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The Effect of Operational Efficiency on the Financial Performance of Islamic Banks Listed on the Indonesia Stock Exchange for the 2019-2023 Period: *Data Envelopment Analysis* (DEA) Approach

Erik Aranda[1], Laila Wardani[2]

[1,2]Faculty of Economics and Business, University of Mataram, Indonesia

ABSTRACT: Islamic banks in Indonesia face challenges in maintaining stable financial performance and operational efficiency amid the dynamics of increasingly fierce competition. This study aims to explore the effect of operational efficiency as measured by technical efficiency and scale efficiency, on the financial performance of Islamic banks listed on the Indonesia Stock Exchange for the period 2019-2023. The research sample consists of three Islamic banks, namely Bank Syariah Indonesia Tbk, Bank BTPN Syariah Tbk and Bank Panin Dubai Syariah Tbk, which were selected using *purposive sampling* method. Operational efficiency is measured by the *Data Envelopment Analysis* (DEA) approach and uses the assumption of *Variable Returns to Scale* (VRS). Financial performance is measured using *Risk, Governance, Earnings* and *Capital* (RGEC) ratios. DEA analysis tools using *Banxia Frontier Analysis* while multiple linear regression calculations using EVIEWS. The results showed that technical efficiency has no significant effect on financial performance, while scale efficiency has a significant negative effect. Simultaneously, technical efficiency and scale efficiency have a significant effect on financial performance. .These findings indicate that an increase in the scale of operations that is not optimal can have a negative impact on the financial stability of Islamic banks. The implication of this study is the importance of managing the appropriate scale of operations so that Islamic banks can achieve sustainable efficiency without sacrificing financial performance.

KEYWORDS: Operational Efficiency, Financial Performance, *Data Envelopment Analysis*, RGEC, Islamic Banks, Indonesia Stock Exchange.

I. INTRODUCTION

Islamic banking has become an important pillar of the financial system in Indonesia since the establishment of Bank Muamalat in 1991. Unlike conventional banks, Islamic banks operate based on Islamic sharia principles that prohibit the practice of usury (interest), speculation, and *gharar* (uncertainty), and emphasize fair sharing of risks and profits between banks and their customers. (Razali in Haron et al., 2020).. Rizvi et al. (2020)said that Islamic banks still play a significant role in encouraging an economy based on sharia principles. In line with the statement by the Financial Services Authority in Indonesian Banking Statistics that by 2023 Islamic banking assets in Indonesia have reached Rp. 600 trillion, still far from Rp. 11,766 trillion in total assets of conventional commercial banks. Although it has fundamental differences with conventional banks, the challenges faced by Islamic banks are not much different, namely how to maintain durability and sustainability in order to face the dynamics of increasingly fierce competition.

Financial performance is an important aspect in maintaining the durability and growth of a bank. (Violeta Ketaren & Mulyo Haryanto, 2020). Harjito said that financial performance is a form of assessment of the financial condition of a company. (Dangnga & Haeruddin, 2018).. The Indonesian government, through Bank Indonesia, has issued Bank Indonesia Regulation (PBI) No. 13/1/PBI/2011 concerning bank health assessment. In the regulation, RGEC (*Risk*, *Governance*, *Earnings*, and *Capital*) is established as the standard for assessing bank soundness, which provides a comprehensive evaluation of a bank's risk management, governance, profit-making ability, and capital strength (Bank Indonesia, 2019). Maintaining stable financial performance is a challenge that must be faced by every business entity, including the banking industry. Poor finances can have a negative impact on the company's comfort and ability to operate which ultimately has the potential to lead to liquidation. Therefore, an effort is

needed to identify and optimize factors that can affect the financial performance of banks. One important component in maintaining financial performance is achieving efficiency in the company's operations. (Onoyi & Windayati, 2021)..

Operational efficiency is one of the key factors that determine the competitiveness and sustainability of an organization. (Tan & Tsionas, 2022). This efficiency includes how a bank utilizes *inputs* to produce *outputs* relative to the scale and technicality of the operation. Technical efficiency can be achieved when the company is able to produce *output* with the minimum amount of *input*, while scale efficiency will be achieved when the *output* produced is optimal when compared to the scale of the company's operations. Banks that are able to maintain their efficiency well have a greater chance of surviving in dynamic competition conditions. (Githinji-Muriithi, 2017).. In Indonesia, the urgency to improve the resilience and sustainability of banks is reflected in the issuance of PBI No. 13/1/PBI/2011. By the government, the regulation is expected to be a reference to improve the resilience of banking industry companies by improving the health of banks in Indonesia.

However, the decline in the number of banks in Indonesia over the past few years points to challenges in bank efficiency and soundness. Based on data from the Central Bureau of Statistics (BPS), the number of commercial banks decreased from 119 banks in 2014 to 105 banks in 2023, and the number of rural banks (BPR) also decreased from 1,807 in 2014 to 1,575 in 2023 (BPS, 2023). Much of this decline is due to operational problems, financial performance issues and a lack of ability to meet minimum capital requirements set by the government (Novira, 2023; Wibowo, 2023). (Novira, 2023; Wibowo & Zakaria, 2021).This decline has far-reaching impacts, ranging from reduced customer confidence in the banking system to losses for capital owners. (Purwati, 2023).

The decline in the number of banks including Islamic banks in Indonesia illustrates the increasingly complex challenges in the banking industry. In the midst of these dynamics, the risky Islamic banking sector is a public company where there are four Islamic banks listed on the Indonesia Stock Exchange (IDX) in the 2019-2023 period, namely Bank Aladin, Bank Syariah Indonesia, Bank BTPN Syariah, and Bank Panin Dubai Syariah. As a public company that raises funds and capital directly from the public, the risk of bank closure can have a more fatal blow to the economy compared to non-public banks. Coupled with global dynamics that can significantly affect the capital market in Indonesia, maintaining the health and efficiency of the company is a high priority at all times.

