China using the copula-DCC-GARCH model. By analyzing data from 2009 to 2021, dynamic correlations and conditional value-at-risk (CoVaR) measures are analyzed. The results reveal significant time-varying correlations, ranging from 0.7 to 0.9, with the banking sector identified as the primary source of systemic risk, followed by the securities and real estate sectors. The real estate sector emerges as a critical risk transmitter to the banking and securities sectors, reflecting its dominant role in China's financial system. Methodologically, the model effectively captures the interdependence of financial sectors, but its reliance on a market-based CoVaR approach may overlook micro-level contagion mechanisms. Additionally, the study highlights heightened spillover risks during events such as the Eurozone debt crisis, the Chinese stock market crash, and the COVID-19 pandemic.

Mandacı and Kırkpınar (2022) examine the volatility spillovers between oil prices (spot and futures) and firm-level stock prices in Borsa Istanbul, utilizing the DCC-GARCH and BEKK-GARCH models to identify sector-specific interactions. The study, covering the period from June 2015 to January 2020, demonstrates significant volatility spillovers, especially in sectors such as electricity, chemicals and petroleum, real estate and construction, and textile, food, and paper. The findings suggest that oil price fluctuations significantly affect stock price volatility, highlighting the sensitivity of energy-dependent sectors to oil market dynamics. Portfolio optimization and hedging strategies based on the analysis show that oil assets enhance portfolio diversification and risk management, with hedging effectiveness notably stronger under the BEKK-GARCH framework compared to the DCC-GARCH model.

Šeho, Ibrahim, and Mirakhor (2021) examine the impact of sectoral diversification of loans and financing on bank returns and risk in dual-banking systems, focusing on six countries—Malaysia, Bahrain, Kuwait, Qatar, Saudi Arabia, and the UAE—between 2000 and 2015. Using the Herfindahl–Hirschman Index (HHI) and Shannon Entropy (SE) as diversification measures, the study applies a system GMM estimator to analyze a panel dataset of 46 Islamic and 60 conventional banks. The findings reveal that sectoral diversification reduces profitability, as measured by Return on Average Assets (ROAA) and Return on Average Equity (ROAE), particularly at lower risk levels, where inefficiencies and monitoring challenges are more pronounced. Additionally, diversification increases risk, as evidenced by higher NPL ratios. Despite the operational differences between Islamic and conventional banks, such as Sharia-compliance constraints, the effects of diversification on returns and risks are statistically similar across the two types. Notably, the adverse effects of diversification on performance and risk were amplified during the 2008 financial crisis, underlining its potential drawbacks in periods of economic instability. The authors argue that the benefits of diversification may depend on effective sectoral expertise and risk management, particularly as risk levels rise. These findings suggest the need for tailored diversification strategies that account for a bank's specific risk profile and operating environment, as well as for robust regulatory frameworks to mitigate potential inefficiencies. Future research could explore cross-country comparisons, the role of regulatory environments, and the impact of diversification during multiple crises to enhance understanding of its implications on banking performance.

Bod'a and Zimková (2021) critique the traditional loan-to-deposit (LTD) ratio as an inadequate metric for assessing financial stability and propose an alternative, the Financial Intermediation Measure (FIM). The LTD ratio, while widely used, is criticized for its descriptive nature and lack of normative guidance on financial intermediation's efficiency and risks. The authors introduce the FIM, rooted in data envelopment analysis (DEA), to assess whether financial systems maximize the transformation of deposits into loans without exceeding acceptable risk levels. Using data from 48 financial systems spanning

1993–2016, sourced from the World Bank's Financial Development and Structure Dataset, the study finds that the FIM provides a more comprehensive assessment of financial intermediation performance compared to traditional indicators. High-income and market-based economies generally show better financial intermediation efficiency, but the study also highlights outliers, such as Luxembourg, where strong non-banking financial intermediation compensates for low LTD ratios. The authors acknowledge the limitations of the FIM, particularly its focus on banking intermediation, which may reduce its applicability to market-based systems. Nevertheless, the study provides a valuable tool for macroprudential regulation by identifying both underutilized and overly risky financial systems. While the FIM demonstrates robustness and applicability, future research could refine its scope by incorporating non-banking financial intermediation and exploring its implications in diverse regulatory environments.

Adão et al. (2022) investigate the relationship between interest rates and banks' risk-taking behavior through an innovative agent-based modeling (ABM) approach, incorporating banks, depositors, the Central Bank, firms, and a clearinghouse as key agents. The study explores how different interest rate regimes influence banks' lending portfolios, focusing on the proportion of loans extended to high-risk firms. Key findings reveal that low-interest rate environments incentivize riskier lending practices, supporting the risk-taking channel of monetary policy, while high-interest rates lead to increased capital buffers and stricter adherence to the Capital Adequacy Ratio (CAR) to mitigate systemic shocks. Methodologically, the study applies a learning mechanism—Experience-Weighted Attraction (EWA)—to simulate how agents adapt their strategies over time. The model highlights critical dynamics, such as the avoidance of central bank loans due to punitive rates and stigma, the essential role of the interbank market in liquidity management, and the differential impacts of interest rate regimes in developed and emerging economies. However, the study's reliance on parameter calibration based on existing datasets and its exclusion of broader macroeconomic variables may limit generalizability. The findings have significant implications for monetary policy, emphasizing the need to balance interest rate adjustments with their potential to amplify

financial instability. Future research could expand this framework to include non-banking financial intermediaries and explore geopolitical and macroprudential factors influencing banks' decision-making under varying economic conditions.

Us (2017) investigates the impact of the global financial crisis on the dynamics of NPLs in the Turkish banking sector, with a specific focus on ownership categories (state, private, and foreign banks) over the period 2002-Q4 and 2013-Q3. Utilizing a fixed-effects and random-effects panel data model, the study examines how bank-specific, macroeconomic, and policy-related factors influence NPLs before and after the crisis. The research highlights how the crisis differentially affected state, private, and foreign banks in Türkiye. The findings indicate that the crisis exacerbated NPL levels across all bank ownership types, but the magnitude and determinants varied. For instance, state banks showed a more vital linkage between capital adequacy and NPLs, while private and foreign banks were more sensitive to lending practices and inefficiencies. The study also underscores the importance of macroeconomic factors such as GDP growth and inflation in influencing NPL dynamics post-crisis. Additionally, the research suggests that ownership-specific variables should be considered in policy design to enhance the effectiveness of macroprudential regulations. This comprehensive analysis provides crucial insights into the heterogeneous impacts of financial crises on banking sectors with diverse ownership structures, contributing significantly to the literature on financial stability and risk management.

Benavides-Franco et al. (2023) analyze how loan volumes and non-performing loan (NPL) ratios evolved within the Colombian banking sector in response to the economic disruptions triggered by the COVID-19 pandemic. Utilizing a Vector Autoregressive Model with Exogenous Variables (VARX), the authors investigate the sensitivity of Colombia's credit market to external influences, with particular emphasis on the central bank's policy rate as a key exogenous determinant. Through impulse response analysis, the study simulates the trajectory of lending and default behavior following the pandemic

shock, uncovering marked and persistent increases in NPL ratios—especially within commercial and consumer loan segments. The research emphasizes the significance of incorporating exogenous macroeconomic shocks into financial system assessments and offers policy-relevant insights for mitigating systemic vulnerabilities. These findings underscore the need for adaptive regulatory frameworks capable of addressing prolonged financial stress conditions.

Köten (2021) explores the relationship between NPLs and profitability in the Turkish banking sector, focusing on the period 2010-Q1 and 2020-Q4. Using panel regression analysis, the study evaluates data from 27 public, private, and foreign banks to determine the impact of the NPL/Total Loans ratio and the Loan/Deposit ratio on Return on Assets (ROA). The results show that a 1% increase in the NPL ratio leads to a 0.23% decrease in ROA, while a 1% increase in the Loan/Deposit ratio corresponds to a 0.115% increase in ROA. The analysis confirms the negative impact of NPLs on bank profitability, emphasizing the importance of effective risk management and credit allocation strategies. The study utilizes econometric techniques, such as the Hausman test and cross-section SUR algorithms, to ensure robust results. However, it is limited by excluding macroeconomic variables and non-bank financial institutions. Köten highlights the critical role of NPLs as an indicator of asset quality and systemic risk, suggesting that policymakers should prioritize strategies to reduce NPL levels to sustain financial stability and economic growth.

Saba et al. (2012) examine the determinants of NPLs in the US banking sector, focusing on the relationship between macroeconomic variables and NPL rates. The study uses time-series data spanning 1985 to 2010 and employs an Ordinary Least Squares (OLS) regression model to analyze the effects of real GDP per capita, interest rates, and total loans on NPLs. The findings reveal a statistically significant negative relationship between interest rates and NPLs, indicating that higher interest rates reduce NPLs due to tightened lending standards. Conversely, total loans positively correlate with NPLs,

suggesting that increased lending volume leads to higher default risks. Real GDP per capita also negatively correlates with NPLs, reflecting that economic growth improves borrowers' repayment capacity. While the study demonstrates the macroeconomic drivers of NPLs, it is limited by its exclusion of bank-specific factors and alternative macroeconomic variables such as inflation or unemployment rates. The research highlights the need for balanced credit policies and macroeconomic stability to mitigate NPLs and ensure financial system resilience.

