



Financing diversification and the stability of Islamic rural banks in Indonesia

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Abstract

Purpose – This study examines the relationship between financing diversification and the stability of Islamic Rural Banks (IRBs) in Indonesia.

Methodology – The study employs panel data from 154 Indonesian Islamic Rural Banks covering 2015 to 2023. Financing diversification is measured using the Herfindahl Hirschman index (HHI), while bank stability is proxied by the Z-Score and risk adjusted return on assets (RAROA). Panel regression techniques were used to estimate the relationships.

Findings – Financing diversification is positively associated with bank stability but exhibits an inverse U-shaped relationship. Moderate diversification enhances stability, whereas excessive diversification weakens it. Market power and the capital adequacy ratio (CAR) have positive and significant effects on stability, while bank size negatively affects it. The interaction between financing diversification and CAR is negative and significant, indicating that banks with concentrated financing portfolios remain vulnerable to stability pressures despite strong capital positions. Robustness tests confirm these findings across alternative model specifications.

Implications – The findings highlight the importance of maintaining an optimal balance between financing diversification and capital adequacy to enhance IRBs stability. Bank managers should avoid excessive financing concentration and over-diversification while maintaining sufficient capital buffers to absorb risks. Regulators should strengthen supervision of larger IRBs due to their greater exposure to operational and financing risks.

Originality – This study extends the literature by providing evidence from Indonesian Islamic Rural Banks, an underexplored sector. It examines the linear and non-linear effects of financing diversification on bank stability and assesses the moderating role of capital adequacy during the Covid-19 period.

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Introduction

Islamic Rural Banks (IRBs) play a vital role in promoting financial inclusion and supporting the development of micro, small, and medium enterprises (MSMEs) in Indonesia. As community-based Islamic financial institutions, IRBs provide financing services to customers who often have limited access to formal banking institutions (Ascarya & Yumanita, 2008; Hosen & Muhari, 2019). Despite their strategic role, IRBs face several structural constraints, including limited capital,

relatively small asset bases, and highly concentrated financing portfolios. These characteristics make IRBs more vulnerable to financing, liquidity, and operational risks than Islamic commercial banks (Čihák Hesse, 2010). Consequently, maintaining the stability of IRBs has become a key concern for regulators and policymakers seeking to strengthen the resilience and sustainability of Indonesia's Islamic banking sector.

The stability of IRBs has attracted increasing attention in recent years. According to data published by the Indonesian financial services authority (Otoritas Jasa Keuangan, OJK), the average stability of IRBs, measured by the Z-score, declined from 8.80 in 2015 to 6.88 in 2023. The Z-score is a widely accepted indicator of bank stability and insolvency risk because it combines profitability, capitalization, and earnings volatility into a single measure. Higher Z-score values indicate greater financial stability and a lower probability of bank failure. The downward trend in the Z-score therefore suggests that IRBs have become increasingly vulnerable to financial distress, highlighting the importance of identifying the factors that can strengthen their resilience and enhance their long-term stability.

One factor that may influence bank stability is the diversification of financing. Financing diversification reduces concentration risk by allocating financing across different economic sectors, customer groups, and Islamic financing contracts. Previous studies generally suggest that diversification contributes positively to bank stability by reducing dependence on a limited number of financing activities (Meslier et al., 2016). In the context of Islamic banking, diversification through various financing contracts, such as murabahah, mudharabah, and ijarah, can improve risk-sharing mechanisms and enhance portfolio resilience (Baroroh, 2023). However, the benefits of diversification are not unlimited. Elsas et al. (2010) argue that excessive diversification may increase monitoring costs, managerial complexity, and operational risk, thereby weakening bank stability. These contrasting findings suggest that the relationship between financing diversification and bank stability may be nonlinear rather than strictly positive.

In addition to financing diversification, market power and capital adequacy are important determinants of bank stability. According to the franchise value hypothesis, banks with greater market power are more likely to adopt prudent risk-taking behavior in order to preserve their long-term franchise value, thereby enhancing financial stability (Berger et al., 2009). However, excessive market power may also reduce competitive pressure and encourage greater risk-taking behavior (Beck et al., 2013). Capital adequacy serves as a financial buffer that enables banks to absorb unexpected losses and withstand adverse economic conditions (Demirgüç-Kunt et al., 2013). Well-capitalized banks are generally better positioned to manage financing risk and maintain financial stability during economic uncertainty.

Macroeconomic conditions also play an important role in determining bank stability. Inflation may affect borrowers' repayment capacity, increase operating costs, and reduce the quality of financing portfolios, thereby influencing banks' financial performance and their stability. Likewise, liquidity has been shown to have mixed effects on bank stability. While adequate liquidity strengthens banks' ability to meet their financial obligations and absorb unexpected shocks, excessive financing expansion may increase default risk and weaken financial stability (Hardianto & Wulandari, 2016). Furthermore, the Covid-19 pandemic intensified these challenges by weakening economic activity, increasing financing risk, and placing additional pressure on the resilience of banking institutions (Goodell, 2020).

Although the relationship between financing diversification and bank stability has been extensively examined, most previous studies have focused on conventional banks and Islamic commercial banks. The empirical evidence on Islamic Rural Banks (IRBs) remains relatively limited. Moreover, existing studies have primarily investigated the direct effect of diversification on bank performance and stability, while relatively little attention has been paid to the potential non-linear relationship between financing diversification and bank stability. Likewise, the moderating role of capital adequacy in the diversification–stability relationship remains underexplored, particularly in the context of Islamic microfinance institutions operating during and after the Covid-19 pandemic. These gaps indicate the need for further research to better understand how financing diversification influences the stability of IRBs under different levels of capital adequacy.

