



Article

Does Equity Matter for Efficiency? A Stochastic Frontier Approach to Examining Economies of Scale in Islamic Banks in Indonesia

¹ Adinda Mialatin and ² Priyonggo Suseno

^{1,2} Islamic Indonesia University, Indonesia

*Corresponding author: 20313238@students.uui.ac.id

ABSTRACT

In general, one way to improve banking efficiency is by increasing the business scale. However, whether increasing the scale of sharia banking businesses will improve their performance needs to be studied more rigorously. This research aims to measure the level of efficiency and examine the occurrence of economies of scale of Islamic commercial banks in Indonesia during the period 2017 - 2022. The level of efficiency is measured using the stochastic frontier approach (SFA) method, while the economies of scale is measured using a panel data regression approach with four business scale measurements: total assets, total financing, total deposits, and total equity. This research is based on annual data on 12 Islamic commercial banks. Using a value range between zero and 1, the results of this study show an average cost efficiency in Islamic banking of 0.69 to 0.84. During the five years observation period, 2017-2022, the level of efficiency experienced a significant decline during the Covid-19 pandemic, especially in the third quarter of 2020. In addition, this research found that economies of scale work in Islamic banks when the size is measured by equity, but there are diseconomies of scale if the size is measured by total financing or total deposits, and there is no economy of scale if the size is measured by total liabilities. The implications of this research are related to sharia banking efficiency development policies which are not always related to increasing business scale, but need to pay attention to measuring the right business scale.

Keywords: Economies of Scale; Islamic Commercial Banks; Stochastic Frontier Analysis

JEL Classification: A15; B12; V6

How to cite: Mialatin, A., Suseno, P. (2024). Does equity matter for efficiency? A stochastic frontier approach to examining economies of scale in Islamic banks in Indonesia. *Proceeding International Conference on Islamic Economics and Business (ICIEB), 2024, 3(1)*, pp. 191-211. DOI: <https://doi.org/10.14421/icieb.2024.3.1.1489>

INTRODUCTION

The development of Islamic banks has improved growth of not only the banking system, but also the financial system and economic growth (Rizvi, Narayan, Sakti, and Syarifuddin, 2020; Mensi, Hammoudeh, Tiwari, and Al-Yahyaee, 2020). In some Moslem majority countries, the banking industry has been moving towards a dual banking system where financial activities can be carried out through two activities including interest-based banking and non-interest-based banking.

The adoption and implementation of sharia banking in various countries is found to be not limited to religious sentiment, but rather the superiority of bank-specific factors such as size, sector and legal status. (Mertzanis, 2016). The

non-economic institutions, social and cultural factors across regions play an important role in predicting the growth of Islamic banks.

As the most populous Moslem country, Indonesia posits at the third top rank on the Islamic Finance Development Indicators (IFDI), below Saudi Arabia and Malaysia (CID-Refinitiv, 2022). The development and growth of Islamic banks in Indonesia has been quite surprising for the last three decades. From one Islamic bank in 1992 to 11 full-fledged Islamic bank and 14 Islamic banking windows in 2023. The assets of Islami banks also have been growing tremendously, from 7.86 trillion rupiah in 2003 to 456.50 trillion rupiah in 2016 and 845,61 trillion rupiah in 2023 (FSA, 2024).