Van den End (2016) develops a macroprudential framework for the loan-to-deposit (LTD) ratio to address liquidity risk, focusing on 11 Economic and Monetary Union (EMU) countries between 1998 and 2012. The study emphasizes the LTD ratio's dual role as a structural and cyclical indicator of liquidity risk, complementing Basel III liquidity measures like the Liquidity Coverage Ratio (LCR) and Net Stable Funding Ratio (NSFR). Using filtering methods, Van den End identifies long-term trends driven by structural financial developments and short-term cycles reflecting pro-cyclical liquidity dynamics. The empirical analysis reveals that loan growth drives LTD increases during upturns, while deposit growth dominates during downturns. The findings suggest that economies with lower LTD ratios weather crises better due to reduced reliance on volatile market funding. Methodologically, the study uses decomposition analysis to isolate loan and deposit effects on LTD changes and proposes policy measures like setting upper and lower LTD bounds to mitigate systemic liquidity risks.

Alaoui Mdaghri (2022) explores the relationship between bank-generated liquidity and NPLs in the Middle East and North Africa (MENA) region. Applying the liquidity creation framework developed by Berger and Bouwman (2009), the study quantifies liquidity provision for a dataset comprising 111 commercial banks operating across ten MENA economies between 2010 and 2017. The empirical results indicate a robust inverse association between liquidity creation and NPL ratios over both short and long horizons, implying that greater liquidity generation by banks contributes to a reduction in credit

defaults. This relationship holds true for both Islamic and conventional banking institutions, suggesting that liquidity creation plays a critical role in lowering credit risk regardless of the banking model employed. The findings lend support to the economic-enhancing perspective, wherein expanded liquidity supply facilitates real-sector activity and strengthens borrowers' repayment capacity. These conclusions carry practical implications for financial authorities in the MENA region, where banks continue to dominate corporate financing due to relatively shallow capital markets. Promoting liquidity creation within the banking system may therefore serve as a policy lever for stimulating economic resilience and curbing the incidence of non-performing loans.

Messai and Jouini (2013) investigated the microeconomic and macroeconomic determinants of NPLs in a sample of 85 banks from Italy, Greece, and Spain between 2004 and 2008, a period characterized by significant financial instability due to the subprime crisis. The authors employ a panel regression model to analyze the effects of key variables, including GDP growth, unemployment rates, real interest rates, return on assets (ROA), loan loss reserves to total loans (LLR/TL), and loan growth. The findings reveal that GDP growth and ROA significantly negatively impact NPLs, indicating that economic growth and profitability enhance loan repayment capacity. Conversely, unemployment and real interest rates positively correlate with NPLs, highlighting the adverse effects of financial distress and increased borrowing costs on loan performance. Additionally, a positive relationship between LLR/TL and NPL suggests that banks anticipating higher default risks increase provisions to safeguard solvency.

The study by Yüksel (2017) investigates the determinants of credit risk in the Turkish banking sector following the economic crises, employing a probit model to analyze annual data from 23 deposit banks between 2004 and 2014. The research identifies the key factors influencing NPLs and examines internal and external determinants. Internal factors include total credits, consumer loans, commercial loans, received credits, and net interest margin, while external factors encompass economic growth, industrial

production index, unemployment rate, and inflation rate. The findings reveal that a decrease in the industrial production index is Türkiye's most significant determinant of increased NPLs, highlighting the importance of macroeconomic stability in managing credit risk. The study emphasizes that effective credit risk management is crucial for preventing banking crises and ensuring the financial system's stability. These insights are vital for policymakers and banking institutions aiming to implement strategies that mitigate credit risk and enhance financial stability in developing economies (Yüksel, 2017).

Vatansever and Hepşen (2013) examine how both macroeconomic indicators and bank-specific variables influence non-performing loan (NPL) ratios in Türkiye's banking sector over the period from January 2007 to March 2013. Employing linear regression and cointegration techniques, the study evaluates long-run associations between NPL levels and multiple explanatory factors. The results demonstrate that indicators such as the industrial production index, the Borsa Istanbul 100 Index, and overall banking sector inefficiency are inversely related to NPL ratios. Conversely, variables like the unemployment rate, return on equity (ROE), and capital adequacy ratio exhibit a positive correlation with credit risk. These outcomes underscore the dual significance of macroeconomic health and sound bank-level governance in reducing NPL prevalence. The authors argue that macroeconomic parameters—particularly economic output and labor market conditions—directly affect loan repayment behavior, while internal performance metrics such as capital strength and operational efficiency further shape credit portfolio quality. The study offers policy-relevant insights for regulators and financial institutions aiming to promote financial stability through proactive credit risk management.

Aydemir, Övenç, and Koyuncu (2018) examine the relationship between the loan-to-deposit ratio (LDR) and bank profitability in the Turkish banking sector from 2002 to 2015 using a dynamic panel data approach with quarterly data. The study employs return

on assets (ROA), return on equity (ROE), and net interest margin (NIM) as profitability measures and applies the fixed-effects generalized method of moments (GMM) estimator to control for endogeneity and autocorrelation. The results reveal a significant and positive relationship between LDR and all three profitability metrics, with the impact of LDR on ROA and ROE characterized by diminishing returns. The findings suggest that while moderate increases in LDR enhance profitability, excessive reliance on loans beyond a critical threshold diminishes returns due to increased costs and liquidity risks. The study also highlights differences before and after 2010, with post-2010 data reflecting heightened reliance on non-core liabilities, making the banking sector more vulnerable to external shocks.

Akça (2023) investigates the sectoral dynamics of NPLs in Türkiye between 2000 and 2020, employing the Event Study method to examine NPL growth across seven critical sectors: retail, wholesale, construction, metal, textile, food, and transportation. By segmenting the timeline into pre-crisis, crisis, and post-crisis periods, the study highlights significant fluctuations in NPL growth, driven by macroeconomic shocks like the 2001 Turkish Banking Crisis and the 2008 Global Financial Crisis. The findings reveal that NPL growth rates are particularly pronounced in the construction, textile, and wholesale sectors, reflecting their heightened vulnerability during economic downturns. Furthermore, the study identifies systemic risks from excessive credit allocation to non-productive sectors, exacerbating banking fragility during crises. The research underscores the need for sector-specific regulatory policies and enhanced credit risk management practices to mitigate systemic risks.

Çolak, Kılıç, Öztürk, and Şamcı (2024) address the challenges of model uncertainty in modeling NPLs within the Turkish banking sector by employing frequentist model averaging (FMA) techniques. Using quarterly panel data from 20 banks spanning 2007 to 2023, the study evaluates the impact of macroeconomic and bank-specific factors on NPL ratios, including variables such as GDP growth, inflation, credit growth, equity/assets, and

the loan-to-deposit ratio. The authors find that macroeconomic variables, particularly GDP growth and inflation, significantly influence NPL ratios, with GDP growth negatively correlating and inflation showing mixed effects. Among bank-specific variables, higher equity/assets and market share are associated with lower NPL ratios, while elevated loan-to-deposit ratios increase credit risk. The FMA approach demonstrates that averaging parameter estimates from multiple models reduces the bias introduced by selecting a single model, providing robust results even under extreme macroeconomic shocks.

3. METHODOLOGY

3.1 Data Collection and Sources

This study is based on the selection of two crucial data sources: CBRT and the BRSA. These sources were chosen carefully for their authoritative status and ability to provide comprehensive and reliable data on Türkiye's financial markets and banking activities, instilling confidence in the study's foundation.

The analysis utilizes weekly data from January 2014 to March 2024. The loan data was sourced from the "Banks and Participation Banks Uniform Reporting Package," prepared within the BRSA Uniform Accounting Plan framework and provided weekly by deposit banks, development and investment banks, and participation banks. The CBRT database is the primary source for obtaining data on loan volumes. Weekly credit volume data for the study period was extracted from the CBRT database, and the loan volume variable was measured as the aggregate sum of all loans disbursed by banks, including consumer loans, commercial loans, and mortgage loans.

Weekly non-performing loan data were obtained from the BRSA database to capture the dynamics of credit quality throughout the study period. NPLs refer to loans where the borrower has not made scheduled payments for a certain period, indicating potential credit risk for financial institutions.

Before analysis, the collected data underwent a series of thorough preprocessing steps to ensure accuracy and consistency. Data cleaning involves identifying and rectifying inconsistencies or missing values in the dataset. Both loan volume and NPL data were normalized to a standard scale to facilitate meaningful comparison and analysis. The weekly data obtained from CBRT and BRSA were meticulously aligned to ensure temporal synchronicity for subsequent correlation analysis, assuring the study's accuracy.

Quality assurance measures were implemented throughout the data collection process to maintain the integrity and reliability of the data. These measures included cross-validating data from multiple sources, reconciling discrepancies, and validating against established industry standards and benchmarks.

3.2 Model Selection

Introduced by Engle and Sheppard (2001), the DCC model extends the multivariate GARCH framework to capture time-varying conditional correlations across financial variables. This model is particularly effective for assessing changing volatility structures in financial time series, making it a valuable tool for empirical studies on market dynamics and interdependencies (Engle, 2002; Engle & Sheppard, 2001).