Addressing these issues is important because IRBs play a strategic role in promoting financial inclusion and financing micro, small, and medium enterprises (MSMEs) in Indonesia. Given their relatively limited capital base and concentrated financing structure, identifying the optimal level of financing diversification and understanding the role of capital adequacy in maintaining bank stability are of considerable importance for both bank managers and regulators. Accordingly, this study addresses three research questions: (1) Does financing diversification affect the stability of Islamic Rural Banks in Indonesia? (2) Does financing diversification exhibit a non-linear relationship with bank stability? and (3) Does capital adequacy moderate the relationship between financing diversification and bank stability? Answering these questions is expected to provide a deeper understanding of how financing diversification and capital management jointly contribute to the resilience and long-term stability of Islamic Rural Banks.

This study contributes to the literature in three important ways. First, it provides new empirical evidence on the relationship between financing diversification and bank stability using data from Islamic Rural Banks in Indonesia, a segment of the Islamic banking industry that has received relatively limited attention in previous studies. Second, unlike most existing studies that focus primarily on linear relationships, this study simultaneously examines both the linear and non-linear effects of financing diversification on bank stability, thereby offering a more comprehensive understanding of the diversification stability nexus. Third, this study investigates the moderating role of capital adequacy in the relationship between financing diversification and bank stability during the Covid-19 pandemic. By integrating financing diversification, capital adequacy, and market power within a unified empirical framework, this study extends the existing literature on bank stability while providing practical insights for bank managers and policymakers in strengthening the resilience and sustainability of Islamic Rural Banks.

Literature Reviews

The relationship between financing diversification and bank stability has attracted considerable attention in the banking literature. Financing diversification refers to the allocation of financing across different economic sectors, customer groups, or financing contracts to reduce concentration risk and enhance portfolio resilience. From a theoretical perspective, however, the impact of financing diversification on bank stability remains inconclusive. Different theoretical frameworks provide contrasting predictions regarding whether diversification strengthens or weakens bank stability, suggesting that the relationship is contingent upon both market conditions and bank-specific characteristics.

One of the most widely used frameworks for explaining the relationship between market structure and bank performance is the structure conduct performance (SCP) paradigm, originally developed by [Mason \(1939\)](#) and [Bain \(1951\)](#). The SCP paradigm argues that market structure influences firms' strategic behavior, which subsequently determines their performance. Within the banking industry, financing diversification enables banks to allocate resources more efficiently, distribute financing risk across multiple sectors or financing contracts, and enhance operational flexibility. By reducing dependence on a limited number of financing activities, diversified banks are expected to become more resilient to adverse economic shocks and less vulnerable to concentration risk. Accordingly, the SCP paradigm predicts that financing diversification positively contributes to bank stability.

The positive role of financing diversification is challenged by the competition fragility theory, which argues that greater competition may erode banks' profit margins and franchise value, thereby encouraging banks to undertake excessive risk in order to maintain profitability ([Keeley, 1990](#)). As banks expand into a broader range of financing activities, they may face higher monitoring costs, greater managerial complexity, and increased operational risk. These challenges are particularly relevant for smaller financial institutions, such as Islamic Rural Banks (IRBs), which generally operate with relatively limited managerial capabilities, technological resources, and capital capacity. Under these conditions, excessive financing diversification may reduce bank stability rather than enhance it.

In contrast, the competition stability theory proposes that greater competition can strengthen financial stability by reducing market power and encouraging more prudent financing decisions (Boyd & De Nicolo, 2005). Greater competition may improve borrower quality, strengthen market discipline, and reduce moral hazards, thereby lowering banks' overall risk exposure. From this perspective, financing diversification accompanied by sound risk management practices can improve portfolio quality and enhance bank resilience. The coexistence of the SCP paradigm, competition–fragility theory, and competition stability theory therefore suggests that the relationship between financing diversification and bank stability remains theoretically inconclusive and warrants further empirical investigation.

This theoretical debate is also reflected in previous empirical studies. Several studies support the view that financing diversification enhances bank stability. Meslier et al. (2016) found that diversification reduces concentration risk and strengthens banks' resilience to adverse shocks. Similarly, Beck et al. (2013) and Abbas and Rehman (2025) reported that greater diversification does not necessarily increase systemic risk and may contribute positively to financial stability. In the context of Islamic banking, Baroroh (2023) argued that diversification across various financing contracts, including *murabahah*, *mudharabah*, and *ijarah*, improves risk-sharing mechanisms and reduces dependence on a single financing product.

However, other empirical studies provide contradictory evidence. Elsas et al. (2010) found that excessive diversification increases agency costs, monitoring difficulties, and operational complexity, ultimately reducing the performance and stability of banks. Likewise, Goetz (2018) demonstrated that diversification may expose banks to unfamiliar business segments, increase risk-taking behavior, and weaken overall stability. These findings suggest that diversification does not always generate positive outcomes and that its effectiveness depends on the extent to which diversification is implemented. Conversely, Gutiérrez et al. (2025) argued that diversification, when accompanied by healthy market competition, can improve borrower quality and ultimately strengthen bank stability.

Recent studies further suggest that the relationship between financing diversification and bank stability may be non-linear. Kim et al. (2020) and Ben Lahouel et al. (2022) documented an inverted U-shaped relationship, indicating that diversification enhances stability only up to an optimal level. Beyond this point, the costs associated with managing increasingly complex financing portfolios may outweigh the benefits of risk diversification, resulting in lower bank stability. These findings imply the existence of an optimal level of financing diversification that maximizes bank stability.