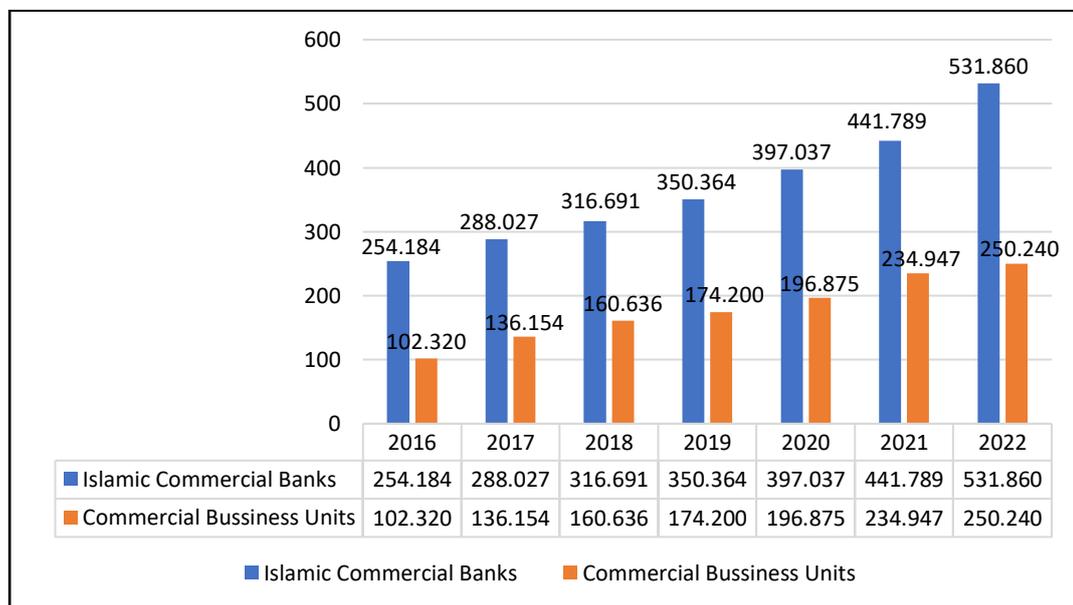


Figure 1

The Total Assets of Islamic Commercial Banks and Unit Commercial Banks (Source, 2023)

As shown at Figure 1, the asset's growth of Islamic fully-pledged banks is higher than that of Islamic windows. The growth of Islamic banks in Indonesia has been supported by policies and strategies implemented by several banks to raise funds from the public in order to support global

economic growth. One of the strategies implemented is through a merger of two a fully-pledged Islamic banks (i.e. Bank BRI Syariah and Bank Mandiri Syariah) and one Islamic window (i.e. Bank BNI Syariah), into a fully-pledged Islamic

bank, i.e. Bank Syariah Indonesia (BSI), on January 27, 2021.

Post-merger Islamic bank assets grow faster than before, as shown at Figure 1, from 13.95% in 2021 to 15.57% in 2022. As seen at Figure 2, the

asset of BSI bank always grows during the whole periods 2016-2022. However, pandemic Covid-19 has lowered the asset growth, even though it can be recovered fast, especially after merger policy.

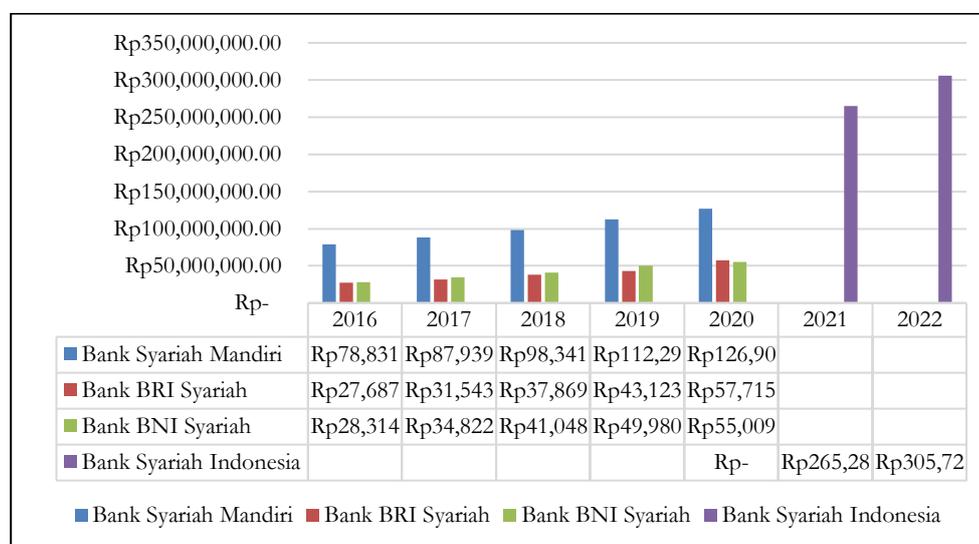


Figure 2

The Asset Growth Before and After the Merger at PT Bank Syariah Indonesia (Source, 2023)

On the one hand, the growth of Islamic bank assets reflects the development of the Islamic banking industry. However, on the other hand, this asset growth does not necessarily mean an improvement in financial performance, such as efficiency and profitability. An inter-bank merger strategy, such as the merger carried out by BSI Bank in 2021, will directly increase the bank's business scale, but this will not necessarily increase efficiency or other financial performance.