This study employs the DCC model, developed by Engle and Sheppard (2001), to capture the dynamic and time-varying relationship between loan volumes and NPLs. The DCC model, a type of multivariate GARCH (Generalized Autoregressive Conditional Heteroskedasticity) model, was selected for its ability to estimate time-varying correlations between financial variables, which is critical for understanding the evolving relationship between NPLs and loan volumes in the context of fluctuating economic conditions.

The DCC model offers several advantages over traditional models:

- **Flexibility:** The model allows for correlations between variables to change over time, providing a more nuanced understanding of the interdependencies between loan volumes and NPLs (Engle, 2002).
- **Computational Efficiency:** The DCC model efficiently handles large datasets without requiring the estimation of numerous parameters, which is particularly beneficial for multivariate time series data like those used in this study (Engle & Sheppard, 2001).
- **Applicability to Financial Data:** This model has been widely used in financial research, particularly in portfolio management, risk analysis, and macroeconomic studies, due to its robust capacity to capture volatility and correlation dynamics (Engle, 2002).

By utilizing this model, the study aims to uncover time-varying correlations between loan volumes and NPLs, offering insights into how credit risk and loan growth evolve in response to external shocks and policy interventions.

The DCC model was chosen over other alternatives (e.g., static correlation models or simple regression analyses) due to its ability to capture the temporal dynamics inherent in the relationship between loan volumes and NPLs (Engle, 2002). During periods of economic volatility, the correlation between financial indicators can fluctuate significantly, making dynamic models such as DCC essential for accurate analysis (Cappiello et al., 2006). A static model would fail to capture these shifts, whereas the DCC model dynamically adjusts to these changes, offering a more accurate representation of the underlying financial relationships (Bala & Takimoto, 2017).

Additionally, the DCC model addresses one of the critical limitations of earlier studies on NPLs: the failure to account for the time-varying nature of correlations in emerging markets like Türkiye, where external shocks and internal policy shifts occur frequently (Benavides-Franco et al., 2023). Thus, the DCC model provides a more robust framework for understanding the long-term and short-term dynamics of NPLs and loan volumes (Cappiello et al., 2006).

The DCC model consists of two main components: univariate GARCH models to capture the volatility of individual variables and a dynamic equation to model the conditional correlation matrix. The conditional correlation matrix is iteratively updated over time, allowing new information to be incorporated and time-varying correlation patterns to be estimated. The DCC model comprehensively explains the relationships between variables over time by combining volatility and correlation dynamics. Its versatility and robustness make it a valuable tool for researchers and practitioners in

finance, economics, and related fields who want to model and analyze complex interdependencies in multivariate time series data (Engle, 2002).

3.2.1 Core Concepts

The multivariate GARCH models can be described as follows:

$$r_t = \mu_t + \epsilon_t$$

$$a_t = H_t^{1/2} z_t$$

Where:

r_t : $n \times 1$ vector of log returns of n assets at time t

μ_t : $n \times 1$ vector of the expected value of the conditional returns r_t .

a_t : $n \times 1$ vector of mean-corrected returns of n assets at time t such that $E[a_t] = 0$ and $\text{Cov}[a_t] = H_t$

z_t : $n \times 1$ vector of iid errors such that $E[z_t] = 0$ and $E[z_t z_t^T] = I$

H_t : $n \times n$ matrix of conditional variances of a_t at time t

$H_t^{1/2}$: any $n \times n$ matrix at time t such that $H_t^{1/2}$ is the conditional variance matrix of a_t . It may be obtained by a Cholesky factorization of H_t .

The specification of the conditional covariance matrix H_t is essential. Various specifications exist, and the parameters in the conditional covariance matrices increase rapidly as the dimension n increases. As H_t depends on time t , it must be inverted in each iteration, making computation demanding unless n is small. Thus, constructing parsimonious yet flexible MGARCH models is crucial. Additionally, ensuring the positive definiteness of the conditional covariance matrix is essential.

The DCC model defines the conditional covariance matrix H_t as:

$$H_t = D_t R_t D_t$$

where D_t is a diagonal matrix of time-varying standard deviations and R_t is the time-varying conditional correlation matrix.

The diagonal matrix D_t is composed of the standard deviations from each univariate GARCH model:

$$D_t = \text{diag}(h_{1t}^{1/2}, h_{2t}^{1/2}, \dots, h_{nt}^{1/2})$$

The conditional correlation matrix R_t is calculated as:

$$Q_t = (1 - \alpha - \beta)Q + \alpha(z_{t-1}z_{t-1}^T) + \beta Q_{t-1}$$

$$R_t = \text{diag}(Q_t)^{-1/2} Q_t \text{diag}(Q_t)^{-1/2}$$

Here:

- Q_t is the time-varying covariance matrix of the standardized residuals $z_{it} = \frac{\epsilon_{it}}{\sigma_{it}}$.
- Q is the unconditional covariance matrix of the standardized residuals z_{it} .
- α and β are DCC model parameters and non-negative scalar parameters.

The multivariate DCC-GARCH model captures individual volatilities and dynamic correlations of multiple financial time series. This model effectively analyzes interdependencies, providing valuable insights for risk assessment and decision-making in financial contexts (Tse & Tsui, 2002).

3.2.2 Advantages of the DCC Model

Flexibility: The DCC model captures the time-varying nature of correlations, allowing for dynamic adjustments (Engle, 2002).

Computational Efficiency: The number of parameters in the correlation matrix does not depend on the number of series, making it computationally efficient even for large datasets (Engle & Sheppard, 2001).

Broad Applicability: The DCC model is widely used in portfolio management, risk management, and macroeconomic analysis due to its ability to model complex interdependencies in multivariate time series data (Engle, 2002).

The DCC model is a powerful and flexible tool for analyzing volatility and correlations in financial time series data. Modeling time-varying conditional correlations provides deeper insights into the dynamic nature of financial markets (Engle, 2002).

We conducted a cross-correlation analysis to determine the lag between two financial time series data. Cross-correlation measures the similarity between two-time series as a function of the lag of one relative to the other (Box et. al., 2015). This analysis allows us to identify the time delay (lag) between the two series where the correlation is maximum (Box et. al., 2015).

We leveraged the efficiency of the numpy library in Python to calculate the cross-correlation and find the lag between the two financial time series. The lag corresponding to the maximum correlation, a key indicator, reveals the time delay between the two series (Box et. al., 2015).

3.3 Software Tools

Data analysis and processing were performed using a combination of R and Excel. Excel was used for initial data processing tasks such as data cleaning, normalization, and harmonization of time series data obtained from the CBRT and BRSA databases. Excel's

user-friendly interface and versatile functions facilitated efficient data manipulation and preparation for subsequent analysis. Next, the DCC model was applied in R to estimate time-varying conditional correlations between loan volumes and non-performing loans. R's comprehensive suite of statistical packages, particularly the *ccgarch* package, provided the necessary tools to fit the DCC model to the data and make robust statistical inferences. The integration of Excel and R provided a seamless workflow by combining the data processing capabilities of Excel with the advanced statistical modeling capabilities of R, thus improving the relationship between loans and NPLs in the Turkish banking sector.

4. RESULTS

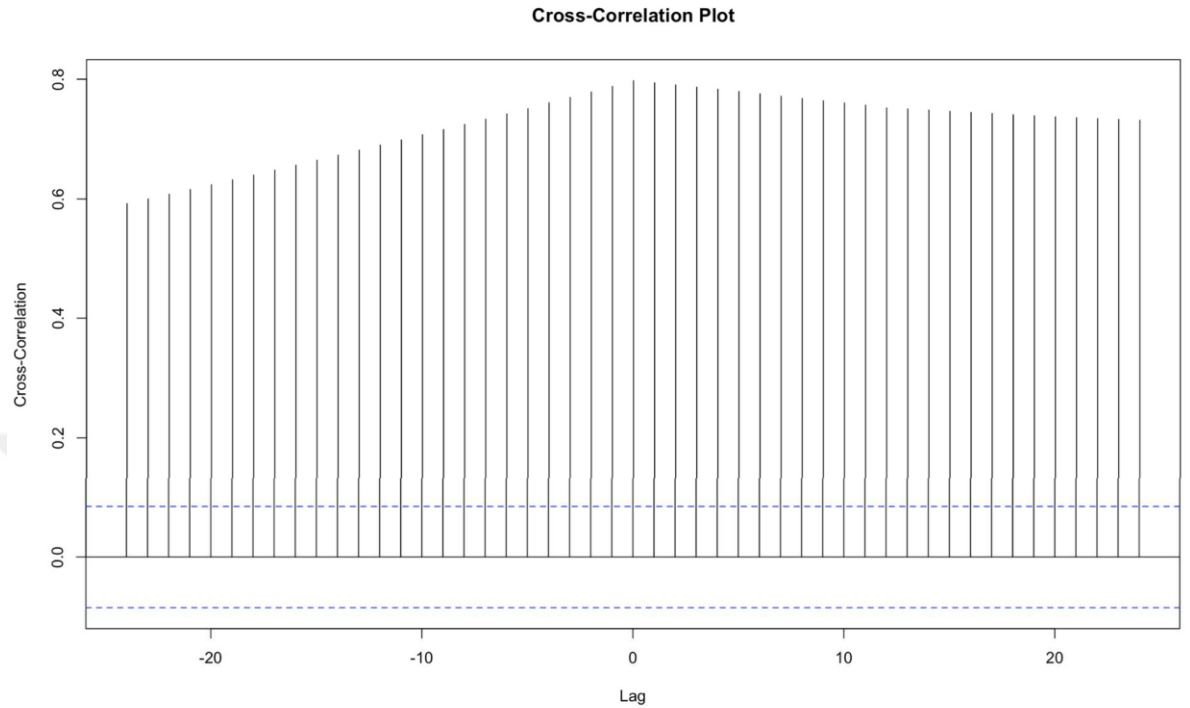
The descriptive statistics of loan volume data provide crucial insights into the credit activity within the Turkish banking sector over the study period. The median loan volume, a key data point, is calculated at 2,407,749.64 TL, indicating that half of the observed loan volumes fall below this value. This median value serves as a benchmark, helping us understand the distribution of loan volumes. The mean loan volume is substantially higher, at 3,446,704.67 TRY, suggesting a right-skewed distribution with a positive skewness coefficient of 1.58. The standard deviation of loan volume data is 2,722,444.10 TRY, reflecting considerable variability around the mean. The distribution of loan volumes is characterized by a kurtosis coefficient of 1.55, indicating a slightly peaked distribution compared to the normal distribution. The minimum observed loan volume is 1,018,991.43 TRY, while the maximum loan volume is 12,213,953.51 TRY, highlighting the range of loan volumes observed during the study period. The descriptive statistics suggest a right-skewed distribution of loan volumes, with considerable variability and a slight positive excess kurtosis.