Table 1.1: Islamic banks listed on the IDX in 2024

No.	Bank Name
1.	PT Bank Aladin Syariah Tbk.
2.	PT Bank Syariah Indonesia Tbk.
3.	PT Bank BTPN Syariah Tbk.
4.	PT Bank Panin Dubai Syariah Tbk.

Source: Indonesia Stock Exchange

Several previous studies have tried to explain the efficiency and financial performance of banks in Indonesia. Ni'mah & Laila (2022) found that Islamic Commercial Banks have not achieved 100% efficiency based on the DEA approach with CRS assumptions. Herli Setyowati et al. (2019) in "The Effect of Operational Efficiency on *Return on Assets* at Islamic Commercial Banks in Indonesia" found that the BOPO ratio and PPAP had a positive effect on the profitability of Islamic Commercial Banks in Indonesia. Fitrianti & Nurbayani (2021) in "*The Efficiency of Islamic Banks and Conventional Banks in Indonesia Using Data Envelopment Analysis Approach*" using the DEA method using fixed assets, deposits and operating expenses as *inputs*, and *outputs* using only credit. The results found that all Islamic banks sampled achieved perfect efficiency while conventional banks sampled did not show perfect efficiency. However, another study showed that the average efficiency of Islamic banks in Indonesia only reached 80% in the 2011-2020 period. (Rusydiana & As-Salafiyah, 2021).. Yusuf & Surjaatmadja (2018) tried to explain the efficiency comparison between conventional banks and Islamic banks in Indonesia. By using the parametric method of *Stochastic frontier Analysis* (SFA) he found that between Islamic and conventional banks for the period 2014-2019 there was no significant difference in efficiency. On the other hand, the financial performance of Islamic banks shows variation, with some studies showing good results, while others show room for improvement. (Astanti et al., 2024).

The results of these studies show that the efficiency and financial performance of Islamic banks in the Indonesian banking industry have not reached the maximum level. (Muhajir &usuf, 2020). Therefore, further research is needed on the topic of operational efficiency and financial performance of Islamic banks in Indonesia, in order to achieve the best solution to the previously mentioned phenomenon. Based on this context, this study intends to explore the role of operational efficiency in

influencing the financial performance of Islamic banks listed on the Indonesia Stock Exchange in the 2019-2023 period. This research departs from the following main problems:

1. Does technical efficiency have a significant influence on the financial performance of Islamic banks listed on the Indonesia Stock Exchange?
2. Does scale efficiency have a significant influence on the financial performance of Islamic banks listed on the Indonesia Stock Exchange?

Departing from the phenomenon of the decline in the number of banks in Indonesia, research problems and inconsistencies in research results such as in (Fitrianti & Nurbayani, 2021), and (Rusydiana & As-Salafiyah, 2021)(Rusydiana & As-Salafiyah, 2021), the author gets an academic suspicion to further research related topics. Compared to using parametric methods such as in the research of (Herli Setyowati et al., 2019) and (Yusuf & Surjaatmadja, 2018)(Yusuf & Surjaatmadja, 2018), researchers used the non-parametric method of *Data Envelopment Analysis* (DEA) to analyze the efficiency level of the company. In contrast to the assumption of *Contsant Returns to Scale (*CRS) as used by (Ni'mah & Laila, 2022)(Ni'mah & Laila, 2022), the researcher uses the assumption of *Variable Returns to Scale* (VRS) to test the pure technical efficiency of the bank. In line with that, compared to (Fitrianti & Nurbayani, 2021) the researcher uses deposits and labor costs (BTK) as *input* variables while the *output* variables use financing and total income to measure the efficiency level of the bank. With the renewal of methods, assumptions and variables, it is hoped that it can provide a new view of the field of knowledge about bank efficiency, especially in the Islamic sector of the Indonesia Stock Exchange, in order to achieve better quality and sustainability of the banking industry.

This study aims to explore the relationship between operational efficiency and financial performance of Islamic banks listed on the Indonesia Stock Exchange in the 2019-2023 period. This study uses the *Data Envelopment Analysis* (DEA) method with an intermediation approach and the assumption of *Variable Returns to Scale* (VRS) to measure operational efficiency. DEA was chosen because this method allows the measurement of relative efficiency between banks without requiring certain production function assumptions. (Camanho et al., 2024).. The data analysis will be conducted on a per-semester basis, in order to obtain more in-depth and comprehensive results. By combining the analysis of operational efficiency and financial performance based on RGEC ratios along with per-semester analysis, this research is expected to provide deeper insights in order to achieve a better and sustainable Islamic banking industry. The following is the average per-semester data of *input* and *output* variables for operational efficiency calculation.

Table 1.2: Average data of *Input* and *Output* Variables in 2019-2023

Semester/Year	***Input* Variables**		***Output* Variable**	
	Savings	Labor Cost	Financing	**Total Revenue**
Semester 1/2019	395.728.298	25.011.560	4.189.224.083	**3.742.150**
Semester 2/2019	179.140.902	61.512.861	4.866.201.028	**8.004.882**
Semester 1/2020	300.219.376	24.475.233	5.104.349.880	**2.964.975**
Semester 2/2020	361.335.465	56.211.696	5.234.356.813	**1.346.050**
Semester 1/2021	397.428.880	25.574.637	5.561.528.206	**2.587.440**
Semester 2/2021	531.442.332	57.560.915	5.445.907.347	**276.140.914**
Semester 1/2022	1.082.363.876	214.413.852	5.494.357.619	**50.041.742**
Semester 2/2022	1.659.370.253	63.405.141	6.249.410.721	**143.370.358**
Semester 1/2023	858.372.417	38.143.537	4.189.871.354	**68.000.848**
Semester 2/2023	1.210.687.368	78.925.408	7.156.883.136	**155.748.403**