Economists have studied the existence of economies of scale in banks for decades. However, until now this research is still in ambiguous territory. The financial crisis and its impact and efforts to reform financial regulations have raised attention to this topic among economists and others. It has been argued that some banks have grown too large and that such size has come at a huge cost to society—including government bailouts—many prominent

observers have advocated breaking up the largest banks. Proponents of this split argue that the economic literature does not find that “big” means more efficient for banks. In other words, they argue that research shows that this is significant in the financial industry because overall economies of scale do not exist (Fieldman, 2010). Mester, DeYoung and Fieldman (2010) came to the same general conclusion, that there are still important unanswered questions about economies of scale in banking. Research that provides answers to such questions will be of great benefit.

In the case of Islamic banking, some research has been conducted to examine the relationship between Islamic banking asset growth and efficiency. In the context of the impact of asset growth on the efficiency of Islamic banks, much research has also been done, but there are no uniform findings. For example, some studies found

that there is a positive influence of bank assets on the level of efficiency or the emergence of economies of scale in Islamic banks (Suseno, 2008; Suhel, 2011; Amalo, 2012; Candra et. al, 2015; Edward, 2015). On the other hands, however, economies of scale do not work either in conventional banks (Humprey, 1990) or Islamic banks (Ascarya et. al, 2006; Pambuko, 2016; Rusydiana et. al, 2019).

Until now, the efficiency and economic scale of Islamic banking has been the focus of research. However, previous research results show non-uniform results regarding whether economies of scale apply to the Islamic banking industry. Regulations and policies for increasing bank assets, such as mergers, need to be studied first regarding the impact of increasing assets on efficiency levels. In other words, it is necessary to study whether increasing the size of sharia banking businesses has a positive effect on economic scale. Therefore, more in-depth research is needed to assess whether or not the economic scale of Islamic banking applies. The main objective of this research is to examine whether or not there are economies of scale in Islamic commercial banks and the structural influence of the Covid-19 pandemic on the efficiency of Islamic commercial banks using the Stochastic Frontier Analysis Approach.

LITERATURE REVIEW

Economics of Scale Theory

Economies of scale refers to financial advantages of producing something in very large quantities, or falling average cost when producing more goods or services (Besanko, Dranove, Schaefer & Shanley, 2017). According to economist Marshall (1890), economies of scale can arise from internal and external aspects. On one hand, internal economies of scale occur when a company utilizes its existing potential to gain

profit by producing goods in sufficient quantity and selling them at relatively low prices. These economies are usually achieved by large companies capable of purchasing raw materials in large quantities and at low prices. However, internal economies of scale can also be achieved by companies that improve technology, find cheaper labor, or have the ability to obtain cheaper capital.

External economies of scale, on the other hands, refers to economies of scale that originate from outside the company. These economies of scale arise when the average cost for each company decreases as the industry output increases. External economies of scale are important in driving the economic growth of an industry in a specific region (such as government infrastructure development) which can reduce costs. This is why external economies of scale are generally concentrated in the same geographical areas.

According to economist Alfred Marshall (1890), economies of scale are divided into two types: internal economies of scale and external economies of scale.

1. Internal Economies of Scale

Internal economies of scale occur when a company utilizes its existing potential to gain profit by producing goods in sufficient quantity and selling them at relatively low prices. These economies are usually achieved by large companies capable of purchasing raw materials in large quantities and at low prices. However, internal economies of scale can also be achieved by companies that improve technology, find cheaper labor, or have the ability to obtain cheaper capital.

2. External Economies of Scale

External economies of scale refer to economies of scale that originate from outside the company. These economies of scale arise when

the average cost for each company decreases as the industry output increases. External economies of scale are important in driving the economic growth of an industry in a specific region (such as government infrastructure development) which can reduce costs. This is why external economies of scale are generally concentrated in the same geographical areas.

