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CREDIT RISK, BANK PERFORMANCE, AND FINANCIAL STABILITY: PANEL EVIDENCE FROM THE TURKISH BANKING SECTOR

RISCO DE CRÉDITO, DESEMPENHO BANCÁRIO E ESTABILIDADE FINANCEIRA: EVIDÊNCIAS DE UM PAINEL DO SETOR BANCÁRIO TURCO

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Abstract
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This study aims to examine the bank-specific and macroeconomic determinants of credit risk and financial stability in Türkiye, focusing on public, private, and foreign-owned banks. Panel data from 25 commercial banks covering the period 2013–2024 were analyzed. Credit risk and financial stability were measured using the Non-Performing Loans (NPL) ratio and the Z-score, respectively. Generalized Linear Models (Logit) were employed to assess the relationships between explanatory variables and these indicators. The findings indicate that higher profitability (ROA) and GDP per capita significantly reduce NPL ratios, while an increase in policy interest rates raises credit risk. For financial stability, capital adequacy (CAR) enhances bank resilience, whereas larger bank size (BS) and ROA are negatively associated with stability. Ownership structure does not have a statistically significant impact on either credit risk or financial stability. The results suggest that operational performance and macroeconomic conditions play a more crucial role than ownership type in determining credit risk and stability in Türkiye's banking sector. Strengthening integrated risk management, maintaining strong capital buffers, and ensuring macroeconomic stability are essential for sustaining financial soundness and resilience in emerging markets.

Resumo
Este estudo visa examinar os determinantes específicos de cada banco e os determinantes macroeconômicos do risco de crédito e da estabilidade financeira na Turquia, com foco em bancos públicos, privados e estrangeiros. Foram analisados dados em painel de 25 bancos comerciais, abrangendo o período de 2013 a 2024. O risco de crédito e a estabilidade financeira foram medidos utilizando-se, respectivamente, o índice de empréstimos não performáticos (NPL) e o escore Z. Modelos Lineares Generalizados (Logit) foram empregados para avaliar as relações entre as variáveis explicativas e esses indicadores. Os resultados indicam que maior rentabilidade (ROA) e PIB per capita reduzem significativamente os índices de NPL, enquanto um aumento nas taxas de juros básicas eleva o risco de crédito. Para a estabilidade financeira, a adequação de capital (CAR) aumenta a resiliência bancária, enquanto um maior porte bancário (BS) e o ROA estão negativamente associados à estabilidade. A estrutura de propriedade não apresenta impacto estatisticamente significativo sobre o risco de crédito ou a estabilidade financeira. Os resultados sugerem que o desempenho operacional e as condições macroeconômicas desempenham um papel mais crucial do que o tipo de propriedade na determinação do risco de crédito e da estabilidade no setor bancário da Turquia. O fortalecimento da gestão integrada de riscos, a manutenção de reservas de capital robustas e a garantia da estabilidade

Keyword: Credit Risk. Financial Stability. Non-Performing Loans. Bank Performance. Emerging Market Banks.

macroeconômica são essenciais para sustentar a solidez e a resiliência financeira nos mercados emergentes.

Palavras-chave: *Risco de Crédito. Estabilidade Financeira. Empréstimos não Performáticos. Desempenho Bancário. Bancos de Mercados Emergentes.*

1 INTRODUCTION

Financial stability refers to a condition in which the financial system -including banks and other financial institutions- demonstrates resilience to shocks and disruptions while maintaining the efficient functioning of its core activities (Gidiş, 2023). Most global economies operate under bank-centered financial systems, making the stability of the banking sector a central determinant of overall financial stability (Ramlall, 2018). In Türkiye, where the financial system is predominantly bank-centered, the sound functioning of banks is critical for sustaining economic stability. A stable financial system facilitates efficient resource allocation, effective risk management, price and employment stability, and the internal absorption of emerging imbalances, thereby mitigating potential adverse effects on the real economy (World Bank, 2023).

Bank stability is influenced by both internal and external factors. Macroeconomic conditions -such as high inflation, rising interest rates, and exchange rate volatility- can undermine bank performance by reducing profitability, increasing credit risk, and weakening overall financial stability. Exchange rate fluctuations, in particular, pose significant risks to banks with substantial foreign currency exposures, potentially leading to balance sheet imbalances, heightened currency risk, and deterioration in capital adequacy.

A commonly used measure to assess bank insolvency risk is the Z-score, where higher values indicate greater stability. Despite its widespread application, the Z-score has limitations: it relies solely on accounting data, which may be subject to manipulation, and evaluates institutions individually without capturing systemic contagion risk. Nevertheless, in contexts where market-based or more advanced data are unavailable, the Z-score remains a useful tool for comparing default risk across banks with different ownership structures (World Bank, 2023). Indeed, a considerable number of empirical studies employ the Z-Score as a measure of financial stability.

