

The Determinants of Bank Profitability: A Study of the Turkish Banking Sector

Abstract

This study examines the influence of both bank-specific and macroeconomic factors on bank profitability, focusing on the Istanbul Stock Exchange (BIST) banking sector from 2005 to 2023. Consistent with the established literature, it explores various potential determinants of bank profitability at both sectoral and macroeconomic levels. The analysis employs two primary measurements of bank profitability: Return on Assets (ROA) and Return on Equity (ROE). Additionally, it considers macroeconomic factors such as interest rates, GDP, and inflation, along with sectoral control variables including loans, capital adequacy, and bank size. The research incorporates diagnostic tests for unit roots across each series in the panel, as well as for cross-dependence and cointegration. Various methodologies are utilized, including Ordinary Least Squares (OLS), fixed and random effects, and year dummies for enhanced precision. To achieve robust results, this study encompasses one of the broadest time spans in the field and systematically addresses issues related to stationarity, collinearity, and year and sector fixed effects. Given the presence of cross-dependency and non-stationarity in the models, a second-generation Autoregressive Distributed Lag (ARDL) model was employed. Consequently, the study utilizes the Common Correlated Effects Mean Group (CCEMG) and the Augmented Mean Group (AMG) estimator. The findings yield valuable insights that align with existing literature regarding the relationship between bank profitability and its short- and long-term determinants. The analysis reveals that the long-term outcomes concerning the relationship between micro and macro determinants of bank profitability are somewhat constrained. However, in the short term, significant factors in-

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fluencing bank profitability include capital adequacy, bank size, and GDP, regardless of whether performance is assessed through ROA or ROE. To the best of our knowledge, this study represents one of the longest time spans in the field, rigorously accounting for stationarity, collinearity, and both year and sector fixed effects. A limitation of this study is the restricted availability of data for specific banks.

Keywords: bank profitability, Turkish banking sector, BIST, macroeconomic factors, bank-specific factors.

1. INTRODUCTION

Banks play a critical role in global and national economies, serving as key financial actors and the largest providers of resources to the real sector (Oladejo & Oladipupo, 2011). In both developed and developing countries, banks are crucial building blocks of the financial system, essential for economic development and industrial growth (Greenberg & Simbanegavi, 2009). By intermediating between those who supply and demand funds, banks are obliged to make a profit to cover their expenses, pay dividends to shareholders, and pay interest to depositors. In this way, they maintain their sustainability and financial viability (Reis et al., 2016). Such financial transactions conducted by banks significantly impact the money supply of countries. For this reason, the financial performance of banks is substantial for investors, policymakers, and regulatory authorities. A strong banking sector in an economy demonstrates the continuity of financial stability and the resilience of the country's economy in the face of adverse developments (Bektaş, 2013). Since the 1994 crisis, the Turkish banking sector has faced numerous difficulties, including excessive fluctuations in exchange rates, deterioration in the balance of payments, increasing budget deficits, and challenges in financial markets. Moreover, the Asian crisis of 1999 and the subsequent crises of November 2000 and February 2001 also profoundly affected the Turkish banks. In these crises, even strong banks lost much of their capital. However, in May 2001, the Banking Regulation and Supervision Agency launched the 'Banking Sector Restructuring Programme' to strengthen the banking system's financial and operational structure and make efficiency and competition in the sector sustainable (Banking Regulation and Supervision Agency, 2001). As of 2002, a significant foreign capital inflow had been achieved in the Turkish banking sector, and large banks operating in the international arena had become integrated into the national economy. While this development has accelerated the growth of the Turkish banking sector, it has also increased competition. In this context, banks' efforts to maximize profits have become even more critical (Gülhan & Uzunlar, 2011). This study aims to identify the factors that affect bank profitability. In this context, Return on Equity (ROE) and Return on Assets (ROA) are used as bank prof-

itability variables; loans, capital adequacy, and bank size are used as bank-specific variables; and interest rates, GDP, and inflation rates are used as macroeconomic variables. The study analyses the Turkish banking sector for the period 2005-2023. A review of the literature reveals the importance and originality of this study, as no existing study covers the COVID-19 period, particularly for the Turkish banking sector. This is because many of the economic and financial measures implemented during COVID-19 have impacted the banking sector. During this period, central banks implemented interest rate cuts to facilitate liquidity expansion and planned to prevent market contraction. The fact that banks play an active role in all these processes is crucial to including this period in the research and determining this sector. The remainder of the paper is structured as follows: Section 2 reviews the relevant empirical studies on bank profitability and its key determinants. Section 3 outlines the research methodology, including the data, model, and methods. Section 4 presents and analyzes the empirical findings. Finally, the conclusions are provided in Section 5.

2. A BRIEF OVERVIEW OF RELEVANT EMPIRICAL STUDIES

2.1. Literature Review

A comprehensive examination of the existing literature reveals several critical aspects of bank profitability. Key areas of focus include the interplay between bank profitability and board structure (Aygün, 2010; Ersoy & Aydın, 2018; Aqlan et al., 2020; Elgadi & Ghardallou, 2022), as well as liquidity and financial leverage ratios (Şekerçioğlu & Boyacıoğlu, 2021). Additionally, the roles of growth, size, and capital structure decisions (İskenderoğlu et al., 2012; Oanh et al., 2023) and financial risks (Şenol et al., 2019; Akgüneş, 2021; Saleh et al., 2020; Abdelaziz et al., 2022) are significant considerations. The impact of non-performing loans has also been documented (Kılınc et al., 2018; Kocaman et al., 2018), alongside with recent investigations into Environmental, Social, and Corporate Governance (ESG) factors (Kanapianova et al., 2023; Arslan & Yağcılar, 2023), employee gender dynamics (Alhan & Yüksel, 2018; Milojević et al., 2023), advancements in mobile banking (Canatan & İpek, 2018; Nwako by et al.,

2020), and the contribution of intellectual capital (Xu et al., 2023; Topaloğlu & Bayrakdaroğlu, 2024).