There are some dimensions of economics of scale, include: (Bamford, Colin & Grant, Susan, 2014)

1. Technical economies, which refer to the direct benefits obtained in the production process. Some production techniques can only be performed at certain production levels.
2. Purchasing economies occur as the scale of the company increases, allowing them to increase purchasing power with suppliers through bulk purchases, thus obtaining cheaper inputs and reducing costs.
3. Marketing economies refer to promotional activities where large-scale companies can promote products through media. Therefore, companies can save distribution costs because they send their products in large quantities.
4. Managerial economies usually occur in large-scale companies due to specialization. Specialists can be employed to manage company operations, finances, human resources, sales, logistics, and so on. In contrast, small-scale companies usually employ multitasking specialists but do not maximize company management. Therefore, cost savings occur when hiring expert labor.
5. Technological economies refer to the utilization of technology to reduce costs. This can also reduce the number of people employed and reduce average costs.

There are some dimensions of economics of scale, include: (Bamford, Colin & Grant, Susan, 2014)

1. Technical economies, which refer to the direct benefits obtained in the production process. Some production techniques can only be performed at certain production levels.
2. Purchasing economies occur as the scale of the company increases, allowing them to increase purchasing power with suppliers through bulk purchases, thus obtaining cheaper inputs and reducing costs.
3. Marketing economies refer to promotional activities where large-scale companies can promote products through media. Therefore, companies can save distribution costs because they send their products in large quantities.
4. Managerial economies usually occur in large-scale companies due to specialization. Specialists can be employed to manage company operations, finances, human resources, sales, logistics, and so on. In contrast, small-scale companies usually employ multitasking specialists but do not maximize company management. Therefore, cost savings occur when hiring expert labor.
5. Technological economies refer to the utilization of technology to reduce costs. This can also reduce the number of people employed and reduce average costs.

On the other hand, Diseconomies of scale occur when the average cost per unit increases over a certain period as the quantity of production continues to increase. The causes of diseconomies of scale include: (1) bureaucratic systems implemented by a country, (2) high labor wages due to a lack of skilled labor, (3) increasing distribution costs due to traffic congestion, (4) limited land availability resulting in increased

fixed costs (land rent). Generally, diseconomies of scale occur when a company increases its scale of operations but is not managed effectively and efficiently, resulting in losses. (Carpenter & Senders in Gozali (2009).

One of the factors used as a benchmark in assessing economies of scale is efficiency. Efficiency can be viewed from two perspectives: cost efficiency and profit efficiency.

The best measurement, according to Berger & Mester (1997), utilizes profit efficiency as it considers inefficiencies from both cost and profit perspectives. However, this research employs cost efficiency because it requires other variables related to the role of banks in carrying out intermediation functions in Indonesia.

Through parametric methods, there are two efficiency measurement approaches: (1) Traditional approach, such as ratios, ROA (return on assets), CAR (capital adequacy ratio), and profitability ratios. (2) Frontier approach, which includes deterministic approaches like data envelopment analysis (DEA) and stochastic approaches such as stochastic frontier analysis (SFA) and distribution-free approach (DFA). According to Coelli in Rabbaniyah (2019), the SFA approach has advantages over other methods because it involves a disturbance term representing disturbances, measurement errors, and other uncontrollable errors. Another reason is that the use of SFA is easier to perform through hypothesis testing using statistics and in identifying outliers (Rabbaniyah & Afandi, 2019).

Economies of Scale in Banking

Economies of scale in banking occur when the duplication of output requires costs more than double. Economies of scale and diseconomies of scale occur when the proportion of inputs varies. Economies of scale in banking can be measured,

in part, by the level of efficiency (Jacewitz et al., 2020).

Knowledge of economies of scale is necessary for regulatory and management decision making. Because of its structure, the financial industry also provides us with an excellent source of data for measuring both cost and output functions. One of the main questions related to economies of scale concerns regulations, mergers, branching out, and some finance industry prices are regulated (partly due to assumptions about economies of scale), thereby requiring regulators to estimate costs. consequences of their decisions (Benston, 1972). A growing body of research supports the view that there are significant scale economies in banking. (Mester, 2010). Some researchers cite old literature that uses data from the 1980s and does not find economies of scale in banking. The consensus from previous studies is that only small banks have the potential for large-scale efficiency improvements and that these benefits are usually small. But more recent studies, using data from the 1990s and 2000s and bank production models that incorporate aspects of banking risk management, find significant economies of scale even at the largest banks in the sample (Feldman, 2010).

