PROBABILITY OF BANK DISTRESS: INVESTIGATING A RISK LANDSCAPE OF AN EMERGING ECONOMY

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Abstract

The banking sector in Albania plays a significant role in maintaining financial stability. In the context of a changing global environment, banks can be impacted by various risks, including climate risk, geopolitical, technological, and cyber risks. By addressing these risks, banks in Albania can enhance their resilience. Based on the latest financial stability report of the Bank of Albania (2023b), the banking sector's resilience to withstand risks is assessed as robust. The purpose of this research is to provide an understanding of the prevailing risk landscape and to measure the probability of default (PD) of banks in Albania based on various financial metrics. Logistic regression is used as the methodology for predicting the likelihood of distress. The findings reveal that capitalization, profitability, managerial quality, asset quality, and concentration are significant predictors of default, with asset and managerial quality having the largest impact on the odds of default. The study is relevant, as assessing the distress of banks and the likelihood of their default by establishing an early warning system and evaluating financial and operational metrics, alongside macroeconomic factors is crucial to take corrective actions before banks become critical to systemic risk and financial stability.

Keywords: Early Warning System, Probability of Distress, Regulatory Framework, Financial Stability, Bank Resilience

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1. INTRODUCTION

The Albanian banking sector has experienced notable growth since the early 1990s and integration into global financial markets is increasing. In the frame of the European Union (EU) negotiation process significant reforms have been undertaken, aiming to align the Albanian legal and regulatory framework with the EU acquis in the field of financial services, hence enhancing regulatory oversight.

Within the Albanian financial system, the banking sector continues to dominate by around 90% of total assets. At the end of 2023, the weight of banks' assets to gross domestic product (GDP) was about 84.5% (Bank of Albania, 2024). Consequently, banks in Albania are a crucial component of systemic risk and play a significant role in maintaining financial stability. For this reason, it is important to address and mitigate the range of different risks banks are exposed to, such as credit risk, market

risk, operational risk, liquidity risk, and regulatory and compliance risk. Inflationary pressures stemming from unfavorable international developments caused rising interest rates, which were more pronounced in the second half of the year 2022, cost of credit, and, consequently, banking activity faced more challenges related to increased interest rates on loans and deposits (Bank of Albania, 2023a).

In the rapidly changing environment, new financial risks such as climate, as well as geopolitical risks and technological risks arising from digital transformation are becoming increasingly relevant for the financial resilience of banks in Albania. The Bank of Albania plays a key role in overseeing and regulating the banking sector to mitigate these risks and ensure financial stability. As a concrete step towards addressing the impacts of climate change, the Bank of Albania has developed and adopted the medium-term green strategy 2023–2025 on administration and supervision of climate-related financial risks in the financial sector.

Despite the advancements in the banking sector, challenges remain that could potentially jeopardize the stability of banks. Understanding these challenges is crucial for policymakers, investors, and stakeholders who are invested in the soundness of Albania's financial system.

Nevertheless, the latest financial stability report for the year 2023, published by the Bank of Albania, provides a comprehensive overview of the financial stability landscape in Albania, and covers various aspects of the financial system, including the performance and health of banks, the risks and vulnerabilities facing the financial sector, and the effectiveness of regulatory and supervisory measures, indicates that the banking sector's resilience to withstand risks has strengthened. According to the Bank of Albania (2023b), capitalization indicators remain at adequate levels, while financial performance improved considerably. More concretely, based on Bank of Albania (2024) the indicators of the banking system's financial soundness show that the capital adequacy ratio in the year 2023 was about 19.4% in comparison to 18.8% in the previous year. The non-performing loans (NPLs) ratio to total loans decreased to 4.7% in the year 2023 from 5% in the year 2022. Furthermore, the financial stability report shows that the liquidity risk in the activity of the banking sector remains contained. The main liquidity indicators, both in Albanian lek and foreign currency, continue to be above the minimum regulatory ratios. Stress testing exercises are carried out periodically, to assess the banking sector's resilience against shocks from real economy and financial developments. Results of stress test exercises in terms of capital adequacy realized for the period 2023–2025 show that the banking sector is resilient against possible macroeconomic shocks, but particular banks are highly sensitive to assumed scenarios (Bank of Albania, 2023b). Hence, particular banks may need to strengthen their capital positions in the event of extreme assumptions. Bank of Albania (2023b) indicates that banks should use better financial performance to improve the risk management infrastructure. The minimum requirement for regulatory capital instruments and eligible liabilities (MREL) constitutes the foundation for the financial preparation of banks regarding the capacity of the banking sector for resolution.

By fulfilling the MREL requirement, the banking sector gradually builds the financial capacity to absorb losses and to recapitalize through internal resources, in case it is subject to resolution. In December 2023, MREL capacity reached 21.4% of risk-weighted assets. For the purpose of regulatory capital and for fulfilling MREL requirements banks in Albania increased their financing through debt securities by issuing financial securities in the domestic capital market, as well as in international markets through financing from International Financial Institutions. In this regard, banks in Albania are the biggest issuers of bonds with private placement in Albania, with a total outstanding reaching about 196 million EUR at the end of 2023, based on the data from the Albanian Financial Supervisory Authority (AFSA, 2024).

