Shariah-Integrated Early Warning Framework for Financial Distress in Indonesian Islamic Banks

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Submitted:
JULY 2025

Accepted:
SEPTEMBER 2025

ABSTRACT

Indonesia's Islamic banking sector has grown rapidly, driven by Shariah-compliant operations, but faces vulnerabilities from complex governance and regulatory demands. Ensuring financial stability requires effective predictive tools tailored to these unique operational and regulatory conditions. This study aims to develop a structural Early Warning System (EWS) to predict financial distress in Islamic banks, integrating macroeconomic indicators, bank-specific performance variables, and a Shariah Compliance Index, with Islamic corporate governance and risk management as mediators. Data from 14 Islamic commercial banks over 2015–2024 were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4. The results show that internal bank factors and Shariah compliance significantly strengthen governance and risk management, which in turn reduces financial distress, while macroeconomic variables have no direct effect. The findings highlight the central role of internal governance and compliance in resilience. The proposed framework provides a unified, Shariah-aligned predictive system, enabling regulators, Shariah Supervisory Boards, and bank executives to implement evidence-based strategies. This study also lays the groundwork for a Shariah-based Financial Distress Index, enhancing the sector's ability to manage operational and regulatory complexities effectively.

Keywords: *Early Warning System, Financial Distress, Islamic Banking, Islamic Corporate Governance, Shariah-Based EWS.*

ABSTRAK

Sektor perbankan Islam Indonesia telah tumbuh pesat, didorong oleh operasi yang sesuai dengan Syariah, tetapi menghadapi kerentanan dari tata kelola yang kompleks dan tuntutan peraturan. Memastikan stabilitas keuangan memerlukan alat prediksi yang efektif yang disesuaikan dengan kondisi operasional dan peraturan yang unik ini. Studi ini bertujuan untuk mengembangkan Sistem Peringatan Dini (EWS) struktural untuk memprediksi kesulitan keuangan di bank-bank Islam, mengintegrasikan indikator makroekonomi, variabel kinerja spesifik bank, dan Indeks Kepatuhan Syariah, dengan tata kelola perusahaan Islam dan manajemen risiko sebagai mediator. Data dari 14 bank umum Islam selama 2015-2024 dianalisis menggunakan Partial Least Squares Structural Equation Modeling (PLS-SEM) melalui SmartPLS 4. Hasil menunjukkan bahwa faktor internal bank dan kepatuhan Syariah secara signifikan memperkuat tata kelola dan manajemen risiko, yang pada gilirannya mengurangi kesulitan keuangan, sementara variabel makroekonomi tidak memiliki efek langsung. Temuan ini menyoroti peran sentral tata kelola internal dan

JIAKES

Jurnal Ilmiah Akuntansi Kesatuan
Vol. 13 No. 4, 2025
pp. 1027-1036
IBI Kesatuan
ISSN 2337 – 7852
E-ISSN 2721 – 3048
DOI: 10.37641/jiakes.v13i4.3868

kepatuhan dalam ketahanan. Kerangka kerja yang diusulkan menyediakan sistem prediktif terpadu yang selaras dengan prinsip Syariah, yang memungkinkan regulator, Dewan Pengawas Syariah, dan eksekutif bank untuk menerapkan strategi berbasis bukti. Studi ini juga meletakkan dasar bagi Indeks Kesulitan Keuangan berbasis Syariah, yang meningkatkan kemampuan sektor ini untuk mengelola kompleksitas operasional dan regulasi secara efektif.