In addition to financing diversification, capital adequacy has been recognized as an important determinant of bank stability. According to the capital buffer theory, capital serves as a cushion against unexpected losses and enhances a bank's capacity to absorb risks arising from financing activities (Demirgüç-Kunt et al., 2013). Well-capitalized banks are generally better equipped to manage diversified financing portfolios and maintain stability during economic uncertainty. Consequently, capital adequacy may influence the extent to which financing diversification affects bank stability. The capital adequacy ratio (CAR) reflects a bank's capital strength and risk-absorbing capacity. Banks with higher CAR levels are better positioned to absorb potential losses associated with diversified financing activities and are therefore more likely to benefit from financing diversification. Conversely, banks with lower capital buffers may face greater challenges in managing the additional complexity and risks arising from diversified financing portfolio. Consequently, capital adequacy may moderate the relationship between financing diversification and the stability of banks. Previous empirical studies also suggest that capital adequacy can either strengthen or weaken the effects of bank-specific factors on performance and stability (Abdul Karim et al., 2014; Koch-Medina et al., 2015; Aziz et al., 2025).

Based on the theoretical arguments and empirical evidence discussed above, financing diversification is expected to enhance bank stability by reducing concentration risk and improving portfolio resilience. However, excessive diversification may increase operational complexity, monitoring costs, and risk management challenges, thereby weakening its positive contribution to the stability of banks. These theoretical and empirical arguments indicate that the relationship

between financing diversification and bank stability may be nonlinear rather than strictly linear. Furthermore, capital adequacy may strengthen or weaken the effect of financing diversification on bank stability by influencing a bank's capacity to absorb the risks associated with diversified financing activities. Accordingly, the following hypotheses are proposed.

H₁: Financing diversification has a positive effect on the stability of Islamic Rural Banks (IRBs).

H₂: Financing diversification exhibits an inverted U-shaped relationship with the stability of Islamic Rural Banks (IRBs).

H₃: Capital adequacy moderates the relationship between financing diversification and the stability of Islamic Rural Banks (IRBs).

Research Methods

Data

This study employs quarterly panel data from 154 Islamic Rural Banks (IRBs) in Indonesia covering the period from the first quarter of 2015 to the fourth quarter of 2023, yielding an unbalanced panel of 5,497 bank-quarter observations. Financial data, including balance sheets and income statements, were obtained from the Indonesian financial services authority (OJK), while macroeconomic data, particularly inflation measured by the consumer price index (CPI), were sourced from Statistics Indonesia (Badan Pusat Statistik, BPS). The panel is unbalanced because some IRBs did not consistently report complete financial statements throughout the observation period. Consistent with established practices in banking and finance research, missing observations were not imputed; instead, all available observations were retained to preserve the accuracy and integrity of the original dataset.

To mitigate the influence of extreme observations and enhance the robustness of the empirical estimates, several continuous financial variables were winsorized at the 5th and 95th percentiles. These variables include the Lerner index, the capital adequacy ratio (CAR), the Z-Score, risk adjusted return on assets (RAROA), and bank size (LAsset). Winsorization is widely employed in banking and finance research to reduce the impact of outliers while preserving the underlying distribution of the data, thereby improving the reliability and robustness of the estimation results (De Andrés & Rodríguez, 2011; Blaine, 2018; Altuntas et al., 2018).

Model development

The empirical model developed in this study is grounded in the theoretical argument that financing diversification influences bank stability through its effects on risk concentration and portfolio management. Financing diversification may enhance stability by reducing concentration risk and improving risk distribution across financing portfolios. However, excessive diversification may increase monitoring costs, managerial complexity, and operational risk, thereby weakening bank stability. To capture these potentially contrasting effects, this study estimates both linear and non-linear specifications of the relationship between financing diversification and the stability of Islamic Rural Banks (IRBs). Furthermore, based on the capital buffer theory, the capital adequacy ratio (CAR) is incorporated as a moderating variable because a stronger capital position enhances a bank's capacity to absorb losses arising from financing activities. Accordingly, an interaction term between financing diversification and CAR is included to examine whether capital adequacy strengthens or weakens the effect of financing diversification on bank stability. The proposed model specification is consistent with previous empirical studies on diversification and bank stability (Adzobu et al., 2017; Shim, 2019; Jolo et al., 2022; Widarjono & Misanam, 2023; Doerr, 2024; Kamau & Simo-Kengne, 2025; Widarjono et al., 2025).

$$ZScore_{it} = \beta_0 + \beta_1 HHIF_{it} + \beta_2 Lerner_{it} + \beta_3 LAsset_{it} + \beta_4 CAR_{it} + \beta_5 IHK_{it} + \beta_6 COVID_{it} + \varepsilon_{it} \quad (1)$$

where HHIF denotes financing diversification, Lerner represents market power, LAsset is bank size, CAR is the capital adequacy ratio, CPI is the consumer price index used as a proxy for inflation, and Covid-19 is a dummy variable representing the Covid-19 period.

To examine the potential non-linear relationship between financing diversification and bank stability, the squared term of financing diversification ($HHIF^2$) is incorporated into the baseline model. The nonlinear specification is expressed as follows:

$$ZScore_{it} = \beta_0 + \beta_1 HHIF_{it} + \beta_2 HHIF_{it}^2 + \beta_3 Lerner_{it} + \beta_4 Lasset_{it} + \beta_5 CAR_{it} + \beta_6 IHK_{it} + \beta_8 COVID_{it} + \varepsilon_{it} \quad (2)$$

To further investigate the moderating role of capital adequacy, the interaction term between financing diversification and CAR ($HHIF * CAR$) is subsequently incorporated into the empirical model, following [Githaiga \(2020\)](#), [Adem \(2022\)](#), and [Chowdhury et al. \(2024\)](#).