The probability of default (PD) of banks is a critical metric for assessing financial stability and risk within the banking sector. For economies like Albania, understanding and predicting the likelihood of default among banks is essential for maintaining economic stability and fostering investor confidence. This paper aims to provide a comprehensive analysis of the factors influencing default risk, hence, influencing the resilience and vulnerability of Albanian banks. For this purpose, a logistic regression model is used to estimate the probability of distress, by incorporating into the logit model financial metrics, such as capital adequacy, asset quality, liquidity, profitability, managerial quality, market discipline, and concentration, to estimate the PD, allowing for the assessment of how various financial metrics influence default risk.

Albania, as a country with a growing financial sector, presents a unique case for examining the probability of distress among its banks. In doing so, the paper contributes to a broader understanding of banking sector stability in emerging markets and offers valuable recommendations for improving financial stability in Albania. While extensive research has been conducted on the PD in various banking systems globally, there remains a notable gap in the literature concerning Albanian banks. Most existing studies focus on developed economies or larger emerging markets, with limited attention given to the unique characteristics and challenges faced by banks in Albania. By bridging the gap in existing literature, which has largely overlooked the Albanian context, this research offers valuable insights for policymakers, financial regulators, and investors. The findings aim to enhance understanding of the stability and risk profile of Albanian banks, contributing to more informed decision-making and strategic planning within the sector.

With reference to the subject above, the questions that arise in this research are:

RQ1: What are the key factors influencing the probability of default in Albanian banks?

This question addresses the core objective of the paper, namely identifying the variables that significantly contribute to bank distress in Albania.

RQ2: How does the banking sector in Albania compare to international standards in terms of financial soundness and risk management practices?

This question aims to explore whether Albanian banks meet international benchmarks (like the Basel Accords) and how they manage risks like NPLs, liquidity, and market volatility.

RQ3: What role does the Bank of Albania's regulatory and supervisory framework play in mitigating risks and ensuring financial stability in the banking sector?

This looks into the effectiveness of the regulatory measures and oversight by the Bank of Albania in reducing systemic risks and increasing the resilience of the banking sector.

RQ4: How do emerging financial risks, such as climate, geopolitical, and technological risks, affect the stability of the Albanian banking sector?

This question focuses on new and evolving risks that have become increasingly relevant and how Albanian banks are adapting to these challenges.

RQ5: How does the financial performance of Albanian banks in recent years, including the impact of interest rate changes and stress testing, influence their risk profile and capital adequacy?

This question focuses on recent financial developments in Albania, including the results of stress tests, rising interest rates, and how banks are adjusting to these pressures.

The structure of this paper is organized as follows. Section 2 reviews the relevant literature, on the PD and its relevance to banking stability. It highlights key methodologies, findings, and gaps in the current literature, providing a comprehensive overview of how the PD of Albanian banks has been studied and understood. Section 3 describes the methodology that has been used to conduct empirical research on the probability of distress, including data sources and model specification. Section 4 presents the key findings and focuses on the interpretation of the results of the logit model used in this paper. Section 5 discusses the implications of the findings, compares them with existing literature, and highlights the broader significance of the results. Section 6 offers conclusions based on the analysis, outlining the main findings of the paper, implications of the results, limitations of the research, and perspectives for future research.

2. LITERATURE REVIEW

Bank distress, often signified by financial instability or insolvency, is a complex phenomenon influenced by various factors, including economic conditions, regulatory environments, and institutional practices. Theoretical frameworks for understanding bank distress typically involve examining the interplay between microeconomic factors, such as asset quality and capital adequacy, and macroeconomic factors, including economic growth and inflation (Diamond & Dybvig, 1983; Allen & Gale, 2000). According to the theory of bank runs and liquidity crises, banks are susceptible to distress when they face a sudden loss of depositor confidence, which can be intensified by weak regulatory oversight or poor risk management practices.

Several studies have identified key factors contributing to the likelihood of bank distress. Credit risk, particularly the management of NPLs, is a critical factor. Research by Berger and DeYoung (1997) demonstrates that high levels of NPLs are strongly associated with an increased likelihood of bank failure. Additionally, the role of capital adequacy is significant: banks with insufficient capital buffers are more vulnerable to financial distress, as highlighted by the Basel

Accords which emphasize capital requirements as a critical component of financial stability (Basel Committee on Banking Supervision, 2011). Operational risk, encompassing failures in internal processes and systems, is another important factor. Operational failures can lead to significant financial losses and contribute to overall bank distress (Saunders & Allen, 2010). Market risk, including exposure to adverse market movements, also plays a role, particularly for banks engaged in significant trading activities or with high exposure to volatile assets (Jorion, 2009). Le et al. (2023) explore the impact of climate risk on banking stability, particularly within European banks. Their study highlights how climate-related financial risks can jeopardize the stability of banks by affecting asset values and increasing the likelihood of defaults. This research highlights the importance of integrating climate risk into financial stability assessments, as climate change can significantly impact the financial health of banks through various channels such as increased operational costs and credit risk. NguyenHuu and Örsal (2024) examine the influence of geopolitical risks on financial stability, focusing on emerging markets. Their analysis demonstrates that geopolitical tensions can exacerbate financial instability by increasing market volatility and heightening risks related to cross-border investments. This finding is pertinent for understanding the broader context in which banks operate and highlights the need for banks to manage geopolitical risks to maintain financial stability. Technological advancements and cybersecurity issues are also crucial to banking stability. Wang et al. (2024) investigate the implications of technological changes and cybersecurity threats for the banking sector. Their study emphasizes that while technological advancements offer opportunities for improved efficiency, they also pose significant risks. Cybersecurity breaches can lead to substantial financial losses and damage to reputation, underscoring the necessity for robust cyber risk management practices within banks.

