JURNAL ECONOMINA
e-ISSN: 2963-1181
Volume 5, Number 10, October 2026
Homepage: ejournal.45mataram.ac.id/index.php/economina

The Effect of Operational Efficiency, Capital Adequacy, and Non-Performing Financing on the Operational Risk of Islamic Commercial Banks in Indonesia for the 2021-2025 Period

Nazma Nurul Azizah[1*], Nining Wahyuningsih[2], Alvien Septian Haerisma[3]
[1*23]Islamic Banking Study Program, Syekh Nurjati State Islamic University of Cyberspace, Cirebon, Indonesia

Corresponding Author: azizahbakaeer@gmail.com, niningwningsih@uinssc.ac.id, alvienseptian@uinssc.ac.id*

Article History
Received: 23-10-2026
Revised: 29-10-2026
Published: 30-10-2026

ABSTRAK

The growth of Islamic banking has increased the operational complexity and operational risk exposure of Islamic Commercial Banks, but the influence of financial ratios on operational risk is still rarely examined. This study analyzes the influence of operational efficiency (BOPO), capital adequacy ratio (CAR), and non-performing financing on the operational risk of Islamic Commercial Banks in Indonesia for the period 2021–2025. Operational risk is proxied by the ratio of Risk - Weighted Assets (RAW) to total RWA. The study uses a quantitative causal associative approach with secondary data from bank annual reports and publications of the Financial Services Authority (OJK). A total of 11 Islamic Commercial Banks (BUS) were selected purposively over five years, resulting in 55 balanced panel data observations analyzed using EViews 13. The Chow and Hausman tests indicate that Fixed Assets (RF) are the most significant variables. The Effect Model is most appropriate. BOPO has a negative and significant effect (coefficient −0.034; p = 0.0138), CAR has a positive and significant effect (coefficient 0.116; p = 0.0000), while NPF has no significant effect (p = 0.5977). Simultaneously, all three variables have a significant effect. However, sensitivity tests indicate that the effect of BOPO and CAR depends on the presence of Bank Aladin Syariah in the sample, and the direction of both coefficients may partly reflect the ATMR calculation mechanism, not solely management behavior. The results of this study therefore need to be interpreted with caution.

Keywords: ***Operational Efficiency, Capital Adequacy, Non-Performing Financing, Operational Risk, Islamic Commercial Banks***

INTRODUCTION

Islamic banking in Indonesia continues to grow. The Financial Services Authority (OJK) reports that Islamic banking assets have exceeded one thousand trillion rupiah (OJK, 2025). This growth in business scale increases the complexity of banks' operations and increases exposure to operational risk. A study on bank holding companies companies in the United States show that larger banks tend to incur higher operating losses per dollar of assets and

experience more extreme events (Berger et al. , 2022). Business complexity is also related to the frequency of operational risk events (Chernobai et al. , 2021). In Indonesia, the merger of three state-owned Islamic banks into Bank Syariah Indonesia (BSI) in February 2021 combined the systems, business processes, and human resources of the original banks, making operational integration a challenging and risky undertaking (Bank Syariah Indonesia, 2022).

The sources of operational risk in Islamic banks are diverse. The disruption of BSI services in May 2023, allegedly caused by a cyberattack, is the most widely reported example (Ramadhan, 2025). The digitalization of services also creates daily operational challenges, such as blocked customer accounts (Mus et al. , 2025), and differences of opinion within the bank can trigger conflicts that disrupt operational processes (Apriliani et al. al. , 2024). A cross-country study of 264 banks in 43 countries concluded that digitalized banking operations are a key driver of operational risk (Uddin et al. , 2023). In Islamic banks, there is also an additional dimension in the form of compliance with sharia principles that requires continuous supervision (Nurlaela et al. et al. , 2026).

