# “Financial risk management, capital adequacy, and stability of Islamic banks: The moderating effect of efficiency in the Indonesian and Malaysian context”


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# FINANCIAL RISK MANAGEMENT, CAPITAL ADEQUACY, AND STABILITY OF ISLAMIC BANKS: THE MODERATING EFFECT OF EFFICIENCY IN THE INDONESIAN AND MALAYSIAN CONTEXT

## Abstract

The instability or failure of financial institutions frequently triggers global financial crises, as exemplified by the 2008 global financial crisis that originated from subprime mortgage defaults in the United States. This study examines the impact of liquidity risk, credit risk, and capital adequacy on the financial stability of Islamic banks in Indonesia and Malaysia and explores the moderating effect of operational efficiency on this relationship. This study utilizes data from 16 Islamic commercial banks in Indonesia and 13 Islamic commercial banks in Malaysia, spanning the period from 2018 to 2024. Data were collected from annual reports and analyzed using panel data regression and System-GMM to address potential endogeneity. The results of panel data analysis indicate that banks with lower liquidity risk and credit risk tend to perform better in terms of stability. Additionally, higher capital adequacy is associated with higher stability. Initially, it was found that efficiency only moderates the effects of liquidity risk and credit risk on bank stability. However, further analysis using System-GMM revealed that efficiency also moderates the relationship between credit risk, liquidity risk, and capital adequacy on bank stability. This outcome confirms that the endogeneity issue has been successfully addressed using Sys-GMM analysis.

**Keywords** financial stability, Islamic banks, liquidity risk, credit risk, capital adequacy, efficiency

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## INTRODUCTION

Banks' financial stability frequently receives insufficient public attention, although financial stability issues can precipitate global economic crises. For instance, the 2007–2008 Global Financial Crisis, which was initiated by subprime mortgage defaults in the United States, had a significant impact that spread to other countries worldwide (Ding et al., 2023). Financial stability becomes even more complex in the context of Islamic banks (IBs) because they operate based on sharia principles that prohibit riba (interest), gharar (uncertainty), and maysir (speculation) (Asif & Nasir, 2024). These principles form a unique operational framework, differentiating IBs from conventional banks in terms of risk structure and financial management (Barau et al., 2023; Trad et al., 2017). In addition, IBs are also responsible for complying with Islamic law principles. This compliance creates a different operational framework from conventional banks, making financial risk management a more complex challenge (Marston & Sundararajan, 2003).

The risk management framework in IBs is organized into several categories: credit risk, equity investment risk, market risk, liquidity risk, rate of return risk, and operational risk (Mahdy, 2012). Credit and liquidity are the most significant IB risks (Shiyyab & Morshed, 2024; Yusoff et al., 2023). IBs face credit risk, but it is managed through profit-sharing contracts such as Mudarabah and Musharakah, which inherently involve risk-sharing (Hassan et al., 2019). IBs often struggle with liquidity risk due to the lack of Shariah-compliant liquidity management tools. This is intensified by prohibiting interest-bearing instruments (Dolgun et al., 2019; Rosman & Rahman, 2015).

Empirical research results related to the influence of liquidity risk, credit risk, and capital adequacy on the stability of IBs in general are still inconclusive, and the results differ between countries/regions and different data analysis techniques. Ghenimi et al. (2017) studied the MENA region and found that credit risk, not liquidity risk and capital adequacy, had a negative effect on the stability of IBs. In the MENA region, Hamdi et al. (2019) found that capital adequacy and liquidity risk had a positive effect on stability, but credit risk had no impact at all. From these two studies, efficiency was found to consistently influence the financial stability of IBs. Furthermore, Hassan et al. (2019), using data from OIC countries, found that liquidity risk negatively affected IBs' stability. The latest findings from Iqbal et al. (2024) in the Asia region show that credit and liquidity risks have a significant negative effect on financial stability. The previous study focused more on Middle Eastern countries; however, few studies have used data from Southeast Asia. With 260 million people, Indonesia and Malaysia are the largest Muslim majority countries in the world (World Population Review, 2025). The similarities in the culture and regulatory characteristics of these two countries are interesting to study and open up opportunities for new contributions to the literature related to the financial stability of IBs.

## 1. LITERATURE REVIEW

Diamond's (1984) Theory of Financial Intermediation posits that banks serve a critical role as intermediaries between surplus units (depositors or investors) and deficit units (borrowers) through a function known as delegated monitoring. This intermediation function addresses the inherent problems of information asymmetry and high monitoring costs, which occur when individual investors engage in direct lending activities. By pooling funds from multiple depositors, banks can more efficiently monitor and allocate capital while mitigating risk through portfolio diversification.

