Economica: Jurnal Ekomomi Islam
Vol 16, No 1 (2025): 147–170
DOI: 10.21580/economica.2025.16.1.23916

economica
Jurnal Ekonomi Islam

Economic Vulnerability and Operational Efficiency in Indonesia's Islamic Banking: A Vector Error-Correction Approach

Faizul Mubarok [1]*, Martino Wibowo [1], Hasta Dwi Pradana [1], Rosimah Ahmad [2]

[1] Universitas Terbuka, Tangerang Selatan/Indonesia
[2] Taylor's University, Selangor/Malaysia

Abstract

Amid Indonesia's fast-growing Sharia-compliant finance sector and heightened global volatility, a clear assessment of how systemic shocks affect bank performance is increasingly urgent. This research analyzes economic vulnerability and its implications for the efficiency of Islamic banking in Indonesia. Using monthly time-series data from 2007 to 2024, it employs a Vector Error Correction Model (VECM). The findings reveal that both disbursed financing (FIN) and non-performing financing (NPF) significantly influence operational efficiency—measured by the BOPO ratio—in both the short and long run. Specifically, higher levels of FIN and NPF diminish efficiency by raising operational costs or reducing income. By contrast, the crisis indicator (CRS) gains significance only in the long run, implying that Islamic banks require time to adjust to macroeconomic shocks. Impulse-Response Function analysis shows mixed efficiency reactions to macroeconomic shocks, while Forecast Error Variance Decomposition highlights BOPO's own shocks as the largest source of its variance and underscores NPF as the most powerful exogenous driver. These insights equip Islamic-bank managers and policymakers to craft strategies that mitigate economic vulnerability and enhance operational performance.

Keywords: Economic Vulnerability; Financial Stability; Islamic Banking Efficiency, Non-Performing Financing, Vector Error Correction Model

Citation (APA):
Mubarok, F., Wibowo, M., Pradana, H. D., & Ahmad, R. (2025). Economic Vulnerability and Operational Efficiency in Indonesia's Islamic Banking: A Vector Error-Correction Approach. *Economica: Jurnal Ekomomi Islam*, 16(1), 147-170. https://doi.org/10.21580/economica.2025.16.1.23916

Submitted: 27 Nov 2024
Revised: 19 Feb 2025
Accepted: 21 May 2025
Published: 31 May 2025

*Corresponding Author. Email: faizul.mubarok@ecampus.ut.ac.id

Introduction

In the face of rapid technological disruption and an evolving financial landscape, the Islamic-banking industry is undergoing profound transformation. Active in more than sixty countries and holding roughly two-thirds of total Islamic-finance assets, Islamic banks now constitute a major pillar of global finance. Although they share with conventional institutions the overarching goal of efficient financial intermediation, Islamic banks adhere to principles rooted in Sharia law—chief among them the prohibition of *riba* (interest), excessive *gharar* (uncertainty), and financing of sinful activities.

Unlike interest-based intermediaries, Islamic banks mobilise funds through profit-sharing deposits *(Mudarabah)* and allocate assets via leasing *(Ijarah)*, cost-plus-profit sales *(Murabahah)*, and equity-based partnerships *(Mudarabah and Musharakah)*. These Sharia-compliant mechanisms bring their own challenges—digital disruption, fintech competition, and evolving client expectations—that resonate with finance professionals, scholars, and students (Dash & Maitra, 2018; Hassan et al., 2019).

A further hallmark of Islamic finance is contractual certainty: terms must be explicit, and every financing arrangement must be asset-backed. Consequently, Islamic banks maintain a tighter nexus with the real economy than their conventional counterparts—a feature underlined by the post-crisis search for finance that supports productive activity. Empirically, investors in Muslim-majority countries often favour Islamic instruments; in Saudi Arabia, for example, issuers' reliance on Islamic bank funding is positively received (Almansour & Ongena, 2018). Sukuk issuers can price at lower coupons than similar conventional bonds (Shafron, 2019), and investors appear willing to pay premiums for higher dividends in Sharia-compliant firms (Lassoued, 2018; Mateev et al., 2022; Safiullah & Shamsuddin, 2019).

Banking-efficiency analysis now commands wide interest among academics, regulators, and practitioners. Macroeconomic studies link higher sectoral efficiency to stronger growth (Abedifar et al., 2016), while micro-level work helps managers and supervisors benchmark performance and risk (Izzeldin et al., 2021; Louhichi & Boujelbene, 2020; Omer, 2019). Cross-country comparisons reveal persistent efficiency gaps between Islamic and conventional banks (Alqahtani et al., 2016; Safiullah, 2023; Salman & Nawaz, 2018), yet the drivers of Islamic-bank efficiency remain under-explored. Given intensifying competition, efficiency has become a

strategic priority for managers, regulators, and policymakers alike (Miah & Uddin, 2017; Solihin et al., 2016; Wasiaturrahma et al., 2020).

Beyond micro-performance, the literature highlights Islamic banking's potential to enhance financial stability (Alexakis et al., 2019; Čihák & Hesse, 2010; Djennas, 2016; Kassim, 2016; Khediri et al., 2015). Still, evidence on how Islamic-bank development feeds into macroeconomic outcomes is comparatively scarce. Some studies document a growth-promoting role for Islamic finance (Boukhatem & Ben Moussa, 2018; Khattak & Khan, 2023; Ledhem & Mekidiche, 2020; Tabash, 2014), whereas others probe its influence on macro-level efficiency (Léon & Weill, 2018; Zins & Weill, 2017).

While prior work centred on profitability, the present study shifts attention to economic vulnerability and its implications for Islamic-bank efficiency. By linking macroeconomic shocks to operational performance, we deepen the understanding of factors that condition the health of the Islamic-banking sector. The results furnish actionable insights for managers and policymakers confronting global economic turbulence and lay an empirical foundation for informed strategy and regulatory design at the industry level.

Literature Review

Research on the financial stability of Islamic banks produces mixed evidence, largely because sample sizes, geographic settings, study periods, and econometric techniques differ markedly across papers. Prior work leans heavily on aggregate macro-indicators, yielding only a partial view of how Islamic banks fare vis-à-vis the wider banking system. To bridge this gap, the present study proposes a novel, efficiency-adjusted measure of financial stability grounded in an operational-efficiency framework; this metric gauges how closely Islamic banks approach an optimal stability frontier.

Guided by Sharia, Islamic banking prohibits *riba* (interest), *gharar* (excessive uncertainty), and financing of sin industries such as alcohol and tobacco. Financing is channelled through profit-sharing *(Mudarabah)*, cost-plus sale *(Murabahah)*, leasing *(Ijarah)*, and other Sharia-compliant contracts. Collectively, these arrangements can generate higher profitability, stronger asset and capital quality, and risk profiles comparable to conventional peers—sometimes even higher technical efficiency. Even so, Islamic banks are not shock-proof; the fallout is often milder, yet still material (Olson & Zoubi, 2017). The sector also offers diversification benefits to investors (Alexakis et al., 2017; Sorwar et al., 2016) and advances

financial inclusion and development in low-income economies (Abedifar et al., 2016).