However, there are also many arguments and empirical research that do not know much about the existence of economies of scale in large banks. For example, Feldman (2010) and Robert DeYoung (2010) argue that the unique nature of today's large banks makes it difficult to apply statistical techniques to historical data to determine the extent of their economies of scale. Some recent studies, however, show that an increase in the size, through consolidation, could yield significant benefits in terms of cost efficiency for small and medium-sized banks, especially if accompanied by a more extensive

adoption of new technologies in the provision of services and a reorganization of the branch network (Patti & Ciocchetta, 2020).

Bank Scale of Operation

The scale of a bank's operations can be understood as the measure or dimension of the operations and activities carried out by a bank. It encompasses various factors such as the number of bank branches, the number of employees employed, the total assets of the bank, the volume

of funds managed by the bank (such as customer deposits and loans granted), and the revenue generated from various banking services and products. The larger the scale of a bank's operations, the greater its impact on the economy and society, as well as the more complex its operations become. Thus, measuring the scale of a bank's operations can provide an overview of the relative size and complexity of the bank within the banking industry (Wahyuni, n.d.).

Table 1
Literature Review

Source	Metode	Results
Suhel (2011)	Simple Regression	The findings of this study indicate an overall scale efficiency greater than 1. This implies that the Islamic banking industry demonstrates economies of scale.
Sendyvia Candra et al. (2015)	Two Stage SFA	The results of the study indicate that FDR (Funding Deposit Ratio) has a significant positive effect on efficiency levels, while other variables do not.
Mohammad Yunies Edward et al. (2015)	Data Envelopment Analysis (DEA)	The results of this study indicate that scale of operations significantly and positively influences banking efficiency levels.
Fitrianingsih Amalo (2012)	Data Envelopment Analysis (DEA)	The results of the study indicate that although BUS and UUS in Indonesia do not reach perfect efficiency levels, there are economies of scale in the banking industry in Indonesia.
Akhmad Afandi et al. (2023)	Panel Data Regression with SFA	The results of the study show that individually, BOPO (Operating Expense to Operating Income Ratio) has a significant positive impact on bank efficiency.
Meina Wulansari Yusniar (2011)	Data Envelopment Analysis (DEA)	The results of this study indicate that total assets, CAR (Capital Adequacy Ratio), NPL (Non-Performing Loans), and LDR (Loan to Deposit Ratio) have a positive and significant impact on influencing the efficiency level of banks. On the other hand, being publicly listed (Go Public) has a negative and significant impact on banking efficiency levels.
N. A. Rumiasih et al. (2018)	Stochastic frontier analysis (SFA)	The research results indicate that BSM falls into the high efficiency category with calculations yielding results close to the number 1.

Zulfikar Bagus Pambuko (2016)	Two Stage DEA with Tobit Models	The research findings indicate that in stage 1, there is still efficiency in Islamic banking during the period 2010-2013. Stage 2 testing shows that GCG has a negative and insignificant influence on the efficiency level.
Aam Slamet Rusydiana et al. (2019)	Data Envelopment Analysis (DEA) with Malmquist Productivity Index (MPI)	The research findings show that the average increase in productivity growth from 2010 to 2016 is very small. Therefore, overall, there is an inefficient increase in monitoring its costs.
Kartika Dewi et al. (2016)	Data Envelopment Analysis (DEA)	The research results indicate significant differences in efficiency levels among the three groups of banks. Differences in economies of scale are identified as one of the factors influencing efficiency levels between these groups.
Ivana Rosediana et al.(2020)	Two Stage SFA	The research shows that Islamic banks in Indonesia exhibit higher efficiency levels compared to those in Malaysia. This difference is also influenced by the specific Islamic banks under study. Meanwhile, among Brunei Darussalam, Thailand, and the Philippines, Brunei Darussalam's Islamic banks demonstrate the highest efficiency levels. Financing that enhances efficiency reflects a bank's capability to manage its operations more productively. Banks with high efficiency typically have lower costs associated with loans or financing.
Lathiefah Rabbaniyah et al. (2019)	Paramethic Method with SFA	The research results indicate the efficiency scores, with BNI Syariah in 2015 having the highest efficiency and BNI Syariah in 2010 and BCA Sharia non-foreign exchange banks in 2010 having the lowest efficiency scores.
Ascarya et al. (2006)	Two Stage SFA	The research results indicate inefficiency in the Rural Banks (BPR). This occurs because their business income is derived from non-profit-sharing margins.
Ascarya et.al (2010)	Data Envelopment Analysis (DEA) and Stochastic Frontier Approach (SFA)	The research findings indicate that through Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA), Islamic banking in Malaysia has progressed and achieved efficiency levels comparable to Islamic banking in Indonesia in 2006. However, according to DEA, Islamic banking in Indonesia shows higher efficiency levels.