Source: Data processed

Based on table 1.2, it can be found that in the time span of semester one to semester 2 in 2019, deposits decreased by -55%, labor costs increased by 146%, financing by 16% and 114% increase in total income. From semester 2 of 2019 to semester 1 of 2020, deposits grew 68%, labor costs decreased -60%, financing increased 5% and total revenue decreased -63%. From semester 1 of 2020 to semester 2 of 2020, deposits increased 20%, labor costs increased 130%, financing increased 3% and total revenue decreased -55%. From semester 2 of 2020 to semester 1 of 2021, deposits increased by 10%, labor costs decreased by -55%, financing increased by 6% and total income increased by 92%. From semester 1 of 2021 to semester 2 of 2021, deposits increased 34%, labor costs increased 125%, financing decreased -2% and total revenue increased 10,572%. from semester 2 of 2021 to

semester 1 of 2022, deposits increased 104%, labor costs increased 272%, financing increased 1% and total revenue decreased -82%. From semester 1 of 2022 to semester 2 of 2022, deposits increased by 53%, labor costs decreased by -70%, financing increased by 14% and total income increased by 187%. From semester 2 of 2022 to semester 1 of 2023, deposits decreased by -48%, labor costs decreased by -40%, financing decreased by -33% and total income decreased by -53%. From semester 1 of 2023 to semester 2 of 2023, deposits increased by 41%, labor costs increased by 107%, financing increased by 71% and total income increased by 129%.

II. LITERATURE REVIEW

A. Agency Theory

Lukitasari said that agency theory is a theory that explains the contractual relationship between several parties, where one of these parties is the owner (*principal*) who hires an agent (*agent*) to carry out business entity operations on behalf of the owner through delegation of authority. (Mensah Onumah et al., 2020).In Islamic banks, which are open commercial banks, the company is owned by shareholders as *principals* and run by managerial and executive *agents*. *Agency* theory raises the potential for conflicts between owners and agents, namely potential conflicts of interest and agency cost conflicts. Conflicts of interest can occur due to the separation of ownership and control, differences in risk preferences, information asymmetry, and *moral hazard*. (Panda & Leepsa, 2017; TEKİN & POLAT, 2020)..

B. Signal Theory

Signalling Theory was introduced by Ross (1977), which states that company executives have more in-depth information about the company's performance and prospects than outsiders, so they tend to communicate this information to investors to increase company value. (Mariani & Suryani, 2018). Sigar and Kalangi added that the information conveyed by the company can be responded positively or negatively by investors, which ultimately affects the stock price. (Qotimah & Kalangi, 2023).. In the context of banking, operational efficiency can serve as a signal to investors regarding management's ability to manage resources. High technical efficiency indicates effective *input* utilization, while optimal scale efficiency signals the bank's ability to grow without straining financial performance. However, excessive and inefficient operational scale can send a negative signal that could potentially degrade the bank's financial performance.

C. Financial Performance

Sutrisno said that financial performance is a series of financial activities in a certain period that are reported in the financial statements. (Dangnga & Haeruddin, 2018). To assess banking performance (health), the country's banking industry refers to PBI No. 6/10 / PBI / 2004 which stipulates that banks must meet the standards of *Capital, Asset quality, Management, Earnings*, and *Liquidity* (CAMEL) ratios to be considered a healthy bank. The reference was used in the following years and then refined with Bank Indonesia Regulation No. 13/1/PBI/2011, by establishing the ratio of *risk, good corporate governance, earnings* and *capital* (RGEC) as a mandatory requirement that must be met to replace the CAMEL ratio (Bank Indonesia*,* 2011). (Bank Indonesia, 2011). The assessment of the four RGEC components is done by comparing the composite rating on each ratio taken into account. The rating is divided into very healthy, healthy, quite healthy, less healthy, and unhealthy criteria. (OJK, 2014).

Table 2.1: RGEC method bank health composite rating criteria

Weight	Composite Rating (PK)	Description
86-100 %	PK-1	**Very Healthy**
71-85 %	PK-2	**Healthy**
61-70 %	PK-3	**Healthy Enough**
41-60 %	PK-4	**Less healthy**
≤ 40 %	PK-5	**Unhealthy**

Source: POJK No. 8/POJK.03/2014

D. RGEC Method

In accordance with Bank Indonesia Circular Letter No. 13/24/DPNP/2011, the calculation of each ratio in the RGEC method can be explained in the following mathematical formula:

1) Risk (Risk Profile)
    a. FDR

$$Financing\ to\ Deposit\ Ratio\ = \frac{total\ pembiayaan}{DPK} \times 100\ \%$$

Source: SEBI No. 13/24/DPNP/2011

Table 2.3: Risk profile health rating criteria

Composite Rating	Rating Description	Criteria
1.	Very Healthy	**50% FDR < 75%**
2.	Healthy	**75 % ≤ FDR < 85%**
3.	Healthy Enough	**85 % ≤ FDR < 100%**
4.	Less healthy	**100 % ≤ FDR < 120 %**
5.	Unhealthy	**FDR ≥ 120 %**

Source: SEBI No. 13/24/DPNP/2011

2) *Governance* (Corporate Governance Profile)

Assessment of *Good* Corporate *Governance* (GCG) factors for Islamic Commercial Banks is an assessment of the managerial quality of banks on the implementation of 5 (five) principles of *Good Corporate Governance*, namely accountability, professionalism, transparency, responsibility and fairness.