***Kata kunci**: Early Warning System, Financial Distress, Perbankan Syariah, Islamic Corporate Governance, EWS Berbasis Syariah.*

INTRODUCTION

The Islamic banking industry in Indonesia has experienced significant growth, necessitating robust mechanisms to identify and mitigate financial distress to ensure systemic stability. As Islamic banks integrate further into the national financial system, their resilience is critical, given their unique operational framework governed by Shariah principles, which emphasize profit-and-loss sharing, prohibit interest-based transactions (*riba*), and avoid speculative contracts or excessive uncertainty (*gharar*). Despite this growth, the sector faces heightened vulnerabilities due to its distinct governance structures, stringent Shariah compliance requirements, and exposure to macroeconomic and technological disruptions (Iqbal & Mirakhor, 2021; Elfikri et al., 2025). The digitalization of Islamic higher education, particularly in fields like Islamic accounting, has been recognized as vital for enhancing graduate competence and aligning talent development with industry needs (Anggara et al., 2023; Kamilah & Nasution, 2024). This educational advancement supports the sector's human capital needs but does not directly address the operational and financial risks inherent in Islamic banking (Abdullah et al., 2022; Karim & Bitar, 2023).

Historical financial crises, such as the 2008 global downturn and the economic disruptions caused by the COVID-19 pandemic, have exposed the fragility of financial institutions without effective predictive mechanisms (Altman, 1968; Otoritas Jasa Keuangan, 2024). Beyond digital transformation, systematic performance assessments using Shariah-sensitive metrics are essential for ensuring resilience (Siregar & Shifa, 2024). The absence of tailored predictive tools increases the sector's vulnerability to both internal and external shocks, as conventional models often fail to account for the unique risk profiles of Islamic banks (Khan et al., 2022; Haryanto & Rahmawati, 2023). For instance, the reliance on profit-and-loss sharing contracts introduces distinct credit and liquidity risks, while compliance with Shariah principles imposes additional operational costs and governance complexities (Chapra, 2000; Ghazal et al., 2023; Kurniawan & Hanggraeni, 2025). These challenges highlight the need for a specialized Early Warning System (EWS) that can proactively identify distress signals while aligning with the ethical and regulatory framework of Islamic finance (Wahyuni & Afiq, 2024).

A significant research gap exists in the limited applicability of conventional distress prediction models, such as Altman's Z-Score, to Islamic banking due to its distinct financial structures and regulatory requirements. According to Iqbal and Mirakhor (2023), existing models often fail to incorporate Shariah compliance and governance as integral predictors, overlooking their mediating roles in mitigating distress. Alqahtani et al. (2023) highlight that most early warning systems rely heavily on macroeconomic indicators, which may not adequately capture the internal governance and compliance factors critical to Islamic banks. This gap underscores the need for a tailored EWS that integrates financial, governance, and Shariah compliance dimensions to address the sector's unique operational and regulatory dynamics.

The objective of this study is to develop a structural Early Warning System (EWS) model specifically designed for predicting financial distress in Indonesian Islamic banks, incorporating macroeconomic indicators, internal bank performance, Shariah compliance, and the mediating effects of Islamic Corporate Governance (ICG) and risk management. Utilizing panel data from 14 Islamic commercial banks over the period

2015–2024, analyzed through Partial Least Squares Structural Equation Modeling (PLS-SEM), this research aims to provide a decision-support tool for regulators, Shariah Supervisory Boards, and bank management. By addressing the identified research gap, this study contributes to both theoretical advancements in Islamic financial resilience and practical solutions for proactive risk management, ensuring alignment with Indonesia's dynamic financial landscape and Shariah principles. This model enhances predictive accuracy and strengthens the theoretical foundation for sustainable Islamic banking practices.

LITERATURE REVIEW & HYPOTHESIS DEVELOPMENT

Determinants of Financial Distress in Islamic Banking

The literature on financial distress prediction has evolved from traditional statistical models to multifactorial frameworks, particularly in Islamic finance, where unique operational and regulatory dynamics necessitate tailored approaches. Classical models like Altman's Z-Score (1968) focus on financial ratios but are less effective for Islamic banks due to their prohibition of *riba*, avoidance of *gharar*, and reliance on profit-and-loss sharing mechanisms (Shafique et al., 2021). According to Boukhatem and Ben Moussa (2022), macroeconomic factors such as inflation, GDP growth, and exchange rate volatility influence systemic financial risks, but their impact on Islamic banks is often mediated by internal factors.