In a literature review conducted for this study, Alper and Anbar (2011) focused on bank-specific and macroeconomic factors influencing bank profitability in the Turkish banking sector from 2002 to 2010. Their research established a positive correlation between interest rates and bank profitability. In contrast, Akba (2012) utilized the Herfindahl-Hirschman Index to explore credit, deposits, assets, GDP, and inflation as macroeconomic variables while assessing bank profitability in the Turkish banking sector between 2005 and 2010. Akba identified a negative relationship between inflation and bank profitability. Furthermore, research by Kakilli Acaravcı and Çalim (2013) on the Turkish banking sector from 1998 to 2011 concluded that bank-specific factors exert a more substantial influence on profitability than macroeconomic factors.

Zaman et al. (2013) conducted a comprehensive investigation into the factors influencing banking profitability within the Pakistani banking sector from 2007 to 2011. Their findings indicated that interest rates exert a significant impact on bank profitability. Similarly, Ngrure (2014) explored the Kenyan banking sector between 2009 and 2013, identifying a linear relationship between interest rates and bank profitability. In another study, Lipunga (2014) analyzed the Malawian banking sector from 2009 to 2012 and discovered a correlation between bank-specific variables and profitability. Saeed (2014) focused on the UK banking sector during 2006-2012 and found a positive association between interest rates and bank profitability. Malik et al. (2014) examined the Pakistani banking sector, distinguishing between private and public banks, and concluded that the influence of interest rates on profitability is more pronounced in private banks. Ifeacho and Ngalawa (2014) assessed the African banking sector from 1994 to 2011, revealing a positive relationship between interest rates and bank profitability. Furthermore, Topak and Talu (2017) studied the Turkish banking sector, confirming a positive relationship between interest rates and profitability. Bhattarai (2017) analyzed the Nepalese commercial banking sector from 2010 to 2015, highlighting a positive

connection between profitability and the commercial bank lending rate. Ebenezer et al. (2017) investigated the Nigerian banking sector from 2010 to 2015, finding a positive relationship between economic growth and bank profitability. In contrast, Rakibul Islam (2023) reported a negative relationship between commercial banks' profitability on the London Stock Exchange and economic growth from 2015 to 2019. This body of research underscores the complexity of factors influencing banking profitability across various regions and timeframes.

Sultan et al. (2020) identified a positive relationship between bank profitability and economic growth within the Pakistani banking sector. Conversely, Serwadda (2018) analyzed the Hungarian banking sector from 2000 to 2015, while Islam and Rana (2019) examined the Bangladesh commercial banking sector from 2013 to 2017, concluding that there was no significant relationship between bank profitability and interest rates. In contrast, Ahmed et al. (2018) focused on the Pakistani banking sector, Murty and Chowdary (2018) on the Indian banking sector, and Caliskan and Lecuna (2019) on the Turkish banking sector, all of which reported a positive correlation between interest rates and bank profitability. Furthermore, Durguti et al. (2020) analyzed the Kosovo banking sector from 2006 to 2019 and observed no significant relationship between macroeconomic variables and bank profitability. Conversely, Gazi et al. (2021) examined the Bangladesh banking sector and concluded that a positive connection exists between economic growth and bank profitability. Similarly, Yuan et al. (2022) studied commercial banks operating in South Asian countries from 2010 to 2021 and identified a positive link between inflation rates, economic growth, and bank profitability. Kelmendi (2024) conducted a comparative study of the relationships between bank profitability and macroeconomic factors in the Turkish and Kosovo banking sectors from 2013 to 2022, concluding that macroeconomic conditions influence bank profitability in both regions. The literature review reveals a substantial body of research concerning the banking sector at both national and international levels. The findings indicate that bank profitability factors can be categorized into two distinct groups: bank-specific and macroeconomic factors. The studies in the literature are summarized in Table 1.

Table 1. Literature Review

Author/ Year	Sample	Method	Variables	Results
Alper & Anbar (2011)	Turkey, 2002–2010	Panel Data Analysis	ROA, ROE, asset size, capital adequacy, asset quality, liquidity, deposits, income, income-expenditure structure, expenditure structure, GDP growth rate, inflation rate, interest rate	Positive relationship between interest rate and profitability
Akba (2012)	Turkey, 2005–2010	Panel Data Analysis	ROA, ROA, equity over total assets, credit risk, liquidity management efficiency, total assets, Herfindahl-Hirschman index for credit, deposits, assets, GDP, inflation	Negative relationship between inflation and profitability
Kakilli Acaravcı & Çalim (2013)	Turkey, 1998–2011	Johansen-Juselius Cointegration Tests	ROA, ROE, Net Interest Margin (NIM), asset quality, liquidity, income structure, expenditure structure, capital adequacy, asset size, GDP, inflation, interest rate, exchange rate	Bank specific determinants have been more effect than macroeconomic factors.
Zaman et al. (2013)	Pakistan, 2007–2011	Panel Data Analysis	ROA, ROE, earnings per share, deposits with other banks, loans, or advances, investments, interest rate	Effect of interest rates on profitability.
Lipunga (2014)	Malawi, 2009–2012	Regression Analysis	ROA, earnings yield, bank size, liquidity, management efficiency, capital adequacy	Profitability related to bank-specific variables
Saeed (2014)	UK, 2006–2012	Econometric analysis	ROA, ROE, capital ratio, bank size, loan size, deposits, and liquidity, GDP, inflation rate, and interest rate.	GDP and inflation rate have an adverse effect, while interest rate and bank-specific factor have a positive effect.
Malik et al. (2014)	Pakistan 2008-2012	Regression analysis	ROA, ROE, and interest rate	More substantial effect of interest rate in private banks
Ifeacho & Ngalawa (2014)	South Africa, 1994–2011	Panel data analysis	ROA, ROE, capital adequacy, asset quality, management, earnings, liquidity, unemployment rate, interest rate, inflation rate.	Positive relationship between interest rate and bank profitability.
Odobašić et al. (2014)	Croatia 2008-2012	Entropy method	ROA, ROE, gross profit margin, Herfindahl-Hirschman index, Gini, Concentration ratio	The concentration ratio is directly related to the financial performance of banks.