Efficiency studies report divergent outcomes. Aghimien et al. (2016) document generally high technical efficiency among Gulf Cooperation Council (GCC) banks, though managerial slack persists; large banks face decreasing returns to scale, while smaller institutions may still harvest scale gains. In Indonesia, Havidz & Setiawan (2015) identify scale inefficiency as the main drag on performance. Similar patterns emerge for Malaysia and Türkiye (Yildirim, 2015) and for MENA and Asian markets (Rahman & Rosman, 2013). Sufian & Kamarudin (2015) show that domestic Islamic banks in Southeast Asia outperform foreign entrants in terms of revenue efficiency. Rahim et al. (2015) add that Islamic subsidiaries of conventional banks tend to be more efficient than standalone Islamic institutions, likely because of shared infrastructure and network synergies.

External conditions—economic development, population size, money supply, and overall financial-sector depth—also shape efficiency. Yet most investigations either concentrate on advanced economies or pursue single-country or narrow regional scopes. This research contributes to the literature by focusing on Islamic banks in Indonesia, encompassing both Islamic commercial banks and Islamic business units, thereby offering a more localized and comprehensive understanding of efficiency and financial stability in the context of a rapidly evolving financial landscape.

Methods

This research utilizes secondary data from trusted sources, including the Financial Services Authority (OJK), the Pacific Exchange Rate Service, Bank Indonesia (BI), and the Central Statistics Agency (BPS), to provide a comprehensive analysis of Islamic commercial banks and Islamic business units in Indonesia. The dataset consists of monthly time series data from 2007 to 2024 and includes key financial and macroeconomic indicators: Bank Operational Efficiency (BOPO), Non-Performing Financing (NPF), Disbursed Financing (FIN), Exchange Rate (KURS), Inflation (INFS), BI Rate (BRTE), Economic Growth (GDP), and Crisis Impact (CRS). BOPO used as a proxy for Islamic banking efficiency, represents the ratio of operational expenses to operating income, where a lower BOPO indicates higher efficiency.

The analytical approach begins with the Vector Autoregressive (VAR) model, which captures the dynamic interrelationships among multiple time series

variables. In this model, each variable is regressed on its own lagged values and those of other variables in the system. VAR is widely used for descriptive analysis, forecasting, and policy evaluation. However, when the time series data are non-stationary but cointegrated, the appropriate model becomes the Vector Error Correction Model (VECM), which integrates both short-term dynamics and long-term equilibrium relationships (MW & Enders, 1995). The VECM estimation equation is specified as follows:

$$\Delta Y_t = \alpha + \Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i} + \varepsilon_t$$

In the Vector Error Correction Model (VECM), the equation is structured to capture both short-term dynamics and long-term equilibrium relationships among variables. The term ΔY_t represents the first-differenced vector of endogenous variables, indicating the short-term changes in the system. The component ΠY_{t-1} captures the long-run cointegration relationship, reflecting how the variables adjust toward equilibrium over time. The summation term $\sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-i}$ accounts for the short-run dynamics by incorporating the lagged differences of the variables. The vector α represents the intercept or constant term in the model, while ε_t denotes the error term, capturing random disturbances or shocks that the model does not explain. This structure allows the VECM to effectively model both immediate fluctuations and long-term trends in multivariate time series data.

The results of stationarity and cointegration tests justify the choice of VECM. If the variables are non-stationary at the level but cointegrated, a VECM is preferred over a VAR because it preserves long-run equilibrium information while modeling short-run fluctuations. This is particularly important in financial and economic systems, where variables such as inflation, interest rates, and financing volumes tend to move in tandem over time.

To determine the optimal lag length, the study uses information criteria such as the Akaike Information Criterion (AIC), Schwarz Information Criterion (SIC), and Hannan-Quinn Criterion (HQ). These criteria help strike a balance between model complexity and predictive accuracy. The VECM framework also enables the use of Impulse Response Functions (IRFs) and Forecast Error Variance decomposition (FEVDs) to assess the impact of shocks and the contribution of each variable to forecast errors over time. By applying the VECM model, this research provides a robust framework for analyzing both short-term and long-term relationships

among financial indicators in Islamic banking. The model provides practical insights for forecasting and policy-making, particularly in the context of economic disruptions and structural changes within the financial sector.

Result and Discussions

Descriptive Statistics

Descriptive statistics reveal key characteristics of the dataset (Table 1). The average BOPO ratio of 0.82, with a standard deviation of 0.10, indicates generally good operational efficiency among Islamic banks, although with some variation. NPF averages 0.04, suggesting manageable financing risks. Total financing disbursed (FIN) shows moderate variation, reflecting stable lending activity. Macroeconomic indicators, such as inflation (average 0.05) and the exchange rate (average 9.39), remained relatively stable, supporting banking performance. Economic growth averaged 0.05, with minor fluctuations, while the BI Rate (average 0.06) reflects consistent monetary policy. The crisis dummy (CRS) indicates that 36% of the period was marked by crisis. Islamic banks demonstrated resilience, maintaining efficiency and stability throughout the period.

Table 1. Descriptive Statistics

	BOPO	NPF	FIN	INFS	KURS	GDP	BRTE	CRS
Mean	0.82	0.04	12.01	0.05	9.39	0.05	0.06	0.36
Median	0.80	0.03	12.25	0.04	9.49	0.05	0.06	0.00
Maximum	0.80	0.07	13.30	0.12	9.70	0.07	0.10	1.00
Minimum	0.08	0.02	9.91	0.01	9.05	-0.05	0.04	0.00
Std. Dev.	0.10	0.01	0.95	0.02	0.20	0.02	0.02	0.48
Observations	210	210	210	210	210	210	210	210

Stationary Data

Stationarity tests using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) methods (Table 2) show that most variables are non-stationary at level but become stationary after differencing, indicating underlying trends in the data. Only BOPO remains stationary at the level in both tests, while variables such as BRTE, CRS, INFS, KURS, and NPF require transformation. GDP and FIN exhibit inconsistent

results between ADF and PP at the level, but both series are stationary after differencing. These findings confirm the need for data transformation to prevent spurious regression and ensure the validity of model estimation. Therefore, further analysis can proceed using the Vector Error Correction Model (VECM) if cointegration exists or the Vector Autoregressive (VAR) model if it does not. This highlights the importance of methodological rigor in time series analysis.