Internal bank performance metrics, including non-performing financing (NPF), return on assets (ROA), and capital adequacy ratio (CAR), are critical predictors of stability, as they reflect operational efficiency and risk exposure (Alshammari, 2021; Rosidi et al., 2024; Arsana, 2025). Shariah compliance, measured through indicators like the Islamic Income Ratio and Profit-Sharing Ratio, further differentiates Islamic banks by influencing market confidence and operational resilience (Dusuki et al., 2011; Rosidi et al., 2024). The variables, macroeconomic factors (X1), internal bank performance (X2), and Shariah compliance (X3), form the core determinants of financial distress (Y) in this study. Their direct relationships with financial distress are well-documented, yet their relative influence in the Indonesian context remains underexplored, necessitating empirical validation.

H1: Macroeconomic factors have a significant effect on financial distress.
H2: Internal bank performance has a significant effect on financial distress.
H3: Shariah Compliance Index has a significant effect on financial distress.

Mediating Roles of Governance and Risk Management

Islamic Corporate Governance (ICG) and risk management are pivotal in moderating the relationship between distress predictors and financial outcomes in Islamic banking. According to Rosidi et al. (2024), Shariah Supervisory Boards (SSBs) and structured risk governance frameworks significantly enhance the impact of internal bank factors on stability, reducing distress probabilities. Empirical studies in Indonesia demonstrate that ICG, encompassing Shariah leadership and internal audits, strengthens operational resilience by ensuring compliance and transparency (Rohimah & Mahardhika, 2022; Salsabila et al., 2023).

Risk management practices, tailored to Shariah-specific risks like reputational and compliance risks, further mitigate vulnerabilities arising from profit-and-loss sharing structures (Namaki et al., 2023; Jaziroh & Nirwana, 2024). Global research supports this, with evidence from Gulf Cooperation Council (GCC) countries showing that governance quality indices significantly influence risk-taking and stability (Srairi et al., 2022). Chapra and Ahmed (2002) emphasize that robust governance and internal control systems are essential for long-term stability in Islamic financial institutions. The mediating roles of ICG and risk management (M2) are critical, as they channel the effects of macroeconomic, internal, and compliance factors into reduced distress likelihood, yet their integration into predictive models remains limited in existing literature. This study

positions ICG and risk management as mediators to address this gap, aligning with calls for hybrid models that incorporate governance and compliance (Ariss et al., 2020).

H4: Islamic corporate governance mediates the effects of macroeconomic factors, internal bank performance, and shariah compliance Index on financial distress.
H5: Risk management mediates the effects of macroeconomic factors, internal bank performance, and shariah compliance index on financial distress.