On the other hand, BOPO, CAR, and NPF are ratios commonly used to assess the health of Islamic banks (OJK, 2014a). Research on Indonesian Islamic banks generally places these three ratios as indicators of profitability, namely ROA (Maulia & Wirman, 2022; Lestari et al., 2014). al. , 2025; Kasmawati et et al. , 2026; Nandani et al. , 2025). Its influence on operational risk as a dependent variable has rarely been examined. This study fills this gap with three contributions. First, operational risk is used as a dependent variable through the ratio of operational risk risk weighted assets (RWA) to total RWA. Second, the 2021–2025 period contains significant operational risk events and changes in the approach to calculating RWA. Third, the relationship between financial ratios and operational risk is interpreted through two mechanisms simultaneously: management behavior and regulatory calculations. The research question is whether BOPO, CAR, and NPF influence the operational risk of Islamic banks (BUS) in Indonesia. The purpose of this study is to analyze the influence of BOPO, CAR, and NPF on the operational risk of Islamic banks (BUS) in Indonesia, both partially and simultaneously. Theoretically, the results enrich the study of operational risk in Islamic banks, which have traditionally primarily used financial ratios as an explanation of profitability. Practically, the results can be used by banks in monitoring operational risk ratios and by regulators in assessing the disclosure of operational risk RWA.

Agency Theory explains that differences in interests between owners and management give rise to agency costs, including inefficient resource management (Jensen & Meckling , 2019). Operational risk is the risk of loss due to inadequate internal processes, human error, system failure, or external events (OJK, 2016). In the Basic Indicator Approach, the operational risk risk risk asset (RWA) is calculated as 15% of the average positive gross income of the last three years multiplied by 12.5 (OJK, 2020). This means that the operational risk risk asset value is determined by income, not by loss events. This is important for interpreting the research results.

Within the agency framework According to the BOPO theory , a high BOPO reflects agency costs, thus increasing operational risk. However, because operational risk risk-weighted assets (RWA) are dependent on revenue, the relationship between BOPO and the operational risk ratio may also be mechanical. Previous research found that BOPO negatively impacts profitability (Maulia & Wirman, 2022; Kasmawati et al. , 2019). al. , 2026), but the dependent variables are different. The direction of the influence of BOPO on operational risk cannot therefore be determined in advance.

Capital buffer theory views high capital as a buffer against losses, while moral hazard Theory warns that excess capital can encourage greater risk-taking (Jokipii & Milne , 2011). The evidence on Islamic banks is not uniform. Market discipline encourages capital buffers especially in conventional banks (Grassa et al. , 2022), and the response of Islamic banks to insolvency risk through additional capital is less effective (Saeed et al. , 2020). CAR was found to be negatively related to profitability in Islamic banks in Bangladesh (Gazi et al., 2020). al. , 2024) and in Indonesia (Lestari et al. , 2025), but has a positive effect on the growth of Bank Muamalat's mudharabah deposits (Rahmalia et al. , 2026). In addition, operational risk ATMR is part of the CAR denominator, so there is a calculation relationship between the two ratios.

Non-performing financing requires additional resources for monitoring, restructuring, and collection. A bibliometric review places non-performing financing as one of the most common causes of operational risk in Islamic banking (Aprilia et al. al. , 2022). However, NPF is not partially significant on ROA (Kasmawati et al. , 2026), while NPF and BOPO have a simultaneous effect on ROA (Nandani et al. , 2025). The influence of NPF is suspected to be positive, but the test remains two-way.

RESEARCH METHODS

This research is a quantitative, associative, causal study (Sugiyono, 2019) using panel data. The data are secondary and were collected through a documentary study of annual reports, risk management implementation reports for each bank, and the Financial Services Authority (OJK) Sharia Banking Statistics. The population comprised all Islamic banks (BUS) supervised by the OJK during 2021–2025 (11 banks as of December 2025). The sample was determined by purposive sampling based on three criteria: the bank operated as the same BUS throughout the period, published complete financial and risk management reports, and had data available for all observation years. Eleven banks met the criteria: BSI, Bank Muamalat Indonesia, BTPN Syariah, BCA Syariah, Panin Dubai Syariah, Bank Mega Syariah, KB Bukopin Syariah, BJB Syariah, Bank Aceh Syariah, Bank NTB Syariah, and Bank Aladin Syariah. With five years of observation, a balanced panel of 55 observations was formed.