In the context of Islamic banking, the intermediation function is tailored to comply with Sharia principles, which prohibit interest (riba), speculative transactions (gharar), and unethical investments. Instead, IBs mobilize funds and channel them into productive, real-sector activities through equity-based (e.g., Mudharabah, Musyarakah) and trade-based (e.g., Murabahah, Ijarah) contracts (Lewis, 2014). This system not only supports economic growth but also ensures that financial activities are anchored in tangible assets and real transactions, thereby reducing the likelihood of speculative bubbles and systemic instability (Ben Jedidia & Hamza, 2024; Hafnida et al., 2015; Muda et al., 2013). Furthermore, IBs emphasize a profit-and-loss sharing (PLS) model, which equitably distributes risks and returns to align the interests of banks and their clients. This risk-sharing mechanism reduces agency problems and strengthens financial discipline, which in turn enhances financial stability.

IBs are inherently exposed to various types of financial risks, including liquidity risk, credit risk, and risks related to capital adequacy. Ghenimi et al. (2017) noted that liquidity risk arises when several depositors simultaneously withdraw their funds, while the bank lacks sufficient liquid assets to meet these obligations. Credit risk emerges when financing recipients fail to meet their payment obligations in a timely manner. Capital adequacy refers to a bank's ability to absorb potential losses, represented by the proportion of capital relative to risk-weighted assets. This capital includes Tier 1 capital, such as common stock, retained earnings, and shareholders' equity, and Tier 2 capital, such as subordinated debt and credit loss provisions (Ding et al., 2023).


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IBs channel funds through various Sharia-compliant instruments, including Murabahah (cost-plus sale), Mudharabah, and Musyarakah (profit- and loss-sharing arrangements). The financial stability of IBs may deteriorate under conditions of constrained liquidity, particularly when large withdrawals coincide with limited access to liquid assets. Similarly, elevated credit risk reflected by increased non-performing financing reduces the availability of liquid funds, further undermining stability. Furthermore, low levels of capital adequacy limit a bank's capacity to absorb losses, increasing its vulnerability to financial distress (Al-Wesabi & Yusof, 2020; Ledhem, 2022).

Empirical findings on the relationship between these risk factors and financial stability remain varied. Ghenimi et al. (2017) found that credit risk negatively affects financial stability, although their study did not establish significant evidence regarding liquidity risk and capital adequacy. In contrast, Hamdi et al. (2019) reported that both liquidity risk and capital adequacy exert a positive influence on the stability of IBs. Meanwhile, Hassan et al. (2019) found a significant negative relationship between liquidity risk and financial stability. More recent studies have concluded that both liquidity risk and credit risk are negatively and significantly associated with the financial stability of IBs (Hassan et al., 2019; Iqbal et al., 2024; Pratami et al., 2023).

The intermediation function enables banks to operate more efficiently by reducing monitoring costs and mitigating risks through portfolio diversification. Empirical evidence confirms that efficiency significantly enhances IBs' financial stability (Albaity et al., 2019; Ashraf et al., 2016; Ghenimi et al., 2017; Hamdi et al., 2019; Ledhem, 2022; Hafez, 2022). Operational efficiency enables banks to better allocate resources, reduce non-essential expenses, and improve risk management capabilities.

Liquidity risk has a negative effect on the financial stability of IBs (Hassan et al., 2019; Iqbal et al., 2024; Pratami et al., 2023). However, efficient banks are better positioned to mitigate liquidity constraints through prudent asset-liability management and cost-effective operations, thereby weakening the adverse impact of liquidity risk on stability. Similarly, credit risk, which arises from the failure of borrowers to fulfill their contractual obligations, poses a significant threat to a bank's solvency (Amara & Mabrouki, 2019; Hassan et al., 2019). In this context, efficiency reduces overhead and enhances monitoring mechanisms, which in turn can mitigate the harmful effects of credit risk on financial stability (Miah & Uddin, 2017). Capital adequacy serves as a buffer against potential financial losses (Al-Wesabi & Yusof, 2020; Ding et al., 2023). Efficient banks are not only better at managing their capital structures but also at maximizing their risk-weighted assets' returns. Therefore, operational efficiency may amplify the positive effect of capital adequacy on financial stability.

Based on the theory and conceptual framework discussed above, this study aims to investigate the impact of liquidity risk, credit risk, and capital adequacy on the financial stability of Islamic banks. This study also examines whether efficiency can influence the effects of risks. The research aims to provide new insights into Islamic banks' resilience and efficiency in reducing the negative effects of liquidity and credit risks. Six hypotheses were used to determine the relationship between Islamic banks' financial risk management, capital adequacy, and stability, as well as the moderating effect of efficiency, which was formulated as follows:

*H1: Liquidity risk has a negative effect on Islamic banks' financial stability.*

*H2: Credit risk negatively affects Islamic banks' financial stability.*

*H3: Capital adequacy has a positive effect on the financial stability of Islamic banks.*

*H4: Efficiency weakens the negative effect of liquidity risk on Islamic banks' financial stability.*

*H5: Efficiency weakens the negative effect of credit risk on Islamic banks' financial stability.*

*H6: Efficiency strengthens the positive effect of capital adequacy on Islamic banks' financial stability.*

# 2. METHOD

This study employs a quantitative approach to empirically examine the impact of liquidity risk, credit risk, and capital adequacy on the financial stability of Islamic banks. Additionally, it investigates the moderating effect of efficiency in this relationship. The dataset consists of 29 Islamic commercial banks operating in Indonesia and Malaysia from 2018 to 2024. Financial and institutional data were obtained from audited annual reports, official corporate websites, and relevant regulatory authorities in each country. A panel data regression analysis was conducted to account for both cross-sectional and time-series variations. System-GMM was used to verify the consistency of the results and address the issue of endogeneity.

