**Addis Ababa University**

**College of Business and Economics**

**Department of Economics**

# The Determinants of Banking System Stability in Ethiopia: A Panel Regression Analysis

A thesis submitted to the College of Business and Economics of Addis Ababa University in partial fulfillment for the Degree of Master of Science in Financial Economics

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**June 15, 2024**

# Declaration

I, undersigned, declare that this thesis entitled "The Determinants of Banking System Stability in Ethiopia: A Panel Regression Analysis" is my own and original work and has not been presented for a degree in any other university, and that all sources of material used for the thesis have been duly acknowledged, following the scientific guidelines of the institute.

Declared by:

Name: Yitayal Demissie

Date: June 15, 2024

Signature:------------

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**COLLEAGE OF BUSINESS AND ECONOMICS**

This is to certify that the thesis prepared **by Yitayal Demissie** entitled **The Determinants of Banking System Stability in Ethiopia: A Panel Regression Analysis** and submitted in Partial Fulfilment of the Requirements for the Degree of Masters of Science in Economics (Financial Economics) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

**Signed by the Examining Committee:**

1. Supervisor Gebeyehu ---------- Signature ---------- Date 16/08/2024
2. Internal Examiner Atlaw Alemu ---------- Signature ---------- Date 16/08/2024.
3. External Examiner ---------------------- Signature --------------- Date--------------------

Acknowledgment

First and foremost, I would like thanks to the almighty God for granting me the strength, wisdom, and perseverance. I would also like to extend my deepest gratitude and appreciation to my thesis advisor, **Dr. Gebeyehu Manie** of Addis Ababa University, for his invaluable guidance, support, and encouragement throughout this journey. His expertise and patience have been instrumental in shaping my understanding of the subject matter and refining my research skills. I am truly fortunate to have had such a dedicated and inspiring mentor.

I would also like to extend my heartfelt thanks to my friends and colleagues who have supported me during this journey. The countless hours spent brainstorming ideas, reviewing drafts, and providing constructive criticism have significantly contributed to the overall improvement of this thesis.

Thank you

Yitayal Demissie

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# Abstract

*Research on the factors influencing stability of banks has shown that both external and bank-specific factors have impacts on banks' financial stability. Nevertheless, the majority of the studies were carried out in industrialized countries, where banks typically have greater wealth and greater fluidity than banks in developing countries have. This thesis investigates the determinants of banks system stability in Ethiopia through a panel regression analysis encompassing 16 commercial banks for the time period 2015 to 2023. The thesis employed the Generalized Method of Moments (GMM) regression technique to address endogeneity concerns, specifically unobserved heterogeneity. The results show that prior year's banks stability positively affects the current year's stability, suggesting persistence in banks performance. Equity-to-asset ratio (ETA) shows a negative impact on banks stability, indicating that higher efficiency values from previous periods may lead to current volatility. Return on equity (ROE) demonstrates an inverse relationship with banks stability, suggesting that historically high profitability may lead to future instability. Additionally, increased mobilized share capital and economic growth positively correlate with banks stability, indicating that higher capital buffers and favorable economic conditions enhance financial stability. These findings provide valuable insights for policymakers and bank management.*

***Keywords: Bank Stability, GMM, Z-Score, Ethiopia***

# Acronyms and Abbreviations

ADF: Augmented Dickey-Fuller

BCBS: Basel Committee on Banking Supervision

BIS: Bank for International Settlements

CAR: Capital Adequacy Ratio

ETA:  Equity-To-Asset Ratio

FSB: Financial Stability Board

FSS:  Financial System Soundness

GDP: Gross Domestic Product

GMM:  Generalized Method of Moments

IMF: International monetary fund

IPS:  Im-Pesaran-Shin

KPSS:  Kwiatkowski-Phillips-Schmidt-Shin

LDR: Total Loans / Total Deposits

LTA: Loans to Assets Ratio

MOB: Market share of Mobilized Capital

ROA: Return on Assets

ROE: Return on Equity

LLP: Loan Loss Provisions

LLC: Levin-Lin-Chu

MENA: The Middle East and North Africa region

NPL: Non-Performing Loans

WDI: World Development Indicators

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# CHAPTER ONE

# 1. INTRODUCTION

## 1.1 Background of the study

The complex narrative of the stability of the banking system takes place in the context of developing financial institutions and a deep recognition of the crucial role that financial stability plays. Formal banking institutions as we know them today originated in medieval Europe. In the field of economics, banks are key players that serve as essential middlemen that facilitate the smooth transfer of funds between savers and borrowers. This orchestration, in its broadest sense, plays a major role in the optimal allocation of capital within an economy (Werner, 2016). Within modern economies, the banking sector is depicted as the fulcrum, intricately linking various financial activities.

The oscillations of banking systems throughout history are documented by crises and panics, which are frequently brought on by regulatory failures, unethical financial practices, or downturns in the economy. A poignant example is the United States' Panic of 1907, which acted as a stimulus for the Federal Reserve System's formation in 1913. The 1930s Great Depression exposed the banking industry's weaknesses, which led to international banking reforms, deposit insurance programs and more regulatory measures designed to bolster stability and prevent future crises (Posner, 2011).

Banks across boundaries experienced a surge in financial globalization in the second half of the 20th century. Although this promoted global investment and trade, it also brought up new difficulties for cross-border financial stability and regulatory coordination. The worldwide monetary system that emerged after World War II was established by the Bretton Woods Conference in 1944, which also brought in organizations like the worldwide Monetary Fund (IMF), whose mission is to advance global economic stability, particularly the stability of banking systems. In the middle of the 20th century, central banks came to play crucial roles. They began to regulate banks, enact monetary policy, and act as lenders of last resort (Staples & Sayward 2006). Established in 1974, the Basel Committee on Banking Supervision was instrumental in developing international standards, such as Basel I in 1988, which offered guidance to strengthen the stability and resilience of banking systems globally. To further enhance the stability of banks and the larger financial system in the wake of the Global

Financial Crisis, continuous regulatory reforms, such as Basel III, were implemented (Sironi, 2018).

Determining and assessing the stability of banks is still difficult. No one definition has been agreed upon by regulatory agencies and researchers (Swamy, 2014). Furthermore, there is no agreed-upon method for assessing banking or financial stability (Segoviano & Goodhart, 2009). Academics highlight the relationship between the real economy, financial stability, and banking stability (Swamy, 2014). A banking system's capacity to remain stable depends on each bank's profitability, liquidity, asset quality, and capital sufficiency. According to the Financial Stability Board (2016), a stable banking system is one that can survive shocks to the financial system and keep performing its essential tasks, which include issuing credit, facilitating payments, and fostering general economic development. As well as a stable banking system promotes public confidence in financial institutions and guarantees the efficient flow of credit throughout the economy.

Principle-based and theoretically-based stability measures are the two grounds of measures covered by the review of stability measures. The liquidity coverage ratio (LCR), which gauges a bank's capacity to fulfill short-term financing demands, and the capital adequacy ratio (CAR), which guarantees banks have enough capital to sustain losses, are two examples of principle-based and theoretically-based stability measurement. In order to create the bank stability index, Karim and AlHabshi (2017) used the two bases of measurement: z-score, CAMELS indicators: capital adequacy, asset quality, management quality, earnings ability, and liquidity (Ibid), and measures from the central bank's activities. A bank's general health and risk management procedures are the main topics of principle-based measurements, as opposed to typical bank stability assessments, which only include quantitative statistics. This method provides a more thorough assessment by focusing on the "why" behind a bank's financial performance IMF, (2018). Principle-based metrics evaluate a bank's resilience to financial shocks and compliance with good banking practices. They go beyond the mere "what" that conventional capital adequacy, liquidity, and profitability measurements "reflect." Regulators can obtain a more comprehensive understanding of a bank's risk management framework by concentrating on the guiding principles of the institution.

The Financial System Soundness with abbreviation (FSS) is one of the few indicators used by the International Monetary Fund (IMF) to assess financial soundness and vulnerability. The five main components of a bank are represented by the CAMELS indicators (Ibid). However, it has been expanded to incorporate the sixth component, "S," making the CAMEL approach the CAMELS approach, which also takes the bank's susceptibility to market fluctuations into account (IBID). This "S" represents the market's susceptibility to factors like inflation, interest rate, and foreign exchange risk, which together represent the system risk.

The Z-score is a popular theoretical framework for evaluating bank stability because of its ease of use and efficiency. Based on a bank's financial statements, this metric provides a quantitative indication of the likelihood that the bank may experience financial hardship (Boyd & Graham, 1986). The Z-score is an extension of Altman's Z-score, which was first created to forecast business bankruptcy. In order to get a single composite score, it combines profitability, solvency, and liquidity ratios. While a lower score denotes a larger danger of insolvency, a higher Z-score often indicates a reduced possibility of bank collapse.

Evaluation of a banking system's stability necessitates a multifaceted approach that extends beyond a single indicator. The Basel Committee on Banking Supervision BIS (2019) has identified a number of indicators that together give a more complete view of a bank's health and resilience to financial shocks. Measures of core capital sufficiency, such the Tier 1 Capital Ratio, are crucial for determining how well a bank can withstand losses. In difficult times, a robust capital buffer guarantees solvency and safeguards depositors BIS (2019). Metrics related to asset quality, such as the Non-Performing Loans (NPL) Ratio, provide insight into how risky a bank's loan portfolio is. A stronger portfolio with a lower chance of defaults is indicated by lower NPL ratios (Teklay, 2019).

Liquidity is another crucial aspect of stability. Liquidity ratios, such as the Loan-to-Deposit Ratio, measure a bank's ability to meet its short-term obligations. A balanced ratio ensures sufficient funds are readily available to cover withdrawals and maintain day-to-day operations. Profitability metrics like Return on Equity (ROE) also play a role. Consistent profitability allows banks to generate capital internally, further bolstering their financial resilience. Beyond these core indicators, a bank's sensitivity to market risks should also be considered. Vulnerability to fluctuations in interest rates, exchange rates, and other market factors can significantly impact stability. Finally, strong corporate governance practices are essential. Effective oversight by the board of directors, robust risk management strategies, and sound internal controls contribute significantly to a bank's long-term stability

In developed economies, non-banking financial institutions (e.g. investment funds, pension funds, private equity funds, brokerage houses) play a significant role in financial stability. In developing countries, where stock exchanges, investment funds, pension funds, and insurance companies are underdeveloped and investments rely on traditional bank loans, banks are the primary pillars of financial stability {Popovska, 2014).

The state-owned Commercial Bank of Ethiopia (CBE) as the country's central bank. Private banks were added to the CBE during the financial sector's liberalization in the 1990s, bringing competition and diversity to the banking sector (Geda A., et al., 2017). Following the financial sector's liberalization, Ethiopia strengthened its regulatory structure, which led to the implementation of risk-based supervision in the early 2000s. It is clear that Ethiopia is committed to bringing its banking and financial systems into compliance with international norms, as advised by organizations such as the Basel Committee on Banking Supervision. Ethiopia's financial industry has remained stable due to financial inclusion measures. However, the country faces challenges in managing credit risk, ensuring liquidity, and preventing financial crimes. To address these issues, continuous changes are made to strengthen the banking sector's stability. The banking industry is crucial for Ethiopia's economic growth, as it helps allocate resources, facilitates investments, and promotes growth. This study aims to understand the factors influencing the stability of the Ethiopian banking sector between 2010 and 2022 using panel regression analysis of sixteen commercial banks.

We seek to find patterns, correlations, and causalities that affect the stability of Ethiopia's banking industry by looking at a variety of macroeconomic and banking data. Furthermore, to handle possible endogeneity problems, we apply the Generalized Method of Moments (GMM) regression approach. This study goes beyond scholarly investigation. The results are intended to give policymakers, regulators, and financial institutions useful information with which to develop well-informed plans that would strengthen the financial environment in Ethiopia. Future economic success in Ethiopia will depend on a more robust and active banking sector.

## 1.2. Statement of the problem

A sound financial system and economic expansion are predicated on a stable banking sector. A stable banking sector serves as the bedrock for a sound financial system and, consequently, fuels economic expansion (Financial Stability Board, 2016). Banks act as the intermediaries between savers and borrowers, channeling funds from those with excess capital to those seeking investment opportunities. When the banking sector is stable, it fosters public confidence in financial institutions. This translates to a willingness to deposit savings and access credit at reasonable rates. The factors impacting this stability have been the subject of much research, which have yielded significant insights for regulators, policymakers, and banks (Bank for International Settlements [BIS], 2019). The BIS (2019) identified several core determinants of the banks' stability, including capital adequacy, which refers to a bank's ability to absorb losses; asset quality, which reflects the risk associated with loan portfolios; liquidity, which is the ability to meet short-term obligations; and profitability, which is the ability to generate capital internally. In-depth analysis of bank-specific variables such as loan-to-asset ratio and income diversification is done by (Rashid et al. ,2017). He explores factors affecting bank-specific risk, including income diversification, loan-to-asset ratio, and bank size. Diversified income streams reduce vulnerability to fluctuations, while high ratios indicate dependence on lending, increasing risk during economic downturns. Larger banks may have more resources for risk management.

Popovska (2014) highlights the importance of bank stability in developing economies due to limited non-banking institutions. A stable banking system facilitates financial transactions, promotes economic activity, and maintains financial stability, preventing crises that can have devastating impacts on these economies. It is crucial for maintaining financial stability and promoting economic activity.

The study by Beck, Demirgüç-Kunt, & Levine (2003) emphasizes how crucial institutional and legal frameworks are to fostering bank stability, particularly in emerging nations. According to the research, a more stable banking industry is a result of robust institutions and well-developed legal structures. The effectiveness of contract enforcement, property rights, and legislation protecting investors are a few more elements that affect bank stability. This research offers significant perspectives for policymakers in developing nations who aim to establish a more resilient and steady financial system through an examination of the interplay between legal and institutional frameworks.

A thorough grasp of the major drivers influencing bank stability and profitability is provided by the study conducted SaaddButton & Masih (2016). By emphasizing stability and profitability, it provides a comprehensive understanding of bank performance. In the context of developing economies, however, the did not covered by the assessment since variables impacting stability and profitability can vary. The assessment can possibly ignore new threats because it mainly concentrates on well-established elements like asset quality and capital sufficiency. Furthermore, it could not offer specific suggestions for additional investigation. But pointing out knowledge gaps and recommending interesting topics for more research might greatly improve the work's overall caliber and effect.

The study by Teklay (2019) highlights the value of context-specific research in advancing bank stability in Ethiopia, a developing nation going through financial reforms. He draws attention to two important components of Ethiopia's banking industry: Financial Inclusion Initiatives, which provide the accessibility of financial services to a larger segment of the population, and Risk-Based Supervision, which customizes regulatory requirements to each bank's risk profile. These observations highlight the significance of taking into account the particular conditions of developing countries while supporting bank stability, even though they might not be applicable everywhere.

Because of the country's changing economic environment, shifting laws and regulations, more global integration, and advances in technology, the stability of Ethiopia's banking system is a complicated problem that calls for careful consideration. The creation of evidence-based policies is limited by the inability to identify particular drivers affecting stability due to the lack of significant empirical evidence. Certain factors like Return on Equity (ROE), Loan-to-Deposit Ratio (LDR), Capital Adequacy Ratios (CAR have the potential to be endogenous, which complicates the analysis of causal links and calls for certain approaches in order to make an appropriate assessment. For instance, Increased profitability might push banks to extend riskier loan terms, which could jeopardize stability in the future. In times of apparent stability, banks may lend more, but if default rates rise, excessive credit growth may cause instability.

Hence, this study differs in the following ways, first in methodological wise, it uses system GMM adopting such an approach will fill the methodological gap of being unable to consider the dynamism; the effect of the previous banking system stability on the current state, endogeneity and omitting of variables.  Secondly, the study plan to come up with different scenario of degerming factors relationship with the banking system stability and mitigative policy recommendation for stability of the banking industry. Therefore, the purpose of this study is to close this gap and add to the body of empirical data already in existence.

## 1.3. Objective of the Study

### 1.3.1. General Objective

The general objective of this study is to investigate the determinants influencing the stability of the banking system in Ethiopia.

**Specifically, this research will try to assess the following specific objectives.**

- Explore and identify the major indicators that serve as determinants of banking system stability within the Ethiopian context.

- Investigate the dynamics of banking stability by examining the persistence of stability over consecutive years.

## 1.4. Hypothesis of the Study

Particularly in industrialized countries, empirical studies have revealed a number of important factors that influence bank stability. Among these capital adequacies meant be a larger capital ratio acts as a safety net against losses, asset quality indicates the likelihood of a bank failing is increased by poor asset quality, which is demonstrated by a high percentage of non-performing loans (NPLs), liquidity management having sufficient liquidity lowers the risk of insolvency by ensuring that banks can satisfy their immediate commitments. Bank's capacity to absorb shocks and produce capital internally is improved by consistent profitability. Ethiopia's banking system is distinct from other banking systems because of its growing financial sector and regulatory framework. This study attempted to examine these empirical findings in this environment.

