

Global Islamic Banking Efficiency: The Impact of Profitability, Liquidity, Solvency, and Technology

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Abstract

This study aims to analyze the influence of profitability, liquidity, solvency, and technology on the efficiency of Islamic banks worldwide. This research is motivated by the importance of operational efficiency in enhancing the performance and competitiveness of Islamic banking amid global economic dynamics and the rapid development of digital technology. The variables used include profitability proxied by Return on Assets (ROA), liquidity by Financing to Deposit Ratio (FDR), solvency by Capital Adequacy Ratio (CAR), and technology (measured via IT cost proxy) as a supporting factor for bank operational efficiency. This study employs a quantitative approach using the Two-Stage Data Envelopment Analysis (DEA) method, with the first stage measuring the efficiency levels of Islamic banks and the second stage applying Tobit regression to analyze the influence of independent variables on efficiency. The data used are secondary data from global Islamic banks registered with the Islamic Financial Services Board (IFSB) for the period 2019–2024. The results indicate that profitability has a significant positive influence and liquidity has a significant negative influence, while solvency and technology show no significant influence on the efficiency of Islamic banks, thus requiring sound financial management and optimal utilization of technology to improve the performance and competitiveness of Islamic banking globally.

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INTRODUCTION

Banking is one of the main pillars of the modern financial system and plays a strategic role in promoting economic growth through its intermediation function, namely collecting and channeling funds to the public (Dalimunthe & Lubis, 2023). In its development, the banking system has been divided into two main types: conventional banking, which is interest-based, and Islamic banking, which operates according to Islamic Sharia principles (Wahyuni & Efriza, 2017). Along with the rapid advancement of technology, the growth of the banking sector has become one of the key indicators of economic development. This growth influences a country's economic performance because the more advanced the banking sector, the greater the opportunities for economic expansion (Fitriyah et

al., 2024). Islamic banking possesses unique characteristics, including a profit-and-loss sharing system and the prohibition of *riba* (interest), making it oriented not only toward profitability but also toward justice and blessings in economic activities (Azzamani, 2024).

Globally, Islamic banking has continued to experience stable growth in line with the increasing interest in Islamic finance worldwide (Wardana et al., 2025). Reports from the Islamic Financial Services Board (IFSB) indicate that the total assets of the Islamic financial industry have continued to grow from 2019 to 2024 despite facing various challenges, such as the COVID-19 pandemic and global economic instability (Amalia & Andrini, 2024). These conditions require Islamic banks to maintain stability while simultaneously improving operational performance in order to remain competitive on a global scale.

One of the main indicators used to assess banking performance is operational efficiency (Wulandari et al., 2020). Efficiency is important because it reflects a bank's ability to manage resources optimally in order to generate maximum output (Wardana & Abdani, 2023). In the context of Islamic banking, efficiency is influenced not only by internal factors such as financial performance but also by external factors such as technological development and global economic dynamics (Gherțescu et al., 2024).

Several financial indicators are commonly used to measure banking efficiency, including profitability, liquidity, and solvency (Ningsih et al., 2025). Profitability, proxied by Return on Assets (ROA), reflects a bank's ability to generate profits from its assets (Masruroh & Wardana, 2022). Liquidity, measured by the Financing to Deposit Ratio (FDR), illustrates a bank's ability to optimally channel funds to society (Munandar, 2022). Meanwhile, solvency, measured through the Capital Adequacy Ratio (CAR), reflects a bank's ability to maintain long-term financial stability (Lestari et al., 2025). These three ratios are important indicators in assessing the soundness and efficiency of Islamic banking institutions (Fuddin et al., 2024).

On the other hand, the development of digital technology has also played a significant role in enhancing banking efficiency (Zuo et al., 2023). Digital transformation, including the utilization of fintech and digital banking services, can reduce operational costs while improving service quality for customers (Laksono & Nisa, 2024). Therefore, technology has become a strategic factor that cannot be overlooked in efforts to improve the efficiency of Islamic banks in the modern era.

Although numerous studies have examined banking efficiency, most have focused primarily on financial aspects without comprehensively integrating the role of technology. According to X-Efficiency Theory, efficiency is determined not only by the quantity of inputs but also by how effectively those resources are managed (Leibenstein, 1979). Therefore, there is a need for research that simultaneously examines the effects of profitability, liquidity, solvency, and technology on the efficiency of Islamic banks within a global context.

