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The Impact of Capital on Profitability and Risk-Taking: Evidence from the US Banks

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ABSTRACT

This thesis explores the connection between bank capital, profitability, and risk-taking within the banking industry in the United States and especially focuses on the difference in these effects between banks of different sizes. The research examines five types of FDIC size (very small, small, medium, large, and very large/G-SIBs) using a panel dataset from 2000 to 2023, and consequently, studies the heterogeneity in business model, regulatory exposure, economic resilience, and strategic capital use. The research time frame covers several crises and post-crisis periods, such as the Global Financial Crisis (2007-2009), the COVID-19 pandemic (2020-2021), and the recent interest rate shock (2022-2023), which allows for evaluating the capital behavior during normal and stressful periods.

The paper has used fixed effects and System GMM estimators to overcome unobserved heterogeneity and possible endogeneity of capital and performance. ROA, ROE, and NIM are used to measure profitability, and Z-score, non-performing loans, and net charge-offs measure risk-taking. The results demonstrate that increased capital can enhance profitability, especially in terms of ROA and net interest margins, which suggest that well-capitalized banks incur less funding costs and have better performance that is driven by stability. The implications on ROE, however, are less significant in very large banks, which indicates leverage dilution and the trade-off between stability and shareholder returns. The findings also indicate that there is a strong positive relationship between capital and financial stability (Z-score) of all sizes, but the decrease in credit risk (NPLs and charge-offs) is greatest at very small and small banks.

The research concludes by stating that the capital-profitability-risk nexus is context and size-dependent. Small and community banks deploy capital as a signal of solvency and confidence, but large and very large banks deploy capital as a buffering system to diversify their strategies and off-balance-sheet growth. The results have significant regulatory implications, especially in proportional capital requirements design. A single-fit regulation has the risk of overloading smaller institutions whilst failing to capture the complexity of risk in G-SIBs. This thesis makes a contribution to current arguments on resilience, prudential policy, and the changing nature of the structure of U.S. banking by combining size segmentation with recent regulatory cycles.

Keywords: Bank capital; Profitability; Risk-taking; Bank size; Capital adequacy; Financial stability; U.S. banking sector; Basel regulation; Panel data; System GMM.

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TIIVISTELMÄ

Tämän pro gradu -tutkielman tarkoituksena on tarkastella pankkien pääoman, kannattavuuden ja riskinoton välistä yhteyttä Yhdysvaltojen pankkisektorilla sekä analysoida, kuinka nämä vaikutukset eroavat pankkien kokoluokittain. Tutkimus hyödyntää FDIC:n kokoluokitusta (erittäin pienet, pienet, keskisuuret, suuret ja erittäin suuret/G-SIB-pankit) ja paneeliaineistoa vuosilta 2000–2023. Aineisto mahdollistaa erilaisten liiketoimintamallien, sääntelyrasitusten, taloudellisen kestävyyden sekä pääoman strategisen käytön kokoluokittaisen tarkastelun. Tutkimusajanjakso kattaa useita kriisi- ja jälkikriisivaiheita, kuten globaalin finanssikriisin (2007–2009), COVID-19-pandemian (2020–2021) sekä viimeaikaisen korkoshokin (2022–2023), mikä mahdollistaa pääomakäyttäytymisen arvioinnin sekä normaaleina että stressijaksoina.

Tutkielmassa käytetään kiinteiden vaikutusten malleja sekä System GMM -menetelmää poistamaan havaitsematonta heterogeenisuutta ja pääoman sekä suorituskykymuuttujien mahdollisia endogeenisuusongelmia. Kannattavuutta mitataan ROA-, ROE- ja NIM-muuttujilla, ja riskinottoa Z-score-arvolla, järjestämättömillä luotoilla sekä luottotappioilla. Tulokset osoittavat, että vahvempi pääomitus lisää kannattavuutta erityisesti ROA:n ja nettorahoitusmarginaalin kautta, mikä viittaa pienempiin varainhankintakustannuksiin ja vakauden kautta syntyvään parempaan tuloksentekokykyyn. ROE-vaikutukset ovat kuitenkin heikompia erittäin suurissa pankeissa, mikä heijastaa velkavivun laimenemista ja vakavaraisuuden ja omistaja-arvon välistä ristiriitaa. Tulokset osoittavat myös vahvan positiivisen yhteyden pääoman ja taloudellisen vakauden (Z-score) välillä kaikissa kokoluokissa, mutta luottoriskin väheneminen (NPL:t ja luottotappiot) on suurinta erittäin pienissä ja pienissä pankeissa. Tutkimuksen johtopäätöksenä todetaan, että pääoma–kannattavuus–riskisuhde on sekä konteksti- että kokoriippuvainen. Pienet ja community-pankit käyttävät pääomaa maksukyvyn ja luotettavuuden signaalina, kun taas suuret ja erittäin suuret pankit hyödyntävät pääomia puskurijärjestelmänä ja hajauttamisstrategioiden mahdollistajana sekä taseen ulkopuolisen toiminnan kasvattajana. Tuloksilla on merkittäviä sääntelyllisiä vaikutuksia erityisesti suhteutettujen pääomavaatimusten suunnittelussa. Yhdenmukainen sääntelykehikko voi kuormittaa suhteettomasti pieniä pankkeja, mutta jäädä riittämättömäksi G-SIB-pankkien monimutkaisen riskiprofiilin kannalta. Tutkielma tarjoaa uutta tietoa Yhdysvaltain pankkisektorin vakaudesta, sääntelystä ja rakenteellisesta muutoksesta yhdistämällä kokoluokittaisen analyysin ajankohtaisiin sääntelykehityksiin.

Avainsanat: pankkien pääoma, kannattavuus, riskinotto, pankkien koko, vakavaraisuus, taloudellinen vakaus, Yhdysvaltain pankkisektori, Basel-sääntely, paneeliaineisto, System GMM.

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CHAPTER 1: INTRODUCTION

The banking industry is vital in determining the health and stability of modern economies because of its efficiency and reliability. Banks are financial intermediaries that transfer savings to productive investments, make payments, and remind people of the existence of a monetary system. Economic growth and financial stability are compromised without a stable banking system.

The global financial crisis of 2007-2008 has brought these realities to the limelight. It revealed the impact of capital buffer vulnerability and dependence on risk-taking, as shown to destabilize not only the individual institutions, but also the whole financial system. Weaknesses in regulatory frameworks and bank business models were revealed by the crisis, compelling academics, regulators, and policymakers to reconsider some of the most basic questions: What is the role of capital in protecting banks? Will better capitalization increase or limit profitability? What is the relationship between capital and the risk-taking behavior of banks?

This thesis answers these questions through the lens of the United States banking industry, where small community banks, medium-sized banks, and very large universal financial conglomerate banks all operate under the same regulatory umbrella but tend to have different business model approaches. In particular, the thesis considers the association between bank capital, profitability and risk-taking; more so, the relationship between these three factors in various groupings of bank size.

1.1 BACKGROUND

1.1.1 CAPITAL AS THE SOURCE OF STABILITY

Bank capital plays a crucial role in ensuring the financial cushion against unforeseen losses, depositor confidence, and making banks solvent. Capital adequacy ensures that banks can keep lending during a period of crisis, thus aiding not only financial stability but also economic growth. Bank capital has been repeatedly highlighted as an essential part of regulatory reforms in the last four decades.

International capital regulation is shaped by the changing experience of financial crises. In Basel I (1988), the attention was on credit risk and standard capital requirements were set. Basel II (2004) introduced risk sensitivity and the so-called three pillars (minimal capital requirements, supervisory overview and market discipline). Directly responding to the global financial crisis, Basel III (2010) substantially enhanced the definition of capital, increased the minimum capital requirements, and added countercyclical buffers.

In the US, these international reforms were complemented by national laws and oversight. The Dodd-Frank Act (2011) also ushered in extensive reforms, which include mandatory stress testing. The Comprehensive Capital Analysis and Review (CCAR) was initially introduced in 2014, and it requires large institutions to indicate capital adequacy when the situation unfolds adversely. Most recently, the Federal Reserve announced new capital requirements and re-examined the stress-testing processes in 2025, further enhancing the resilience of large banks to systemic shocks; however, the empirical analysis in this thesis relies only on data up to 2023.

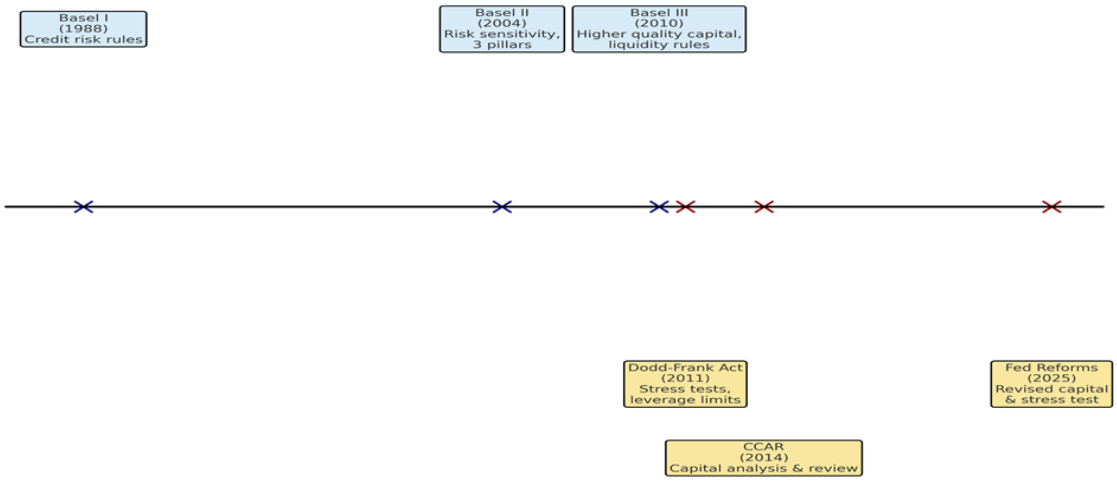

FIGURE 1.1. Evolution of Capital Regulation in Banking (1988-2025), Basel Accords (Top) vs US Reforms (Bottom, Staggered).

This timeline separates international Basel accords (top row, blue) from U.S.-specific reforms (bottom row, gold). It clearly shows the progression from Basel I (1988) to Basel III (2010), alongside U.S. reforms such as the Dodd-Frank Act (2011), the Comprehensive Capital Analysis and Review (CCAR, 2014), and the most recent 2025 Federal Reserve revisions. Source: Author's

illustration based on Basel Committee on Banking Supervision (2011), Federal Reserve Board (2020), and recent U.S. regulatory updates (Reuters, 2025).

1.1.2 US BANKING SECTOR CONTEXT

The United States banking system is a very fruitful environment to be studied in the context of profitability and risk sensitivity to capital, because of its wide variety of institutions, covering five size categories:

Very small (community banks): These are usually local, limited geographically, institutions often engaged in traditional intermediation, including household and small business lending. Depositor trust and preserving high capital buffers are usually determinants of their resilience.

Small banks: These are modestly larger than community banks and are just large enough to enjoy modest economies of scale but are confined to particular areas. Capital adequacy is an important factor of stability given its narrow diversification.

Medium banks: These banks are in the middle of the pack and usually serve more than one region and have more products. They trade part of the benefits of scale to remain exposed to local economic shocks, and their capital strategies are the core of their profitability and risk management.

Large banks: These are banks that are nationally diversified in their portfolios. They are involved in more intricate activities, like syndicated lending and structured finance, in which capital regulation influences competitive behavior and risk appetite.

Very large banks (including U.S. G-SIBs): The largest banks in the size spectrum are broadly involved in international markets by trading, securitizing, and managing assets. Their systemic nature implies that capital requirements not only respond to market expectations of implicit government support, but also to increased regulatory scrutiny and international standards.

This heterogeneity highlights the need to analyze U.S. banks in terms of size. Regulatory capital ratio could have vastly different profitability and risk-taking implications based on the type of business model and the size of a bank.

1.2 RESEARCH PROBLEM AND OBJECTIVES

Despite the abundance of literature on the capital role in banking, it is stated that most studies focus on Europe, Asia, or emerging markets (Lee & Hsieh, 2013; Nisar et al., 2018; Maudos, 2017). However, the U.S. context, although of global financial significance, has received a comparatively lower focus, particularly in terms of the heterogeneous effect of capital even among this group of bank sizes.

The majority of the available studies involve international samples or aggregate influences. But a competitive dual banking system, a highly regulated environment (e.g., FDIC, Federal Reserve, and OCC) and both small community banks and very large, globally systemically important banks (G-SIBs) all contribute to the distinct environment that U.S. banks operate in. The heterogeneity is not easily reflected in cross-country studies.

In this way, the research problem of this thesis can be formulated as follows:

How does bank capital affect profitability and risk-taking in U.S. banks, and how has that changed across five categories of bank sizes (very small, small, medium, large, very large, including G-SIBs)?

This overarching issue is dealt with in three objectives:

To examine the correlation between bank capital and profitability among the U.S. banks, it is important to consider the traditional (Return on Assets, Return on Equity, Net Interest Margin) and non-traditional income sources.

In determining the capital factors of risk-taking behavior, indicators that will be used are the Z-score, the ratio of non-performing loans, and net charge-offs.

To analyze the differences between these relationships in five bank size categories (very small, small, medium, large, and very large with G-SIBs) and thus capture the structural and strategic variations in business models.

The responses to these questions can shed light not only on the academic discussion but also on the practical problems that policymakers and bankers have to deal with.

1.3 MOTIVATION

This study has both practical and academic motivations.

Academic Motivation

Academically, the issue of the role of capital in banking is still unresolved. On the one hand, research indicates that increased capital can enhance the financial stability and profitability of banks due to the minimization of costs related to distress and the preservation of investor confidence (Berger & Bouwman, 2013; Goddard et al., 2013). Conversely, overcapitalization can reduce returns on equity, especially in big banks in which leverage is a key driver of profitability (Kleff & Weber, 2008; Maudos, 2017). Likewise, although there are studies that show that increased capital can reduce excessive risk-taking (Anginer et al., 2018; Jokipii & Milne, 2011), there are also studies that reveal that higher capitals allow banks greater freedom to engage in riskier non-interest activity (Stiroh & Rumble, 2006; Koelker et al., 2015).

This contention suggests that more empirical studies are necessary, especially in the American context. In addition, most of the previous research analyses banks as a homogeneous entity, not because capital may have completely different implications in small and large banks. This thesis addresses an important gap in the academic literature by explicitly considering size heterogeneity.

Policy Motivation

Politically, the capital-profitability-risk nexus is important to understand to effectively regulate it. Regulatory bodies have increasingly tightened capital requirements across the globe via Basel III reforms, stress testing regimes, and macroprudential measures since the global financial crisis. In the United States, supervisory systems now revolve around the Federal Reserve through its CCAR stress tests and upgraded prudential requirements on systemically important banks.

The rising events also contribute to the realization of the timeliness of this study. In 2025, the Federal Reserve suggested new capital requirements for big banks with the aim of extracting the

experience of the pandemic, interest fluctuations, and the changes in systemic risks (Reuters, 2025). In the meantime, medium banks and community banks argue that they are overburdened by this type of one-size-fits-all regulation. Evaluating the size group capital effects on profitability and risk is evidence that can be taken into account in regime-specific regulation.

Practical Motivation

The results of this study provide practical implications to practitioners, including bank managers, investors, and analysts. Bank executives are always involved in trade-offs between holding a strong capital buffer, high levels of profitability and risk exposure. Besides evaluating the bank's resilience in terms of profitability ratios, investors also evaluate the bank's resilience in terms of capitalization level and risk indicators. This study will enable stakeholders to make better decisions by explaining the different impacts of capital on performance depending on the size of the bank.

1.4 CONTRIBUTION OF THE STUDY

This thesis has several contributions to the literature and practice of banking and finance.

Academic Contributions

Size-Based Analysis: In contrast to most of the preceding studies, which assume banks are homogeneous, this study decomposes the sample into five sizes (very small, small, medium, large, and very large). This makes it possible to understand the effect of capital on profitability and risk-taking in a more subtle way at each end of the size range.

Combination of Profitability and Risk: Several previous studies have considered profitability (e.g., ROA, ROE) or risk (e.g., Z-score, non-performing loans), but few of these studies have been performed on both dimensions at the same time in the U.S. setting. This thesis brings the two together in that it provides a comprehensive view of the dual role of capital.

Current Context: This study includes recent evidence by incorporating new information and taking into account recent events such as COVID-19, the increasing interest-rate environment of

2022-2023, and the U.S. capital reforms of 2025, which can improve the understanding of the challenges and resilience of modern banks.

Conceptual Framework: The thesis formulates and tests a model where capital influences profitability and risk-taking, and bank size mediates between these variables.