METHODOLOGY

The research employs a quantitative approach with two measurements undertaken: technical efficiency (TE) measurement through the SFA method, followed by an assessment of economies of scale (SE) using panel data regression. The data used are secondary data sourced from the Financial Services Authority (FSA) and the official publication websites of individual banks as

complementary sources. The sample in this study comprises 12 Islamic commercial banks (ICB) in Indonesia.

The research conducts two stages of analysis: (1) calculating efficiency levels using the SFA approach, and (2) estimating economies of scale using multiple regression analysis. In broad terms, the research framework can be depicted as follows:

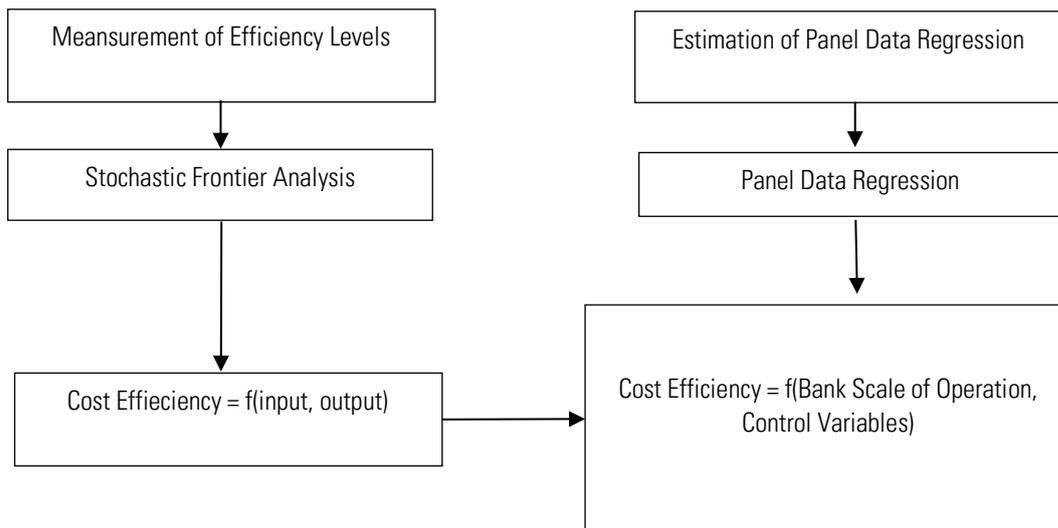


Figure 3
Schematic Diagram of the Study

Technical Efficiency Measurement (TE)

Technical efficiency (TE) can generally be defined as the effectiveness of using a certain

amount of inputs to produce outputs. The level of technical efficiency (TE) is typically measured by the formula:

$$TE = \frac{\text{The actual output given a specific input}}{\text{the maximal potential output given a specific input}} \times 100$$

This study employs four models of TE, including:

1. Model TE 1 is a measurement of technical efficiency considering financing heteroscedasticity.
2. Model TE 2 is a measurement of technical efficiency considering liability heteroscedasticity.
3. Model TE 3 is a measurement of technical efficiency considering third party funds heteroscedasticity.

4. Model TE 4 is a measurement of technical efficiency considering capital heteroscedasticity.

This study employs a log-linear production function approach, considering that the required assumptions are not as strict as those in Cobb-Douglas, such as homogeneous or neutral technology, and there should be no zero observation values. Therefore, the production cost function (C):

$$C = c(y, w, z, u, e)$$

Where C measures the total bank cost, y is the output vector, w is the input price vector, z represents a set of bank parameters, u is an inefficiency term that describes the difference between the efficient cost level for a given output level, input price, and actual cost, and e is the level of error term.