3) *Earnings*

a. Return On Assets

$$ROA\ = \frac{Laba\ Bersih}{Total\ Aset} \times 100\%$$

Source: SEBI No. 13/24/DPNP/2011

Table 2.4: Earnings Profile Rating Criteria

Composite Rating	Rating Description	Criteria
1.	Very Healthy	**ROA ≥ 1,5 %**
2.	Healthy	**1.25% < ROA ≤ 1,5%**
3.	Healthy Enough	**0.5% < ROA < 1.25%**
4.	Less healthy	**0% < ROA ≤ 0,5 %**
5.	Unhealthy	**ROA ≤ 0 %**

Source: SEBI No. 13/24/DPNP/2011

4) Capital

$$Capital\ Adequacy\ Ratio\ = \frac{Modal}{Aktiva\ Tertimbang\ Menurut\ Resiko} \times 100\%$$

Source: SEBI No. 13/24/DPNP/2011

Table 2.6: Capital Profile Rating Criteria

Composite Rating	Rating Description	Criteria
1.	Very Healthy	**CAR ≥ 12%**
2.	Healthy	**9% ≤ CAR < 12%**
3.	Healthy Enough	**8% ≤ CAR < 8%**
4.	Less healthy	**6% < CAR < 8%**
5.	Unhealthy	**CAR ≤ 6%**

Source: SEBI No. 13/24/DPNP/2011

E. Operational Efficiency

According to the Big Indonesian Dictionary (KBBI), efficiency can be defined as the accuracy of the way of doing something and the ability to carry out tasks properly and precisely without wasting excess costs, time, and energy. In the context of economics,

Gunawan argues that operational efficiency is the ability to get the job done right or in mathematical concepts is the ratio between *input* and *output* (Mulyadi et al. (2023). Operational efficiency is one of the important indicators to evaluate bank performance. In the context of banking, this efficiency includes two main aspects: technical efficiency and scale efficiency.

Technical efficiency refers to the bank's ability to maximize the *output* generated from the use of a certain amount of *input*, or minimize the *input* used to achieve a certain level of *output*. With the *Data Envelopment Analysis* (DEA) approach, there are two assumptions *to* find technical efficiency, namely the *Constant Returns to Scale* (CRS) assumption and the *Variable Returns to scale* (VRS) assumption. The CRS assumption assumes that changes in *inputs* will result in proportional changes in *output*. That is, if all *inputs* are increased by a certain percentage, *output* will also increase by the same percentage. In contrast the VRS assumption considers that operational scale can affect efficiency, meaning that regardless of size small banks and large banks can have different levels of efficiency (Banker et al., 2003). (Banker et al., 2003).

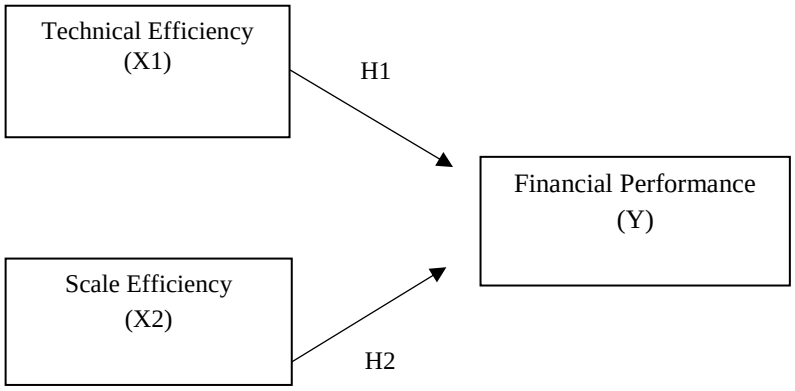
Scale Efficiency, on the other hand, measures how efficiently a bank operates based on the size or scale of its operations. A bank can be said to be scale efficient if the *output* produced is optimal in accordance with the scale of its operations. A *Decicion Makin Units (*DMUs) is said to be scale efficient if it produces optimal *output* compared to its scale of operation. If the bank operates at full scale efficiency, it means that each additional *input* produces the corresponding *output* proportionally, and the bank has reached the optimal scale. Conversely, if there is scale inefficiency, the bank may be operating at a scale that is too small or too large. (Banker et al., 2003)**.**

F. *Data Envelopment Analysis* (DEA)

DEA analysis was first introduced by *Charnes, Chooper* and *Rhodes* in 1978 and was originally known as CCR analysis. *Data Envelopment Analysis* is one of the non-parametric methods that can be used to measure the efficiency of a company, this is due to DEA's ability to measure Decicion Making Units (DMUs), without requiring assumptions about the shape of a particular production function. (Charnes et al., 1978).. This method is very relevant to evaluate the operational performance of banks, because DEA can measure efficiency by considering different *inputs* and *outputs* in a *Decision Making Units* (DMUs).

The DEA method was chosen considering its ability to measure relative efficiency among banks with different characteristics. DEA is also flexible because it can handle various *inputs* and *outputs* used by banks without requiring certain assumptions about the relationship between *inputs* and outputs. (Zhu, 2014). The DEA approach assuming *Variable Returns to Scale* (VRS) was chosen in this study because it provides more accurate results in measuring the technical efficiency of banks operating with different sizes, which is very relevant to the condition of Islamic banking in Indonesia.