Table 2. Stationary Data

Variable	Augmented Dickey-Fuller		Phillips-Perron	
	Level	Difference	Level	Difference
BOPO	0.00	0.00	0.00	0.00
BRTE	0.17	0.00	0.15	0.00
CRS	0.12	0.00	0.11	0.00
FIN	0.07	0.03	0.00	0.00
GDP	0.03	0.00	0.02	0.00
INFS	0.10	0.00	0.11	0.00
KURS	0.86	0.00	0.83	0.00
NPF	0.27	0.00	0.18	0.00

Optimal Lag

The optimal lag test results (Table 3) indicate that various information criteria are employed to determine the appropriate lag, including the Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz Criterion (SC), and Hannan-Quinn Criterion (HQ). Based on the analysis results using the Schwarz Criterion (SC), the optimal lag chosen is lag one, as it has the lowest SC value, namely -47.05. The SC criterion tends to be more conservative in selecting the optimal lag because it imposes a more significant penalty on model complexity, reducing the risk of overfitting. The selection of this more minor optimal lag ensures that the model remains efficient without losing essential information for analyzing dynamic relationships between variables. This study's analysis uses lag 1 as the basis for building a reliable and valid time series model, providing a solid foundation for further research and analysis.

Table 3. Optimal Lag

Lag	LR	FPE	AIC	SC	HQ
0	NA	7.67	-25.92	-25.79	-25.86
1	4428.68	1.57	-48.23	-47.05	-47.75
2	149.81	1.32	-48.41	-46.18	-47.50
3	74.77	1.64	-48.19	-44.92	-46.87
4	76.60	1.99	-48.01	-43.69	-46.26
5	58.40	2.66	-47.74	-42.37	-45.57
6	90.72	2.87	-47.70	-41.28	-45.10
7	78.46	3.30	-47.61	-40.14	-44.59
8	87.19	3.51	-47.61	-39.10	-44.17

Cointegration

The results of the cointegration test, as determined by the Trace Test (Table 4), reveal a significant cointegration relationship among the variables under scrutiny. This discovery of four cointegration equations, each marked by a Trace Statistics value surpassing the Critical Value in the None hypothesis, At most 1, At most 2, and At most 3, underscores the importance of our research. The Trace Statistics value in the Null hypothesis, a substantial 371.25, far exceeds the Critical Value of 187.47, with a p-value of 0.00, unequivocally rejecting the null hypothesis of no cointegration relationship. A similar pattern is observed in the hypotheses "At most 1" and "At most 3", with Trace Statistics values of 220.82 (Critical Value: 150.56, p-value: 0.00) and 90.69 (Critical Value: 88.80, p-value: 0.04), respectively.

While the Trace Statistics value loses significance for most of the four hypotheses, it is evident that the cointegration relationship extends beyond the four equations. This implies a robust, long-term relationship between the variables in the model, enabling the model to integrate long-term information into the analysis. These findings provide strong support for the use of the Vector Error Correction Model (VECM), a model we can confidently rely on to capture short-term dynamics while maintaining a long-term balance between variables.

Table 4. Cointegration

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.51	371.25	187.47	0.00
At most 1 *	0.33	220.81	150.56	0.00
At most 2 *	0.21	138.93	117.71	0.00
At most 3 *	0.15	90.69	88.80	0.04
At most 4	0.11	57.82	63.88	0.15
At most 5	0.07	32.98	42.92	0.34
At most 6	0.05	16.80	25.87	0.43
At most 7	0.03	5.82	12.52	0.48

VAR Stability

The Vector Autoregression (VAR) model is a statistical model used to capture the linear interdependencies among multiple time series. The results of the model stability test (Table 5), based on characteristic roots, show that all roots are located inside the unit circle. In this context, the resulting root moduli, both natural and complex, are all smaller than unity, indicating that the model system is stable. In detail, the identified roots have the following moduli: 0.990849, 0.959347, 0.959347, 0.941676, 0.883948, 0.883948, 0.865298, and 0.571108, all of which are smaller than one.

Table 5. VAR Stability

Root	Modulus
0.990849	0.990849
0.955896 - 0.081297i	0.959347
0.955896 + 0.081297i	0.959347
0.941676	0.941676
0.883061 - 0.039591i	0.883948
0.883061 + 0.039591i	0.883948
0.865298	0.865298
0.571108	0.571108

The absence of roots outside the unit circle (modulus > 1) is a key indicator of the reliability of the Vector Autoregression (VAR) model. This stability condition ensures that the VAR model will not exhibit uncontrolled or divergent behavior in the long run. This robustness provides a solid foundation for further analysis, such as long-term forecasting and estimation. With a stable model, the potential for exciting and insightful future work is vast, as it guarantees dependable and consistent results in describing the relationships between the analyzed variables.

Short-Run and Long-Run Equilibrium Relationships

The results of the Vector Error Correction Model (VECM) analysis (Table 6), conducted on variables that influence the operational efficiency of Islamic banking, both in the short and long term, provide essential insights into understanding the factors that contribute to financial efficiency and health in the era of disruption. In the short term, the financing (FIN) variable has a significantly negative impact on operational efficiency, with a coefficient of -0.450778 and a t-statistic of -2.55844. This suggests that suboptimal financial management could lead to a reduction in operational efficiency in Islamic banking, which supports the theory that poor financial performance disrupts operational stability (Salsabilla & Jaya, 2024; Setiawan, 2021).

It is crucial to understand that the impact of these factors extends not only to the short term but also to the long term. Therefore, long-term strategies are needed to ensure the operational efficiency and health of Islamic banking in the era of disruption. This finding aligns with previous research, which indicates that an increase in non-performing financing (NPF) is detrimental to operational efficiency, as it creates burdens for banks and impacts their financial health (Akhter et al., 2011; Ali et al., 2016; Majeed & Zainab, 2021). Although the BI Rate (BRTE) and exchange rate (KURS) do not show significant short-term effects, BRTE demonstrates a positive long-term impact on Islamic banking efficiency. This suggests that Islamic banks are less sensitive to short-term monetary policy changes due to their Sharia-compliant structure, which avoids interest-based instruments. Alternatively, it reflects a delayed transmission of monetary policy through Islamic financial products or the influence of other factors such as regulatory support, customer loyalty, or asset-backed financing models that buffer short-term volatility.

In the long term, the results show that interest rate (BRTE) has a positive coefficient of 0.993738, although it is insignificant at the 5% significance level. This indicates that an increase in interest rates in the long term will not necessarily

impact operational efficiency. However, the positive direction of the coefficient can mean that if the allocation of capital costs due to higher interest rates is used optimally, such as for investment in technology or infrastructure that increases productivity and operational performance of banks, then long-term efficiency has the potential to increase (Asutay & Ubaidillah, 2024; Bitar et al., 2018; Salsabilla & Jaya, 2024).