1. **Null Hypotheses ($H_0$)**

   **$H_{01}$:** There is no statistically significant effect of past banks stability on current banks stability

   **$H_{02}$:** There is no statistically significant effect of bank-specific factors (e.g., capital ratio, loan-to-deposit ratio) on banks stability

   **$H_{03}$:** There is no statistically influence of macroeconomic variables (e.g., GDP growth) on bank stability with the direction of the relationship depending on the specific variable.

2. **Alternative Hypotheses ($H_1$)**

   **$H_{11}$:** Past bank stability has a statistically significant effect on current bank stability.

   **$H_{12}$:** Bank-specific factors (e.g., capital ratio, loan-to-deposit ratio) have a statistically significant effect on bank stability.

   **$H_{13}$:** Macroeconomic variable (e.g., GDP growth) has a statistically significant effect on bank stability.

## 1.5. Significance of the Study

The study offers empirical knowledge that can help government organizations, regulatory bodies, and legislators improve the stability of Ethiopia's banking industry. It provides a detailed examination of certain factors, enhancing the theoretical framework of research on financial stability, especially in developing nations. Banking institutions can utilize the results to make strategic decisions, deal with problems early on, streamline processes, and strengthen resilience in a changing economic climate. For Ethiopia's economy to flourish and to create jobs and reduce poverty, stability in the financial sector is essential. The study's emphasis on Ethiopia advances knowledge about the stability of banking systems worldwide by offering comparative analyses of various economic situations. The findings can also serve as a basis for capacity building and training programs, enhancing the skills of professionals in the banking and financial sectors in Ethiopia, leading to improved risk management practices and regulatory frameworks. The results can also be used as a foundation for training and capacity development initiatives that will increase the knowledge and abilities of professionals working in Ethiopia's banking and financial industries, ultimately resulting in better risk management procedures and regulatory frameworks.

## 1.6. Scope of the Study

The study examines the stability of the Ethiopian banking sector, focusing on commercial banks operating from 2015 to 2023. It uses a 9-year period to analyze determinants, including equity-to-asset ratio, bank size, loans-to-assets ratio, revenue diversification, macroeconomic factors, market-related factors, and stability indicators. The research uses the Panel Regression Analysis methodology, specifically the System Generalized Method of Moments (GMM) regression technique, to explore relationships between variables and address endogeneity challenges. Two main challenges limited this study's scope. First, there is a scarcity of existing literature on the factors influencing banking system stability in Ethiopia. While research on banking stability exists, it may not comprehensively address the unique factors at play in the Ethiopian context. Second, the availability of official data on Ethiopian financial institutions is limited. This data scarcity restricted the study period to only nine years, even though all the included banks have been operating for more than fifteen years.

## 1.7. Organization of the Study

The backgrounds of the study, the problem statement, the research question, the study's objectives, its significance, its scope, its limitations, and its organization are all included in the first chapter, which serves as an introduction. The literature was thoroughly studied in the second chapter, which includes a survey of theoretical, conceptual, empirical, and other literatures pertaining to the study's theme. The source of the data, the methodology, and the data analysis approach are covered in the third chapter. The data analysis, discussion, and outcomes summary will be covered in the fourth chapter. Conclusions, suggestions, and the findings' implications for the future are covered in the fifth chapter.

# CHAPTER TWO

# 2. REVIEW OF LITRATURE

The stability of a nation's banking system is a crucial factor in sustaining economic growth and ensuring financial security. This review of literature delves into existing studies, theories, and empirical evidence relevant to the determinants of banking system stability, with a specific focus on Ethiopia. The exploration encompasses various dimensions, including financial indicators, macroeconomic factors, foreign investment, market-related variables, and the theoretical frameworks shaping our understanding of banking stability.

## 2.1. Operational Definition of The Terms

### 2.1.1 Financial Stability Indicators

According to the Financial Stability Board (2016), financial stability is the capacity of a financial system to withstand shocks, preserve vital operations, and continue fostering economic development. A stable financial system ensures that credit flows freely across the economy by fostering public confidence in banks and other financial institutions. Consequently, this enables companies to make investments, generate employment, and stimulate the economy (Mishkin, 2007). For the purposes of this research, financial stability is defined as the capacity of the banking system in Ethiopia to withstand any shocks to the economy, preserve its primary roles of payment services and credit intermediation, and carry on supporting the country's economic expansion.

An essential set of financial Stability indicators determines the state of a banking system. These measures provide as a window into the general health, resilience, and risk profile of specific banks in relation to the economy. Through analyzing the correlation between these indicators and stability, decision-makers, oversight bodies, and investors can protect the stability of the financial industry. Let's examine a few of these core financial metrics and their effects on the stability of the banking system.

**Capital Adequacy Ratio (CAR)** One important indicator of a bank's financial stability and loss-absorbing capacity is the capital adequate ratio. In order to guarantee banks, have a sufficient cushion to withstand financial crises, regulatory agencies frequently impose a minimum CAR. Usually, a higher CAR denotes more stability and ability to absorb risk and it computed as: **(Tier 1 Capital + Tier 2 Capital) / Risk-Weighted Assets.** According to BIS, (2019) Core equity and retained profits are examples of the most fundamental and reliable types of a bank's capital that are included in Tier 1 Capital and Tier 2 Capital is Though it is regarded as less loss-absorbing than Tier 1 capital, this category contains additional capital that can serve as a secondary cushion. Risk-Weighted Assets: These take into account the different risk levels of a bank's holdings, giving loans and other riskier assets a larger weight to represent the higher potential for losses.

**Asset Quality:** Credit risk is reflected in the quality of a bank's assets, which is frequently evaluated using measures like the Non-Performing Loan (NPL) ratio. Non-Performing loans (NPLs) are loans where the borrower is overdue on repayments or considered unlikely to repay in full. The ratio of non-performing loans to total loans is known as the NPL ratio. Reduced non-performing loan (NPL) ratios indicate better asset quality, which lowers the likelihood of large loan defaults and promotes stability.

**Earnings Performance:** Profitability measures that provide light on a bank's performance include Return on Equity (ROE) and Return on Assets (ROA). ROE is determined by dividing net profit by shareholders' equity while ROA is determined by dividing net profit by Total Assets. According to Horne and Wachowicz (2008), a higher return on equity (ROE) and Return on Assets (ROA) signifies that a business is making more money than the equity that shareholders have contributed. Consistently high profits show that an organization is doing well and can make enough money to cover losses and operating expenses.

**Liquidity Ratios:** A bank's capacity to fulfill both short- and long-term obligations is gauged by liquidity ratios, such as the Loan deposit Ratio (LDR) and Net Stable Funding Ratio (NSFR). A crucial liquidity measure called the Loan-to-Deposit measure (LDR) which computed as Total Loans / Total Deposits and used to evaluate a bank's capacity to satisfy requests for short-term withdrawals. Sufficient liquidity guarantees a bank's ability to fulfill its commitments and withdrawals, hence promoting general stability.

**Leverage Ratio:** A bank's leverage and risk exposure are determined by calculating the Leverage Ratio, which evaluates the ratio of capital to total assets. Preventing excessive risk-taking and preserving financial stability require a constant leverage ratio.

**Efficiency Ratios:** Efficiency ratios, such the Cost-to-Income Ratio, are used to assess a bank's operational effectiveness. Reduced efficiency ratios indicate efficient cost control, which boosts profitability and promotes long-term stability. Comprehending the complex interrelationships between various financial metrics offers a comprehensive perspective on the stability of a banking system. Using this data, regulators and policymakers may put policies into place that fortify financial institutions and preserve the stability of the whole economy. A robust and stable banking industry depends on the ongoing observation and modification of financial indicators as financial environments change.

Understanding the determinants of banking system stability requires a theoretical framework that encompasses various economic, financial, and regulatory factors. This theoretical review seeks to provide a foundation for investigating the specific determinants shaping the stability of the banking system in Ethiopia, utilizing a Panel Regression Analysis approach.

### 2.1.2 Application of Z-Score Analysis to Financial Indicators

This review synthesizes existing literature, setting the stage for a Panel Regression Analysis on the determinants of banking system stability in Ethiopia. By integrating insights from financial indicators, macroeconomic factors, market-related variables, and theoretical frameworks, Incorporating Z-score measurements into the panel regression analysis for Ethiopian banks enhances the empirical precision of determining the key determinants of banking system stability. This combined approach provides a robust empirical foundation for the proposed thesis. We will see in detail in chapter three

This algorithm, which requires careful selection and manipulation of financial data, is a generalization of the Z-Score for a banking system. To examine the combined effects of several variables on the Z-Score and the stability of the banking system, panel regression analysis is utilized. The approach should be customized to the unique features and regulatory framework of the banking industry, such as Ethiopia or any other context under consideration, and the formula should be applied to several institutions throughout time. Always make sure to modify the formula and methodology to fit the unique features and legal framework of Ethiopia's banking industry or any other particular context that is being studied. Z-Score analysis and panel regression are combined to provide a comprehensive methodology for identifying stability factors.

**Capital Adequacy and Z-Score Analysis:** Employing Z-score assessments globally consistently emphasizes the significance of capital sufficiency in determining the stability of the banking system, according to (Ali, & Iness, 2020). By combining factors such as capital ratios, Z-score offers a quantitative method for evaluating banks' resilience. Panel regression and Z-score analysis of Ethiopian banks can provide detailed insights into the capital-stability link.

**Liquidity Management and Z-Score Dynamics:** In order to assess a bank's capacity to fulfill short-term obligations, Z-score models frequently incorporate liquidity indicators. The impact of liquidity on stability can be experimentally revealed by applying Z-score analysis within a panel regression framework for Ethiopian banks, as suggested by empirical evaluations that show a positive association between higher Z-scores and effective liquidity management.

**Asset Quality and Z-Score Metrics:** Z-score models take asset quality into account, emphasizing loan loss provisions and non-performing loans (NPLs). The inverse association between NPLs and Z-scores is supported by empirical data, emphasizing the importance of high-quality assets. Z-score metrics are used in an empirical study of Ethiopian banks to improve the accuracy of understanding stability determinants. (Naser, 2019).

**Macroeconomic Factors and Z-Score Insights:** It emphasizes how macroeconomic factors and Z-score analysis are combined to evaluate the stability of banks. Empirical research on Ethiopian banks using panel regression and Z-score measurement can reveal the relationship between macroeconomic variables (such as inflation and GDP growth) and Z-scores (Sunney, 2020).

**Market Share, Loan Loss Provisions, and Z-Score Analysis:** Market share and loan loss provisions are frequently included in Z-score models, which provide a thorough understanding of stability factors. Global empirical data suggests that Z-scores and large market share or excessive loan loss provisions may be negatively correlated. Precise measurement of these consequences is possible for Ethiopian banks by utilizing Z-score analysis in panel regression.

**Historical Evolution and Z-Score Trends:** When Z-score models are used on past data, stable trends over time are produced. Z-score analysis within a panel regression framework is used to conduct empirical examinations into the historical evolution of Ethiopian banks, providing empirical evidence of how historical influences shape contemporary stability trends.

## 2.2. Theoretical Literature Review

**2.2.1 The Capital Adequacy Theory:** this theory isn't explicitly associated with a single, well-known idea. Although capital adequacy is a cornerstone of banking regulation, the idea has developed and been improved throughout time thanks to contributions from several organizations and scholars. International criteria for capital adequacy are mostly set by the Basel Committee on Banking Supervision (BCBS). They have created a number of frameworks (Basel I, Basel II, and Basel III) that set minimum capital requirements for banks according to their risk profiles since the 1980s. The purpose of these dynamic frameworks is to address new risks and advance financial stability.

The theory states that banks need to have an adequate level of capital in relation to the risks they record. In this sense, capital refers to a bank's internal resources, which are effectively a financial safety net that can absorb possible losses without impeding the bank's capacity to continue operating. There are several facets to the relationship between capital sufficiency and bank stability. First and foremost, capital serves as a cushion, taking in unanticipated losses from loan defaults, volatile markets, or downturns in the economy. By doing this, banks are kept from going bankrupt, which is the state in which they are unable to pay their debts. The financial system as a whole may become unstable as depositors rush to take their money out of banks and bank failures have a cascading effect. Furthermore, confidence among depositors and other creditors is fostered by a robust capital foundation. Greater capital adequacy ratios are an indicator of a bank's stability and strength of finances. The Capital Adequacy Theory helps create a more stable banking system, safeguards depositors, lowers the likelihood of bank failures, and creates a sound financial environment that supports general economic growth by ensuring banks have enough capital.

**2.2.2 Profitability Theory:** According to Beck et al. (2002) analysis, the profitability theory suggests a direct correlation between a bank's profitability and the overall stability of the banking system. Stability benefited from profitable banks in a number of ways. First, internal capital created by profits serves as a safety net against unforeseen losses. This buffer lowers the danger of bank failure and the ensuing systemic disruptions by assisting banks in absorbing financial shocks and maintaining solvency. Second, banks that are profitable can increase their capital adequacy ratios by reinvesting their earnings. This strengthens the bank's financial resilience by increasing the buffer against future losses and boosting confidence among creditors and depositors. Ultimately, a bank's trust and reputation in the market are improved by profitability. This results in easier access to capital and maybe cheaper borrowing rates, which helps the bank deal with its financial difficulties more skillfully. Essentially, banks that are profitable have the means and position in the market to manage risks and weather financial storms more pro-actively. In the end, this helps to create a more stable banking system by safeguarding depositor money and promoting easy credit availability for the business sector.

### 2.2.3 Liquidity Theory

The ability of a bank to fulfill its short-term obligations is crucial for preserving the stability of the banking system, according to the liquidity theory. According to Mishkin (1991), this hypothesis emphasizes the possible cascading effect of bank illiquidity. A bank that is having trouble making its short-term loan payments risks losing the trust of its depositors very fast. This may lead to a bank run, in which depositors take money all at once, severely taxing the bank's liquidity. If left unchecked, this can result in bank failure, which could have an effect on other institutions due to the financial system's interconnection. The Liquidity Theory emphasizes how crucial it is for banks to have efficient liquidity management procedures.

Banks may easily fulfill their obligations if they maintain a good balance between short-term liabilities and liquid assets, which are easily convertible to cash. As a result, the banking system is more stable and depositors and other creditors are more confident. A stronger banking system is also enhanced by regulatory frameworks that support prudent liquidity management techniques.

### 2.2.4 Asset Quality Theory

According to SaaddButton & Masih (2016), the Asset Quality Theory emphasizes the need of a robust loan portfolio for the stability of the banking system. This hypothesis highlights the detrimental effects of non-performing loans (NPLs) on the financial stability of banks as well as the possible systemic risk they pose.

NPLs are loans with difficult-to-repay borrowers, which could result in losses for the bank. A bank's capital base is weakened by high NPL levels because resources are diverted to unrecoverable loans. Depositor confidence may be damaged as a result, and the bank's capacity to withstand future losses is diminished. Furthermore, banks with significant non-performing loans (NPLs) could be reluctant to offer new credit, which would restrict credit availability to consumers and companies and impede economic growth.

The Asset Quality Theory emphasizes how crucial it is for banks to handle their loans well and with caution. Banks can reduce non-performing loans (NPLs) and preserve their financial stability by continuing to emphasize creditworthiness and managing loan portfolios efficiently. Strong loan origination and monitoring procedures are encouraged by regulatory frameworks, which also help to create a more stable banking sector with sound loan portfolios.

**2.2.5 Financial Intermediation Theory**: According to Gorton & Winton (2003), The main focus of financial intermediation theory is on banks and other financial organizations' function as middlemen that help money move between savers and borrowers. Understanding how the efficacy and efficiency of financial intermediation contribute to overall economic stability can be gained by analyzing this theory in the context of the stability of the banking system. The theory of financial intermediation and how it affects the stability of the banking system: banks act as middlemen, transferring money from depositors, or savers, to borrowers, or individuals, or enterprises. For the economy to allocate capital efficiently, this intermediation role is crucial. The stability of the financial system is influenced by this intermediation process' efficacy. Stability and economic activity are supported by a fluid and effective flow of funds.

By accepting different kinds of risks from depositors such as credit risk and interest rate risk and managing these risks through lending and investing activities, banks participate in risk transformation. Stability in banking is influenced by effective risk transformation. The capacity of banks to diversify and manage risks responsibly is essential for stability since it reduces the possibility of significant financial shocks. acknowledges the existence of information asymmetry, in which banks have access to more data about depositors than they do about borrowers. Banks are able to evaluate and control risks because of this knowledge advantage. If information asymmetry isn't adequately managed, it can affect stability. To lessen negative consequences on stability, open communication and efficient risk assessment tools are crucial (Raghavan, 2003).

**2.2.6 Agency Theory:** Researchers like Jensen and Meckling (1976) have studied agency theory, which provides insight into possible conflicts of interest within banks and how they may affect the stability of the banking system. According to this view, shareholders (principals) and bank management (agents) may have conflicting interests. In an attempt to increase their bonuses or further their careers, managers may put short-term profits or excessive risk-taking ahead of the bank's long-term stability.