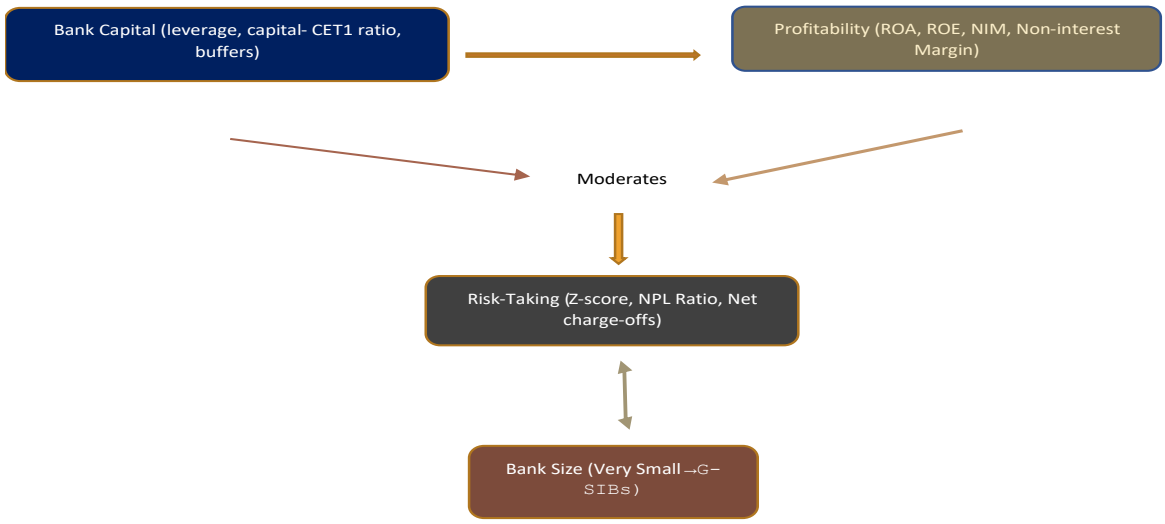

FIGURE 1.2. Conceptual Framework of Capital-Profitability-Risk Nexus.

This model depicts the supposed relationships discussed in the thesis. Bank capital moderates both the magnitude and direction of relationships between bank capital and profitability and risk-taking.

Policy Contributions

Supporting Regulation: The results will inform policymakers on the effects of capital requirements on various types of banks. This becomes especially applicable when discussion is made in proportional regulation, as community banks insist that they should not be treated similarly to G-SIBs in terms of required capital.

Implications of Stress Testing: The results of the size relationship between capital and profitability and risk-taking illuminate stress testing and capital planning activities design.

Systemic Risk Knowledge: It is important to understand that capital buffers can be treated differently in different- sized banks, and this insight can assist the regulators in predicting systemic weaknesses, particularly when the economy is under stress.

Practical Contributions

Strategic Implications on Bank Managers: Bank executives are confronted with trade-offs between profitability, capital adequacy, and risk exposure. This thesis offers empirical evidence to guide capital planning, dividend and risk management policies.

Capitalization Relevance to Investors: To investors, capitalization levels serve as an important resilience marker. This research explains the impact of capital on bank performance, such that it aids in investment decision-making.

1.5 STRUCTURE OF THE THESIS

The rest of this thesis was structured in the following manner:

Chapter 2 - Literature Review: A careful review of theoretical insights and empirical research studies regarding bank capital, its profitability, and risk-taking. Particular focus is applied to size heterogeneity, regulatory frameworks and recent crises.

Chapter 3 - Research Methodology: Outlines the research design, data sources, selection of variables, and econometric models that are used to examine the relationship between capital, profitability, and risk.

Chapter 4 - Empirical Results: Reports and discusses the empirical results and shows the variations between the sizes of banks and robustness checks.

Chapter 5 -Discussion: Interprets the observations regarding the literature, policy implications, and the applicability of the results in regulatory discussions.

Chapter 6 - Conclusion: Sums up the key findings of the research, discusses limitations, and pinpoints future research directions. This paper thus enables the clear distinction of the results presentation (Chapter 4), their interpretation (Chapter 5), and the general conclusions (Chapter 6).

1.6 SUMMARY

To conclude, the chapter has described the context and background, research problem, objective, and motivation of the study on the role of capital in U.S. banks. It has indicated the gaps in the literature and reported the contributions of this thesis. Lastly, it has presented a conceptual framework and described the thesis structure.

CHAPTER 2: LITERATURE REVIEW

The theoretical, empirical, and regulatory approaches to the relationship between bank capital, profitability, and risk-taking have a vast literature. This chapter provides an overview of the most pertinent contributions, and it shows where consensus has been achieved, where results are inconsistent, and where significant gaps are present.

2.1 THEORETICAL BACKGROUND

The capital of the bank is at the center of determining the behavior of the bank, their performance and their risk-taking incentive. Despite the simplicity of its concept, the economic role of capital in banking is multidimensional and in numerous cases context-dependent. Various branches of financial theory provide opposing ideas towards the question of whether the increase of capital requirements contributes to financial stability, profitability or restricts efficiency and risk-taking. Due to the material differences between commercial banks by their size, funding structure, business model, and regulatory oversight, the impact of capital cannot be supposed to be homogenous across the industry. This part provides the theoretical basis of the bank capital performance-risk nexus, starting with the general finance theory to the banking-specific models that emphasize the dynamics based on size.

2.1.1 CLASSICAL CAPITAL THEORIES OF STRUCTURE

The first perspective in understanding the bank capital decisions is the traditional corporate finance theories. The Modigliani Miller (M&M) proposition stipulates that capital structure does not affect the firm value in a frictionless market (Modigliani & Miller, 1958). Such a neutrality, however, fails in the context of taxes, the cost of bankruptcy, the agency problems, which are extremely topical in the banking sector. The trade-off theory is based on the fact that companies undertake an optimal debt level by trading between the tax benefits of debt and anticipated cost of financial distress (Kraus & Litzenberger, 1973). Equally, the pecking-order hypothesis states that

the favored order of firms to use internal funding, followed by debt, and lastly equity is because of the cost of information asymmetry (Myers & Majluf, 1984).

Although these theories do offer an effective understanding, it is not fully applicable to banks because of the deposit insurance, the creation of liquidity and excessive regulation. An example is the pecking-order view, which argues that banks are not supposed to issue equity, whereas the banks are subject to regulation to minimum capital ratios, and supervisors may compel the capital to be issued regardless of market demand. Equally, trade-off theory is weaker on the tax-shield argument in banking since the deposit financing will already be subsidized in the form of insurance. In this way, though the general capital-structure theories are fundamental, they cannot be used to explain the capital behavior of banks, unless one integrates the banking-specific mechanisms. The following subsection presents theories that were strictly formulated in the case of regulated credit institutions.

2.1.2 BANKING-SPECIFIC CAPITAL, PROFITABILITY AND RISK THEORIES

Buffer Capital Hypothesis

The hypothesis of buffer capital argues stating that highly capitalized banks hold capital above minimum regulatory requirements to cover the unexpected losses and prevent expensive supervisory action (Berger, 1995). An increase in capital will help a bank withstand credit shocks and boost depositor and creditor confidence, reducing funding costs and allowing successful and more consistent lending. The hypothesis assumes that there is a positive correlation between capital and financial performance, especially among a bank that depends mainly on the deposit-based fund, and relationship-lending facilities. Small banks have a higher likelihood of being affected by the effect, as they are closer to local markets and heavily rely on the stability of trust and franchise.

Hypothesis of Regulatory Pressure

Complementing the buffer view, the regulatory pressure hypothesis highlights the fact that those banks which are near to the regulatory capital levels change behavior in order to escape fines or expensive recapitalization (Jokipii & Milne, 2011). The banks having fewer capital positions slow down the growth of assets and risk exposure whereas the banks having stronger capitalization experience less supervision and may operate more freely. The restrictions of regulatory intervention have a disproportionate impact on smaller institutions that are less likely to obtain wholesale funding and have a higher reputation. In this regard, capital not only buffers losses but it also serves as a compliance buffer, and incentives to reduce risk are elevated in small banks.

Risk-Absorption Hypothesis

Conversely, risk-absorption hypothesis holds that an increase in capital could actually allow banks to increase risk instead of decreasing it (Konishi & Yasuda, 2004). Capital is a buffer to provide an expansion to greater yield opportunities such as market-based and trading. The theory is especially applicable in the case of large banks that have access to implicit government support and the ability to be diversified. Moral hazard intensifies as banks expand and grow to be systemically important with the anticipation of bailouts. As a result, capital can be employed in a strategic manner to finance expansion to more risky operations rather than simply decreasing risk exposure.

Franchise Value Hypothesis

The franchise value hypothesis (Keeley, 1990) suggests that banks that have strong long run profit prospects act in a conservative way so as to sustain their franchise. The high value of charter and reputation means that banks will not operate excessively since they will not risk losing future profits by making short-term profits. Nevertheless, when operating in low-franchise settings or very competitive markets financial institutions might become riskier to ensure continued profitability. This structure suggests that both capital and franchise value affect risk-taking and

that the capital effect of stability is greatest in banks that have large reputational interests - which are in general smaller, relationship-based banks.

2.1.3 OVERVIEW OF THEORETICAL REFLECTIONS

Combined, the banking theory implies that capital can play a stabilizing and risk enabling role. The net impact is based on the regulatory conditions, market discipline and the business models. Notably, all these theoretical models suggest that capital-profitability-risk relationship is scale dependent. Like small banks find it useful that capital has been seen as a mark of strength and a shield of franchise image. But large banks can have access to capital to grow risky activities by use of implicit guarantees and diversified business practices.

2.2 CAPITAL AND PROFITABILITY

One of the most controversial issues in banking and finance has been the relationship between the bank capital and profitability. In traditional wisdom, the greater capital ratios restrict profitability through limits of leverage and decrease in return on equity. Nevertheless, the current empirical and theoretical literature is questioning this perspective more and more, as it is believed that capital can contribute to profitability through a reduction in the cost of funding, increases in risk management potential, and market confidence. This relationship is usually conditional on the size of the bank, business model, and regulatory environment.

The capital often helps profitability in smaller banks as it serves as an indicator of financial health and lowers the perceived risk of default in the eyes of depositors and other members of the local market. Due to the fact that community and regional banks are often more dependent on deposit funding and relationship lending, customer confidence and stability of the financing situation is promoted by high levels of capitalization. Reduced credit risk premia and improved access to stable financing are potentially converted into an increased intermediation process, with greater net interest margins. Besides this, smaller banks are more likely to develop revenue more in the

context of conventional lending exchanges than in capital-market exchanges, so the strength of balance sheets is a fundamental generator of long-term profits. In this view, capital is strategically useful in enhancing lending capacity, reducing the cost of funding, as well as asset quality and eventually increasing profitability.

Big and systemically important banks on the other hand tend to be more diversified and tend to depend on noninterest revenue that is attained as a result of trading, fee-based services and investment banking. In the case of such institutions, capital buffers might not be as important as scale economies, market power, and risk-taking strategies in determining profitability. Increased capital requirements can limit leverage-based returns and flexibility in asset allocation, especially in the operations where risk-taking is a key to remaining competitive. Furthermore, the reduced marginal benefits of excess capital on systemically important banks might be due to the fact that they have access to wholesale markets and are believed to be supported by the government. Consequently, in the case of large banks, increment of capital can dilute the return on equity as well as have a non-linear impact on the profitability when capital ratios are in excess of the effective regulatory levels.

This ambiguity is manifested in empirical findings. There is significant literature that reports the existence of a positive relationship between capital and profitability. To illustrate, the more capitalized banks were more robust and highly profitable during stress periods in the financial environment, especially the global financial crisis, owing to its robust balance-sheet status and reduced funding expenses. However, other studies find that an increase in the capital decreases profitability of big banks especially in situations where the competition is intense and returns are due to risk-weighted activities. The new theory is that the capital-profitability nexus is situation-dependent and that a critical moderating variable in the capital and profitability relationship is the size of the bank.

On the whole, theory and empirical evidence indicate a size-contingent and non-linear correlation. In the case with smaller banks which are deposit-funded, capital is supposed to stimulate profitability by enhancing trust, decreasing funding expenses, and maintaining

consistent lending. In the case of large banks, the impact can be less or negative since leverage can restrict and marginal benefits of extra capital buffers can be less.

Hypothesis	Empirical Impact on Profitability
Buffer Hypothesis	Positive-stability reduces funding cost
Risk-Absorption Hypothesis	Mixed-may increase through riskier activities
Regulatory Pressure Hypothesis	Neutral/Negative- capital constraints may reduce ROE
Franchise Value Hypothesis	Positive-long term stability and trust enhances return
Trade-off Theory	Mixed-depends on balance between tax shields and costs
Pecking Order Theory	Negative-in short term (cost of equity), Neutral-long term
Agency/Moral Hazard	Mixed-depends on incentive alignment and discipline
Scope &Scale Effects	Varies-large banks may gain scale-scope of economies, small banks may signal solvency

Source: a synthesis based on Berger (1995), Myers & Majluf (1984), Keeley (1990), and so on.

This panel is the summary of how the principal theoretical views predict the connection between bank capital and profitability.

2.3 CAPITAL AND RISK-TAKING

Connection between capital and bank risk-taking has served as a focal point in the banking theory and there is some ambiguity as to its direction, which is the subject of empirical debate. Prudent traditions contend that well-capitalized banks are more conservative in behavior, but according to modern strategic approaches of banking, additional capital can facilitate greater risk-taking in some circumstances. The overall impact is influenced by the regulatory pressure, access to outside capital, structure of the market, and the business models' banks pursue- none of which differ by size of bank very substantially.

Traditionally, prudential views are expected to lower the risk-taking by banks since greater capital ratios would lower risk-taking. Capital absorbs the unexpected losses, which cushions against insolvency. Banks with a lot of capital have reduced probabilities of default and hence have higher

incentives of financial stability. Moreover, capital lessens the moral hazard of the deposit insurance since banks whose capital is greater have more reputational capital at risk. This stabilizing role is especially applicable to the case of relationship-based lenders and community institutions where the business model is based on depositor trust, the long-term relationships with customers and reputational capital. Having capital exceeding regulatory minimums is a risk-management strategy to such banks as well as a competitive signal that franchise value and market discipline. Consequently, small and middle-sized banks tend to perceive capital as a risk-mitigating, risk-reducing, and risk-containing asset, which makes banks more resilient.

Nevertheless, theoretical arguments vary in pointing out a situation in which capital can lead to the heightening of banks to take risks. The risk-absorption hypothesis says that banks that have greater capital buffers can more easily bear risky assets and absorb the possible losses. Capital is therefore not a cushion, but a lever to higher activities with higher yields and lesser volatility. This process is particularly applicable to the case of large banks that diversify on other than traditional lending into trading, market-based products, derivatives, off-balance-sheet exposures and investment banking services. These institutions are also highly equipped in terms of risk-management systems, technological capacity, and diversified portfolio, which enable them to tactically mobilize their capital by taking strategic risk of opportunities. In that regard, increased capital is not a weakness but an empowered of risk-taking that is not excessive.

On the other hand, implicit government guarantees and expectations of too-big-to-fail large banks can also lead them to take more risks. Participants in the market often assume that systemically important financial institutions would be supported by the government whenever they are in distress. This safety net in the background enhances less discipline in the market as well as increased leverage and exposure to complicated financial products. Capital in big banks can therefore be used to support diversification into non-traditional business instead of supporting prudence. Therefore, capital works effectively to stabilize a small bank, but possibly works to fund aggressive policies of a large bank to take advantage of market power and economies of scale.

This duality is replicated in empirical literature. Most of the researches have demonstrated that better-capitalized banks have less likelihood of taking up extravagant credit risks and speculative investments, especially in the case of smaller and domestically focused banks. The reaction of these banks to capital buffers is enhanced lending criteria and safeguarding long-run franchise worth. In contrast, there has been an indication by evidence of systemically significant banks that capital can co-exist with, and even promote larger exposure to market-based operations and non-traditional sources of income. When there is an overall feeling of market optimism or loose credit cycles, it has been noted that the big banks whose capital positions are greater expand their trading and underwriting activity, which again validates the argument that capital can facilitate risk-taking by institutions in a position to take on risk, due to size and market expectations.

Hypothesis	Empirical Impact on Risk-taking
Buffer Hypothesis	Negative-reduce probability of distress
Risk-Absorption Hypothesis	Positive- stronger capital enables higher risk
Regulatory Pressure Hypothesis	Negative- regulatory oversight reduces risk-taking
Franchise Value Hypothesis	Negative-strong charter value discourages risk
Trade-off Theory	Mixed-high quality reduces risk, but leverage incentives remain
Pecking Order Theory	Negative-reliance on internal funds curbs risk
Agency/Moral Hazard	Positive- deposit insurance encourages risk, mitigated by capital rules
Scope &Scale Effects	Varies-diversification may increase or decrease risk depending on management.

Source: A synthesis following Konishi & Yasuda (2004), Jokipii & Milne (2011), Merton (1977), etc.

This panel is a summary of how the hypotheses explain the relationship between bank capital and risk-taking behavior.

The literature taken as a whole suggests that the impact of capital on risk-taking by banks is not consistent across all banks, but is conditional on the size of the bank, funding structure, and strategic orientation. Smaller banks are likely to apply capital to preserve stability and reputation whereas large banks can apply capital to seek attractive risky opportunities supported by diversification and sophistication as well as a perceived regulatory cover. This heterogeneity

contributes to the significance of size-segmented analysis in the investigation of the capital-risk nexus of the U.S. banking system.