The Turkish banking system consists of various financial institutions, including commercial banks, development and investment banks, participation banks (Islamic banking), and foreign banks operating in Türkiye. The system is characterized by a diverse structure in which different types of institutions operate in cooperation. Deposit banks hold the largest share of total assets (85%), loans (85%), and deposits (90%), making them vital to the country's financial system (TBB data). By providing liquidity and supporting credit flows across the economy, these banks form the backbone of Turkey's financial infrastructure. Therefore, this study focuses solely on commercial banks.

The commercial banking sector in Türkiye comprises state-owned banks, privately-owned domestic banks, and foreign banks. Ownership structure is considered one of the key determinants of bank performance, influencing risk-taking behavior, lending strategies, and contributions to financial stability. Empirical evidence shows that larger banks generally assume lower credit risk, whereas smaller banks may engage in riskier lending practices. This highlights the importance of examining bank size and ownership structure in relation to credit risk.

Credit risk, commonly measured through non-performing loans (NPLs), represents the likelihood that loan obligations are not repaid on time. In banking, loans overdue by 90 days or more are typically classified as non-performing. Rising NPLs adversely affect bank profitability and, in severe cases, may trigger systemic crises that threaten overall financial stability. Studies on NPL determinants consistently emphasize the role of both bank-specific characteristics and macroeconomic variables in shaping credit risk.

This study provides a comprehensive analysis of the determinants of financial stability and credit risk in an emerging economy, using Türkiye as a case study. By examining the interplay of bank-specific factors, macroeconomic conditions, and ownership structures, the study addresses a gap in the literature and contributes to understanding risk management and financial stability in bank-centered systems.

2 LİTERATURE REVİEW

The stability of the banking sector is widely recognized as a critical determinant of overall economic resilience, given banks' central role in financial intermediation,

payment facilitation, and credit creation (Oino, 2021). A substantial body of literature has examined the impact of credit risk on bank performance and financial stability, revealing consistently that elevated credit risk undermines both short- and long-term institutional resilience (Laeven & Levine,2009; Goswami, 2022; Ali, 2023; Safiria Ayu Ditta et al., 2024; Aryal & Singh, 2024; Amoa-Gyarteng et al., 2025). Non-performing loans (NPLs) and loan loss provisions are frequently employed as key indicators of such risks, with numerous studies confirming their negative implications for profitability and solvency (Matey, 2021; Tang My & Nguyen, 2022; Nguyen, 2023).

Empirical evidence from emerging and developed economies demonstrates that bank-specific, ownership-related, and macroeconomic factors jointly shape credit risk outcomes. For instance, Amoa-Gyarteng et al. (2025) highlight a significant negative relationship between problematic loans and financial sustainability in Ghanaian banks, emphasizing the protective role of a strong deposit base. Similarly, Aryal and Singh (2024) identify that non-performing loans in Nepalese commercial banks are positively correlated with bank size and return on assets but negatively influenced by asset quality and bank age, while inflation emerges as a significant macroeconomic driver of credit risk.

The governance and operational strategies of banks also play a pivotal role in mediating credit risk. In the context of Islamic rural banks, Addury and Ramadhani (2024) find that profit-margin financing exacerbates credit risk and negatively affects financial stability, whereas profit-sharing financing promotes stability. Such findings stress the importance of aligning funding strategies with robust risk management frameworks to ensure long-term sustainability. Nguyen (2023) further confirms the critical role of credit risk management in Vietnam, showing that both direct and indirect pathways link NPLs and loan loss provisions to profitability and institutional stability, consistent with prior theoretical and empirical insights.

Bank ownership structures and competition patterns also significantly influence risk-taking behavior and financial outcomes. Studies in MENA countries illustrate that reduced competition tends to lower risk-taking and enhance financial stability, while the effects of market concentration and ownership type are heterogeneous across bank categories (Halim et al., 2023; Naili & Lahrichi, 2022). Ayinuola and Gumel (2023) demonstrate that liquidity and credit risks have a negative and significant impact on bank stability. In addition, bank size, equity, and capital adequacy, as well as economic growth,

positively affect bank performance, while inflation has a negative but statistically insignificant effect. The study emphasizes the importance of the simultaneous and effective management of credit and liquidity risks.

Studies on the Turkish banking system also reveal the effects of certain financial and macroeconomic factors on financial stability. Aydemir et al. (2024) examine the effects of the exchange rate, unemployment rate, policy interest rate, and public debt-to-GDP ratio on NPLs and find that the results differ across bank types. Overall, participation banks are shown to be more vulnerable to adverse scenarios driven by the exchange rate, unemployment, and public debt compared to conventional banks. Likewise, Yağlı and Topcu (2023) find that credit risk is influenced by both bank-specific and macroeconomic factors. Furthermore, the variation of these effects across ownership structures suggests that uniform regulatory approaches may not be adequate for the entire sector. Kartal et al. (2023) and Ekinci and Poyraz (2019) reveal that in the Turkish banking sector, credit volume, risk-weighted assets, unemployment, exchange rate, and economic growth affect NPLs, with financial indicators being more decisive than macroeconomic ones. Consistently, Demirel (2015) and Halim et al. (2023) stress the systemic importance of monitoring NPLs as indicators of banking sector vulnerability, particularly in the presence of rising market or macroeconomic stressors.