IRB stability measure

This study measures the stability of Islamic Rural Banks (IRBs) using the Z-score, one of the most widely adopted indicators of bank stability in the banking literature. The Z-score reflects a bank's distance from insolvency by combining profitability, capitalization, and earnings volatility into a single measure. A higher Z-score indicates greater financial stability and a lower probability of bank failure. Consistent with previous studies on Islamic banking ([Beck et al., 2013](#); [Hassan et al., 2019](#); [Widarjono, 2020](#)), the Z-score is calculated using annualized financial ratios derived from quarterly observations over the 2015 to 2023 period. The Z-score is computed as follows:

$$Z\text{-score} = \frac{(ROA + CAR)}{STDV(ROA)} \quad (3)$$

Financing product diversification measure

This study measures financing product diversification using the Herfindahl Hirschman Index (HHI), which captures the degree of concentration of financing across different Islamic financing contracts. The financing diversification index (HHIF) is calculated based on the proportion of each financing contract to total financing, following [Trinugroho et al. \(2018\)](#) and [Widarjono et al. \(2020\)](#). The index is computed as follows:

$$HHIF = \left(\frac{\text{Mudharabah}}{TF} \right)^2 + \left(\frac{\text{musyarakah}}{TF} \right)^2 + \left(\frac{\text{murabahah}}{TF} \right)^2 + \left(\frac{\text{istisna}}{TF} \right)^2 + \left(\frac{\text{salam}}{TF} \right)^2 + \left(\frac{\text{ijarah}}{TF} \right)^2 + \left(\frac{\text{multijasa}}{TF} \right)^2 + \left(\frac{\text{qard}}{TF} \right)^2 \quad (4)$$

where TF denotes the total financing. The HHIF ranges from 0 to 1, with lower values indicating greater financing diversification because financing is distributed more evenly across different contract types. Conversely, values closer to 1 indicate a higher degree of financing concentration, implying that financing is concentrated in one or a few contract categories and, therefore, reflects lower diversification.

Market power measure

Market power is measured using the Lerner Index, which captures a bank's ability to set prices above the marginal cost. The Lerner Index is calculated as the difference between the output price and the marginal cost relative to the output price. Higher values indicate greater market power, whereas values closer to zero indicate a more competitive market environment. Although the Lerner Index is commonly interpreted within the range of 0 to 1, empirical banking studies may report values outside this range because of differences in marginal cost estimation and banking operating conditions. The Lerner Index has been widely applied in banking studies to measure market competition and to examine its implications for bank profitability, risk taking behavior, and financial stability ([Azad et al., 2023](#)). The index is calculated as follows.

$$Lerner = \frac{\text{Price} - MC}{\text{Price}} \quad (5)$$

where Price represents the output price, proxied by the ratio of total operating income to total assets, and MC denotes marginal cost, defined as the additional cost incurred to produce one

additional unit of financial output. The marginal cost is estimated from the first derivative of the translog cost function with respect to total assets as follows:

$$MC_{it} = (\rho_1 + \rho_2 \ln Asset_{it} + \sum_{k=1}^2 \rho_{2k} \ln V_{k,it}) \frac{TC_{it}}{\ln Asset_{it}} \quad (6)$$

Following Risfandy et al. (2020), the translog cost function is specified as

$$TC_{it} = (\theta_0 + \sum_{k=1}^2 \theta_1 \ln V_{k,it} + 0.5 \sum_{k=1}^2 \sum_{k=1}^2 \rho_{kl} \ln V_{k,it} \ln V_{l,it} + \rho_1 \ln Asset_{it} + 0.5 \delta_2 (\ln Asset_{it})^2 + \sum_{k=1}^2 \rho_{2k} \ln Asset_{it} \ln V_{k,it} + \varepsilon_{it} \quad (7)$$

where TC denotes total cost, comprising profit-sharing expenses and other operating expenses; V1 is the ratio of profit-sharing expenses to total customer deposits; V2 is the ratio of other operating expenses to total fixed assets; and Ln denotes the natural logarithm.

Control variables

The empirical model incorporates several control variables representing both bank-specific characteristics and macroeconomic conditions, following previous studies (Widarjono et al., 2020; Al-Kayed & Aliani, 2020; Aisjah et al., 2022; Gleißner et al., 2022; Jolo et al., 2022). Bank-specific variables include bank size (LAsset), measured as the natural logarithm of total assets, and the capital adequacy ratio (CAR), which serves as a proxy for bank capitalization. Macroeconomic conditions are represented by the consumer price index (CPI) as a proxy for inflation. In addition, a Covid-19 dummy variable is included to capture the potential impact of the pandemic on the stability of Islamic Rural Banks during the study period from the first quarter of 2015 to the fourth quarter of 2023.

Results and Discussion

Descriptive statistics

Table 1 presents the descriptive statistics for the study variables. The results indicate that the stability of Islamic Rural Banks (IRBs), measured by the Z-Score, has a mean value of 7.39 with considerable variation, suggesting substantial differences in banks' resilience to financial risk. Financing diversification (HHIF) has an average value of 0.70, indicating that IRBs' financing portfolios remain relatively concentrated in specific financing contracts. Market power, measured by the Lerner Index, has a mean of 0.41, with values ranging from -0.74 to 1.70, reflecting considerable heterogeneity in market power across IRBs. While positive Lerner Index values indicate that banks are able to price above marginal cost, negative values suggest that marginal costs exceed output prices. The wide dispersion of the Lerner Index further highlights the differences in competitive conditions and market structures across banks and regions.