Table 6. Short-Term and Long-Term Relationships

Variable	Short Term		Long Term	
	Coeffisien	[t-statistic]	Coeffisien	t-statistic
BRTE	-0.957474	[-0.65529]	0.993738	[1.63819]
CRS	0.003475	[0.20163]	0.032667	[2.71278]*
FIN	-0.450778	[-2.55844]*	-0.096801	[-4.72906]*
GDP	-0.134558	[-0.45417]	-0.287931	[-1.09317]
INFS	0.032296	[0.06549]	-0.212078	[-0.55105]
KURS	0.067618	[0.58023]	-0.027020	[-0.30277]
NPF	-2.257857	[-2.94657]*	-5.872492	[-7.14356]*

The crisis (CRS) variable has a significant positive influence on operational efficiency, with a coefficient of 0.032667 and a t-statistic of 2.71278. This indicates that Islamic banks could utilize the credit-to-deposit ratio more optimally during the crisis. An increase in this ratio can reflect the bank's ability to maintain stable liquidity and channel financing effectively, which ultimately supports operational efficiency. The management of this variable is crucial for Islamic banks to ensure operational stability during challenging times.

The crisis variable (CRS) significantly improves operational efficiency, with a coefficient of 0.032667 and a t-statistic of 2.71278. This suggests that Islamic banks were able to optimize their credit-to-deposit ratio during periods of economic stress. Unlike conventional banks, Islamic banks operate on risk-sharing principles and asset-based financing, which reduces exposure to speculative losses and enhances liquidity management (Bitar et al., 2018). During crises, these features help Islamic banks maintain stable financing and operational performance. Studies show that Islamic banks tend to be more resilient and efficient in downturns due to their conservative investment approach and closer alignment with real economic activities (Causevic, 2018). In contrast, conventional banks often face higher non-

performing loans and volatility, which can reduce efficiency. Thus, the crisis reinforces the structural strengths of Islamic banking, enabling it to achieve better operational outcomes under pressure.

Meanwhile, financing (FIN) in the long term shows a smaller negative coefficient (-0.096801) and a higher t-statistic (-4.72906), indicating that although poor financial management in the long term has a negative impact, the impact is more limited than in the long term. NPF, which also exhibits a significant negative coefficient (-5.872492) and a highly significant t-statistic (-7.14356), underscores that problematic financing is the primary factor detrimental to the operational efficiency of Islamic banking, both in the short and long term. A sustained increase in NPF can burden banks with losses, reduce their capital adequacy ratios, and negatively impact overall financial performance (Amijaya & Alaika, 2023; Cohen & Scatigna, 2016).

These results confirm operational efficiency theories in Islamic banking, such as the Market Efficiency Theory, which posits that efficient markets can facilitate optimal resource allocation (Banna & Alam, 2020; Mai et al., 2023). Increasing capital costs and credit-to-deposit ratios can enhance efficiency, while problematic financing poses a serious threat to bank operational stability and efficiency (Iqbal & Nosheen, 2023; Zheng et al., 2023). The Modigliani-Miller theory of capital structure is also relevant in this context, which states that, in the long term, an appropriate capital structure and effective management of capital costs can lead to increased operational efficiency.

In the context of Islamic banking, this theory posits that a well-managed and balanced capital structure, coupled with efficient management of capital costs, can lead to improved operational efficiency and financial stability (Fukui et al., 2023; Mehzabin et al., 2023). Therefore, effective risk management and strengthening financial structures are vital to ensuring sustainable operational efficiency in the face of the challenges of the era of disruption, especially in Islamic banking. Islamic banks must focus on NPF management, increasing the credit-to-deposit ratio, and investing in infrastructure and technology to ensure better operational efficiency and financial health (Akdeniz et al., 2023; Jawad & Naz, 2023).

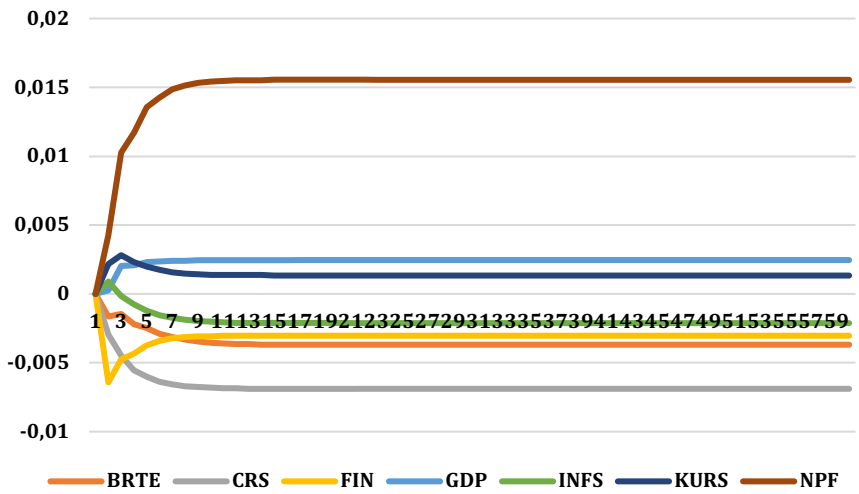
Impulse Response Function (IRF)

The impulse Response Function (IRF) results (Figure 1) play a significant role in understanding how BOPO responds to shocks or impulses from changes in each variable, such as Crisis (CRS), distributed financing (FIN), Gross Domestic Product

(GDP), Inflation (INFS), exchange rate (KURS), and Non-Performing Financing (NPF). A crucial aspect of this analysis is the variable Operating Costs to Operating Income (BOPO), which indicates the operational efficiency of a financial institution, such as a bank. The BOPO response, in this context, offers insight into how changes in macroeconomic factors or financial indicators, such as CRS, GDP, and INFS, impact cost and revenue efficiency within the industry.

According to the IRF results presented, it is evident that BOPO experienced a continuous decline throughout the observation period. This consistent decrease suggests an increase in operational efficiency resulting from shocks in other variables. For instance, surprises in GDP that show positive results over time contribute to increasing operating income, thereby improving the BOPO ratio. This aligns with the theory that links economic growth with the operational performance of financial institutions. In banking sector analysis, stable economic growth tends to increase bank revenues, enabling them to manage operational costs more effectively (Ibrahim & Ismail, 2020).

Figure 1. Impulse Response Function



Furthermore, inflation (INFS), which shows a slight but continuous decline in IRF results, has significant implications for decreased purchasing power, directly affecting operational costs and revenue management in the banking sector. A reduction in inflation can lead to a decrease in loan interest costs, thereby allowing

financial institutions to lower their Borrowing and Overdraft Protection (BOPO) requirements. These findings align with research by Ghertescu et al. (2024), Bortoluzzo et al. (2024), and Nasim et al. (2024), who found that controlled inflation can contribute to reducing bank operational costs, thereby increasing operational efficiency.