2.4 THE BANK SIZE AS A MODERATING MECHANISM

Capital has structural, behavioral and regulatory variations in its influence on the bank profitability and risk-taking and this difference is deeply rooted in the size of the bank. The size of a bank has an impact on business models, source of funds, regulatory expectation, and market discipline, and as such, it is one of the most important moderating factors when it comes to capital-related results. Trying to make the banking industry homogenous blur these differences and may result in erroneous implications about the relationship of capital operations within the system.

Small & Very Small Bank

Small banks (e.g., community banks) are advantaged in terms of capital in maintaining depositor confidence and profitability. The Federal Reserve Bank of Kansas City reported that almost two-thirds of community banks have maintained a stable net interest coverage because of the 2022-2023 increase in interest rates, with stable and low-cost deposit bases and efficient restructuring of assets and liabilities (Federal Reserve Bank of Kansas City, 2023).

Disproportionate compliance costs are, however, felt in small banks. The results of the survey provided by the Conference of State Bank Supervisors (CSBS, 2025) lead to the observation that the regulatory burden (in percentage of overall costs) of community banks is significantly higher compared to bigger banks. This influences the low capital levels of the net profitability.

Medium-Sized Banks

The medium banks are less homogenous in response: capital gives the flexibility required to offer regional diversification, but the impact on profitability and risk is ambivalent.

Schreiber (2024) finds that medium-sized banks are less responsive to the diversity of revenue. The profitability, capitalization, and credit risk are rather stable compared to smaller community banks and very large institutions.

Large Banks

Capital buffers enable large banks, particularly those that are close to the G-SIB threshold, to diversify their income through non-interest income through securitization or synthetic risk transfers.

Deloitte (2024) emphasizes that the large regional banks in the U.S. have implemented credit risk transfer mechanisms at a higher rate as a capital efficiency technique.

Nonetheless, as the FDIC (2023) data shows, the same banks are struggling with the unrealized long-term securities losses, which may cause a reduction in capital-adjusted profitability.

Very Large Banks (G-SIBs)

For large banks, capital is important not only to survive, but also to have complicated and international business processes.

The 2025 Federal Reserve stress tests allowed U.S. G-SIBs not just to be well-capitalized in a scenario of an extreme recession but also to be able to reinstate their dividend distributions and share buybacks (Financial Times, 2025).

While some recent analyses suggest that large banks should reduce capital, the opponents argue that any amendments can increase the systemic risk (Financial Times, 2025).

Size also matters to create public confidence. When regional banks struggled in 2023, large banks were in a strong flight-to-safety mode. It proves the capital-based trust advantage of G-SIBs (Federal Reserve, 2023).

Through regulatory structures, size-based heterogeneity is enhanced. Although minimum capital requirements apply to all banks, larger and more systemically relevant banks are more likely to be subjected to heightened Scrutiny, and also greater reporting requirements. However, the most

ironic thing is that the biggest banks are allowed to be more strategically autonomous, as their collapse will potentially cause the systemic destruction. This factor will elevate controls on risky behavior by smaller banks to the risk of promoting measured risk-taking by larger institutions. Capital, therefore, has various strategic functions of the different size groups; a stability buffer of a community bank and a risk-capacity tool of global banking institutions.

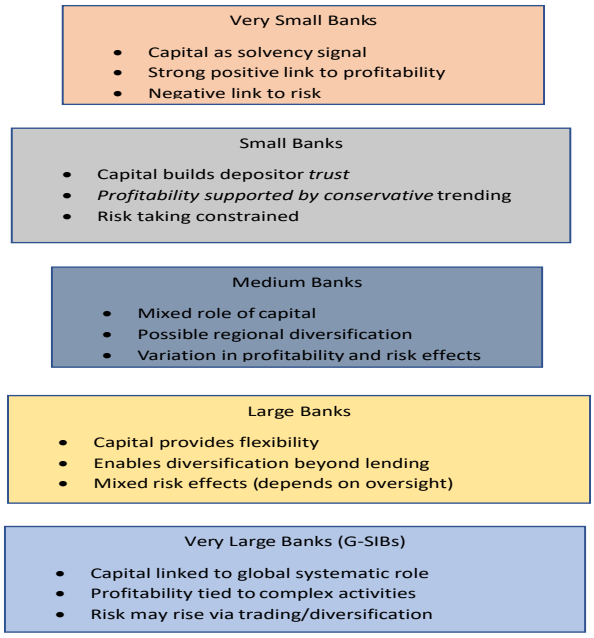

FIGURE 2.1. Capital-Profitability-Risk Nexus across various Bank Sizes.

Source: Overview based on FDIC (2023), Schreiber (2024), CSBS (2025) and other publications.

This chart displays the association among capital, profitability, and risk-taking within very small, small, medium, large, and very large (G-SIB) banks.

Considering these differences, the study of one capital performance relationship of all banks would be prone to obscuring the structural reality. By dividing the banks into sizes, it is possible to permit a more contemplated perception of the non-homogeneous roles of capital in profitability and risk-taking. This method of analysis is consistent with the contemporary regulatory trend where banks are grouped into a set of size categories and subjected to a differentiated supervisory burden. In this connection, the following section presents the main

gaps in the literature and locates this study in the context of the overall academic and regulatory discourse.

2.5 SCOPE OF STUDY

There is some controversy in the literature on bank capital, profitability, and risk. The buffer hypothesis and perspective of franchise value theories argue that more capital has a positive influence on stability and profitability, but based on some other theories (risk-absorption, agency theory), more capital can encourage risk-taking. This uncertainty is justified by empirical data: capitalization is more likely to stabilize during a crisis, yet in the normal state, the effect may vary depending on the size of the bank, business model, and the regulatory environment.

2.5.1 THEORETICAL AND EVIDENTIAL INTEGRATION

The pre-existing studies are synthesized to lead to four major themes:

Dual Role of Capital: Capital has the dual role of being a buffer against shock as well as flexibility to expand. Better off-balance sheet, which the large banks use to get involved in more complex and higher-risk operations, is less expensive to fund, and large banks have access to capital in an amount that is greater than that of small banks.

Heterogeneity of the Bank Size: It is an established fact that capitalization is more significant in small banks than in big banks. Capital is a solvency indicator applied by very small and small banks, capital illustrates diluted impacts in medium banks, and capital is applied strategically by large/G-SIBs as a diversification instrument.

Crisis Dependence: Capital plays the most important role during a crisis. During the GFC, COVID-19, and the interest rate shock of 2022-2023, capital buffers were the key variable that determined whether a bank remained solvent or not.

Regulation as Adaptive Mechanism: The numerous restructures in capital standards (Basel III, Dodd-Frank, CCAR, 2025 Fed reforms) indicate that capital standards are not fixed but responsive to changes in risk.

2.5.2 CONCEPTUAL INTEGRATION

In order to synthesize these insights, the following chart provides a conceptual map that interrelates theory, empirical evidence, and crisis-regulatory dynamics.

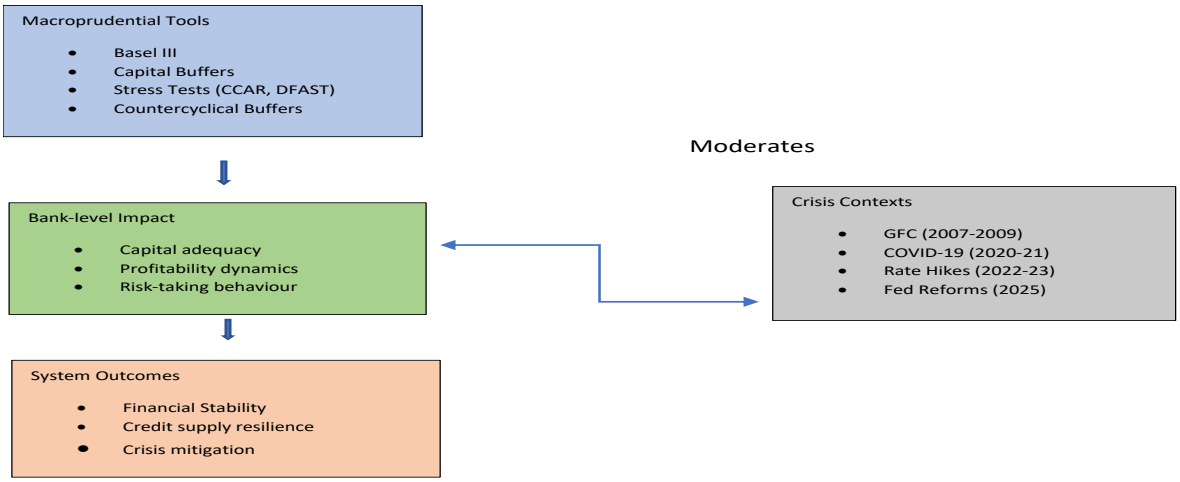

FIGURE 2.2. Macroprudential Regulation and Crisis Framework.

This diagram indicates the impacts of the macroprudential measures (Basel III, capital requirements, stress tests) on the profitability and risk-taking at the bank level. Such correlations are mediated by the context of a crisis (e.g., GFC, COVID-19, 2022-23 shocks, 2025 reforms). The stability of the system has some effects and feed back to regulatory changes.

2.5.3 IDENTIFIED RESEARCH GAP

Despite the extensive research undertaken on the connection between bank capital, profitability and risk conducted in the banking and finance literature, there are still many gaps visible in the

situation regarding the United States banking sector. First of all, in spite of the general awareness created concerning the importance of bank capital, there are loopholes in the literature. Much of the existing literature has been based upon an international sample (e.g., Lee & Hsieh, 2013; Nisar et al., 2018) or a specific banking system in Europe and Asia (Altunbas et al., 2007; Koeler, 2015). As much as these studies may provide very valuable information, the findings cannot be wholly relevant to the banking sector in the United States, which has its structural, regulatory, and market peculiarities.

Secondly, a good portion of the groundwork in this area has been devoted to the pre-crisis or crisis-induced capital behavior, and the reaction of regulation to that behavior. Consequently, the empirical evidence regarding the dynamics of the capital reflects little to capture the transformation of capital dynamics within various macroeconomic and regulatory contexts, such as the post-GFC, the COVID-19 shock, and the recent tightening cycle. Major structural changes have occurred in the U.S. banking system in this period, such as non-interest income activities, digitalization, more stringent regulatory frameworks, more frequent and intense stress testing, and changing funding structures that might affect the role of capital by determining bank performance and risk-taking.

Moreover, most of the existing literature assumes that banks can be viewed as a homogenous group, implicitly suggesting that capital influences the sector in the same way. Nevertheless, the U.S. banking system is very heterogeneous, comprising of community banks, mid-tier regional institutions, and business banks that operate globally and each have a business model, mix of funds, and regulation, and risk-taking behavior. These differences imply that capital could have varying economic functions against institutional features and strategic goals.

Although this thesis does not obtain individual regressions by each size category, this structural dimension is considered by the fact that it involves the use of bank size fixed effects to prevent the heterogeneity by size. Besides, this paper supplements the empirical study with theoretical and literature-based discussion on the manner in which capital behavior and profit-risk responses can differ among bank size segments. This method offers a more subtle interpretation of the empirical findings, but is still methodologically consistent.

Another scope is associated with the lack of academic studies of medium-sized U.S. banks, even though they have become more significant sources of credit in the regions, lending to SMEs, and in local financial intermediation. The big institutions and the smaller community banks are well researched, whereas the mid-sized banks are in between regulatory and analysis. It is thus crucial to learn about the capital effects within the framework of recognition of the existence of these institutions.

Besides the gaps in size, another contradictory theoretical view concerning the role of capital can also be found in the literature. The franchise-value perspective states that increased capital enhances market discipline and minimizes risk-taking (Keeley, 1990; Berger and Bouwman, 2013). Conversely, the risk-absorption and moral-hazard perspective implies that banks with huge capitalization can assume more risks and capital capacity serves as a buffer to absorb losses (Konishi and Yasuda, 2004; Allen and Gale, 2007). These conflicting forecasts bring an empirical debate that eludes a definitive resolution on whether an increase in the level of capital eventually disciplines risk-taking or enables risk-taking.

In summary, there remains a need of recent U.S.-specific empirical data that would study the impact of capital on profitability and risk based on various regulatory regimes and macroeconomic cycles and would suitably capture the size-based structural variations. The thesis will serve the purpose of filling this gap by implementing the size fixed effects, estimating the relationship between capital - profitability and capital - risk over a past multi-cycle duration, and discussing the results within the framework of the competing theoretical perspectives. By doing so, the study offers modern evidence as to whether capital is more of a disciplinary stabilizing force or a buffer that allows risks to be taken within the U.S. banking system.

2.6 RESEARCH HYPOTHESES

On the basis of the theoretical discussion, the following hypotheses are developed:

H1: There is a positive relationship between increased bank capital ratios and profitability (ROA, ROE, NIM).

H2: The higher the bank capital ratios, the less risk (greater Z-score, fewer NPLs, fewer charge-offs).

H3: Effect of capital on profitability and risk is different by bank size.

CHAPTER 3: METHODOLOGY

This study is based on a panel-data econometric model to investigate the relationship between bank capital and profitability, and risk-taking in the U.S. banks (2000-2023). Cross-sectional and time variation used in panel methods exploit both unobserved heterogeneity (e.g., management style, local conditions) that is common in banking research (e.g., Berger, 1995; Berger & Bouwman, 2013; Lee & Hsieh, 2013). Further, System GMM was used as an additional robustness measure to deal with the possibility of endogeneity, since there may be an interaction between bank capital and profitability/risk.

The two most frequently used estimation techniques in panel-data analysis are Fixed Effects (FE), which permits the correlation between unobserved heterogeneity and explanatory variables, and Random Effects (RE), which does not. FE was used in this study because bank-specific features, including business model, management practices and regional orientation, were expected to be correlated with capital ratios and performance. FE was thus taken as the main specification to manage the unobserved heterogeneity at the bank-size level, which cannot be measured, but which remains constant over time, whereas RE was merely used as a checkpoint to ensure that results are not sensitive to the estimator.

The study also takes into account the differences in the size of banks since the capital can imply different meanings to small, medium, and large banks (Schreiber, 2021). To this end, the regressions were performed independently of each of the size groups, and the coefficients are compared among categories.

3.1 DATA AND SAMPLE

3.1.1 DATA SOURCE

The empirical analysis used the secondary data of Reports of Condition and Income (Call Reports), which was collected quarterly by the Federal Deposit Insurance Corporation (FDIC) and the Federal Financial Institutions Examination Council (FFIEC), respectively. Call Reports are highly comprehensive, and they reflect practically all the U.S. commercial banks. The FDIC portal of

Statistics on Depository Institutions (SDI) was used to download data, and macro controls were obtained through FRED.

3.1.2 SAMPLE PERIOD AND COVERAGE

The research refers to a 23-year retrospective experience, between 2000-2023, which encompasses the period of expansion, Global Financial Crisis (2007-2009), post Global Financial Crisis regulation (Basel III), and COVID-19 shock. The sample collects data based on annual FDIC Call Report. During this more than two decades time period, many banks were consolidated in the U.S. banking industry, and the size of the FDIC-insured commercial banks was reduced, as there were more than 8,000 banks in 2000s and about 4,000 by 2023. This panel thus consists of all the banks that qualified as per the reporting requirements and data-quality test. This period presents a good leeway to experiment with the role of capital in the different regulations and macroeconomic conditions.

3.1.3 SAMPLE SIZE

The empirical sample comprises 120 US bank-years observations, where all the data on the necessary financial and Macroeconomic variables are available and consistent. Although the U.S. banking sector has thousands of financial institutions, the regulatory reporting framework, mergers and collapses over the years, and the occasional lack of disclosure in financial reports make the full balanced panel impossible. In line with the customary approach to the empirical study of banking, this thesis employs a curated unbalanced panel, meaning that there is no data for all banks covering every year of the 2000-2023 period. However, in the years when they appear, the data are complete, and no values are missed. This method ensures that the regression estimates are made using consistent high-quality data rather than pure counts, which is necessary, and conforms to the known econometric methodology in the research of the bank level. Each regression table reports the number of observations, and thus, is not repeated during

the interpretation of the results to ensure that the results are clear and do not create any redundancy.

3.1.4 BANK SIZE CLASSIFICATION

According to Schreiber (2021) and the FDIC conventions, Banks are divided into five size groups based on total assets (Schedule RC of Call Report) as follows:

Very Small banks: Assets less than USD 100 million

Small Banks: USD 100-USD 1 billion of assets.

Medium banks: USD 1 billion-USD 10 billion.

Large banks: USD 10 billion- USD 250 billion.

Very Large banks: USD 250 billion or more of assets.

3.1.5 DATA CLEANING

The 1st and 99th percentiles are winsorized.

Banks that do not have three years of consecutive data are not included.

There is consistency in constructing ratios amongst banks.

3.2 VARIABLES

3.2.1 DEPENDENT VARIABLES

Two types of dependent variables are taken into account in the analysis:

Profitability:

Return on Assets (ROA): Net income/ Total assets.