Table 1. Summary statistics

Variable	Obs	Mean	Std	Min	Max
ZScore	5,496	7.3954	4.9224	1.66	19.59
HHIF	5,496	0.7056	0.1958	0.00	1.00
Lerner	5,496	0.4143	0.5816	-0.74	1.70
LAsset	5,496	17.5404	1.1499	13.76	21.37
CAR	5,496	16.9928	12.7562	4.75	50.77
CPI	5,496	110.5941	15.4755	84.55	145.40
COVID	5,496	0.1133	0.3170	0.00	1.00

Source: SPS processed data, 2025

Bank size (LAsset) exhibits moderate variation, whereas the capital adequacy ratio (CAR) averages 16.99%, with substantial dispersion, indicating considerable differences in capitalization levels among IRBs. The consumer price index (CPI) has an average value of 110.59, ranging from 84.55 to 145.40, reflecting notable variation in price levels over the study period. In addition, the

Covid-19 dummy variable indicates that approximately 11% of observations were recorded during the pandemic. Overall, these descriptive statistics demonstrate substantial heterogeneity in the financial characteristics, risk profiles, operational conditions, and macroeconomic environment of Islamic Rural Banks in Indonesia.

Table 2 presents the correlation matrix of the study variables. Overall, the pairwise correlation coefficients range from -0.5892 to 0.4999, well below the commonly accepted threshold of ± 0.80 , indicating that the independent variables are not highly correlated and that multicollinearity is unlikely to pose a concern in the regression analysis. The results further show that financing diversification (HHIF) and the Capital Adequacy Ratio (CAR) are weakly and positively correlated, whereas bank size (LAsset) is negatively associated with both financing diversification and CAR. Overall, these correlation patterns support the inclusion of all explanatory variables in the regression models, as they do not indicate a significant risk of multicollinearity.

Table 2. Correlation matrix

	ZScore	HHIFINA	Lerner	LAsset	CAR	CPI	COVID
ZScore	1,0000						
HHIF	0.2423	1,0000					
Lerner	0.1369	0.0835	1,0000				
LAsset	-0.3425	-0.2831	-0.2541	1,0000			
CAR	0.4999	0.1892	0.2297	-0.5892	1,0000		
CPI	0.0365	0.0241	0.0111	-0.0496	0.0121	1,0000	
COVID	-0.0242	-0.0171	-0.0143	0.0439	-0.0133	-0.1676	1,0000

Source: SPS processed data, 2025

Results

Table 3 presents the estimation results of the linear model examining the relationship between financing diversification and the stability of Islamic Rural Banks (IRBs). Three model specifications were estimated. Model (1) reports the estimation results excluding both the Consumer Price Index (CPI) and the Covid-19 dummy variable. Model (2) includes the Covid-19 variable while excluding CPI, and Model (3) represents the full specification, incorporating all explanatory and control variables. Based on the model selection tests, the fixed effects (FE) model was identified as the most appropriate estimator for all three specifications.

The estimation results indicate that financing diversification (HHIF) has a positive but statistically insignificant effect on IRBs stability across all model specifications, with coefficients ranging from 0.184 to 0.208. These findings suggest that financing diversification does not significantly enhance bank stability when examined within a linear framework. In contrast, market power, measured by the Lerner Index, has a positive and statistically significant effect at the 1% level, with coefficients ranging from 0.280 to 0.287, indicating that banks with greater market power tend to be more stable. Bank size (LAsset) has a negative and significant effect on stability (-0.265 to -0.298), suggesting that larger IRBs may face greater operational and financing risks. The capital adequacy ratio (CAR) also exerts a positive and statistically significant effect (0.253 to 0.255), highlighting the importance of adequate capital buffers in strengthening bank resilience.

Among the macroeconomic variables, inflation, measured by the consumer price index (CPI), has a positive and statistically significant effect on bank stability (0.007), whereas the Covid-19 dummy variable has a negative but statistically insignificant coefficient, indicating that the pandemic did not exert a significant direct effect on the stability of IRBs during the observation period. Overall, the direction and statistical significance of the estimated coefficients remain largely consistent across the three model specifications, providing evidence of the robustness of the baseline linear model.

Table 4 presents the estimation results of the non-linear model examining the relationship between financing diversification and the stability of Islamic Rural Banks (IRBs). Three model specifications were estimated. Model (4) reports the results excluding both the Consumer Price Index (CPI) and the Covid-19 dummy variable. Model (5) includes the Covid-19 variable while

excluding CPI, and Model (6) represents the full specification, incorporating all explanatory and control variables. Based on the model selection tests, the random effects (RE) model was identified as the most appropriate estimator for all three specifications.

Table 3. Linear impact

Variables	(1)	(2)	(3)
HHIF	0.208	0.186	0.184
	0.136	0.162	0.166
Lerner	0.287***	0.286***	0.280***
	0.000	0.000	0.000
LAsset	-0.298***	-0.265***	-0.282***
	0.000	0.000	0.000
CAR	0.254***	0.255***	0.253***
	0.000	0.000	0.000
CPI	-	0.007***	0.007***
		0.000	0.000
COVID	-	-	-0.034
			0.297
_cons			7,030
			0.000
R_Square			
Within	0.5628	0.0541	0.5644
Between	0.1902	0.1615	0.1926
Overall	0.2556	0.0812	0.2553
No.obser	5496	5496	5496
Bank No.	154	154	154
F Test	249.46	11.26	250.91
LM	69026.40	4263.57	69095.10
Hausman	22.92	26.70	36.86

Notes:***p<0.01;**p<0.05;*p<0.1;Probability is reported in parentheses

Source: processed data, 2025

The estimation results consistently reveal an inverted U-shaped relationship between financing diversification (HHIF) and IRBs stability across all model specifications. The coefficient of HHIF is positive and statistically significant (3.744 to 4.080), whereas its squared term (HHIF²) is negative and significant (-2.550 to -2.851). These findings indicate that financing diversification initially enhances bank stability by reducing financing concentration and spreading risk. However, once diversification exceeds an optimal level, its stabilizing effect diminishes, suggesting that excessive diversification may increase managerial complexity, monitoring costs, and inefficiencies, thereby weakening bank stability.