However, the Non-Performing Financing (NPF) factor, which tends to increase during the observation period, indicates an increase in credit risk, which can lead to higher operational costs. An increase in NPF creates pressure on banks' operating costs as more resources are required to handle non-performing loans and provision for credit losses. Khan et al. (2020), Wood & Skinner (2018), and Iqbal & Nosheen (2023) in their research demonstrate that high NPF can be detrimental to banks, as it increases the cost of providing for losses and harms the BOPO ratio.

The IRF results show a decrease in BOPO, indicating an increase in efficiency in managing bank operational costs. However, this needs to be balanced with control over credit risk (NPF) and inflation, which can affect profit margins. Mai et al. (2023) and Otaviya & Rani (2020) emphasize the critical importance of managing operational efficiency in the banking sector to maintain long-term profitability in the face of external shocks from macroeconomic variables, as highlighted in their research. This highlights the importance of strategic decision-making and a balanced approach to managing operational efficiency.

Forecast Error Variance Decomposition (FEVD)

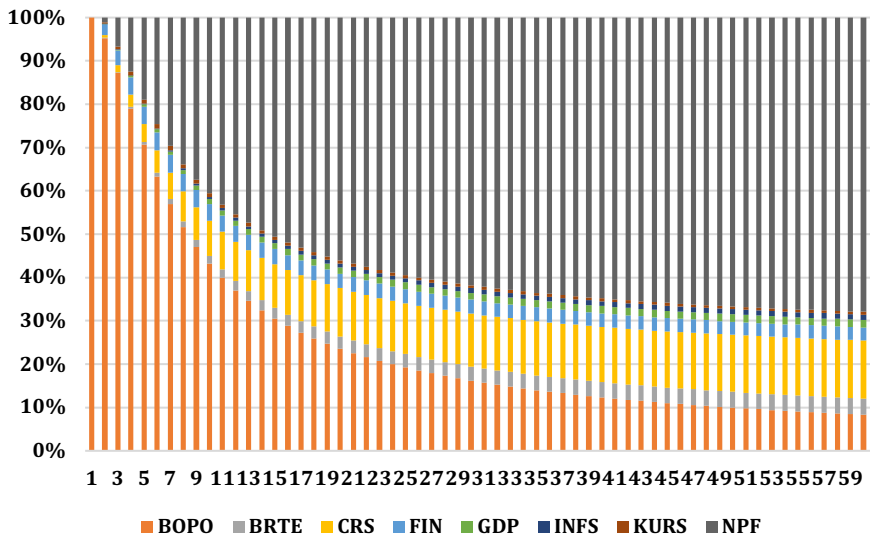
The key findings of the Forecast Error Variance Decomposition (FEVD) (Figure 2) are significant, revealing a complex relationship between macroeconomic and microeconomic factors that influence the stability and financial health of Islamic banks. The study shows the substantial influence of variables such as Operational Efficiency (BOPO), Interest Rates (BRTE), Crisis (CRS), Financing (FIN), Economic Growth (GDP), Inflation (INFS), Exchange Rates (KURS), and Non-Performing Financing (NPF) on Islamic banking performance.

Operational efficiency, as measured by BOPO, contributes to controlling costs and maximizing income, which plays a significant role in the bank's overall financial performance. Research by Mai et al. (2023) and Nasim et al. (2024) suggests that operational efficiency is crucial for maintaining the competitiveness of Islamic banks, particularly in the face of economic uncertainty. For example, the lower the BOPO ratio, the more efficient the bank's operational management is in reducing costs and increasing the profitability of Islamic banks. Interest rates, replaced by

profit-sharing ratios in the context of Islamic banks, play an essential role in reflecting how Islamic banks manage risk. Islamic banks strive to balance risk costs and profit distribution among customers and shareholders, adhering to Islamic principles that emphasize fairness and transparency in financial management. Research by Amijaya & Alaika (2023) reveals that banks with sound risk management can minimize losses and maintain stability, which ultimately contributes to the bank's financial health.

In the context of CRS, the FEVD results, which demonstrate the significant influence of this factor, align with research by Ahmed et al. (2022) and Tashkandi (2022). These studies found that economic crises, such as global crises, can destabilize bank financial stability, especially during periods of market uncertainty. The crisis forces banks to be more cautious in managing their financing and risks, which can impact their long-term performance. FIN, one of the essential variables in this analysis, also provides an overview of how Islamic banks operate in accordance with Islamic principles and how banks can manage their credit risk. Research by Nafi'ah & Widyianingsih (2021) and Hana et al. (2021) indicates that effective financing management can minimize non-performing financing (NPF), thereby reducing losses for Islamic banks.

Figure 2. Forecast Error Variance Decomposition



The influence of GDP and INFS on Islamic banking performance cannot be overstated. These factors directly influence people's purchasing power and the level of demand for banking products. Research by Apriyana et al. (2023) and Huwaida et al. (2023) has demonstrated that an increase in GDP is associated with a corresponding rise in demand for financing and an improvement in the overall performance of Islamic banks. However, high inflation can erode people's purchasing power and increase operational costs for banks, thereby affecting their profitability and stability (Botev et al., 2019; Nasim et al., 2023). KURS, as a significant contributor to FEVD, is also worth noting. Its influence is tied to its impact on foreign financing and exposure to global market fluctuations. These fluctuations can disrupt the balance of financing and currency risk, potentially destabilizing Islamic banks involved in international financing (Alzarooni et al., 2024; Athari et al., 2023).

Lastly, NPF, one of the leading indicators in measuring a bank's financial health, greatly influences bank stability. An increase in NPF is associated with a decrease in bank liquidity and profits, so financing risk management is essential to maintain the quality of Islamic bank assets (Havidz & Setiawan, 2015; Louhichi & Boujelbene, 2020; Mubarok et al., 2024). The FEVD results show that NPF influences variability in bank performance predictions, indicating the importance of risk management policies and improving the quality of supervision of the financing provided.

Conclusion

The findings confirm that economic vulnerability significantly affects the efficiency of Islamic banking in Indonesia, with distinct effects in the short run and the long run. Disbursed financing and non-performing financing (NPF) have a significant impact in both horizons, underscoring the need to manage financing quality to preserve operational stability. By contrast, the crisis variable becomes significant only in the long run, indicating that true resilience to external shocks demands adaptive, sustainability-oriented strategies.

Impulse-response analysis shows mixed—positive and negative—efficiency reactions to macroeconomic shocks, reflecting the sector's flexibility. Forecast-error variance decomposition reveals that BOPO, the dependent efficiency proxy, naturally accounts for the largest share of its own variance, while among the exogenous drivers, NPF exerts the greatest marginal influence. Elevated NPF raises costs and erodes profitability, making robust credit-risk management indispensable.