Based on the research problems, literature review and theory in this study, the framework and hypotheses that can be formulated are:



1. **H0** : Technical Efficiency has no significant effect on Financial Performance
   H1 : Technical Efficiency has a significant effect on Financial Performance

2. **H0** : Scale Efficiency has no significant effect on Financial Performance
   H2 : Scale Efficiency has a significant effect on Financial Performance

III. RESEARCH METHODS

This research is a quantitative-descriptive research. Quantitative-descriptive research is research that explains the count variables as they are (Sugiyono in Asri & Julisman, 2022).. The population of this study only includes Islamic banks listed on the

Indonesia Stock Exchange (IDX) during the 2020-2023 period, there are four Islamic banks listed on the IDX, namely: 1) Bank Syariah Indonesia Tbk (BRIS), 2). Bank Panin Dubai Syariah Tbk (PNBS), 3). PT Bank BTPN Syariah Tbk (BTPS) and 4) PT Bank Aladin Syariah Tbk (BANK). The sampling method is purposive sampling with criteria: 1) Islamic banks listed on the Indonesia Stock Exchange for the period 2020-2023 and 2) have financial statement data needed for data analysis. So that as a research sample collected, namely: 1) Bank Syariah Indonesia Tbk (BRIS), 2). Bank Panin Dubai Syariah Tbk (PNBS) and 3) PT Bank BTPN Syariah Tbk (BTPS). PT Bank Aladin Syariah Tbk. was not included as a sample because it did not meet the research limitation criteria, namely not having the financial statement data needed for analysis. This sample limitation is determined to maintain data consistency and ease of access to complete financial reports within the specified time frame. The data used is in the form of Semester Financial Statements obtained through the Indonesia Stock Exchange (BEI/IDX), the Financial Services Authority and the official website of each bank.

The research is divided into three stages. The first stage is to measure the efficiency of bank operations using the DEA method and using Banxia Software analysis tools. The second stage is to analyze the financial performance of sample banks with the ratio of Risk (NPF), Governance, Earnings (ROA) and Capital (CAR). The third stage is to measure the effect of operational efficiency calculation results (technical efficiency and scale efficiency) on the results of financial performance analysis (Risk, governance, Earnings, Capital) using multiple linear regression methods (EVIEWS).

In this study, the independent variable is the result of the calculation of operational efficiency, namely technical efficiency and scale efficiency. Technical efficiency used is the calculation result using the assumption of Variable Returns to Scale (VRS), while scale efficiency is obtained by dividing the analysis result of Constant Returns to Scale (CRS) assumption with the calculation result of VRS assumption analysis (Coelli et al., 1998; Cooper et al., 2007). (Coelli et al., 1998; Cooper et al., 2007).. The inputs used in the DEA model consist of two main components, namely deposits (total funds raised by the bank) and labor costs (expenses incurred by the bank for labor). The measured outputs include financing (total financing disbursed by the bank) and total income (overall income from the bank's operational activities).

$$Efisiensi\ Skala = \frac{Efisiensi\ CRS}{Efisiensi\ VRS}$$

The dependent variable is the Financial Performance of Islamic banks as measured using the RGEC approach. RGEC consists of four components, namely: Risk measured by *Financing to Deposit Ratio* (FDR) which reflects bank liquidity, *Governance* describes corporate governance, Earnings is assessed through *Return on Assets* (ROA), and *Capital* is measured by *Capital Adequacy Ratio* (CAR) to reflect the adequacy of bank capital to absorb risk. The merging of RGEC data is done by normalizing the values using the *Z-Score Normalization* method, then performing a simple average division calculation to find the average value of the variables. Data normalization is a technique of changing the scale of data that has different dimensions into a uniform scale. Normalization is needed if a data set has too large a scale variation so that data calculations can be biased by the highest data variation. (Whendasmoro & Joseph, 2022).

Z-Score Normalization Formula:

$$v' = \frac{(v - A)}{\sigma_A}$$

Where:

v' = Z-score value

v= Actual Value

A= Average

σ_A= Standard Deviation

Simple average formula:

$$Y = \frac{v'R + v'G + v'E + v'C}{4}$$

Where;

Y= Dependent Variable

v'R= Risk Z-score

v'G= Governance Z-score

v'E= Earnings Z-score value

v'C= Z-score Capital

The stages of measuring operational efficiency with DEA begin with the collection of *input* and *output* data from the financial statements of listed Islamic banks. The calculation of efficiency is done using *Banxia Frontier Analysis* software, which allows the calculation of technical efficiency and scale efficiency of each DMUs. The value of technical efficiency (ET) is calculated through the ratio of output to input with the following formula:

$$ET = \frac{\sum_{r=1}^{s} u_r y_{rj}}{\sum_{i=1}^{m} v_i x_{ij}}$$

Where:

y_rj= the sum of the rth output of DMU-j,

x_ij= sum of i-th input of DMU-j

u_r= weight for the rth output

v_i= weight for i-th input

Efficiency values range from 0 to 100%, where a value of 1/100% indicates full efficiency, while values below indicate inefficiency.

After the efficiency value and financial performance were calculated, multiple linear regression was conducted to test the effect of operational efficiency on the financial performance of Islamic banks as measured by RGEC and EVIEWS tools. The regression model used is:

RGEC= α+β_1 Technical Efficiency+β_2 Scale Efficiency + ϵ

With RGEC as financial performance measured through risk, governance, earnings, and capital components, and Efficiency as the independent variable measured using DEA. To test the significance of the relationship between operational efficiency and financial performance, a p-value test is conducted, where a p-value <0.05 is considered significant.

IV. RESULTS AND DISCUSSION

A. Calculation of Operational Efficiency (X1 & X2) and Financial Performance (Y)

Operational Efficiency is calculated using deposits and labor costs as *inputs* and using total financing and total revenue as *outputs*. Variable X1 (technical efficiency) measures the extent to which banks utilize *inputs* to maximize *output*, while X2 (scale efficiency) measures efficiency based on the scale of bank operations. Y is financial performance measured using the RGEC approach. *Risk* value is calculated using the ratio of *Financing to Deposit Ratio* (FDR), *Governance* using the ratio of *Good Corporate* Governance (GCG), *Earnings* using the ratio of *Returns non Assets* (ROA) and Capital using the ratio of *Capital Adequacy Ratio* (CAR).