The descriptive statistics of non-performing loan data yield valuable insights into the quality of loans within the Turkish banking sector over the study period. The median

non-performing loan amount, at 100,567.00 TL, indicates that half of the observed NPL fall below this value. The mean non-performing loan amount, slightly higher at 103,382.25 TRY, suggests a nearly symmetric distribution with a skewness coefficient close to zero (0.03). The standard deviation of non-performing loan data, at 52,873.62 TRY, reflects moderate variability around the mean. This variability is crucial to understanding the banking sector's comprehensive view of loan quality. The distribution of NPL is characterized by a negative excess kurtosis coefficient of -1.66, indicating a less peaked distribution with thinner tails than the normal distribution. The minimum observed non-performing loan amount is 29,398.00 TRY, while the maximum non-performing loan amount is 197,055.00 TRY, illustrating the range of non-performing loan amounts observed during the study period. The descriptive statistics suggest a nearly symmetric distribution of non-performing loan amounts, with moderate variability and a slightly leptokurtic distribution.

4.1 Cross-Correlation Analysis of Loan Volume and Non-Performing Loans:

Graph 4.1.1 Cross-Correlation Analysis



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>

The cross-correlation function (CCF) graph illustrates the relationship between loan volume and NPLs over time lags. The x-axis represents the lag, with negative values indicating that NPLs are leading indicators and positive values suggesting that loan volumes are leading indicators. The y-axis shows the correlation coefficient (ACF).

Peak Correlation: The highest correlation coefficient is observed around a specific positive lag, with the peak value reaching approximately 0.8. This peak signifies the most significant lead-lag relationship between loan volumes and NPLs. The specific lag at which this peak occurs can offer insights into the typical time frame within which loan

quality issues manifest after loans are issued. For example, if the peak is at lag 12, it might suggest that it takes about one week for changes in loan volumes to significantly impact NPLs. These practical implications make the findings directly applicable to risk management and policy formulation in the banking sector.

Overall Assessment: The cross-correlation analysis uncovers a dynamic relationship between loan volumes and NPLs, with loan volumes typically leading NPLs. This discovery aligns with the nature of credit markets, where lending activities precede the emergence of credit risk. Grasping this temporal relationship is pivotal for risk management and policy formulation in the banking sector. It equips banks and regulators with the ability to foresee and mitigate potential increases in NPLs based on observed changes in loan volumes, empowering them with actionable insights.

These insights from the cross-correlation analysis not only stand on their own but also enhance the observations from the previous DCC and loan volume graphs. This comprehensive approach provides a thorough understanding of the temporal dynamics between loan issuance and credit risk in the Turkish banking sector, leaving no stone unturned.

4.2 Analysis of DCC Model Results

The table provided presents the optimal parameters estimated for the DCC model, which was applied to the log returns of loans (Credit) and NPL (Debit). These parameters, including the mean (μ), autoregressive coefficient ($AR1$), and the DCC components ($dcca1$ and $dccb1$), are crucial for understanding the dynamics of the loan and NPL returns. Here's a detailed interpretation of these results:

Log Returns of Loans: The mean estimate for the log returns of loans is 0.004035, which is statistically significant (p-value<0.00001). This indicates a positive average return on loans. The autoregressive coefficient (0.092348) is not statistically significant (p-value=0.216126), suggesting that the previous period's returns have a limited effect on the current period's returns. The variance equation constant (0.000009) is statistically significant (p-value < 0.00001), indicating a non-zero baseline level of volatility in the loan returns. The ARCH effect parameter (0.320565) is statistically significant (p-value < 0.00001), suggesting that past shocks have a substantial impact on current volatility. The GARCH effect parameter (0.624107) is statistically significant (p-value < 0.00001), indicating that past volatility persists into the current period.

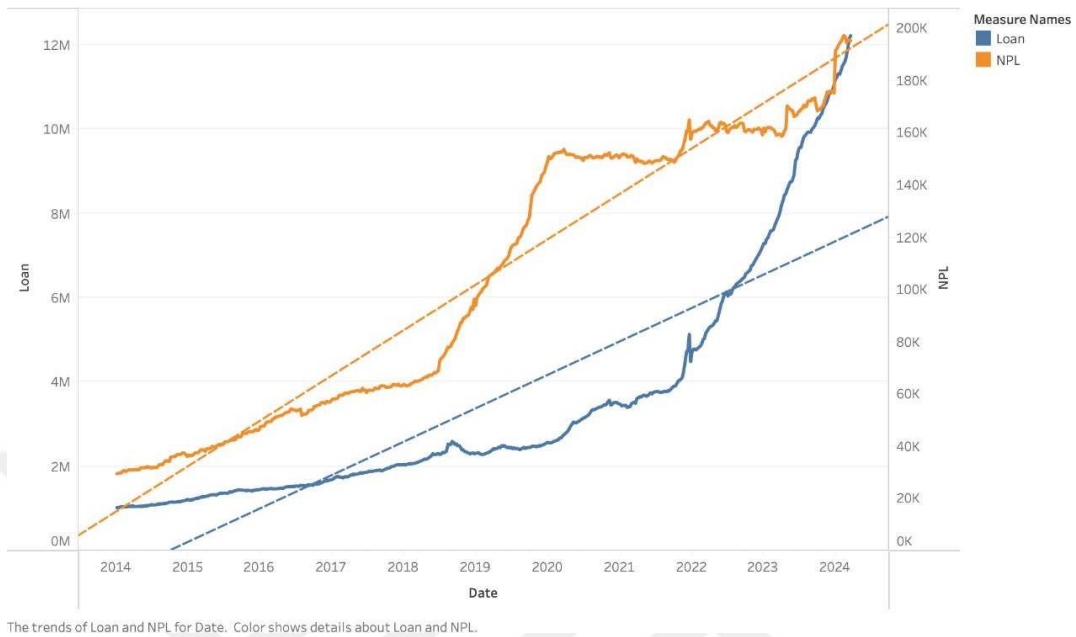
Log Returns of Non-Performing Loans: The mean estimate for the log returns of NPL is 0.003569, which is statistically significant (p-value < 0.00001). This indicates a positive average return on NPLs. The autoregressive coefficient (−0.020176) is not statistically significant (p-value = 0.701006), suggesting that the previous period's returns have a negligible effect on the current period's returns. The variance equation constant (0) is not statistically significant (p-value = 0.804597), implying a shallow baseline level of volatility in NPL returns. The ARCH effect parameter (0) is not statistically significant (p-value = 1.0), indicating no significant impact of past shocks on current volatility. The GARCH effect parameter (0.999) is statistically significant (p-value < 0.00001), indicating that past volatility has a near-perfect persistence into the current period.

Joint DCC Parameters: The first DCC parameter ($dcca1$) is statistically significant (p-value = 0.000481), suggesting that the conditional correlation responds to past shocks in the returns. The second DCC parameter ($dcc\beta1$) is statistically significant (p-value < 0.00001), indicating a strong persistence in the conditional correlation.

The outcomes of the DCC model reveal a significant persistence of volatility in both loan and NPL returns. The high values of the GARCH parameters (β_1) for both series further underline this. The noteworthy DCC parameters ($dcca1$ and $dcc\beta_1$) indicate that past shocks influence the DCC between loan returns and NPL returns, demonstrating a robust persistence. This suggests that changes in loan and NPL returns are intricately linked, with past volatility and shocks playing a pivotal role in shaping their relationship.