This study outlines five policy recommendations. First, Islamic banks should tighten credit-risk controls through enhanced NPF monitoring and stricter financing criteria. Second, regulators such as the OJK ought to develop macro-prudential tools tailored to Sharia-compliant institutions. Third, Bank Indonesia should widen access to Islamic liquidity instruments—for example, sukuk-based repos. Fourth, government support for digital transformation, including fintech partnerships and agile regulation, would bolster competitiveness. Lastly, embedding Islamic banking within national financial-inclusion initiatives can amplify its contribution to economic resilience.

BIBLIOGRAPHY

Abedifar, P., Hasan, I., & Tarazi, A. (2016). Finance-growth nexus and dual-banking systems: Relative importance of Islamic banks. *Journal of Economic Behavior & Organization*, *132*, 198–215. https://doi.org/10.1016/j.jebo.2016.03.005

Aghimien, P. A., Kamarudin, F., Hamid, F., & Noordin, B. (2016). Efficiency of Gulf Cooperation Council Banks. *Review of International Business and Strategy*, *26*(1), 118–136.

Ahmed, H. M., El-Halaby, S. I., & Soliman, H. A. (2022). The Consequence Of The Credit Risk On The Financial Performance In Light Of Covid-19: Evidence From Islamic Versus Conventional Banks Across Mea Region. *Future Business Journal*, *8*(1), 1–22. https://doi.org/10.1186/s43093-022-00122-y

Akdeniz, Ö. O., Abdou, H. A., Hayek, A. I., Nwachukwu, J. C., Elamer, A. A., & Pyke, C. (2023). Technical Efficiency In Banks: A Review Of Methods, Recent Innovations And Future Research Agenda. In *Review of Managerial Science* (Vol. 18, Issue 11). Springer Berlin Heidelberg. https://doi.org/10.1007/s11846-023-00707-z

Akhter, W., Raza, A., Orangzab, & Akram, M. (2011). Efficiency and Performance of Islamic Banking: The Case of Pakistan. *Far East Journal of Psychology and Business*, *2*(2), 54–70.

Alexakis, C., Izzeldin, M., Johnes, J., & Pappas, V. (2019). Performance and Productivity in Islamic and Conventional Banks: Evidence from the Global Financial Crisis. *Economic Modelling*, *79*, 1–14. https://doi.org/10.1016/j.econmod.2018.09.030

Alexakis, C., Pappas, V., & Tsikouras, A. (2017). Hidden Cointegration Reveals Hidden Values in Islamic Investments. *Journal of International Financial Markets,*

Institutions and Money, *46*, 70–83. https://doi.org/10.1016/j.intfin.2016.08.006

Ali, A., Hui, L., & Ali, A. (2016). Efficiency And Performance Of Islamic Banking In Pakistan: A Stochastic Frontier Analysis. *International Journal of Economics, Finance and Management*, *5*(2), 42–48.

Almansour, A., & Ongena, S. (2018). Bank Loan Announcements and Religious investors: Empirical Evidence from Saudi Arabia. *Journal of Empirical Finance*, *47*, 78–89. https://doi.org/10.1016/j.jempfin.2018.02.002

Alqahtani, F., Mayes, D. G., & Brown, K. (2016). Economic Turmoil and Islamic Banking: Evidence from the Gulf Cooperation Council. *Pacific Basin Finance Journal*, *39*, 44–56. https://doi.org/10.1016/j.pacfin.2016.05.017

Alzarooni, L., Al-Shboul, M., & Maghyereh, A. (2024). The Influence Of Foreign Direct Investment On Banking Stability In A Dual Banking System During The Covid-19 Pandemic And The Global Financial Crisis. *Borsa Istanbul Review*, *24*(5), 1046–1058. https://doi.org/10.1016/j.bir.2024.06.001

Amijaya, R. N. F., & Alaika, R. (2023). Does Financial Risk Matter for Financial Performance in Sharia Banks? *Jurnal Ilmu Ekonomi Terapan*, *8*(1), 24–40. https://doi.org/10.20473/jiet.v8i1.44675

Apriyana, M., Tanjung, H., & Suprianto, T. (2023). The Effect of Sharia Bank Financing and Economic Growth on Inflation. *Jurnal Syarikah*, *9*(1), 111–123.

Asutay, M., & Ubaidillah. (2024). Examining the Impact of Intellectual Capital Performance on Financial Performance in Islamic Banks. *Journal of the Knowledge Economy*, *15*(1), 1231–1263. https://doi.org/10.1007/s13132-023-01114-1

Athari, S. A., Irani, F., & AlAl Hadood, A. (2023). Country risk factors and banking sector stability: Do countries' income and risk-level matter? Evidence from global study. *Heliyon*, *9*(10), e20398. https://doi.org/10.1016/j.heliyon.2023.e20398

Banna, H., & Alam, M. R. (2020). Islamic Banking Efficiency and Inclusive Sustainable Growth: The Role of Financial Inclusion. *Journal of Islamic Monetary Economics and Finance*, *6*(1), 213–242. https://doi.org/10.21098/jimf.v6i1.1089

Bitar, M., Kabir Hassan, M., Pukthuanthong, K., & Walker, T. (2018). The Performance of Islamic Vs. Conventional Banks: Evidence on the Suitability of the Basel Capital Ratios. *Open Economies Review*, *29*(5), 1003–1038. https://doi.org/10.1007/s11079-018-9492-1

Bortoluzzo, A. B., Ciganda, R. R., & Bortoluzzo, M. M. (2024). Determinant factors of banking profitability: an application of quantile regression for panel data.

Future Business Journal, *10*(1), 56. https://doi.org/10.1186/s43093-024-00347-z

Botev, J., Égert, B., & Jawadi, F. (2019). The nonlinear relationship between economic growth and financial development: Evidence from developing, emerging and advanced economies. *International Economics*, *160*, 3–13. https://doi.org/10.1016/j.inteco.2019.06.004

Boukhatem, J., & Ben Moussa, F. (2018). The effect of Islamic banks on GDP growth: Some evidence from selected MENA countries. *Borsa Istanbul Review*, *18*(3), 231–247. https://doi.org/10.1016/j.bir.2017.11.004

Causevic, E. (2018). The Relationship Between the Performance of Islamic and Conventional Banks. In M. Hadžikadić & S. Avdaković (Eds.), *Lecture Notes in Networks and Systems* (Vol. 28, pp. 256–264). Springer International Publishing. https://doi.org/10.1007/978-3-319-71321-2_23

Čihák, M., & Hesse, H. (2010). Islamic Banks and Financial Stability: An Empirical Analysis. *Journal of Financial Services Research*, *38*(2–3), 95–113. https://doi.org/10.1007/s10693-010-0089-0

Cohen, B. H., & Scatigna, M. (2016). Banks and capital requirements: Channels of adjustment. *Journal of Banking & Finance*, *69*(September), S56–S69. https://doi.org/10.1016/j.jbankfin.2015.09.022