Table 4.1: X1, X2 and Y variable data

Name	Period	X1 (Technical Efficiency)	X2 (Scale Efficiency)	Y (Financial Performance)
BRIS	2019 S1	100	32,1	**0,739959**
	2019 S2	63,1	31,3	**-0,2497**
	2020 S1	64,2	93,7	**-1,13946**
	2020 S2	100	100	**-0,89852**
	2021 S1	38,4	44	**-0,29252**
	2021 S2	23,8	63,4	**-0,23888**
	2022 S1	67,6	73	**-0,34224**
	2022 S2	42,2	90	**-0,24225**
	2023 S1	74,5	82	**-0,28366**
	2023 S2	66,3	87,4	**-0,24257**
	Average	**64,01**	**69,69**	**-0,319**
BTPS	2019 S1	100	88,9	**0,082509**
	2019 S2	100	100	**0,236016**

	2020 S1	100	100	**0,023957**
	2020 S2	100	100	**0,282781**
	2021 S1	100	53	**0,230699**
	2021 S2	100	100	**-0,02282**
	2022 S1	100	84,4	**0,22812**
	2022 S2	100	100	**0,760258**
	2023 S1	100	100	**0,141976**
	2023 S2	100	100	**0,221086**
	Average	**100**	**92,63**	**0,21846**
PNBS	2019 S1	100	100	**0,002706**
	2019 S2	100	100	**-0,04305**
	2020 S1	100	100	**-0,03028**
	2020 S2	100	88,8	**0,108111**
	2021 S1	100	100	**0,248003**
	2021 S2	100	100	**0,449574**
	2022 S1	72,6	100	**0,052208**
	2022 S2	100	100	**0,19409**
	2023 S1	100	100	**-0,153**
	2023 S2	100	100	**0,176915**
	Average	**96,95**	**98,75**	**0,0920**

Source: Data Processed

From table 4.1, it can be seen that Bank Syariah Indonesia (BRIS) has an average technical efficiency of 64.01%, scale efficiency of 69.69% and financial performance of -0.319. Then Bank BTPN Syariah (BTPS) has an average technical efficiency of 100%, scale efficiency of 92.63% and financial performance of 0.21846. Finally, Bank Panin Dubai Syariah (PNBS) has an average technical efficiency of 96.95%, scale efficiency of 98.75% and financial performance of 0.0920.

B. Descriptive Statistics

Table 4.2: Descriptive Statistical Value of Count Variables

	X1 (Technical Efficiency)	**X2 (Scale Efficiency)**	**Y (Financial Performance)**
mean	87,09	87,06667	**1,72085**
min	23,8	31,3	**-1,13946**
max	100	100	**0,760258**
STD	21,73439	20,68815	**0,384812**

Source: Data processed

From table 4.2 it can be seen that the mean (average) value of technical efficiency is 87.09 with a standard deviation value of 21.73439 where the value is smaller than the mean which means that the data distribution is stable and concentrated. Similarly, the scale efficiency where the mean value is 87.06667 with a standard deviation value smaller than the mean value of 20.68815 indicates that the data distribution of this variable is stable and concentrated.

C. Panel Data Regression Analysis

Data analysis begins with model selection using the Chow test, Hausman test and Lagrange Multiplier test if no suitability is found during the Chow test and Hausman test. Model selection is carried out with the aim of finding the best model that can produce the best data interpretation. After model selection, proceed with the classical assumption test, namely multicollinearity test and heteroscedasticity test.

D. Chow Test

Redundant Fixed Effects Tests
Equation: Untitled
Test cross-section fixed effects

Effects Test	Statistic	d.f.	Prob.
Cross-section F	5.917498	(2,25)	0.0079
Cross-section Chi-square	11.627176	2	0.0030

Figure 4.1: Chow test results

Source: Data Processed

Based on Figure 4.1, it can be seen that the Prob value of 0.0030 is smaller than 0.05, so the selected model based on the Chow Test is the *Fixed Effect Method* (FEM) model.

E. Hausman Test

Correlated Random Effects - Hausman Test
Equation: Untitled
Test cross-section random effects

Test Summary	Chi-Sq. Statistic	Chi-Sq. d.f.	Prob.
Cross-section random	11.834996	2	0.0027

Figure 4.2: Hausman Test Results

Source: Data Processed

Based on Figure 4.2, it can be seen that the prob value is 0.0027 <0.05, so in the Hausman Test the selected model is the *Fixed Effect Method* (FEM) model.

Since the results of the Chow and Hausman tests are appropriate, the best model selected is the FEM model. The selection of the Fixed Effects Model indicates that the unique characteristics of each bank may affect their efficiency and financial performance. Therefore, the FEM model is considered appropriate to capture these differences.

F. Normality Test

The normality test is carried out with the aim of testing whether the residual variables or confounding variables have a normal distribution (Ghozali in Sifki & Dalimunthe, 2022).Sifki & Dalimunthe, 2022)). In this study, the normality test was carried out using the *Jarque-Bera* normality test method where the probability value must be> 0.05.