Return on Equity (ROE): Net income/Total equity.

Net Interest Margin (NIM): Net interest income/ Earning assets.

Risk-taking:

Z-score:(ROA + Equity/Assets)/Standard deviation of ROA (bank-level).

Non-performing Loan (NPL) ratio: non-performing loans/ total loans.

3.2.2 INDEPENDENT VARIABLES

The main independent variables were the alternative measures of capital adequacy:

Equity-to-Assets (ETA): Book equity capital is in the form of a ratio of total assets.

Tier 1 Capital Ratio (Tier 1): Core capital to risk-weighted assets.

Total Risk-Based Capital Ratio (Total RB): The total regulatory capital to risk-weighted assets.

These capital specifications are individually run in each regression to compare their impacts.

3.2.3 CONTROL VARIABLES

To reduce the effects of capital, several control variables are involved:

Liquidity Ratio: Ratio of liquid assets to total assets.

NII/EA: The noninterest income to earning assets.

NIE/EA: Noninterest expense to earning assets.

Non-interest Expense to Equity-to-Assets: Proxy of operational efficiency.

Risk-Weighted Assets to Total Assets: Measure of general asset risk.

GDP Growth: Measures the effect of business cycles.

Inflation: Checks macroeconomic price pressures.

Federal Funds Rate: Reflects the monetary policy.

3.2.4 FIXED EFFECTS

Year Fixed Effects (Year FE): Adjustment of time-specific unobservable shocks (e.g., crisis, regulatory changes).

Size Fixed Effects (Size FE): Adjustment of systematic variation by groups of banks.

In summary:

Dependent variables: Profitability and Risk.

Capital specs: ETA, Tier1, Total RB.

Controls: Liquidity, Income/Expenses, Risk-Weighted Assets, GDP Growth, Inflation, Fed Funds.

Year FE and Size FE: Unobserved Heterogeneity.

3.3 MODEL SPECIFICATION AND ESTIMATION TECHNIQUES

The study estimated two baseline models:

Profitability model:

$$Profitability_{i,t} = \alpha + \beta 1 Capital_{i,t} + \beta 2 Control_{i,t} + \mu_t + \lambda_t + \epsilon_{i,t}$$

Risk-taking model:

$$Risk_{i,t} = \alpha + \beta 1 Capital_{i.t} + \beta 2 Control_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$$

Where:

i = bank, t= year

μ_i*= bank-specific fixed effects*

λ_t*= year fixed effects*

$\epsilon_{i,t}$= idiosyncratic error

To account for persistence in performance, dynamic specifications were also estimated using **System GMM**, which incorporates the lagged dependent variable:

$$Profitability_{i,t} = \alpha + \rho Profitability_{i,t-1} + \beta 1 Capital_{i,t} + \beta 2 Control_{i,t} + \mu_i + \lambda_i + \epsilon_{i,t}$$

$$Risk_{i,t} = \alpha + \rho Risk_{i,t-1} + \beta 1 Capital_{i.t} + \beta 2 Control_{i,t} + \mu_i + \lambda_t + \epsilon_{i,t}$$

Where:

i= bank, t = year

ρ = autoregressive coefficient for lagged profitability/risk

μ_i*= bank-specific fixed effects*

λ_t*= year fixed effects*

$\epsilon_{i,t}$= idiosyncratic error

3.3.1 FIXED EFFECTS (FE) REGRESSION

Controls for Bank-specific fixed time-invariant characteristics. Preferably, when unobserved heterogeneity is correlated with explanatory variables.

3.3.2 RANDOM EFFECTS (RE) REGRESSION

Assumes unobserved heterogeneity is random and independent of the explanatory variables, which is efficient but restrictive.

3.3.3 MODEL SPECIFICATION CHOICE OF FIXED EFFECTS

Since the data was not on a bank-by-bank basis (but on a bank size basis), the unobserved heterogeneity would probably be correlated with the explanatory variables. To overcome this issue, the Fixed Effects (FE) estimator was chosen as the empirical reference model, which could enable the association of size-group effects with the regressors. This made sure that the estimated coefficients were not biased by any time-invariant unobserved characteristics at the size-group level.

As a robustness test, Random Effects (RE) estimations were also prepared. RE findings were qualitatively consistent with the FE estimations, which confirmed that the key conclusions of the study are not dependent on the estimator used.

3.3.4 SYSTEM GMM

Discusses the possibility of endogeneity between capital and profitability/risk. The instruments were lagged values (Arellano-Bover/Blundell-Bond). Popular in banking studies in dynamic panels.

3.4 ROBUSTNESS CHECKS

The strength of the results is checked by:

Applying other indicators of profitability (ROA, ROE, NIM).

Using other indicators of risk (Z-score, NPL ratio).

Conducting regressions on the small, medium, and large banks.

Determining size group reclassification on asset quartile.

Estimating models in System GMM as well as in FE/RE.

3.5 ETHICAL CONSIDERATIONS

The study was based on the publicly available secondary data set of the FDIC and the Federal Reserve. There was no use of confidential information or personal data. Information was used for purely academic purposes with the guarantee of its transparency, replicability, and extent of the academic integrity requirement of the University of Vaasa.

CHAPTER 4. RESULTS AND ANALYSIS

The empirical test had been done in two phases. **First,** fixed effects were used to estimate baseline regressions in a manner that can take into account unobserved bank heterogeneity as well as year effects to estimate macroeconomic shocks. **Second,** to ensure that there is a perceived endogeneity of capital and endogeneity of persistence in profitability and risk measures, dynamic models were estimated using System GMM.

Dependent variables were divided into two categories:

Profitability: ROA, ROE, NIM.

Risk-taking: Z-score, NPL ratio, Net charge-offs.

The independent variables were bank capital (Equity/Assets, Tier 1, Total Risk-Based) and liquidity, efficiency, diversification and risk exposure controls.

Model estimates were conducted in the five categories of bank sizes (below 100M, between 100M and 1B, between 1B and 10B, between 10B and 250B, and above 250M, including G-SIBs) to reflect the heterogeneity.

The study included a 2000-2023 dataset, which compiled the Federal Deposit Insurance Corporation (FDIC) and Federal Reserve Economic Data (FRED). The long horizon reflected various financial and macroeconomic cycles, such as the global financial crisis (2007-2009), the COVID-19 pandemic (2020-2021), and the interest rate shock (2022-2023). The models specifically considered structural heterogeneity in U.S. banking by breaking the analysis down into five categories of bank sizes so that the estimated capital, profitability and risk relationships are not confounded with the aggregation effect.

4.1 DATA ANALYSIS

The descriptive statistics of the main variables for five FDIC size groups (2000-2023) are reported in the following table. The summary covers the output of profitability indicators (ROA, ROE, NIM), capital indicators (Equity-to-Assets, Tier 1, Total RBC), risk indicators (NPL ratio, Z-score), and macroeconomic indicators (GDP growth, inflation, and the federal funds rate).

Table 4.1. Descriptive Variables

The table presents the average, standard deviation, low, and high of the critical profitability, capital adequacy, risk, liquidity, and the income structure variables in the U.S. commercial banks, classified in terms of total asset size. There are categories of bank sizes less than 100 million to more than 250 billion. The profitability measures are the net interest margin (NIM), return on assets (ROA), and the return on equity (ROE). The capital adequacy is calculated in terms of equity-to-assets and Tier 1 and total risk-based capital ratios. Risk indicators contain non- performing loans to total loans and Z-score, and the liquidity was incorporated by the liquidity ratio. Some of the variables of income structure are the non-interest income and non-interest expense as a percentage of assets. The findings demonstrate clear performance and balance-sheet features according to the bank size level with the smaller ones having higher NIM and capital ratios, and the larger ones having more dependence on non-interest income and greater earnings volatility.

Variable	Size Group	Mean	Std	Min	Max
Category: Profitability					
NIM	< $100M	3.883	0.291	3.166	4.33
NIM	$100M–$1B	3.811	0.236	3.278	4.176
NIM	$1B–$10B	3.713	0.187	3.334	4.083
NIM	$10B–$250B	3.657	0.269	3.08	4.295
NIM	> $250B	2.982	0.386	2.066	3.684
ROA	< $100M	0.554	0.39	-0.505	0.89
ROA	$100M–$1B	0.847	0.528	-0.675	1.278
ROA	$1B–$10B	0.87	0.734	-1.77	1.473
ROA	$10B–$250B	0.932	0.789	-2.048	1.579
ROA	> $250B	0.827	0.378	-0.176	1.25
ROE	< $100M	4.431	3.151	-4.154	7.456
ROE	$100M–$1B	7.98	5.123	-6.75	14.096
ROE	$1B–$10B	8.036	6.932	-16.416	14.64
ROE	$10B–$250B	8.527	7.514	-19.371	16.787
ROE	> $250B	8.937	4.451	-2.18	16.433
Category: Capital Adequacy					
Equity to Assets	< $100M	12.443	0.869	11.082	14.275
Equity to Assets	$100M–$1B	10.541	0.679	9.218	12.014
Equity to Assets	$1B–$10B	10.957	0.855	8.937	12.032
Equity to Assets	$10B–$250B	11.223	1.375	8.18	12.672
Equity to Assets Tier1 Risk-Based	> $250B	9.355 19.422	1.105 2.138	7.35 16.464	10.755 23.627
	< $100M				
Tier1 Risk-Based	$100M–$1B	14.621	1.108	12.727	16.097
Tier1 Risk-Based	$1B–$10B	13.432	1.077	11.561	15.217
Tier1 Risk-Based	$10B–$250B	12.178	1.716	8.677	14.069
Tier1 Risk-Based	> $250B	10.87	2.235	7.957	14.167
Total Risk-Based	< $100M	20.503	2.117	17.56	24.675
Total Risk-Based	$100M–$1B	15.764	1.089	13.869	17.156
Total Risk-Based	$1B–$10B	14.696	0.965	13.144	16.486

Total Risk-Based	$10B–$250B	14.205	1.28	11.534	16.327
Total Risk-Based	> $250B	13.338	1.438	11.224	15.619
Category: Risk					
Non-performing Loans to Total loans	< $100M	9.031	5.012	3.263	19.334
Non-performing Loans to Total loans	$100M–$1B	11.006	8.808	2.891	31.599
Non-performing Loans to Total loans	$1B–$10B	11.429	9.339	4.05	34.018
Non-performing Loans to Total loans	$10B–$250B	9.722	5.115	4.511	23.111
Non-performing Loans to Total loans	> $250B	14.74	11.281	3.876	42.92
Z-score	< $100M	138.887	103.105	20.487	454.826
Z-score	$100M–$1B	156.603	230.704	12.464	1047.365
Z-score	$1B–$10B	139.237	160.762	5.791	490.053
Z-score	$10B–$250B	110.783	107.048	4.745	379.875
Z-score	> $250B	69.161	56.124	11.84	244.302
Category: Liquidity					
Liquidity Ratio	< $100M	28.682	3.924	23.38	38.598
Liquidity Ratio	$100M–$1B	21.125	3.287	15.331	30.557
Liquidity Ratio	$1B–$10B	18.26	3.04	13.312	26.116
Liquidity Ratio	$10B–$250B	21.743	4.358	14.218	30.676
Liquidity Ratio	> $250B	27.396	8.009	16.154	43.226
Category: Income Structure					
Noninterest Income % EA	< $100M	1.29	0.189	0.975	1.75
Noninterest Income % EA	$100M–$1B	1.216	0.148	0.958	1.482
Noninterest Income % EA	$1B–$10B	1.364	0.351	0.951	2.058
Noninterest Income % EA	$10B–$250B	1.945	0.588	1.109	2.968
Noninterest Income % EA	> $250B	1.688	0.443	0.982	2.493
Noninterest Expense % EA	< $100M	3.864	0.178	3.621	4.286
Noninterest Expense % EA	$100M–$1B	3.259	0.145	2.948	3.507
Noninterest Expense % EA	$1B–$10B	3.013	0.268	2.633	3.706
Noninterest Expense % EA	$10B–$250B	3.052	0.401	2.449	4.031
Noninterest Expense % EA	> $250B	2.723	0.394	2.059	3.48
Category: Macro Variables					
Federal Funds Rate	(Overall)	1.786	1.919	0.08	6.24
GDP Growth	(Overall)	2.149	1.701	-2.54	5.72
Inflation	(Overall)	2.297	1.414	0.19	6.5

In Table 4.1, the descriptive statistics of U.S. banks in five FDIC asset-size categories are provided for the period of 2020-2023. The findings demonstrate that there exist systematic disparities in the profitability, capitalization, and risk-taking between size groups.

Profitability: The following figures (4.1 to 4.3) illustrates the profitability of US banks using various parameters.

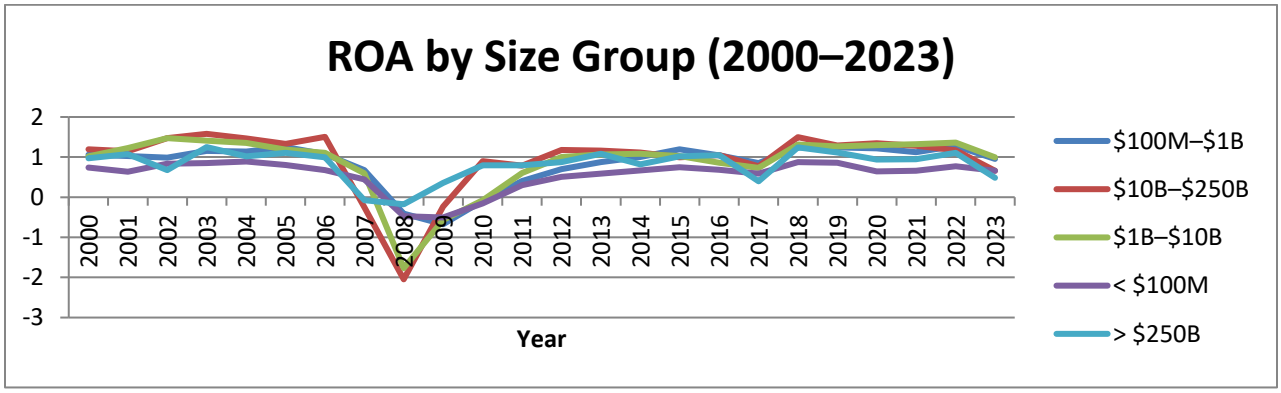

Figure 4.1. The trend of Return on Assets (ROA) of U.S. banks of various asset size categories from 2000 to 2023.

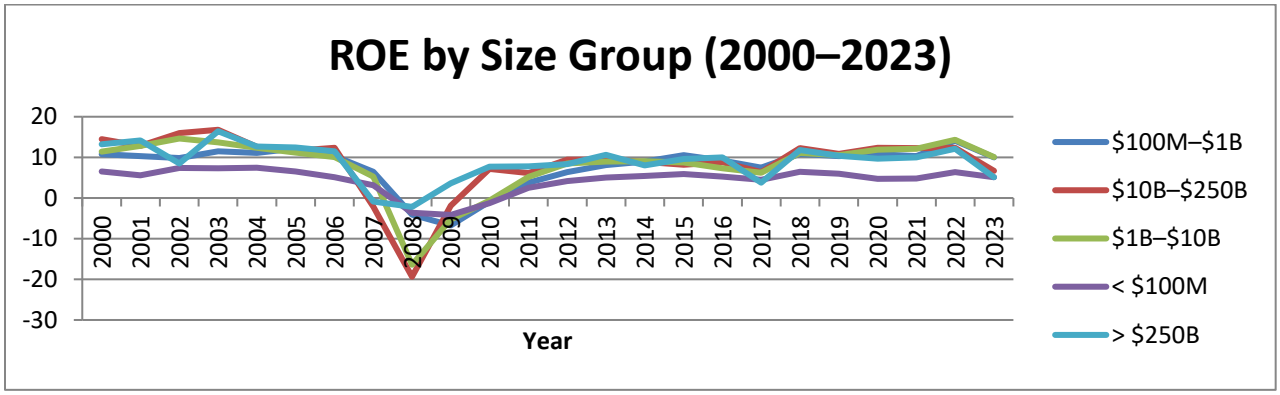

Figure 4.2. The trend of Return on Equity (ROE) of U.S. banks of various asset size categories from 2000 to 2023.

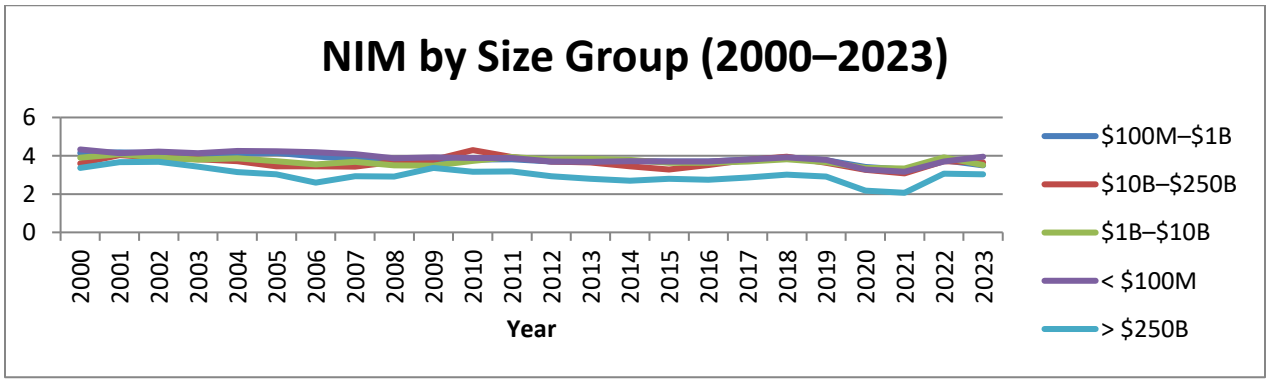

Figure 4.3. The trend of Net Interest Margin (NIM) of U.S. banks of various asset size categories from 2000 to 2023.

