



Stability and Survival of the Banking Sector in Indonesia

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ABSTRACT

Purpose – This paper seeks to examine the stability and survival of banking institutions listed on the Indonesia Stock Exchange (IDX) from 2015 to 2024, using the Altman Z"-Score to assess financial distress and the Cox Proportional Hazards Model to evaluate the impact of macroeconomic factors such as inflation, interest rates, and economic growth on their survival probability. **Methodology/approach** – A quantitative research approach was employed, using financial data from annual reports of banking institutions listed on the Indonesia Stock Exchange (IDX) for the 2015–2024 period. Financial distress was measured using the Altman Z"-Score, while survival probability was assessed using the Cox Proportional Hazards Model. Macroeconomic variables—including inflation, interest rates, and economic growth—were incorporated to analyze their influence on survival of distress banks. Purposive sampling was used to select banks that consistently published financial statements throughout the study period. **Findings** – It was found that several banking institutions listed on the IDX experienced financial distress during the 2015–2024 period, as indicated by low Altman Z"-Scores. The survival analysis revealed that inflation and interest rates had a statistically significant negative effect on the survival probability of distressed banks, while economic growth had a positive impact. Among the three macroeconomic variables, interest rates were the most dominant factor influencing bank survival. **Novelty/value** – This study offers a novel integration of Altman Z"-Score and Cox Proportional Hazards Model to assess bank survival under macroeconomic pressure, providing insights for early detection of financial distress in Indonesian banks.

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INTRODUCTION

The banking sector plays a vital role in sustaining financial stability and facilitating national economic growth. As financial intermediaries, banks are responsible for collecting and distributing public funds through credit disbursement and other financial services that directly support productive sectors. On a global scale, the banking system has become a cornerstone of financial resilience, as disruptions within it can quickly spread across economies. The experiences of the 2008 global financial crisis and the COVID-19 pandemic revealed how weaknesses in banking systems could trigger widespread economic downturns. These events underscore the importance of studying global banking stability to understand how financial institutions can remain robust amid increasing uncertainty and interconnected markets. In Indonesia, the importance of banking institutions is further emphasized by their contribution to



macroeconomic balance, poverty alleviation, and the expansion of financial inclusion. The Indonesian banking industry, however, has been increasingly exposed to various internal and external challenges, including volatile global financial markets, fluctuating interest rates, rising inflation, foreign exchange instability, and significant regulatory transformations. These conditions necessitate a more thorough and dynamic evaluation of financial stability and survival potential within the sector.

To ensure systemic resilience, Indonesian authorities have introduced a series of policies aimed at reinforcing the soundness of banks. Regulations such as PBI No.14/18/PBI/2012 mandate the provision of adequate capital to absorb potential losses, while POJK No.17/POJK.03/2020 focuses on the implementation of comprehensive risk management practices. Moreover, POJK No.34/POJK.03/2018 requires the use of integrated evaluation tools to monitor bank performance. Despite these regulatory efforts, macroeconomic pressures continue to threaten the survival of financial institutions. For example, external factors such as the COVID-19 pandemic and ongoing geopolitical conflicts have not only disrupted global supply chains but also led to a surge in inflation, exchange rate volatility, and higher policy interest rates by central banks, including Bank Indonesia. According to OJK (2024) and Bank Indonesia (2024), these developments have weakened banks' asset quality, increased non-performing loans, and reduced profitability across the sector. These developments underscore the urgent need to assess financial health and predict long-term viability, particularly for banks exposed to financial distress (Rama Nopiana & Rusmiati Salvi, 2022; Rohmawati & Utami, 2025; Soesetio, 2023).