Among the bank specific variables, market power, measured by the Lerner Index, remains positive and statistically significant at the 1% level, with coefficients ranging from 0.284 to 0.289, indicating that banks with stronger market power are better positioned to maintain financial stability. In contrast, bank size (LAsset) has a negative and significant effect on stability (-0.265 to -0.294), suggesting that larger IRBs may face greater operational and financing risks. The capital adequacy ratio (CAR) also exerts a positive and significant effect (0.253 to 0.255), highlighting the importance of adequate capital buffers in strengthening bank resilience.

Regarding the macroeconomic variables, inflation, measured by the Consumer Price Index (CPI), has a positive and statistically significant effect on bank stability (0.007). In contrast, the Covid-19 dummy variable has a negative but statistically insignificant coefficient (-0.042), indicating that the pandemic did not exert a significant direct effect on the stability of IRBs during the observation period. Overall, the findings remain consistent across all model specifications and provide strong evidence of a non-linear relationship between financing diversification and IRB stability. Furthermore, the relatively high coefficient of determination ($R^2 = 0.56$), together with

the results of the F-test, Lagrange Multiplier (LM) test, and Hausman test, indicates that the estimated models provide a satisfactory fit to the observed data.

Table 4. Non-linear effect

Variables	(4)	(5)	(6)
HHIF	3,744*** 0.001	3,978*** 0.000	4,080*** 0.000
HHIF ²	-2,550*** 0.002	-2,775*** 0.001	-2,851*** 0.001
Lerner	0.289*** 0.000	0.289*** 0.000	0.284*** 0.000
LAsset	-0.294*** 0.000	-0.265*** 0.000	-0.282*** 0.000
CAR	0.253*** 0.000	0.255*** 0.000	0.254*** 0.000
CPI	-	0.007*** 0.000	0.007*** 0.000
COVID	-	-	-0.042 0.254
_cons	6,841 0.000	5,496 0.000	5,796 0.000
R_Square			
Within	0.5636	0.5660	0.5653
Between	0.1859	0.1847	0.1873
Overall	0.2519	0.2515	0.2508
No.obser	5496	5496	5496
Bank No.	154	154	154
F Test	244.12	245.29	245.57
LM	66786.01	66879.11	66822.08
Hausman	3.35	29.27	28.50

Notes:***p<0.01;**p<0.05;*p<0.1;Probability is reported in parentheses

Source: processed data, 2025

The effect of capital adequacy ratio (CAR)

$$Zscore_{it} = \beta_0 + \beta_1 HHIF_{it} + \beta_2 HHIF_{it}^2 + \beta_3 HHIF_{it} * CAR_{it} + \beta_4 Lerner_{it} + \beta_5 Lasset_{it} + \beta_6 CAR_{it} + \beta_7 CPI_{it} + \beta_8 COVID_{it} + \varepsilon_{it} \quad (8)$$

The results of the linear and non-linear estimations reported in [Tables 3](#) and [4](#) indicate that financing diversification does not have a significant linear effect on the stability of Islamic Rural Banks (IRBs). However, the non-linear specification reveals a statistically significant inverted U-shaped relationship, indicating that financing diversification enhances bank stability at lower levels but diminishes it once diversification exceeds an optimal threshold. Building on these findings, this study further investigates the role of capital adequacy, measured by the Capital Adequacy Ratio (CAR), as both a direct determinant of bank stability and a moderating variable influencing the relationship between financing diversification and stability.

The estimation results presented in [Table 5](#) show that the selected specifications include Fixed Effects (FE) models (Models 7 and 9) and a Random Effects (RE) model (Model 8). Across Models (7) and (9), the findings consistently confirm a robust inverted U-shaped relationship between financing diversification and IRB stability. The coefficient of HHIF is positive and statistically significant (3.831 to 4.158), whereas its squared term is negative and significant (-2.353 to -2.680) at the 1% significance level, confirming that moderate diversification strengthens stability while excessive diversification weakens it. Furthermore, the interaction term between financing diversification and capital adequacy (HHIF*CAR) is consistently negative and significant (-0.017 to -0.021), suggesting that higher capital adequacy reduces the marginal contribution of financing diversification to stability, particularly at higher levels of diversification. In contrast, CAR exerts a

positive and significant direct effect on bank stability (0.267 to 0.270), highlighting its role as a financial buffer against risk. Among the control variables, market power has a positive and significant effect (0.287 to 0.293), whereas bank size has a negative and significant effect (-0.253 to -0.291). Inflation is positively associated with stability (0.007), while the Covid-19 dummy variable remains statistically insignificant. Overall, the results demonstrate strong explanatory power and suggest that capital adequacy not only enhances bank stability directly but also moderates the relationship between financing diversification and stability.

Table 5. The effect of capital adequacy ratio

Variables	(7)	(8)	(9)
HHIF	4.075*** 0.000	3,831*** 0.001	4.158*** 0.000
HHIF ²	-2,578*** 0.002	-2,353*** 0.002	-2,680*** 0.001
HHIF*CAR	-0.019** 0.057	-0.021** 0.045	-0.017** 0.075
Lerner	0.293*** 0.000	0.292*** 0.000	0.287*** 0.000
LAsset	-0.291*** 0.000	-0.253*** 0.000	-0.275*** 0.000
CAR	0.269*** 0.000	0.270*** 0.000	0.267** 0.000
CPI	-	0.007*** 0.000	0.007*** 0.000
COVID	-	-	-0.041 0.260
_cons			5,516 0.000
R_Square			
Within	0.5638	0.5662	0.5654
Between	0.1861	0.2866	0.1883
Overall	0.2522	0.2533	0.2517
No.obser	5496	5496	5496
Bank No.	154	154	154
F Test	242.18	243.35	245.57
LM	66225.08	66310.29	66299.78
Hausman	13.68	5.97	30.18