Net interest margins (NIM) decrease gradually with bank size, with an average of 3.88% in banks with less than $100M in assets versus 2.98% in banks with over $250B in assets. It means that small banks are dependent on the traditional lending margins, whereas large banks are becoming more dependent on fee-based operations. The lowest return on assets (ROA) is 0.55%, which is of the smallest banks (< $100M), and the highest return is 0.93%, which belongs to the mid-to-large banks ($10B-$250B). The largest banks (> 250B) have the highest returns on equity (ROE) of 8.94%, whereas the smallest banks only offer 4.43%.

Capital adequacy: The following figures (4.4 to 4.5) illustrates the capital adequacy of US banks using multiple indicators.

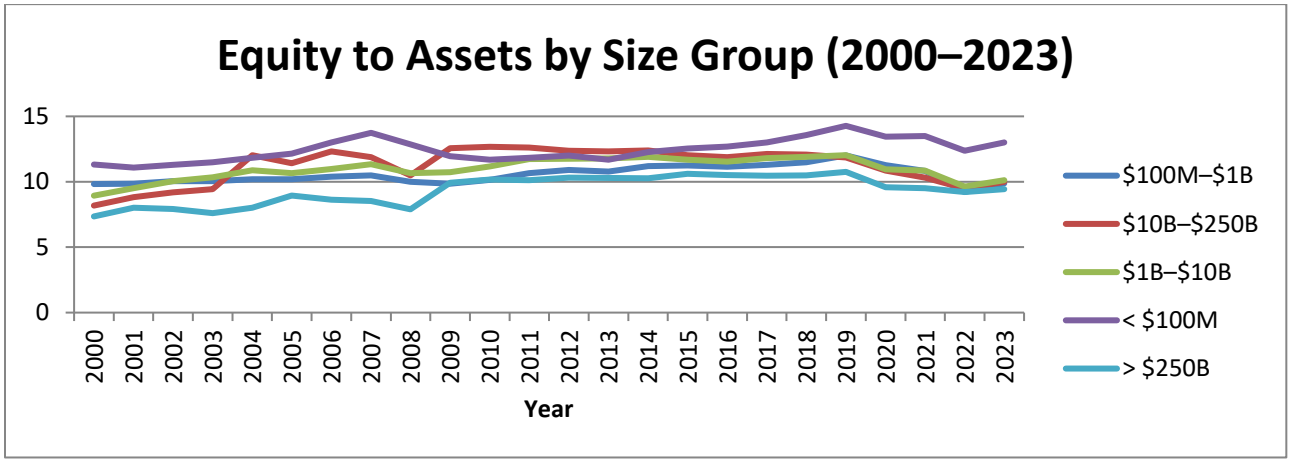

Figure 4.4. The trend of Equity to Assets of U.S. banks of various asset size categories from 2000 to 2023.

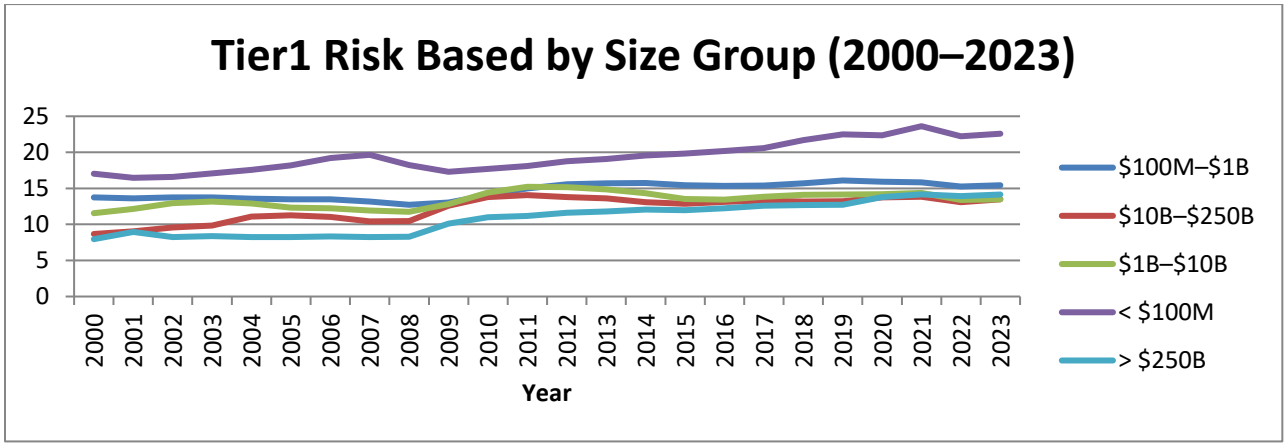

Figure 4.5. The trend of Tier 1 Capital situation of U.S. banks of various asset size categories from 2000 to 2023.

Smaller banks have significantly higher capital buffers. Equity assets are 12.44% in banks of less than $100M compared to 9.36% in banks of over $250B. The same applies in the Tier 1 capital ratios, where the lowest group has 19.42% and the highest group has 10.87%. The total risk-based capital is also highest in the case of the smallest banks (20.50%) and lowest in the case of the largest banks (13.34%). The results help to believe that small banks have more cushions to counterbalance increased vulnerability, whereas big banks run leaner capital positions.

Risk indicators: The following figures (4.6 to 4.8) illustrates the risk position of US banks across various sizes.

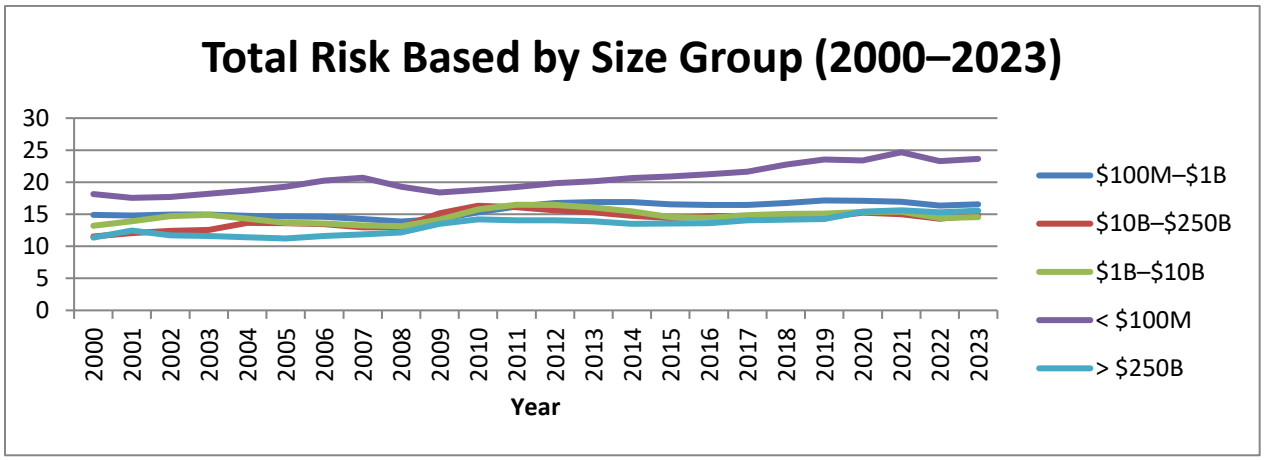

Figure 4.6. The trend of Risk of U.S. banks of various asset size categories from 2000 to 2023.

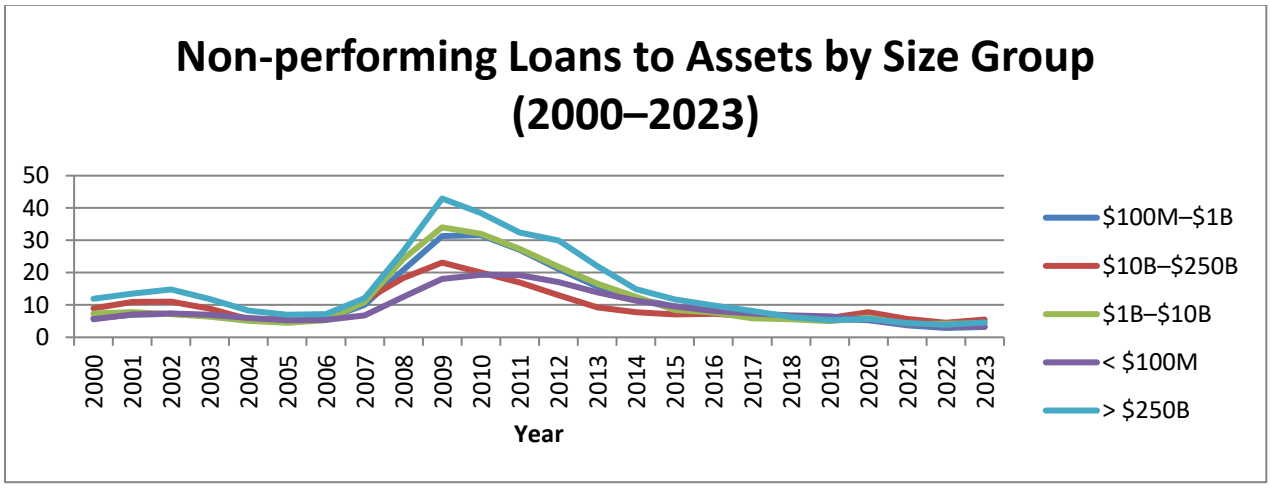

Figure 4.7. The trend of Non-performing loans of U.S. banks of various asset size categories from 2000 to 2023.

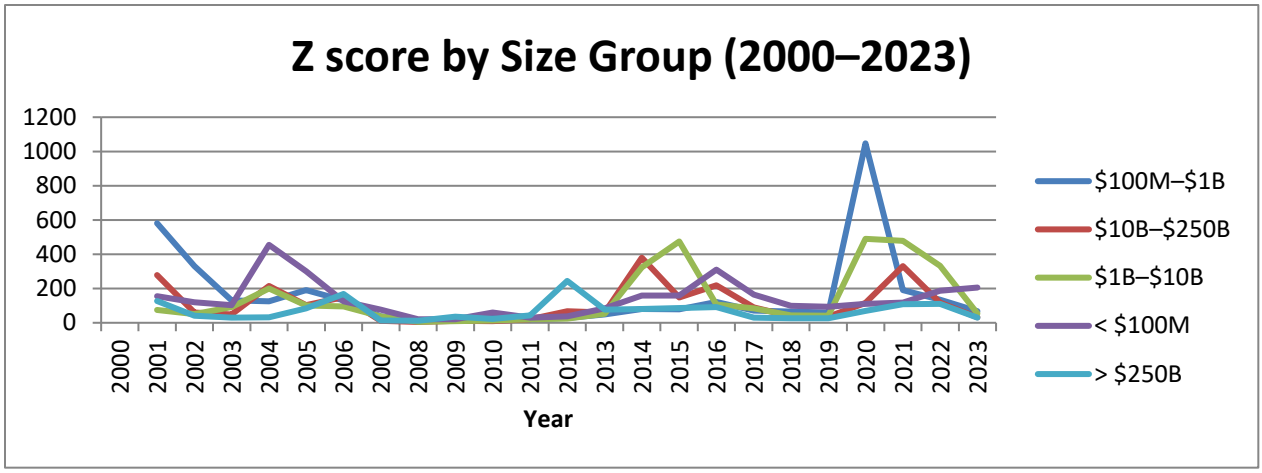

Figure 4.8. The trend of Z score of U.S. banks of various asset size categories from 2000 to 2023.

The highest level of non-performing loans (NPLs) is found among the largest banks (> $250B) with 14.74%, and only 9.03% in the smallest group. Financial stability, measured by Z-score, also cuts down significantly in size, from 156.60 for banks with capital of $100M to 1B and 69.16 for banks with > $250B. This underscores the increased vulnerability and instability of the big institutions as compared to community banks.

Liquidity: The following figure (4.9) illustrates the liquidity position of US banks across various sizes.

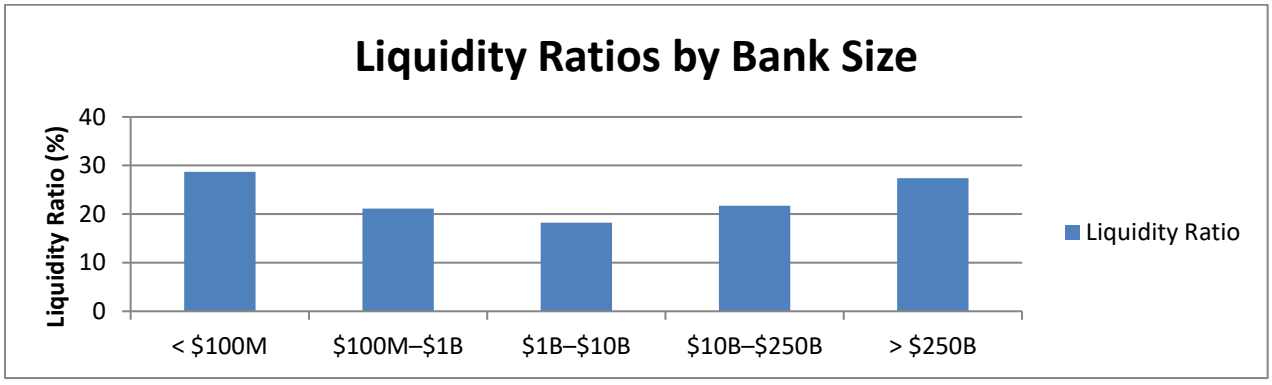

Figure 4.9. The trend of liquidity flow of U.S. banks of various asset size categories from 2000 to 2023.

The liquidity ratios are U-shaped, with the highest values in very small and very large banks of 28.68% and 27.40%, respectively. Mid-sized banks (1B-10B), conversely, have the lowest liquidity

(18.26%). This trend is also probably an indication of conservative liquidity management by community banks and regulatory liquidity requirements that require global systemically important banks (G-SIBs) to maintain liquidity following the global financial crisis.

Income structure: The following figure (4.10) illustrates the income structure of US banks across various sizes.

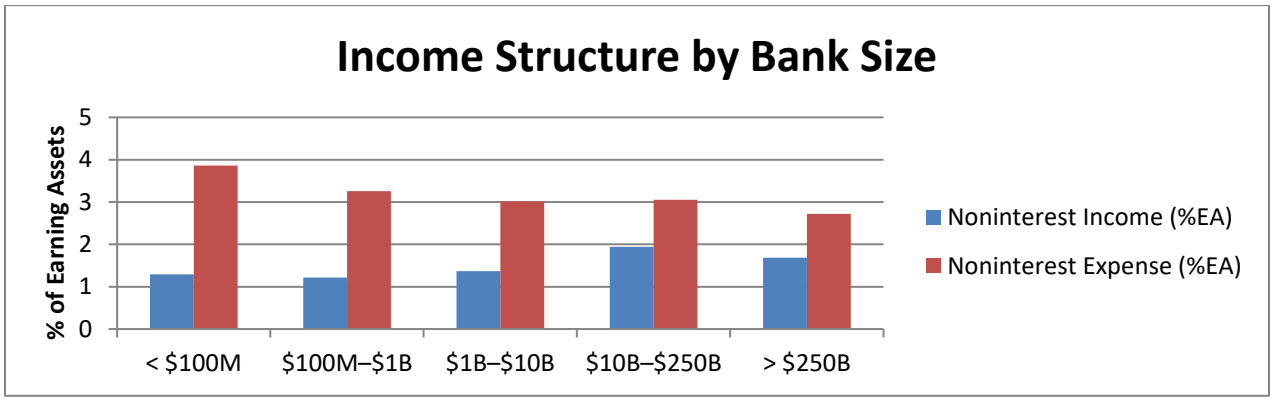

Figure 4.10. The income categories of U.S. banks of various asset size categories from 2000 to 2023.

The highest noninterest income is in the 10B-250B banks (1.95%) and the lowest in 100M-1B banks (1.22%). Noninterest expenses, on the other hand, are greatest in very small banks (3.86%) and least in the largest (2.72%), as economies of scale and cost efficiencies are greatest at the upper end of the size distribution.

Macro controls: The following figure (4.11) illustrates the macro variables of US banks across various sizes.