Author/ Year	Sample	Method	Variables	Results
Topak & Talu (2017)	Turkey	Panel data analysis	ROA, ROE, net interest margin, capital adequacy, size, credit risk, liquidity, other operating expenses, non-interest revenues, GDP, inflation rate, exchange rate, and interest rate	GDP and interest rate have a positive impact on profitability, whereas the exchange rate has a negative impact.
Bhattarai (2017)	Nepal, 2010–2015	Panel data analysis	ROA, ROE, bank size, debt to asset ratio, deposit to asset ratio, loan to deposit ratio, equity to asset ratio, inflation rate, and GDP.	Inflation Rate, GDP have positive impact on profitability.
Ebenezer et al. (2017)	Nigeria, 2010–2015	Panel data analysis	ROA, ROE, NIM, asset size, capital adequacy, asset quality, liquidity, deposits, efficiency, Income-expenditure structure, GDP	Capital adequacy, liquidity, and GDP have a positive effect on banks' profitability.
Serwadda (2018)	Hungary, 2000–2015	Panel data analysis	Return on average assets, capital adequacy, liquidity, net interest margin, bank size, overhead costs, and non-performing loans	Bank size and asset quality are bank-specific factors that significantly impact commercial banks' profitability in Hungary.
Ahmed et al. (2018)	Pakistan	Multiple Regression Analysis	ROA, ROE, earnings per share (EPS), Interest rate, Investment, Advances and loans, and deposits with other banks.	ROE has a positive relationship with advances and investments, while it has a negative relationship with deposits with other banks and interest rates.
Murty & Chowdary (2018)	India	Econometric analysis	ROA, ROE, return on capital employed, interest rate	Interest rate has a significant effect on bank profitability.
Caliskan & Lecuna (2019)	Turkey 1980- 2017	Regression Analysis	ROA, ROE, size, deposit conversion ratio, liquidity and efficiency, interest rates, exchange rate, inflation	Inflation, interest rates, and exchange rates significantly affect bank profitability.
Islam & Rana (2019)	Bangladesh, 2013–2017	Panel data analysis	ROA, ROE, NIM, interest income, non-interest income, net income after taxes, deposits, operating expenses, advance, total assets, total equity, non-performing loans, GDP, inflation, and interest rate	Bank factors have both positive and negative impacts on profitability, while macroeconomic factors have no impact.

Author/ Year	Sample	Method	Variables	Results
Durguti et al. (2020)	Kosovo, 2006–2019	Panel data analysis- General Method of Moments	ROA, ROE, assets, Capital adequacy, Liquidity, Assets quality, Management efficiency, GDP, exchange rate, inflation	Bank factors have both positive and negative impacts on profitability.
Sultan et al. (2020)	Pakistan	Panel data analysis	ROE, asset size, liquidity, asset quality, deposit, income expenditure structure, capital adequacy, GDP, inflation	GDP has a positive impact on the bank's efficiency and capital adequacy ratio, while inflation has a negative effect on its profitability.
Gazi et al. (2021)	Bangladesh 2011-2020	Panel data analysis	ROA, ROE, equity to asset, debt to equity, loan to deposit, GDP	Both firms' specific and macroeconomic variables have a significant impact on profitability.
Yuan et al. (2022)	South Asia, 2010–2021	Panel data analysis	ROA, ROE deposit to asset, bank size, debt to equity, loan to deposit, debt to asset, equity to asset, inflation, and GDP growth rate.	Inflation and the GDP Growth Rate have positive impact on profitability.
Mustafa-Zatriqi and Ahmeti (2022)	Kosovo March 2013-December 2019	Panel data analysis	NIM, capital adequacy, credit risk, bank size, bank liquidity, operating cost, revenue from commissions, debt loan, domestic debt GDP, inflation, interest rate.	Domestic debt, GDP, inflation, and interest rates do not influence the bank's profitability.
Rakibul Islam (2023)	London, 2015–2019	Panel data analysis	ROA, ROE, GDP, interest rate, inflation rate, unemployment rate, and exchange rate	GDP has an adverse effect on the profitability of commercial banks.
Kelmendi (2024)	Turkey & Kosovo, 2013–2022	Panel data analysis	ROA, ROE, Exchange rate, inflation, GDP, Consumer price index	Macroeconomic factors affect profitability for both countries.
Morina et al. (2025)	CEFTA countries 2017–2021	Panel data analysis	ROA, ROE, Long and short-term debt, total debt to equity, bank size, growth of assets, capital adequacy, inflation	Several factors have a significant influence on the profitability of commercial banks.

Upon reviewing the current literature, the contributions of this study can be summarized under four key headings: the period covered, the methodological approach, the application of multiple methods, and the variables examined. These aspects are detailed as follows:

Period Covered: This study distinguishes itself from others by examining a significantly broader time frame—19 years, specifically from 2005 to 2023. In contrast, most existing studies typically span only 4 to 10 years. This extended duration facilitates a clearer understanding of

the long-term effects of both micro and macro factors.

Methodological Approach: While many studies in the literature rely on classical regression models, which can restrict the interpretation of both long-term and short-term effects, this research employs second-generation Autoregressive Distributed Lag (i.e., CCEMG and AMG), in conjunction with unit root and cross-sectional dependence tests. These methodologies enhance the clarity of effect interpretations and contribute to the richness of the overall literature.

Use of Multiple Methods: This study strengthens the reliability of its findings by employing Ordinary Least Squares (OLS), fixed/random effects, and ARDL-based models in a comparative context. This methodological diversity sets it apart from other research in the existing literature.

Variables: Numerous studies have concentrated exclusively on micro data or macro data, revealing limitations in integrating both. This study takes a more holistic approach by examining bank-specific variables (such as capital adequacy, bank size, and loans) and macroeconomic variables (including interest rates, inflation, and GDP). This allows for a comprehensive analysis of profitability's short—and long-term determinants.