BSI's 2021 annual report does not disclose operational risk risk assets (RWA). Its value was estimated using the Basic Indicator Approach, resulting in an operational risk RWA of IDR 27,483,210 million and an operational risk ratio of 19.46%. The same formula yielded the same 2020 figure as BSI's official figure, making this calculation consistent with the bank's practices.

Because this estimate is not published data, the robustness of the results was tested through sensitivity tests.

Table 1. Operational Definition of Variables

Variables	Size	Scale
Operational risk (RO, Y)	ATMR operational risk / total ATMR × 100%	Ratio
Operational efficiency (BOPO, X1)	Operating expenses / operating income × 100%	Ratio
Capital adequacy (CAR, X2)	Capital / ATMR × 100%	Ratio
Non-performing loans (NPF, X3)	Problem financing / total financing × 100%	Ratio

Source: OJK (2014b, 2020)

The analysis was conducted using EViews 13 through descriptive statistics, model selection (Chow test and Hausman test), classical assumption tests (Jarque -Bera, VIF, Glejser , Durbin-Watson), t-test, and F-test (Basuki & Prawoto, 2016; Ghozali & Ratmono, 2017). The estimated models are:

$ROit = \alpha i + \beta 1\ BOPOit + \beta 2\ CARit + \beta 3\ NPFit + \varepsilon it$

With αi as the fixed effect of bank i . H4 testing uses the redundant test. variables over the three regressors because the F statistic in the FEM output also contains fixed effects. Sensitivity tests were conducted with five additional estimates, namely (1) the 2021 BSI RWA estimate based on profit sharing rights only, (2) the 2021 BSI was excluded, (3) the addition of a dummy variable for the RWA calculation approach, (4) a subsample of banks with the same calculation approach, and (5) Bank Aladin Syariah was excluded because its BOPO and CAR values were far beyond those of other banks.

RESULTS AND DISCUSSION

RESULTS

Descriptive Statistics

The average operational risk ratio was 16.94% with a standard deviation of 13.26 points, indicating that the operational risk risk ratio (RWA) varied widely between banks and between years . The average BOPO (Board of Ownership) of 101.97% exceeded 100% due to several very high observations, particularly at smaller banks. The large standard deviations of BOPO and CAR indicate outliers .

Table 2. Descriptive Statistics (n=55)

Variables	Average (%)	Standard deviation	Minimum	Maximum
RO (Y)	16.94	13.26	3.53	57.84
BOPO (X1)	101.97	64.16	58.12	428.40
CAR (X2)	39.53	54.75	18.70	390.50
NPF (X3)	2.37	1.83	0.00	8.83

Source: Output EViews 13, edited by the author (2026)

Model Selection and Classical Assumption Testing

Chow test yielded F = 99.691 (prob . 0.0000) and chi-square = 177.727 (prob . 0.0000), so FEM is more appropriate than Common Effect Model. The Hausman test yielded a chi-square of 38.525 with degrees of freedom of 3 (prob . 0.0000), so FEM was also chosen over Random Effect Model. The results of the classical assumption test on the FEM residuals are presented in Table 3. It should be noted that the Durbin-Watson test is designed for time series data, so that in the panel with T = 5 the conclusion is only an initial indication.

Table 3. Summary of Classical Assumption Tests

Test	Statistics	Conclusion
Normality (Jarque -Bera)	JB = 4.153; prob . = 0.125	Normal residual
Multicollinearity (centered VIF)	BOPO 3.57; CAR 3.93; NPF 1.26	There is no serious multicollinearity
Heteroscedasticity (Glejser)	prob . BOPO 0.0882; CAR 0.1016; NPF 0.6037	Homoscedastic
Autocorrelation (Durbin-Watson)	DW = 1.745 (dU = 1.681)	No autocorrelation

Source: Output EViews 13, edited by the author (2026).