In recent years, several studies have investigated the efficiency and profitability of Islamic banks at both global and regional levels. Some panel studies indicate that solvency and CAR significantly affect the profitability of Islamic banks worldwide, whereas FDR has shown insignificant effects in certain contexts, suggesting the need for more prudent liquidity management. Other studies employing technical efficiency analysis, such as Data Envelopment Analysis (DEA) and panel approaches, reveal that Islamic banks exhibit varying levels of efficiency across countries depending on regulations, market structures, and their ability to manage operational costs (Mai et al., 2023).

In addition, studies on the X-efficiency of Islamic banks emphasize that relative efficiency largely depends on the optimization of input utilization and adaptation to environmental changes, including regulatory and technological developments (Akdeniz et al., 2024). However, the majority of these studies still focus predominantly on traditional financial reporting variables (profitability, liquidity, and solvency) and industrial structures without explicitly integrating technology and digitalization dimensions. Several recent studies on Islamic banks in Indonesia and the MENA region have examined the influence of fintech or digital banking on efficiency, but they are generally limited to a single country or treat technology merely as a moderating variable rather than a primary determinant in a global model (Yusuf et al., 2021).

Several previous studies have examined Islamic banking efficiency from the perspectives of profitability, liquidity, solvency, and technical efficiency, including those conducted by Kweh et al. (2024), Yusuf et al. (2021), Mai et al. (2023), and Akdeniz et al. (2024). However, these studies tend to focus on traditional financial ratios or technical efficiency in isolation, while the role of technology in shaping the operational efficiency of global Islamic banks has not been explicitly integrated.

Unlike previous studies that largely positioned technology merely as a supporting context, this study employs Leibenstein's (1979) X-Efficiency framework to position technology as an important determinant in shaping the efficiency frontier of Islamic banks in the digital era.

From the current literature review, several major limitations can be identified. First, many studies only examine the effect of one or two financial ratios on profitability or efficiency, thus failing to provide a comprehensive picture of how the combination of ROA, FDR, and CAR simultaneously influences the efficiency of Islamic banks globally. Second, technology adoption is often mentioned only as background information or examined partially, leaving the comprehensive impact of digital transformation on operational efficiency insufficiently measured. Third, several global studies still rely on relatively outdated data or limited samples, making them unable to fully capture the dynamics of Islamic banking efficiency in the post-pandemic era and the acceleration of fintech development.

Based on these backgrounds and limitations, this study aims to analyze the effects of profitability (ROA), liquidity (FDR), solvency (CAR), and technology on the efficiency of Islamic banks globally. It is expected to provide stronger empirical contributions to the literature and serve as a reference for policymaking in the Islamic banking sector. The main novelties of this study lie in: (1) the use of a global sample covering various countries with different regulatory characteristics and levels of technological adoption; (2) the simultaneous integration of the three key financial ratios (ROA, FDR, and CAR) with technology as a primary determinant of efficiency; and (3) the application of the X-efficiency theoretical framework explicitly linked to digital transformation, enabling a better explanation of how resource optimization and technology utilization jointly shape the efficiency of Islamic banks in the modern era.

Through this approach, the study is expected not only to fill the gaps in previous research that have been limited to financial or technological dimensions separately, but also to provide more holistic policy recommendations for regulators and Islamic bank management in enhancing operational efficiency and global competitiveness. Based on the above background, this study aims to analyze the effects of profitability, liquidity, solvency, and technology on the efficiency of Islamic banks worldwide. It is expected to contribute empirically to the development of the literature and serve as a reference for policymaking in the Islamic banking sector.

METHOD

This study employs a quantitative approach to examine the relationship between profitability, liquidity, solvency, and technology and the efficiency of Islamic banks at the global level. A quantitative approach is considered appropriate because it enables objective measurement through numerical data analysis and facilitates the empirical testing of relationships among variables (Sahir, 2022).

The subjects of this study are Islamic banks registered with the Islamic Financial Services Board (IFSB), covering several countries that represent the global Islamic banking industry. The sample was selected using a purposive sampling technique based on specific criteria, including the availability of financial statement data and the completeness of research variables throughout the observation period (Ani et al., 2021).

Data were collected through secondary documentation by accessing annual financial reports of Islamic banks, macroeconomic data, and official publications issued by international financial institutions relevant to the research objectives. The primary data sources include annual financial reports obtained from the official websites of the respective banks, annual reports and industry statistics published by the IFSB, and international financial databases providing financial information and relevant digital banking indicators. These secondary data were subsequently processed and converted into quantitative variables consistent with the research model, including financial ratios and technology indicators.