Finally, cross-country analyses, including those in South Asia and Vietnam, reinforce the centrality of credit risk management for financial performance. Siddique et al. (2022) report that NPL ratios, cost-efficiency, and liquidity ratios adversely affect profitability in Pakistan and India, whereas capital adequacy and average lending rates exert a positive influence. Tang My and Nguyen (2022) similarly find direct and indirect linkages between credit risk, profitability, and financial stability in Vietnamese banks, highlighting the reinforcing role of past profitability and bank size in sustaining stability.

Overall, the literature converges on several key points: credit risk remains a fundamental determinant of bank stability; ownership and governance structures regulate risk-taking behaviors; macroeconomic conditions impact a significant yet context-dependent influence; and robust credit risk management practices are essential to safeguard both profitability and financial system resilience. These findings collectively inform the design of regulatory policies and institutional strategies aimed at mitigating systemic vulnerabilities in the banking sector across diverse global contexts.

3 MATERİALS AND METHODS

The data employed in this study are primarily drawn from the annual reports of commercial banks, which are accessible through the official website of the Banks Association of Türkiye (TBB). These reports provide comprehensive financial statements, including balance sheets and income statements. In addition, key financial indicators are obtained from the Central Bank of the Republic of Türkiye (CBRT) and the Turkish Statistical Institute (TUIK). The sample covers 25 commercial banks operating in the Turkish banking sector, consisting of 3 state-owned, 8 privately-owned domestic, and 14 foreign-owned banks. One domestic bank and seven foreign banks were excluded from the analysis due to inconsistent data availability, as they did not operate continuously throughout the study period.

Descriptive statistics were computed for all variables, including mean, standard deviation, minimum, and maximum values. Normality was assessed using skewness, kurtosis, and the Kolmogorov–Smirnov test. As all variables, except for bank size (BS), exhibited non-normal distributions, nonparametric methods were employed. Unit root tests were not conducted, given the ratio-based structure of the variables and the use of a logit model. To examine associations and effects, Spearman's rho correlation and Generalized Linear Model (Logit) analyses were applied. All statistical procedures were performed using SPSS version 25.0, with a 95% confidence interval and a significance threshold of 0.05.

This study employs both bank-specific and macroeconomic variables to analyze the determinants of credit risk and financial stability in Turkish banks, consistent with the existing literature (Table 1). Two dependent variables are considered in the analysis: the Non-Performing Loans ratio (NPL), which serves as an indicator of credit risk, and the Z-score (ZS), which reflects the financial stability of banks. Accordingly, both types of explanatory variables are included in the regression models, specified as follows:

$$NPL_{it} = \beta_0+\beta_1 BS_{it}+\beta_2 CAR_{it}+\beta_3 ROA_{it}+\beta_4 LIQ_{it}+\beta_5 LODit+\beta_6 INF_t+\beta_7 PIRt+\beta_8 GDPt+\beta_9 EXR_t+\varepsilon_{it} \quad (1)$$

$$ZS_{it} = \beta_0+\beta_1 BS_{it}+\beta_2 CAR_{it}+\beta_3 ROA_{it}+\beta_4 LIQ_{it}+\beta_5 LODit+\beta_6 INFt+\beta_7 PIR_t+\beta_8 GDP_t+\beta_9 EXR_t+u_{it} \quad (2)$$

where:

i denotes the bank, t denotes the year
NPL_{it}: Non-performing loans to total loans ratio
ZS_{it}: Z-score indicator of financial stability
BS_{it}: Bank size (natural logarithm of total assets)
CAR_{it}: Capital adequacy ratio
ROA_{it}: Return on assets
LIQ_{it}: Liquidity ratio (liquid assets /total assets)
LOD_{it}: Loans-to-deposits ratio
INF_t: Inflation rate
PIR_t: Policy interest rate
GDP_t: GDP per capita (constant prices)
EXR_t: Exchange rate
β: Estimated regression parameters
ε_{it}, u_{it}: Error terms.

Table 1 presents the definitions, notations, and data sources of the dependent, bank-specific, and macroeconomic variables employed in the empirical analysis. Bank-specific variables were obtained from the Banks Association of Türkiye (TBB) database, while macroeconomic indicators were sourced from the Turkish Statistical Institute (TUIK) and the Central Bank of the Republic of Türkiye (TCMB).

Table 1

Summary information of the variables

Variables	**Notation**	**Description**
Dependent variables		
Non-Performing Loans Ratio	NPL	Non-performing loans over total loans
Z-score	ZS	Z = [Return on assets ratio + (Equity/Total assets)]/Std(Return on assets ratio)
Bank-specific variables		
Bank Size	BS	Natural logarithm of total assets
Capital Adequacy Ratio	CAR	Ratio of total capital to risk-weighted assets
Return on Assets	ROA	Net income over total assets
Liqudity Ratio	LIQ	Liquid Assets /Total Assets
Macroeconomic variables		
Inflation rate (%)	INF	Inflation rate (annual percentage change in general price level)
Interest rate (%)	PIR	Central bank policy interest rate
GDP per capita	GDP	GDP per capita (economic output per person, in constant terms)
Exchange rate	EXR	Consumer Price Index (CPI)-Based Real Effective Exchange Rate, TL/USD

In this study, non-performing loans (NPL) are employed as a measure of bank credit risk, while the Z-score is used to assess financial stability, both of which are widely adopted in empirical research. Both measures provide critical insights into the assessment of banks' credit risk and financial stability.