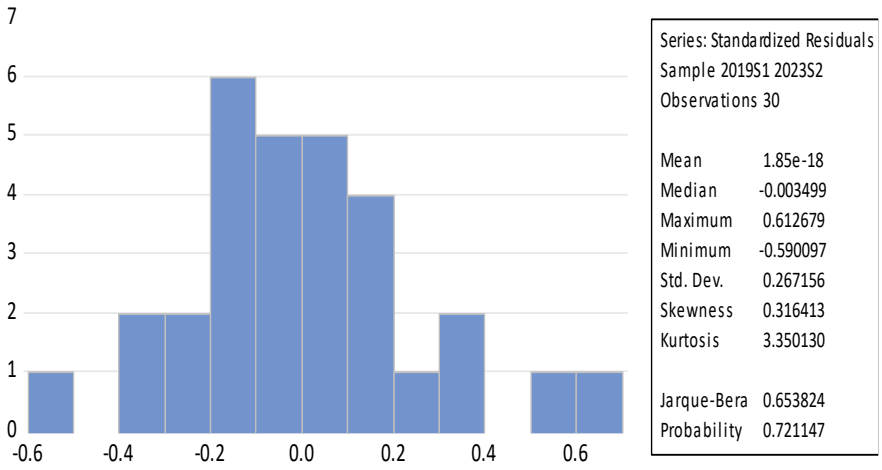


Figure 4.3: Normality Test Results

Source: Data Processed

In Figure 4.3, it can be seen that the probability value is 0.721147>0.05, which means that the data is normally distributed.

G. Multicollinearity Test

According to Ghozali in Noval & Aisyah (2021)Multicollinearity test is carried out to determine whether or not there is a correlation between independent variables. In this study, the multicollinearity test was carried out using the *Pair Wise Colleration* method where the correlation coefficient value must be <0.80.

	X1	X2
X1	1.000000	0.468995
X2	0.468995	1.000000

Figure 4.4: Multicollinearity Test Results

Source: Data Processed

From Figure 4.4, it can be seen that the correlation between X1 and X2 is 0.468995 <0.80 so it can be concluded that the variables X1 and X2 are free from the Multicollinearity test.

H. Heteroscedasticity test

Heteroscedasticity test is needed to determine whether in the regression model there is an inequality of residual variance from one observation to another. In this study, the heteroscedasticity test was carried out using the Glesjer Test method where if the prob. value> 0.05 then there are no symptoms of heteroscedasticity.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.054355	0.228044	-0.238354	0.8135
X1	0.003947	0.002017	1.957003	0.0616
X2	-0.000991	0.001755	-0.564724	0.5773

Figure 4.5: Heteroscedasticity Test Results

Source: Data processed

From Figure 4.5 it can be seen that the prob value. X1 is 0.0616> 0.05 and the prob value. X2 is 0.5773> 0.05, so it can be concluded that the variables are free from the heteroscedasticity test.

I. Multiple Linear Regression Equation Results *Fixed Effect Method* (FEM)

Multiple linear regression is performed to measure the relationship between the independent variable and the dependent variable (Wibisono 2015: in Sifki & Dalimunthe, 2022).). In this study, there are two independent variables, namely technical efficiency and scale efficiency, and one dependent variable, namely financial performance.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.595508	0.415768	1.432307	0.1644
X1	0.002777	0.003677	0.755213	0.4572
X2	-0.009617	0.003199	-3.006241	0.0059

Figure 4.6: FEM Model Analysis Results

Source: Data Processed

Based on Figure 4.6, a multiple linear regression equation Y = 0.5955082 + 0.002777 * X1 - 0.009617 * X2 can be obtained. The constant value obtained is 0.5955082, which means that if the independent variable increases by one unit on average, an increase of 0.5955082 will also occur in the dependent variable. The regression coefficient value of variable X1 is positive (+) of 0.00277, this result means that if variable X1 increases by 0.00277, variable Y will also increase by 0.00277, the opposite applies.

The regression coefficient value of the X2 variable is negative (-) of 0.0096. These results can be interpreted that if there is an increase of 0.00961 in the X2 variable, the opposite will occur a decrease of 0.00961 in the Y variable, and vice versa.

J. T Test (Partial)

Based on Figure 4.6, the analysis using the *Fixed Effect Method* (FEM) model found that the t-statistic value of Variable X1 is 0.755 with a prob. (significance) value of 0.4572 (>0.05) which means that there is no significant influence between Variable X1 on Variable Y. The findings on Variable X2 have a t-statistic value of -3.006 with a prob. (significance) value of 0.005 (<0.05), so it can be concluded that the X2 variable has a significant negative effect on Variable Y.

K. F Test (Simultaneous)

Effects Specification			
Cross-section fixed (dummy variables)			
R-squared	0.534082	Mean dependent var	3.33E-11
Adjusted R-squared	0.459535	S.D. dependent var	0.391391
S.E. of regression	0.287736	Akaike info criterion	0.497466
Sum squared resid	2.069801	Schwarz criterion	0.730999
Log likelihood	-2.461986	Hannan-Quinn criter.	0.572175
F-statistic	7.164383	Durbin-Watson stat	1.567527
Prob(F-statistic)	0.000548		

Figure 4.7: F Test Results

Source: Data Processed

In Figure 4.7, it can be seen that the f-statistic value is 7.164383 with a prob. (F-statistic) value of 0.000548 (<0.05), this means that the Independent variable (X) technical efficiency and scale efficiency have a significant effect simultaneously on the Dependent Variable of financial performance (Y).

L. Test Coefficient of Determination (R)

The coefficient of determination is a measuring tool for how far the ability of a model to describe variations in the dependent variable. From Figure 4.7, it can be seen that the *Adjusted R. Square* value is 0.459535, so it can be concluded that the contribution of the influence of the Independent variable on the dependent variable simultaneously (simultaneously) is 45.9%. This means that technical efficiency and scale efficiency using savings *inputs* and labor costs and *outputs* in the form of total financing and total income, can explain financial performance by 45.9%. While the other 54.1%, explained by other variables not used in this study.

M. The Effect of Technical Efficiency on Financial Performance

The analysis found that technical efficiency has no significant influence on the financial performance of Islamic banks listed on the Indonesia Stock Exchange during the study period. With a t-statistic value of 0.755 and a *p-value* of 0.4572 (>0.05), this result means that the first hypothesis (H1) is rejected and indicates that changes in the level of technical efficiency of banks are not necessarily followed by significant changes in financial performance.