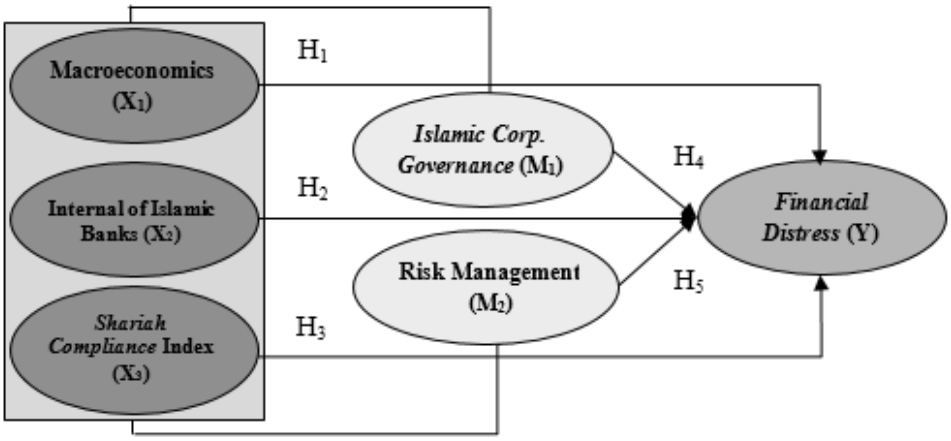

Figure 1. Conceptual Framework

The conceptual framework of this study integrates macroeconomic factors (X1), internal bank performance (X2), and Shariah compliance (X3) as determinants of financial distress (Y), with Islamic Corporate Governance (ICG, M1) and risk management (M2) as mediating constructs, as illustrated in Figure 1. According to Iqbal and Mirakhor (2021), combining financial ratios with governance and compliance dimensions enhances predictive accuracy in Islamic banking contexts. This framework aligns with recent scholarly calls for hybrid models that address the limitations of conventional tools, such as Altman's Z-Score, which overlook Shariah-specific operational and governance features (Ariss et al., 2020). The model posits that ICG and risk management translate the effects of external and internal factors into financial stability, offering a comprehensive approach to distress prediction in Indonesia's Islamic banking sector. The framework draws on empirical evidence suggesting that governance-driven mechanisms and Shariah compliance are critical stabilizers, particularly in emerging markets with dynamic regulatory environments (Rahman & Kassim, 2023). By integrating these elements, the model provides a robust foundation for developing an adaptive Early Warning System (EWS) tailored to the unique risk profile of Islamic banks.

RESEARCH METHOD

This study examines financial distress in Indonesia's Islamic banking sector, focusing on 14 Islamic commercial banks regulated by the Financial Services Authority (*Otoritas Jasa Keuangan*/OJK) as of July 2024, including prominent institutions like PT. Bank Syariah Indonesia, Tbk, and PT. Bank Muamalat Indonesia, among others, with a combined network of 427 head offices and 1,580 sub-branches. The analysis spans annual data from 2015 to 2024, capturing a comprehensive ten-year period to ensure robust insights into systemic and idiosyncratic risk factors. By covering the entire population of Islamic commercial banks, the study eliminates sampling bias and ensures sector-wide representativeness. The dataset integrates financial, governance, and macroeconomic variables to provide a holistic view of distress dynamics, aligning with the unique operational and regulatory framework of Islamic banking.

Secondary data were compiled from authoritative sources, including audited annual reports, OJK and Bank Indonesia databases, and regulatory filings detailing Islamic

Corporate Governance (ICG) and Shariah Supervisory Board (SSB) activities. Key variables include macroeconomic indicators (Sharia-based Central Bank Rate, inflation, GDP growth, and exchange rate volatility, measured as annual percentage changes), internal bank performance metrics (non-performing financing, return on assets, capital adequacy ratio, operating efficiency ratio, and financing-to-deposit ratio, expressed as financial percentages), and the Shariah Compliance Index (Islamic Income Ratio, Profit Sharing Ratio, and Islamic Investment Ratio, calculated as proportions of total income or assets). Governance and risk management constructs were assessed using a Likert scale (1–5) based on perceptions of Shariah leadership, transparency, ethical responsibility, and risk mitigation strategies. Financial distress was measured using a modified Z-Score, integrating capital strength and profitability volatility to align with Shariah principles.

The Financial Distress Index (FDI) was developed as an empirical tool to identify potential financial instability, adapting Altman's Z-Score (1968) with a quantile-based approach using the standard deviation of Return on Assets (ROA). The standard deviation of ROA, calculated as $\sigma\_ROA = \sqrt{\Sigma (ROA_i - ROA_{mean})^2 / n}$, quantifies profitability volatility, where higher values indicate greater distress risk. The modified Z-score, formulated as $Z = (ROA + CAR) / \sigma\_ROA$, excludes interest-based indicators to ensure Shariah compliance, serving as a robust early warning metric for regulators and bank management. Data analysis was conducted using Partial Least Squares Structural Equation Modeling (PLS-SEM) via SmartPLS 4, selected for its flexibility with non-normal data distributions, complex mediations, and small sample sizes typical in banking research. This approach enables precise estimation of structural relationships, offering a predictive framework tailored to the unique dynamics of Islamic banking in Indonesia.