These findings are not just numbers but valuable insights into the risk dynamics within the Turkish banking sector. They underscore the critical importance of understanding volatility and correlation structures for effective risk management and policy formulation, making this analysis a crucial tool for your work. Bala and Takimoto (2017) argue that during crisis periods, volatility spillovers are more intense within developed markets, while emerging markets tend to exhibit higher internal volatility, suggesting limited transmission of external shocks

Graph 4.2.1 Trends in Loan Volume and Non-Performing Loans



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>
2) All numbers are rounded up to millions.

The provided graph displays the trends in loan volume and NPL in the Turkish banking sector over a specified period. Several noteworthy movements can be observed, which can be linked to significant economic events in Türkiye:

Graph 4.2.2 Loan Volume and Non-Performing Loans in 2018



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>
2) All numbers are rounded up to millions.

The graph indicates a marked increase in both loan volume and NPL during the year 2018.

Economic Context: In 2018, Türkiye experienced a severe currency crisis, which was triggered by political developments, leading to a sharp depreciation of the TL and a surge in inflation rates (Orhangazi & Yeldan, 2021). These economic disruptions likely caused difficulties in loan repayments, thereby increasing the volume of non-performing loans. Banks may have also expanded their loan portfolios in response to economic pressures, contributing to the observed increase in loan volume.

Graph 4.2.3 Loan Volume and Non-Performing Loans in 2020



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>
2) All numbers are rounded up to millions.

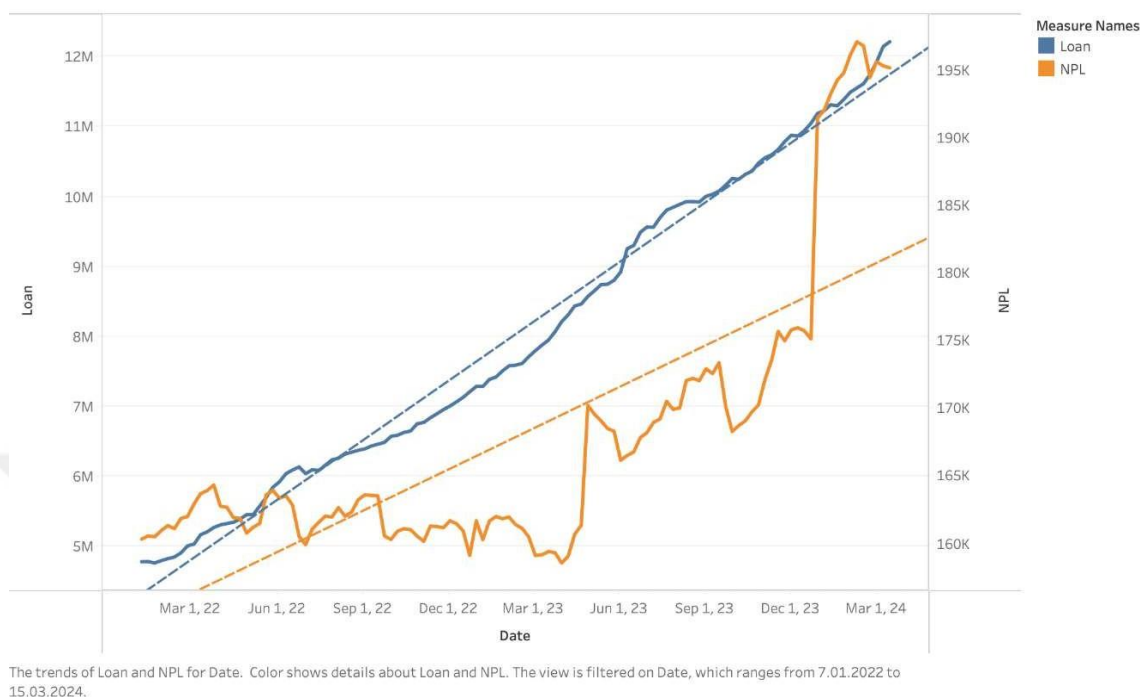
A significant fluctuation in loan volume and NPL was observed in 2020.

Economic Context: The COVID-19 pandemic in 2020, a global crisis of unprecedented scale, had a profound impact on the Turkish economy (Özatay, 2020). The economic slowdown and disruptions in business activities led to financial stress among borrowers, causing a rise in non-performing loans. However, banks, demonstrating their resilience, extended more credit to support businesses and individuals during the crisis, increasing loan volume. The COVID-19 pandemic in 2020 caused an abrupt disruption in global financial markets, significantly influencing loan volumes and non-performing loan (NPL) ratios (Demirgüç-Kunt et. al., 2020). For example, Benavides-Franco et al. (2023) find that the pandemic induced persistent increases in NPLs across various loan categories

in Colombia, emphasizing the prolonged effects of exogenous shocks on financial stability.

In response to the economic disruptions caused by the COVID-19 pandemic, BRSA of Türkiye has made a significant decision to amend the criteria for classifying loans as non-performing. The decision, numbered 8948 and dated March 17, 2020, extends the delinquency period for classifying loans as non-performing from 90 days to 180 days. This extension is applicable to loans classified under the First and Second Groups until December 31, 2020. It's important to note that despite this extension, loans classified under the Second Group after 90-day delinquency will continue to be provisioned according to banks' internal risk models as per TFRS 9 standards. This regulatory adjustment, in effect until the end of this year, aims to mitigate the adverse effects of the pandemic on economic and commercial activities by providing banks and borrowers with additional flexibility during this period. The decision has been communicated to relevant institutions and published on the BRSA's official website. This decision's duration was extended after 31 December 2020 and terminated as of 30.09.2021, with the decision numbered 9795, dated 16.09.2021.

Graph 4.2.4 Loan Volume and Non-Performing Loans in 2022-2024



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>
 2) All numbers are rounded up to millions.

From 2022 onwards, there is a noticeable upward trend in both loan volume and non-performing loans.

Economic Context: Post-2022, Türkiye continued to grapple with high inflation and financial instability. Persistent economic uncertainties and fluctuations in interest rates likely affected the repayment capacity of borrowers, contributing to the rise in non-performing loans. However, banks, in a proactive move to manage and mitigate the economic impacts, might have led to an expansion in their lending activities, thus increasing the loan volume (IMF, 2023).

In the period following 2022, there is a notable observation where the loan volume continues to increase while the NPLs remain relatively stable. Several factors could explain this phenomenon:

Government Support and Policies: Post-2022, the Turkish government implemented various economic stimulus packages and supported banks, which likely contributed to the increase in loan volume. Government-backed guarantees and loans enabled banks to extend more credit while maintaining control over NPLs. These measures help ensure liquidity in the market and support economic activity without a corresponding rise in loan defaults (CBRT, 2023).

Restructuring and Deferral Programs: Banks may have adopted restructuring and deferral programs for borrowers facing financial difficulties. By offering more accessible repayment terms and temporary deferrals, banks can manage and mitigate the risk of loans becoming non-performing. Such programs can effectively keep NPL levels stable while allowing the total loan volume to grow as borrowers are given more time and flexibility to repay their debts (Osmanlı, 2023).

Impact of Inflation on Nominal Loan Volume: During periods of high inflation, the nominal value of loans can increase, reflecting the devaluation of currency rather than genuine economic growth. This inflation-driven rise in loan volumes does not necessarily translate to a higher incidence of loan defaults. Consequently, the nominal growth in loan volumes might outpace the growth in NPLs, which remain more closely tied to the actual economic performance and borrowers' financial health (Ozili, 2019).

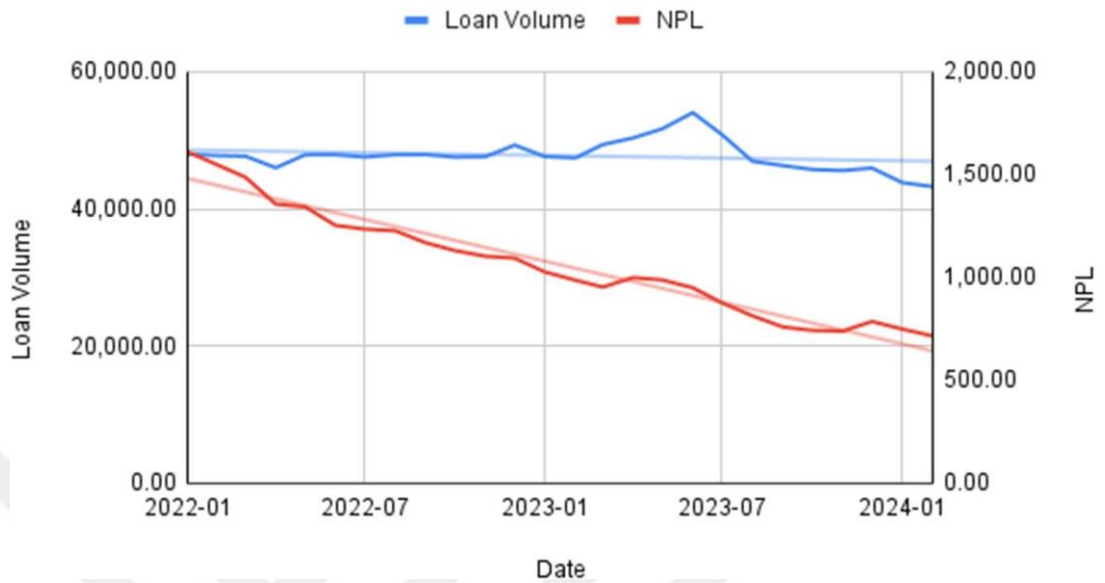
Changes in Bank Lending Policies: Banks may have tightened their lending criteria, focusing on lower-risk borrowers to minimize the likelihood of defaults. By being

more selective and cautious in their lending practices, banks can increase their loan portfolios while keeping NPLs under control. Enhanced credit risk assessment and management practices could lead to higher-quality loan books, thus reducing the propensity for loans to become non-performing (Makri et al., 2014).