Various studies have attempted to understand the relationship between macroeconomic factors and the financial stability of banks. Zhou et al. (2022) found that exchange rate volatility and rising interest rates increase default risks, while Kristanti et al. (2021) highlighted that some banks remain profitable under high inflation due to adaptive asset-liability strategies. Conversely, other studies suggest that aggressive risk-taking in periods of economic expansion can leave banks vulnerable during downturns. These inconsistent findings likely arise from differences in research contexts and methodologies. Zhou's study focused on East Asian banks using default-risk indicators during periods of monetary tightening, whereas Kristanti's analysis examined Indonesian banks' profitability and their ability to adjust balance-sheet structures under inflationary pressure. Such variations in economic environments, timeframes, and analytical approaches explain why results may diverge even when studying similar macroeconomic variables. This highlights the importance of adopting a context-sensitive approach, particularly in developing countries like Indonesia, where financial institutions face distinct regulatory, operational, and market constraints (Abidah et al., 2024; Agaba & Christine, 2023).

In this context, the Altman Z''-Score model remains one of the most widely used tools for assessing the financial distress of companies. This model incorporates key financial ratios—including working capital, retained earnings, EBIT, and book value of equity—to generate a composite score that predicts the likelihood of bankruptcy. However, while the Altman Z''-Score effectively categorizes firms into distress or non-distress zones, it is limited in its ability to model the duration of survival or estimate the time-to-failure under dynamic economic conditions. This is where the Cox Proportional Hazards Model provides added value. As a semi-parametric survival analysis tool, the Cox model allows researchers to analyze the probability of firm survival over time, accounting for the influence of time-varying macroeconomic variables. Studies by Kim (2019) and Castaldo et al. (2023) confirm the superiority of this method in capturing the complexity of firm longevity, especially when compared to static financial ratio models.

While numerous studies have applied either the Altman Z''-Score or Cox regression independently, integrated approaches remain scarce—particularly in the context of Indonesian banking. Previous research has either focused on static financial assessments or macroeconomic impacts in isolation,

without exploring how distress and survival are linked over time. A few researchers focused on financial health assessment using Altman Z'-Score, and others have applied Cox Proportional Hazards for survival analysis. However, there have been limited studies concerned with integrating these two analytical approaches to examine the survival of distressed banking institutions in emerging economies such as Indonesia. Therefore, this research intends to bridge this gap by employing a two-stage approach: first, identifying financially distressed banks using the Altman Z'-Score; and second, analyzing the survival probability of these banks using the Cox Proportional Hazards Model in the presence of key macroeconomic variables such as inflation, interest rates, and economic growth.

The objective of this research is to examine the financial condition of Indonesian banks listed on the IDX between 2015 and 2024 and to analyze the impact of macroeconomic variables on the survival probability of banks that fall into financial distress. This study contributes to the literature by offering a comprehensive and sequential evaluation framework that combines bankruptcy prediction with survival modeling. It is expected to assist regulators, policymakers, and bank managers in developing more accurate early-warning systems and adaptive strategies to enhance banking resilience in an increasingly uncertain economic environment.

LITERATURE REVIEW

Financial Distress in the Banking Sector

Financial distress in the banking sector is a critical condition where a financial institution faces significant liquidity or solvency issues that may lead to bankruptcy if not mitigated (Altman et al., 2017). As banks play a systemic role in financial intermediation, distress in this sector can trigger widespread economic instability. To identify early signs of distress, researchers commonly employ financial ratio models. Among them, the Altman Z-Score has become widely recognized. Originally developed for manufacturing firms, it was later refined into the Z"-Score to suit non-manufacturing entities such as banks, by removing the sales variable and incorporating financial ratios that better reflect the structure of service-based firms (Altman et al., 2017). Studies in various countries have validated the use of Z"-Score in diagnosing financial health among banks and service sector firms (Say, 2024). In Indonesia, the model has been applied in evaluating public banking institutions due to its capacity to work with publicly available financial statements (Kristanti et al., 2021). However, one limitation of the Z"-Score is its static nature—it evaluates risk at a single point in time without providing insights into the timeline of financial collapse or recovery.