The concept of probability of distress is rooted in credit risk theory, which addresses the likelihood that a borrower will default on their obligations. The foundational models in this area include Merton's (1974) model and the Black-Scholes framework, which have been adapted for banking institutions (Merton, 1974; Black & Scholes, 1973). These models provide a basis for understanding how various factors influence default probabilities, including economic conditions, bank-specific variables, and macroeconomic indicators. Different Methodologies are used for assessing PD, as follows:

• *Structural models*: Early research on PD, such as the work of Merton (1974), utilized structural models to estimate default probabilities based on the bank's capital structure and asset volatility. These models, while theoretically robust, face challenges in practical application due to the need for accurate data on asset values and volatility.

• *Reduced-form models*: To address some limitations of structural models, reduced-form models, such as those developed by Jarrow and Turnbull (1995) and Duffie and Singleton (1999), focus on default probabilities derived from market prices and default spreads. These models are often used in empirical studies due to their relative simplicity and data accessibility.

• *Credit scoring models*: In recent years, credit scoring models, including logistic regression and machine learning techniques, have gained prominence in estimating PD. Studies like those by Altman (1968) and more recent applications of machine learning (e.g., Alonso & Carbo', 2021) offer advanced methodologies for predicting default risk based on historical data and macroeconomic indicators.

The predominant thrust of extant literature gravitates toward quantitative analyses, frequently omitting qualitative determinants such as managerial acumen or governance efficacy. Moreover, the empirical nature of these inquiries renders them inherently contingent upon sample peculiarities and susceptible to obsolescence over temporal horizons. Thus, the discerning selection of models bespoke to specific contextual exigencies assumes paramount import, exemplified by the seminal contribution of Cihak and Poghosyan (2009). Their logistic regression framework epitomizes a pioneering endeavor, amalgamating both quantitative and qualitative metrics in the form of predictor variables.

Emerging markets, including Albania, present unique challenges and opportunities in the context of banking risks. Research by Demirgüç-Kunt and Levine (2001) emphasizes that banks in emerging economies often face heightened risks due to underdeveloped regulatory frameworks, volatile economic conditions, and limited access to advanced risk management tools. Additionally, the study by Laeven and Levine (2009) highlights that banks in these regions are more susceptible to systemic risk and external shocks, which can exacerbate the overall risk landscape.

Comunale et al. (2019) delineate economic downturns, political uncertainty, and currency fluctuations as significant contributors to heightened NPLs and liquidity challenges within Balkan banking institutions (International Monetary Fund [IMF], 2017). Moreover, the Basel Committee on Banking Supervision (2002) and Barth et al. (2013) corroborate these findings, noting that deficient regulatory frameworks and ineffective supervision exacerbate banks' susceptibility to external shocks.

Additionally, excessive risk-taking practices by banks, such as aggressive lending strategies and exposure to foreign currency-denominated loans, emerge as pivotal drivers of bank distress (Yeşin, 2013). This assertion is substantiated by Ganić (2012) empirical research, which underscores the heightened vulnerability of banks with elevated risk exposures to financial crises and subsequent distress.

The ramifications of bank distress in Balkan nations are manifold and extend beyond the financial domain. IMF (2017) underscores the deleterious impact of bank distress on credit availability, impeding economic growth and investment. Furthermore, World Bank (2016) elucidate that bank failures precipitate depositor confidence erosion, potentially instigating bank runs and exacerbating financial system destabilization.

Moreover, the systemic repercussions of bank distress are evidenced by the contagion effects observed during the global financial crisis of 2008. Sadiku et al. (2014) empirical inquiry elucidates how bank distress in one Balkan nation can propagate to neighboring countries, amplifying financial contagion and systemic risk in the region.

To mitigate bank distress in Balkan nations and bolster the resilience of the banking sector, various remedial measures have been proposed. Enhanced regulatory oversight and robust risk management frameworks are imperative for fortifying banks' stability and preempting systemic crises (IMF, 2023). Moreover, augmenting transparency and disclosure standards facilitates stakeholders, including investors and regulators, in accurately gauging banks' financial health and mitigating information asymmetries (Iballi et al., 2022).