Estimation Results and Hypothesis Testing

Variables	Coefficient	Std . error	t-statistic	Prob .
Constant	15,35648	1.418429	10.82640	0.0000
BOPO (X1)	−0.034346	0.013350	−2.572764	0.0138
CAR (X2)	0.116461	0.016285	7,151372	0.0000
NPF (X3)	0.204677	0.384855	0.531828	0.5977

R^2 = 0.9756; Adjusted R^2 = 0.9678; N = 55. Source: Output EViews 13, edited by the author (2026).

Table 5. Results of FEM Model Sensitivity Test

Model	N	BOPO	CAR	NPF	The main results hold?
Main model	55	−0.0343; 0.0138	0.1165; 0.0000	0.2047; 0.5977	–
BSI 2021 ATMR based on profit sharing rights	55	−0.0353; 0.0119	0.1174; 0.0000	0.1466; 0.7063	Yes
BSI 2021 issued	54	−0.0347; 0.0141	0.1168; 0.0000	0.1831; 0.6433	Yes
Dummy calculation approach	55	−0.0378; 0.0087	0.1199; 0.0000	0.1795; 0.6434	Yes
Same approach subsample	40	−0.0785; 0.0001	0.1620; 0.0000	0.6581; 0.2356	Yes
Without Aladin Syariah Bank	50	0.0011; 0.9327	0.1743; 0.1023	0.4075; 0.1827	No

Source: Output EViews 13, edited by the author (2026)

The direction and significance of the coefficients remain unchanged across the first five estimations. The calculation approach dummy is insignificant (coefficient −1.5789; prob . 0.2857), so changes in the RWA approach do not appear to affect the main results. However, after excluding Bank Aladin Syariah, BOPO and CAR are no longer significant. A simultaneous test on 50 observations also does not support H4 (F = 1.465; prob . 0.2399). Thus, the results of H1, H2, and H4 depend on the presence of a single bank with very extreme BOPO and CAR values, while NPF remains insignificant across all estimations.

DISCUSSION

Bopo and Operational Risk

The negative BOPO coefficient contradicts expectations from a management perspective. This direction is more easily understood through the calculation mechanism. When operating income decreases, BOPO increases, but the operational risk risk weighted average (RWA), calculated from gross income, also decreases. This negative relationship may stem partly from

the numerator and denominator moving together, rather than from the quality of cost control. This result cannot be interpreted as meaning that less efficient banks have lower operational risk. The negative direction in this study also differs from the findings of BOPO on ROA (Maulia & Wirman, 2022; Kasmawati et al., 2019) . al. , 2026), because the variable explained is not profitability.

CAR and Operational Risk

CAR has a positive effect, so it is closer to moral hazard theory of capital buffer theory (Jokipii & Milne , 2011). This finding is in line with evidence that the function of capital as a buffer in Islamic banks is not yet uniform (Grassa et al. , 2022; Saeed et al. , 2020). However, CAR and the operational risk ratio use total risk-weighted assets (RWA) as the denominator. When total RWA decreases, CAR increases, and the portion of operational risk RWA also increases, so some of the positive relationship may stem from the calculation's identity. Therefore, the CAR coefficient cannot be interpreted as a pure cause-and-effect relationship, and high capital does not automatically mean a bank is safer from operational risk.

NPF and Operational Risk

The NPF (Non-Performing Loan) has no significant effect, although the coefficient is positive, as expected. There are three possible explanations. First, gross income in the Basic Indicator Approach is principally calculated before allowances for losses, so an increase in NPF does not directly reduce the basic risk-weighted assets (RWA). Second, non-performing assets, which are weighted more highly in the credit risk RWA, increase the denominator and can lower the ratio, thus neutralizing the two opposing channels. Third, the NPF effect may operate indirectly through the BOPO (Operating Expenses to Losses) when non-performing loans increase collection and restructuring costs, even though BOPO is already included in the model. These results align with the findings of Kasmawati et al. al. (2026) for ROA, and the relationship between NPF and BOPO is also seen in Nandani et et al. (2025). These explanations are still conjectures that need to be tested, for example with mediation analysis.