Survival Analysis and Cox Proportional Hazards Model

To address the limitations of static models, survival analysis methods such as the Cox Proportional Hazards Model have gained traction in financial research. This model enables the estimation of a firm's survival probability over time and identifies variables that influence the hazard (risk) of failure (Cox, 1972; Kim, 2019). Unlike conventional regression, Cox regression is semi-parametric and does not assume a particular distribution of survival times, making it highly adaptable to corporate financial datasets (Castaldo et al., 2023). In the context of banking, macroeconomic factors such as interest rates, inflation, and economic growth are key variables influencing survival. Research has shown that higher interest rates can raise borrowing costs and increase credit risk (Zhou et al., 2022), while inflation affects loan performance by eroding real income and weakening repayment capacity (Kristanti et al., 2021). Conversely, robust economic growth tends to enhance survival prospects through improved credit quality and revenue expansion (Kristanti & Isyнуwardhana, 2018). Despite these advantages, many applications of Cox regression in banking literature have treated survival analysis separately from financial distress modeling, resulting in a fragmented understanding of bank risk dynamics (Iskamto et al., 2019).

Integration of Financial Distress and Survival Models

An integrated approach that links financial distress with survival outcomes remains relatively underexplored, particularly in the Indonesian banking context. Existing studies often analyze distressed institutions without extending the analysis to their survival probability, or vice versa (Kristanti et al., 2019). This presents a significant gap in understanding the trajectory from distress to either recovery or failure. Furthermore, few studies span a sufficiently long observation period to capture the effects of



economic cycles, policy shifts, and structural reforms, such as those occurring in Indonesia between 2015 and 2024.

The combined use of Z"-Score for distress detection and Cox regression for survival analysis can provide a more holistic view of banking resilience. Such integration allows researchers to track not only whether a bank is at risk but also how long it can survive under different macroeconomic pressures. However, most existing works either focus on developed economies or specific crisis periods, thereby limiting their applicability to emerging markets with unique regulatory and economic conditions.

Research Gap and Contribution

In summary, although the Altman Z"-Score and Cox Proportional Hazards Model have each been widely used, there remains a lack of research that applies both methods in a sequential and integrated manner to analyze banking resilience. In the context of Indonesia—where banking institutions face structural volatility, regulatory transitions, and macroeconomic uncertainties—the application of such a framework is both timely and necessary. This study aims to fill this gap by integrating the Altman Z"-Score and the Cox Proportional Hazard Model within a unified analytical framework to evaluate both the financial distress status and the survival probability of banks listed on the Indonesia Stock Exchange from 2015 to 2024. The Z"-Score is applied to measure the internal financial condition of banks, while the Cox Model captures the influence of macroeconomic variables—specifically inflation, interest rates, and economic growth—on their likelihood of survival over time. By focusing on the influence of inflation, interest rates, and economic growth, this research contributes new empirical insights into how macroeconomic risks shape the long-term viability of banking institutions in an emerging market setting. This integrated approach enhances the understanding of financial stability and informs strategies for regulatory intervention, capital adequacy planning, and risk mitigation in the banking sector.

METHOD

This study applies a quantitative research design with a descriptive approach, aiming to assess the financial health and survival probability of banking institutions listed on the Indonesia Stock Exchange (IDX) during the 2015–2024 period. The ten-year observation window was chosen to capture structural changes in Indonesia's banking sector following the implementation of OJK's risk management regulations in 2015, as well as to encompass major macroeconomic shocks such as the COVID-19 pandemic and the subsequent recovery phase. The research is conducted in two stages: first, the detection of financial distress using the Altman Z"-Score; and second, the survival analysis of distressed banks using the Cox Proportional Hazards Model (Altman et al., 2017; Cox, 1972).

Research Population and Sample

The population of this research consists of all banking institutions listed on the IDX from 2015 to 2024. The sampling technique used is purposive sampling, which selects banks based on specific criteria: (1) the bank must be actively listed on the IDX throughout the observation period, (2) the bank must have published complete audited annual financial statements for each year between 2015 and 2024, and (3) the bank must not be involved in mergers or acquisitions that significantly alter its financial structure during the period (Sugiyono, 2019).

Based on these criteria, a total of 47 banks met the inclusion requirements and were selected for analysis.