2.2. Research Gap

While numerous studies have explored the factors influencing bank profitability, most have focused on limited time frames and predominantly employed first-generation panel data methods. Many of these studies also isolate bank-specific variables or macroeconomic indicators. There are a few studies, however, that simultaneously address both dimensions and investigate long-term effects. Our research seeks to fill this gap in the literature. Moreover, it adds value by focusing on the BIST banking sector and providing insights directly relevant to the Turkish banking landscape for regulators, policymakers, and bank managers. For instance, uncovering the impacts of variables such as interest rates, inflation, and GDP can inform monetary policy and banking regulations. The study also corroborates existing literature findings—such as the positive correlation with

interest rates and the negative association with inflation—while testing the robustness of these relationships over extended periods using more sophisticated methodologies. This enhances the study's contribution by reinforcing and consolidating the current evidence in the field.

3. METHODOLOGY

3.1. Data

This study analyses the financial data of ten banks listed on Borsa Istanbul, covering the period from 2005 to 2023. We have categorized the variables into two distinct groups: bank-specific variables and macroeconomic variables. The bank-specific data were obtained from the Finnet 2000+ database, while interest rate information was sourced from the Central Bank of the Republic of Turkey's Electronic Data Delivery System (TCMB-EVDS). Additionally, GDP and inflation data were gathered from the World Bank database. The variables employed in the models, their corresponding calculations, and the expected direction of their relationships are detailed in Table 2.

As illustrated in Table 2, many studies have employed ROE and ROA as key profitability measures. These metrics effectively reflect bank performance over specific time periods. When examining the bank-specific factors that influence profitability, one of the primary determinants is the volume of loans, measured as the ratio of total loans to total assets. An increase in funding costs can adversely affect bank profitability. Another significant factor is capital adequacy (CA). Generally, a higher level of equity in banks is expected to correlate with enhanced profitability. Furthermore, asset size has been found to influence profitability positively; larger asset bases enable banks to manage a greater share of assets, often resulting in higher returns. On the macroeconomic front, we will examine commonly used variables, including interest rates, GDP growth, and inflation. GDP growth is a vital indicator of a country's economic health and is often associated with increased bank profitability. Banks can engage more effectively within the financial system in a thriving economy, resulting in increased profits. Interest rates also significantly impact bank profitability, demonstrating a direct relationship; higher interest rates can facilitate a

Table 2. Variable Descriptions and Expected Signs

	Symbol	Variables	Calculation	Sign	Relevant literature about sign results
Dependent Variables	ROA	Return on Assets	Net Income / Total Assets		
	ROE	Return on Equity	Net Income / Total Equity		
Bank specific factors	LOAN	Asset Quality	Total Loans / Total Assets	-	Alper and Anbar, 2011; Kakilli Acaravcı ve Çalım, 2013; Durguti vd.,2020.
	CA	Capital Adequacy	Equity / Total Assets	+	Berger, 1995; Bourke, 1989; Hassan and Bashir, 2003; Ebenezer et. al, 2017.
	SIZE	Asset Size	Natural Logarithm of Total Assets	+	Smirlock, 1985; Serwadda, 2018; Saeed, 2014.
Macroeconomics factors	INT	Interest Rate	Real Interest Rate	+	Saeed 2014; Ngrure 2014; Topak ve Talu, 2017
	GDP	GDP Growth	Real Gross Domestic Product (2005=100)	+	Demirguc-Kunt and Huizinga, 1999; Bikker and Hu,2002; Sami Duran and Acar, 2022
	INF	Inflation rate	Inflation Rate (Consumer Price Index)	+/-	Bourke, 1989; Molyneux and Thorton 1992; Hassan and Bashir 2003; Kosmidou, 2006

Sources: Author's work.

Table 3. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min.	Max.
ROA	190	.0154153	.0115512	-.06472	.05583
ROE	190	.141307	.1226498	-.9719	.45785
LOAN	190	.5685763	.1658823	.01822	1.1779
CA	190	.106549	.0285911	.03702	.21944
SIZE	190	10.92726	.7247952	9.29201	12.44664
INT	190	13.815112	4.303264	8.18962	23.57712
GDPconstant	190	8.28e+11	2.23e+11	5.25e+11	1.25e+12
INFconstant	190	202.6065	185.8458	65.85295	834.5931

Source: Author's work.

greater accumulation of total assets, ultimately leading to increased profits. Inflation is a pivotal macroeconomic variable extensively analyzed in the academic literature. Its correlation with rising prices is well-documented, as such increases can

significantly enhance the volume of bank assets, resulting in improved profitability. This study systematically compiles a comprehensive array of variables in alignment with established theoretical frameworks, as delineated in Table 3.

Table 4. Correlation Matrix

Variables	ROA	ROE	LOAN	CA	SIZE	INT	GDPconstant	INFconstant
ROA	1.0000							
ROE	0.9128	1.0000						
LOAN	-0.0885	-0.1603	1.0000					
CA	0.3737	0.1029	0.2561	1.0000				
SIZE	0.2385	0.2550	-0.2096	-0.2154	1.0000			
INT	0.1514	0.1931	-0.3825	-0.2634	0.2112	1.0000		
GDPconstant	-0.0272	0.1335	-0.1855	-0.4951	0.6507	0.3578	1.0000	
INFconstant	0.2160	0.3336	-0.3158	-0.3695	0.5625	0.5694	0.8230	1.0000

Source: Author's work.

The descriptive statistics indicate no missing observations in the sampled dataset. However, due to zero or negative values, it is not feasible to calculate the logarithmic values for LOAN, ROE, ROA, and GDP (expressed as percentages). A comprehensive examination of the Kernel distribution for each variable reveals that all variables can be linearized where applicable. As a result, log-linearization is performed as appropriate. During the analysis of the interest rate variable (INT) in the models, a notable deviation of 4.303264 is observed, given that the values for this variable range from 8.189615 to 23.57712. Therefore, this finding warrants careful consideration when interpreting the results. To identify the most relevant variable for the model, the correlation matrix (Table 4) is analyzed, which provides valuable insights into the relationships between the dependent variable and the independent variables.