Technical efficiency relates to the company's ability to maximize *output* by using existing *inputs* optimally. In the banking industry, technical efficiency shows how well a bank utilizes resources in obtaining maximum revenue. Banks that have achieved optimal technical efficiency are able to avoid wasting resources, which in turn supports the financial stability of the bank. Islamic banks in this study are expected to be able to optimize the use of deposits and labor costs (*inputs*) to produce higher financing and total income (*outputs*). However, the results that show that technical efficiency has no significant effect on financial performance, can be interpreted that although bank management has maximized the use of *inputs* used it does not directly affect the financial performance of Islamic banks on the Indonesia Stock Exchange. In the signaling theory by Ross (1977), companies can send signals to external parties regarding the quality of management and the company's prospects through the information they convey. In this study, technical efficiency should be able to serve as a positive signal to investors and stakeholders, showing that banks are able to manage *inputs* optimally to produce efficient *outputs*.

From the perspective of agency theory, this finding can be interpreted that bank management (agents) potentially has not fully focused on the optimal utilization of resources to improve technical efficiency. This can be caused by several factors, such as greater management attention on network expansion or development than on optimizing the use of *inputs*. A potential factor that could explain this is that agents prioritize other stronger signals, such as financial risk management or good governance, which can indicate the stability and sustainability of bank operations.

Until this research is completed, there is no previous research that discusses the effect of technical efficiency on financial performance to corroborate or refute these findings. Similar studies only use the ratio of operating costs to operating income (BOPO) to find the effect of operational efficiency on financial performance, no breakdown of efficiency categories into technical efficiency and scale efficiency. One of them is the result of research by Andrayani (2018) using the BOPO ratio approach found that operational efficiency has a significant negative effect on financial performance, strengthening the findings of the effect of scale efficiency.

N. Effect of Scale Efficiency on Financial Performance

In contrast to technical efficiency, scale efficiency has a significant negative effect on financial performance, with a t-statistic value of -3.006 and a p-value of 0.005 (<0.05). This finding means that the second hypothesis (H2) is accepted and shows that an increase in scale efficiency tends to reduce the financial performance of Islamic banks in the research sample. That is, when banks increase their operational scale, their financial performance decreases.

Scale efficiency relates to the optimal operational size for a company to minimize its costs. In the banking industry, scale efficiency shows whether the scale of bank operations is too large, too small, or optimal to achieve the desired profitability. In this study, Islamic banks are expected to be able to optimize the use of deposits and labor costs (inputs) to produce financing and maximum total revenue (output) in accordance with the scale of operations carried out. This can be achieved when a bank achieves optimal scale efficiency, where operational costs can be reduced so that the bank can generate higher revenue with lower per unit costs.

According to signaling theory, signals sent by a firm to the market can influence the perception of investors and stakeholders. Optimal scale efficiency can provide a positive signal about the bank's ability to manage growth well. However, when scale efficiency shows negative results, as shown by this study, the signal sent is an indication that the scale of the bank's operations may have passed the optimal point and could potentially lead to *diseconomies of* scale. (Stimpert & Laux, 2011).. This could send a negative signal to investors that the bank's management may be inefficient in handling operational expansion, which could ultimately lower confidence in the bank's financial prospects. Excessive efficiency of scale leads to a greater increase in operating costs than the increase in revenue, which results in a decrease in profitability. Literature by Banker et al. (2003) mentioned that too large an operating scale can be a burden if not balanced with appropriate efficiency strategies.

From an agency theory perspective, bank management (as agents) have the responsibility to manage the scale of bank operations with the aim of maximizing the interests of owners or shareholders (principals). However, there is a potential conflict of interest between agents and principals that can influence management's decision to expand the scale of operations. Management could potentially be driven to increase the scale of bank operations not for efficiency reasons, but to strengthen reputation or secure personal incentives associated with expansion. This may occur if management sees that increasing the size of the bank increases their profile or position in the industry, which benefits them personally but may hurt the bank's performance in the long run.

The findings of this study are in line with the findings of previous studies. By using the operating cost to operating income (BOPO) ratio approach, the results found are that operational efficiency has a significant negative effect on financial performance. (Andrayani, 2018; Ariani & Prinoya, 2021; Sahabuddin & Amelia Rahman, 2022).. The practical implication of this finding is that Islamic banks need to consider the right operational scale to maintain efficiency and not operate on too large a scale that can become a financial burden.

CONCLUSIONS

From the discussion of the results of this study it can be concluded that:

1. Technical efficiency partially has no significant effect on the financial performance of Islamic banks listed on the Indonesia Stock Exchange for the period: 2019-2023.
2. Scale efficiency partially has a significant negative effect on the financial performance of Islamic banks listed on the Indonesia Stock Exchange for the period: 2019-2023.
3. Simultaneously, technical efficiency and scale efficiency have a significant effect on the financial performance of Islamic banks listed on the Indonesia Stock Exchange for the period: 2019-2023.

The findings of this study indicate that increasing technical efficiency alone is not enough to boost the financial performance of Islamic banks. On the other hand, Islamic banks need to be vigilant in expanding operational scale in order not to burden financial performance. To maintain optimal financial performance, Islamic banks are advised not only to focus on operational scale growth,

but also on more comprehensive efficiency management such as controlling operational costs and implementing better governance strategies.

ACKNOWLEDGMENT

Despite the results that have been presented, certain limitations that exist in this study need to be considered. Limitations such as a short research period, a limited number of samples and a small number of *input* and output variables may not be able to accurately explain the actual situation. Therefore, the researcher suggests increasing the period of analysis, using a different approach, increasing the sample, adding *input* and *output* variables or considering external factors that might affect financial performance in order to enrich the research treasure.

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