Dash, S. R., & Maitra, D. (2018). Does Shariah index hedge against sentiment risk? Evidence from Indian stock market using time–frequency domain approach. *Journal of Behavioral and Experimental Finance*, *19*, 20–35. https://doi.org/10.1016/j.jbef.2018.03.003

Djennas, M. (2016). Business cycle volatility, growth and financial openness: Does Islamic finance make any difference? *Borsa Istanbul Review*, *16*(3), 121–145. https://doi.org/10.1016/j.bir.2016.06.003

Fukui, T., Mitton, T., & Schonlau, R. (2023). Determinants of Capital Structure: An Expanded Assessment. *Journal of Financial and Quantitative Analysis*, *58*(6), 2446–2488. https://doi.org/10.1017/S0022109022001405

Gherțescu, C., Manta, A. G., Bădîrcea, R. M., & Manta, L. F. (2024). How Does the Digitalization Strategy Affect Bank Efficiency in Industry 4.0? A Bibliometric Analysis. *Systems*, *12*(11), 492. https://doi.org/10.3390/systems12110492

Hana, K. F., Ridwan, R., & Chodlir, E. A. (2021). Elaborasi Analisis Pembiayaan Dalam Meminimalisir Non Performing Finance (NPF) Pada Lembaga Keuangan Syariah. *MALIA: Journal of Islamic Banking and Finance*, *5*(2), 121. https://doi.org/10.21043/malia.v5i2.12548

Hassan, M. K., Khan, A., & Paltrinieri, A. (2019). Liquidity risk, credit risk and stability in Islamic and conventional banks. *Research in International Business and Finance*, *48*, 17–31. https://doi.org/10.1016/j.ribaf.2018.10.006

Havidz, S. A. H., & Setiawan, C. (2015). Bank Efficiency and Non-Performing Financing (NPF) in the Indonesian Islamic Banks. *Asian Journal of Economic Modelling*, *3*(3), 61–79. https://doi.org/10.18488/journal.8/2015.3.3/8.3.61.79

Huwaida, N., Ufairoh, U., & Wahyudi, R. (2023). Pengaruh Pengeluaran Pemerintah dan Pembiayaan Bank Syariah terhadap Tingkat Pertumbuhan Ekonomi Indonesia Pada Tahun 2016–2020. *AKSES: Jurnal Ekonomi Dan Bisnis*, *18*(1), 1–12. https://doi.org/10.31942/akses.v18i1.8591

Iqbal, S., & Nosheen, S. (2023). Moderating impact of non-performing loans on the relationship between sustainable development goals and the financial performance of banks. *Future Business Journal*, *9*(1), 46. https://doi.org/10.1186/s43093-023-00224-1

Izzeldin, M., Johnes, J., Ongena, S., Pappas, V., & Tsionas, M. (2021). Efficiency convergence in Islamic and conventional banks. *Journal of International Financial Markets, Institutions and Money*, *70*, 101279. https://doi.org/10.1016/j.intfin.2020.101279

Jawad, M., & Naz, M. (2023). Financial Technological Innovation, Sustainable Operations, and Efficiency: a Study of SMBs in Times of Crisis. *Journal of the Knowledge Economy*, *15*(3), 13160–13181. https://doi.org/10.1007/s13132-023-01574-5

Kassim, S. (2016). Islamic finance and economic growth: The Malaysian experience. *Global Finance Journal*, *30*, 66–76. https://doi.org/10.1016/j.gfj.2015.11.007

Khan, M. A., Siddique, A., & Sarwar, Z. (2020). Determinants of non-performing loans in the banking sector in developing state. *Asian Journal of Accounting Research*, *5*(1), 135–145. https://doi.org/10.1108/AJAR-10-2019-0080

Khattak, M. A., & Khan, N. A. (2023). Islamic Finance, Growth, and Volatility: A Fresh Evidence From 82 Countries. *Journal of Islamic Monetary Economics and Finance*, *9*(1), 39–56. https://doi.org/10.21098/jimf.v9i1.1625

Khediri, K. Ben, Charfeddine, L., & Youssef, S. Ben. (2015). Islamic versus conventional banks in the GCC countries: A comparative study using classification techniques. *Research in International Business and Finance*, *33*, 75–98. https://doi.org/10.1016/j.ribaf.2014.07.002

Lassoued, M. (2018). Comparative study on credit risk in Islamic banking institutions: The case of Malaysia. *The Quarterly Review of Economics and Finance*, *70*, 267–278. https://doi.org/10.1016/j.qref.2018.05.009

Ledhem, M. A., & Mekidiche, M. (2020). Economic growth and financial performance of Islamic banks: a CAMELS approach. *Islamic Economic Studies*, *28*(1), 47–62. https://doi.org/10.1108/IES-05-2020-0016

Léon, F., & Weill, L. (2018). Islamic banking development and access to credit. *Pacific-Basin Finance Journal*, *52*(7), 54–69. https://doi.org/10.1016/j.pacfin.2017.04.010

Louhichi, A., & Boujelbene, Y. (2020). Credit risk pricing and the rationality of lending decision-making within dual banking systems: A parametric approach. *Economic Systems*, *44*(1), 100740. https://doi.org/10.1016/j.ecosys.2019.100740

Mai, X. T. T., Nguyen, H. T. N., Ngo, T., Le, T. D. Q., & Nguyen, L. P. (2023). Efficiency of the Islamic Banking Sector: Evidence from Two-Stage DEA Double Frontiers Analysis. *International Journal of Financial Studies*, *11*(1), 32. https://doi.org/10.3390/ijfs11010032

Majeed, M. T., & Zainab, A. (2021). A comparative analysis of financial performance of Islamic banks vis-à-vis conventional banks: evidence from Pakistan. *ISRA International Journal of Islamic Finance*, *13*(3), 331–346. https://doi.org/10.1108/IJIF-08-2018-0093

Mateev, M., Nasr, T., & Sahyouni, A. (2022). Capital regulation, market power and bank risk-taking in the MENA region: New evidence for Islamic and conventional banks. *The Quarterly Review of Economics and Finance*, *86*, 134–155. https://doi.org/10.1016/j.qref.2022.07.005

Mehzabin, S., Shahriar, A., Hoque, M. N., Wanke, P., & Azad, M. A. K. (2023). The effect of capital structure, operating efficiency and non-interest income on bank profitability: new evidence from Asia. *Asian Journal of Economics and Banking*, *7*(1), 25–44. https://doi.org/10.1108/AJEB-03-2022-0036

Miah, M. D., & Uddin, H. (2017). Efficiency and stability: A comparative study between islamic and conventional banks in GCC countries. *Future Business Journal*, *3*(2), 172–185. https://doi.org/10.1016/j.fbj.2017.11.001

Mubarok, F., Wibowo, M., & Latif, S. D. H. (2024). Safeguarding Stability and Enhancing Profitability: The Case of Islamic Banking in Indonesia. *International Journal of Islamic Economics and Finance (IJIEF)*, *7*(1), 455–472. https://doi.org/10.18196/ijief.v7i1.20537