4 RESULTS

The descriptive statistics of the study variables are presented in Table 2. Mean NPL was 4.42±5.12 with 0.01-48.59 range, and ZS mean was 13.09±16.83. BS mean was 10.97±1.96 and CAR mean was 19.53±12.38. The return on assets (ROA) ranged from –11.90 to 17.30, with a mean of 1.74 (SD = 2.29). The liquidity ratio (LIQ) averaged 27.04 (SD = 12.65). With respect to the macroeconomic indicators, the inflation rate (INF) exhibited a mean of 79.26 (SD = 17.94), and the policy interest rate (PIR) had a mean of 17.45 (SD = 12.58). GDP per capita ranged from 9.06 to 10.73, while the exchange rate (EXR) varied between 50.28 and 106.56.

Table 2

Descriptive statistics of research parameters and normality test results

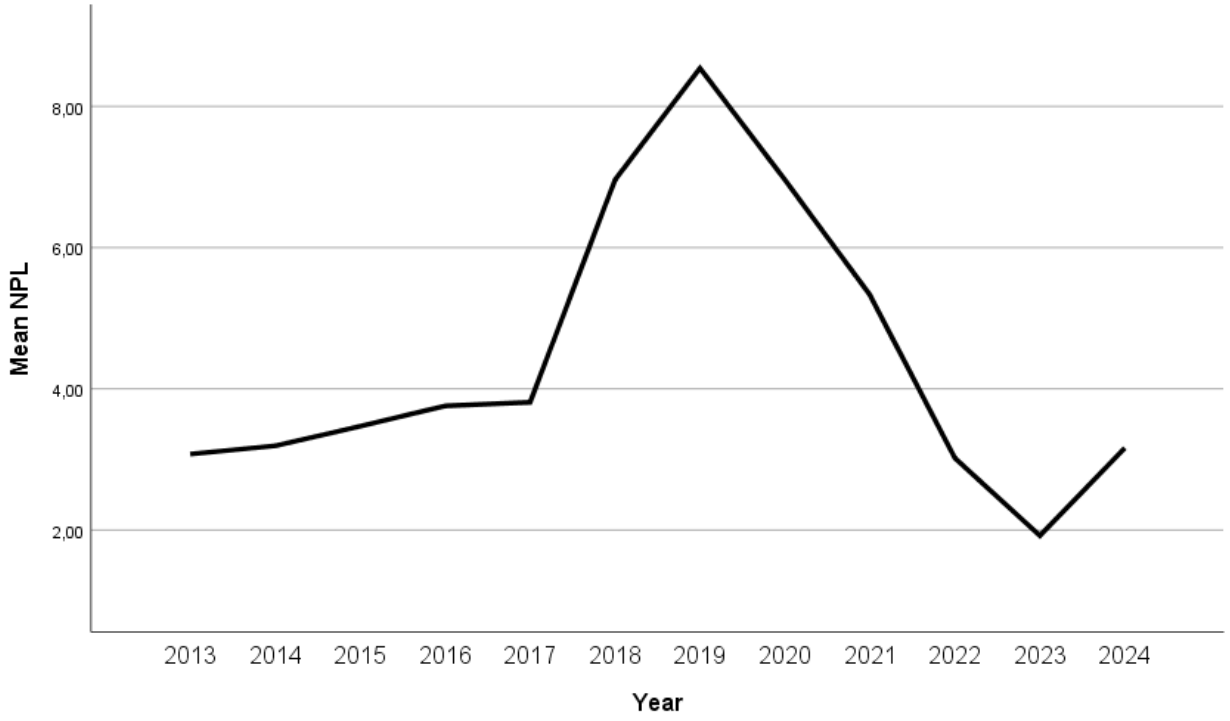
	Mean	**SD**	**Minimum**	**Maximum**
NPL	4.42	5.12	0.01	48.59
ZS	13.09	16.83	4.54	225.26
BS	10.97	1.96	6.01	15.50
CAR	19.53	12.38	12.19	204.20
ROA	1.74	2.29	-11.90	17.30
LIQ	27.04	12.65	8.37	88.26
INF	79.26	17.94	50.28	106.56
PIR	17.45	12.58	7.05	54.65
GDP	9.40	0.42	9.06	10.73
EXR	79.26	17.94	50.28	106.56

An analysis of the time series pattern of NPL reveals an upward trend between 2013 and 2019, with a particularly sharp increase in 2017. Following 2019, the ratio declined until 2023, after which it began to rise again (Figure 1). The 2017 surge in NPLs coincides with significant macroeconomic shocks in Türkiye, particularly the depreciation of the Turkish lira and tightening financial conditions, which adversely affected borrowers' repayment capacity. Similarly, the post-2019 decline may be associated with regulatory measures, credit restructuring programs, and expansive

monetary policies that temporarily reduced credit risk. However, the renewed upward movement after 2023 indicates persistent structural fragilities in the banking sector, suggesting that credit risk remains highly sensitive to macro-financial fluctuations.