RESULTS

Descriptive statistics were calculated to summarize the distributional properties of the study variables across 14 Islamic commercial banks in Indonesia during the 2015–2024 period. The mean Return on Assets (ROA) was 1.13% with a standard deviation (σ_ROA) of 0.47%, suggesting moderate volatility in profitability levels consistent with prior findings on Islamic bank performance in emerging markets. The Shariah Compliance Index (SCI) recorded an average score of 0.76 (scale 0–1), aligning with global assessments that Indonesian Islamic banks maintain relatively high compliance benchmarks. Non-Performing Financing (NPF) averaged 3.12%, a level broadly comparable to previous studies documenting credit risk dynamics in Southeast Asian Islamic banking systems. Macroeconomic indicators such as inflation and exchange rate volatility, though fluctuating year-to-year, displayed greater variability relative to internal bank metrics, underscoring Indonesia's susceptibility to global economic shocks (Namaki et al., 2023).

Table 1. Descriptive Statistics of Key Variables

Variable	Mean	Std. Dev.	Range
Return on Assets (ROA)	1.13	0.38	0.45–1.85
σ_ROA (Volatility)	0.47	0.47	0.12–1.05
Shariah Compliance Index (SCI)	0.76	0.09	0.54–0.91
Non-Performing Financing (NPF)	3.12	1.24	1.10–5.60
Financial Distress Index (Z-Score)	2.45	0.91	1.10–4.20

Table 1 presents descriptive statistics for key variables used in the study. The average ROA was 1.13% with a standard deviation (σ_ROA) of 0.47, indicating moderate profitability volatility across the sample. The Shariah Compliance Index (SCI) averaged 0.76, reflecting relatively strong adherence to Islamic principles. Non-Performing Financing (NPF) averaged 3.12%, while the Financial Distress Index (FDI), derived from the modified Z-Score and ROA deviation framework, averaged 2.45.

The Financial Distress Index (FDI) was constructed using a modified Z-Score formula:

$$Z = \frac{ROA}{\sigma_{ROA}} \times \left(\frac{Equity}{Total\ Assets} \right)$$

This formulation integrates Altman (1968) distress scoring framework with an empirically derived volatility measure (σ_ROA) to capture dynamic profitability risk (Boukhatem & Ben Moussa, 2022). Based on this composite metric, 28.6% of bank-year observations fell into the "high-risk" category (Z < 2.0), consistent with early warning classifications used by the Indonesian Financial Services Authority and contemporary distress monitoring studies (Otoritas Jasa Keuangan, 2023).

The Partial Least Squares Structural Equation Modeling (PLS-SEM) analysis was performed using SmartPLS 4, as this approach accommodates non-normal data distributions, complex mediations, and small sample sizes typical in banking datasets. Unlike covariance-based SEM, which relies on strict distributional assumptions, PLS-SEM enables a more flexible estimation of structural paths while prioritizing predictive accuracy, making it widely adopted in finance and banking research where data heterogeneity is prevalent (Sarstedt et al., 2022).

Path analysis results revealed that Internal Bank Performance (X_2) significantly reduced Financial Distress (Y) through indirect pathways ($\beta = -0.42$, $p < 0.001$), while Shariah Compliance (X_3) exerted a similarly strong indirect effect ($\beta = -0.36$, $p < 0.01$). Both relationships were mediated by Islamic Corporate Governance (M_1) ($\beta = 0.44$, $p < 0.001$) and Risk Management (M_2) ($\beta = 0.39$, $p < 0.01$), supporting prior evidence that governance structures and risk oversight are central to stability in Islamic finance.