Tabel 1. Summary of Reasearch Population and Sample

Description	Criteria/Information
Population	All banks listed on the Indonesia Stock Exchange (IDX) during 2015–2024
Sampling Method	Purposive Sampling
Selection Criteria	1. Active listing throughout 2015–2024 2. Complete audited annual reports 3. No mergers or acquisitions during observation period
Number Of Banks Selected	47 banks
Data Sources	IDX Official Website, Bank Indonesia, Badan Pusat Statistik (BPS)

Data Collection

Data were collected using documentation techniques, where secondary data such as audited financial statements were obtained from the IDX official website, and macroeconomic indicators (inflation, interest rates, GDP growth) were collected from Bank Indonesia and the Badan Pusat Statistik (BPS).

Data Analysis

The analysis was carried out in two stages:

1. Financial Distress Analysis using Altman Z"-Score

The Altman Z"-Score, originally developed by Altman (1968) and later adjusted for non-manufacturing and financial firms (Altman et al., 2017), was used to identify banks experiencing financial distress. The modified model excludes the sales variable and uses the following ratios:

$$Z'' = 6.56X_1 + 3.26X_2 + 6.72X_3 + 1.05X_4$$

Where :

X_1 = Working Capital / Total Assets

X_2 = Retained Earnings / Total Assets

X_3 = EBIT / Total Assets

X_4 = Book Value of Equity / Total Liabilities

2. Survival Analysis using Cox Proportional Hazards Model

To examine the effect of macroeconomic variables on the survival of distressed banks, the Cox Proportional Hazards Model (Cox, 1972) was employed. This method is widely used in longitudinal studies involving time-to-event data and allows for modeling the risk (hazard) of an event occurring (bank exit) as a function of explanatory variables that may change over time (Allison, 2010; Kristanti & Isyнуwardhana, 2018).

RESULT AND DISCUSSION

This study assessed the financial condition of 35 banks —selected from an initial pool of 47 banks listed on the Indonesia Stock Exchange (IDX)—by applying the Altman Z"-Score model as an initial indicator of financial distress. The reduction in the number of analyzed banks reflects data availability and completeness over the 2015–2024 observation period, ensuring that only institutions with consistent and audited financial information were included in the final sample. Based on the most recent available financial data, each bank was categorized into one of three risk levels: Healthy ($Z'' > 2.6$), Gray Area ($1.1 < Z'' \leq 2.6$), and Distressed ($Z'' \leq 1.1$). The descriptive results show that the majority of banks (25 out of 35) fall into the healthy category, indicating strong capitalization and effective risk management. Meanwhile, seven banks were classified in the gray area, reflecting moderate vulnerability, and three banks were categorized as distressed, suggesting potential solvency concerns. The distribution of banks by Z"-Score classification is presented in Table 1.

Table 2. Summary Z"-Score Classification (2015-2024)

Z"-Score Category	Numbers of Banks	Percentage
Healty	25	71,4%
Grey Area	7	20,0%
Distressed	3	8,6%

Source : Processed IDX Financial Reports (2025)

The result shows that only 20% of banks are in the Healthy zone, while the majority (71.4%) fall into the Gray Area, indicating financial uncertainty. A smaller group (8.6%) is already in the Distressed category, facing high risk of financial instability. These findings are consistent with previous research by Altman et al. (2017) and Say (2024), which confirm the Altman Z"-Score as a reliable tool to detect early signs of distress, especially in non-manufacturing and financial sectors. Similar evidence was also found by Kristanti and Isyuardhana (2018), who observed that the Z"-Score effectively predicts potential bank failure in Indonesia, particularly during adverse macroeconomic conditions. Furthermore, Rahman et al. (2020) and Haryanto (2022) emphasized that the Z"-Score serves as a robust early-warning indicator when combined with macroeconomic variables such as inflation and capital adequacy. Collectively, these studies reinforce the robustness of the Z"-Score in evaluating the financial soundness of banks in emerging markets.

Following this classification, banks that fell into the Gray Area and Distressed categories (a total of 28 banks) were subjected to further analysis using the Cox Proportional Hazards Model. This model was used to evaluate the influence of macroeconomic variables—namely inflation, interest rate, and GDP growth—on the survival probability of these banks. By incorporating time-to-event analysis, the Cox model allows for dynamic estimation of survival likelihood under varying external economic pressures (Cox, 1972; Allison, 2010).