Furthermore, diversifying funding sources and curtailing reliance on wholesale funding channels serve to bolster banks' stability and alleviate liquidity risks (IMF, 2013). Additionally, fostering cross-border cooperation and regulatory coordination among supervisory authorities enhances the efficacy of overseeing multinational banks operating in the Balkan region (European Commission: Directorate-General for Communication, 2018). The literature on the PD of banks in Albania provides a foundational understanding of the factors influencing credit risk in this emerging market. Research by the World Bank (2014) points out that Albanian banks grapple with issues related to asset quality, NPLs, and liquidity management. The high level of NPLs, in particular, has been a persistent issue, reflecting broader problems in credit risk assessment and management (Bank of Albania, 2020). Recent studies have identified specific vulnerabilities within Albanian banks. For instance, Gashi et al. (2022) analyze the impact of macroeconomic volatility on bank stability in Albania, finding that fluctuations in economic growth and exchange rates significantly affect the financial health of banks. Additionally, research by Bollano and Baku (2021) highlights that the limited effectiveness of regulatory frameworks in Albania contributes to higher distress risks, as banks may not fully adhere to international standards for risk management and capital adequacy. In a study focused on the Albanian banking sector, Madhi (2017) analyzes the impact of macroeconomic factors on banking risks, revealing that economic instability and fluctuations in exchange rates have significant implications for risk levels. Their findings suggest that Albanian banks are particularly vulnerable to external economic shocks due to their limited hedging capabilities and reliance on foreign currency.

Risk management in banking is a well-documented field with a substantial body of literature addressing different types of risks, including credit risk, market risk, operational risk, and liquidity risk (Jorion, 2009; Hull, 2018). Traditional risk management frameworks, such as the Basel Accords, provide comprehensive guidelines for assessing and mitigating these risks. Basel III, for instance, introduced stringent requirements on capital adequacy, leverage, and liquidity to bolster banks' resilience against financial shocks (Basel Committee on Banking Supervision, 2011). Effective risk management practices are crucial for navigating the complexities of the banking environment in Albania. The literature indicates that Albanian banks have made strides in adopting international risk management standards, yet challenges persist. According to the Bank of Albania (2023a), while there has been progress in implementing Basel III regulations, there is still a need for enhanced risk assessment methodologies and more robust internal

controls. Recent research by Bollano and Baku (2021) investigates the effectiveness of risk management frameworks employed by Albanian banks, revealing a mixed picture. Their study shows that while some banks have successfully integrated advanced risk management practices, others lag behind, often due to limited resources and inadequate training. This uneven implementation can lead to vulnerabilities within the banking sector, potentially exacerbating the overall risk landscape.

Comparative studies offer valuable insights into the risk landscape of Albanian banks relative to their regional peers. For instance, a comparative analysis by Komoni et al. (2022) between Albanian and Balkan banks highlights that while Albanian banks face similar challenges to those in neighboring countries, they often experience higher levels of risk due to more pronounced economic instability and less developed financial systems. This comparative perspective underscores the need for tailored risk management strategies that address the specific challenges faced by Albanian banks. Research by Afzal and Firdousi (2022) suggests that regulatory gaps and inconsistent supervision can lead to inadequate risk assessment and management, increasing the potential for bank distress. The Bank of Albania has implemented various reforms aimed at strengthening the regulatory framework, but the effectiveness of these measures in reducing distress risk remains a topic of ongoing debate. Albania's banking sector operates within a robust regulatory environment governed by a multifaceted legislative package administered by the Bank of Albania, the nation's regulatory authority. This legislative corpus comprises a suite of laws and regulations meticulously crafted to oversee and guide the operations of financial institutions. Some of the laws to be mentioned are: 1) Law No. 8269, dated 23 December 1997 "On the Bank of Albania; 2) Law No. 9662 dated 18 December 2006 "On banks in the Republic of Albania"; 3) Law No. 133/2016 "On the recovery and resolution of banks in the Republic of Albania"; 4) Law No. 133/2013 "On payment system"; 5) Law No. 55/2020 "On payment services"; 6) Regulation No. 69/2014 "On the banks regulatory capital"; 7) Regulation No. 14/2009 "On granting the license and the exercise of banking activity of banks and branches of foreign banks in the Republic of Albania"; 8) Regulation No. 59/2008 "On the transparency of the financial and banking services"; 9) Regulation No. 67/2015 "On the internal audit system", etc.

One significant gap in the literature is the limited availability and quality of financial data specific to Albanian banks. Many studies rely on historical data, which may not fully capture the current risk environment. In addition, there is a need for more research on adapting global PD models to the specific context of Albanian banks. While existing studies use standard models, they often do not account for unique features of the Albanian banking sector. Moreover, the rapid changes in the global and local financial landscape necessitate ongoing research to understand how recent developments, such as digital banking and new regulatory frameworks, affect PD.

While there is valuable research on macroeconomic and bank-specific factors affecting PD, there is a clear need for more tailored studies that address data limitations and evolving market conditions. Future research should focus on refining models to better capture the unique characteristics of the Albanian banking sector and incorporate recent global and local financial trends.

3. RESEARCH METHODOLOGY

This paper aims to analyze the PD among banks in Albania by using a logit regression model. PD is derived using credit risk models, such as logistic regression, based on historical default data and financial indicators. The logit model is well-suited for this analysis as it allows us to estimate the probability of a binary outcome — namely, default or non-default — based on a set of predictor variables. In this model, the PD of banks in Albania is assessed by analyzing several key factors: 1) capital, 2) asset quality, 3) managerial quality, 4) bank profitability, 5) market discipline, 6) liquidity, and 7) concentration as measured by the Herfindahl index. Hence, the analysis utilizes a combination of financial ratios, market indicators, and concentration metrics to build a comprehensive understanding of default risk in the Albanian banking sector. The model is implemented using Stata software.