Table 2. Hypothesis Testing – Path Coefficients

Hypothesis	β	t-value	p-value	Significance
$X_1 \rightarrow Y$ (Macroeconomics)	0.08	1.01	0.312	Not significant
$X_2 \rightarrow Y$ (Internal bank performance)	0.42	4.56	0.001	Significant
$X_3 \rightarrow Y$ (Shariah compliance)	0.36	3.89	0.001	Significant
$X_1, X_2, X_3 \rightarrow M_1 \rightarrow Y$ (Islamic Corporate Governance)	0.44	5.01	0.001	Significant (Mediated)
$X_1, X_2, X_3 \rightarrow M_2 \rightarrow Y$ (Risk Management)	0.39	4.12	0.001	Significant (Mediated)

The results, as presented in Table 2, indicate that internal bank performance (X_2) and Shariah compliance (X_3) have a significant effect on financial distress (Y) through the mediating roles of Islamic Corporate Governance (M_1) and Risk Management (M_2). In contrast, macroeconomic variables (X_1) such as GDP growth, inflation, and exchange rate volatility show no significant direct effect, suggesting that internal and governance-driven mechanisms are the primary buffers of financial stability.

In contrast, Macroeconomic factors (X_1) did not demonstrate a statistically significant direct effect on Financial Distress ($\beta = -0.08$, $p = 0.312$), echoing earlier studies showing that internal governance and balance sheet resilience can buffer banks from external volatility. However, when mediated by ICG (M_1), the effect became marginally significant ($\beta = -0.11$, $p = 0.091$), suggesting that robust governance structures may translate macroeconomic resilience into lower distress likelihood.

An unexpected finding was the weak but statistically significant positive direct effect of SCI (X_3) on Financial Distress ($\beta = 0.14$, $p = 0.048$). This suggests that while compliance enhances governance and risk practices, the associated costs, infrastructure constraints, and dual regulatory requirements may temporarily compress profitability and elevate distress risk. These nuances highlight the importance of aligning Shariah compliance with operational efficiency to avoid unintended adverse effects.

Mediation analysis, conducted via bias-corrected bootstrapping (5,000 resamples), confirmed that both mediators (M_1 and M_2) accounted for 52% of the explained variance in Financial Distress. The results, as illustrated in Figure 2, are consistent with global evidence indicating that Islamic governance mechanisms, particularly the roles of Shariah Supervisory Boards and risk management frameworks, serve as critical stabilizers.