The production cost function transformed into logarithmic function as follow:

$$\ln C = f(y, w, z) + \varepsilon$$

The equation to estimate the cost is:

$$\begin{aligned} \ln Cost_{st} &= \alpha_0 + \sum_{i=1}^2 \alpha_i \ln y_{ist} \\ &+ \frac{1}{2} \sum_{i=1}^2 \sum_{k=1}^2 \alpha_{ik} \ln y_{ist} \ln y_{kst} + \sum_{j=1}^3 \beta_j \ln w_{jst} \\ &+ \frac{1}{2} \sum_{j=1}^3 \sum_{m=1}^3 \beta_{jm} \ln w_{jst} \ln w_{mst} \\ &+ \sum_{i=1}^2 \sum_{j=1}^3 \delta_{ij} \ln y_{ist} \ln w_{jst} + \sum_{t=1}^9 Z_{it} + v_{st} \\ &+ u_{st} \end{aligned}$$

After estimating the cost function, the cost efficiency for bank i is measured by the ratio

between the cost (C_{min}) required to produce the bank's output and the actual cost (C):

$$\begin{aligned} TI &= \frac{C_{min}}{C_i} \\ &= \frac{\exp[f(y, w, z)] x \cdot \exp(\ln \mu_{min})}{\exp[f(y, w, z)] x \cdot \exp(\ln \mu_i)} = \frac{\mu_{min}}{\mu_i} \end{aligned}$$

Where TI is technical inefficiency, and μ_{min} is the minimum value of μ_i across all samples.

Economies of Scale Measurement (SE)

Economies of scale are measured using a quadratic function between the level of efficiency and the scale of operations with the following equation:

$$\begin{aligned} SE_{ti} &= \delta_0 + \delta_{1i} \sum_{i=1}^4 \ln(Skala) \\ &+ \delta_{1i} \sum_{i=1}^4 \ln(skala)^2 + \delta_3 Z_t^i \\ &+ \varepsilon_t^i \end{aligned}$$

Where Z is control variable used NPF and Covid. While scale variable indicates the scale of operations consisting of financing, liabilities, Third Party Funds and capital.

Data in Variable

This research employs a quantitative approach with two measurements undertaken: technical efficiency (TE) measurement through the SFA method, followed by an assessment of economies of scale (SE) using panel data regression. The data used are secondary data sourced from the Financial Services Authority (FSA) and the official publication websites of individual banks as complementary sources. The sample in this study comprises 12 Islamic commercial banks (ICB) in Indonesia.

Table 2
Operational Definition of Variable

Variable	Indicator	Notation	Measurement Unit	Description
Cost Efficiency	Operational Costs	BO	Log(BO)	The operational costs of a bank are calculated from the profit and loss statement.
	Fixed Assets	AT	Log(AT)	Fixed assets are obtained from fixed assets and inventory before being reduced by accumulated depreciation on the balance sheet.
	Labor Costs	TK	Log(TK)	Labor costs are obtained from revenues and operating expenses on the profit and loss statement.
	Total Deposits	IT	Log(IT)	Total deposits obtained from the aggregate deposits reported on the bank's balance sheet.
Costs Efficiency	Technical Costs Efficiency	EB	$EB = \frac{C_{min}}{C_i}$	Calculation with SFA
Bank Scale of Operation	Total Financing	PT	Log(PT)	Provision for money or bills originating from profit-sharing financing in the bank's balance sheet.
	Third-party funds	DPK	Log(DPK)	Third-party funds are obtained from the total deposits and savings reported in the bank's balance sheet.
	Liability	L	Log(L)	Liabilities or bank loans commonly referred to as current liabilities originate from the total liabilities in the bank's balance sheet.
	Total Assets	AT	Log(TA)	The total assets owned by the bank as of December 31 are derived from the bank's balance sheet.
Management Quality	Assets Quality	NPF	NPF(%)	The asset quality calculated through financing, in this study,

				uses gross non-performing financing (NPF) which does not account for specific provisions and write-offs of productive assets (PPAP).
Shock/Impact	Covid-19	Covid	Dummy	"Value 0 before 2020 Q3 and 1 thereafter."