The selection of Islamic banks in Indonesia and Malaysia is based on the fact that both countries have the largest Muslim majority in the world, with a total of 260 million people (World Population Review, 2025). The similarities in culture and regulatory characteristics of these two countries are interesting to study and open up opportunities for new contributions to the literature related to the stability of Islamic banks in Southeast Asia.

## 2.1. Operationalization variables and measurement

Financial stability is the dependent variable in this study. It is defined as a condition where the financial system can withstand shocks without triggering a cumulative disruption to the savings allocation, investment financing, and payment settlement processes (Ghassan & Krichene, 2025). Islamic bank stability is commonly measured using the Z-score (Al-Wesabi & Yusof, 2020; Belkhir et al., 2025; Bitar et al., 2021; Čihák & Hesse, 2010; Hafez, 2022; Rinaldi & Prasetyo, 2019; Safiullah, 2021a). The Z-score is calculated by dividing the return on assets (ROA) plus the equity-to-assets ratio (ETA) by the standard deviation of return on assets over time (σROA). ROA represents the return on assets, ETA represents the equity-to-assets ratio, and σROA represents the standard deviation of return on assets over time, reflecting earnings volatility. A higher Z-score indicates a lower probability of insolvency and greater financial stability. Conversely, a higher ROA standard deviation suggests greater volatility in profitability, which can signal a higher risk of instability. The Z-score provides an integrated measure that captures a bank's profitability, capitalization, and earnings volatility to assess its resilience to financial shocks.

**Table 1.** Variable measurement

| Variables | Label | Formula | Reference |
|---|---|---|---|
| **Dependent Variable** | | | |
| Financial Stability | ZSCORE | $\left(\frac{ROA+ETA}{\sigma ROA}\right)\cdot 100$ | Al-Wesabi and Yusof (2020), Belkhir et al. (2025), Čihák and Hesse (2010), Hafez (2022), Safiullah (2021b) |
| **Independent Variables** | | | |
| Liquidity Risk | LIQR | $\left(\frac{total\ financing}{deposit\ from\ cust}\right)\cdot 100$ | Badwan et al. (2024), Iqbal et al. (2024) |
| Credit Risk | CRDR | $\left(\frac{NPF}{total\ financing}\right)\cdot 100$ | Badwan et al. (2024), Iqbal et al. (2024) |
| Capital Adequacy | CADR | $\left(\frac{equity}{risk\ weighted\ asset}\right)\cdot 100$ | Al-Wesabi and Yusof (2020), Badwan et al. (2024), Ding et al. (2023), Kamran et al. (2019) |
| Moderation Variable | | | |
| Management Efficiency Ratio | MEFR | $\left(\frac{operational\ expense}{operational\ income}\right)\cdot 100$ | Ledhem (2022), Ledhem and Mekidiche (2020) |
| **Control variables** | | | |
| Bank Size | SIZE | Ln (Total Assets) | Ding et al. (2023), Ledhem (2022) |
| Bank Age | AGE | Number of years | Ben Abdallah and Bahloul (2024), Mansour et al. (2025) |


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The independent variables in this study are liquidity risk (LIQR), credit risk (CRDR), and capital adequacy (CADR). Liquidity risk (LIQR) refers to the potential difficulties that Islamic banks may face in meeting their short-term financial obligations due to a lack of sufficient liquid assets. This variable is represented by the ratio of total financing to total customer deposits, which is consistent with findings from previous studies (Badwan et al., 2024; Iqbal et al., 2024). The higher the ratio, the more the bank provides credit or financing compared to obtaining deposits from customers, indicating an increased vulnerability to liquidity shortfalls.

Credit risk (CRDR) refers to the likelihood that counterparts will not fulfill their financial obligations, resulting in financial losses for the bank. It is quantified by the ratio of non-performing financing (NPF) to the total amount of financing disbursed by the banks (Badwan et al., 2024; Iqbal et al., 2024; Pratami et al., 2023). A higher ratio indicates a decline in asset quality, which increases the risk of default-related losses and signifies a greater exposure to credit risk.

The capital adequacy ratio (CAR) is a key indicator of a bank's financial stability and ability to withstand potential losses due to adverse economic conditions. It is calculated by dividing the bank's total regulatory capital by its risk-weighted assets (Al-Wesabi & Yusof, 2020; Badwan et al., 2024; Ding et al., 2023; Kamran et al., 2019). A higher CAR indicates a stronger capital buffer, which enables the bank to better absorb financial shocks and maintain stability.

The moderating variable in this study is the management efficiency ratio (MEFR), which measures the operational efficiency of Islamic banks in managing their resources to maximize returns while adhering to Shariah principles. Previous studies have used various proxies to measure efficiency, including asset management efficiency, efficiency index scores, net interest margin, and net non-interest margin (Ledhem, 2022; Ledhem & Mekidiche, 2020; Hafez, 2022). In this study, efficiency is specifically measured by the MEFR, which is calculated as the ratio of total operating expenses to gross income, as per Ledhem (2022) and Ledhem and Mekidiche (2020). A lower MEFR indicates higher efficiency in managing operational activities.