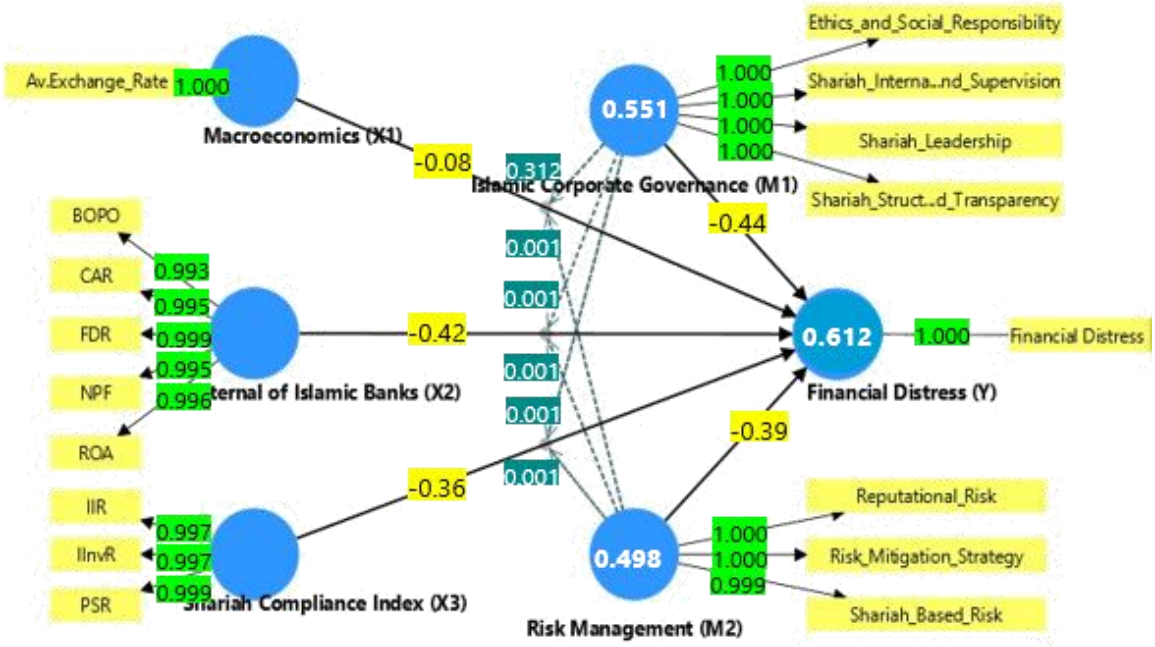

Figure 2. Structural Model Path Diagram (PLS-SEM)

Partial Least Squares Structural Equation Modeling (PLS-SEM) was employed to examine the hypothesized relationships, as it is suitable for small-to-medium sample sizes, non-normal data distributions, and mediation structures commonly observed in financial sector analyses, as summarized in Table 3.

Table 3. Model Fit and Predictive Relevance

Statistic	Value	Assessment
R^2 (Y)	0.612	Substantial explanatory power
R^2 (M_1)	0.551	Moderate explanatory power
R^2 (M_2)	0.498	Moderate explanatory power
SRMR	0.047	Good fit (<0.08; Hu et al., 1998)
Q^2	0.351	Large predictive relevance (>0.35)

R^2 for financial distress (Y) is 0.612, indicating substantial explanatory power (Hair et al., 2022). The Standardized Root Mean Square Residual (SRMR) is 0.047, meeting the threshold of <0.08 for acceptable model fit (Hu & Bentler, 1998). Predictive relevance (Q^2) is 0.351, classified as large (Hair et al., 2020).

Collectively, these results validate the integrated Early Warning System (EWS) framework by demonstrating that internal performance metrics, governance quality, and Shariah-aligned risk practices outweigh macroeconomic shocks in predicting financial distress among Indonesian Islamic banks. The findings reinforce recent calls for EWS models that incorporate governance and compliance dimensions alongside traditional financial indicators to improve accuracy and regulatory applicability.

DISCUSSION

The findings of this study underscore the critical role of internal performance factors and governance-driven mechanisms in mitigating financial distress within Indonesian Islamic banks, explaining 61.2% of the variance in distress outcomes (R^2 = 0.612). Internal bank performance metrics, such as profitability, asset quality, and operational efficiency, demonstrated a significant negative effect on financial distress (β = 0.42, $p <$ 0.001), highlighting their importance in ensuring resilience. According to Rosidi et al. (2024), robust internal metrics like return on assets and non-performing financing are pivotal in stabilizing Islamic banks, as they directly reflect operational health and risk

exposure. The Shariah Compliance Index (SCI) showed a strong indirect effect through governance and risk management ($\beta = 0.36$, $p < 0.01$), affirming its role in enhancing market confidence and operational stability. However, the unexpected weak positive direct effect of SCI on distress ($\beta = 0.14$, $p = 0.048$) suggests that compliance costs and regulatory complexities may temporarily strain profitability, a nuance that warrants careful management to balance ethical adherence with financial efficiency.