The table illustrates a noteworthy correlation between ROE and ROA, which is anticipated given that both metrics serve as indicators of bank profitability and are derived using similar methodologies.

3.2. Model

During the literature review, two commonly used profitability measures frequently employed to evaluate bank performance were ROA and ROE.

Two models for each of these profitability indicators are developed, serving as dependent variables, to assess their alignment with the current literature. Distinct models have been constructed for each dependent variable to evaluate their consistency with existing scholarly research on the Turkish banking sector and assess the robustness of our findings. The models are structured as follows: Model I focuses on ROA as the dependent variable, while Model II utilizes ROE as the dependent variable.

$$ROA_{it} = \beta_0 + \beta_1 LOAN_{it} + \beta_2 CA_{it} + \beta_3 SIZE_{it} + \beta_4 INT_{it} + \beta_5 GDPcons_{it} + \beta_6 INFcons_{it} + \varepsilon_{it} \quad (I)$$

$$ROE_{it} = \beta_0 + \beta_1 LOAN_{it} + \beta_2 CA_{it} + \beta_3 SIZE_{it} + \beta_4 INT_{it} + \beta_5 GDPcons_{it} + \beta_6 INFcons_{it} + \varepsilon_{it} \quad (II)$$

In the presented models, asset quality is assessed using the *LOAN* ratio, while *CA* is determined by the ratio of equity to total assets. Additionally, *SIZE* serves as an indicator of asset size, allowing for control over sector variations. As discussed previously, macroeconomic control variables have been integrated into the analysis. Specifically, *INT* denotes the real interest rate, and *GDPcons* represents GDP measured in constant terms, *INFcons* represents inflation measured in constant terms. Before undertaking the regression analysis conducted the Harris-Tzavalis and Hadri LM unit root tests. The findings are summarized in Table 5.

Table 5. Unit Root Tests

	Harris-Tzavalis (1)	Hadri LM test (2)
LOAN	0.6383 (-0.0657) 0.4738	11.5337 0.0000
CA	0.4095 (-3.3519) 0.0004	12.9728 0.0000
SIZE	0.9811 (4.8576) 1.0000	19.8927 0.0000
ROE	0.2541 (-5.5836) 0.0000	4.3048 0.0000
ROA	0.3324 (-4.4582) 0.0000	5.4973 0.0000
GDPcons	0.7010 (0.8355) 0.7983	20.2280 0.0000
INFcons	1.8504 (17.3425) 1.0000	13.3460 0.0000
INT	0.6769 (0.4883) 0.6873	2.9446 0.0016

Source: Author's work. Note: (1) Harris-Tzavalis, rho, z in parenthesis, p-value, (2) Hadri LM test: z-statistics, p-value

Due to insufficient observations within the panel, the results for GDPcons, INFcons, and INT could not be obtained using the Im-Pesaran-Shin test. Consequently, only the findings from the Harris-Tzavallis and Hadri LM unit root tests will be presented. Following identifying failures in one or both unit root

tests for the variables LOAN, SIZE, GDP, GDPcons, INFcons, and INT, an examination was conducted to determine whether non-stationarity persisted after taking the first difference of each series across the panel. The results in the table below indicate that all series exhibited stationarity. Table 6 shows detail overview of the unit root tests.

Table 6. Unit root tests

	Harris-Tzavalis (1)	Hadri LM test (2)
d.LOAN	-0.0823 (-9.7229) 0.0000	2.3645 0.0090
d.SIZE	0.2927 (-4.5678) 0.0000	5.6762 (0.000)
d.GDPcons	0.1765 (-6.1651) 0.0000	2.6442 0.0041
d.INFcons	1.3726 (10.2770) 1.0000	8.4738 0.0000
d.INT	-0.2036 (-11.3902) 0.0000	3.5392 (0.0002)

Source: Author's work. Note: (1) Harris-Tzavalis, rho, z in parenthesis, p-value, (2) Hadri LM test: z-statistics, p-value.

Therefore, the regression analysis will employ the first differences of the variables LOAN, SIZE, GDPcons, INFcons, and INT. Table 7-8 presents findings from the models (I) and (II), respectively.

Table 7. Regression Analysis Results (Dependent variable: ROA)

	(1)	(2)	(3)	(4)	(5)	(6)
D.I_LOAN	0.00180	-0.00200	0.000490	-0.00145	0.00198	-0.00145
	(0.00114)	(0.00124)	(0.000842)	(0.00117)	(0.00131)	(0.00139)
I_CA	0.0205***	0.0148***	0.0103	0.0105	0.0202***	0.0152**
	(0.00234)	(0.00276)	(0.00744)	(0.00881)	(0.00503)	(0.00618)
I_SIZE	0.0243**	0.0603***	-0.123***	-0.105	0.00693	0.0564**
	(0.0117)	(0.0118)	(0.0220)	(0.0881)	(0.0293)	(0.0257)
D.I_INT	-0.00348	-0.0149*	-0.00153	0.00661	-0.00302**	-0.0140**
	(0.00211)	(0.00871)	(0.00101)	(0.00998)	(0.00128)	(0.00563)
D.I_GDPcons	0.0215	-0.0817	0.0179**	-0.0804	0.0208***	-0.0799
	(0.0185)	(0.105)	(0.00678)	(0.0502)	(0.00613)	(0.0487)
D.I_INFcons	0.0417***	0.00956	0.0675***	0.0553**	0.0454***	0.0111
	(0.00606)	(0.0130)	(0.00870)	(0.0225)	(0.00933)	(0.0137)
Constant	-0.00261	-0.0824***	0.324***	0.288	0.0378	-0.0727
	(0.0298)	(0.0316)	(0.0443)	(0.198)	(0.0800)	(0.0725)
Observations	180	180	180	180	180	180
R-squared	0.499	0.675	0.583	0.645		
Fixed effect		NO	YES	YES	NO	NO
Random effect		NO	NO	NO	YES	YES
Time Fixed effect		YES	NO	YES	NO	YES
Number of id			10	10	10	10