The research instruments consist of quantitative data represented by financial ratios, namely Return on Assets (ROA) as a measure of profitability, Financing to Deposit Ratio (FDR) as a measure of liquidity, and Capital Adequacy Ratio (CAR) as a measure of solvency, as well as technology indicators reflecting the level of digital banking adoption. Bank efficiency is measured using the Data Envelopment Analysis (DEA) method. Data collection was conducted through documentation by accessing publicly available financial reports, international financial institution databases, and official publications relevant to the study.

The research procedure began with the collection of secondary data in the form of annual financial reports of Islamic banks and other supporting data from official sources. Subsequently, the data were processed and screened according to the requirements of the research variables, including data transformation, consistency checks, and measurement unit adjustments to ensure their suitability for analysis. The operational definitions of the research variables are presented in Table 1.

Table 1. Operational Definition of Variables

No.	Variable	Operational Definition	Measurement	Source
Input Variables				
1	Third-Party Funds (TPF)	Third-Party Funds (TPF) refer to funds collected by Islamic banks from the public through various Sharia-compliant deposit products, including wadiah yad dhamanah demand deposits, unrestricted mudharabah savings, and restricted mudharabah or wadiah time deposits.	Data Envelopment Analysis	(Putri & Latifah, 2025)
2	Labor Cost	Labor cost refers to the total expenditures incurred by banks for employee compensation, including basic salaries, fixed allowances (healthcare, transportation), variable allowances (bonuses, holiday allowances), overtime pay,	Data Envelopment Analysis	(Fitri et al., 2025)

		social security contributions, and employee training and development expenses.		
3	Fixed Assets	Fixed assets are tangible assets owned by Islamic banks and used in banking operations or administrative purposes, with a useful life exceeding one accounting period, such as office buildings, land, office equipment, operational vehicles, computer/server systems, and information technology infrastructure.	Data Envelopment Analysis	(Putra et al., 2025)
Output Variables				
1	Financing	Financing refers to the provision of funds or equivalent claims by Islamic banks to customers based on Sharia contracts (mudharabah, musyarakah, murabahah, ijarah), requiring repayment after a specified period through profit-sharing, profit margins, or agreed rental fees.	Data Envelopment Analysis	(Fitri et al., 2025)
2	Investment	Investment in the context of Islamic banking refers to the placement of bank funds in Sharia-compliant financial instruments such as sukuk, Islamic stocks, interbank Islamic deposits, or investment financing (mudharabah/musyarakah) to generate returns based on profit-sharing or Sharia-compliant margins.	Data Envelopment Analysis	(Sunarsih & Fitriyani, 2018)
Independent Variables				
1	Profitability (ROA)	Return on Assets (ROA) is a profitability ratio that measures a bank's ability to generate profit from its total assets.	$ROA = (\text{Net Income} / \text{Total Assets}) \times 100\%$	(Wijaya, 2019)
2	Liquidity (FDR)	Financing to Deposit Ratio (FDR) measures the ability of Islamic banks to fulfill short-term financial obligations through financing activities.	$FDR = (\text{Total Financing} / \text{Total Third-Party Funds}) \times 100\%$	(Choiri et al., 2025)
3	Solvency (CAR)	Capital Adequacy Ratio (CAR) is a capital adequacy ratio that measures a bank's ability to absorb risks associated with risk-weighted assets.	$CAR = (\text{Bank Capital} / \text{Risk-Weighted Assets}) \times 100\%$	(Ismaulina et al., 2020)
4	Technology (NIE)	Fintech refers to innovation in financial services involving the development and implementation of new ideas in the financial sector to enhance efficiency, accessibility, and service quality.	$Ti = \ln(\text{Non-Interest Expenses})$	(Alshehadeh & Al-khawaja, 2022)
Dependent Variable				
1	Islamic Bank Efficiency	Bank efficiency refers to a bank's ability to utilize resources (such as funds, labor, and assets) optimally in order to generate maximum outputs (income, financing, or services) at the lowest possible cost.	Data Envelopment Analysis	(E. D. Lestari & Yandri, 2024)

Data analysis was conducted using a two-stage approach. In the first stage, Data Envelopment Analysis (DEA) was employed to measure the efficiency level of each Islamic bank during the observation period. The efficiency scores obtained from the DEA model were then used as the dependent variable in the second stage, namely Tobit regression analysis, which was applied to examine the effects of profitability, liquidity, solvency, and technology on Islamic bank efficiency while accounting for the bounded nature of efficiency scores. Prior to the Tobit regression analysis, classical assumption tests were performed, including normality, multicollinearity, heteroscedasticity, and likelihood ratio tests, to ensure that the model met the required statistical assumptions. In addition,

descriptive analysis was conducted to enrich the interpretation of findings and identify potential limitations of the study.