Figure 1

NPL change according to years



Skewness, kurtosis, and normality test results indicated that all parameters, except bank size (BS), exhibited non-normal distributions. In this study, ratio-based variables were employed with deflator adjustments. Moreover, since the generalized linear model (logit) was applied for the empirical analysis, unit root tests were not conducted. The results of skewness, kurtosis, and normality tests for the research parameters are presented in Table 3.

Table 3

Skewness, Kurtosis and normality test results of research parameters

	Skewness	**Kurtosis**	**Kolmogorov Smirnov Test**	
			Z	**p**
NPL	5.443	38.223	0.202	0.000
ZS	8.835	97.148	0.338	0.000
BS	.066	-.629	0.038	0.200
CAR	11.750	168.724	0.286	0.000

ROA	1.921	17.605	0.211	0.000
LIQ	1.489	2.623	0.154	0.000
INF	-.008	-1.289	0.130	0.000
PIR	2.102	3.636	0.314	0.000
GDP	2.584	5.642	0.337	0.000
EXR	-.008	-1.289	0.130	0.000

Spearman's rho correlation analysis revealed that the non-performing loans ratio (NPL) was significantly associated with several variables. Specifically, NPL was positively correlated with the Z-score (ZS) ($r = 0.216$; $p < 0.01$) and negatively correlated with return on assets (ROA) ($r = -0.300$; $p < 0.01$), liquidity ratio (LIQ) ($r = -0.296$; $p < 0.01$), and gross domestic product per capita (GDP) ($r = -0.431$; $p < 0.01$) (Table 4). The significant negative correlations with ROA and GDP ($r = -0.300$ and -0.431; $p < 0.01$) indicate that higher profitability and economic growth reduce the ratio of non-performing loans. On the other hand, a positive correlation with PIR ($r = 0.016$, not significant) suggests that increases in interest rates may exert pressure on loan repayments.

In addition, ZS exhibited significant correlations with multiple parameters. It was negatively correlated with bank size (BS) ($r = -0.511$; $p < 0.01$), ROA ($r = -0.510$; $p < 0.01$), policy interest rate (PIR) ($r = -0.427$; $p < 0.01$), and GDP ($r = -0.158$; $p < 0.01$). Conversely, positive correlations were observed between ZS and liquidity ratio (LIQ) ($r = 0.162$; $p < 0.01$), inflation rate (INF) ($r = 0.495$; $p < 0.01$), and exchange rate (EXR) ($r = 0.495$; $p < 0.01$). Negative correlations with BS and ROA and positive correlations with CAR ($p < 0.01$) were observed, supporting the classical relationship between capital adequacy, profitability, and bank stability. Some strong correlations with macroeconomic variables such as INF, PIR, and EXR indicate the importance of macroeconomic fluctuations for bank stability.

Table 4

Spearman's rho correlation analysis for correlation between research parameters and non-performing loans ratio

		NPL	ZS	BS	CAR	ROA	LIQ	INF	PIR	GDP	EXR
NPL	r	1.000	.216**	-.055	-.099	-.300**	-.296**	.016	-.025	-.431**	.016
	p	.	.000	.360	.100	.000	.000	.787	.673	.000	.787
ZS	r	.216**	1.000	-.511**	-.050	-.510**	.162**	.495**	-.427**	-.158**	.495**
	p	.000	.	.000	.396	.000	.006	.000	.000	.007	.000
BS	r	-.055	-.511**	1.000	-.089	.301**	-.498**	-.310**	.298**	.051	-.310**
	p	.360	.000	.	.123	.000	.000	.000	.000	.377	.000
CAR	r	-.099	-.050	-.089	1.000	.415**	.164**	-.484**	.423**	-.106	-.484**

	p	.100	.396	.123	.	.000	.004	.000	.000	.067	.000
ROA	r	-.300**	-.510**	.301**	.415**	1.000	.144*	-.346**	.342**	.178**	-.346**
	p	.000	.000	.000	.000	.	.013	.000	.000	.002	.000
LIQ	r	-.296**	.162**	-.498**	.164**	.144*	1.000	.231**	-.148*	.283**	.231**
	p	.000	.006	.000	.004	.013	.	.000	.010	.000	.000
INF	r	.016	.495**	-.310**	-.484**	-.346**	.231**	1.000	-.650**	.350**	1.000**
	p	.787	.000	.000	.000	.000	.000	.	.000	.000	.
PIR	r	-.025	-.427**	.298**	.423**	.342**	-.148*	-.650**	1.000	.042	-.650**
	p	.673	.000	.000	.000	.000	.010	.000	.	.469	.000
GDP	r	-.431**	-.158**	.051	-.106	.178**	.283**	.350**	.042	1.000	.350**
	p	.000	.007	.377	.067	.002	.000	.000	.469	.	.000
EXR	r	.016	.495**	-.310**	-.484**	-.346**	.231**	1.000**	-.650**	.350**	1.000
	p	.787	.000	.000	.000	.000	.000	.	.000	.000	.