Macprudential Measures: The CBRT and BRSA might have introduced macroprudential measures to improve risk management within the banking sector. Such measures could include stricter capital requirements, enhanced supervision, and better risk assessment protocols. These regulatory interventions help banks maintain financial stability and reduce the risk of an increase in NPLs even as loan volumes expand (CBRT, 2022).

Overall, the fluctuations in the graph correspond closely with periods of economic crises and instability. During such times, banks often experience an increase in both loan issuance and the volume of NPL due to heightened financial stress among borrowers. These trends suggest that the Turkish banking sector may face continued challenges in the coming years, such as currency shocks and interest shocks (IMF, 2023).

Graph 4.2.5 Loan Volume and Non-Performing Loans Adjusted Inflation



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>
2) All numbers are rounded up to millions.

The graph illustrating the relationship between the real credit volume and real NPLs in the Turkish banking sector from January 2022 to January 2024 presents several noteworthy trends. The blue line represents the real loan volume, while the red line represents the real NPLs. Consistent methodologies were applied across all evaluated periods. However, the periods of 2022 and 2024 were additionally assessed based on the dramatic inflation increases.

Real Loan Volume: The real loan volume, depicted by the blue line, showcases a reassuring stability over the observed period. Despite minor fluctuations, the overall trend remains remarkably consistent. This steadfastness is a testament to the banks' ability to maintain a steady level of credit issuance, adjusted for inflation, indicating a consistent

and reliable credit policy. The absence of significant increases or decreases in the real credit volume implies that banks are prudently managing their lending activities, striking a balance between credit growth and risk management.

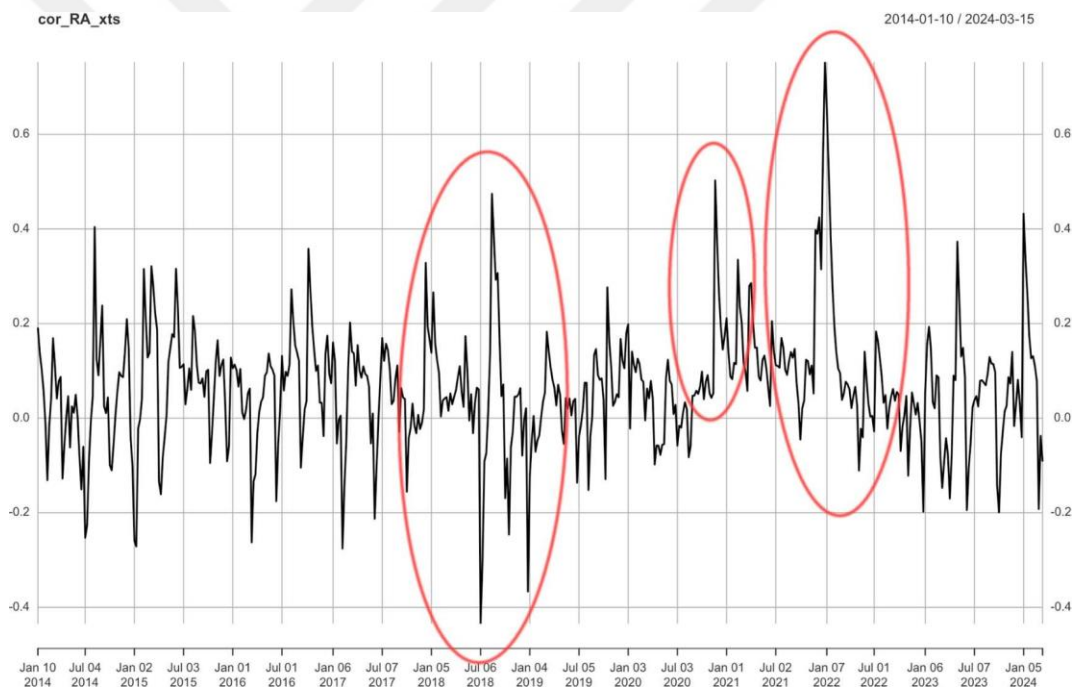
Real NPLs: In contrast, the real NPLs, represented by the red line, demonstrate a clear and encouraging downward trend throughout the same period. The continuous decline in the real NPLs is a strong indicator of the banks' effective risk management strategies and possibly enhanced credit assessment practices. This positive trend can also be attributed to improved economic conditions, which have bolstered borrowers' repayment capacities, further reinforcing the banks' confidence in their risk management capabilities.

Economic and Policy Implications: The observed stability in real loan volume, coupled with the decrease in real NPLs, highlights the effectiveness of the banks' credit risk management policies. The consistent real loan volume suggests that banks have been able to sustain their lending operations without significantly increasing their exposure to credit risk. On the other hand, the decline in real NPLs positively affects the banks' ability to manage and mitigate credit risk, likely through improved credit monitoring and recovery processes. Additionally, macroeconomic indicators, such as the unemployment rate, inflation, and interest rate, have been widely examined in the literature concerning credit risk in the banking sector. In developing countries like Türkiye, the impact of fluctuations in these indicators on credit quality is more pronounced (Klein, 2013). Moreover, Klein (2013) highlights that high NPL ratios in emerging markets are significantly influenced by poor macroeconomic performance and weak regulatory systems.

The graphical analysis underscores the successful implementation of risk management strategies within the Turkish banking sector. The stability in real credit

volume indicates prudent lending practices, and reducing real NPLs suggests effective credit risk management. These trends collectively reflect a robust banking environment that balances growth with risk mitigation, which is crucial for maintaining financial stability. This analysis provides valuable insights into the dynamic interplay between credit issuance and loan performance, offering a comprehensive understanding of the sector's resilience amidst varying economic conditions.

Graph 4.2.6 Loan Volume And Non-Performing Loans DCC Results



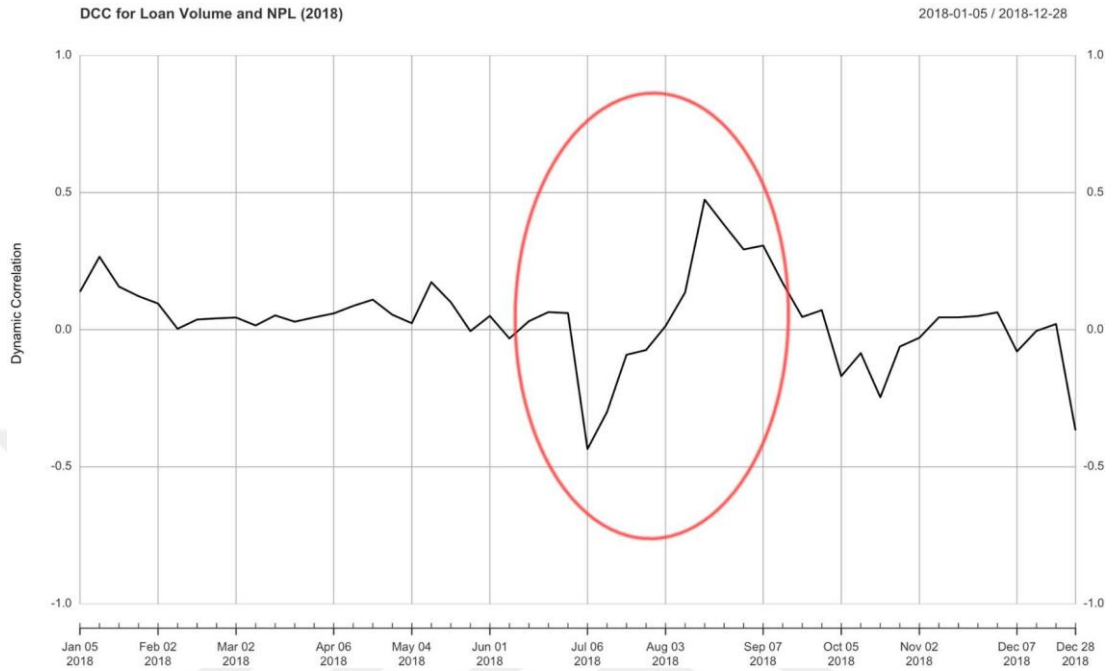
Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>

4.3 Analysis of Dynamic Conditional Correlation and Its Implications

The DCC model graph provides valuable insights into the relationship between loan volume and NPLs in the Turkish banking sector. When examined in conjunction with the previous graph, several noteworthy patterns emerge:

The 2018 Crisis: 2018, the DCC graph shows significant fluctuations and peaks. This period corresponds to the sharp increase in loan volume and NPLs observed in the earlier graph. Türkiye's currency crisis and economic turbulence during 2018 led to heightened market volatility and increased risks within the banking sector. Consequently, the correlation between loan volumes and NPLs experienced marked fluctuations, reflecting the financial instability of the period.