There are several possible outcomes from this conflict that could jeopardize the stability of the banking sector. For instance, managers may take an aggressive approach to lending in order to boost profits temporarily, even though there is a greater chance of default on these loans. This may erode the bank's capital adequacy and result in an accumulation of non-performing loans (NPLs), which could cause financial difficulties should losses occur. Furthermore, too risk-taking managers run the risk of exposing the bank to unforeseen financial shocks, which could cause the bank to fail and destabilize the entire financial system.

Agency Theory emphasizes how crucial good corporate governance procedures are to reducing these risks and fostering the stability of the banking system. Strong independent boards, comprehensive risk management policies, and performance-based pay that is in line with long-term shareholder value are a few examples of mechanisms that can be used to make sure bank managers behave in the best interests of the bank and its depositors. Banks have the ability to promote a more stable and long-lasting financial environment by resolving possible agency conflicts.

## 2.3. Empirical Reviews

An economy that runs well must maintain a sound and stable banking system. Scholars have conducted extensive research to comprehend the elements that impact bank stability, and this analysis examines several significant discoveries from diverse empirical investigations.

One important component of stability is the capital adequacy ratio, which expresses a bank's own resources as a percentage of its risk-weighted assets. The Capital Adequacy Ratio (CAR) has become a vital indicator for evaluating the soundness of banks. This ratio illustrates a bank's capacity to withstand possible losses without jeopardizing its solvency. It is computed by dividing a bank's capital by its risk-weighted assets Demirgüç-Kunt and Huizinga (2016). In their cross-country investigation, Demirgüç-Kunt and Huizinga (2014) discover a significant positive association between CAR and bank stability. This implies that banks with larger capital ratios are more resilient to economic downturns and financial shocks, which eventually helps to create a more stable banking system internationally. They discovered that bank stability and capital adequacy are positively correlated in several nations. In a similar vein, Berger and DeYoung (1997) show that lower bank failure rates in the US are correlated with greater capital ratios. This supports the idea that having enough capital buffers helps banks stay solvent by acting as a shock absorber and enabling them to withstand financial catastrophes. While some research goes deeper, regulatory organizations specify minimal requirements for CAR. Alessandri and Rocchi (2016), for example, investigate the effects of capital ratios over minimum thresholds. According to their findings, institutions that have CARs above statutory requirements show more stability and resilience when the financial system is under strain. Adequate capital is not a stand-alone component. Christopoulos et al. (2015) look into how risk management techniques and CAR interact. Their study indicates that strong risk management techniques increase the efficacy of capital buffers. This emphasizes how crucial a comprehensive strategy is for maintaining bank stability.

Other aspect affecting a bank's stability is the quality of its loan portfolio, often known as asset quality. This review examines the relationship between asset quality and bank health as shown by a number of empirical research, with a focus on the amount of non-performing loans (NPLs). The study by Naceur and Omran (2011), investigate the connection between profitability and asset quality in MENA nations. According to their research, there is a negative association between high levels of non-performing loans and profitability. This eventually reduces the resources available to withstand possible losses, weakening the bank's financial stability and health. A worldwide investigation by Claessens et al. (2011) shows that banks are more vulnerable to financial crisis when their percentage of non-performing loans (NPLs) is higher. This supports the idea that a strong loan portfolio with minimal non-performing loans (NPLs) is necessary to keep banks stable in a variety of economic environments. NPLs may have consequences beyond only a profit. Ghosh (2015) examines how non-performing loans (NPLs) affect bank lending practices. According to the report, banks with significant non-performing loans (NPLs) have a tendency to become risk-averse, which could impede credit flow to individuals and companies and have an adverse effect on economic growth. According to Acharya et al. (2014), efficient debt management techniques are crucial. According to their research, proactive loan monitoring and effective NPL resolution procedures can lessen the detrimental effect of non-performing loans (NPLs) on bank stability.

The stability of banks depends on maintaining adequate liquidity. Liquidity ratios evaluate a bank's capacity to quickly turn assets into cash in order to pay short-term obligations. Spain's situation is examined by Saurina (2007). According to the study, banks that have effective liquidity management techniques are less susceptible to bank runs and liquidity crises when evaluated by liquidity ratios. This emphasizes how crucial it is to keep short-term liabilities and easily accessible assets (high liquidity ratios) in check so that banks can fulfill their responsibilities and stay out of trouble financially. A wider perspective is used by Allen and Gale (2000). According to their research conducted in several nations, banks that experience a lack of liquidity are more prone to turn to riskier lending methods in an effort to make quick cash. Over time, this conduct may make financial instability worse. A possible trade-off is acknowledged by Acharya et al. (2014). They suggest that as banks store more low-yielding assets, overly high liquidity ratios may have a negative impact on profitability. The study does discover, however, that the advantages of increased stability outweigh any potential negative effects on profitability. According to Huang et al. (2012), liquidity ratios might not be sufficient to fully explain the situation. They suggest that when evaluating liquidity risk, a wider range of criteria be taken into account, such as the marketability of a bank's assets.

A recent addition to the collection for evaluating bank stability is the Leverage Ratio, which contrasts a bank's total debt to its equity capital. Leverage ratios, according to Borio and Zhu (2016), are a useful addition to conventional capital adequacy ratios like the CAR. They contend that by taking into account all of a bank's liabilities rather than just risk-weighted assets, the leverage ratio offers a more comprehensive picture of its risk profile. The influence of the leverage ratio on bank lending practices is investigated by Angelini et al. (2018). Based on their findings, banks may limit lending, especially to riskier borrowers, if Leverage Ratio regulations are tougher. Economic growth may suffer as a result of this. Alessandri and Rocchi (2016) investigate the ideal leverage ratio level. According to their research, extremely high leverage ratios may make banks more vulnerable, but excessively low ratios may not offer enough protection against losses. Achieving the ideal balance is essential to fostering stability. Adrian and Shin (2014) draw attention to the Leverage Ratio's shortcomings as a static metric.

They contend that variables including the makeup of a bank's obligations and the state of the financial system as a whole affect how effective the ratio is.

Bank stability is known to be influenced by capital adequacy and asset quality, but the function of efficiency ratios is still being investigated. According to Ayayi and Sene (2010), operational efficiency which is determined by expense ratios is essential to the stability and long-term viability of banks. Banks that have lower expenditure ratios are more adept at controlling costs, which enables them to increase earnings and reserve capital. In the end, this makes the financial system more stable. Efficiency, according to Shah and Jan (2014), is more than just cost management. They contend that more complete images are provided by wider operational efficiency ratios, which take into account variables like productivity and resource allocation. Banks that do well in these areas may be able to handle financial difficulties better.

Efficiency and profitability are related, as Beck et al. (2000) point out. Their proposal suggests that banks with greater efficiency are better able to generate and distribute income, which ultimately results in increased profitability. As was previously mentioned, profitability can serve as a buffer for resources, enhancing a bank's stability. Certain research recognizes possible compromises. Demirgüç-Kunt and colleagues (2008) propose that an overemphasis on efficiency may result in riskier lending practices as a means of achieving increased profitability. Over time, this conduct can jeopardize the stability of banks.

Internal elements like asset quality and capital sufficiency do not alone determine bank stability. The entire state of the financial system is influenced by external factors as well, which are very important. The relationship between macroeconomic conditions and bank stability is examined by Bordo et al. (2015). According to their research, economic downturns which are typified by slow growth and increased unemployment may increase the number of loan defaults, which would ultimately deteriorate bank asset quality and perhaps spark financial crises. Van Horen and Claessens (2013) look at the effects of regulations. They contend that robust regulatory frameworks, accompanied by strict capital requirements and efficient supervision, can encourage prudent risk management techniques in banks, hence augmenting the stability of the banking sector. In their 2002 work, Forbes and Rigobello explore the idea of financial contagion. According to their research, the global financial system's interconnection can cause bank failures or financial crises in one country to have an impact on the soundness of banks in other nations. Acharya et al. (2014) draw attention to the increasing significance of outside variables that are not conventional, such as cyberattacks. According to their claims, successful cyberattacks on banks have the potential to cause operational disruptions, damage consumer confidence, and even cause financial instability.

## 2.4. Conceptual Framework

### 2.4.1 Understanding How Factors Affect Banking System Stability

**Stability of the Banking System and the Equity-to-Asset Ratio (ETA):** The stability of the banking sector is significantly influenced by the Equity-to-Asset Ratio (ETA). It shows how much equity (capital) a bank has in relation to all of its assets. A stronger capital buffer is indicated by a higher ETA. Equity serves as a safety net against any losses, safeguarding depositor money and enabling banks to withstand economic downturns. This makes a bank more resilient and helps to create a banking system that is more stable Berger and DeYoung, (1997). Investors are encouraged to have faith and confidence in the banking system by a robust ETA, which indicates financial strength. As a result, bank capital may increase and general stability may be enhanced (Common Equity Capital, Banks' Riskiness and Required Return on Equity, European Central Bank (2011). Although a high ETA is preferred, some research advises against focusing too much on the ratio by itself (Alessandri and Rocchi, 2016). Banks may store additional low-yield assets as a result of excessively high ETAs, possibly at the expense of some profitability. To ensure long-term stability, a solid financial base and effective risk management techniques are essential Christopoulos et al., (2015).

**Stability of the Banking System and the Loans-to-Assets Ratio (LTA):** One important indicator of a bank's risk profile that eventually affects Banking System Stability (BS) is the Loans-to-Assets Ratio (LAR). A high loan-to-asset ratio (LAR) suggests that a bank has more loans than assets. Although banks rely heavily on lending, they run the risk of experiencing loan defaults if borrowers are unable to make their payments. This raises the possibility of losses and has the potential to upset a bank's financial stability, which could have an effect on the entire banking system (Claessens et al., 2011). It's critical to keep loans and other assets in a healthy balance. During economic downturns, excessive risk exposure can result in financial difficulty, even while a high LAR can yield larger earnings from loan interest (Fahrul Puas Sriawan Rio Prabowo et al., 2019). The quality of a bank's loan portfolio affects LAR's effect on BS as well. According to Ghosh (2015), a high loan-to-asset ratio (LAR) that includes a sizable percentage of non-performing loans (NPLs) is riskier than a high LAR that is composed primarily of well-performing loans. Strict credit evaluation procedures and efficient loan management techniques are essential for reducing the risk connected with large loan amounts.

Apart from the total amount of lending, the concentration of loans in particular industries must also be taken into account. A high leverage ratio focused in high-risk industries, such as real estate, can dramatically increase possible losses in a downturn and jeopardize the viability of a bank (Borio and Zhu, 2016). Sectoral diversification can aid in reducing the risk of concentration.

**The stability of the banking system and macroeconomic factors (MF):** Macroeconomic factors (MF) have a significant impact on the stability of the banking system (BS). These more general economic factors shape the environment in which banks function and have a big influence on the stability and well-being of these institutions. A more stable financial system is typically associated with a robust and expanding economy (Bordo et al., 2015). An expanding economy is more likely to benefit both individuals and businesses, which raises the demand for loans and lowers the default rate. This makes banks more profitable and fortifies their capital reserves, which makes the banking system more robust. The stability of the banking sector can be seriously weakened by high unemployment rates. Bank losses result from loan defaults, which are more common among jobless people and struggling companies. If defaults become common, this may weaken a bank's capital basis and could set off a chain reaction (Claessens et al., 2011). The stability of the banking system may also be threatened by unchecked inflation. Bank profitability may suffer if inflation increases more quickly than loan interest rates. High inflation might also cause financial markets to become uncertain, which could discourage lending and impede economic growth (Beck et al., 2013). The stability of the financial sector can also be impacted by central bank interest rate policies. While higher interest rates may boost bank profits, they may also reduce the demand for loans, which would have an effect on the economy as a whole. Low interest rates, on the other hand, may encourage borrowing but also put pressure on bank profit margins (Brice et al., 2018).

A secure banking system requires strong corporate governance principles, such as accountability, transparency, and a culture of risk awareness promoted by management (Claessens and van Horen, 2013). In the end, these procedures contribute to BS by reducing the possibility of careless behavior and guaranteeing that management acts in the bank's and its stakeholders' best interests. Even the best-run banks occasionally have unanticipated catastrophes. In these situations, the management team's capacity to act quickly, decisively, and with an emphasis on maintaining financial stability is essential (Brunnermeier et al., 2016).

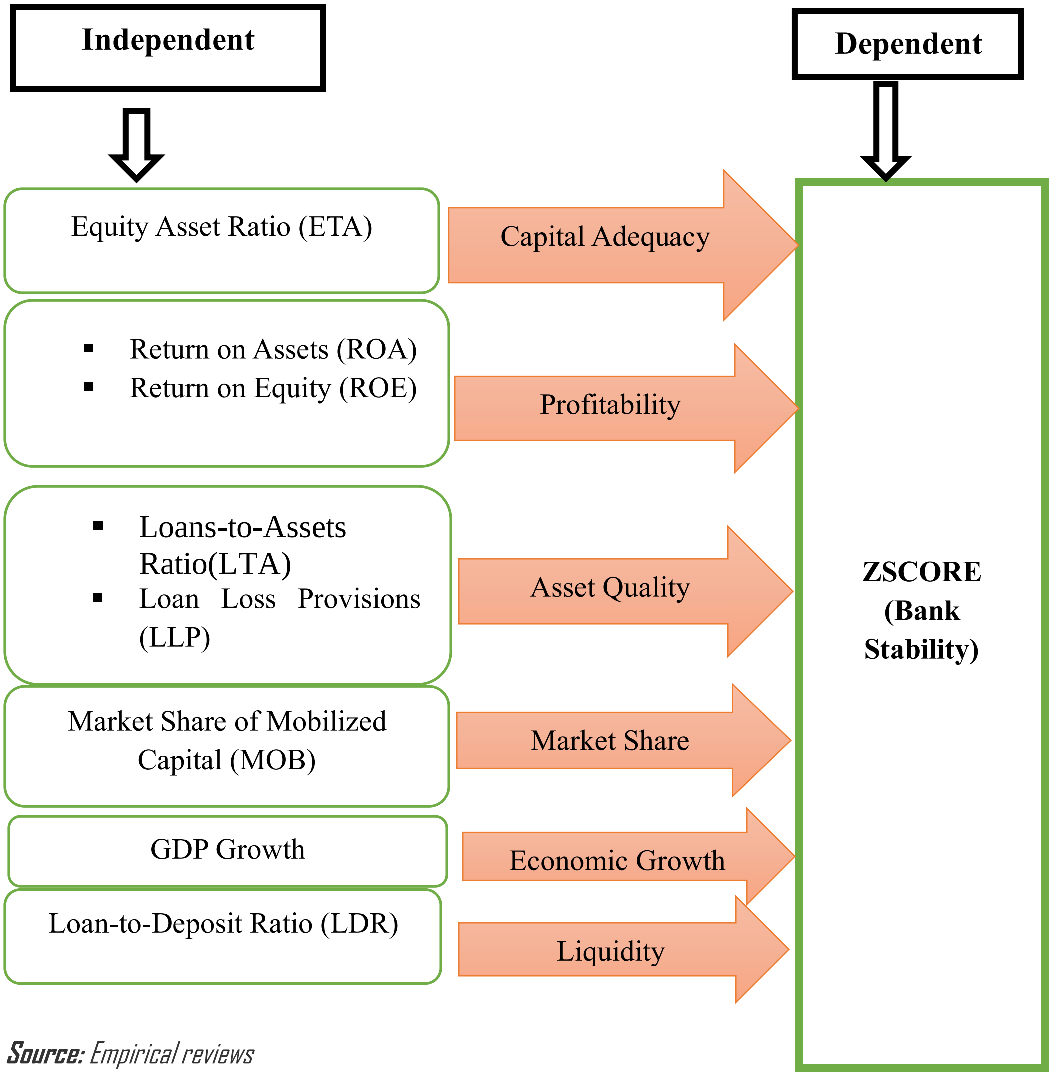
Good crisis management techniques may protect BS and lessen the effects of unfavorable incidents.

**The stability of the banking system and loan loss provisions (LLP):** Banks use Loan Loss Provisions (LLP) as a vital instrument for risk management and to support the stability of the banking system (BS). In essence, LLPs serve as a financial safety net against any loan defaults. Banks can sustain losses without suffering a major decrease in capital by reserving a part of income to cover possible losses (Naceur and Omran, 2011). This protects a bank's liquidity and capacity to carry on business, even in periods of economic contraction when bank failures may occur more often. A stable financial system requires sufficient capital buffers. By proactively putting up reserves for anticipated losses, LLPs assist banks in maintaining capital adequacy ratios (Duggan, 2009).