The results of the Generalized Linear Model (Logit) indicated that ROA (B = -1.272; $p < 0.01$), PIR (B = 0.209; $p < 0.01$), and GDP (B = -5.853; $p < 0.01$) had statistically significant effects on the NPL ratio (NPL). Specifically, ROA and GDP exhibited negative effects, whereas PIR had a positive effect.

ROA (B = -1.272, $p < 0.01$) and GDP (B = -5.853, $p < 0.01$) have a negative effect on NPL, indicating that higher profitability and economic growth reduce the ratio of non-performing loans. PIR (B = 0.209, $p < 0.01$) has a positive effect, suggesting that rising policy interest rates may make loan repayments more difficult. Ownership effect: the coefficients of private and public banks on NPL are negative but not statistically significant ($p > 0.05$). This indicates that ownership structure does not directly determine NPL, while bank performance and macroeconomic conditions are more influential.

For the Z-score (ZS), BS (B = -2.107; $p < 0.01$), CAR (B = 0.262; $p < 0.01$), and ROA (B = -1.608; $p < 0.01$) were significant predictors. The effects of BS and ROA on ZS were negative, while CAR demonstrated a positive effect (Table 5).

BS (B = -2.107, $p < 0.01$) and ROA (B = -1.608, $p < 0.01$) have negative effects, while CAR (B = 0.262, $p < 0.01$) has a positive effect. This indicates that capital adequacy and profitability strengthen bank stability, whereas larger bank size may be associated with certain risks. Ownership effect: although private banks show a tendency toward a positive effect on ZS (B = 3.738, $p = 0.073$), it is not statistically significant at the 5% level. The effect of public banks is also not significant. This finding suggests that the impact of ownership structure on ZS is limited, with bank performance indicators and capital adequacy being the main determinants.

Table 5

Generalized Linear Model (Logit) for effects of research parameters on NPL and ZS

Parameter	B	Std. Error	95% Wald Confidence Interval		Hypothesis Test		
			Lower	Upper	Wald X^2	df	p
NPL							
(Intercept)	59.169	16.7507	26.338	91.999	12.477	1	0.000
Ownership structure=Private	-0.403	0.6036	-1.587	0.780	0.447	1	0.504
Ownership structure=Public	-1.130	0.9401	-2.973	0.712	1.446	1	0.229
Ownership structure=Foreign	Reference	.	.	.	.	.	.
BS	-0.254	0.1993	-0.644	0.137	1.618	1	0.203
CAR	0.104	0.0665	-0.026	0.234	2.438	1	0.118
ROA	-1.272	0.1832	-1.631	-0.913	48.237	1	0.000
LIQ	-0.015	0.0297	-0.073	0.043	0.255	1	0.613
INF	0.004	0.0269	-0.049	0.056	0.017	1	0.895
PIR	0.209	0.0755	0.061	0.357	7.629	1	0.006
GDP	-5.853	2.0724	-9.915	-1.791	7.976	1	0.005
EXR	0[a]	.	.	.	.	.	.
(Scale)	18.412[b]	1.5617	15.592	21.742			
ZS							
(Intercept)	-13.460	57.5833	-126.321	99.401	0.055	1	0.815
Ownership structure=Private	3.738	2.0842	-0.347	7.823	3.217	1	0.073
[Ownership structure=Public	2.850	3.2925	-3.603	9.303	0.749	1	0.387
[Ownership structure=Foreign	0[a]	.	.	.	.	.	.
BS	-2.107	0.6591	-3.399	-0.815	10.220	1	0.001
CAR	0.262	0.0823	0.100	0.423	10.095	1	0.001
ROA	-1.608	0.5313	-2.649	-0.566	9.156	1	0.002
LIQ	0.069	0.0991	-0.125	0.263	0.482	1	0.488
INF	0.051	0.0921	-0.130	0.231	0.305	1	0.581
PIR	-0.150	0.2616	-0.663	0.362	0.330	1	0.566
GDP	4.565	7.2388	-9.623	18.753	0.398	1	0.528
EXR	0[a]	.	.	.	.	.	.
(Scale)	229.639[b]	19.1699	194.979	270.459			

a. Set to zero because this parameter is redundant, b. Maximum likelihood estimate.

The Generalized Linear Model (Logit) results indicated that ROA (B = -1.272; $p < 0.01$), PIR (B = 0.209; $p < 0.01$), and GDP (B = -5.853; $p < 0.01$) have statistically significant effects on the non-performing loans ratio (NPL). Specifically, ROA and GDP exhibit negative effects, whereas PIR has a positive effect.

For the Z-score (ZS), BS (B = -2.107; $p < 0.01$), CAR (B = 0.262; $p < 0.01$), and ROA (B = -1.608; $p < 0.01$) were significant predictors. While BS and ROA had negative effects on ZS, CAR showed a positive effect (Table 5).