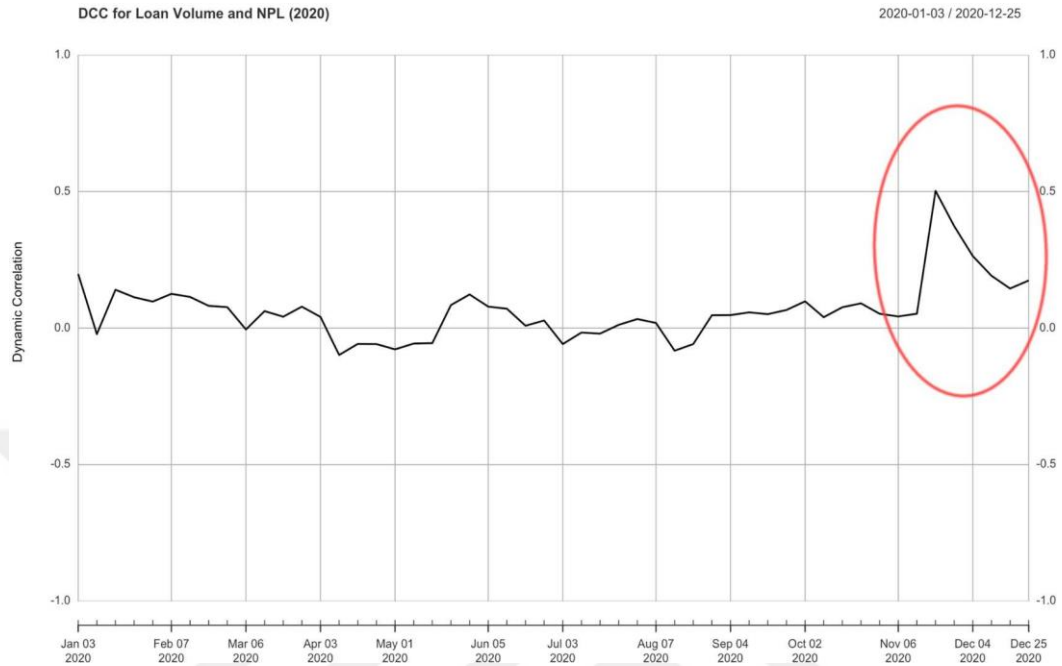
Graph 4.3.1 Analysis of Dynamic Conditional Correlation in 2018



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>

The 2020 Pandemic: The year 2020 is characterized by notable volatility in the DCC graph. The COVID-19 pandemic introduced unprecedented economic uncertainties and financial stress globally, including in Türkiye. The disruptions caused by the pandemic led to increased difficulties in loan repayments, which is mirrored in the rise of NPLs alongside expanding loan volumes. This high economic uncertainty and increased lending likely caused significant variability in the correlation between loans and NPLs.

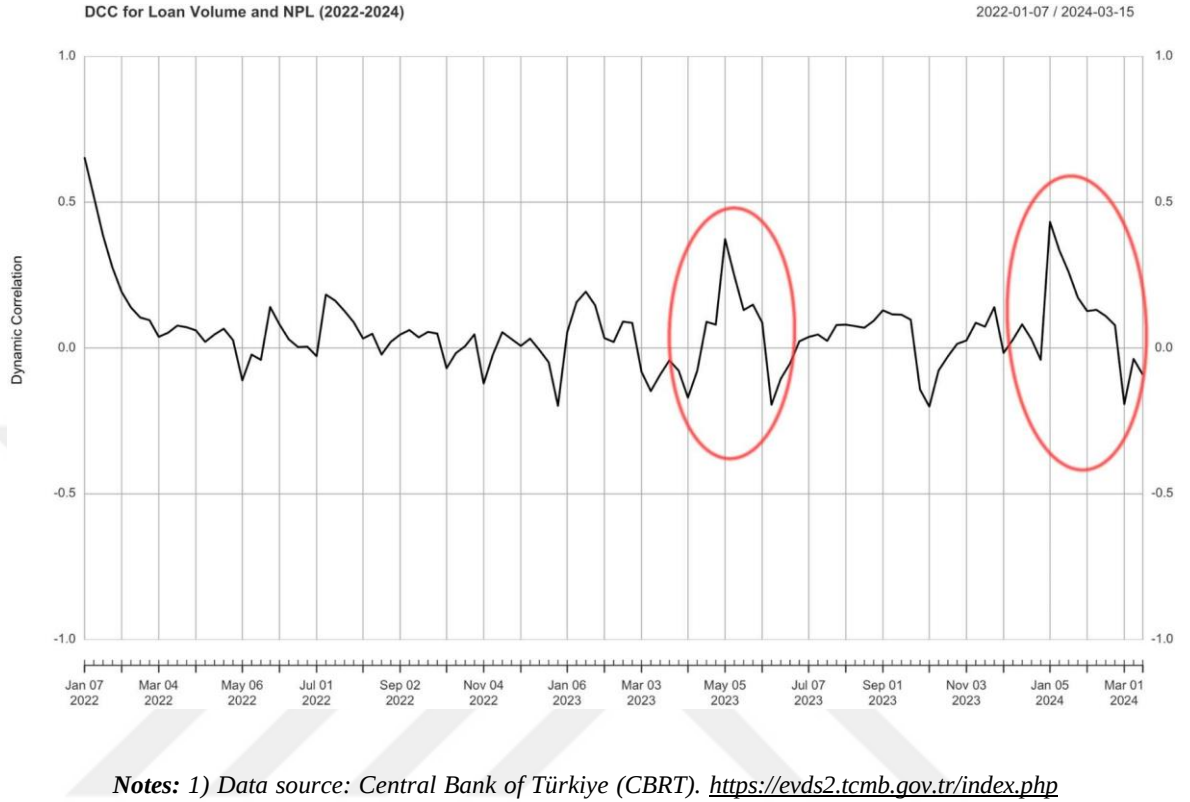
Graph 4.3.2 Analysis of Dynamic Conditional Correlation in 2020



Notes: 1) Data source: Central Bank of Türkiye (CBRT). <https://evds2.tcmb.gov.tr/index.php>

Post-2022 Period: Post-2022, the DCC graph continues to exhibit fluctuations, although there are intervals where the correlation appears more stable. During this period, the previous graph shows an increase in loan volume while NPLs remain relatively controlled. This stability can be attributed to several factors, including government economic support packages, loan restructuring, and deferral programs, and macroprudential measures implemented by regulatory bodies. These interventions likely helped manage and mitigate credit risk, maintaining a stable correlation between loan volume and NPLs.

Graph 4.3.3 Analysis of Dynamic Conditional Correlation in 2022 and 2024



General Assessment: The DCC model highlights the dynamic relationship between loan volume and NPLs, which is influenced by various economic conditions. Economic crisis and uncertainty periods are marked by increased correlation volatility, as evidenced by the significant peaks and troughs in the DCC graph. Government interventions, improved bank lending practices, and robust risk management strategies contribute to stabilizing this relationship during more stable economic periods.

Overall, the DCC analysis underscores the importance of dynamic risk management and regulatory policies in the banking sector. Understanding the fluctuations in correlation

between loan volumes and NPLs can provide deeper insights into the sector's resilience and the effectiveness of economic policies.

5. CONCLUSION

This study has uncovered significant insights by thoroughly examining the dynamic relationship between loan volume and NPLs in the Turkish banking sector. The analysis reveals that loan volume substantially influences NPLs, a relationship intricately woven with past shocks and economic conditions, and how the correlation reacts in the short and long term. This finding is consistent with Yüksel (2017), who highlighted the relevance of dynamic correlation models in analyzing credit risk in the Turkish banking sector. Moreover, the model shows a volatile relationship between loan volume and NPL in the short term.

Similar observations were made by Us (2016), who emphasized that short-term macroeconomic and political events could significantly disrupt the stability of credit markets. Economic conditions, governmental approaches, or global developments may affect the correlation between loan volume and NPL in the short term. Therefore, banks should decide by considering the relationship between loan volume and NPL and analyzing the correlation between long-term and short-term changes.

These findings, with their potential to inform risk management and policy formulation in the banking sector, are valuable to the existing body of knowledge and literature. The ability to anticipate the effects of changes in loan volumes on NPLs can empower banks to develop more effective risk management strategies and ensure economic stability, instilling hope for the banking sector's future.

5.1 Policy and Practical Implications:

5.1.1 Strengthening Risk Management Practices:

Enhanced Credit Risk Assessment: Banks must adopt more sophisticated credit risk assessment tools incorporating macroeconomic indicators and stress testing. This recommendation aligns with Vatansever and Hepşen (2013), who found that macroeconomic variables such as the unemployment rate and industrial production index significantly impact NPL ratios. The strategy will enable them to anticipate and manage potential increases in NPLs, a risk that can significantly impact the stability of the Turkish banking sector.