Two control variables are incorporated to ensure the model's robustness based on empirical evidence suggesting their relevance to IBs' financial stability. SIZE, measured as the natural logarithm of total assets, reflects the scale and capacity of the bank's operations. Bank Age (AGE), measured by the number of years since the bank's establishment, represents institutional experience and market presence (Ding et al., 2023; Ledhem, 2022).

## 2.2. Model specifications

This study investigates the influence of liquidity risk, credit risk, and capital adequacy on IBs' financial stability while also examining the moderating role of efficiency in these relationships. Panel data were collected from IBs in Indonesia and Malaysia from 2018 to 2024. A linear panel regression model is employed to estimate the effects, as specified in the following equation:

Model 1

$$\begin{aligned} ZSCORE_{i,t} &= \beta_0 + \beta_1 LIQR_{i,t} + \beta_2 CRDR_{i,t} \\ &+ \beta_3 CADR_{i,t} + \beta_4 MEFR_{i,t} \\ &+ \beta_5 SIZE_{i,t} + \beta_6 AGE_{i,t} + \varepsilon_{i,t}, \end{aligned} \quad (1)$$

Model 2

$$\begin{aligned} ZSCORE_{i,t} &= \beta_0 + \beta_1 LIQR_{i,t} + \beta_2 CRDR_{i,t} \\ &+ \beta_3 CADR_{i,t} + \beta_4 MEFR_{i,t} \\ &+ \beta_5 LIQR_{i,t} \cdot MEFR_{i,t} + \beta_6 CRDR_{i,t} \cdot MEFR_{i,t} \\ &+ \beta_7 CADR_{i,t} \cdot MEFR_{i,t} + \beta_8 MEFR_{i,t} \\ &+ \beta_9 SIZE_{i,t} + \beta_{10} AGE_{i,t} + \varepsilon_{i,t}, \end{aligned} \quad (2)$$

Model 2 (Sys-GMM)

$$\begin{aligned} ZSCORE_{i,t} &= \beta_0 + \beta_1 ZSCORE_{i,t-1} \\ &+ \beta_2 LIQR_{i,t} + \beta_3 CRDR_{i,t} + \beta_4 CADR_{i,t} \\ &+ \beta_5 MEFR_{i,t} + \beta_6 LIQR_{i,t} \cdot MEFR_{i,t} \\ &+ \beta_7 CRDR_{i,t} \cdot MEFR_{i,t} + \beta_8 CADR_{i,t} \cdot MEFR_{i,t} \\ &+ \beta_9 MEFR_{i,t} + \beta_{10} SIZE_{i,t} + \beta_{11} AGE_{i,t} + \varepsilon_{i,t}, \end{aligned} \quad (3)$$

where $ZSCORE_{i,t}$ represents the financial stability of IBs for bank $i$ in year $t$. The term α denotes the constant, while $\beta_{1-7}$ represent the coefficients associated with the independent, moderating, and

control variables. The error term is denoted by $\varepsilon_{i,t}$, and $ZSCORE_{i,t-1}$ refers to the dependent variable's lagged value from the previous year. The independent variables include $LIQR_{i,t}$, which captures liquidity risk; $CRDR_{i,t}$, representing credit risk; $CADR_{i,t}$, indicating the capital adequacy ratio; and $MEFR_{i,t}$, which measures the management efficiency ratio. The moderating variables are the interaction terms: $LIQR_{i,t} \times MEFR_{i,t}$, $CRDR_{i,t} \times MEFR_{i,t}$, and $CADR_{i,t} \times MEFR_{i,t}$, which examine the moderating effect of efficiency on the respective relationships. The control variables included SIZE and AGE, representing the size and age of the bank, respectively. The analysis was conducted using the STATA 14 statistical software.

# 3. RESULT

## 3.1. Descriptive statistics

The descriptive statistics presented in Table 2 provide an overview of the research data characteristics. The average financial stability (ZSCORE) was 1.075, with a standard deviation of 1.663, indicating a high level of heterogeneity among Indonesian and Malaysian banks. The maximum ZSCORE value of 11.390 suggests strong stability. The average liquidity ratio (LIQR) was 84%, with a deviation of 15.6%, indicating that the liquidity level of banks is generally at a fairly ideal level and is relatively consistent across banks. The average credit risk (CRDR) was 2.44%, which is below the maximum non-performing financing ratio of 5% required by Basel III. This suggests that most banks in the sample have met the Basel III requirement. The minimum value of the capital adequacy ratio (CADR) was 12.4%, which is above the minimum requirement of 8% as set by Basel III. This indicates that all banks in the sample have met the Basel III standard. These results suggest that despite significant variations in financial stability, Indonesian and Malaysian banks have healthy liquidity, credit risk, and capitalization conditions.