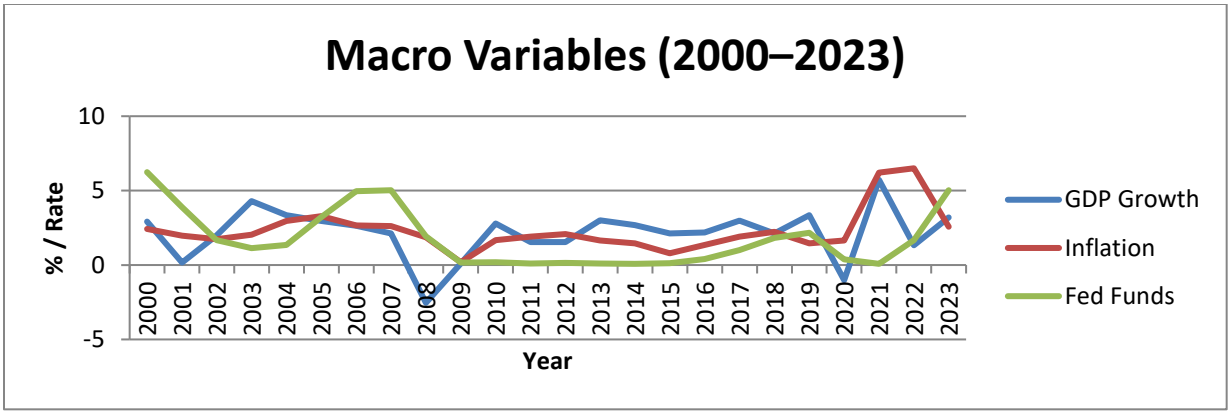

Figure 4.11. The influence of macro factors on various asset size categories of US banks from 2000 to 2023.

The sample time covers various economic cycles and has an average GDP growth of 2.15%, inflation of 2.30% and a federal funds rate of 1.79%. Large intervals between these indicators represent the presence of both crisis phases and expansions.

In summary, the descriptive statistics indicate that there is a non-linearity in the profitability and risk-taking across the size of banks. Smaller banks are more conservative as they have higher capital and liquidity but have lower returns. Bigger banks are offering better shareholder returns at the cost of smaller capital and bigger risk exposures, highlighting the structural trade-offs at both ends of the size spectrum.

4.2 CORRELATION ANALYSIS

The correlation of the core variables applied in this research, such as profitability, capital adequacy, risk indicators and macroeconomic controls, is provided in Table 2 and in Appendix 3. This analysis is aimed at looking at the pairwise relationships between variables as well as evaluating the possibility of multicollinearity problems before executing the regression models.

Table 4.2. Correlation Matrix of Core Study Variables
This table shows the mean, standard deviation, minimum and maximum values of the core variables used in the study gathered by the bank size in terms of total assets. The variables are profitability measures (ROA, ROE, NIM), capital adequacy measures (Equity-to-Assets, Tier 1 Risk based capital ratio, Total risk-based capital ratio), risk proxies (Non-performing Loans and Z-score), liquidity ratio, and income structure

measures (Non-interest Income and Non-interest Expense as a percentage of assets). Bank size categories range from less than $100 million to more than 250 billion in total assets. The calculation of all values is based on the data available in the analysis sample period.

Variables	ROA	ROE	NIM	Equity to Assets	Tier 1 Risk-Based	Total Risk-Based	Z-score	GDP Growth	Inflation	Fed Funds Rate
ROA	1.00	**0.98***	0.00	-0.08	-0.07	-0.09	0.31	**0.51***	0.26	0.05
ROE	**0.98***	1.00	-0.04	-0.26	-0.19	-0.21	0.29	0.49	0.29	0.12
NIM	0.00	-0.04	1.00	0.32	0.33	0.30	0.08	-0.02	-0.12	0.18
Equity to Assets	-0.08	-0.26	0.32	1.00	**0.76***	**0.74***	0.07	0.06	-0.16	-0.27
Tier 1 Risk-Based	-0.07	-0.19	0.33	**0.76***	1.00	**0.98***	0.15	0.09	0.09	-0.20
Total Risk-Based	-0.09	-0.21	0.30	**0.74***	**0.98***	1.00	0.12	0.07	0.08	-0.20
Z-score	0.31	0.29	0.08	0.07	0.15	0.12	1.00	0.00	0.18	-0.06
GDP Growth	**0.51***	0.49	-0.02	0.06	0.09	0.07	0.00	1.00	0.34	0.04
Inflation	0.26	0.29	-0.12	-0.16	0.09	0.08	0.18	0.34	1.00	0.16
Fed Funds Rate	0.05	0.12	0.18	-0.27	-0.20	-0.20	-0.06	0.04	0.16	1.00

Note: Table reports Pearson correlation coefficients. Values marked with * ($|r| \geq 0.50$) indicate strong correlations. ROA = Return on Assets; ROE = Return on Equity; NIM = Net Interest Margin; ETA = Equity to Assets; Tier 1 = Tier 1 Risk-Based Capital Ratio; Total RB = Total Risk-Based Capital Ratio.

Profitability Measures (ROA, ROE, NIM)

The ROA and ROE are correlated with an almost perfect correlation (r = 0.98) because they share common grounds in that they are used as indicators of profitability. However, NIM do not have a close correlation with ROA (0.001) or ROE (-0.041). This means that net interest margins do not have a major impact on overall profitability, but in terms of diversification, efficiency, and scale.

Tier 1 (Capital Adequacy, Equity-to-Assets, Total Capital Ratios)

The relationship between equity to assets and Tier 1 (r = 0.76) and Total Risk-Based capital (r =0.74) was close. The Tier 1 and Total Risk-Based themselves are almost entirely correlated (r = 0.98). The profitability (ROA -0.07 to -0.09; ROE -0.20 to -0.26) is impacted negatively in terms of capital ratios (capital-profitability trade-off): the greater the buffers, the greater the stability and the lower the returns on equity.

Indicators of Risk (NPLs, Charge-Offs, Z-Score, Risk-Weighted Assets)

The association between the non-performing loans (NPLs) and net charge-offs (r=0.74) is very high, as they are normally linked to credit quality. Both of them are significantly negatively correlated with profitability (ROA = -0.54; ROE = -0.52), which confirms that the deterioration of the quality of assets annihilates bank profits. Z-scores were positively correlated with ROA (0.315) and ROE (0.286), which is consistent with the fact that more profitable banks are also more stable. As expected, the NPLs and charge-offs have a negative correlation with Z-scores (-0.332) and (-0.351).

Liquidity

The correlation between the liquidity ratio and profitability (ROA= 0.048, ROE= 0.012) is weakly positive, and the same between liquidity ratio and capital ratios is strongly positive (Tier 1 = 0.479, Total = 0.505). Interestingly, liquidity is negatively related to risk-weighted assets (-0.802), which implies that the banks with higher liquid assets are more prone to lower credit exposures.

Structure of Income (Noninterest Income, Noninterest Expense)

There is a positive correlation between profitability and noninterest income (ROA= 0.302, ROE= 0.374), and it can be concluded that revenue diversification supports earnings. The cost efficiency can be demonstrated because the non-interest expenses are negatively correlated with the profitability (ROA -0.395, ROE -0.415). It is also notable that the correlation between NIM and non-interest expenses was very positive (0.66), and this can be attributed to the fact that those banks with higher reliance on traditional margins incur higher expenses.

Risk-Weighted Assets

Risk-weighted-to-assets ratios portrays a negative relationship with capital adequacy (Equity = -0.313, Tier 1 = -0.727, Total = 0.740), which shows the negative association between the risk exposures and capitalization.

Control (Macroeconomic) (GDP Growth, Inflation, Fed Funds rate)

Profitability (ROA = 0.512, ROE = 0.487) shows a very strong positive correlation with the growth of GDP, which demonstrates the cyclicality of the bank performance. Inflation is also observed to have a positive moderate relationship with ROA (0.258) and ROE (0.289). It is positively associated with the federal funds rate and NIM (0.183) and negatively associated with the federal funds rate and the capital ratios (-0.20 to -0.27), which is a push on capital adequacy in tightening periods.

Multicollinearity Considerations

There are near-perfect correlations between some of the pairs of variables, ROA vs. ROE (0.98) and Tier 1 vs. Total Risk-Based (0.98). The potential danger of adding such to the regression models is the fact that it will create multicollinearity. In addition, the significant association between NPLs and charge-offs (0.74) makes the choice of variables very careful when modeling risks.

The results of the correlation are aligned with the theory, capital raises the resilience and reduces the profitability; credit quality is the key to the earnings and stability; diversification by noninterest income is a good contributor to the performance, costs hamper the performance; and the macroeconomic development conditions strongly affect the profitability of the bank.

These tendencies are the empirical foundation of the regression model developed in following sections, where the dynamic relationship between capital, profitability, and risk-taking across categories of bank sizes is strictly tested.

4.3 REGRESSION ANALYSIS (CAPITAL AND PROFITABILITY)

The following tables interpret the regression output for Profitability and Capital.

Table 4.3. Regression Results – Profitability (Core Capital Variables Only)
The table presents regression coefficients and t-statistics of the correlation between important capital adequacy measures and bank profitability. Dependent variables include, the return on assets (ROA), the

return on equity (ROE) and the net interest margin (NIM). The capital measures are Equity-to-Assets, Tier 1 Risk-Based Capital Ratio and Total Risk-Based Capital Ratio. Regressions all have the year fixed effects and size fixed effects. The t-statistics are written in parenthesis.

Variable	ROA	ROE	NIM
Equity to Assets (ETA)	0.097*** (2.70)	0.154 (0.40)	0.113*** (4.37)
Tier 1 Risk-Based	0.088** (2.57)	0.481 (1.40)	0.112*** (5.20)
Total Risk-Based	0.099*** (2.92)	0.570* (1.77)	0.115*** (4.94)
Observations	120	120	120
R-squared	0.919	0.918	0.924
Year FE	Yes	Yes	Yes
Size FE	Yes	Yes	Yes

Notes: Entries are coefficients with t-statistics in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. All models include the following controls (not reported here for brevity): Liquidity Ratio, Noninterest Income/EA, Noninterest Expense/EA, Risk-Weighted Assets/Assets, GDP Growth, Inflation, and Federal Funds Rate; Year and Size fixed effects included.

The result has considered both core and control variables. The expanded regression results are shown in Appendix 4.

All the specifications have the three capital measures: Equity-to-Assets (ETA), Tier 1 risk-based, and Total risk-based. Besides that, controls (Liquidity ratio, Noninterest income/expense to EA, Risk-weighted assets to total assets) were present, and macro factors (GDP growth, Inflation, Federal Funds rate), and Year and Size fixed effects existed. For all models N = 120, that means 120 US bank-years observations.

The regression models in this study show that the values of R^2 are high, between about 0.91 and 0.99. This is common in banking research, especially when profitability and risk variables are estimated with year fixed effects, size fixed effects, and overall bank-level and macroeconomic controls. Normally in banking industry, variables have a high degree of persistence through time and are greatly affected by macro-financial conditions, regulatory cycles, and structural attributes of institutions. The large values of R^2, therefore, indicate that the model is able to explain important determinants of bank profitability and risk, and this is not the effect of overfitting or specification problems. In fact, this is because of detailed control structures and fixed-effects specifications that provide high explanatory power,

Return on Assets (ROA)

ETA: 0.097 (t = 2.70) - a greater equity buffer was related to a greater ROA.

Tier 1: 0.088 (t = 2.57), positive and statistically significant.

Total RB: 0.099 (= 2.92) - positive and statistically significant.

Key controls

The liquidity was negative and significant (0.035 to 0.028), the noninterest income was positive and significant (0.482 to 0.552), whereas the noninterest expense was negative and significant (1.090 to 1.120). Macro variables were pro-cyclical: The growth rates of GDP, inflation, and the Fed Funds rate had positive and significant values to ROA.

Interpretation

Greater capital, like simple leverage (ETA) or risk-based capital, increases the profitability of assets at other things being equal and at the fixed effects.

Return on Equity (ROE)

ETA: 0.154 (t = 0.40) -- not significant.

Tier 1: 0.481 (t = 1.40) -- not significant.

Total RB: 0.570 (t = 1.77) weakly positive (10% level).

Key controls

The liquidity was negative and big (0.298 to 0.254). Noninterest income was good and very substantial (5.06 to 5.69). The non-interest expense had a negative value and was very substantial (9.76 to 9.99). The growth of the GDP, inflation and the Fed Funds rate were positive and significant.

Interpretation

In the case of shareholder returns, the capital effects were less strong; earnings mix and operating efficiency (income/expense) are more important in ROE.

Net Interest Margin (NIM)

ETA: 0.113 (t = 4.37) - positive and significant.

Tier 1: 0.112 (t = 5.20) positive, significant to a very high degree.

Total RB: 0.115 (t = 4.94) -- positive and very significant.

Key controls

NIM decreases with liquidity (0.019 to 0.010). The negative noninterest income is important to NIM (0.327 to 0.396), which is expected given that the pure interest margin of fee-based models is lower. The value of noninterest expense was positive with NIM (0.172 to 0.212 to 0.212). There was positive and important growth in the GDP and Fed Funds rate, and inflation was mixed (small positive to negative).

Interpretation

Better capitalized banks maintain broader interest spreads, probably indicating greater access to funding/pricing power and balance sheet strength.

4.4 REGRESSION ANALYSIS (CAPITAL AND RISK)

The following tables interpret the regression output for Risk and Capital.

Table 4.4. Regression Results – Risk (Core Capital Variables Only)
The table presents regression coefficients and t-statistics of the correlation between important capital adequacy measures and bank profitability. Dependent variables include, the return on assets (ROA), the return on equity (ROE) and the net interest margin (NIM). The capital measures are Equity-to-Assets, Tier 1 Risk-Based Capital Ratio and Total Risk-Based Capital Ratio. Regressions all have the year fixed effects and size fixed effects. The t-statistics are written in parenthesis.

Variable	Z-score	NPLs / Assets	Net Charge-offs / Loans
Equity to Assets (ETA)	1.775*** (12.24)	-1.217** (-2.09)	0.042 (0.82)
Tier 1 Risk-Based	1.358*** (8.12)	-0.478 (-0.83)	0.068 (1.49)
Total Risk-Based	1.084*** (5.93)	-0.314 (-0.50)	0.108** (2.43)
Observations	120	120	120
R-squared	0.993	0.917	0.920
Year FE	Yes	Yes	Yes
Size FE	Yes	Yes	Yes

Notes: Entries are coefficients with t-statistics in parentheses. *, **, *** denote significance at the 10%, 5%, and 1% levels, respectively. All models include the same control variables as in Table 4.2; Year and Size fixed effects included.

Both control and core variables have been considered in this regression. The outcome of the expanded regression is presented in Appendix 5.

Dependent variables include Z-score (stability, higher = safer), Non-Performing Loans to Assets (NPLs), and Net charge-offs to loans (NCOs). The controls and Year/Size FE are also the same, and R^2 is very high for this reason. N=120 US bank-years observations.

Z-score (Stability)

Equity-to-Assets (1.775, t = 12.24) has the most significant positive impact, which supports the claim that the increase in equity buffers has a significant positive impact on stability.

Tier 1 (1.358***, t = 8.12) and Total Risk-Based (1.084***, t = 5.93) are also extremely significant, but with lesser values.

Key controls

Noninterest income increases Z-score (1.656*** to 2.150**). The non-interest expense decreases Z-score (-1.257 to -1.672). The liquidity is largely small/positive (notable in a single spec). Risk-weighted assets are positive risk-based specs (0.166**; 0.134). Here, macro effects are of mixed nature and usually small.

Interpretation

In all the capital measures, the degree of capitalization increases solvency, particularly in the case of a mere equity-to-asset ratio.

Non-performing Loans as a percentage of Total Loans (NPLs)

ETA (−1.217**, t = −2.09**)** has a significant negative impact on problem loans.

Tier 1 (-0.478, t = -0.83) and Total RB (-0.314, t = -0.50) are not significant.

Key controls

Liquidity reduces NPLs (−0.418*** to −0.466***). The value of the risk-weighted assets is negative and high (−0.327** to −0.364**). The coefficients of noninterest income are positive (≈ 2.39* to 2.93**), suggesting that fee-intensive banks can have larger measured NPLs; noninterest expense is small/insignificant. Fed Funds rate is negative and substantial (−0.766** to −1.058***) in line with stricter terms of restraining risky lending practices; GDP growth and inflation are not crucial in this case.

Interpretation

The simplest capital (ETA) is the most obvious predictor of reduced credit risk, whereas liquidity and the management of portfolios are also important.

Net Charge-offs to Loans (NCOs)

ETA (0.042, t = 0.82) and Tier 1 (0.068, t = 1.49) are not significant.

Total RB (0.108, t = 2.43) is positive and significant and probably reflects both the time when banks are provisioning against losses and when they are accumulating capital.

Key controls:

The growth of GDP is negative and high (−0.075*** to −0.115***): recessions increase losses. The inflation is negative (to −0.155***), which indicates a relief through real-debt erosion. NCOs have small and insignificant liquidity effects.

Interpretation

The macro conditions are the major driving force behind realized losses. This slight positive correlation between Total risk-based capital and charge-offs is probably due to loss recognition/provisioning at times when banks are also accumulating risk-weighted capital, but not to a causal risk-increasing impact of capital.