MW, & Enders, W. (1995). Applied Econometric Time Series. *Journal of the American Statistical Association*, *90*(431), 1135. https://doi.org/10.2307/2291367

Nafi'ah, E. A., & Widyianingsih, B. (2021). Strategi Restrukturisasi Pembiayaan Bermasalah untuk Menjaga Fortofolio Keuangan Bank Syariah Indonesia (BSI) Kantor Cabang Jombang. *Jurnal Ekonomi Syariah Teori Dan Terapan*, *8*(4), 474. https://doi.org/10.20473/vol8iss20214pp474-482

Nasim, A., Nasir, M. A., & Downing, G. (2024). Determinants of bank efficiency in developed (G7) and developing (E7) countries: role of regulatory and economic environment. *Review of Quantitative Finance and Accounting*, *65*(1), 257–294. https://doi.org/10.1007/s11156-024-01272-6

Nasim, A., Ullah, S., Kim, J. R., & Hameed, A. (2023). Energy shocks and bank efficiency in emerging economies. *Energy Economics*, *126*, 107005. https://doi.org/10.1016/j.eneco.2023.107005

Olson, D., & Zoubi, T. (2017). Convergence in bank performance for commercial and Islamic banks during and after the Global Financial Crisis. *The Quarterly Review of Economics and Finance*, *65*, 71–87. https://doi.org/10.1016/j.qref.2016.06.013

Omer, M. (2019). Monetary Policy Pass-through, Excess Liquidity and Price Spillover: A Comparative Study of Conventional and Islamic Banks of Pakistan. *Journal of Islamic Monetary Economics and Finance*, *5*(2), 287–320. https://doi.org/10.21098/jimf.v5i2.1064

Otaviya, S. A., & Rani, L. N. (2020). Productivity and Its Determinants in Islamic Banks: Evidence From Indonesia. *Journal of Islamic Monetary Economics and Finance*, *6*(1), 189–212. https://doi.org/10.21098/jimf.v6i1.1146

Rahim, A., Rahman, A., & Rosman, R. (2013). Efficiency of Islamic banks: A comparative analysis of MENA and Asian countries. *Journal of Economic Cooperation and Development*, *34*(1), 63–92.

Rahim, S. R. M., Bakar, J. binti A., & a/p Ganapathy, T. (2015). How Efficient Are Islamic Banks in Malaysia? *Journal of Business Studies Quarterly*, *6*(3), 164–174.

Safiullah, M. (2023). Funding liquidity in Islamic banks: Does the Shariah supervisory board's higher educational attainment matter? *Pacific-Basin Finance Journal*, *78*, 101976. https://doi.org/10.1016/j.pacfin.2023.101976

Safiullah, M., & Shamsuddin, A. (2019). Risk-adjusted efficiency and corporate governance: Evidence from Islamic and conventional banks. *Journal of Corporate Finance*, *55*, 105–140. https://doi.org/10.1016/j.jcorpfin.2018.08.009

Salman, A., & Nawaz, H. (2018). Islamic financial system and conventional banking: A comparison. *Arab Economic and Business Journal*, *13*(2), 155–167. https://doi.org/10.1016/j.aebj.2018.09.003

Salsabilla, L. Z., & Jaya, T. J. (2024). The impact of non-performing financing and operational efficiency on the stability of Islamic banks in Persian Gulf countries. *Journal of Islamic Economics Lariba*, *10*(2), 623–640. https://doi.org/10.20885/jielariba.vol10.iss2.art1

Setiawan, I. (2021). The Impact of Financing Risk on Islamic Banking Performance in Indonesia. *Share: Jurnal Ekonomi Dan Keuangan Islam*, *10*(2), 208–229. https://doi.org/10.22373/share.v10i2.9400

Shafron, E. (2019). Investor tastes: Implications for asset pricing in the public debt market. *Journal of Corporate Finance*, *55*, 6–27. https://doi.org/10.1016/j.jcorpfin.2018.08.006

Solihin, S., Achsani, N. A., & Saptono, I. T. (2016). The Islamic Banking and the Economic Integration in Asean. *Buletin Ekonomi Moneter Dan Perbankan*, *19*(1), 81–106. https://doi.org/10.21098/bemp.v19i1.601

Sorwar, G., Pappas, V., Pereira, J., & Nurullah, M. (2016). To debt or not to debt: Are Islamic banks less risky than conventional banks? *Journal of Economic Behavior & Organization*, *132*, 113–126. https://doi.org/10.1016/j.jebo.2016.10.012

Sufian, F., & Kamarudin, F. (2015). Determinants of revenue efficiency of Islamic banks. *International Journal of Islamic and Middle Eastern Finance and Management*, *8*(1), 36–63. https://doi.org/10.1108/IMEFM-12-2012-0114

Tabash, M. I. (2014). The Flow of Islamic Finance and Economic Growth: an Empirical Evidence of Middle East. *Journal of Finance and Accounting*, *2*(1), 11. https://doi.org/10.11648/j.jfa.20140201.12

Tashkandi, A. A. (2022). Shariah supervision and corporate governance effects on Islamic banks' performance: evidence from the GCC countries. *Journal of Business and Socio-Economic Development*, *3*(3), 253–264. https://doi.org/10.1108/JBSED-02-2022-0024

Wan Ibrahim, W. H., & Ismail, A. G. (2020). Do Regulation, Maqasid Shariah and Institutional Parameter Improve Islamic Bank Efficiency? *Journal of Islamic Monetary Economics and Finance*, *6*(1), 135–162. https://doi.org/10.21098/jimf.v6i1.1195

Wasiaturrahma, Sukmana, R., Ajija, S. R., Salama, S. C. U., & Hudaifah, A. (2020). Financial performance of rural banks in Indonesia: A two-stage DEA approach. *Heliyon*, *6*(7), e04390. https://doi.org/10.1016/j.heliyon.2020.e04390

Wood, A., & Skinner, N. (2018). Determinants of non-performing loans: evidence from commercial banks in Barbados. *The Business & Management Review*, *9*(3), 44–64.

Yildirim, I. (2015). Financial efficiency analysis in Islamic banks: *Pressacademia*, *2*(3), 289–289. https://doi.org/10.17261/Pressacademia.2015312956

Zheng, C., Rahman, M. A., Hossain, S., & Moudud-Ul-Huq, S. (2023). Does Fintech-Driven Inclusive Finance Induce Bank Profitability? Empirical Evidence from

Developing Countries. *Journal of Risk and Financial Management*, *16*(10), 457. https://doi.org/10.3390/jrfm16100457

Zins, A., & Weill, L. (2017). Islamic banking and risk: The impact of Basel II. *Economic Modelling*, *64*, 626–637. https://doi.org/10.1016/j.econmod.2017.05.001