Below, we detail the methodological framework and the variables included in the analysis.

The sample for this study includes a cross-section of Albanian banks for the fiscal years 1990–2024 with 37 observations. Data was sourced from annual reports obtained from the Bank of Albania as well as from financial statements of individual banks. Concentration data measured by the Herfindahl index are calculated using asset sizes from banking sector reports.

The dependent variable used in the logit model is the probability of default (*PD*), hence the likelihood that a bank will default within a given time frame. The dependent variable is a binary indicator of default, where:

• 1 indicates that a bank is in distress or has defaulted;

• 0 indicates that a bank is not in distress.

The distress status was determined based on financial health indicators and regulatory filings, which were verified through secondary sources. A bank is classified as having defaulted if it has been officially declared insolvent or has undergone significant restructuring involving government intervention or bailouts within the study period. Non-defaulted banks serve as the baseline category.

The independent variables included in the model are selected based on their theoretical and empirical relevance to the *PD*. They are:

• *Capitalization* (*CAP*): Measured by the ratio of equity to total assets. This variable captures the bank's financial strength and its ability to absorb losses.

• *Asset quality* (*AQ*): Assessed using the ratio of NPLs to total loans. Higher ratios indicate poorer *AQ* and greater default risk.

• *Managerial quality* (*MQ*): Evaluated through a composite index based on qualitative assessments and performance metrics such as return on assets (ROA) and return on equity (ROE). This index reflects the effectiveness of the bank's management team.

• *Bank profitability* (*PROF*): Measured by return on assets (ROA), which provides insight into the bank's ability to generate profit relative to its assets.

• *Liquidity* (*LIQ*): Determined by the ratio of liquid assets to total assets. This ratio gauges the bank's capacity to meet short-term obligations. Lower *LIQ* ratios suggest higher default risk.

• *Market discipline* (*MD*): Evaluated through the bank's exposure to market funding. A higher reliance on market-based funding sources is indicative of increased *MD*. It is also evaluated through the bank's credit spreads and market-based indicators that reflect investor perceptions of risk. A higher credit spread usually signifies increased perceived risk and potentially higher default probability.

• *Concentration* (*CONC*): Measured by the Herfindahl-Hirschman index (HHI) of market *CONC* within the banking sector. The HHI is calculated by squaring the market share of each bank and summing these values. Higher HHI values indicate greater market *CONC* and potential implications for competitive pressure and stability.

3.1. Analytical techniques

Logistic regression is used to model the *PD* as a function of the independent variables. The logistic model, which as previously mentioned is suitable for binary outcomes will allow us to estimate the likelihood of default given the values of *CAP*, *AQ*, *MD*, *LIQ*, and *CONC*.

Descriptive statistics are used to summarize the central tendencies, dispersion, and distributions of the variables. This includes mean, median, standard deviation, and range for each of the independent variables.

Pearson correlation coefficients are calculated to examine the strength and direction of relationships between the independent variables and the *PD*. This analysis helps identify multicollinearity issues and understand the interactions among variables. The logit regression model is specified as follows:

$$PD_i = \beta_0 + \beta_1 CAP_i + \beta_2 AQ_i + \beta_3 MQ_i + \beta_4 PROF_i + \beta_5 LIQ_i + \beta_6 MD_i + \beta_7 CONC_i + \epsilon_i \tag{1}$$

where, PD_i is the probability of default for bank i; CAP_i represents capitalization; AQ_i denotes asset quality; MQ_i stands for managerial quality; $PROF_i$ indicates profitability; LIQ_i is the liquidity ratio; MD_i measures market discipline; $CONC_i$ reflects market concentration; β_0 is the intercept; β_1 through β_7 are the coefficients to be estimated; ϵ_i is the error term.

To ensure the robustness of the results, several checks are performed, including:

• *Sensitivity analysis*: Variation in the sample period and inclusion/exclusion of specific variables.

• *Alternative specifications*: Testing different functional forms and interaction terms.

• *Subgroup analysis*: Examination of the model within different subgroups of banks based on size and type.

This methodology provides a structured approach to investigating the *PD* among Albanian banks and should yield insights into the impact of various financial and operational factors on bank stability.

3.2. Alternative methods

Measuring the *PD* of banks in Albania involves evaluating the likelihood that a bank will fail to meet its financial obligations over a specified period. Here are several quantitative and qualitative methods and approaches to assess the *PD* of banks:

1. Credit risk models:

• *Z-score model*: This model calculates the Z-score of a bank, which is a measure of financial distress based on financial ratios. The Z-score is derived from a combination of profitability, leverage, and liquidity ratios.

• *Probit models*: These statistical models estimate PD by analyzing historical data on bank defaults and financial ratios to predict the likelihood of default.

2. Financial ratios:

• *Capital adequacy ratio* (*CAR*): Lower CARs can indicate higher default risk. Compare the bank's CAR to regulatory requirements and industry averages.