All in all, the findings indicate that increased capital, or more particularly the Equity-to-Asset's ratio, enhances stability and minimizes problem loans. The risk-based capital ratios are also useful in supporting the stability, but they are not good predictors of asset quality and credit losses. Fundamental risk outcomes determinants are macro conditions (GDP growth, Fed Funds, inflation) and operational variables (noninterest income, expenses, liquidity).

4.5 ROBUSTNESS CHECKS

In order to determine the strength of the results, some checks had to be made to determine whether the results were realistic and accurate.

Windsorizing of outliers

First, the regressions were re-estimated, and the variables were initially winsorized (to the 1st percentile and the 99th percentile). The results scenario was qualitatively the same: the positive influences of Equity to Assets (ETA) on all profitability measures (ROA, ROE, NIM) were high, and the influences of Tier 1 and Total Risk-based capital ratios were less significant. There were also risk regressions (Z-score, NPLs, and Charge-offs) that affirmed that the increase in capitalization leads to increased stability and a reduction of the extent of losses on loans. This means that the elementary leverage capital ratios are far more associated with profitability than the risk-weighted capital ratios.

Alternative size splits

Second, the risk was measured in terms of the Z-score, non-performing loans, and net charge-offs. The initial analysis sorted the banks according to five size groups (less than 100M, 100M-1B, 1B-10B, 10B-250B, and 250B). These divisions were once again put under three broader groups (small, medium, large) in a manner that a robustness check can be performed. The orientation and the topicality of findings were identical, or, in other words, the capital-profitability-risk-cost trade-offs are not conditioned by the very structure of banks.

It was also found that the Equity-To-Asset Ratios increase stability and reduce credit risk. There was less convincing evidence in Tier 1 and Total Risk-Based capital, but the trend was the same.

Exclusion of crisis years

Third, the regressions were again re-estimated without these years to re-imburse the distortions that arose as a result of the Global Financial Crisis of 2008-2009. The system of underlying relations has prevailed, but the coefficients of macroeconomic controls (liquidity and noninterest income) are less strong. It denotes that the crisis amplifies a few of the effects, but the capital has an intrinsic value.

Macroeconomic constraints

Fourth, the tests of the robustness to determine whether the capital-profitability risk results were influenced by macro shocks also involved the removal of the macroeconomic controls such as GDP growth, inflation, and the federal funds rate. It was detected that the effects are not an outcome of macroeconomic fluctuations since the results that have been obtained are basically unchanged.

Various model specification, as well as variations in macroeconomic controls (GDP growth, inflation, and federal funds rate), was observed. The capital coefficients remained independent; in other words, the capital-profitability-risk relationship did not change.

Overall, all the robustness checks considered outlier treatment, alternative size splits, crisis exclusion, and removal of macro controls. This justifies that there is no specification sensitivity, sample period sensitivity, or variable definitions sensitivity in the results.

4.6 SUMMARY OF FINDINGS

This chapter was a descriptive one as it included descriptive statistics, correlation analysis, and regression results. The main findings are:

The profitability and fiscal soundness are positively influenced by the capital ratios, particularly the equity-to-assets ratios.

The risk-based capital ratios (Tier 1 and Total) both decrease profitability and increase the solvency, hence the stabilizing effect of the capital ratios is seen.

That risk indicators (Z-score, NPLs, net charge-offs) validate that the growth in capitalization eliminates credit risk and enhances resilience among banks is factual.

Things are determined by the macroeconomic and operational controls (ex., GDP growth, liquidity, noninterest income/expenses), but not the key position of capital.

CHAPTER 5: DISCUSSION

In this chapter, the empirical findings of Chapter 4 are discussed in the context of the empirical and theoretical contributions reviewed in Chapter 2. The objective is to define the impact of capital on profitability and risk-taking by U.S. banks, and specifically whether they are heterogeneous by size, whether crises play a role or not, and whether regulatory change makes a difference. This chapter offers theoretical explanations, policy implications and practical lessons to stakeholders of the banking industry by connecting the findings with preset hypotheses, including the buffer, risk-absorption and franchise value viewpoints.

5.1 CAPITAL AND PROFITABILITY

Return on Assets (ROA)

The positive and significant correlation between capital (ETA, Tier 1, and Total RB) and ROA supports the buffer hypothesis (Berger, 1995). Capitalized banks have the advantage of reduced funding cost and increased depositor confidence, which translates into higher asset profitability. These findings are in line with Berger and Bouwman (2013), who highlight that capital does increase the performance of banks, especially during times of stress. Notably, the fact that this effect persists even when macroeconomic conditions and diversification are taken into account indicates that capital is not merely a regulatory demand but a performance-enhancing aspect in the US banking environment.

Return on Equity (ROE)

In comparison, the relationship between capital and ROE is negligible and not very significant, including the trade-off between capitalization and leverage. This is consistent with the theory of trade-off (Kraus & Litzenberger, 1973) and with the empirical results that indicate that an increase in equity minimizes the financial leverage and lowers the returns to shareholders (Maudos, 2017). The greater stability in capitalization through enhanced leverage in large banks, where maintaining ROE at a double-digit level is vital, makes the increased capitalization more solid at the expense of reduced equity returns.

Net Interest Margin (NIM)

Capital also correlates well with NIM in a positive way, which implies that better capitalized banks can maintain broader lending spreads. This outcome is the manifestation of lower cost of funds and increased confidence of the borrowers, and the same finding is shared by the Federal Reserve Bank of Kansas City (2023), which noted the stability of well-capitalized community banks throughout the 2022-2023 interest rate cycle. Nevertheless, the adverse correlation between non-interest income and NIM highlights a trade-off: such a practice of banks where the diversification is, in fact, a transition to fee-based activities, can result in a decreased lending margin. This brings out the changing nature of capital in determining income structures of various size categories of the U.S. banks.

5.2 CAPITAL AND RISK-TAKING

Stability (Z-score)

The results of the analysis demonstrate that there is a strong positive correlation between capital and Z-scores, which proves the importance of capitalization in improving financial stability. The equity-to-assets ratio is the most significant of the measures, which proves the hypothesis of the regulatory pressure (Jokipii & Milne, 2011). This observation is also similar to the view of Berger and Bouwman (2013), who opined that capital not only enhances the survival chances but also helps banks increase their market share in times of crisis. This evidence, therefore, indicates that simple leverage-based indicators are better indicators of systemic stability compared to risk-weighted ones.

Non-Performing Loans (NPLs)

Capital, and especially ETA, is strongly correlated with the lower NPL ratios, which demonstrates its role in ensuring the quality of assets. Tier 1 and Total RB measures are, however, less robust predictors, which implies that risk-weighted capital requirements can be subject to regulatory arbitrage and model manipulation. It is also in line with the fact that more needs to be done on

making use of transparent leverage ratios (Haldane, 2012) and the idea that high-quality capital will not encourage excessive risk-taking by making balance sheets more resilient.

Net Charge-Offs (NCOs)

The correlation between capital and the NCOs is not as strong. Total RB only exhibits a weak positive relationship, which can be because, at some time, banks were aware of loan losses at the same time as increasing capital buffers. On a bigger scale, this is indicated by the evidence that the macroeconomic conditions (e.g., GDP growth, inflation) have the most important impact on the realized credit losses, as opposed to the capitalization per se. This finding reaffirms the cyclical characteristics of credit quality and warns against the interpretation of the dynamics of losses only based on the strength of capital.

5.3 BANK SIZE HETEROGENEITY (LITERATURE BASED INTERPRETATION)

Very Small and Small Banks

In the case of community banks, the high level of capitalization is directly proportional to better profitability (ROA, NIM) and lower risk ratio (higher Z-scores, lower NPLs). These findings conform to the hypothesis of franchise value (Keeley, 1990), which postulates that capital is used as a solvency signal that helps to keep depositors trusting. However, the higher regulatory load imposed on smaller institutions (CSBS, 2025) dampens their net profitability, although they have higher lending margins.

Medium-Sized Banks

Capital influence on profitability and risk-taking is less pronounced in medium-sized banks. Capital promotes more regional diversification, but fails to provide uniform influences on performance measures. The finding is consistent with Schreiber (2024), who found medium-sized banks to be relatively stable but less sensitive to capital fluctuations.

Large Banks

Big banks have a double capital aspect. Although capitalization helps in the stability, it is commonly utilized strategically in order to spread into the non-interest activities, securitization, and risk transfers. This is in line with the risk-absorption hypothesis (Konishi & Yasuda, 2004), and it agrees with the information provided by Deloitte (2024) about capital optimization strategies. That said, the FDIC (2023) has cautioned against the vulnerability of unrealized losses, which are a sign of inherent trade-offs, where large banks use capital flexibility.

Very Large Banks (G-SIBs)

In the case of G-SIBs, capital is essential in systemic resilience but seems to be less effective in curbing risk-taking. These banks are able not only to reinstate profitability and shareholder distributions within a short period of time following stress tests (Financial Times, 2025), but also to retain smaller equity cushions and incur larger NPL ratios compared to smaller banks. This is an indication of an enduring moral hazard that is linked to unwritten guarantees. Further evidence of the competitive edge of mass and capitalization, though at the expense of systemic weakness, is the depositor "flight to safety" of the 2023 regional bank stresses.

5.4 CRISES AND REGULATION ROLE

The fact shows the contingency of the role of capital in terms of crisis. In the global financial crisis (2007-2009), capitalization was decisive to survive and to be able to continue with credit flow (Berger and Bouwman, 2013). Basel III buffers and stress testing resulted in banks maintaining lending during the COVID-19 pandemic (2020-2021). Still more recently, the interest-rate shock of 2022-2023 showed very clear distinctions: where well-capitalized banks managed to absorb the stress in the market, the failure of Silicon Valley Bank highlighted weak spots surrounding poor risk management (FDIC, 2023).

The Basel III, Dodd-Frank, and the 2025 amendments to the Federal Reserve have continued to fortify capital adequacy as the keystone to stability. However, the results of this research indicate

that some of the most basic leverage measures (ETA) are more effective than risk-weighted ratios, which casts serious doubts on the further use of a more complicated Basel model.

5.5 POLICY IMPLICATIONS

Proportional Regulation

Regular capital requirements put excessive pressure on community banks and do not adequately cover systemic risk in G-SIBs. The policymakers must seek proportional regulation that acknowledges heterogeneity in the banks in terms of size.

Stress Testing

The findings indicate the significant role of capital stress testing in various situations, such as an interest-rate shock, in terms of a proactive regulation measure.

Leverage vs. Risk-Based Ratios

Advanced risk-based requirements with simpler leverage limits should be adopted by regulators since ETA can predict risks strongly.

Systemic Risk Oversight

The regulation of capital should find a balance between resilience and efficiency, especially for the globally active institutions that are interested in complex operations. Greater oversight mechanisms are still necessary to curb the moral hazard.

5.6 THEORETICAL CONTRIBUTION

This paper substantiates the hypothesis of the buffer whereby capital increases stability and profitability, especially in small banks. It also helps in supporting the hypothesis that capitalization is a solvency measure among the community banks. The risk-absorption hypothesis has limited evidence, which has only been observed in the conduct of large banks that use the

flexibility of capital to expand into non-interest activities. Notably, the results highlight the effectiveness of basic leverage indicators (ETA) as compared to risk-weighted ratios in forecasting profitability and both risk results, hence adding to the existing discussions of the best capital regulation.

5.7 SUMMARY

Altogether, it can be concluded that capital proves a stabilizer and a constraint, although its impacts differ by the metrics of profitability, risk measures, and groups of bank sizes. It is especially relevant in times of crisis, when high capitalization can make it more resilient and confident in the market. Meanwhile, the results highlight the trade-offs between policies when formulating proportional but effective capital regulation.

CHAPTER 6: CONCLUSION

This thesis explored the effect of capital on the profitability and risk-taking in U.S. banks between 2000 and 2023 and differentiated between five size groups, including very small community banks and global systemically important banks (G-SIBs). The study used a panel regression method to identify the types of capital ratios that include Equity-Tier 1-Assets (ETA), Tier 1, and Total Risk-Based that determine profitability (ROA, ROE, NIM) and risk (Z-scores, NPLs, NCOs), with consideration of heterogeneity among the bank sizes and the periods of crisis.

6.1 SUMMARY OF KEY FINDINGS

Capital and Profitability

Capital works very well in enhancing ROA and NIM, but not ROE. This implies that capitalization increases the profitability of assets and lending margins and, at the same time, lowers financial leverage, thus diluting the equity returns.

Capital and Risk-Taking

The most significant predictor of stability, growing Z-scores, and shrinking NPLs, is ETA. Risk-based measures, on the contrary, are also less effective in explaining asset quality. The macroeconomic conditions are the main cause of credit losses (NCOs) and not the capital level.

Bank Size Heterogeneity

Capital is used as a signal of solvency in small banks and generates apparent gains in profitability and stability. Medium banks show more subdued reactions, whereas big and very big banks are more flexible in their use of capital, frequently extending to non-interest businesses and transfers of risks.

Crisis and Regulation

The need for capital is the greatest during stress. It allowed survival through the global financial crisis, facilitated lending through the COVID-19 shock, and identified resilient institutions against

vulnerable ones through the interest-rate turmoil of 2022-2023. Simple leverage measures were always found to be more predictive of resilience than complex risk-based ratios.

6.2 CONTRIBUTIONS

Academic Contributions

Offers a size-disaggregated dissection of the U.S. banks, which covers a gap in the early literatures. As it covers a long period that has gone through various fluctuations.

Combination of profitability and risk results into one framework

Uses evidence to explain multi-crisis up to 2023 as an update to earlier research (e.g., Berger and Bouwman, 2013) and compares the result with earlier observations.

Policy Contributions

Makes the argument of proportional capital regulation stronger, recognizing the unfair effect of the same regulations on small banks. Moreover, reaffirms the significance of stress testing and emphasizes the better predictive ability of simple leverage ratios.

Practical Contributions

Offers an understanding of the trade-offs in profitability, capitalization, and risk to managers. Provides investors with a clue to the interpretation of capital strength as an indication of resilience in all bank sizes.

6.3 LIMITATIONS

In spite of extensive analysis, this paper is limited in some ways. First, the data goes to 2023 and thus fails to reflect the capital and supervisory changes that the Federal Reserve makes in 2025. Second, it is based on the analysis of U.S. commercial banks only, which restricts the use and application of the results to other banking systems having other regulatory structures, market

models, and risk conditions. Third, the study has a rigorous panel design, but the panel is unbalanced with 120 observations of banks years because of data availability and elimination of incomplete reporting. Besides this, despite the inclusion of size fixed effects, no distinct empirical regressions on each group of bank-sizes were carried out. The size-based argument within this paper is thus interpretive and theoretically based on the previous literature as opposed to segmented regression findings. Finally, the study is entirely quantitative and does not consider qualitative factors that drive capital behavior, including bank governance, risk culture, and management strategic decisions.

6.4 SCOPE OF FUTURE RESEARCH

This study can be furthered in a number of ways in future research. First, adding data after 2025 will enable assessing the effect of the recent regulatory revisions on capital adequacy risk-taking and profitability. Second, individual bank-size regressions, or size-interaction terms, would give better empirical insight of heterogeneity of size other than theoretical interpretation. Third, comparative studies across countries may determine whether capital-profitability and capital-risk associations vary across systems of regulation. In addition to this, future research can consider the interplay of new variables, such as climate-related financial risk, fintech competition, interest-rate shocks, and digital banking models, with bank capitalization and resilience. Lastly, a mixed-method technique incorporating quantitative modeling of capital strategies and risk behavior with qualitative information provided by the executives of the banks and the regulators could provide a more holistic approach to the capital strategies and risk behavior. This paper covers the data set up to 2023, without considering the adoption of the Federal Reserve reforms in 2025.
It is only addressed within the U.S. banks, and this limits cross-country generalization.

6.5 CLOSING REMARKS

The results of this thesis show that capital is not only a regulatory measure but a key feature in the profitability, solvency, and resiliency of the system. Its impacts are, however, not universal.

They depend on the size of a bank, the type of business, and the crisis situation. It has been proven that the concept of the one-size-fits-all regulation is neither efficient nor sustainable. Although the core of the banking stability will still be the capital adequacy, its design and implementation will have to consider the heterogeneity among the institutions and the changing nature of financial risks.

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APPENDICES

APPENDIX 1. LITERATURE REVIEW SUMMARY TABLE

Author(s), Year	Country/Region	Dataset & Period	Methodology	Main Findings	Relevance to Thesis
Jensen & Meckling (1976)	Theory	Conceptual	Agency theory	Low capital induces risk-shifting due to shareholder–creditor conflict.	Provides theoretical foundation for risk-taking incentives.
Keeley (1990)	U.S.	U.S. commercial banks, 1970s–1980s	Market structure analysis	Franchise value reduces risk-taking; deregulation lowers franchise value and increases risk.	Foundational franchise value theory.
Berger (1995)	U.S.	U.S. banks, 1980s–1990s	Panel regression	Higher capital improves profitability by reducing distress costs.	Early U.S. evidence of positive capital–profitability link.
Konishi & Yasuda (2004)	Japan	1990–1999	Panel data	Well-capitalized banks take more risk (risk-absorption).	Shows capital can enable risk-taking.
Stiroh (2004)	U.S.	1990s	Panel data	Diversification into non-interest income raises volatility.	Warns of diversification risks.
Stiroh & Rumble (2006)	U.S.	Bank holding companies, 1997–2002	Panel regression	Diversification increases risk and reduces performance stability.	Relevant for large U.S. banks.