**Table 2.** Descriptive statistics

| Variable | Obs. | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| ZSCORE | 149 | 1075 | 1663 | 4.00 | 1139 |
| LIQR | 149 | 84.78 | 15.689 | 15.25 | 111.71 |
| CRDR | 149 | 2.443 | 2.071 | 0.040 | 9.54 |
| CADR | 149 | 26.08 | 16.863 | 12.42 | 149.68 |
| MEFR | 149 | 81.148 | 19.527 | 1.00 | 206.19 |
| SIZE | 149 | 137658.5 | 216525.3 | 1660.84 | 1185261 |
| AGE | 149 | 14.349 | 7.983 | 1 | 41 |

The multicollinearity test results, as presented in Table 3, confirm that the estimated values are not significantly correlated with the independent variables. The variance inflation factor (VIF) values for all variables are below 10, and the correlation between variables is no more than 0.8, indicating that the research model does not exhibit multicollinearity.

## 3.2. Econometric results

Table 4 presents the results of the panel data regression analysis for model 1, which is the test model without any interaction with the moderating variables. Based on the results of the Chow, LM, and Hausman tests, the REM model was determined to be the best model. However, all models are pre-

**Table 3.** Correlation matrix

| Variable | VIF | ZSCORE | LIQR | CRDR | CADR | MEFR | SIZE | AGE |
|---|---|---|---|---|---|---|---|---|
| ZSCORE | – | 10.000 | – | – | – | – | – | – |
| LIQR | 1.04 | −0.4587 | 10.000 | – | – | – | – | – |
| | | 0.0000 | | | | | | |
| CRDR | 2.64 | −0.0970 | −0.0838 | 10.000 | – | – | – | – |
| | | 0.2394 | 0.3098 | | | | | |
| CADR | 3.28 | 0.0557 | −0.0034 | 0.0075 | 10.000 | – | – | – |
| | | 0.5001 | 0.9670 | 0.9278 | | | | |
| MEFR | 1.15 | 0.0736 | −0.0652 | 0.3401 | 0.0786 | 10.000 | – | – |
| | | 0.3722 | 0.4298 | 0.0000 | 0.3405 | | | |
| SIZE | 9.27 | 0.0146 | 0.2578 | −0.3613 | −0.2702 | −0.2471 | 10.000 | – |
| | | 0.8599 | 0.0015 | 0.0000 | 0.0009 | 0.0024 | | |
| AGE | 4.73 | 0.3637 | −0.1380 | −0.0476 | −0.1701 | −0.0852 | 0.1405 | 10.000 |
| | | 0.0000 | 0.0933 | 0.5639 | 0.0380 | 0.3018 | 0.0874 | |


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sented simultaneously to verify the consistency of the estimation results between variables. The model's fitness test results show an F-test value of 56.69 (p = 0.000) and an overall $R^2$ of 0.3104, indicating that the model is a good fit and can explain 31% of the variability in financial stability values. The liquidity risk coefficient (LIQR) of the REM model has a value of β = –2.178 (p < 0.01). These results indicate that liquidity risk has a significant negative effect on IBs' financial stability, thereby supporting hypothesis *H1*. The consistency of the results and the same level of significance between the CEM, FEM, and REM models confirm the strong influence of liquidity risk.

The results of the REM model indicate that credit risk (CRDR) has a significant negative effect on the financial stability of the Islamic bank. This is evident from the coefficient value of β = –8.699, which is statistically significant at a p-value less than 0.1. Therefore, hypothesis *H2* is accepted. Similarly, the coefficient value of β = 1.815 for capital adequacy (CADR) is statistically significant at a p-value less than 0.01, indicating a significant positive effect on the financial stability of IBs. As a result, hypothesis *H3* is accepted. The results also show that the efficiency of banks' operations has a positive influence on their financial stability. The MEFR value for the three models indicates a p-value less than the alpha level, suggesting that banks that operate more efficiently tend to be more stable. This supports the research model, which uses efficiency as a moderating variable to be tested in Model 2 (Table 5).

Table 5 presents the results of testing the MEFR's moderating effect on the relationship between IBs' financial risk, capital adequacy, and financial stability. The estimation model was chosen after conducting a series of Chow, LM, and Hausman tests. The REM model was found to be the most suitable based on these test results. To ensure consistency, all three estimation models – the Common Effects Model (CEM), the Fixed Effects Model (FEM), and the REM – were presented simultaneously.