This adds to overall BS by guaranteeing banks have enough capital to handle unforeseen losses and satisfy regulatory obligations. Effective LLP procedures may help raise investor assurances on the soundness of a bank's finances. A proactive approach to risk management is demonstrated by providing transparency, which may draw in new capital and strengthen the bank's capital base (Ben Naceur and Alkassim, 2005). Trust in the financial industry is fostered by a stable and well-capitalized banking system, which further promotes BS... Keeping an eye on LLP patterns can also act as a warning mechanism for any issues with a bank's loan portfolio. A significant increase in provisions might be a sign of declining credit quality, necessitating remedial action to stop more losses and protect BS (Saurina, 2007)

**Banking System Stability (BS) and Market Share of Mobilized Capital (MOB):** There is a complicated link between Banking System Stability (BS) and the Market Share of Mobilized Capital (MOB), which is the concentration of financial resources into a limited number of major banks. Additionally, a highly concentrated MOB may increase systemic risk. Due to the huge bank's interconnection with other institutions and the larger financial system, problems with it may have a cascading impact, perhaps resulting in a wider financial crisis (Bordo et al., 2014). A less concentrated MOB and a more competitive banking environment can promote system stability. Competition pushes banks to improve their efficiency, properly manage risk, and provide clients with better rates (Allen and Gale, 2000). This has the potential to foster a financial system that is more stable and dynamic.

**Table 2.1 Conceptual Framework**




***Source:** Empirical reviews*

# CHAPTER THREE

# 3. RESEARCH METHODOLOGY

## 3.1. Research design and approach

The study uses a longitudinal panel data and employed panel regression analysis to examine the stability of the banking system from 2015 to 2023. The research focuses on 16 private commercial banks, and the type of data was mainly secondary data which was collected from their audited financial reports audited by external auditing companies and conform to legal requirements. The study further collected macroeconomic factor such as GDP growth during the period of 2015–2023 from World Bank data base. These indicators are retrieved from World

Bank Database. The Z-Score is used to quantify banking system stability. The study's variables include important factors such as capital adequacy, liquidity management, asset quality, macroeconomic factors, and market capital share.

## 3.2. Data type and source

An analysis of panel regression used secondary sources and the summary of the data and variables tabulated below.

**Table 3.1. Definition of variables**

| No | Variable | Data Source | Explanation | Calculation |
|---|---|---|---|---|
| | | | | |
| | Dependent Variable | | | |
| 1 | Zscoreit | Bank financial statements and Own computation | Stability at the bank i at the time t | (ETA+ROA)/STDEROA |
| | | Independent Variables | | |
| 2 | Zscoreit-1 | Bank's stability in the previous year | Stability score/rating from previous year | Zscore at the previous year |
| 3 | LDR | Bank yearly Audited financial statements, | key metric used to assess a bank's liquidity and risk profile | LDR = Total Loans / Total Deposits |
| 4 | ETA | | Equity-To-Asset ratio (shareholder equity ratio) | Equity/Assets |
| 5 | LTA | | Loans to assets ratio (so-called credit risk) | Total loans outstanding as a percentage of total assets |
| 6 | MOB | | Market share of mobilized capital | Total mobilized capital/Total assets |
| 7 | ROA | | Measures how much profit a bank generates for each Birr of shareholder equity | ROA = Net Income / Total Assets |
| 8 | ROE | | Measures how much profit a bank generates for each Birr of shareholder equity | Net Income / Shareholders' Equity |
| 9 | LLP | | Loan loss provisions | Loan loss provisions /Gross loan |
| 10 | GDP | WDI Database | GDP growth | percentage |

## 3.3. Variables and Proxy Measures

We need to define variables and select proxy measures that best capture the concepts that the study wants to investigate. Below are suggested variables and proxy measures:

### 3.3.1 Dependent Variable

**Banking System Stability (BS**) is the capacity of a nation's banking industry to endure economic shocks while carrying out its primary duties of processing payments, managing financial risks, and extending credit. Growth and stability in the economy as a whole depend on a stable banking sector.

Z-score as used in BS assessment is a useful tool for combining financial health indicators such as Return on Equity (ROE), Return on Assets (ROA), Equity-to-Asset Ratio (ETA), Loans-to-Assets Ratio (LTA) etc. into one consistent measurement. The Z-score is a statistical tool for comparison rather than a direct indicator of BS. It shows the number of standard deviations that a particular statistic, such as the capital adequacy ratio of a bank, deviates from the average (mean) of a set of data, such as the average capital adequacy ratio of banks in an area.

For policymakers and researchers, the Banking System Stability Z-score provides a useful composite assessment of the health of a nation's banking industry. Demirgüç-Kunt and Huizinga (2016) support the use of the Z-score to compare the stability of banking systems in various nations. They facilitate a systematic evaluation of relative stability by computing a Z-score based on aggregate banking sector data for variables like capital adequacy and profitability. The number of standard deviations that a particular point (data value) deviates from the mean (average) of a distribution is represented by the Z-score, sometimes referred to as a standard score. Because of its standardization, this unit of measurement enables comparisons across variables with various scales. Z-scores are calculated with the general formula:

$Z = (X - \mu) / \sigma$

- Z represents the Z-score
- X represents the specific data value (e.g., a bank's capital adequacy ratio)
- $\mu$ (mu) represents the mean of the data set (e.g., average capital adequacy ratio of banks in a region)
- $\sigma$ (sigma) represents the standard deviation of the data set

Numerous studies demonstrate the relevance of Z-scores in evaluating bank performance. While Altman et al. (1994) created a Z-score model especially for banks and showed that it might forecast financial distress, Demirbas et al. (2014) discovered that Z-scores in Turkey were successful in differentiating between healthy and failing banks. For a more thorough assessment, Tasche (2008) notes that Z-scores should be used in conjunction with other financial analysis methods like capital adequacy ratio (CAR) of a bank to the national average of banks in that nation. This enables us to evaluate the bank's capital cushion in comparison to its competitors. Z-scores can be used to examine loan default rates. One way to determine which banks are more likely to experience defaults is to compare the non-performing loan (NPL) ratio of each bank to the average NPL ratio. To understand a bank's relative strengths and weaknesses, we could compute Z-scores for different financial ratios, such as profitability or liquidity ratios, and compare them to industry averages. The Z-Score is a financial metric that helps assess the financial health and stability of a company, including banks. One measure of bank stability is Z-score. Z-score comprises accounting measures of profitability, leverage and volatility Demirgüç-Kunt & Huizinga (2014). its application in banks stability analysis is computed in as:

$$Z - score/BS = \left[\frac{ROA_{i,t} + \frac{E_{i,t}}{A_{i,t}}}{\sigma ROA_{it}}\right]$$

where $BS_{it}$ is the stability Z-score of banks i in year t, $ROA_{it}$ is the return on assets ratio, E/A is the equity-to-asset ratio of bank i in year t and $\sigma ROA_{it}$ is the standard deviation of the ROA of bank i over the whole sample period t.

### 3.3.2 Independent Variables:

**Loan-to-Deposit Ratio (LDR):** One important indicator for evaluating a bank's liquidity and risk profile is the Loan-to-Deposit Ratio (LDR). It gauges how much of a bank's deposits are utilized to pay for loans**.**

**Equity-to-Asset Ratio (ETA):** The ratio of equity to total assets, which shows banks' financial safety net.

**Loans-to-Assets Ratio (LTA)**: The ratio of loans to total assets, reflecting the risk exposure of banks.

**Return on Assets (ROA):** used to assess a company's profitability in relation to banks total asset. ROA is determined by dividing a company's net income (profit after all expenses) by its total asset total asset

**Return on Equity (ROE):** used to assess a company's profitability in relation to the money invested by its shareholders. ROE is determined by dividing a company's net income (profit after all expenses) by its total shareholders' equity.

**Lagged Banking System Stability (Lagged BS):** Reflecting the persistence and temporal dynamics of banking system stability.

**Market Share of Mobilized Capital (MOB):** The proportion of total capital mobilized by the bank in the market.

**Loan Loss Provisions (LLP):** Provisions set aside by banks for potential loan losses.

## 3.4. Method of data analysis

The research commenced the analysis by means of a collecting of secondary data, changing into ratio values, estimation of the dependent variable for all observation and time period. Next, we define the panel regression model, which includes the independent, and dependent variables. Include lag variable of the dependent variable in order to represent the data's dynamic nature. A dynamic panel model is necessary due to the dynamic nature of the study's data and the fact that the participants' present behavior is influenced by their prior conduct. The dynamic character of the model precludes the use of typical Ordinary Least Squares (OLS) estimators because of the possibility of bias and inconsistent results from the correlation between the lagged dependent variable and the unobserved panel-level effects Latic and Hasanovic (2017). We Applied (GMM) strategy to account for endogeneity and potentially unobserved panel effects. endogeneity is the state in which there is a correlation between the error term (unobserved variables) and the explanatory variable (Bank Size), for example. As a result of this correlation, estimations of the actual connection between the variables may become skewed and untrustworthy. we'll probably experience Measurement error occurs when data used to measure the explanatory variable is not entirely accurate, omitted variable bias occurs when significant factors influencing both the explanatory and the dependent variables (e.g., Banking System Stability) are left out of the model, and reverse causality occurs when the dependent variable may also influence the explanatory variable.

Arellano & Bond (1991) addressed the endogeneity issue by introducing a new (GMM) estimator for the dynamic panel model and it state that the (GMM) is an effective method for handling endogeneity problems. GMM uses instrumental variables to address this problem (IVs) Instrumental variables (IVs) are variables that have a correlation with the explanatory variable but not with the error term. It is essential to choose the right instrumental variables. They shouldn't have a direct impact on the dependent variable, but they should have a significant correlation with the explanatory variable. Economic theory is frequently useful in determining appropriate tools. Moment conditions, or limitations on the predicted values of products between the instruments and the error term, are used in GMM. These requirements guarantee that there is no correlation between the instruments and the error term.

Even if GMM is an effective method, depending on the context of our research, there are other options. While it is a popular technique that uses IVs in a two-step procedure, Two-Stage Least Squares (2SLS) may not always be as effective as GMM. When handling endogeneity, Two-Stage Least Squares (2SLS). is frequently utilized in studies like as Pandey et al.'s (2019) study on the effect of bank rivalry on stability. Finding instrumental factors that have an impact on the explanatory variable (like bank competitiveness) but have no direct correlation with the error term (like bank stability) is how 2SLS operates. This two-step procedure aids in determining the explanatory variable's actual influence.

## 3.5. Model specification

This research delves into the intricate dynamics governing banking stability, employing a sophisticated analytical approach Panel Regression with a System of Generalized Method of Moments (GMM). This model encapsulates the temporal evolution and contemporaneous relationships within a panel of 16 commercial banks spanning the period from 2015 to 2023.

The primary objective is to discern the key determinants influencing the stability of Ethiopia's banking system. Beyond conventional variables.

This study formulated the following econometric model:

$$(BS/ZSCORE)_{it} = \beta_0 + \beta_1 LDR_{it} + \beta_2 ETA_{it} + \beta_3 ROA_{it} + \beta_4 LTA_{it} + \beta_5 ROE_{it} + \beta_6 MOB_{it} + \beta_7 lagged\ BS_{it} + \beta_8 LLP_{it} + \beta_{10} RGDP_{it} + \epsilon_{it}$$

**Dynamic Component:**

$$(ZSCORE)_{it} - (ZSCORE)_{it-1} = \gamma_1((ZSCORE)_{it-1} - (ZSCORE)_{it-2})) + \gamma_2((ZSCORE)_{it-2} - (ZSCORE)_{it-3})) + \cdots \ldots . \gamma_k((ZSCORE)_{it-k} - (ZSCORE)_{it-(k+t)})) + \mu_{it}$$

**Where,**

BS: stability Z-score of banks

LDR: Loan-to-Deposit Ratio

ETA: Equity-to-Asset Ratio

LTA: Loans-to-Assets Ratio

ROA: Return on Assets

ROE: Return on Equity

MOB; Market Share of Mobilized Capital

LLP: Loan Loss Provisions

$(ZSCORE)_{it-k}$ **:** Lagged Banking System Stability (Lagged BS)

Error Terms: ϵit and µit are the error terms for the main equation and dynamic component, respectively. This enhanced model incorporates the crucial aspect providing a more comprehensive understanding of the determinants of banking system stability in Ethiopia.
Diagnostic Tests
In the context of a Panel Regression Analysis with a System of GMM, several diagnostic tests can be employed to assess the validity and reliability of the model.

### 3.6.2 Unit root test for panel data

Determining the direction of causality among our main variables of interest Equity-to-Asset Ratio (ETA), Loans-to-Assets Ratio (LTA), Market Share of Mobilized Capital (MOB), loan loss provisions (LLP), Return on Equity (ROE), Return on Asset (ROA) and GDP Growth rate is important. To go further for econometric analysis, it is crucial to check whether the series of data is stationary or not. To check for unit root, the study used Levin, Lin, & Chu test and Im-Pesaran-Shin unit-root test. The Im-Pesaran-Shin (IPS) and Levin-Lin-Chu (LLC) tests are used in panel data analysis to evaluate the stationarity of variables. An essential premise of many econometric models is stationarity, which is the persistence of a variable's mean and variance across time.

The Levin-Lin-Chu Unit Root Test (LLC), This test was developed by Levin, Lin, and Chu (2002) and looks at whether unit roots, or non-stationarity, are present in each panel of a panel data set. Panel-specific intercepts, or average values, can be used, but trends in time cannot. Similar to a unit root test for a single time series, the LLC test performs Augmented Dickey-Fuller (ADF) regressions for each panel. The LLC test mathematically represented as:

$$\Delta y_{it} = \alpha_i + \beta y_{i,t-1} + \sum_{j=1}^{p} \gamma_{ij}\, \Delta y_{i,t-j} + \epsilon_{it}$$

Where $y_{it} = \ is\ the\ value\ of\ the\ series\ for\ cross-section\ i\ at\ t$

$\Delta, denotes\ the\ first\ difference\ operator\ \alpha_i, is\ the\ individual\ fixed\ effect$

$\beta, is\ the\ coefficient\ of\ the\ lagged\ level\ term\ (common\ across\ cross-sections)\ \gamma_{ij}, are\ the\ coefficients\ of\ lagged\ differences,\ \epsilon_{it}, is\ the\ error\ term$

After accounting for any autocorrelation in the error terms with an autoregressive term, the ADF regression aggregates the distinct ADF statistics from every panel into a solitary group statistic. If we can reject the null hypothesis of unit roots for all panels, this group statistic is compared with pre-established critical values based on the number of panels and periods (observations). This test applied on both independent dependent variables.

The Im-Pesaran-Shin Unit Root Test (IPS), This test, which was developed by Im, Pesaran, and Shin (2003), is more flexible than the LLC test. It can be used to test for stationarity in at least one panel (alternative hypothesis) or for unit roots in all panels (null hypothesis). Additionally, panel-specific intercepts and autoregressive terms are permitted. The IPS test performs separate ADF regressions for every panel, much like the LLC test does. After that, it takes into consideration the panel dimension and creates a group statistic by averaging the individual ADF statistics. It computation,

$$\Delta y_{i,t} = \alpha_i + \beta_i y_{i,t-1} + \sum_{j=1}^{p} \gamma_{ij}\, \Delta y_{i,t-j} + \epsilon_{it}$$

Where $y_{it} = \ is\ the\ value\ of\ the\ series\ for\ cross-section\ i\ at\ t$

$\Delta, denotes\ the\ first\ difference\ operator\ \alpha_i, is\ the\ individual\ fixed\ effect$

$\beta_i, is\ the\ coefficient\ of\ the\ lagged\ level\ term\ (common\ across\ cross-sections)$
$\gamma_{ij}, are\ the\ coefficients\ of\ lagged\ differences, \epsilon_{it}, is\ the\ error\ term$

The IPS test statistic is computed as:

$$IPS = \frac{1}{N}\sum_{i=1}^{N} t_i$$

To provide a test statistic that is more trustworthy, this group statistic is further modified for the quantity of panels and time periods. The adjusted statistic is compared with pre-determined critical values based on the test type (all panels have unit roots vs. at least one panel is stationary) and the number of panels and periods to determine if we can reject the null hypothesis. This test also applied on both independent dependent variables.

### 3.6.3 Hausman Specification Test

The Hausman test is a statistical hypothesis test that is used to evaluate two different parameter estimators. Two estimators are being compared: the random effects estimator and the fixed effects estimator. The Hausman test is used to determine if the estimator is more dependable or less likely to be biased. The fixed effects estimator is a simple estimate that may be used to account for time-invariant unobserved heterogeneity. The random effects estimator may be used to account for both time-varying and time-invariant unobserved heterogeneity, but it is a more complex estimate. The random effects estimator can only be consistent if and only if the individual effects are uncorrelated with the regressors, as indicated by the Hausman test. If each individual impact is connected to the regressors, the random effects estimator will be biased. The test involves estimating the coefficients of the model using both fixed effects and random effects approaches. It then compares these estimates to see if there is a systematic difference. If the estimates differ significantly, it suggests that the random effects model is inconsistent, and the fixed effects model should be used instead.