Role of Bank Characteristics

The large difference between R^2 FEM (0.9756) and CEM (0.3820) indicates that the fixed characteristics of each bank, such as risk culture, control systems, and governance, play an important role that is not captured by the three research variables (Kunz & Heitz , 2021; Nainggolan et al. , 2023). This model is more appropriately understood as a test of the influence of financial ratios after accounting for fixed differences between banks , rather than as a model that fully explains operational risk.

CONCLUSION AND SUGGESTIONS

In 11 Islamic banks (BUS) for the 2021–2025 period (55 observations), BOPO had a negative and significant effect on operational risk (H1 was accepted), CAR had a positive and

significant effect (H2 was accepted), NPF had no significant effect (H3 was rejected), and all three had a significant effect simultaneously in the main model (H4 was accepted). These results are robust to the 2021 BSI RWA estimation and changes in the calculation approach, but not to Bank Aladin Syariah's expenditures. The direction of the BOPO and CAR coefficients is also more appropriately interpreted as a reflection of the RWA calculation mechanism rather than evidence of management behavior.

This study has several limitations, including a small panel (11 banks, five years), the proxy for the dependent variable being the RWA ratio rather than actual operational losses, the 2021 BSI RWA being an estimate, the presence of outliers , the lack of panel-specific autocorrelation tests (e.g., Wooldridge), and the limited scope of variables. For banks, the operational risk ratio needs to be monitored alongside total RWA and income structure to distinguish changes in exposure from changes in calculations. For the Financial Services Authority (OJK), disclosure of operational risk RWA and the approach used needs to be standardized across banks and across years . For future research, it is recommended to expand the period and number of banks, use actual operational loss data or alternative proxies, add control variables such as bank size and digitalization, test for NPF mediation through BOPO, and conduct systematic outlier tests.

BIBLIOGRAPHY

Aprilia, Y., Khilmia , A., & Ahmad, ZI (2022). Operational Risk Management in Islamic Banking: Bibliometrics . IQTISHADIA Journal of Islamic Economics & Banking, 9(2), 192–203.

Apriliani, A., Salam, A., & Haerisma , AS (2024). The Effectiveness of Conflict Management in Overcoming Problems at Bank BJB Syariah Cirebon Branch . Journal of Islamic Economics, Accounting and Banking (JESKaPe), 8(1), 137–159.

Bank Syariah Indonesia. (2022). 2022 Annual Report. https://ir.bankbsi.co.id/financial_reportsqfs.html/year/2022

Basuki, AT, & Prawoto, N. (2016). Regression analysis in economic and business research.

Berger, A. N., Curti, F., Mihov, A., & Sedunov, J. (2022). Operational risk is more systemic than you think: Evidence from US bank holding companies. Journal of Banking & Finance, 143, 106619.

Chernobai, A., Ozdagli, A., & Wang, J. (2021). Business complexity and risk management: Evidence from operational risk events in US bank holding companies. Journal of Monetary Economics, 117, 418–440.

Gazi, M. A. I., Karim, R., Senathirajah, A. R. bin S., Ullah, A. K. M. M., Afrin, K. H., & Nahiduzzaman, M. (2024). Bank-specific and macroeconomic determinants of profitability of Islamic Shariah-based banks: Evidence from new economic horizon using panel data. Economies, 12(3), 66.

Ghozali, I., & Ratmono, D. (2017). Multivariate analysis and econometrics : theory, concepts, and applications with review 10.

Grassa, R., Moumen, N., Kabir Hassan, M., & Hussainey, K. (2022). Market discipline and capital buffers in Islamic and conventional banks in the MENA region. Eurasian Economic Review, 12(1), 139–167.

Jensen, M. C., & Meckling, W. H. (2019). Theory of the firm: Managerial behavior, agency costs and ownership structure. In Corporate governance (pp. 77–132). Gower.

Jokipii, T., & Milne, A. (2011). Bank capital buffer and risk adjustment decisions. Journal of Financial Stability, 7(3), 165–178.

Kasmawati, K., Albahi , M., & Harahap, RSP (2026). The Effect of BOPO and NPF on Returns on Assets (ROA) of Islamic Commercial Banks during the Pandemic and Post-Pandemic Transition 2020–2024. Jesya, 9(2), 969–976.