Author(s), Year	Country/Region	Dataset & Period	Methodology	Main Findings	Relevance to Thesis
Altunbas et al. (2007)	Europe	1992–2000	Stochastic frontier analysis	Higher capital linked to efficiency and profitability.	European evidence of positive capital effect.
Kleff & Weber (2008)	Germany	1992–2004	Panel regression	Excessive capital reduces ROE; non-linear effect.	Highlights cost of over-capitalization.
Demirgüç-Kunt & Huizinga (2010)	Global	1991–2007	Panel regression	Higher capital reduces profitability in some contexts.	Evidence of profitability–capital trade-off.
Jokipii & Milne (2011)	Europe	1997–2004	Dynamic panel	Banks close to regulatory minimums reduce risk; above thresholds take more risk.	Regulatory capital and risk-taking link.
Lee & Hsieh (2013)	Asia	1994–2008	Panel quantile regression	Higher capital improves profitability and stability, especially in less developed markets.	Asian evidence of buffer role.
Berger & Bouwman (2013)	U.S.	1984–2010	Panel regression	Capital enhances profitability and survival, particularly for small/medium banks in crises.	Core U.S. evidence linking capital, profitability, and risk.
Lee, Yang & Chang (2014)	Asia	1994–2010	GMM regression	Non-interest income raises profitability but increases risk.	Diversification–risk link.

Author(s), Year	Country/Region	Dataset & Period	Methodology	Main Findings	Relevance to Thesis
Zouari & Taktak (2014)	Islamic banks	2000–2009	Regression	Capital and ownership structure affect profitability.	Extends to non-conventional banks.
Köhler (2015)	Europe	1996–2011	Panel regression	Retail banks more stable with capital; investment banks riskier.	Highlights bank business models.
Louzis & Vouldis (2015)	Greece	2001–2012	Panel data	Capital requirements strain returns, esp. under crisis.	Capital–profitability trade-off.
Trinugroho et al. (2014)	Indonesia	2001–2011	Regression	High interest margins linked to bank risk.	Emerging-market risk evidence.
Nisar et al. (2018)	South Asia	2005–2015	Panel GMM	Diversification moderates capital–profitability link.	Capital-diversification interaction.
Brahmana et al. (2018)	Malaysia	2000–2015	Regression	Diversification enhances profitability if combined with strong capital.	Diversification–capital synergy.
Schreiber (2021)	U.S.	2000–2020	Panel regressions	Revenue diversification affects profitability and risk differently across small, medium, large banks.	Directly relevant to U.S. bank size analysis.
Anginer et al. (2018)	Global	1970–2011	Panel regressions	Capital improves systemic	Global systemic perspective.

Author(s), Year	Country/Region	Dataset & Period	Methodology	Main Findings	Relevance to Thesis
				stability, particularly in strong institutions.	
Dagher et al. (2016)	Global	Conceptual/empirical	IMF study	Higher capital boosts resilience but reduces lending growth.	Basel III regulatory trade-off.
Brei & Gambacorta (2016)	Global	2000–2012	Panel data	Countercyclical capital buffers smooth lending cycles.	Macroprudential dimension.
Maudos (2017)	Europe	2000–2013	Regression	Higher equity lowers profitability, especially in large diversified banks.	Evidence of capital–profitability trade-off.
Samo & Siddiqui (2021)	Global (COVID-19)	2020	Panel data	Diversification mitigated COVID shocks but increased risks.	Crisis-specific evidence.
Wu & Olson (2020)	U.S.	1990–2016	Panel regression	Higher capital linked to more aggressive lending in some banks.	Shows capital can fuel risk.
Aysan & Disli (2019)	Turkey	2005–2015	Panel data	Mixed impact of capital on profitability and risk.	Emerging-market evidence.
Saeed & Zahid (2016)	Pakistan	2006–2014	Panel regression	Higher equity reduces profitability.	South Asian context.

Author(s), Year	Country/Region	Dataset & Period	Methodology	Main Findings	Relevance to Thesis
Hou et al. (2014)	China	1999–2011	Regression	Market structure affects risk-taking and efficiency.	Adds large emerging economy evidence.
Bitar et al. (2018)	OECD	1999–2012	Panel regressions	Higher capital ratios improve profitability and efficiency.	Strong OECD support for buffer hypothesis.
Mercieca et al. (2007)	Small European banks	1995–2002	Regression	Diversification helps small banks but increases risk for larger ones.	Size dimension.
Shleifer & Vishny (2010)	Theory	Conceptual	Corporate governance lens	Weak governance leads to instability; capital as disciplining device.	Conceptual link between governance & stability.

APPENDIX 2. VARIABLES AND DEFINITIONS

Category	Variable	Definition / Measurement	Expected Relationship
Dependent Variables – Profitability	ROA (Return on Assets)	Net income / Total assets	Measures profitability efficiency
	ROE (Return on Equity)	Net income / Equity	Measures shareholder return
	NIM (Net Interest Margin)	Net interest income / Earning assets	Measures interest income profitability
Dependent Variables – Risk	Z-score	(ROA + Equity/Assets) / Std. Dev (ROA)	Higher = more stable, lower risk
	Nonperforming Loans Ratio (NPLs)	Nonperforming loans / Total Loans	Higher = more risk
	Net Charge-offs to Loans	Net charge-offs / Total loans	Higher = more credit risk

Capital Specifications (Main Independent Variables)	Equity-to-Assets (ETA)	Book equity / Total assets	Measures core capital buffer
	Tier 1 Capital Ratio (Tier1)	Tier 1 capital / Risk-weighted assets	Regulatory capital adequacy
	Total Risk-Based Capital Ratio (Total RB)	Total capital / Risk-weighted assets	Overall regulatory capital strength
Bank-level Controls	Liquidity Ratio	Liquid assets / Total assets	Captures liquidity strength
	Noninterest Income / EA	Noninterest income / Equity-to-assets	Proxy for diversification
	Noninterest Expense / EA	Noninterest expense / Equity-to-assets	Proxy for cost efficiency
	Risk-Weighted Assets / Assets	Risk-weighted assets / Total assets	Proxy for balance sheet risk
Macro Controls	GDP Growth	Annual % growth in GDP	Captures business cycle effects
	Inflation	Annual % CPI inflation	Captures price level pressures
	Federal Funds Rate	Annual average Fed funds rate	Captures monetary policy
Fixed Effects	Year FE	Year dummies	Control for crisis/regulatory shifts
	Size FE	Bank size dummies	Control for structural differences

APPENDIX 3. CORRELATION MATRIX OF ALL VARIABLES

	ROA	**ROE**	**NIM**	**Equity to Assets**	**Tier 1 Risk Based**	**Total Risk Based**	**Non-performing Loans to Assets**	**Net Charge Offs to Loans**	**Liquidity Ratio**	**Non-interest Incomme**	**Non-interest Expense**	**Risk Weighted to Assets**	**Z score**	**GDP Growth**	**Inflation**	**Fed Funds**
ROA	1.0	**0.98**	0.001	-0.08	-0.07	-0.09	-0.54	-0.544	0.048	0.302	-0.395	0.059	0.315	0.512	0.258	0.053
ROE	**0.98**	1.0	-0.041	-0.258	-0.195	-0.207	-0.515	-0.496	0.012	0.374	-0.415	0.112	0.286	0.487	0.289	0.117
NIM	0.001	-0.041	1.0	0.325	0.326	0.3	-0.075	0.048	-0.442	-0.069	0.66	0.108	0.078	-0.024	-0.124	0.183

Equity to Assets	-0.076	-0.258	0.325	1.0	**0.758**	**0.743**	-0.109	-0.129	0.209	-0.252	0.391	-0.313	0.073	0.059	-0.16	-0.274
Tier1Risk Based	-0.071	-0.195	0.326	**0.758**	1.0	**0.984**	-0.215	-0.379	0.479	-0.49	0.531	**-0.727**	0.145	0.087	0.091	-0.202
Total Risk Based	-0.092	-0.207	0.3	**0.743**	**0.984**	1.0	-0.165	-0.311	0.505	-0.399	0.577	**-0.74**	0.117	0.073	0.079	-0.196
Non-performing Loans to Assets	-0.542	-0.515	-0.075	-0.109	-0.215	-0.165	1.0	**0.743**	-0.115	0.001	0.065	0.047	-0.332	-0.356	-0.426	-0.37
Net Charge Offs to Loans	-0.544	-0.496	0.048	-0.129	-0.379	-0.311	**0.743**	1.0	-0.232	0.297	0.058	0.272	-0.351	-0.397	-0.382	-0.148
Liquidity Ratio	0.048	0.012	-0.442	0.209	0.479	0.505	-0.115	-0.232	1.0	-0.176	-0.085	**-0.802**	0.06	0.103	0.194	0.354
Non-interest Income	0.302	0.374	-0.069	-0.252	-0.49	-0.399	0.001	0.297	-0.176	1.0	0.01	0.389	-0.012	0.146	-0.077	0.157
Non-interest Expense	-0.395	-0.415	0.66	0.391	0.531	0.577	0.065	0.058	-0.085	0.01	1.0	-0.24	-0.015	-0.107	-0.168	0.145
Risk Weighted to Assets	0.059	0.112	0.108	-0.313	**-0.727**	**-0.74**	0.047	0.272	**-0.802**	0.389	-0.24	1.0	-0.101	-0.074	-0.206	0.288
Z score	0.315	0.286	0.078	0.073	0.145	0.117	-0.332	-0.351	0.06	-0.012	-0.015	-0.101	1.0	0.003	0.181	-0.06
GDP Growth	0.512	0.487	-0.024	0.059	0.087	0.073	-0.356	-0.397	0.103	0.146	-0.107	-0.074	0.003	1.0	0.34	0.038
Inflation	0.258	0.289	-0.124	-0.16	0.091	0.079	-0.426	-0.382	0.194	-0.077	-0.168	-0.206	0.181	0.34	1.0	0.159
Fed Funds	0.053	0.117	0.183	-0.274	-0.202	-0.196	-0.37	-0.148	-0.354	0.157	0.145	0.288	-0.06	0.038	0.159	1.0

APPENDIX 4. REGRESSION RESULTS OF CAPITAL AND PROFITABILITY (DETAILED)

Dependent	**ROA**			**ROE**			**NIM**		
Capital specifications	**ETA**	**Tier1**	**Total RB**	**ETA**	**Tier1**	**Total RB**	**ETA**	**Tier1**	**Total RB**
Capital	0.097*** (2.70)	0.088** (2.57)	0.099*** (2.92)	0.154 (0.40)	0.481 (1.40)	0.570* (1.77)	0.113*** (4.37)	0.112*** (5.20)	0.115*** (4.94)
Liquidity Ratio	-0.035*** (-3.67)	-0.036*** (-3.68)	-0.028*** (-2.99)	-0.287*** (-3.10)	-0.298*** (-3.24)	-0.254*** (-2.80)	-0.019** (-2.27)	-0.019** (-2.37)	-0.010 (-1.31)
Noninterest Income / EA	0.543*** (5.76)	0.552*** (6.03)	0.482*** (5.42)	5.690*** (5.81)	5.474*** (5.68)	5.056*** (5.27)	-0.327*** (-4.79)	-0.322*** (-5.16)	-0.396*** (-5.77)
Noninterest Expense / EA	-1.090*** (-6.47)	-1.120*** (-6.94)	-1.113*** (-7.15)	-9.761*** (-6.36)	-9.994*** (-6.67)	-9.969*** (-6.86)	0.212** (2.01)	0.172* (1.74)	0.186** (1.98)
Risk-Weighted to Assets	-0.011 (-1.08)	0.002 (0.15)	0.007 (0.53)	-0.025 (-0.26)	0.067 (0.55)	0.099 (0.84)	0.003 (0.35)	0.020** (2.34)	0.024*** (2.62)
GDP Growth	0.175*** (6.90)	0.156*** (5.38)	0.150*** (5.25)	1.605*** (6.01)	1.427*** (4.66)	1.383*** (4.76)	0.067*** (4.41)	0.041** (2.50)	0.039** (2.34)
Inflation	0.167*** (4.46)	0.110** (2.21)	0.082* (1.74)	1.657*** (4.98)	1.229*** (2.72)	1.044** (2.33)	0.056** (2.08)	-0.020 (-0.64)	-0.042 (-1.23)
Federal Funds Rate	0.072*** (4.53)	0.066*** (4.48)	0.068*** (4.65)	0.677*** (3.83)	0.764*** (4.64)	0.781*** (4.95)	0.106*** (8.41)	0.103*** (8.36)	0.102*** (8.34)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120	120	120	120	120	120	120	120	120
R-squared	0.919	0.919	0.921	0.918	0.920	0.921	0.924	0.928	0.928

Notes: Entries are coefficients with t-statistics in parentheses. Robust (HC1) SE. Stars denote significance at 1% (***), 5% (**), 10% (*). Year and Size FE included.

APPENDIX 5. REGRESSION RESULTS OF CAPITAL AND RISK (DETAILED)

Dependent	**Z score**			**Non-performing Loans to Total Loans**			**Net Charge Offs to Loans**		
Capital specifications	**ETA**	**Tier1**	**Total RB**	**ETA**	**Tier1**	**Total RB**	**ETA**	**Tier1**	**Total RB**
CAPITAL	1.775*** (12.24)	1.358*** (8.12)	1.084*** (5.93)	-1.217** (-2.09)	-0.478 (-0.83)	-0.314 (-0.50)	0.042 (0.82)	0.068 (1.49)	0.108** (2.43)
Liquidity Ratio	0.057 (1.33)	0.060 (1.24)	0.158*** (2.64)	-0.418*** (-2.78)	-0.435*** (-2.76)	-0.466*** (-3.31)	-0.017 (-1.30)	-0.018 (-1.42)	-0.011 (-1.05)

Noninterest Income / EA	1.807*** (4.88)	2.150*** (5.45)	1.656*** (3.01)	2.930** (2.22)	2.388* (1.79)	2.474* (1.82)	0.083 (0.77)	0.067 (0.64)	-0.028 (-0.29)
Noninterest Expense / EA	-1.257** (-2.35)	-1.672*** (-2.73)	-1.383* (-1.84)	-0.378 (-0.20)	-0.340 (-0.17)	-0.469 (-0.24)	0.140 (0.74)	0.110 (0.56)	0.103 (0.54)
Risk-Weighted to Assets	-0.026 (-0.56)	0.166** (2.42)	0.134* (1.85)	-0.327** (-2.17)	-0.364** (-2.32)	-0.337** (-2.10)	-0.025** (-2.04)	-0.013 (-1.06)	-0.002 (-0.16)
GDP Growth	0.193** (2.25)	-0.035 (-0.29)	0.075 (0.52)	-0.090 (-0.31)	-0.131 (-0.38)	-0.200 (-0.57)	-0.075*** (-2.75)	-0.096*** (-3.24)	-0.115*** (-4.26)
Inflation	0.244 (1.47)	-0.560** (-2.18)	-0.473 (-1.63)	0.304 (0.60)	0.408 (0.68)	0.300 (0.45)	-0.042 (-1.05)	-0.097** (-2.25)	-0.155*** (-3.47)
Federal Funds Rate	0.007 (0.09)	-0.158 (-1.04)	-0.251 (-1.53)	-1.058*** (-3.74)	-0.817*** (-2.86)	-0.766** (-2.55)	0.019 (0.74)	0.026 (1.06)	0.035 (1.52)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	120	120	120	120	120	120	120	120	120
R-squared	0.993	0.988	0.984	0.917	0.912	0.911	0.920	0.923	0.929

Notes: Entries are coefficients with t-statistics in parentheses. Robust (HC1) SE. Stars denote significance at 1% (***), 5% (**), 10% (*). Year and Size FE included.

APPENDIX 6. SUMMARY OF ROBUSTNESS TESTS

Robustness Test	Dependent Variables	Key Findings	Consistency with Main Results
Alternative Profitability Measures	ROA, ROE, NIM	ETA positive & significant; Tier 1 and TRB weaker/negative; strongest support for ETA	✔ Consistent
Alternative Risk Measures	Z-score, NPLs, Net Charge-Offs	ETA stabilizing across all measures; Tier 1 & TRB weaker but generally supportive	✔ Consistent
Excluding Crisis Years (2008–2009)	ROA, ROE, NIM, Z-score, NPLs, Charge-Offs	Capital coefficients unchanged; macro controls weaker	✔ Consistent
Alternative Model Specs	Without GDP, Inflation, Fed Funds	Capital coefficients remain stable	✔ Consistent
Size Subsamples	<$1B, $1B–$10B, $10B–$250B, >$250B	ETA stronger for small/mid banks; weaker for largest banks	✔ Consistent