To further investigate the influence of macroeconomic variables on the survival probability of banks categorized as Gray Area and Distressed by the Altman Z"-Score, this study utilized the Cox Proportional Hazards Model, a semi-parametric model widely applied in survival analysis. The Cox model, developed by David R. Cox in 1972, estimates the hazard (failure) rate at a given time, accounting for the effect of covariates without requiring the baseline hazard function to be specified (Cox, 1972). This makes it particularly useful in analyzing time-to-event data in economics and finance. The general form of the model is expressed as:

$$h(t) = h_0(t) \cdot e^{\beta_1 X_1 + \beta_2 X_2 + \dots + \beta_k X_k}$$

Where:

- $h(t)$ is the hazard function at time t ,
- $h_0(t)$ is the baseline hazard function,
- $X_1, X_2, \dots, X_k$ are explanatory variables (in this case: inflation, interest rate, and GDP growth),
- $\beta_1, \beta_2, \dots, \beta_k$ are coefficients estimating the effect of each variable.

The model assumes proportionality, meaning the hazard ratios between groups remain constant over time. It is widely used in the finance sector for evaluating bankruptcy risks and firm survival (Allison, 2010; Kristanti & Isyuardhana, 2018).

Table 3. Cox Regression Results for Bank Survival Probability

Variable	Coefficient (β)	Hazard Ratio ($\text{Exp}(\beta)$)	Significance (p-value)
Inflation	0,435	1,545	0,031*
Interest Rate	0,693	2,000	0,007*
GDP Growth	-0,550	0,577	0,045*

Note: $p < 0.05$ indicates statistical significance

Source : SPSS Output, processed (2025)

The results indicate that **inflation and interest rates** significantly increase the probability of failure for distressed banks, while **GDP growth** reduces the risk, acting as a protective factor. A one-unit increase in interest rates raises the risk of bank failure by 100%, whereas higher GDP growth reduces the risk by 42.3%.

These findings are aligned with prior empirical studies such as those by Zhou et al. (2022) and Kristanti & Isywardhana (2018), emphasizing that macroeconomic conditions are crucial determinants in the sustainability of financial institutions in emerging markets.

C O N C L U S I O N

This study concludes that macroeconomic conditions have a significant influence on the survival of Indonesian banks experiencing financial distress. Inflation and interest rates are shown to increase the risk of failure, making banks more vulnerable during periods of monetary tightening or rising consumer prices. These two factors contribute to shrinking margins, declining credit performance, and overall deterioration in financial sustainability. In contrast, economic growth tends to support survival, although its effect in this study was not statistically dominant. The findings affirm that macroeconomic stability plays a crucial role in determining whether a financially distressed bank can continue to operate over time.

The application of the Altman Z"-Score and the Cox Proportional Hazards Model in a sequential framework proves effective in identifying both the initial financial condition and the subsequent survival dynamics of banking institutions. The survival curve further reveals that banks in distress are most at risk during the fourth to sixth year of distress, suggesting a critical window for recovery or intervention.

Based on these findings, this study suggests that regulators and banking institutions should integrate macroeconomic indicators into their early warning systems and strategic planning. Timely intervention, especially within the first three years after signs of distress appear, is essential to enhance the survival prospects of troubled banks. For future research, it is recommended to expand the model by incorporating variables such as digital transformation, bank size, and governance structure, which may further improve the predictive accuracy of survival analysis in the financial sector. The inclusion of digital transformation is important because the adoption of financial technology, automation, and data-driven decision-making can influence a bank's operational efficiency and resilience to macroeconomic shocks. Bank size can also play a moderating role, as larger banks typically possess stronger capital buffers and diversified portfolios that may reduce default probability. Meanwhile, governance structure—including board independence, ownership concentration, and managerial oversight—affects the effectiveness of internal control and risk management mechanisms. Considering these factors in future survival models will enable a more comprehensive understanding of how both macroeconomic and institutional characteristics jointly determine the long-term viability of banks.

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