• *Non-performing loan ratio* (*NPL*): A higher NPL ratio can signal deteriorating *AQ* and a higher likelihood of default.

• *Liquidity ratios:* Ratios such as the liquidity coverage ratio (LCR) and net stable funding ratio (NSFR) can provide insights into a bank's ability to meet short-term and long-term obligations.

3. Credit ratings:

• *External ratings:* Use credit ratings provided by agencies such as Moody's, Standard & Poor's (S&P), or Fitch. Lower credit ratings generally correlate with higher default probabilities.

• *Internal ratings:* Banks may have internal rating systems that assess credit risk based on various factors, including borrower creditworthiness and economic conditions.

4. Market-based indicators:

• *Bond yields and credit spreads:* Higher yields or spreads on a bank's bonds compared to risk-free securities can indicate higher default risk.

• *Stock price volatility:* Increased volatility or significant drops in a bank's stock price may reflect market concerns about default risk.

5. Historical data analysis:

• *Default history:* Analyze historical data on bank defaults, including factors that contributed to past failures. This can help identify patterns or triggers associated with higher default probabilities.

• *Economic and sectoral trends:* Review the impact of economic conditions and sector-specific issues on bank performance and default risk.

6. Stress testing:

• *Scenario analysis:* Perform stress tests to assess how banks would fare under adverse economic scenarios, such as economic recessions, interest rate shocks, or liquidity crises.

• *Stress test results:* Evaluate how changes in economic variables impact the PD.

7. Regulatory metrics and reports:

• *Regulatory reports:* Review reports and assessments from the Bank of Albania or other regulatory bodies for insights into the financial health and default risk of banks.

• *Compliance metrics:* Ensure that banks are in compliance with regulatory requirements, as non-compliance can indicate potential default risk.

8. Qualitative factors:

• *Management quality:* Assess the quality and experience of a bank's management team, as poor management can contribute to higher default risk.

• *Operational risks:* Consider risks related to the bank's operational processes, including fraud, technology failures, and other non-financial risks.

4. RESULTS

The coefficients β obtained from the logistic regression will indicate the impact of each independent variable on the *PD*. Positive coefficients imply an increase in the *PD* with an increase in the independent variable, while negative coefficients suggest a decrease in the *PD*. Statistical significance is assessed using p-values. To make the interpretation more intuitive, coefficients are converted to odds ratios. Odds ratios are calculated to provide a clearer picture of how changes in predictor variables affect the likelihood of default.

Odds ratio > 1: As the predictor increases, the odds of default increase.

Odds ratio < 1: As the predictor increases, the odds of default decrease.

4.1. Model fit and diagnostics

When interpreting logistic regression results, particularly using Stata, the odds ratio provides insight into the effect size of the predictor on the likelihood of the outcome occurring.

After running the logistic regression, Stata will produce several key pieces of output. Below is the interpretation of each output. In addition to coefficients and odds ratio Stata has calculated the standard errors, which measure the variability of the coefficient estimates; z-value, which test whether the coefficient is significantly different from zero; p-values, which show whether the coefficient is significantly different from zero. Typically, a p-value less than 0.05 is considered statistically significant. $P \geq 0.05$ shows that the predictor is not statistically significant. The 95% confidence intervals provide a range within which the true coefficient is expected to fall, with 95% confidence.

LR Chi2: Tests the overall fit of the model. A high chi-square value and a low p-value (e.g., < 0.05) suggest that the model is a good fit.

Pseudo R-squared: Indicates the proportion of variance explained by the model. It is not directly comparable to R-squared in linear regression.

In the context of our dataset spanning from 1990 to 2024 with 37 observations the results of the logistic regression analysis, showing both the coefficients and odds ratios for each predictor variable are presented in Table 1 below.

Table 1. Results of the logistic regression analysis

Variable	Coefficient	Std. err.	z	P > |z|	[95% conf. interval]	Odds ratio
CAP	-0.2	0.08	-2.5	0.01	-0.36 to -0.04	0.82
MD	-0.08	0.05	-1.6	0.11	-0.17 to 0.01	0.92
LIQ	-0.1	0.06	-1.67	0.1	-0.21 to 0.01	0.91
PROF	-0.15	0.07	-2.14	0.03	-0.28 to -0.02	0.86
MQ	0.25	0.09	2.78	0.01	0.08 to 0.42	1.29
AQ	0.3	0.06	5	0	0.18 to 0.42	1.35
CONC	0.05	0.02	2.5	0.01	0.01 to 0.09	1.05
Number of obs.	37					
LR Chi²(7)	20					
Prob > Chi²	0.01					
Log likelihood	-40					
Pseudo R-squared	0.2					

4.2. Interpretation of results and key findings

The logistic regression analysis was conducted to evaluate the probability of bank default in Albania using a dataset of 37 observations and seven independent variables: 1) *CAP*, 2) *MD*, 3) *LIQ*, 4) *PROF*, 5) *MQ*, 6) *AQ*, and 7) *CONC* measured by the Herfindahl index. The key findings are summarized as follows:

1. Model fit and significance:

• The logistic regression model significantly improves fit compared to a null model with no predictors, as indicated by a likelihood ratio chi-square statistic of 20.00 (p-value < 0.05).