RESULTS AND DISCUSSION

The results of this study were obtained through two stages of analysis, namely efficiency measurement using Data Envelopment Analysis (DEA) and hypothesis testing using Tobit regression. The average efficiency scores of global Islamic banks calculated using MaxDEA are presented in Table

2.

Table 2. Average Efficiency Scores of Global Islamic Banks

Bank Name	Average Efficiency Score
Al Salam Bank	0,017638833
Bahrain Islamic Bank	0,074508833
Sharjah Islamic Bank	0,007140333
Al Hilal Bank	0,000186333
Abu Dhabi Islamic Bank	0,016561333
Dubai Islamic Bank	0,9850045
Emates Islamic Bank Phsc	0,0007435
Maybank Islamic Berhad	0,063849167
Bank Islam Malaysia Berhad	0,000582
Bank Muamalat Malaysia Berhad	0,000667833
RHB Islamic Bank Berhad	0,0187255
Qatar Islamic Bank	0,064372667
Masraf Ar Rayan	0,046710333
Dukhan Bank	0,001259167
Jordan Islamic Bank	9,33333E-06
Bank Syariah Indonesia	0,000409667
Al Rajhi Bank	0,002484667
Bank Islam Brunei Darussalam Berhad	0,036271667
Jaiz Bank Plc	0,0752205
Boubyan Bank K.S.C	0,008224333
Ziraat Katilim Bankasi	0,002485333

In the first stage, the efficiency measurement revealed that the efficiency levels of Islamic banks across different countries were uneven. Several banks achieved optimal efficiency with an efficiency score of 1, indicating their ability to utilize inputs maximally to generate outputs. However, a number of banks still recorded efficiency scores below 1, suggesting inefficiencies in resource management, including operational costs, asset utilization, and technology usage. This variation reflects differences in managerial capability, business scale, and levels of technological adoption among Islamic banks worldwide.

Furthermore, the descriptive analysis indicated differences in financial performance across regions. Islamic banks in the Middle East tended to demonstrate higher efficiency levels compared to banks in Southeast Asia and other developing countries. This condition may be attributed to larger business scales, stronger regulatory support, and more mature industry development. In contrast, Islamic banks in developing countries continue to face challenges in improving efficiency due to infrastructure limitations, intense competition, and uneven technological capacity.

Table 3. Descriptive Statistics Analysis Results

Variable	Profitability (X1)	Liquidity (X2)	Solvency (X3)	Technology (X4)	Bank Efficiency (Y)
Mean	1,666984	8,439627	1,896627	506109,3	0,067765
Median	1,300000	8,310000	1,865000	7682,000	0,008201
Maximum	1,333000	1,180000	2,850000	11789330	1,000000
Minimum	0,020000	5,230000	1,359000	8,450000	6,00E-06
Std. Dev.	1,627850	1,063971	2,177860	1932045,	0,208761

The descriptive statistics indicate that the average profitability, liquidity, solvency, and efficiency of the sampled Islamic banks were relatively low, with considerable variation across banks. The average ROA of approximately 1.67% suggests that asset utilization for profit generation remains suboptimal. Meanwhile, the average FDR of 8.44% indicates that banks tend to maintain a highly cautious liquidity position, as only a small proportion of third-party funds is channeled into financing activities. The average CAR of approximately 1.90% reflects a relatively adequate but still low solvency level, with considerable dispersion among banks, indicating differences in their ability to absorb potential losses. The technology variable, measured through technology-related expenditures, shows a mean significantly higher than the median, suggesting that a few banks invest heavily in technology while most allocate relatively limited resources to technological development. The average efficiency score of approximately 0.068, combined with a relatively large standard deviation, indicates that most banks operate at very low efficiency levels, although a small number of banks are close to achieving maximum efficiency.

In the second stage, the Tobit regression results indicate that profitability, liquidity, solvency, and technology exert varying influences on Islamic bank efficiency. A summary of the results is presented in Table 4.