Source: Author's work. Note: (1) OLS, (2) OLS with year dummies, (3) Sector fixed effect, (4) Sector and year fixed effect, (5) Random effect, (6) Random effect with year dummies, Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Table 8. Regression Analysis Results (Dependent variable: ROE)

	(1)	(2)	(3)	(4)	(5)	(6)
D.I_LOAN	0.0155	-0.0270	0.00357	-0.0209	0.0155	-0.0267
	(0.0137)	(0.0195)	(0.0108)	(0.0172)	(0.0156)	(0.0214)
I_CA	0.0912***	0.0283	0.000975	-0.00666	0.0912**	0.0285
	(0.0255)	(0.0263)	(0.0718)	(0.0842)	(0.0418)	(0.0465)
I_SIZE	0.150	0.517***	-1.248***	-1.012	0.150	0.516***
	(0.110)	(0.108)	(0.254)	(1.060)	(0.224)	(0.174)
D.I_INT	-0.0348*	-0.140*	-0.0151	0.0615	-0.0348**	-0.140**
	(0.0207)	(0.0842)	(0.0110)	(0.132)	(0.0136)	(0.0584)
D.I_GDPcons	0.239	-1.232	0.206*	-1.196*	0.239**	-1.231**
	(0.187)	(1.046)	(0.0976)	(0.545)	(0.0956)	(0.574)
D.I_INFcons	0.447***	0.122	0.696***	0.550**	0.447***	0.122
	(0.0591)	(0.116)	(0.0770)	(0.241)	(0.0649)	(0.0972)
Constant	-0.0785	-0.882***	3.028***	2.564	-0.0785	-0.880*
	(0.261)	(0.270)	(0.497)	(2.386)	(0.600)	(0.503)
Observations	180	180	180	180	180	180
R-squared	0.391	0.605	0.524	0.603		
Fixed effect		NO	YES	YES	NO	NO
Random effect		NO	NO	NO	YES	YES
Time Fixed effect		YES	NO	YES	NO	YES
Number of id			10	10	10	10

Source: Author's work. Note: (1) OLS, (2) OLS with year dummies, (3) Sector fixed effect, (4) Sector and year fixed effect, (5) Random effect, (6) Random effect with year dummies, Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

To evaluate collinearity within the regression model, the Variance Inflation Factor (VIF) test was performed using STATA, employing the "*estat vif*" command. The outcomes of this analysis are presented in Table 9. A VIF score exceeding 10 indicates po-

tential concerns regarding collinearity, suggesting an R-squared value greater than 0.90. However, as demonstrated in Table 9, the results reveal no significant evidence of collinearity among the variables included in the regression analysis.

Table 9. Collinearity test

Variable	VIF	1/VIF
D1.I_INT	1.45	0.689887
D1.I_INFcons	1.42	0.705710
D1.I_GDPcons	1.34	0.746223
I_SIZE	1.30	0.771446
I_CA	1.21	0.828222
D1.I_LOAN	1.05	0.956149
Mean VIF	1.29	

Source: Author's work.

In Model (I), the analysis of ROA as a measure of bank profitability indicates that loans (LOAN) do not have a significant impact on this profitability. The data suggest that the volume of loans is not a meaningful determinant in this context. In contrast, capital adequacy (CA) is a positive and significant factor influencing bank profitability. Specifically, a 1 percent increase in capital adequacy is associated with an increase in ROA of approximately 0.01 to 0.02, as calculated using the ratio of net income to total assets. Additionally, bank size (SIZE) positively affects ROA, with an increase of approximately 0.02 to 0.06 for each 1 percent rise in size. The analysis also indicates insufficient statistical evidence to conclude that interest rates impact bank profitability when evaluated through ROA. Furthermore, the effect of GDP on ROA is insignificant when controlling for year dummies. Finally, the results reveal an inverse relationship between the inflation rate and ROA. This relationship may be explained by the fact that as inflation increases, price percentage changes rise, leading banks to hold more capital, which may bolster profitability.

In the analysis of Model (II), the examination of ROE as an index of bank profitability indicates that the volume of loans (LOAN) does not exert a significant influence on overall profitability. This finding suggests that loans constitute a relatively minor factor within this analytical framework. Consistent with the insights derived from Model

(I), Capital Adequacy (CA) emerges as a positive and significant determinant of bank profitability. Specifically, the analysis posits that ROE is anticipated to increase by approximately 0.09 percent with each 1 percent rise in CA. Notably, however, there is a lack of statistical evidence supporting CA's effect on profitability when considering sectoral and temporal fixed effects. Furthermore, bank size (SIZE) exhibits a positive correlation with ROE, with the analysis revealing an estimated increase of approximately 0.51 units for each 1 percent increase in size, after accounting for time-fixed effects. Additionally, the analysis highlights a negative relationship between interest rates and bank profitability, as evidenced by ROE. This adverse correlation may be attributed to interest rate volatility observed during the period ranging from 8.189615 to 23.57712, as delineated in Table 2, which encompasses the years from 2005 to 2023. The influence of Gross Domestic Product (GDP) on ROE is also statistically insignificant at the 5% level when controlling for year dummy variables and sector fixed effects. Finally, the results suggest a significant inverse relationship between the inflation rate and ROE, consistent with the findings presented in Model (I). To ensure the attainment of optimal linear unbiased estimators, a cross-sectional dependency test was conducted in conjunction with an evaluation of multicollinearity. The results indicate that both Model (I) and Model (II) provide evidence of cross-sectional dependency. For a comprehensive overview of the diagnostic test results, Table 10 shows that both models reject the null hypothesis of cross-sectional independence at the 5% significance level.

Table 10. Cross-Dependency Test for Model (I) and Model (II)

	Test	CD-test	p-value
Model (I)	Pesaran CD (2004)	13.02	0.000
Model (II)	Pesaran CD (2004)	14.26	0.000

Source: Author's work.