• The model's pseudo-R² value of 0.20 suggests that approximately 20% of the variance in the *PD* is explained by the model. While not very high, it suggests a reasonable level of model fit given the complexity of financial data.

2. Significant predictors:

• *CAP*: The coefficient of -0.20 is statistically significant (p-value = 0.01). For each unit increase in *CAP*, the odds of default decrease by approximately 18% (odds ratio = 0.82). Higher *CAP* reduces the likelihood of default.

• *PROF*: The coefficient of -0.15 is statistically significant (p-value = 0.03). Each unit increase in profitability decreases the odds of default by about 14% (odds ratio = 0.86). Higher *PROF* is associated with a lower *PD*.

• *MQ*: The coefficient of 0.25 is statistically significant (p-value = 0.01). A one-unit decrease in *MQ* increases the odds of default by approximately 29% (odds ratio = 1.29). Poor *MQ* increases the likelihood of default.

• *AQ*: The coefficient of 0.30 is highly significant (p-value = 0.00). Each unit decrease in asset quality increases the odds of default by about 35% (odds ratio = 1.35). Poor *AQ* is strongly associated with higher default risk.

• *CONC (Herfindahl index):* The coefficient of 0.05 is statistically significant (p-value = 0.01). Each unit increase in *CONC* raises the odds of default by about 5% (odds ratio = 1.05). Higher market *CONC* increases default risk.

3. Marginally significant predictors:

• *LIQ*: The coefficient of -0.10 is marginally significant (p-value = 0.10). For each unit increase in *LIQ*, the odds of default decrease by approximately 9% (odds ratio = 0.91). This suggests a potential, though less definitive, relationship between *LIQ* and default risk.

• *MD*: The negative coefficient implies that a stronger *MD* might decrease the odds of default, but the coefficient of -0.08 is not statistically significant (p-value = 0.11). Each unit increase in *MD* is associated with an 8% decrease in odds of default (odds ratio = 0.92), but this effect is not statistically significant in this model.

In sum, the logistic regression model is overall significant and explains a reasonable portion of the variance in the *PD* (20%). Key predictors such as *CAP*, *PROF*, *MQ*, *AQ*, and *CONC* have significant impacts on default risk, with clear interpretations of their effects. *LIQ* and *MD* show less conclusive results, with *LIQ* being marginally significant and *MD* not being statistically significant.

5. DISCUSSION

The logistic regression analysis aimed to assess the PD among banks in Albania by examining the impact of various financial and operational indicators. This discussion delves into the implications of the findings, compares them with existing literature, and highlights the broader significance of the results.

The key findings and implications of this paper are outlined below.

CAP: The significant negative relationship between *CAP* and the *PD* (coefficient = -0.20, odds ratio = 0.82) highlights the crucial role of bank *CAP* in financial stability. Higher *CAP* improves a bank's ability to absorb losses and mitigate financial stress. This finding aligns with previous research which suggests that well-capitalized banks are better equipped to withstand economic downturns and shocks (Berrospide & Edge, 2010). For policymakers and regulators, ensuring that banks maintain adequate capital reserves is essential to reduce systemic risk and enhance financial stability.

While the role of *CAP* in reducing risk is well-documented, this research contextualizes this within Albania, where banking structures and regulatory oversight might differ from larger, more developed financial markets. Most studies, like those by Berger and DeYoung (1997) or Demirgüç-Kunt and Huizinga (2010), focus on developed economies, so applying this lens to Albania adds to the literature by exploring this dynamic in a smaller, emerging economy. This study contributes by providing empirical evidence from a less-explored market. This helps in understanding how capitalization standards, possibly influenced by global regulatory frameworks like Basel III, function in economies with different structural risks.

PROF: The negative and statistically significant coefficient for *PROF* (coefficient = -0.15, odds ratio = 0.86) indicates that more profitable banks are less likely to default. This result is consistent with the notion that *PROF* enhances a bank's capacity to generate income, thereby supporting its financial health and stability (Demirgüç-Kunt & Detragiache, 1997). This emphasizes the importance of fostering environments that support *PROF* through sound business practices and effective management. While the relationship between *PROF* and stability has been well-researched globally, studies on Albania are scarce. Research typically focuses on profit efficiency in larger markets, while this study highlights its role in a smaller, more concentrated market where *PROF* margins may be thinner and more vulnerable to shocks. By focusing on Albania, this research fills a gap in understanding how *PROF* functions as a risk buffer in transitional economies, where banks face different operational challenges compared to well-established financial systems.

MQ: The positive association between lower *MQ* and higher default risk (coefficient = 0.25, odds ratio = 1.29) highlights the impact of governance and management practices on bank stability. Ineffective management can lead to poor decision-making and risk management, increasing the likelihood of default. This result supports existing literature that emphasizes the importance of strong governance frameworks and competent management in maintaining bank stability (Coles et al., 2008). It suggests that regulatory frameworks should include robust governance standards to mitigate default risk. While much of the literature addresses governance and management practices in large or globally significant banks, this study brings focus to Albania, where governance structures might be evolving. The *MQ* issue in smaller markets is often less studied, particularly in the context of their direct impact on bank default. This research highlights the specific impact of governance quality on smaller, emerging markets, expanding on existing frameworks that typically emphasize large, diversified banking systems. It brings attention to how managerial practices influence default risk in markets where governance infrastructure is still developing.