**Fixed effects model,**

$$y_{it} = \alpha_i + \beta X_{it} + \in_{it}$$

Where $y_{it} = is\ the\ dependent\ variable\ for\ individual\ i\ at\ time\ t,$ $\alpha_i, represents\ the\ individual\ specific\ effect, \in_{it}\ \ \beta\ is\ \ the\ vector\ of\ coefficients,$

$$X_{it}\ is\ the\ vector\ of\ explanatory\ variables, \in_{it}\ \ is\ the\ error\ term$$

Whereas the **Random Effect Model**

$$y_{it} = \alpha + \beta X_{it} + u_{it} + \in_{it}$$

Where $\alpha\ overall\ intercept, u_{it} is\ the\ rondom\ idvidual\ effect.$

Then the **Hausman Test Statistic:**

$$H = (\beta_{FE} - \beta_{RE})'(Var(\beta_{FE}) - Var(\beta_{RE})^{-1}(\beta_{FE} - \beta_{RE})$$

$$\beta_{FE}, \quad is\ the\ coefficient\ vector\ from\ the\ fixed\ effects\ model,$$

$$\beta_{RE} is\ the\ coefficient\ vector\ from\ the\ random\ effects\ model,$$

$$Var(\beta_{FE})\ \ is\ the\ variance -\ covariance\ matrix\ of\ the\ fixed\ effects\ estimator,$$

$$Var(\beta_{RE})\ is\ the\ variance - covariance\ matrix\ of\ the\ random\ effects\ estimator.$$

The test statistic HHH follows a chi-square distribution with degrees of freedom equal to the number of coefficients tested and applied on both independent and dependent variables

## 3.6.1 Hansen J Test

The validity of instruments is tested in the context of instrumental variables (IV) estimation using the Hansen J Test, commonly referred to as the J-test for overidentifying restrictions. It assesses if the regression's instruments are valid since they are uncorrelated with the error term.

The residuals from the IV estimate are examined in order to perform the test. The instruments shouldn't be associated with these residuals if they are legitimate.

The number of overidentifying limitations (instruments minus endogenous variables) is compared to the related residuals using the Hansen J Test. The instruments are associated with the residuals according to a significant test statistic, indicating that the instruments are not genuine (Hansen, 1982). The Hansen J Test is applied to the residuals of the instrumental variables regression and the instruments used in the model. In the context of banking stability, this might involve testing the validity of instruments like GDP growth, or other macroeconomic indicators used to instrument endogenous variables such as capital ratios or loan-to-deposit ratios. We compute the test statistic by looking at the correlation between the instruments and the residuals after doing an IV regression to acquire the residuals. Next, we compare the test statistic to a chi-square distribution. The null hypothesis that the instruments are valid is rejected if the statistic is significant.

### 3.6.2 Arellano-Bond Serial Correlation Test

When testing for serial correlation in the residuals of dynamic panel data models, the Arellano-Bond Serial Correlation Test is employed. In particular, it looks for serial correlation of both the first and second order, which is essential to the reliability of the (GMM) estimators Arellano & Bond (1991). The autocorrelation of the differenced residuals from the dynamic panel data model is investigated by the Arellano-Bond test. The instruments are deemed valid if the residuals from the first differenced equation exhibit considerable first-order autocorrelation but no significant second-order autocorrelation. Use GMM to estimate the dynamic panel data model then the first differenced equations, obtain the residuals. Conduct tests to determine if the differenced residuals have first-order (AR(1)) or second-order (AR(2)) serial correlation.

Mathematically, it computed as,

Considering Dynamic Panel Data Model,

$y_{it} = \alpha_i y_{i,t-1} + \beta X_{it} + \in_{it}$

Then First-Differenced Equation

$\Delta y_{it} = \Delta \alpha_i y_{i,t-1} + \Delta \beta X_{it} + \Delta \in_{it}$

From the above we can compute Arellano-Bond Test Statistics.

AR(1) Test for first order autocorrelation

$$\frac{\sum_{i=1}^{N} \sum_{t=2}^{T} \Delta \in_{it} \Delta \in_{i,t-1}}{\sqrt{Var(\sum_{i=1}^{N} \sum_{t=2}^{T} \Delta \in_{it} \Delta \in_{i,t-1})}}$$

AR(2) Test for second order autocorrelation

$$\frac{\sum_{i=1}^{N}\sum_{t=3}^{T}\Delta\epsilon_{it}\ \Delta\epsilon_{i,t-2}}{\sqrt{Var(\sum_{i=1}^{N}\sum_{t=3}^{T}\Delta\epsilon_{it}\ \Delta\epsilon_{i,t-2})}}$$

The residuals from the first differenced dynamic panel data model are subjected to the Arellano-Bond test. The test would be used in the context of banks stability to make sure that there is no significant serial correlation in the residuals from the GMM estimation of the banking stability model (i.e., stability indicators as dependent variables and bank-specific and macroeconomic factors as explanatory variables).

### 3.6.3 Endogeneity Test

According to Wooldridge (2010), when an independent variable and a dependent variable in a model have a relationship that is not causal but rather shows a two-way impact, this is known statistically as endogeneity. It can be challenging to determine the precise influence of the independent variable on the dependent variable because, to put it another way, both variables may be influencing one another at the same time. In particular, taking into account the independent variables indicated, endogeneity might occur in banking system stability analysis. Equity-to-Asset Ratio (ETA), while generally considered as a measure of bank health (independent variable), a higher ETA might also be a response to perceived banking system instability (dependent variable), creating endogeneity. Banks might increase capital buffers during periods of perceived risk. Loans-to-Assets Ratio (LTA) can be driven by bank risk appetite, which in turn could be affected by the perceived stability of the banking system. A stable banking system could induce more lending activity. Loans-to-Assets Ratio (LTA) can be impacted by bank risk appetite, which in turn could be affected by the perceived stability of the financial system. A stable banking system could induce more lending activity. A bank's market share can be impacted by general economic conditions (possibly connected to banking system stability) and its own lending activity. Economic downturns can affect both market share and stability (endogeneity). Bank profitability can be affected by overall economic conditions, which also influence banking system stability. A stable banking system might lead to improved profitability for banks.

Few typical techniques to handle endogeneity, one is employing Instrumental Variables (IV) approach. This strategy entails finding variables that are correlated with the endogenous variable (e.g., lagged values of the variable, industry-specific factors) but not directly influenced by the error term in the model. These instrumental variables can then be utilized to assess the real causal influence of the endogenous variable on the dependent variable. The second way to deal with endogeneity is to use System GMM, a methodology that enables the estimate of many equations at once while taking potential endogeneity between system variables into consideration. Carefully defining the moment circumstances and instruments is necessary. The study employed both methodologies.

**Hansons Sargan- Tests** are essential tools to evaluate the independent variables' possible endogeneity. By assessing validity of the moment criteria set in the system GMM estimation, it minimizes this concern. The error term, or disturbance, is limited by these moment constraints from being uncorrelated with the model's instrumentation. The test determines the validity of the overidentifying restrictions that the moment conditions imply. A statistically significant p-value (often less than 0.05) raises the possibility that endogeneity may be present and shows that the limitations may not hold true. The other is a test for the validity of the instrument set that is a broader specification test. A significant p-value in this case also raises the possibility of endogeneity-related problems with the instruments or model specification.

# CHAPTER FOUR

# 4. EMPERICAL RESULTS AND DISCUSSION

In this chapter, we apply both descriptive and econometric techniques of the data analysis to answer the research question. The factors pertinent to bank stability are the main focus of the descriptive study. We discuss the distribution of important metrics, including return on equity (ROE), equity-to-asset ratio (ETA), and loan-to-deposit ratio (LDR) as well as the unconditional relationships between these measures of bank stability. Under the econometric analysis part, we examine diagnostic tests to make sure they are appropriate for evaluating bank stability. In order to comprehend the correlations between the selected factors and their influence on bank stability and we present econometric results.

## 4.1. Descriptive Statistics

With the highest average ZSCORE of (69.29), Bank 6 has demonstrated outstanding stability during the time. Bank 16 (60.44) and Bank 5 (57.74) both have good rankings, demonstrating sound financial standing. Bank 1 (47.97), has a decent average ZSCORE but indicates possible instability swings. Concerns regarding their relative stability in comparison to other banks are raised by Bank 4 (17.00), Bank 7 (21.43), Bank 8 (18.01), Bank 8 (24.23), Bank 10 (23.34), Bank 14 (17.89), and Bank 15 (28.51).

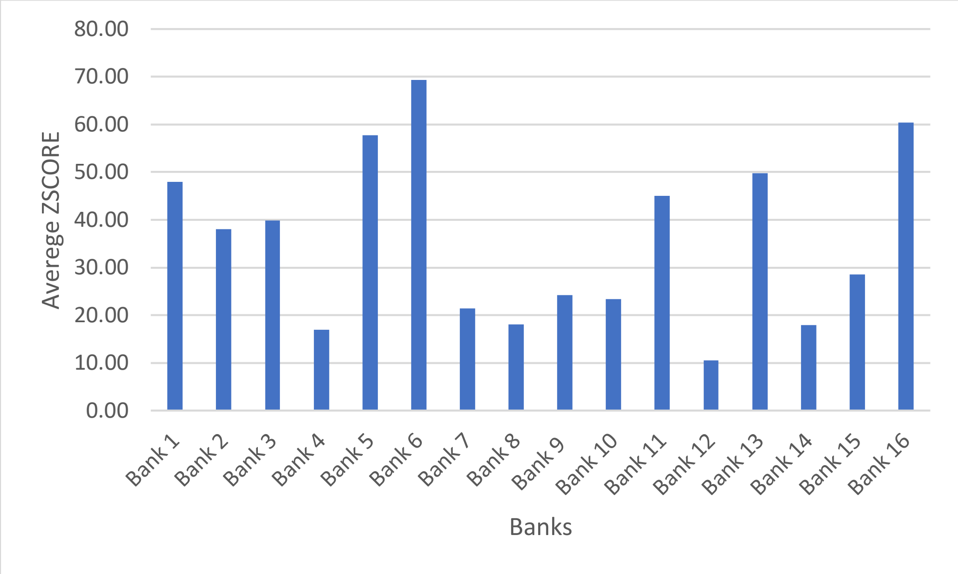



**Figure 4.1. Average Z-score of each bank in the Period of 2015–2023**

*Source: Author's Computation*

As we have seen in figure 4.2, a remarkable pattern is seen by examining the average ZSCORE for 16 banks during the last nine years. The average ZSCORE shows a steady rise from 2015 to 2019, reaching its highest point in the data set in 2019 with a value of 37.58. This pattern points to a possible uptick in bank stability generally over this time frame. It is possible that improved capital adequacy ratios or higher profitability have helped banks bolster their financial stability. But throughout the past three years (2020–2023), the situation has somewhat changed. The data shows that following the 2019 peak, the average ZSCORE has leveled off or plateaued. Even if there is a little increase between 2021 and 2023, it is far less than the previous growth. This implies that in recent years, bank stability may have slowed down or even achieved a new steady level

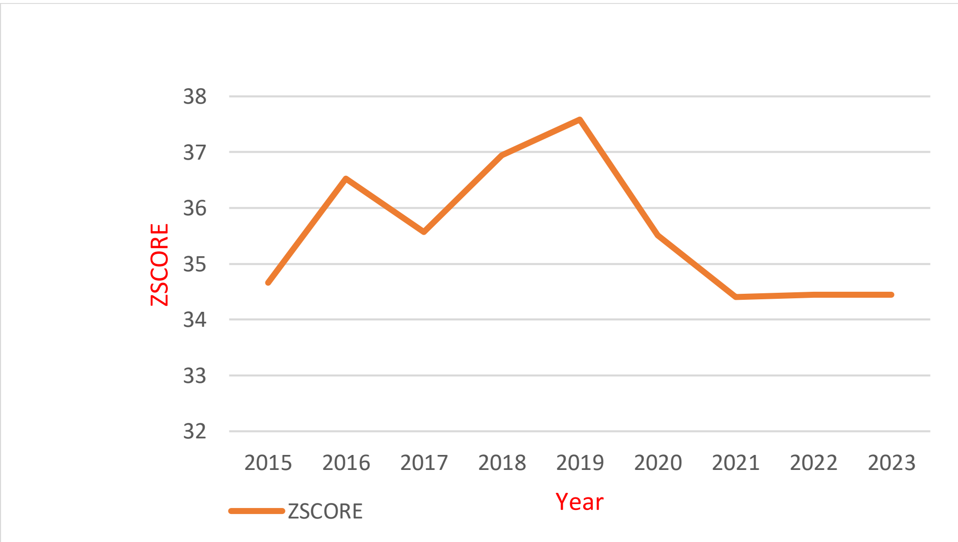


**Figure 4.2. Average Z-score in Banking Industry in the Period of 2015–2023**

*Source: Author's Computation*

The data shows a remarkable variation of stability experiences across the 16 banks when one looks past the average trend. There have been ups and downs in the cycle of Bank 1, suggests that there have been oscillations in its stability during the nine-year period. On the other hand, Bank 2 has an ongoing trend of growth, peaking prior to a little downturn in recent times. The two banks with the most unexpected changes are Bank 11 and Bank 3. Conversely, the Bank 2 demonstrates exceptional stability during the time, with almost constant levels of stability. However, Bank 16 stands out due to its noticeably declining stability

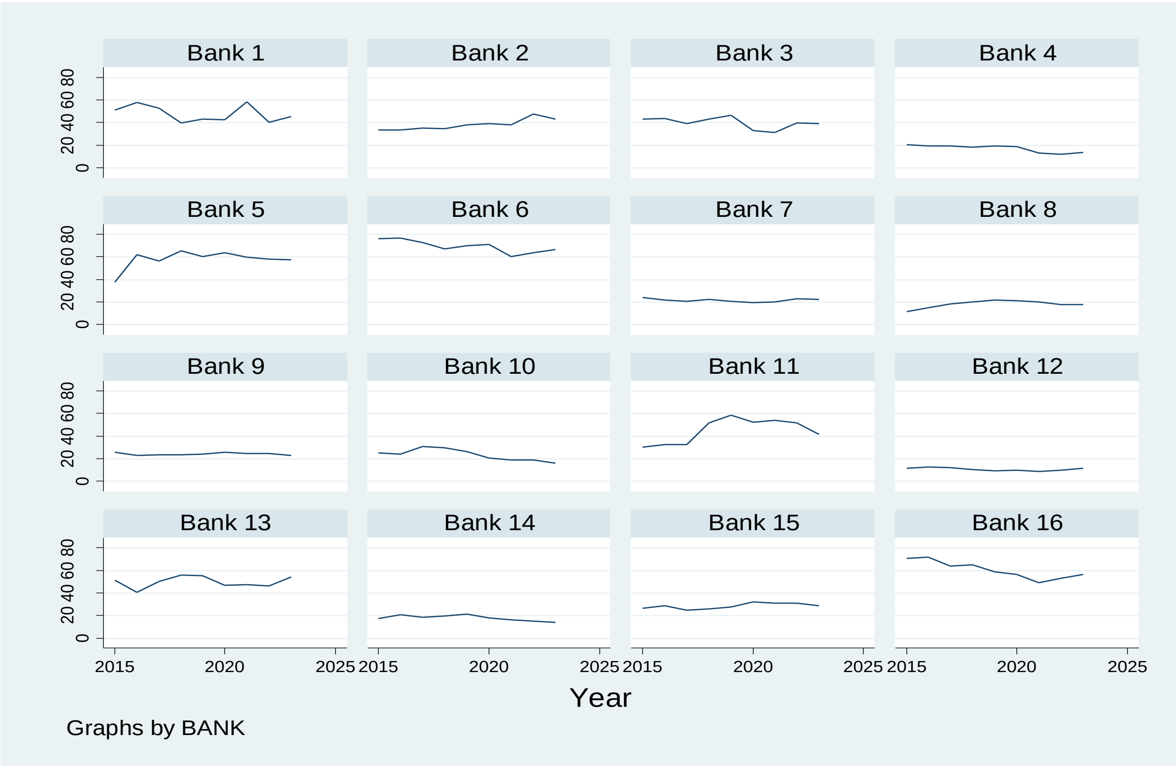



**Figure 4.3. Z-score of Private Commercial Banks in the Period of 2015–2023**
*Source: Author's Computation*

Table 4.1 presents the summary statistics of key variables of interest. The results show that the sample's banks appear to have a generally excellent degree of solvency, as indicated by the average ZSCORE of 35.57. The standard deviation of the variable, 18.17, suggests a notable difference across banks, with a possibility that some have lower levels of solvency.

With an average loan-to-deposit ratio (LDR) of 72.9%, banks are lending out more than 70% of the consumer deposits they receive. This might have both positive and negative implications for bank system stability. If a high LDR results in more loans to both consumers and companies, this can be considered a good thing. This can encourage development and economic activity by supplying money for spending and investment. Banks are essential in directing deposits toward the economy's more constructive purposes (Mishkin, 2007). Still, there are issues with the stability of the banking system when there is a large LDR. Less liquid assets are easily accessible for banks to cover unforeseen withdrawals or loan defaults when they lend out a significant amount of their deposit base. According to Acharya et al. (2014), this may result in issues with liquidity and may even cause bank collapses if depositors begin to lose faith in the scheme.