Notes:***p<0.01;**p<0.05;*p<0.1;Probability is reported in parentheses

Source: processed data, 2025

Robustness test

Based on the robustness test results reported in [Table 6](#), several additional analyses were conducted to assess the consistency of the main findings. First, the dependent variable was replaced from the Z-Score to the risk adjusted return on assets (RAROA) as an alternative proxy for bank stability. Second, three alternative model specifications were estimated: Model (10) excludes both the Consumer Price Index (CPI) and the Covid-19 dummy variable. Model (11) incorporates the Covid-19 variable while excluding the CPI. Model (12) represents the full specification, including all the explanatory and control variables. Across these alternative specifications, the relationship between financing diversification and IRB stability remains non-linear, exhibiting a robust inverted U-shaped pattern.

The estimation results from Models (10) and (12) consistently confirm that financing diversification has a stable inverted U-shaped effect on the stability of Islamic Rural Banks (IRBs). The coefficient of HHIF remains positive and statistically significant (1.551 to 1.695), while its squared term remains negative and significant (-0.660 to -0.779), indicating that the non-linear relationship is robust across alternative model specifications. Furthermore, the interaction term

between financing diversification and capital adequacy (HHIF* CAR) is consistently negative and significant (-0.013 to -0.014), confirming that higher capital adequacy weakens the marginal effect of financing diversification on bank stability. Among the control variables, market power remains positive and significant (0.265 to 0.268). In contrast to the main estimations, bank size becomes positive and significant (0.131 to 0.163), suggesting potential scale advantages under the robustness specifications. Although the direct effect of CAR is no longer statistically significant, inflation continues to exert a positive and significant effect (0.007 to 0.008). The Covid-19 dummy variable is negative and significant (-0.156), indicating a stronger adverse effect of the pandemic under the alternative specifications. Overall, despite minor differences in the estimated coefficients, the principal findings remain robust, particularly the inverted U-shaped relationship between financing diversification and bank stability and the moderating role of capital adequacy.

Table 6. Robustness test

Variables	(10)	(11)	(12)
HHIF	1,579*** 0.004	1,551*** 0.003	1,695*** 0.002
HHIF ²	-0.671** 0.062	-0.660*** 0.063	-0.779** 0.035
HHIF*CAR	-0.014*** 0.008	-0.014*** 0.005	-0.013** 0.010
Lerner	0.268*** 0.000	0.268*** 0.000	0.265*** 0.000
LAsset	0.131*** 0.000	0.163*** 0.000	0.163*** 0.000
CAR	-0.005 0.124	-0.003 0.200	-0.005 0.263
CPI		0.008*** 0.000	0.007*** 0.000
COVID			-0.156*** 0.000
_cons			-3,684 0.000
R_Square			
Within	0.0495	0.0766	0.0812
Between	0.2179	0.2175	0.2100
Overall	0.1139	0.1306	0.1316
No.obser	5496	5496	5496
Bank No.	154	154	154
F Test	18.13	18.64	18.80
LM	9860.94	10255.31	10380.14
Hausman	4.10	4.19	3.64

Notes:***p<0.01;**p<0.05;*p<0.1;Probability is reported in parentheses

Source: processed data, 2025

Discussion

Table 3 shows that financing diversification (HHIF) has a positive but statistically insignificant effect on the stability of Islamic Rural Banks (IRBs). This finding is consistent with Handayani (2021), who reported that diversification does not necessarily improve bank stability unless it is accompanied by favorable market conditions or reduced market volatility. In contrast, other studies have found that diversification strategies, particularly revenue diversification, can significantly enhance bank stability by reducing income concentration and spreading risk (Octavianus & Fachrudin, 2022). These mixed findings suggest that the effectiveness of diversification depends on the institutional and operational characteristics of the banking sector.

Among the control variables, market power (Lerner Index) has a positive and significant effect on bank stability, supporting the view that banks with greater market power generate higher

profit margins and possess stronger buffers against financial risk (Liu et al., 2013). In contrast, bank size (LAsset) has a significant negative effect, indicating that larger banks may face greater operational complexity and risk exposure, thereby reducing stability, which is consistent with the findings of Indraswari and Sari (2023). The capital adequacy ratio (CAR) also exerts a positive and significant effect, confirming the important role of capital in strengthening bank resilience (Gustama & Danarsari, 2025). However, previous studies have reported inconsistent evidence regarding the role of diversification. For example, Ben Lahouel et al. (2022) and Lestari and Hersugondo (2021) found that income diversification had no significant effect on the stability of conventional banks. Therefore, the present findings should not be interpreted as evidence that diversification universally enhances bank stability. Instead, they suggest that financing diversification must be implemented at an appropriate level and managed effectively to maximize its benefits while avoiding potential inefficiencies.

Table 4 presents the non-linear estimation results, showing that financing diversification (HHIF) has a positive and significant coefficient, whereas its quadratic term (HHIF²) is negative and statistically significant. These results indicate an inverted U-shaped relationship between financing diversification and bank stability. Moderate diversification improves stability by reducing financing concentration, whereas excessive diversification diminishes stability because of increasing monitoring costs, managerial complexity, and potential inefficiencies. This finding is consistent with Ben Lahouel et al. (2022) and Yang et al. (2020), who emphasize that the relationship between diversification and bank stability is inherently non-linear rather than strictly linear.