As Goodhart (2005) emphasized, regulatory frameworks, particularly Basel accords, have focused more on improving individual bank risk management rather than

addressing systemic risk management. The key parameters of a bank's credit portfolio are profitability and risk. Bank activities are directly influenced by various types of risks that affect profitability (Tang My and Quoc, 2022). In addition to bank-specific risks, macroeconomic factors also directly impact credit risk and financial stability. The main objective of credit portfolio management is to achieve the highest return at an acceptable level of risk (Samorodov et al., 2019). Considering the significant weight of the banking sector within Turkey's financial system, risk management is critically important for maintaining overall financial stability. In this study, the ratio of non-performing loans (NPL) is employed as an indicator of credit risk, while the Z-score (ZS) is used to measure financial stability.

At the bank level, the relationship between NPLs and ROA (Return on Assets) or ROE (Return on Equity) is generally expected to be negative in the literature. As NPLs increase, a bank's asset profitability (ROA) tends to decline. Profitable banks are generally expected to maintain higher credit quality due to better risk management practices. In line with numerous studies, this research also finds a negative relationship between NPLs and profitability measured by ROA (Oino, 2021; Beni et al., 2023; Jiang and Zheng, 2024; Amoa-Gyarteng et al., 2025; Hidayet et al., 2025; Kalkan, 2025).

The results of the Generalized Linear Model (Logit) reveal a positive relationship between NPLs and the policy interest rate (PIR). Several academic studies have similarly demonstrated that increases in policy interest rates raise NPL levels (Mahrous et al., 2020; Koskei and Samoei, 2023). Conversely, a negative relationship is observed between NPLs and GDP. Most studies report a negative association between economic growth (GDP) and credit risk (NPL) (Aryal and Singh, 2024; Aydemir et al., 2023). During periods of economic expansion, rising corporate and household incomes reduce the probability of default by strengthening debt repayment capacity.

With respect to financial stability (measured by the Z-score), the findings indicate that as bank size increases, the Z-score declines. This suggests that despite the advantages of economies of scale, larger banks may adopt riskier lending practices. The results are consistent with prior literature arguing that smaller banks tend to have more flexible and manageable risk profiles (Yong and Christos, 2013; Nguyen and Duong, 2021; Mahmud, 2023). In the literature, this phenomenon is often explained by the "high risk–high return" trade-off, implying that higher profitability is sometimes achieved through riskier credit or investment strategies, which may adversely affect financial stability in the short run.

The positive relationship between the Z-score and CAR demonstrates that strong capitalization reduces risk and contributes to financial stability. This finding is consistent with expectations in the banking sector and aligns with the objectives of policymakers. The results also corroborate previous research (Mahmud, 2023).

In the literature, a positive relationship is generally expected between ROA and the Z-score (Lepetit & Strobel, 2013). As ROA increases, the Z-score typically rises, implying a lower probability of financial distress. However, in this study, a negative relationship is observed between ROA and the Z-score, diverging from conventional literature findings (Hesse & Čihák, 2007; Li et al., 2017; Mahmud, 2023).

5 DİSCUSSİON

Effective credit risk management and solid operational performance play a critical role in maintaining financial stability. As previously stated, two dependent variables are considered in the analysis: the Non-Performing Loans ratio (NPL), which serves as an indicator of credit risk, and the Z-score (ZS), which reflects the financial stability of banks. While NPL captures the asset quality dimension of credit risk, the Z-score is a widely used composite indicator of bank soundness, reflecting insolvency risk.

The empirical findings of this study largely align with prior literature on the determinants of credit risk and financial stability in the banking sector. Consistent with Oino (2021) and Amoa-Gyarteng et al. (2025), higher profitability, as measured by ROA, exhibits a significant negative relationship with the NPL ratio, indicating that more profitable banks are better able to manage credit risk and maintain asset quality.

As emphasized by Goodhart (2005), regulations, particularly Basel frameworks, have focused more on improving individual bank risk management rather than systemic risk management. The primary parameters of a bank's credit portfolio are profitability and risk. Bank operations are influenced by various types of risks that directly affect bank profitability (Tang My & Quoc, 2022). In addition to bank-specific risks, macroeconomic factors also directly impact credit risk and financial stability. The primary objective of credit portfolio management is to achieve the highest return at an acceptable level of risk (Samorodov et al., 2019). Considering the significant role of the banking system within Turkey's financial system, effective risk management is critical for financial stability. In

this study, the non-performing loans (NPL) ratio is used as an indicator of credit risk, while the Z-score (ZS) is employed to measure banks' financial stability.

At the bank level, the relationship between NPL and ROA (Return on Assets) or ROE is generally expected to be negative in the literature. As NPL increases, a bank's asset profitability (ROA) declines. Profitable banks are expected to have higher credit quality due to better risk management practices. Consistent with the literature, this study finds a negative relationship between NPL and ROA (Oino, 2021; Beni et al., 2023; Jiang & Zheng, 2024; Amoa-Gyarteng et al., 2025; Hidayet et al., 2025; Kalkan, 2025).