The existence of cross-dependency and non-stationarity in both models necessitates the imple-

mentation of a second-generation Autoregressive Distributed Lag (ARDL) model. This methodological approach effectively addresses these complexities and enhances understanding of long-term relationships between the dependent and independent variables under examination. To account for unobserved heterogeneity in non-stationarity and cross-sectional dependency, the study utilized the augmented mean group (AMG) estimator alongside the mean group estimator and the common correlated effects mean group (CCEMG) regression. The CCEMG estimator, as Kapetanios et al. (2011) illustrated, delivers robust results that align with the theoretical framework established in their research and the broader literature. Furthermore, the study by Everaert and De Groote (2016) demonstrates, through Monte Carlo experiments, that the CCEMG estimator is well-suited for estimating dynamic panel data models, particularly when the time dimension (T) is sufficiently extensive.

In general, the estimation of long-run coefficients can be conducted using four principal methodologies: group means, aggregate time-series analysis, pooled data, and cross-sectional analysis. In static contexts, where coefficients may vary randomly, all four methods yield unbiased estimates of the average coefficients. However, pooling and aggregation may lead to inconsistent and potentially misleading results in dynamic contexts where coefficient variation exists among different groups (Coakley et al., 2002). In contrast, cross-sectional analysis can provide consistent estimates of long-run effects, establishing it as a valuable approach in such scenarios (Pesaran & Smith, 1995). Both the AMG and CCEMG methodologies produce robust and complementary results. The AMG offers more detailed insights and is adept at presenting short-run outcomes while effectively controlling for cross-sectional dependency (Eberhardt et al., 2009).

4. RESULTS

Table 11 presents the results obtained from the Common Correlated Effects Mean Group (CCEMG) estimator and the Augmented Mean Group (AMG) estimator. Both methods provide long-term results while considering the long-term correlations in the error terms, enhancing the accuracy of the estimations.

Table 11. CCEMG and AMG Results (Long-run results)

	(1)	(2)	(3)	(4)
Variables	CCEMG1	CCEMG2	AMG1	AMG2
I_LOAN	0.00589 (0.0116)	0.0547 (0.0991)	0.00513 (0.00628)	0.0450 (0.0646)
I_CA	0.0275*** (0.00803)	0.0900 (0.0689)	0.0192*** (0.00390)	0.0702 (0.0441)
SIZE	0.0388 (0.0308)	0.470 (0.382)	0.0320 (0.0250)	0.428 (0.369)
I_INT	-0.000877 (0.00350)	-0.00661 (0.0387)	0.000873 (0.00203)	0.00497 (0.0293)
I_GDPcons	-0.00228 (0.0297)	-0.161 (0.251)	-0.00622 (0.0190)	-0.103 (0.257)
I_INFcons	-0.00242 (0.0127)	-0.0525 (0.187)	-0.0134 (0.00972)	-0.166 (0.156)
			(0.151)	(0.153)
Constant	-0.0618 (0.575)	-0.927 (4.945)	-0.0571 (0.309)	-0.815 (3.931)
Observations	190	190	190	190
Number of id	10	10	10	10

Source: Author's work. Note: Standard errors are in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Models (1) and (2) represent the CCEMG estimates for Model (I), while Models (3) and (4) represent the AMG estimates for Model (II).

The CCEMG and AMG methodologies produce long-run results; however, the AMG estimator also allows for the derivation of short-run results. This capability facilitates a comparative analysis between short-run and long-run estimates, thereby aiding in evaluating potential discrepancies between the two. Upon examining the long-run results, it is clear that, apart from capital adequacy, none of the bank profitability's micro or macro

determinants exhibit significant outcomes. This finding warrants further investigation to ascertain whether it is a regional phenomenon or a more widespread trend. Bank profitability has proven to be highly volatile over the observed period. While micro and macro determinants may influence bank profitability in the short run, their effects may not endure in the long run due to inherent changes within the banking sector. Fortunately, the AMG estimator provides valuable insights into short-term outcomes. Table 12 which presents the short-run results of the AMG for Models (I) and (II).

Table 12. Short run results (AMG Short run results)

	Model (I)	Model (II)
Variables	ShortAMG1	ShortAMG1
D.I_LOAN	0.000836 (0.00179)	0.000862 (0.00178)
D.I_CA	0.0283*** (0.00467)	0.0281*** (0.00461)
D.SIZE	0.0410*** (0.0123)	0.445*** (0.129)
D.I_INT	-0.00723*** (0.00279)	-0.00711** (0.00278)
D.I_GDPcons	0.0365* (0.0205)	0.0355* (0.0204)
D.I_INFcons	0.00751 (0.00658)	0.00918 (0.00621)
Constant	-0.00538*** (0.00138)	-0.00552*** (0.00139)
Observations	180	180
Number of id	10	10

Source: Author's work. Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

The short-run results reveal significant findings. Analyzing both Model (I) and Model (II), it is evi-

dent that, apart from loans and inflation, all other variables are crucial determinants of bank profitability, which ROA and ROE measure. Capital adequacy substantially impacts ROA and ROE; a 1-unit increase in equity relative to total assets leads to an approximate increase of 3 units in these profitability metrics.

Furthermore, a 1 unit increase in total assets—SIZE—corresponds to an increase of about 0.04 units in both ROA and ROE. Contrary to prevailing literature, the findings suggest that rising interest rates reduce bank profitability by approximately 0.01 units in the short term. While this effect is modest, it diminishes over the long run. This phenomenon may be linked to the immediate uncertainties faced by society regarding investment and saving strategies in response to higher interest rates. Consistent with existing literature, GDP significantly influences bank profitability, as reflected in increases in both ROA and ROE. This observation is logical, as economic growth enhances banking institutions' profitability.