The average equity-to-asset ratio (ETA) of 13.3% indicates a potential concern for bank system stability, but the level of concern depends on the following two contexts. First, A low ETA suggests that banks have a little capital cushion. This ratio indicates the percentage of a bank's assets that are funded by its own capital. According to Aziz and Greenwood (2011), a lower ratio indicates a smaller buffer in relation to total assets. Because of this, banks are more susceptible to suffering losses as a result of loan defaults, recessions, or unforeseen circumstances. A substantial reduction in a bank's capital might result in insolvency and jeopardize the stability of the financial system as a whole. Secondly, the 0.030 standard deviation indicates that the different banks' ETAs may not differ much from the average 13.3%. This suggests that a sizable percentage of banks may be concentrated around this low capital level, increasing the possibility of systemic risk in the event of a crisis.

When considering the overall assets under their management, banks appear to be making a low profit on average, as indicated by their average return on assets (ROA) of 2.4%. There are two possible ways that this might affect the stability of the banking sector. It is challenging for banks to hold onto earnings and develop capital reserves naturally when they are not profitable. Underlying possible losses from loan defaults, recessions, or unforeseen circumstances are cushioned by capital buffers. Banks are less able to fortify their capital positions when ROA is lower, which might make them more susceptible to financial shocks and raise questions about the stability of the system (Brunnermeier et al., 2016). Moreover, banks are earning a strong return on shareholders' investments, as seen by their average return on equity (ROE) of 26.8%. This looks to be profitable and might help maintain the stability of the banking system. But extremely high ROE may also indicate riskier lending methods used to maximize returns, raising the possibility of losses and endangering stability over time (Berger and Bouwman, 2009). For a final determination, a more thorough examination taking into account other profitability ratios and risk measures would be required.

When we are looking at the relationship between a bank's historical performance (ZSCORE) and its present or future performance because lagged ZSCORE (L1. ZSCORE) is present. This link may be better understood by examining the correlation between lagged ZSCORE and current ZSCORE or by employing lagged ZSCORE as a predictor in a regression model. In a similar vein, additional analysis of Capital Adequacy Ratios (such as LTA) might help comprehend the capital buffers that these banks uphold.

**Table 4.1. Summary Statistics of Variables**

| Variables | Obs | Mean | SD | Min | Max |
|---|---|---|---|---|---|
| Dependent Variable | | | | | |
| Z-Score | 144 | 35.567 | 18.1758 | 8.639618 | 76.73 |
| Independent Variables | | | | | |
| L1. ZSCORE | 144 | 35.707 | 18.229 | 8.640 | 76.727 |
| ETA | 144 | 0.133 | 0.030 | 0.063 | 0.205 |
| ROA | 144 | 0.024 | 0.008 | 0.003 | 0.049 |
| LTA | 144 | 0.562 | 0.095 | 0.293 | 0.759 |
| ROE | 144 | 0.268 | 0.112 | 0.112 | 0.575 |
| MOB | 144 | 0.141 | 0.035 | 0.063 | 0.259 |
| LDR | 144 | 0.729 | 0.121 | 0.409 | 1.044 |
| LLP | 144 | 0.019 | 0.016 | 0.002 | 0.113 |
| GDP | 144 | 0.156 | 0.225 | 0.053 | 0.788 |

*Source: Author's Computation*

If our data is structured as panel data the by default pairwise correlations calculate within each panel unit. With 16 banks and 9 years, we have 144 observations (16 banks * 9 years). However, correlation might be calculating the correlation within each bank (16 sets of correlations, one for each bank with 9 observations each), resulting in 128 observations (16 banks * 8 correlations, excluding the correlation of a variable with itself. Including ZSCORE, the lagged ZSCORE (L. ZSCORE), and other bank performance factors are displayed in the following table. The linear link between two variables' strength and direction are measured by correlation coefficients. Perfect positive correlation is represented by a value of +1, perfect negative correlation by a value of -1, and no linear relationship by a value of 0. We examined the correlation among the different variables used in this paper.

As shown on Table 4.2, ZSCORE and the lagged ZSCORE (L.ZSCORE) have Statistically significant positive correlation (0.955). This implies that there is a positive correlation between a bank's performance in the previous period and its current performance. Put differently, banks that have historically performed well also typically do well now, and vice versa. As anticipated, there is also a significant strong positive connection (0.859) between LDR and LTA (Loan-to-Asset Ratio). Higher percentages of assets are often funded by loans (high LTA) in banks that depend more heavily on deposits for lending (high LDR). LDR, however, has poor relationships with the majority of other factors.

The relationship between ETA and ZSCORE (0.39) is a significant moderate positive association, suggesting that banks with larger equity capital ratios often have more stable operations. This is probably because having greater money protects against future losses. The majority of other variables have poor associations with ROA (Return on Assets) Given that ROE and MOB have a weakly positive association (0.434), banks with better return on equity may be valued more highly than their book value.

There is a substantial positive association between the market share of mobilized capital (MOB) and earnings surprises (ETA), and a large negative correlation between MOB and shareholder equity ratio (ETA). This implies that businesses with higher market shares of mobilized capital are typically those with good earnings surprises and lower shareholder equity. In this perspective, it is important to understand what "mobilized capital.

There is a somewhat positive association between RGDP and LDR (0.4609) and LTA (0.3911). This implies that banks may have a greater loan-to-deposit ratio and a higher percentage of assets funded by loans in areas with faster economic development. But there aren't many strong relationships between RGDP and other performance indicators.

**Table 4.2. Pairwise correlations**

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) ZSCORE | 1.000 | | | | | | | | | |
| (2) L.ZSCORE | 0.955 | 1.000 | | | | | | | | |
| | (0.000) | | | | | | | | | |
| (3) LDR | 0.037 | 0.051 | 1.000 | | | | | | | |
| | (0.662) | (0.566) | | | | | | | | |
| (4) ETA | 0.390 | 0.301 | -0.005 | 1.000 | | | | | | |
| | (0.000) | (0.001) | (0.952) | | | | | | | |
| (5) ROA | 0.021 | -0.020 | -0.144 | 0.010 | 1.000 | | | | | |
| | (0.806) | (0.824) | (0.086) | (0.906) | | | | | | |
| (6) LTA | 0.161 | 0.178 | 0.859 | -0.012 | -0.201 | 1.000 | | | | |
| | (0.054) | (0.045) | (0.000) | (0.885) | (0.016) | | | | | |
| (7) ROE | 0.162 | 0.170 | 0.031 | -0.323 | 0.426 | 0.132 | 1.000 | | | |
| | (0.053) | (0.055) | (0.715) | (0.000) | (0.000) | (0.114) | | | | |
| (8) MOB | -0.004 | -0.026 | -0.209 | 0.279 | 0.434 | -0.361 | -0.456 | 1.000 | | |
| | (0.960) | (0.767) | (0.012) | (0.001) | (0.000) | (0.000) | (0.000) | | | |
| (9) LLP | -0.346 | -0.360 | 0.134 | -0.045 | -0.377 | 0.113 | -0.276 | -0.146 | 1.000 | |
| | (0.000) | (0.000) | (0.108) | (0.594) | (0.000) | (0.176) | (0.001) | (0.081) | | |
| (10) RGDP | -0.021 | -0.026 | 0.445 | -0.067 | -0.034 | 0.385 | 0.040 | -0.093 | 0.079 | 1.000 |
| | (0.807) | (0.774) | (0.000) | (0.423) | (0.689) | (0.000) | (0.633) | (0.267) | (0.345) | |

*Source: Author's Computation*

## 4.2. pre-estimation tests

Here are some of the most common pre-estimation tests conducted before running a system GMM estimation

### 4.3.1 Unit Root Tests

According to the GMM system, there is no pattern or seasonality in the variables across time. For stationarity in the levels or initial differences of the variables, unit root tests such as the KPSS or Augmented Dickey-Fuller (ADF) test are used. It may be required to do pre-treatment such as differencing in cases when non-stationary variables result in erroneous regressions.

For applied researchers, testing for unit roots in time-series studies is standard procedure. Levin and Lin (1992), Im, Pesaran and Shin (1997), Harris and Tzavalis (1999), Maddala and Wu (1999), Choi (1999a), and Hadri (1999) are among the recent studies that have tested for unit roots in panels. As long as the panel is balanced and each cross-section's t-statistics for the unit-root are identically distributed to have the same variance and mean, the IPS test can, in theory, be used in conjunction with any parametric unit-root test.

Although the IPS test needs a balanced panel, it is the test most generally used in practice since it is straightforward and easy to implement.

**Levin-Lin-Chu test presented below has breakdown:**

**Unadjusted t-statistic:** This provides an initial indication and the raw test statistic calculated by the Levin-Lin-Chu test based on the ZSCORE data. However, the unadjusted t-statistic doesn't account for the small sample size (number of periods) relative to the number of panels (cross-sectional units) in our data, meaning it's not reliable for small samples.

**Adjusted t*:** This is the unadjusted t-statistic adjusted for the small sample size. This value used as critical values specific for panel data for The Levin-Lin-Chu test to determine statistical significance. The adjusted t* statistic and the corresponding p-value are used for drawing conclusions about stationarity based on the adjusted critical values for panel data

**P-value:** the p-value reported is based on the adjusted t statistic*.

**Im-Pesaran-Shin (IPS) unit-root test breakdowns:**

**t-bar:** This statistic is an intermediate value used in the calculation of the IPS test statistic. It doesn't have a direct interpretation on its own.

**t-tilde-bar:** This statistic is another intermediate value used in the IPS test statistic. It's also not directly interpretable on its own.

**Z-t-tilde-bar:** This statistic is the adjusted version of the t-tilde-bar statistic. It accounts for the panel dimension (number of panels) and is used to compare with critical values for determining stationarity with corresponding p-value

**Table 4.3. Im-Pesaran-Shin unit-root test & Levin-Lin-Chu unit-root test Result**

| Variables | Levin-Lin-Chu unit-root test | | | status | Im-Pesaran-Shin unit-root test | | | | Status |
|---|---|---|---|---|---|---|---|---|---|
| | Unadjusted t | Adjusted t* | p-val | | t-bar | t-tilde-bar | Z-t-tilde-bar | p-value | |
| ZSCORE/Bank system stability | -7.365 | -3.33 | 0.0004 | Stationary | -2.131 | -1.50 | -1.424 | 0.0772 | Stationary |
| LDR | -2.691 | -0.59 | 0.2769 | Non-Stationary | -0.389 | -0.37 | 4.8166 | 1 | Stationary |
| Equity-to-Asset Ratio (ETA) | -7.386 | -4.085 | 0.0000 | Stationary | -1.845 | -1.36 | -0.6210 | 0.2673 | Non-Stationary |
| Differenced. Equity-to-Asset Ratio (ETA) | -8.872 | 4.92 | 0 | Stationary | -3.265 | -1.86 | 3.6298 | 0.0001 | Stationary |
| Return on Asset (ROA) | -8.715 | -3.86 | 0.0001 | Stationary | -2.398 | -1.75 | -2.7645 | 0.0029 | Stationary |
| Loans-to-Assets Ratio (LTA) | -1.893 | 0.27 | 0.3938 | Stationary | -0.44 | -0.40 | 4.6342 | 1 | Stationary |
| Differenced. Loans-to-Assets Ratio (LTA) | -10.28 | 5.57 | 0 | Stationary | -3.42 | -1.96 | -4.1667 | 0 | Stationary |
| Return on Equity (ROE) | -12.31 | -8.74 | 0 | Stationary | -2.339 | -1.78 | -2.9726 | 0.0015 | Stationary |
| Market Share of Mobilized Capital (MOB) | -8.15 | -6.02 | 0 | Stationary | -1.56 | -1.37 | -0.7087 | 0.2393 | Stationary |
| Differenced. Market Share of Mobilized Capital (MOB) | 10.37 | -5.41 | 0 | Stationary | -3.18 | -1.90 | 3.8458 | 0.0001 | Stationary |
| loan loss provisions (LLP) | -6.54 | -3.12 | 0.0009 | Stationary | -1.617 | -1.36 | -0.613 | 0.2699 | Stationary |
| GDP Growth rate (RGDP) | -7.50 | 77.33 | 1 | Stationary | -1.43 | -1.3 | -0.498 | 0.3092 | Stationary |

*Source: Author's Computation*

The output table above shows that, despite the fact that some are not stationary at the level, all of them became stationary at the first difference (even at the 1% significance level), indicating that the unit root of the data in this research is not a concern.

### 4.3.2 Serial Correlation/ Autocorrelation

The connection between a variable's current values and its lagged (previous) values is referred to as serial correlation, often called autocorrelation. Serial correlation tests determine if the error components in our model are serially correlated in the context of GMM (Generalized Method of Moments) estimation. The GMM estimates may be inefficient and have larger variances than necessary if the mistakes are serially connected. The accuracy of our findings may be impacted by this. An essential step in verifying the validity of a two-step system GMM model is evaluating serial correlation in the residuals. Nevertheless, the Arellano-Bond (AB) AR tests, the standard test used in the Arellano-Bond (AB) difference GMM estimator, are not directly applicable to two-step system GMM. This is because the two-step system GMM technique lacks the differencing transformation that is utilized in AB-GMM.

The method that is frequently employed to diagnose serial correlation in two-step system GMM is the Sargan-Hansen Tests, which evaluate the moment conditions' validity. A statistically significant Sargan or Hansen test statistic may suggest model misspecification, which may include serial correlation, even though it is not a direct test for serial correlation. The other is, these tests, the autocorrelation patterns in the system GMM residuals are directly analyzed. But it's crucial to recognize that because there is no differencing in these tests, they might not be as effective as the AB AR tests (Arellano and Bond, 1991).

Wooldridge test for autocorrelation

**Null Hypothesis (H0):** No first-order autocorrelation in the residuals

**Alternative Hypothesis (Ha):** There is first-order autocorrelation in the residuals

**Table 4.4. Wooldridge test for autocorrelation in panel data**

| Wooldridge test for autocorrelation in panel data | |
|---|---|
| H0: no first-order autocorrelation | |
| F( 1, 15) | 10.174 |
| Prob > F | 0.0061 |

*Source: Author's Computation*

The very small p-value (0.0066) leads us to reject of the null hypothesis of no first-order autocorrelation. This statistically significant result suggests that the error terms in our model are likely serially correlated. In simpler terms, the error term in one period is correlated with the error term in the previous period. with serial correlation, the coefficient estimates might be inefficient, meaning their variances are larger than necessary. This can make it harder to draw statistically significant conclusions from our hypothesis tests. In severe cases, serial correlation can lead to biased estimates, where the coefficients do not accurately reflect the true relationships between variables. Depending on the severity of the autocorrelation and your research question, we have used robust **GMM** which can be less sensitive to serial correlation. There are situations in which serial correlation might indicate endogeneity, although this is not always the case. Endogeneity and serial correlation can both result from omitted factors, measurement errors, or reverse causality (Wooldridge, 2010). A red sign indicating that we should look at any endogeneity problems in our model is serial correlation. our estimates' efficiency is mostly impacted by serial correlation, although endogeneity can skew them. Finding serial association does not prove endogeneity; rather, it points to the need for more research.

### 4.3.3 Heteroskedasticity

**Null Hypothesis (H0):** where the variance of the error term (ε) is constant across different values of the independent variable(s) or $\boldsymbol{\sigma_i^2} = \boldsymbol{\sigma^2}$.. This indicates that for all groups (i) in the panel data, variance of the error terms or residuals which $\boldsymbol{\sigma^2}$ is constant. Stated differently, each group's residuals in the model have the same distribution (homoskedasticity).

**Alternative Hypothesis (Ha):** For every i, $\boldsymbol{\sigma_i^2} \neq \boldsymbol{\sigma^2}$. This indicates that the error term's variation varies throughout groups. Put otherwise, the residuals of the model exhibit heteroskedasticity, meaning that their spreads vary depending on the group.

The Breusch-Pagan LM test is a popular test for heteroskedasticity, or uneven variance of residuals, in two-step system GMMs. This test verifies the null hypothesis, according to which the variance of the error terms in your model is constant. Heteroskedasticity is indicated by a statistically significant LM test statistic, often with a low p-value.

The subsequent table presents a robust rejection of the homoskedasticity null hypothesis in our fixed-effects regression model. There is compelling evidence in our fixed-effects regression model that the error term's variance is not constant across all groups. This points to the possibility of heteroskedasticity, which might defy model assumptions and result in skewed standard errors and inaccurate coefficient estimations.

**Table 4.5. Modified Wald test for groupwise heteroskedasticity**

| Modified Wald test for groupwise | |
|---|---|
| in fixed effect regression model | |
| $\boldsymbol{\sigma^2}$. for all i | |
| chi2 (16) | 5259.38 |
| Prob>chi2 | 0.000 |

*Source: Author's Computation*

To address this, we employ robust standard errors. This is less susceptible to heteroskedasticity than traditional standard errors.

### 4.3.4 Endogeneity Tests

endogeneity happens when there is a correlation between an independent variable (explanatory variable) and the error term (e) in a regression model. Ordinary least squares (OLS) regression assumptions are broken by this association, which results in skewed and untrustworthy coefficient estimates.