Results from the Generalized Linear Model (Logit) indicate a positive relationship between NPL and the policy interest rate (PIR). Some studies also show that increases in the policy interest rate raise NPL levels (Mahrous et al., 2020; Koskei & Samoei, 2023). Conversely, a negative relationship is observed between NPL and GDP. Most studies indicate a negative association between economic growth and credit risk; during periods of economic expansion, rising incomes of firms and households reduce default risk and increase debt repayment capacity (Aryal & Singh, 2024; Aydemir et al., 2023).

Regarding financial stability, measured by the Z-score, the findings suggest that as bank size increases, the Z-score decreases. This indicates that, despite the advantages of economies of scale, large banks may engage in riskier lending practices. This is consistent with literature suggesting that smaller banks have more flexible and manageable risk profiles (Yong & Christos, 2013; Nguyen & Duong, 2021; Mahmud, 2023). In the literature, this phenomenon is often explained by the "high return, high risk" relationship, meaning that high profitability may sometimes be achieved through risky lending or investment strategies, which can negatively affect short-term financial stability.

The positive relationship between the Z-score and CAR indicates that a strong capital structure reduces risk and contributes to financial stability. This finding aligns with expectations in the banking sector and is encouraged by policymakers. The results support previous research (Mahmud, 2023). In the literature, ROA is generally expected to be positively associated with the Z-score (Lepetit & Strobel, 2013). As ROA increases, the Z-score typically rises, indicating a lower probability of financial distress. However, in this study, the relationship between ROA and the Z-score is negative, diverging from expected literature findings (Hesse & Čihák, 2007; Li et al., 2017; Mahmud, 2023). This

negative relationship indicates that banks achieving higher profits are simultaneously taking on greater risk.

Overall, the study's empirical findings validate key insights from the literature: (i) credit risk remains a fundamental determinant of bank stability; (ii) profitability and capital adequacy critically influence financial soundness; (iii) macroeconomic conditions, particularly GDP growth and interest rates, modulate risk exposure; and (iv) ownership effects, while theoretically relevant, are less pronounced in the Turkish banking context. These results demonstrate the necessity of integrated risk management frameworks, robust capital buffers, and effective regulatory supervision to enhance the stability of the banking sector in emerging economies.

6 CONCLUSİONS

This study provides a comprehensive assessment of the determinants of credit risk and financial stability in the Turkish banking sector, examining both bank-specific and macroeconomic factors. Using data from 25 commercial banks over the period 2013–2024, the effects of bank size (BS), capital adequacy (CAR), profitability (ROA), liquidity (LIQ), as well as macroeconomic indicators such as inflation (INF), policy interest rates (PIR), GDP per capita (GDP), and exchange rates (EXR) on non-performing loans (NPL) and bank stability (Z-Score, ZS) were analyzed.

In the literature, credit risk in the banking sector is typically measured using the non-performing loan ratio (NPL) and the ratio of loan loss provisions to total loans (LLP), whereas financial stability is commonly assessed through the Z-Score. Moreover, credit risk and financial stability have often been examined separately. This study is distinguished by its integrated approach, simultaneously addressing both critical dimensions.

The findings of the study largely align with trends reported in the literature. At the bank level, the negative relationship between non-performing loans (NPL) and return on assets (ROA) indicates that increasing credit risk adversely affects bank profitability. High NPL levels prompt banks to increase loan loss provisions, thereby reducing profits. Furthermore, an increase in the policy interest rate (PIR) is observed to raise NPL levels, as expected. At the macroeconomic level, the negative relationship between GDP and

NPL suggests that periods of economic growth reduce non-performing loans, thereby mitigating credit risk.

The second dependent variable used as a measure of financial stability is the Z-Score. The results indicate that, in terms of financial stability, large banks reduce their Z-Score by adopting riskier credit and investment strategies compared to smaller banks, whereas smaller banks exhibit a more manageable risk profile. As expected, a strong capital structure (CAR) appears to enhance financial stability. However, the negative relationship between ROA and the Z-Score deviates from the positive relationship typically reported in the literature, suggesting that high profitability is sometimes achieved through risky credit or investment strategies, which may negatively impact financial stability.

In conclusion, these findings underscore that effective management of bank-specific factors and the enhancement of macroeconomic conditions are critically important not only for banks but also for policymakers to ensure the sound functioning of the financial system. Future research could examine the determinants of credit risk and financial stability more comprehensively by employing dynamic models that incorporate macroeconomic shocks and stress testing, alongside conventional panel data analyses.

AUTHOR CONTRİBUTİONS

Conceptualization, S.T.; methodology, S.T.; software, K.Y.; validation, K.Y.; formal analysis, K.Y.; investigation, S.T.; resources, S.T.; data curation, S.T.; writing—original draft preparation, S.T.; writing—review and editing, S.T.; visualization, S.T. and K.Y.; supervision, S.T. All authors have read and agreed to the published version of the manuscript.

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Authors' Contribution

Both authors contributed equally to the development of this article.

Data availability

All datasets relevant to this study's findings are fully available within the article.

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