Kunz, J., & Heitz, M. (2021). Banks' risk culture and management control systems: A systematic literature review. Journal of Management Control, 32(4), 439–493.

Lestari, DE, Oktavia, V., & Nuswantoro , UD (2025). The Role of CAR, NPF and BOPO on Profitability in Islamic Commercial Banks in Indonesia. COSTING: Journal of Economic , Business and Accounting , 8(3).

Maulia, LA, & Wirman. (2022). The Effect of NPF, FDR, CAR, and BOPO on ROA in Islamic Commercial Banks in Indonesia for the 2016–2020 Period. Media Ekonomi, 22(2). https://doi.org/10.30595/medek.v22i2.13110

Mus, SK, Haerisma , AS, & Setiowati, NE (2025). Implementation of Online Services Through Muamalat DIN (Digital Islamic Network) to Increase Customer Loyalty at Bank Muamalat KC Sumber. Al Fiddhoh : Journal of Banking , Insurance, and Finance, 6(1), 76–85.

Nainggolan, Y. A., Prahmila, D. I., & Syaputri, A. R. (2023). Do board characteristics affect bank risk-taking and performance? Evidence from Indonesian and Malaysian Islamic banks. Journal of Management and Governance, 27(4), 1115–1145.

Nandani , DR, Atika, A., & Rahmani, N.A. (2025). Analysis of the Influence of Non-Performing Finance (NPF) and Operating Costs and Operating Income (BOPO) on Return on Return on Assets (ROA) at Bank Syariah Indonesia, Medan Padang Bulan Branch. Indonesian Journal of Digital Business, 5(4), 1641–1654.

Nurlaela, E., Aisah, S., Rahayu, S., Khoer , M., Rokhlinasari , S., & Haerisma , AS (2026). Analysis of the Distribution and Sharia Compliance of Bank Muamalat's Kuningan Branch "Soleh" (Hijrah Gold Solution) Product in the Digital Age. JOURNAL OF ECONOMICS, 5(4), 787–799.

Financial Services Authority (OJK). (2014a). Financial Services Authority Regulation Number 8/POJK.03/2014 concerning the Assessment of the Health Level of Sharia Commercial Banks and Sharia Business Units.

Financial Services Authority (OJK). (2014b). Financial Services Authority Circular Letter Number 10/SEOJK.03/2014 concerning the Assessment of the Health Level of Sharia Commercial Banks and Sharia Business Units.

Financial Services Authority (OJK). (2016). Financial Services Authority Regulation Number 65/POJK.03/2016 concerning the Implementation of Risk Management for Sharia Commercial Banks and Sharia Business Units.

Financial Services Authority (OJK). (2020). Calculation of Risk-Weighted Assets for Operational Risk Using the Basic Indicator Approach (SEOJK No. 6/SEOJK.03/2020).

Financial Services Authority (OJK). (2025). Increasingly Accelerating, Sharia Banking Assets Reach One Thousand Trillion [Press release, December 11, 2025].

Rahmalia, D., Haerisma , AS, & Rokhlinasari , S. (2026). Analysis of the Influence of Profit Sharing Rate, Capital Adequacy Ratio (CAR), and Third Party Funds on the Growth of Mudharabah Deposits at Bank Muamalat Indonesia for the Period 2015-2024. JPSDa : Darussalam Islamic Banking Journal, 6(1), 88–107.

Ramadhan, AZ (2025). Application of risk management to cyber attacks: a case study of Bank Syariah Indonesia (BSI). Maliki Interdisciplinary Journal , 3(12).

Saeed, M., Izzeldin, M., Hassan, M. K., & Pappas, V. (2020). The inter-temporal relationship between risk, capital and efficiency: The case of Islamic and conventional banks. Pacific-Basin Finance Journal, 62, 101328.

Sugiyono. (2019). Quantitative, qualitative, and R&D research methods. Alfabeta .

Uddin, M.H., Mollah, S., Islam, N., & Ali, M.H. (2023). Does digital transformation matter for operational risk exposure ? Technological Forecasting and Social Change , 197, 122919.