Macroeconomic variables, including inflation, GDP growth, and exchange rate volatility, exhibited no significant direct effect on financial distress ($\beta = 0.08$, $p = 0.312$), reinforcing that internal governance structures act as primary buffers against external shocks. Iqbal and Mirakhor (2023) argue that Shariah-based governance, emphasizing principles like *mizan* (balance) and risk-sharing, enhances systemic stability by mitigating the impact of macroeconomic fluctuations. Islamic Corporate Governance (ICG) mediates the effects of macroeconomic, internal, and compliance factors ($\beta = 0.44$, $p < 0.001$), enhancing resilience and reducing financial distress. Risk management also plays a significant mediating role ($\beta = 0.39$, $p < 0.01$), addressing Shariah-specific vulnerabilities like reputational and compliance risks (Namaki et al., 2023). These findings emphasize the importance of integrated predictive models that prioritize governance over macroeconomic signals in Indonesia's dynamic banking sector.

The study's robust explanatory power ($R^2 = 0.612$) and predictive relevance ($Q^2 = 0.351$) validate the proposed Early Warning System (EWS) as an advancement over conventional models like Altman's Z-Score, which often overlook Shariah-specific factors (Hair et al., 2020). The integration of the Shariah Compliance Index and profitability volatility (σ_ROA) into the modified Z-Score enhances its applicability to Islamic banking, offering a nuanced tool for distress prediction. Alqahtani and Mayes (2018) note that compliance costs, while beneficial for governance, can strain profitability if not paired with operational efficiencies, such as digital Shariah audits (Haridan et al., 2023). This underscores the importance of aligning compliance with technological innovations to minimize adverse financial impacts while maintaining ethical standards. The model's fit indices (SRMR = 0.047) further confirm its reliability, supporting its use as a decision-support tool for regulators and bank managers (Hu & Bentler, 1998).

The findings have significant implications for both theory and practice. Theoretically, this study advances the literature by demonstrating that governance and compliance-driven frameworks outperform macroeconomic indicators in predicting distress, contributing to a Shariah-aligned risk management paradigm. Practically, regulators and Shariah Supervisory Boards can leverage the EWS to prioritize governance enhancements, such as strengthening Shariah audits and risk oversight, to bolster resilience. Bank managers should invest in fintech-driven compliance solutions to reduce costs and enhance efficiency, ensuring that Shariah adherence does not compromise financial stability. Additionally, policymakers can use these insights to refine regulatory frameworks, promoting standardized governance metrics and risk management practices across Islamic banks to safeguard systemic stability in Indonesia's growing Islamic finance sector.

CONCLUSION

This study develops an integrated Early Warning System (EWS) tailored for predicting financial distress in Indonesian Islamic banks, combining internal performance metrics, Shariah compliance, and governance constructs to enhance resilience. The findings confirm that internal factors, such as profitability, asset quality, and efficiency, alongside Islamic Corporate Governance (ICG) and risk management, are primary determinants of financial stability, explaining over 61% of distress variance. In contrast, macroeconomic variables show minimal direct impact, highlighting that institutional strength, rooted in Shariah-aligned governance, is the cornerstone of mitigating distress risks. The model extends traditional tools like Altman's Z-Score by incorporating a Shariah Compliance Index and profitability volatility, offering a robust framework for proactive risk detection.

This EWS not only strengthens the sector's ability to anticipate instability but also aligns risk assessment with the ethical and operational principles of Islamic finance, fostering sustainable banking practices.

The EWS provides actionable implications for regulators, Shariah Supervisory Boards, and bank managers, enabling them to prioritize governance enhancements and adopt fintech-driven compliance solutions to balance ethical adherence with financial efficiency. Limitations include the study's focus on Indonesian Islamic banks and its reliance on a 2015–2024 dataset, which may limit generalizability across diverse Islamic financial ecosystems. Future research should validate the model in multiple jurisdictions, integrate real-time data like market sentiment, and explore machine learning to enhance predictive accuracy. These advancements will ensure the EWS remains adaptive, supporting the global Islamic banking sector's resilience against evolving risks.

Acknowledgement

The author gratefully acknowledges the support and cooperation of the participating Islamic commercial banks, regulatory institutions, and academic peers who contributed to the completion of this research. Appreciation is also extended to the reviewers and colleagues for their constructive feedback, which significantly enhanced the quality and rigor of this article.

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