**Table 4.6. Pairwise Correlation Coefficients**

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) e | 1.000 | | | | | | | | | |
| | | | | | | | | | | |
| (2) ZSCORE | 0.769* | 1.000 | | | | | | | | |
| | (0.000) | | | | | | | | | |
| (3) LDR | 0.000 | 0.037 | 1.000 | | | | | | | |
| | (1.000) | (0.662) | | | | | | | | |
| (4) ETA | 0.000 | 0.390* | -0.005 | 1.000 | | | | | | |
| | (1.000) | (0.000) | (0.952) | | | | | | | |
| (5) ROA | 0.000 | 0.021 | -0.144 | 0.010 | 1.000 | | | | | |
| | (1.000) | (0.806) | (0.086) | (0.906) | | | | | | |
| (6) LTA | 0.000 | 0.161 | 0.859* | -0.012 | -0.201* | 1.000 | | | | |
| | (1.000) | (0.054) | (0.000) | (0.885) | (0.016) | | | | | |
| (7) ROE | 0.000 | 0.162 | 0.031 | -0.323* | 0.426* | 0.132 | 1.000 | | | |
| | (1.000) | (0.053) | (0.715) | (0.000) | (0.000) | (0.114) | | | | |
| (8) MOB | 0.000 | -0.004 | -0.209* | 0.279* | 0.434* | -0.361* | -0.456* | 1.000 | | |
| | (1.000) | (0.960) | (0.012) | (0.001) | (0.000) | (0.000) | (0.000) | | | |
| (9) LLP | 0.000 | -0.346* | 0.134 | -0.045 | -0.377* | 0.113 | -0.276* | -0.146 | 1.000 | |
| | (1.000) | (0.000) | (0.108) | (0.594) | (0.000) | (0.176) | (0.001) | (0.081) | | |
| (10) RGDP | 0.000 | -0.021 | 0.445* | -0.067 | -0.034 | 0.385* | 0.040 | -0.093 | 0.079 | 1.000 |
| | (1.000) | (0.807) | (0.000) | (0.423) | (0.689) | (0.000) | (0.633) | (0.267) | (0.345) | |
| *** *p*<0.01, ** *p*<0.05, * *p*<0.1 | | | | | | | | | | |

***Source: Author's Computation***

The correlation coefficient between "e" and "ZSCORE" is 0.769, indicating a positive linear relationship between the two variables. A positive correlation coefficient implies that when "ZSCORE" values rise, so do "e" values; conversely, when "ZSCORE" values fall, so do "e" values. It is important to remember that the correlation coefficient measures the strength and direction of a linear relationship, not necessarily a cause-and-effect relationship. The fact that "e" is the error term is critical; ideally, the error term should not be correlated with any of the explanatory variables in the model. A correlation between "e" and "ZSCORE" could indicate some issue with omitted variables or other causes for endogeneity. When a relevant variable is left out of the regression model, it leads to omitted variable bias. The error term and the included explanatory factors may be associated with this missing variable. Biased estimations of the coefficients for the included variables result from the error term, which then represents the combined influence of the unexplained error and the omitted variable. It is possible that omitted variable bias is indicated by a correlation between the error term (e) and (ZSCORE) in our regression model, and missing variables are most likely lagged dependent variables.

It's possible that the model is lacking a pertinent variable that explains "L.ZSCORE" and the dependent variable. The impact of this missing variable would then be captured by the error term, resulting in a correlation with "L.ZSCORE." Dynamic Panel GMM estimation may be used. This estimator can manage possible endogeneity problems and is intended for models with lagged dependent variables. Using an IV technique, we may find legitimate instruments that exhibit correlation with the missing lag dependent variable but not with the error term. This entails identifying factors that have an impact on the missing variable but have no direct effect on the dependent variable that is being used (ZSCORE).

## 4.3. Dynamic panel-data estimation, Two-step system GMM

The Hausman test can be used to determine which model best fits the data characteristics; testing for autocorrelation, heteroskedasticity, according to Wooldridge (2002), pooled OLS makes sense when each entity has a distinct sample (cross-sectional data). Random or fixed effects are, however, typically favored for panel data including repeated observations on the same items. Although GLS may handle some problems like as autocorrelation and heteroskedasticity, it necessitates certain presumptions regarding the nature of the error term. It may not always be the "best choice" when analyzing panel data. It is useful practice to verify coefficient robustness with pooled OLS and FE. According to Arellano and Bond's (1991) both pooled OLS and FE methods do not necessarily address the regression between regressors and error terms; rather, it addresses autocorrelation in dynamic panel data. Model's multicollinearity is also essential to guarantee model validity.

In dynamic models when there is possible endogeneity, or a connection between the error term and explanatory factors, the (GMM) is frequently a more reliable method than pooled OLS , FE, or RE. GMM can produce more accurate estimates and lessen the impact of endogeneity bias. Factors influencing the banks stability can be estimated using pooled OLS, FE and RE, especially to correct diagnostics problems by using GLS and GMM. The result has been reported in Table 4.7.

**Table 4.7. Regression Results**

| Variables | POLS | FE | RE | GLS | Two-step system GMM |
|---|---|---|---|---|---|
| ZSCORE | Dependent variable | | | | |
| Zscore_1 | NA | NA | NA | NA | .5422371 ***(0.117) |
| LDR | -41.124**(20.69) | 1.233(3.83) | 1.03(3.87) | -46.579**(20.17) | -24.45384*(14.889) |
| ETA | 279.246***(44.14) | 228.748***(8.78) | 229.030***(8.88) | 246.117***(40.3691) | -134.6653** (62.666) |
| ROA | -955.110***(278.31) | 16.685(53.79) | 11.403(54.43) | -804.46***(263.85) | |
| LTA | 77.499**(26.89) | 1.187(5.26) | 1.496(5.32) | 2.207***(25.76) | 159.8049***(61.06) |
| ROE | 80.474***(20.17) | 7.443*(4.39) | 7.918*(4.44) | 65.103**(16.21) | -71.22495 ***(32.189) |
| MOB | 161.507 **(62.97) | 35.873***(12.72) | 36.12***(12.87) | 80.49*(48.11) | 383.3041***(99.087) |
| LLP | -41.124 ***(81.47) | 5.991(14.59) | 4.925**(14.77) | -386.543***(76.50) | |
| RGDP | -0.326(5.99) | 0.249(0. .83) | 17.620*(0.84) | -0.326(5.803457) | 17.5209***(6.72) |
| _cons | -30.41***(14.87) | -4.093(2.70) | .243***(4.74) | -30.41**(14.40) | 120.2248***(46.108) |
| No of Obs. | 144 | | | | |
| No of groups | 16 | | | | |
| InVs | 57 | | | | |
| Mean | 2.83 | | | | |

| | | | |
|---|---|---|---|
| VIF | | | |
| Breusch- Pagan test | | Test | 0 |
| | | chibar2(01) | 347.36 |
| | | Prob > chibar2 | 0.00 |
| AR(2) | Pr > z = 0.179 | | |
| Sargan test | Prob > chi2 = 0.374 | | |
| Hansen test | Prob > chi2 = 1.000 | | |
| Note: (***), (**), (*) denote for the significant level of 1%, 5%, and 10%, respectively. The standard errors are in parentheses | | | |

**Hausman (1978) specification test**

| | Coef. |
|---|---|
| Chi-square test value | 0 |
| P-value | 1.25 |

***Source: Author's Computation***

The model's test and regression results are displayed in Table 4.7. First, multicollinearity is not present since, according to variance inflation factors (VIF), the value of VIF is 2.83 and less than 10. The model exhibits heteroskedasticity and autocorrelation, as demonstrated by the results of the Breusch-Pagan test for heteroskedasticity with Prob>chi2 = 0.0000 and GLS, or generalized least square, is taken into consideration to solve the issues. Furthermore, based on the results of the Hansen test with Prob > chi2 = 1.0, the Sargent test with Prob > chi2 = 0.34, and the test of AR(2) with Pr > z = 0.179, it was possible to determine the correlation between the observation matrix (the regressors) and the error terms. These tests concluded that the absence of endogeneity was resolved and that GMM was a better fit for the model. According to Bond et al. (2001), the corresponding fixed effects estimate should be regarded as a lower-bound estimate, while the POLS estimate for coefficient of regression should be regarded as an upper-bound estimate. The system GMM should be chosen in this instance as the difference GMM estimate we got is less than the fixed effects estimate, and the system GMM's coefficient of regression is in the center of the coefficients of regression from POLS and FE. we next interpret the findings paying particular attention to comprehending how the major explanatory variables affect the dependent variable, i.e., ZSCORE of the estimated coefficients, their implications, and their economic significance.

***Zscore the year prior (Zscore_1):*** The outcome shows that Zscore_1's coefficient is statistically and positive. It is preferable to suggest that the bank's stability from the prior year have a beneficial effect on it this year. The findings implies that greater values of the dependent variable in the current period are connected with larger lagged Z scores, which may indicate prior risk or performance. This relationship is statistically significant, with an effect size of 0.542, indicating that economically strong effect.

***Equity-To-Asset Ratio (ETA):*** An association with banks system stability is indicated by the statistically significant p-value (0.032) and the negative coefficient (-134.665) for the lag difference of the independent variable (L2D). This implies that lower financial system stability in the current period is connected with higher efficiency values from two periods ago (L2D). To put it another way, banks that did better the last two times could be more vulnerable to volatility this time.

***Return on Equity (ROE):*** The coefficients of both the lagged and level ROE are negative and statistically significant, indicating an inverse relationship between historical profitability and the stability of the banking sector today. This suggests that banks that have historically had very high ROE (either at the current level or over a lagged term) may be more vulnerable to volatility in the present. ROE Coefficient (-71.225). This negative coefficient may point to unsustainable practices or a market correction that could cause instability in the future for banks with extremely high current profitability. Lagged ROE statistically significant coefficient (-113.197).

***Market Share of Mobilized Capital (Mob):*** The difference in mobilized share capital has a positive and statistically significant coefficient (383.3041), indicating a possible positive correlation between changes in bank capital and the stability of the current banking system. We are unable to evaluate the effect of the capital level directly since the lag term is missing. According to the positive coefficient, banks that raised their mobilized share capital in the current period for example, by issuing additional shares might be linked to higher levels of bank system stability. This might occur because, a bank with higher capital is better able to withstand financial shocks since it acts as a buffer against possible losses. Raising capital could be interpreted as a vote of confidence from authorities and investors, enhancing the general stability and health of the bank.

***Economic Growth (Real GDP Growth Rate):*** Macroeconomic factors like economic growth are known to influence bank system stability. A potential positive correlation between the stability of the current banking system and a recent shift in economic growth is suggested by the positive and statistically significant coefficient (17.5209, p-value 0.009). This may suggest that a more stable banking system may be linked to periods of economic expansion, possibly as a result of elements like increased loan demand, increased bank profitability, and less credit risk. On the other hand, a steep reduction in economic growth (negative difference) may indicate a drop in stability since banks may see a rise in loan defaults and consequent losses. The difference in RGDGR has a positive and significant coefficient, indicating that there may be a connection between increased financial system stability and recent gains in economic growth. The two step GMM omitted the variables which are highly sensitive to multicollinearity, ROA and LLP in our case.

## 4.4. Discussion

Studies indicate that bank performance has a certain level of tenacity. Research on this persistence by Demsetz & Strahan (1997) and Berger & Humphrey (1997) suggests that good performance in one period may translate to improved performance in other periods. The findings implies that greater values of the dependent variable in the current period are connected with larger lagged Z scores, which may indicate prior risk or performance. This relationship is statistically significant, with an effect size of 0.542, indicating that economically strong effect.

This negative coefficient of the above result supports the hypothesis that extraordinarily high past returns could be a risk factor for a lagged ROE term (presumably ROE from the prior period). The hypothesis that very high previous returns might be a risk factor for future profitability is supported by the negative coefficient on the lag ROE term. To put it another way, banks that had previously had extraordinarily high ROE may have inflated their returns by using riskier tactics like aggressive lending or laxer credit rules. The current analysis shows that these riskier strategies may eventually backfire, resulting in loan defaults and diminished profitability in later decades. This result is consistent with earlier study by Demirgüç-Kunt and Detragiache (1998), who discovered a negative correlation between historical high returns and future bank profitability. These findings imply that taking excessive risks in the hope of making quick money might have unfavorable long-term effects.

As previously indicated, in order to increase profits, banks with extremely high ROE in the current or prior era may have turned to aggressive lending, excessive risk-taking, or loose underwriting requirements The relationship between bank risk-taking and profitability in Spain was studied by Campuzo and Rojo (2004). According to their findings, banks that had previously experienced greater profitability tended to engage in riskier lending practices, which may have made them more susceptible to future crises. These behaviors might not be able to be sustained, which could result in losses, defaults, and eventually instability. A correction in the market may also be indicated by the negative association. A bank may come under regulatory scrutiny or see a natural correction in profitability in the upcoming period(s) if its ROE is disproportionately high when compared to its rivals. This can lead to a deterioration in the stability of the banking system.

According to certain research, bank capital contributes to the maintenance of financial stability. In order for banks to sustain lending during financial crises and absorb losses, Brunnermeier et al. (2016) emphasize the significance of capital buffers. This is consistent with the notion that higher capital might support the stability of the banking sector. The relationship between capital restrictions and bank risk-taking is examined by Acharya et al. (2014). They discover that more stringent capital requirements may encourage banks to take on less hazardous ventures, which might result in a more stable banking sector.

Several research back up the favorable correlation seen here, In India, Sahoo & Mohapatra (2010) discover a favorable correlation between bank profitability and economic growth. This is consistent with the idea that economic expansion might improve bank conditions and possibly bring about stability. Levine (1998) investigates the relationship between economic expansion and financial development. His work implies that there may be a two-way relationship between economic growth and a sound and stable banking system, even though it is not directly tied to bank stability.

## CHAPTER FIVE

# 5. CONCLUSIONS AND POLICY RECOMMENDATION

## 5.1. CONCLUSIONS

Not only is the idea that a stable banking system and economic expansion go hand in hand, but historical occurrences like the 2008 financial crisis also support this reality. When banks fail, the credit system collapses, businesses find it difficult to make investments, and consumers consumption may decline. This cascading effect impairs economic output, resulting in recessions and general misery. On the other hand, a thriving economy depends on a sound and stable banking system. The vital component that banks supply to businesses in order for them to grow, invest, and generate jobs is credit. Furthermore, public trust is increased by a healthy financial system, which motivates people and businesses to save and invest and accelerates economic growth.

The aim of the study is to investigate the key determinants of a bank's stability using yearly data from the banking sector for the years 2015–2023. The panel generalized method of moments (GMM) regression methodology was used to for analysis. When it comes to panel data analysis, this method is especially helpful because it helps account for unobserved bank-specific effects that could eventually affect stability. The annual audited financial reports of sixteen banks served as the source of data for this investigation. Our preliminary research indicates some intriguing correlations between several financial indices and bank stability.

Stability is generally positively correlated with measures of a bank's size and power, such as the market share of capital mobilized. This implies that larger banks that are more widely distributed throughout the financial system may profit from economies of scale and diversification, which could increase their ability to withstand shocks to the economy. On the other hand, variables such as loan-to-deposit ratio (LDR) and return on equity (ROE) show a negative link. Although a high return on equity (ROE) may seem ideal, it may also be a sign of riskier lending practices. These preliminary findings demonstrate the intricate interplay between various factors influencing bank stability. Further analysis using the GMM regression allowed us to quantify these relationships and identify the most significant drivers of banking sector stability in our sample. It is possible that banks with a higher proportion of debt financing (lower equity ratio) might be adopting strategies to improve profitability, but this needs to be examined in conjunction with other risk management practices.

The study also looks into how stable things can stay throughout time. Our research may show that a bank's stability in one year typically correlates with its stability in the subsequent year. The idea of "path dependence," which holds that choices made in the past about risk management, capital adequacy, and lending policies have a long-term effect on a bank's present state of health, may help to explain this. Strong risk management procedures have historically been followed by banks, which should result in long-term stability. On the other hand, banks that had difficulties in the previous year would be more careful when making loans, which would have an effect on their profits but might, in the short run, increase their stability.

## 5.2. POLICY RECOMMENDATION

These study results have important implications for financial sector policymakers and bank managers. Among the most important conclusions is that a bank's present stability positively correlates with its future stability, implying a potent idea called "path dependence." In other words, the risk management procedures, capital adequacy standards, and lending policies that are put in place today have a substantial impact on a bank's capacity to withstand future economic downturns.

This finding serves as a reminder to bank managers of how critical it is to prioritize and uphold a stable financial position. Banks can safeguard themselves against future financial crises and build public confidence in the banking system by putting in place strong risk management frameworks, keeping sufficient capital buffers, and prudent lending practices. These results can be used by policymakers to establish a regulatory framework that supports the stability of the banking industry over the long run. Promoting the expansion of a bank's mobilized capital the entire sum of deposits and other liabilities a bank employs to fund its operations is one possible tactic.