The model fitness test results show that all models have high statistical significance, with F-statistic values as follows: CEM = 11.93 (p = 0.000), FEM = 5.92 (p = 0.000), and REM = 62.93 (p = 0.000). This indicates that all three models can significantly explain the variation in financial stability (ZSCORE), and the consistency of the test results across different estimation models is demonstrated

In the REM model, the interaction between liquidity risk and efficiency (LIQR*MEFR) has a significant impact on the financial stability of an Islamic bank. The coefficient for this interaction is –0.028 with a significance level of p < 0.1. The coefficient for liquidity risk (LIQR) in Model 1 is –2.178 with a significance level of p < 0.01. However, in Model 2, where the interaction with efficiency (LIQR*MEFR) is included, the moderating coefficient is –0.028 with a significance level of p < 0.1. These results suggest that efficiency can mitigate the negative effect of liquidity risk on financial stability, thereby supporting hypothesis *H4*. Specifically, IBs facing high liquidity risk

**Table 4.** Estimation results for Model 1 with panel data regression analysis

| Variables | Exp. Sign | CEM | | FEM | | REM | | Hypothesis Testing Results |
|---|---|---|---|---|---|---|---|---|
| | | Coef. | Std. error | Coef. | Std. error | Coef. | Std. error | |
| Constant | | –690.3 | 347.5** | 1,581 | 1,589 | –170.6 | 546.8 | |
| LIQR | – | –5.164 | 0.752*** | –2.003 | 0.508*** | –2.178 | 0.484*** | H1: Accepted |
| CRDR | – | –5.994 | 6.096 | –10.65 | 5.040** | –8.699 | 4.594* | H2: Accepted |
| CADR | + | 2.134 | 0.766*** | 1.754 | 0.473*** | 1.815 | 0.446*** | H3: Accepted |
| MEFR | + | 1.487 | 0.623** | 0.708 | 0.391* | 0.744 | 0.378** | |
| SIZE | + | 31.72 | 10.68*** | –49.41 | 52.20 | 8.376 | 17.73 | |
| AGE | + | 5.163 | 1.520*** | 12.32 | 5.508** | 7.271 | 2.511*** | |
| Number of obs | | 149 | | 149 | | 149 | | |
| Number of groups | | 29 | | 29 | | 29 | | |
| F-Test | | 14.44 | | 8.08 | | 56.69 | | |
| Prob > F | | 0.0000 | | 0.0000 | | 0.0000 | | |
| $R^2$ (overall) | | 0.3790 | | 0.1436 | | 0.3104 | | |

*Note:* Significance levels are denoted by *** p < 0.01, ** p < 0.05, and * p < 0.1.

**Table 5.** Estimation results for Model 2 with panel data regression analysis

| Variables | Exp. Sign | CEM | | FEM | | REM | | Hypothesis Testing Results |
|---|---|---|---|---|---|---|---|---|
| | | Coef. | Std. error | Coef. | Std. error | Coef. | Std. error | |
| Constant | | –1,149 | 355.1*** | 1,882 | 1,593 | –346.4 | 503.6 | |
| LIQR | – | –0.690 | 2.793 | 0.400 | 1.512 | 0.167 | 1.514 | H1: Rejected |
| CRDR | – | 22.64 | 21.49 | –18.24 | 12.90 | –14.09 | 12.60 | H2: Rejected |
| CADR | + | 11.83 | 3.549*** | 5.872 | 2.703** | 6.481 | 2.532** | H3: Accepted |
| MEFR | + | 10.55 | 2.809*** | 3.942 | 1.667** | 4.287 | 1.612*** | |
| LIQR*MEFR | +/– | –0.053 | 0.031* | –0.028 | 0.016* | –0.028 | 0.016* | H4: Accepted |
| CRDR*MEFR | +/– | –0.380 | 0.236 | 0.085 | 0.124 | 0.062 | 0.125 | H5: Rejected |
| CADR*MEFR | +/– | –0.107 | 0.037*** | –0.044 | 0.028 | –0.050 | 0.026* | H6: Accepted |
| SIZE | + | 35.82 | 10.90*** | –63.15 | 52.40 | 9.920 | 16.26 | |
| AGE | + | 5.104 | 1.475*** | 12.88 | 5.522** | 6.590 | 2.356*** | |
| Number of obs | | 149 | | 149 | | 149 | | |
| Number of groups | | 29 | | 29 | | 29 | | |
| F-Test / Wald chi2 | | 11.93 | | 5.92 | | 62.93 | | |
| Prob > F | | 0.0000 | | 0.0000 | | 0.0000 | | |
| $R^2$ (overall) | | 0.4357 | | 0.1225 | | 0.3506 | | |

*Note:* Significance levels are denoted by *** p < 0.01, ** p < 0.05, and * p < 0.1.

tend to experience decreased financial stability. Nevertheless, if a bank can efficiently manage its operations, it can minimize the adverse impact of liquidity risk.

The interaction between credit risk and efficiency had no significant effect on financial stability, indicating that hypothesis *H5* was rejected. This means that operational efficiency does not moderate the relationship between credit risk and the financial stability of Islamic banks in this study. On the other hand, the interaction between capital adequacy and efficiency had a significant effect on financial stability. In Model 1, the coefficient for capital adequacy was –8.699, and after moderation by efficiency, the interaction coefficient was –0.050. This finding supports hypothesis *H6*, which suggests that efficiency strengthens the effect of capital adequacy on investment banks' financial stability. Specifically, investment banks with a high level of capital adequacy tend to have better financial stability, and this relationship is further strengthened when the bank can efficiently manage its operational activities.