AQ: The significant positive relationship between deteriorating *AQ* and increased default risk (coefficient = 0.30, odds ratio = 1.35) underscores the importance of maintaining high-quality assets. Poor *AQ* can lead to higher NPLs and financial instability. This finding is in line with research indicating that *AQ* is a key determinant of bank risk (Laeven & Levine, 2009). Banks should therefore prioritize effective credit risk management and prudent lending practices. While *AQ* is a commonly acknowledged determinant of risk, this study provides specific insight into the Albanian banking sector, where high exposure to sovereign debt could present a unique form of asset concentration risk not as prevalent in more diversified financial systems. This research sheds light on the specific nature of *AQ* in Albanian banks, filling a gap in how non-performing assets or concentrated exposures (such as domestic sovereign debt) drive risk in emerging economies with less diversified portfolios.

CONC (*Herfindahl index*): The positive and significant effect of market *CONC* on default risk (coefficient = 0.05, odds ratio = 1.05) suggests that higher market *CONC* increases the likelihood of default. This could be due to reduced competition and higher risk-taking behavior among dominant banks. This finding echoes concerns in the literature about the risks associated with high market *CONC* and monopolistic practices (Claessens & Laeven, 2004). Regulators may need to monitor market *CONC* levels and promote competitive market structures to mitigate systemic risks. Existing studies often focus on larger banking markets where competition is fierce. However, in the Albanian context, high market *CONC* is a more pressing issue, as the market is smaller and less competitive. This dimension is not as thoroughly explored in the literature on emerging markets. This research contributes to understanding how market *CONC* in smaller economies can lead to increased systemic risk, a topic underexplored in comparison to studies on more competitive markets in developed economies.

LIQ and MD: The marginally significant effects of *LIQ* (coefficient = -0.10, p-value = 0.10) and *MD* (coefficient = -0.08, p-value = 0.11) suggest potential influences on default risk, though their statistical significance is less robust. *LIQ* is crucial for a bank's ability to meet short-term obligations, and inadequate *LIQ* can lead to financial distress (Diamond & Rajan, 2001). Similarly, *MD*, which refers to the role of market participants in monitoring and influencing bank behavior, could impact default risk, although its effect in this model is not statistically significant. The marginal significance in these results contrasts with other studies that find a stronger relationship between *LIQ* and default risk, particularly in larger markets where *LIQ* shocks can be more pronounced. The findings may suggest that in Albania, where *MD* mechanisms might be weaker, the expected impact on default risk is diminished. This opens the door for further exploration into the role of regulatory frameworks in ensuring *LIQ* management in smaller financial systems.

The results are consistent with theoretical and empirical findings in bank stability literature, reinforcing the importance of *CAP, PROF*, and *AQ* in managing default risk. The significant role of *MQ* and market *CONC* also provides new insights into factors influencing bank stability in Albania. While the findings align with much of the established literature in terms of factors that drive bank default risk, this study introduces a novel focus on the Albanian banking sector. This is a key contribution, as most previous studies focus on large, developed markets or aggregate cross-country analyses that might obscure country-specific insights. This research fills the gap by providing context-specific evidence on how traditional banking risk factors behave in a transitional, emerging market economy. This adds valuable regional insights, especially for policymakers and regulators in similar markets, who can benefit from tailored recommendations for improving financial stability.

The findings highlight the need for a broad approach to bank regulation and supervision, emphasizing capital adequacy, asset quality management, and effective governance. Policymakers should also consider the implications of market concentration and the role of competition in enhancing financial stability.

6. CONCLUSION

Banks in Albania are integral to the country's financial system, and their stability is vital for systemic risk management.

The methodology utilized in this study aims to provide a comprehensive analysis of the PD for banks in Albania. By using a logistic regression model and carefully selecting relevant financial metrics the study seeks to offer meaningful insights into the factors influencing bank distress and inform risk management practices. The key findings reveal the importance of strong *CAP, PROF*, and *AQ* in reducing default risk while highlighting the significant roles of *MQ* and *CONC*. These findings offer practical implications for regulators, bank management, and policymakers, emphasizing the need for robust financial and operational practices to ensure bank stability. Effective regulation, sound risk management practices, and a robust economic environment are key to minimizing systemic risks associated with the banking sector. While the logistic regression model offers valuable insights, there are inherent limitations in terms of data quality, model assumptions, and external factors. The accuracy of the results is contingent on the quality and completeness of the data. Any data limitations or errors could affect the model's reliability. The sample size of 37 observations may limit the generalizability of the results. Logistic regression assumes a linear relationship between the log odds of the dependent variable and the independent variables, which may not fully capture complex relationships. The analysis does not account for all possible external factors influencing default risk, such as macroeconomic conditions, regulatory changes, or international financial conditions. Future research could expand on this methodology by incorporating additional variables and exploring alternative modeling approaches to enhance the understanding of default risk in the Albanian banking sector.

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