Regular Stress Testing: Implement regular stress testing procedures to evaluate the impact of adverse economic scenarios on the loan portfolio. This will help banks to prepare and respond effectively to potential crises (Taşkınsoy, 2022).

Dynamic Provisioning: Introduce dynamic provisioning practices that adjust the level of loan loss provisions based on real-time risk assessments and changing economic conditions (IMF, 2011).

5.1.2 Regulatory Framework Enhancements:

Macroprudential Regulation: Develop and enforce macroprudential regulations that limit the concentration of risk within particular sectors or geographic regions. This

can help prevent systemic risks arising from overexposure to specific areas (Claessens et al., 2013).

Periodic Review of Classification Criteria: Regularly review and update the criteria for classifying loans as non-performing to reflect current economic realities and ensure timely recognition of loan impairments. Benavides-Franco et al. (2023) emphasized the importance of adapting classification systems to reflect real-time macroeconomic shocks in their study of the Colombian banking sector during the COVID-19 pandemic .

Enhanced Supervision and Reporting: Strengthen banks' supervisory practices and reporting requirements, ensuring they provide detailed and timely information on their credit portfolios and risk management practices (BCBS, 2010).

5.1.3 Promoting Financial Inclusion and Diversification:

Support for Small and Medium Enterprises (SMEs): Implement targeted financial support programs for SMEs, which are often more vulnerable to economic fluctuations. This can include loan guarantees, subsidized interest rates, and technical assistance for improving financial management (Beck et al., 2005).

Diversification of Loan Portfolios: To spread risk more evenly, encourage banks to diversify their loan portfolios across different sectors and regions. This can be achieved through regulatory incentives and guidelines (Berger & Udell, 2004).

Inclusive Lending Practices: Promote inclusive lending practices, extend credit to underserved populations and regions, and enhance financial stability and economic growth (World Bank, 2022).

5.1.4 Leveraging Technology and Data Analytics:

Advanced Data Analytics: Encourage banks to invest in advanced data analytics and artificial intelligence to enhance their credit scoring models and early warning systems for detecting potential defaults. This is supported by Fiszeder et al. (2019), who demonstrated that using advanced range-based models significantly enhances risk forecasting compared to traditional volatility approaches.

Adoption of Blockchain and Fintech Innovations: Integrating blockchain technology and fintech-driven solutions into the banking ecosystem can significantly enhance operational transparency, reduce intermediation and transaction costs, and streamline credit assessment and loan monitoring processes. Blockchain's immutable ledger structure ensures data integrity and traceability, reducing the risk of fraud and improving regulatory compliance (Catalini & Gans, 2016). Moreover, fintech platforms utilizing artificial intelligence and big data analytics offer more accurate and dynamic credit scoring models, particularly for underserved or unbanked populations (Arner, Barberis, & Buckley, 2017). These technologies not only improve financial inclusion but also contribute to proactive risk detection and efficiency gains in credit markets, aligning with broader goals of financial stability and innovation-driven growth.

5.1.5 Policy Coordination and Collaboration:

Development of Structured Debt Restructuring Frameworks: Establishing well-defined, transparent, and accessible debt restructuring mechanisms is essential for maintaining credit quality and reducing default risks during periods of financial distress. Effective restructuring frameworks can facilitate orderly resolution processes, improve borrower repayment capacity, and minimize systemic disruptions (Aiyar et al., 2015). Such mechanisms not only benefit distressed borrowers but also enhance asset recovery prospects for financial institutions.

Enhancing Inter-agency Coordination: Strengthening collaboration among supervisory authorities, financial institutions, and government entities is crucial to ensure a harmonized response to emerging credit risks and macroeconomic shocks. A coordinated policy environment improves regulatory efficiency, promotes consistent implementation of macroprudential measures, and enhances crisis management capacity (Financial Stability Board, 2021). Integrated inter-agency collaboration also supports proactive supervision and fosters system-wide financial stability.

International Best Practices: We propose to benchmark against international best practices in credit risk management and regulation. However, we understand the importance of adapting these strategies to the local context. Yun and Moon (2014) proposed similar international benchmarking strategies in the context of systemic risk, advocating for dynamic models that capture the time-varying contributions of bank-specific characteristics.

The findings of this study underscore the importance of understanding the dynamic interplay between loan volumes and non-performing loans (NPLs) within the Turkish banking sector. The results obtained from the DCC-GARCH model demonstrate that this relationship is not static but evolves in response to macroeconomic fluctuations and external shocks. These insights emphasize the need for policymakers and financial

institutions to adopt data-driven and forward-looking approaches in credit risk management. Based on the empirical evidence, this study recommends the implementation of targeted policy interventions aimed at enhancing the banking sector's capacity to absorb shocks, minimize NPL accumulation, and maintain healthy credit growth. These policy suggestions are not only intended to reinforce financial stability but also contribute to broader macroeconomic objectives by supporting sustainable lending practices and reducing financial inequalities. Moreover, aligning these strategies with the Sustainable Development Goals (particularly SDG 8 and SDG 10) ensures that financial resilience is pursued alongside inclusive and equitable economic development.

The relationship between loan volumes and NPLs in the Turkish banking sector directly contributes to several SDGs, particularly SDG 8: Decent Work and Economic Growth and SDG 10: Reduced Inequalities. As shown by Alaoui Mdaghri (2022), increased liquidity creation improves loan repayment capacities, particularly among underserved segments, thereby promoting both financial stability and inclusivity. Understanding and addressing NPLs is vital for fostering sustainable economic growth, ensuring financial stability, and reducing inequalities within the financial system.

The findings of this study align with the objectives of SDG 8, which emphasizes the promotion of sustained, inclusive, and sustainable economic growth. High NPL ratios can severely constrain banks' ability to provide credit, limiting economic investment and consumption opportunities. By addressing the factors that drive NPLs, financial institutions can enhance their ability to extend credit to businesses, especially small and medium-sized enterprises (SMEs), which are critical to job creation and economic development. Improved risk management practices and regulatory frameworks that stabilize the banking sector contribute to a more resilient economy capable of sustaining decent work opportunities and fostering entrepreneurship.

Moreover, ensuring the financial system's health supports economic recovery during periods of crisis, such as the COVID-19 pandemic, when many businesses and individuals rely heavily on access to credit to maintain operations and livelihoods. Reducing NPLs through proactive interventions like loan restructuring ensures that banks can continue to provide liquidity, stimulate economic activity, and maintain employment levels, which are central to achieving SDG 8.

Addressing the challenges NPLs pose also ties into SDG 10: Reduced Inequalities. High levels of NPLs can lead to tighter lending criteria, which disproportionately affects marginalized and underserved groups, including low-income borrowers and SMEs in rural areas. When banks become more risk-averse due to rising NPLs, access to credit becomes more difficult for these groups, exacerbating financial inequality.

By improving the management of NPLs and maintaining a stable credit environment, financial institutions can expand access to credit for all segments of the population, including underserved communities. This supports economic inclusion and promotes a more equitable distribution of financial resources, ensuring that all individuals and businesses, regardless of their socio-economic status, can contribute to and benefit from economic growth.

The findings of this study also resonate with the objectives of SDG 17: Partnerships for the Goals, which emphasizes the importance of global collaboration and multi-stakeholder partnerships in achieving sustainable development. Addressing the challenges of NPLs and loan volume management requires a coordinated effort among various stakeholders, including banks, regulatory bodies, policymakers, and international financial institutions. Effective partnerships between these entities are crucial for creating regulatory frameworks, risk management systems, and policy interventions that can stabilize the banking sector and foster sustainable economic growth.

By fostering strong domestic and international partnerships, the Turkish banking sector can continue to address the challenges associated with NPLs and promote long-term financial stability. This collaborative approach ensures that efforts to manage credit risk are aligned with broader goals of inclusive economic growth and sustainable development, further supporting the realization of SDG 17.

Future Research Directions: Future research could build on the findings of this study by addressing some of the limitations and exploring new, innovative avenues that have the potential to revolutionize our understanding of loan volumes and NPL in the banking and finance sector.

Longer Time Series: Extending the analysis period beyond January 2014 and March 2024 would help understand these developments' long-term trends and impacts.

Real-Time Data Analysis: Incorporating real-time data analysis techniques could enhance the banking sector's ability to capture and respond to dynamic changes.

Sectoral Analysis: Conducting sector-specific analyses could uncover unique dynamics within different segments of the economy, such as retail banking, corporate banking, or SME lending.

Structural Break Analysis: Implementing structural break analysis to identify and account for significant shifts in the relationship due to policy changes or economic shocks.

Policy Impact Studies: Examining the specific impacts of regulatory changes, such as changes in the BRSA definition of NPLs in 2020, on the banking sector's performance and risk profile, aiding in developing effective policies and strategies.

Comparative Studies: Conduct comparative studies across different regulatory environments or countries to understand how regulatory frameworks impact the dynamics between loan volumes and NPLs.

By pursuing these future research directions, subsequent studies can contribute to a more nuanced understanding of the complexities involved in managing loan volumes and non-performing loans, ultimately aiding in developing more effective policies and strategies for financial stability.

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