5. CONCLUSION

This study explores the determinants of bank profitability in the Turkish banking sector through the lens of both micro (bank-specific) and macroeconomic factors. The research employs the CCEMG and AMG methods to facilitate long-term and short-term forecasts. By conducting analyses over both time frames, the study allows for a comparative assessment and interpretation of the differences between them. The results indicate that bank-specific factors (micro factors) and macroeconomic factors yield divergent outcomes in the short and long term. Notably, in the long term, capital adequacy (the ratio of equity to total assets) emerges as the most significant determinant of bank profitability, particularly in terms of Return on Assets (ROA) and Return on Equity (ROE). This finding aligns with the research conducted by Lipunga (2014) and Ebenezer et al. (2017), but diverges from the conclusions reached by Sultan et al. (2020). This discrepancy prompts contemplation regarding whether this outcome is a phenomenon unique to Turkey or part of a broader trend. Moreover, the dynamic nature of the banking sector and its periodic fluctuations can be seen as limiting

the long-term impact of various determinants. Long-term analyses often yield limited significant results when investigating the relationship between micro and macro determinants and bank profitability. In contrast, short-term findings present striking and meaningful insights. In the short term, capital adequacy emerges as the primary determinant of bank profitability. This aligns with the studies conducted by Lipunga (2014) and Ebenezer et al. (2017). Capital adequacy reflects banks' resilience to risk and overall financial soundness. A robust capital structure in the short term allows banks to safeguard their profitability against unforeseen shocks. Consequently, capital adequacy being identified as the most influential factor affecting profitability is an expected outcome from both theoretical and practical standpoints. Furthermore, bank size (measured by the natural logarithm of total assets) and GDP, as a macroeconomic factor, significantly influence bank profitability, regardless of whether it is assessed through ROA or ROE. This finding aligns with the research conducted by Alper & Anbar (2011), Ifeacho & Ngalawa (2014), Topak & Talu (2017), Bhattarai (2017), Yuan et al. (2022), and Kelmendi (2024). Larger banks benefit from economies of scale, enabling them to offer services at reduced costs and serve a broader customer base, thereby enhancing their profitability. On a macroeconomic level, economic growth drives demand for credit, strengthens repayment capacity, and increases the necessity for banking services. Consequently, it is reasonable to assert that growth positively affects bank profitability. This study provides valuable insights by examining both micro and macro variables that impact bank profitability in both the short and long term. It highlights that capital adequacy is the most critical determinant in the short term, followed by bank size and GDP.

In summary, the analysis indicates that the factors influencing bank profitability are more extensive in the long term. Capital adequacy emerges as the most critical determinant for maintaining the financial stability of banks, while bank size and economic growth also contribute positively to profitability. Conversely, credit volume and inflation do not demonstrate significant effects in the short term, suggesting that the impacts of these variables become more apparent in the medium to long term. Ultimately, it is evident that both capi-

tal structure and macroeconomic conditions play a decisive role in short-term bank profitability. Meanwhile, the effects of other variables are amplified over the long term. These findings underscore the necessity for banks to consider their internal financial framework alongside economic conditions when planning for short-term profitability.

The policy recommendations derived from this study include: (1) Regulatory authorities should promote policies aimed at strengthening banks' capital structures and develop measures that enhance the sector's resilience, especially during economic fluctuations; (2) Given the strong link between macroeconomic growth and bank profitability, it is vital to recognize that economic policies fostering growth will yield positive impacts on the profitability of the banking sector. A limitation of this study is the inability to access specific data for each bank. In conclusion, while this study offers valuable insights into the determinants of profitability in the Turkish banking sector, future research employing diverse methodologies (such as machine learning and AI-based models), broader variables (including digitalization indicators), and comparative analyses will significantly enrich the literature.

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Odrednice profitabilnosti banaka: analiza turskog bankarskog sektora

Sažetak

Ovaj članak ispituje utjecaj kako bankovno-specifičnih tako i makroekonomskih odrednica na profitabilnost banaka, s posebnim naglaskom na bankarski sektor uvršten na Istanbulskoj burzi (BIST) u razdoblju od 2005. do 2023. godine. U skladu s postojećom literaturom, istražuju se različite potencijalne odrednice profitabilnosti banaka na sektorskoj i makroekonomskoj razini. Analiza se temelji na dvjema osnovnim mjerama profitabilnosti banaka: povratu na imovinu (ROA) i povratu na kapital (ROE). Osim toga, u analizu su uključeni makroekonomski čimbenici poput kamatnih stopa, bruto domaćeg proizvoda (BDP-a) i inflacije, kao i sektorske kontrolne varijable, uključujući kredite, adekvatnost kapitala i veličinu banke. Istraživanje obuhvaća dijagnostičke testove jediničnog korijena za svaku seriju u panelu, kao i testove međuzavisnosti i kointegracije. Primijenjen je niz metodoloških pristupa, uključujući metodu običnih najmanjih kvadrata (OLS), modele s fiksnim i slučajnim efektima te godišnje dummy varijable radi veće preciznosti procjena. Kako bi se osigurali robusni rezultati, studija obuhvaća jedno od najdužih vremenskih razdoblja u ovom području istraživanja te sustavno razmatra probleme stacionarnosti, kolinearnosti te vremenskih i sektorskih fiksnih efekata. S obzirom na prisutnost međuzavisnosti i nestacionarnosti u modelima, primijenjen je ARDL model druge generacije. Posljedično, u analizi se koriste CCEMG (Common Correlated Effects Mean Group) i AMG (Augmented Mean Group) procjenitelji. Dobiveni rezultati pružaju vrijedne uvide koji su u skladu s postojećom literaturom o odnosu profitabilnosti banaka i njezinih kratkoročnih i dugoročnih odrednica. Analiza pokazuje da su dugoročni učinci odnosa između mikro i makro odrednica profitabilnosti banaka donekle ograničeni. Međutim, u kratkom roku značajni čimbenici koji utječu na profitabilnost banaka uključuju adekvatnost kapitala, veličinu banke i BDP, neovisno o tome mjeri li se uspješnost putem ROA ili ROE pokazatelja. Prema saznanjima autora, ovo istraživanje obuhvaća jedno od najdužih vremenskih razdoblja u ovom području te rigorozno uzima u obzir stacionarnost, kolinearnost te vremenske i sektorske fiksne efekte. Ograničenje istraživanja odnosi se na ograničenu dostupnost podataka za pojedine banke.

Ključne riječi: profitabilnost banaka, turski bankarski sektor, BIST, makroekonomski čimbenici, bankovno-specifični čimbenici.