Table 4. Tobit Regression Results

Variable	Coefficient	Direction of Effect	Probability	Significance
Profitability (X1)	0.700199	Positive	0.0075	Significant
Liquidity (X2)	-0.062299	Negative	0.0165	Significant
Solvency (X3)	0.811348	Positive	0.0599	Not Significant
Technology (X4)	-0.381553	Negative	0.3138	Not Significant

Based on the results, profitability and liquidity were found to significantly influence Islamic bank efficiency, whereas solvency and technology did not have a statistically significant effect. These

findings address the study's objective of identifying the determinants of Islamic bank efficiency at the global level.

The positive and significant effect of profitability suggests that a bank's ability to generate profits is a primary factor in enhancing efficiency. This can be explained by the fact that profitability reflects the effectiveness of asset management. Banks that are able to optimize their assets to generate profits tend to operate more efficiently. This finding is consistent with previous studies indicating that strong financial performance contributes positively to efficiency improvement.

Conversely, liquidity exhibits a negative and significant effect on efficiency. This finding suggests that a higher financing ratio does not necessarily improve efficiency. Scientifically, this condition may occur when financing activities are expanded aggressively without being accompanied by adequate financing quality, thereby increasing the risk of non-performing financing. Furthermore, excessive liquidity may indicate inefficient fund management, ultimately reducing operational efficiency. This result differs from some previous studies that reported a positive relationship, suggesting that the link between liquidity and efficiency is highly contextual.

Furthermore, solvency has a positive but statistically insignificant effect on efficiency. This finding implies that capital adequacy is not a primary determinant of Islamic bank efficiency. Conceptually, a strong capital position may enhance stability and support expansion opportunities; however, if capital is not utilized productively, it may not significantly contribute to efficiency improvement. Therefore, the results indicate that capital adequacy must be accompanied by effective management strategies to generate meaningful efficiency gains.

Meanwhile, the technology variable demonstrates a negative and insignificant effect on efficiency. This finding suggests that investments or expenditures in technology have not yet contributed directly to improving the efficiency of Islamic banks. One possible explanation is the high initial cost of technology implementation, which may prevent immediate efficiency gains in the short term. Additionally, disparities in technology adoption and utilization across banks may also contribute to this outcome.

The finding that technology exerts a negative and insignificant effect on efficiency can be explained through the concept of the IT Productivity Paradox, a phenomenon in which substantial investments in information technology do not immediately translate into higher efficiency or productivity in the short run (Mahri & Adrianto, 2024). This occurs because technology implementation often involves significant costs, organizational adaptation, and learning processes that require time before the technology can be utilized effectively. Consequently, the impact of technology on efficiency tends to be long-term and may not be fully observable within the study period.

Overall, the findings indicate that Islamic bank efficiency is influenced not only by financial performance but also by how banks manage risk, capital, and technological investments. The differences in direction and significance across variables demonstrate that improvements in financial indicators do not automatically lead to higher efficiency. Therefore, Islamic banks need to optimize resource management in a balanced manner to achieve sustainable efficiency.

CONCLUSION

This study confirms that the efficiency of global Islamic banks remains heterogeneous and generally suboptimal. Empirically, profitability has been proven to be the primary determinant that

enhances efficiency, while liquidity exerts a significant negative effect, indicating inefficiencies in fund allocation strategies. In contrast, solvency and technology do not demonstrate significant effects, suggesting that capital accumulation and technological investment are not automatically translated into greater efficiency unless supported by effective management quality and resource utilization.

These findings imply that efficiency is more managerial-driven than resource-driven. Therefore, Islamic bank management should focus on optimizing productive assets and maintaining disciplined liquidity management. Technological investment should also be reoriented from merely financing infrastructure toward the digitalization of core banking services that directly contribute to reducing operational costs. At the regulatory level, policy frameworks that encourage performance-based efficiency and provide more outcome-oriented guidelines for technology investment allocation are needed.

Nevertheless, this study has several limitations. First, the technology proxy used is based on expenditure measures, which may not adequately capture the substantive effectiveness of digitalization. Second, the use of aggregated cross-country data may obscure structural heterogeneity among Islamic banks operating in different institutional and economic environments. Future research is therefore encouraged to employ more granular and output-based technology indicators, while also incorporating institutional and macroeconomic variables to develop a more comprehensive and contextually relevant model of Islamic bank efficiency.

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