## 3.3. Robustness checks

This robustness test employs an alternative statistical modeling approach to assess the consistency of the primary test results. The test was conducted using System-GMM with the system dynamic panel data estimation method. This method was selected because it can address various statistical issues, such as heterogeneity, potential endogeneity, omitted variables, measurement error, and the correlation between independent variables and residual error, which often occur in panel data (Pratami et al., 2023; Raouf & Ahmed, 2022; Umar et al., 2024). Additionally, the GMM approach is considered more efficient than the cross-sectional units in studies with limited observation years. For this estimation, an additional observation period, specifically 2018, was included to account for the lagged-dependent variable (ZSCOREt-1) necessary in the dynamic estimation. The results of the two-step System-GMM estimation are presented in Table 6.

The estimated model yields a Wald chi2 value of 930,489.59, which is statistically significant at p = 0.000. This suggests that the overall model is suitable and capable of explaining the variability of the dependent variable. Additionally, the results of the Sargan test and the Arellano-Bond test indicate that the model meets the assumptions of validity and consistency in parameter estimation, as the probability values are greater than 0.1. The estimation results reveal that the lagged ZSCORE variable ($ZSCORE_{t-1}$) has a positive and significant effect on ZSCORE in the current year, with a coefficient of 0.5992 and a p-value less than 0.000. This confirms the dynamics in the financial stability of Islamic banks over time. Furthermore, the analysis shows that liquidity risk (LIQR) has a sig-


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**Table 6.** Estimation results for Model 3 with System Dynamic Panel-Data GMM

| Variables | Expected Sign | System dynamic panel–data estimation (GMM) | | | Hypothesis Testing Results |
|---|---|---|---|---|---|
| | | Coef. | Std. error | P>\|z\| | |
| Constant | | –634.96 | 105.14 | 0.000*** | |
| $ZSCORE_{t-1}$ | + | 0.5992 | 0.0057 | 0.000*** | |
| LIQR | – | 1.3101 | 0.5752 | 0.023*** | H1: Accepted |
| CRDR | – | –24.760 | 4.1904 | 0.000*** | H2: Accepted |
| CADR | + | 10.498 | 0.8428 | 0.000*** | H3: Accepted |
| MEFR | + | 6.2154 | 0.3563 | 0.000*** | |
| LIQR*MEFR | +/– | –0.0509 | 0.0049 | 0.000*** | H4: Accepted |
| CRDR*MEFR | +/– | 0.2654 | 0.0421 | 0.000*** | H5: Accepted |
| CADR*MEFR | +/– | –0.0955 | 0.0084 | 0.000*** | H6: Accepted |
| SIZE | + | 6.0871 | 2.8995 | 0.036*** | |
| AGE | + | 12.053 | 0.8693 | 0.000*** | |
| Number of obs | | 145 | | | |
| Number of groups | | 29 | | | |
| Wald chi2 | | 930489.59 | | | |
| Prob > chi2 | | 0.0000 | | | |
| Sargan test – chi2 | | 23.59465 | | Prob. (0.2122) | |
| Arellano–Bond – order 1 | | –0.95788 | | Prob. (0.3381) | |
| Arellano–Bond – order 2 | | –0.74553 | | Prob. (0.4560 | |

*Note:* Significance levels are denoted by *** p < 0.01, ** p < 0.05, and * p < 0.1.

nificant effect, with a coefficient of 1.3101 and a p-value of 0.023. In contrast, credit risk (CRDR) has a significant negative effect on financial stability, with a coefficient of -24.760 and a p-value of 0.000. Capital adequacy (CADR) was found to have a positive and significant effect, with a coefficient of 10.498 and a p-value of 0.000. These findings are consistent with the results of the main test, which demonstrated model consistency across various analysis methods. The interaction test between efficiency and each risk variable (LIQR*MEFR, CRDR*MEFR, and CADR*MEFR) also indicated a direction of relationship consistent with the hypothesis and significant at the 1% level. This finding supports previous research, indicating that efficiency significantly moderates the relationship between liquidity risk, credit risk, and capital adequacy to the financial stability of Islamic banks in Indonesia and Malaysia.

## 4. DISCUSSION

The results of testing three panel data regression analysis models combined with the two-step system generalized method of moments analysis for the 2018–2024 period showed that liquidity risk has a negative impact on the financial stability of Islamic banks. Consequently, higher liquidity risk, as measured by the finance-to-deposit ratio (FDR), is likely to weaken IBs' financial stability. The results of this study also confirm the significant negative effect of credit risk on financial stability, which is in line with the findings of previous studies by Iqbal et al. (2024) and Pratami et al. (2023). Furthermore, this study found that capital adequacy has a positive effect on IBs' financial stability. Specifically, the higher the capital ratio compared to risk-weighted assets, the greater the IBs' financial stability. This finding is consistent with previous research by Hamdi et al. (2019) and Pratami et al. (2023).

Testing the moderating role of the Management Efficiency Factor Ratio (MEFR) using the Random Effect Model (REM) analysis model found that efficiency moderates the influence of liquidity risk and capital adequacy on the Islamic Banks' financial stability. Further testing using the System-GMM model revealed that efficiency moderates the influence of three independent variables on bank financial stability: liquidity risk, credit risk, and capital adequacy. These results indicate that efficiency can mitigate the negative effects of liquidity and credit risk on IBs' financial stability. Therefore, Islamic banks with high levels of liquidity and credit risk tend to be stable when operational efficiency can be maintained.