During times of economic hardship, banks can absorb possible losses and preserve solvency with greater ease if they have a larger pool of mobilized capital. This could be accomplished by policymakers enacting laws that encourage firms and individuals to make deposits, or by supporting financial inclusion programs that open up banking services to a larger segment of the public. Maintaining a sound and stable banking system requires economic growth. The promotion of both domestic and foreign investment should all be priorities for policymakers. As a result, conditions are favorable for long-term growth and economic diversification.

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# Appendix A

**1. Descriptive Statistics**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| ZSCORE | 144 | 35.567 | 18.176 | 8.64 | 76.727 |
| LDR | 144 | .729 | .121 | .409 | 1.044 |
| ETA | 144 | .133 | .03 | .063 | .205 |
| ROA | 144 | .024 | .008 | .003 | .049 |
| LTA | 144 | .562 | .095 | .293 | .759 |
| ROE | 144 | .268 | .112 | -.112 | .575 |
| MOB | 144 | .141 | .035 | .063 | .26 |
| LLP | 144 | .019 | .016 | .002 | .113 |
| RGDP | 144 | .156 | .225 | .053 | .788 |

**2. Unit Root Tests**

**2.1 Levin-Lin-Chu unit-root test for ZSCORE**

**1. Levin-Lin-Chu unit-root test for ZSCORE**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -7.3646 | |
| Adjusted t* | -3.3325 | 0.0004 |

2. **Levin-Lin-Chu unit-root test for LDR**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -2.6910 | |
| Adjusted t* | -0.5920 | 0.2769 |

**3. Levin-Lin-Chu unit-root test for ETA**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -7.3856 | |
| Adjusted t* | -4.0847 | 0.0000 |

**4. Levin-Lin-Chu unit-root test for ROA**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -8.7149 | |
| Adjusted t* | -3.8631 | 0.0001 |

**5. Levin-Lin-Chu unit-root test for LTA**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -1.8929 | |
| Adjusted t* | -0.2693 | 0.3938 |

**6. Levin-Lin-Chu unit-root test for ROE**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -12.3056 | |
| Adjusted t* | -8.7393 | 0.0000 |

**7. Levin-Lin-Chu unit-root test for MOB**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -8.1524 | |
| Adjusted t* | -6.0145 | 0.0000 |

**8. Levin-Lin-Chu unit-root test for LLP**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -6.5441 | |
| Adjusted t* | -3.1242 | 0.0009 |

**9. Levin-Lin-Chu unit-root test for RGDP**

Ho: Panels contain unit roots Number of panels = 16
Ha: Panels are stationary Number of periods = 9
AR parameter: Common Asymptotics: N/T -> 0
Panel means: Included
Time trend: Not included
ADF regressions: 1 lag
LR variance: Bartlett kernel, 6.00 lags average (chosen by LLC)

| | Statistic | p-value |
|---|---|---|
| Unadjusted t | -7.5023 | |
| Adjusted t* | 77.3360 | 1.0000 |

**2.2 Im-Pesaran-Shin unit-root test**

**Im-Pesaran-Shin unit-root test for ZSCORE**

Ho: All panels contain unit roots Number of panels = 16
Ha: Some panels are stationary Number of periods = 9
AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | Fixed-N exact critical values 1% | 5% | 10% |
|---|---|---|---|---|---|
| t-bar | -2.1312 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -1.5024 | | | | |
| Z-t-tilde-bar | -1.4240 | 0.0772 | | | |

1. **Im-Pesaran-Shin unit-root test for LDR**

Ho: All panels contain unit roots — Number of panels = 16
Ha: Some panels are stationary — Number of periods = 9
AR parameter: Panel-specific — Asymptotics: T,N -> Infinity sequentially
Panel means: Included
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | Fixed-N exact critical values 1% | 5% | 10% |
|---|---|---|---|---|---|
| t-bar | -0.3895 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -0.3698 | | | | |
| Z-t-tilde-bar | 4.8166 | 1.0000 | | | |

2. **Im-Pesaran-Shin unit-root test for ETA**

Ho: All panels contain unit roots — Number of panels = 16
Ha: Some panels are stationary — Number of periods = 9

AR parameter: Panel-specific — Asymptotics: T,N -> Infinity sequentially
Panel means: Included
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | Fixed-N exact critical values 1% | 5% | 10% |
|---|---|---|---|---|---|
| t-bar | -1.8452 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -1.3567 | | | | |
| Z-t-tilde-bar | -0.6210 | 0.2673 | | | |

3. **Im-Pesaran-Shin unit-root test for ROA**

Ho: All panels contain unit roots — Number of panels = 16
Ha: Some panels are stationary — Number of periods = 9
AR parameter: Panel-specific — Asymptotics: T,N -> Infinity sequentially
Panel means: Included
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | Fixed-N exact critical values 1% | 5% | 10% |
|---|---|---|---|---|---|
| t-bar | -2.3986 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -1.7457 | | | | |
| Z-t-tilde-bar | -2.7645 | 0.0029 | | | |

4. **Im-Pesaran-Shin unit-root test for LTA**

Ho: All panels contain unit roots — Number of panels = 16
Ha: Some panels are stationary — Number of periods = 9
AR parameter: Panel-specific — Asymptotics: T,N -> Infinity sequentially
Panel means: Included
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | Fixed-N exact critical values 1% | 5% | 10% |
|---|---|---|---|---|---|
| t-bar | -0.4480 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -0.4030 | | | | |
| Z-t-tilde-bar | 4.6342 | 1.0000 | | | |

5. **Im-Pesaran-Shin unit-root test for ROE**

Ho: All panels contain unit roots — Number of panels = 16
Ha: Some panels are stationary — Number of periods = 9
AR parameter: Panel-specific — Asymptotics: T,N -> Infinity sequentially
Panel means: Included

Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | 1% | 5% | 10% |
|---|---|---|---|---|---|
| | | | Fixed-N exact critical values | | |
| t-bar | -2.3387 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -1.7835 | | | | |
| Z-t-tilde-bar | -2.9726 | 0.0015 | | | |

**6. Im-Pesaran-Shin unit-root test for MOB**

Ho: All panels contain unit roots Number of panels = 16
Ha: Some panels are stationary Number of periods = 9
AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | 1% | 5% | 10% |
|---|---|---|---|---|---|
| | | | Fixed-N exact critical values | | |
| t-bar | -1.5661 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -1.3726 | | | | |
| Z-t-tilde-bar | -0.7087 | 0.2393 | | | |

**7. Im-Pesaran-Shin unit-root test for LLP**

Ho: All panels contain unit roots Number of panels = 16
Ha: Some panels are stationary Number of periods = 9
AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | 1% | 5% | 10% |
|---|---|---|---|---|---|
| | | | Fixed-N exact critical values | | |
| t-bar | -1.6173 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -1.3552 | | | | |
| Z-t-tilde-bar | -0.6130 | 0.2699 | | | |

**Im-Pesaran-Shin unit-root test for RGDP**

Ho: All panels contain unit roots Number of panels = 16
Ha: Some panels are stationary Number of periods = 9

AR parameter: Panel-specific Asymptotics: T,N -> Infinity
Panel means: Included sequentially
Time trend: Not included
ADF regressions: No lags included

| | Statistic | p-value | 1% | 5% | 10% |
|---|---|---|---|---|---|
| | | | Fixed-N exact critical values | | |
| t-bar | -1.4307 | | -2.060 | -1.890 | -1.800 |
| t-tilde-bar | -1.3344 | | | | |
| Z-t-tilde-bar | -0.4980 | 0.3092 | | | |

**3. Pooled OLS regression**

| ZSCORE | Coef. | St.Err. | t-value | p-value | [95% Conf | Interval] | Sig |
|---|---|---|---|---|---|---|---|
| LDR | -41.124 | 20.696 | -1.99 | .049 | -82.055 | -.193 | ** |
| ETA | 279.246 | 44.145 | 6.33 | 0 | 191.942 | 366.551 | *** |
| ROA | -955.11 | 278.316 | -3.43 | .001 | -1505.533 | -404.687 | *** |
| LTA | 77.499 | 26.899 | 2.88 | .005 | 24.3 | 130.698 | *** |
| ROE | 80.474 | 20.175 | 3.99 | 0 | 40.574 | 120.373 | *** |
| MOB | 161.507 | 62.978 | 2.56 | .011 | 36.956 | 286.057 | ** |
| LLP | -337.239 | 81.474 | -4.14 | 0 | -498.37 | -176.107 | *** |
| RGDP | -.326 | 5.996 | -0.05 | .957 | -12.184 | 11.533 | |
| Constant | -30.411 | 14.876 | -2.04 | .043 | -59.832 | -.991 | ** |

| | | | |
|---|---|---|---|
| Mean dependent var | 35.567 | SD dependent var | 18.176 |
| R-squared | 0.409 | Number of obs | 144 |
| F-test | 11.682 | Prob > F | 0.000 |
| Akaike crit. (AIC) | 1185.122 | Bayesian crit. (BIC) | 1211.850 |

**** p<.01, ** p<.05, * p<.1*

## 4. Variance inflation factor

| | VIF | 1/VIF |
|---|---|---|
| LTA | 4.487 | .223 |
| LDR | 4.302 | .232 |
| ROE | 3.543 | .282 |
| MOB | 3.449 | .29 |
| ROA | 3.192 | .313 |
| RGDP | 1.257 | .796 |
| LLP | 1.237 | .809 |
| ETA | 1.188 | .842 |
| Mean VIF | 2.832 | . |

## 5. Random-effects

| ZSCORE | Coef. | St.Err. | t-value | p-value | [95% Conf | Interval] | Sig |
|---|---|---|---|---|---|---|---|
| LDR | 1.033 | 3.875 | 0.27 | .79 | -6.561 | 8.627 | |
| ETA | 229.03 | 8.886 | 25.77 | 0 | 211.613 | 246.447 | *** |
| ROA | 11.403 | 54.438 | 0.21 | .834 | -95.293 | 118.098 | |
| LTA | 1.496 | 5.327 | 0.28 | .779 | -8.945 | 11.937 | |
| ROE | 7.918 | 4.449 | 1.78 | .075 | -.802 | 16.638 | * |
| MOB | 36.122 | 12.876 | 2.81 | .005 | 10.885 | 61.358 | *** |
| LLP | 4.925 | 14.775 | 0.33 | .739 | -24.034 | 33.884 | |
| RGDP | .243 | .845 | 0.29 | .774 | -1.413 | 1.899 | |
| Constant | -4.174 | 4.743 | -0.88 | .379 | -13.47 | 5.122 | |

| | | | |
|---|---|---|---|
| Mean dependent var | 35.567 | SD dependent var | 18.176 |
| Overall r-squared | 0.161 | Number of obs | 144 |
| Chi-square | 814.362 | Prob > chi2 | 0.000 |
| R-squared within | 0.874 | R-squared between | 0.100 |

**** p<.01, ** p<.05, * p<.1*

## 6. Fixed-effects

| ZSCORE | Coef. | St.Err. | t-value | p-value | [95% Conf | Interval] | Sig |
|---|---|---|---|---|---|---|---|
| LDR | 1.233 | 3.827 | 0.32 | .748 | -6.344 | 8.81 | |
| ETA | 228.748 | 8.78 | 26.05 | 0 | 211.365 | 246.131 | *** |
| ROA | 16.685 | 53.794 | 0.31 | .757 | -89.823 | 123.192 | |
| LTA | 1.187 | 5.262 | 0.23 | .822 | -9.233 | 11.606 | |
| ROE | 7.443 | 4.399 | 1.69 | .093 | -1.267 | 16.152 | * |
| MOB | 35.873 | 12.723 | 2.82 | .006 | 10.683 | 61.062 | *** |
| LLP | 5.99 | 14.591 | 0.41 | .682 | -22.899 | 34.879 | |
| RGDP | .249 | .834 | 0.30 | .766 | -1.402 | 1.9 | |
| Constant | -4.093 | 2.702 | -1.51 | .133 | -9.443 | 1.258 | |

| | | | |
|---|---|---|---|
| Mean dependent var | 35.567 | SD dependent var | 18.176 |
| R-squared | 0.874 | Number of obs | 144 |
| F-test | 104.271 | Prob > F | 0.000 |
| Akaike crit. (AIC) | 596.491 | Bayesian crit. (BIC) | 623.219 |

**** p<.01, ** p<.05, * p<.1*

## 7. Hausman (1978) specification test

| | Coef. |
|---|---|
| Chi-square test value | 0 |
| P-value | 1.25 |

## 8. Pairwise correlations

| Variables | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
|---|---|---|---|---|---|---|---|---|---|---|
| (1) e | 1.000 | | | | | | | | | |
| (2) ZSCORE | 0.769* | 1.000 | | | | | | | | |
| | (0.000) | | | | | | | | | |
| (3) LDR | 0.000 | 0.037 | 1.000 | | | | | | | |
| | (1.000) | (0.662) | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| (4) ETA | 0.000 | 0.390* | -0.005 | 1.000 | | | | | | |
| | (1.000) | (0.000) | (0.952) | | | | | | | |
| (5) ROA | 0.000 | 0.021 | -0.144 | 0.010 | 1.000 | | | | | |
| | (1.000) | (0.806) | (0.086) | (0.906) | | | | | | |
| (6) LTA | 0.000 | 0.161 | 0.859* | -0.012 | -0.201* | 1.000 | | | | |
| | (1.000) | (0.054) | (0.000) | (0.885) | (0.016) | | | | | |
| (7) ROE | 0.000 | 0.162 | 0.031 | -0.323* | 0.426* | 0.132 | 1.000 | | | |
| | (1.000) | (0.053) | (0.715) | (0.000) | (0.000) | (0.114) | | | | |
| (8) MOB | 0.000 | -0.004 | -0.209* | 0.279* | 0.434* | -0.361* | -0.456* | 1.000 | | |
| | (1.000) | (0.960) | (0.012) | (0.001) | (0.000) | (0.000) | (0.000) | | | |
| (9) LLP | 0.000 | -0.346* | 0.134 | -0.045 | -0.377* | 0.113 | -0.276* | -0.146 | 1.000 | |
| | (1.000) | (0.000) | (0.108) | (0.594) | (0.000) | (0.176) | (0.001) | (0.081) | | |
| (10) RGDP | 0.000 | -0.021 | 0.445* | -0.067 | -0.034 | 0.385* | 0.040 | -0.093 | 0.079 | 1.000 |
| | (1.000) | (0.807) | (0.000) | (0.423) | (0.689) | (0.000) | (0.633) | (0.267) | (0.345) | |

**** p<0.01, ** p<0.05, * p<0.1*

**9. Two Step GMM Regression results**

| ZSCORE | Coef. | St.Err. | t-value | p-value | [95% Conf | Interval] | Sig |
|---|---|---|---|---|---|---|---|
| L | .542 | .117 | 4.64 | 0 | .313 | .771 | *** |
| LDR | -24.454 | 14.889 | -1.64 | .101 | -53.636 | 4.728 | |
| L | -94.147 | 26.728 | -3.52 | 0 | -146.533 | -41.761 | *** |
| L2 | 42.341 | 14.935 | 2.84 | .005 | 13.069 | 71.613 | *** |
| D | 0 | . | . | . | . | . | |
| LD | 11.548 | 33.419 | 0.35 | .73 | -53.951 | 77.048 | |
| L2D | -134.665 | 62.666 | -2.15 | .032 | -257.489 | -11.842 | ** |
| ROA | 0 | . | . | . | . | . | |
| L | 0 | . | . | . | . | . | |
| L2 | 0 | . | . | . | . | . | |
| D | 82.224 | 51.097 | 1.61 | .108 | -17.925 | 182.373 | |
| LD | 159.805 | 61.06 | 2.62 | .009 | 40.13 | 279.479 | *** |
| L2D | 68.73 | 33.674 | 2.04 | .041 | 2.73 | 134.73 | ** |
| ROE | -71.225 | 32.189 | -2.21 | .027 | -134.313 | -8.136 | ** |
| L | -113.197 | 51.792 | -2.19 | .029 | -214.708 | -11.686 | ** |
| L2 | 3.894 | 7.455 | 0.52 | .601 | -10.718 | 18.506 | |
| D | 383.304 | 99.087 | 3.87 | 0 | 189.098 | 577.51 | *** |
| LD | 0 | . | . | . | . | . | |
| L2D | 0 | . | . | . | . | . | |
| LLP | 0 | . | . | . | . | . | |
| L | 0 | . | . | . | . | . | |
| L2 | 0 | . | . | . | . | . | |
| D | 17.521 | 6.72 | 2.61 | .009 | 4.351 | 30.691 | *** |
| LD | 48.27 | 35.552 | 1.36 | .175 | -21.411 | 117.95 | |
| L2D | 0 | . | . | . | . | . | |
| Constant | 120.225 | 46.108 | 2.61 | .009 | 29.855 | 210.594 | *** |

| | | | |
|---|---|---|---|
| Mean dependent var | 35.557 | SD dependent var | 17.859 |
| Number of obs | 144 | Chi-square | 1847847.228 |

**** p<.01, ** p<.05, * p<.1*