The control variables produce results that are largely consistent with the baseline model. Market power (Lerner index) remains positively associated with bank stability, supporting the Structure Conduct Performance (SCP) hypothesis that banks with stronger market positions are better able to absorb financial risks (Berger & Hannan, 2014). Conversely, bank size (LAsset) continues to have a significant negative effect, suggesting that larger banks may be exposed to greater operational and financing risks (Indraswari & Sari, 2023). The Capital Adequacy Ratio (CAR) remains positive and significant, reinforcing the role of capital as a key determinant of financial resilience (Handayani, 2021). Among the macroeconomic variables, inflation (CPI) has a positive but relatively small effect on bank stability, whereas the Covid-19 dummy variable is statistically insignificant, indicating that the pandemic did not exert a direct effect on the stability of IRBs during the observation period.

Table 5 reports the estimation results after incorporating the moderating role of capital adequacy. Financing diversification (HHIF) continues to have a positive and significant effect on bank stability, while its quadratic term (HHIF²) remains negative and significant, confirming the existence of an inverted U-shaped relationship. These findings provide empirical support for Hypothesis 2, indicating that moderate financing diversification enhances bank stability, whereas excessive diversification weakens its stabilizing effect. This result is consistent with Liu (2013), who documented the non-linear relationship between diversification and bank stability.

The interaction between financing diversification and the Capital Adequacy Ratio (HHIF*CAR) is negative and statistically significant at the 5% level, suggesting that higher capital adequacy reduces the marginal contribution of financing diversification to bank stability, particularly when financing portfolios become highly diversified. This finding supports the view that capital adequacy moderates the relationship between diversification and stability by influencing banks' capacity to absorb financing risk (Fuad et al., 2021). Furthermore, market power (Lerner Index) remains positive and significant, indicating that banks with stronger market positions are more capable of maintaining financial stability. Bank size (LAsset) continues to exert a significant negative effect, implying that larger banks are exposed to greater risks that may reduce resilience (Indraswari & Sari, 2023). In addition, CAR maintains a positive and significant direct effect on stability, highlighting the importance of adequate capitalization. Inflation (CPI) exhibits a positive, although relatively small, effect, whereas the Covid-19 dummy variable remains statistically insignificant, suggesting that the pandemic did not directly affect IRB stability during the study period.

Table 6 presents the robustness test results, which demonstrate that the principal findings are consistent across alternative model specifications. Financing diversification ($HHIF$) continues to have a positive and significant effect on bank stability, while its squared term ($HHIF^2$) remains negative and significant, confirming the robustness of the inverted U-shaped relationship and indicating the existence of an optimal level of financing diversification before stability begins to decline. Likewise, the interaction between financing diversification and the Capital Adequacy Ratio ($HHIF \cdot CAR$) remains negative and statistically significant, providing further evidence that capital adequacy moderates the relationship between financing diversification and bank stability. Market power (Lerner Index) also continues to have a positive and significant effect, confirming its important role in strengthening bank resilience. Unlike the main estimations, however, the Covid-19 dummy variable becomes negative and statistically significant, indicating that the pandemic imposed additional pressures on the stability of Islamic Rural Banks under the alternative model specifications.

Conclusion

This study examines the relationship between financing diversification and the stability of Islamic Rural Banks (IRBs) in Indonesia. The analysis is based on panel data from 154 IRBs covering the period 2015 to 2023. Financing diversification is measured using the Herfindahl Hirschman Index (HHI), while bank stability is proxied by the Z-Score and Risk-Adjusted Return on Assets (RAROA). The study employs panel regression models, including linear, non-linear, and interaction specifications between financing diversification ($HHIF$) and the Capital Adequacy Ratio (CAR), complemented by robustness tests to validate the findings.

The results indicate that financing diversification positively influences IRBs stability; however, the relationship is nonlinear, exhibiting an inverted U-shaped pattern. Moderate financing diversification enhances bank stability, whereas excessive diversification weakens it. Market power (Lerner Index) and capital adequacy (CAR) have positive and significant effects on bank stability, while bank size (LAsset) has a significant negative effect. Furthermore, the interaction between financing diversification and CAR is negative and significant, suggesting that higher capital adequacy reduces the marginal contribution of financing diversification to bank stability, particularly at higher levels of diversification. Among the macroeconomic variables, inflation has a small but positive effect on bank stability, whereas the Covid-19 pandemic does not have a significant direct effect during the study period. Robustness tests further confirm the consistency of the empirical findings across alternative model specifications.

From a policy perspective, IRBs managers should establish prudent limits on sectoral financing exposure by defining maximum portfolio concentration thresholds and conducting regular quarterly stress tests to monitor financing risk. Capital adequacy should be strengthened through retained earnings and prudent dividend distribution policies to maintain sufficient capital buffer. In addition, the OJK should integrate financing concentration indicators into its early warning system and implement risk based capital requirements that adjust capital buffers according to the risk profile of financing portfolios.

Abbreviation

IRBs: Islamic Rural Banks
 BPS: Badan Pusat Statistik
 OJK: Otoritas Jasa Keuangan
 MSMEs: Micro, Small, and Medium Enterprises
 HHI: Herfindahl Hirschman Index
 CAR: Capital Adequacy Ratio
 CPI: Consumer Price Index
 LM: Lagrange Multiplier

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Data availability statement

The data supporting the findings of this study were obtained from the Indonesian Financial Services Authority (OJK) and the Statistics Indonesia (BPS). The processed dataset used for the analysis is available from the corresponding author upon reasonable request.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this manuscript, the authors used ChatGPT (OpenAI) to improve its readability, language, and grammatical quality. After using this tool, the authors carefully reviewed and edited the content and take full responsibility for the final version of the manuscript.

Conflict of interest statement

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Ethic approval and consent to participate

The authors declare that ethical approval and informed consent were not required for this study because it used anonymized secondary data obtained from the Indonesian Financial Services Authority (OJK) and Statistics Indonesia (BPS).

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