The findings of this study make a significant contribution to the development of the literature on financial risk management and Islamic banking stability. This is particularly evident in the consideration of efficiency as a moderating variable. The results of this study theoretically confirm the financial intermediation theory (Diamond, 1984). This theory suggests that the effectiveness of financial intermediaries in managing risk and allocating resources efficiently has a significant impact on financial system stability. This study also expands our understanding of the dynamics of Islamic banking financial stability in developing countries, specifically in Indonesia and Malaysia. It provides empirical evidence that efficiency plays a crucial role in strengthening the financial resilience of Islamic banking institutions.

Furthermore, these results offer a new perspective in the literature on the relationship between risk and bank stability, showing that a bank's managerial efficiency can impact how liquidity risk and capital adequacy affect stability. These implications support a comprehensive approach that combines risk management with strategies aimed at improving efficiency. These findings suggest that Islamic banks should pay more attention to resource allocation and operational management efficiency. When facing high liquidity risks or when capital becomes limited, operational efficiency has been proven to help maintain bank financial stability. Islamic banks must strengthen their management information systems and managerial capacity to efficiently perform their intermediation function. Investing in digital technology and human resource capacity development is a strategic step toward achieving long-term efficiency. These findings are also significant for regulators such as the Financial Services Authority (OJK) in Indonesia and Bank Negara Malaysia, which need to encourage more transparent reporting of bank efficiency as part of their risk-based supervisory indicators. Adding efficiency indicators to the bank health assessment system could improve the accuracy of measuring the Islamic banking sector's resilience.

## CONCLUSION

This study aims to investigate the impact of liquidity risk, credit risk, and capital adequacy on the financial stability of Islamic banks in Indonesia and Malaysia. It also examines the role of operational efficiency in moderating this relationship. The result shows that banks with lower liquidity and credit risk generally achieve better stability. Higher capital adequacy is associated with greater financial stability. Initially, it was discovered that efficiency only moderated the impact of liquidity risk and credit risk on bank stability. Further analysis using System-GMM analysis showed that efficiency also moderates the relationship between credit risk, liquidity risk, and capital adequacy with bank stability. Theoretically, this study reinforces the relevance of the Financial Intermediation Theory in the context of Islamic banking, highlighting the importance of efficiency in maintaining financial system stability. Practically, the study's findings provide policy implications for Islamic bank management and regulators to incorporate efficiency-enhancing strategies into risk management and strengthen banking resilience. Future research may investigate whether the adoption of advanced information technology enhances the financial stability of Islamic banks. The integration of digital technologies is widely acknowledged as a driver of efficiency, enabling faster business processes, improved risk management, and more effective decision-making, which may ultimately strengthen the resilience and competitiveness of Islamic banks.

## AUTHOR CONTRIBUTIONS

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Writing – original draft: Agus Maulana, Murdhaningsih, Nabillah Farras Luthfi.
Writing – reviewing & editing: Agus Maulana, Murdhaningsih, Nabillah Farras Luthfi.

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# APPENDIX A

**Table A1.** List of Islamic banks in Indonesia and Malaysia

| No. | Country | Bank Name |
|---|---|---|
| 1 | Indonesia | PT. Bank Aceh Syariah |
| 2 | | PT BPD Nusa Tenggara Barat Syariah |
| 3 | | PT. Bank Muamalat Indonesia |
| 4 | | PT. Bank Victoria Syariah |
| 5 | | PT. Bank BRI Syariah |
| 6 | | PT. Bank Jabar Banten Syariah |
| 7 | | PT. Bank BNI Syariah |
| 8 | | PT. Bank Syariah Mandiri |
| 9 | | PT. Bank Mega Syariah |
| 10 | | PT. Bank Panin Dubai Syariah |
| 11 | | PT. Bank Syariah Bukopin |
| 12 | | PT. BCA Syariah |
| 13 | | PT. Bank Tabungan Pensiunan Nasional Syariah |
| 14 | | PT Bank Syariah Indonesia (BSI) |
| 15 | | PT BPD Riau Kepri Syariah |
| 16 | | PT. Bank Aladin Syariah, Tbk |
| 17 | Malaysia | Al Rajhi & Investment Corporation Berhad |
| 18 | | Alliance Islamic Bank Berhad |
| 19 | | Bank Islam Malaysia Berhad |
| 20 | | Bank Muamalat Malaysia Berhad |
| 21 | | Hong Leong Islamic Bank Berhad |
| 22 | | HSBC Amanah Malaysia Berhad |
| 23 | | Kuwait Finance House (Malaysia) Berhad |
| 24 | | Maybank Islamic Berhad |
| 25 | | OCBC Al-Amin Bank Berhad |
| 26 | | Public Islamic Bank Berhad |
| 27 | | RHB Islamic Bank Berhad |
| 28 | | Standard Chartered Saadiq Berhad |
| 29 | | CIMB Islamic Bank Berhard |


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