RESULT AND DISCUSSION

Result of Technical Efficiency (TE)

This study utilizes quarterly data from Islamic commercial banks (ICB) in Indonesia covering the period from January 2017 to December 2022, which has been published by the Financial Services Authority (FSA). The research method employs stochastic frontier analysis to calculate the economies of scale in Indonesian ICB.

Economies of scale are represented by the efficiency level of BUS based on the bank's ability to manage costs from the inputs and outputs used. The output variable (Y) used is operational costs represented by OC. Meanwhile, the input variables (X) used are total financing, labor costs, fixed assets, and total deposits. The sample variables used in the study are listed in the table below:

Table 3
Descriptive Statistical Analysis

Variables	N	Minimum	Maximum	Mean	Std. Dev Coefficient
Operational Cost	296	0	32.114.963	31.030.769,97	0,04
Labor	296	4158	4.849.593	354.863,09	1,68
Fixed Asset	296	13	4.861.000	650.533,45	1,70
Deposit	296	0	172.755.636	17.751.377	1,67

Table 1 shows the observation variables over 6 years (2017-2022) in Islamic Commercial Banks (ICB) in Indonesia. The output variable represented by BO in the table above indicates that out of 296 samples, the minimum value is Rp.0 and the maximum value is Rp 32.115 Trillion Rupiah.

The standard deviation coefficient, it shows 0.04 or 4% of the average of Rp 31.030 Trillion Rupiah. This value indicates that the distribution of operational costs in BUS in Indonesia is relatively even.

Labor costs as input variables show that out of 296 samples, the minimum value is Rp 4.2 Billion Rupiah and the maximum reaches Rp 4.849

Trillion. Looking at the standard deviation, it shows 1.68% of the average of Rp 354.863 Billion Rupiah. This indicates that labor costs among BUS in Indonesia are relatively uneven.

Fixed assets or fixed assets as input variables show that out of 296 samples, the minimum value is Rp 13 Billion Rupiah and the maximum reaches Rp 4.861 Trillion. Looking at the standard deviation, it indicates 1.70 from the average of Rp 650.533 Billion Rupiah. This indicates that fixed assets among BUS in Indonesia are relatively uneven.

Total deposits as input variables show that out of 296 samples, the minimum value is Rp 0 and the maximum reaches Rp 172.755 Trillion

Rupiah. Looking at the standard deviation, it indicates 1.67 from the average of Rp 17.751 Trillion Rupiah. This indicates that capital among BUS in Indonesia is relatively uneven.

Economies of scale are also measured using the scale of operations, where the scale of operations used in this study is:

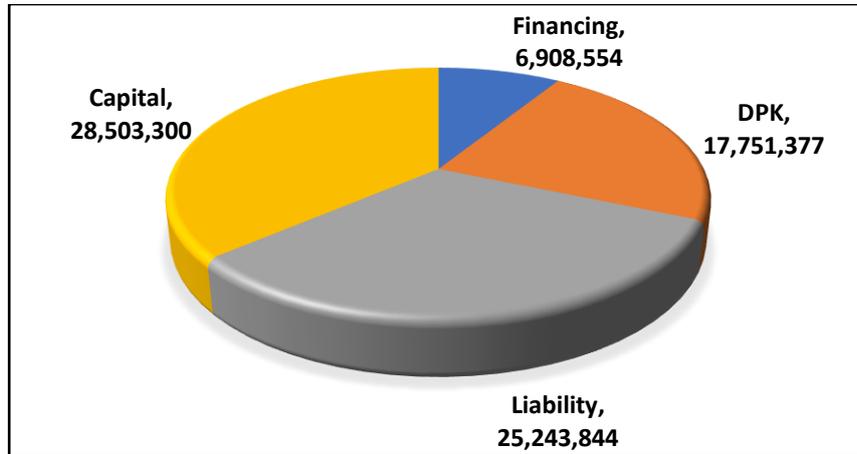


Figure 4
Average Value of Scale of Operations Variable in ICB

Figure 4 shows the average scale of operations values of ICB in Indonesia when viewed from financing, liabilities, third-party funds, and capital. The highest scale of operations value comes from bank capital, and the lowest comes from financing. This is because bank capital is the main driver in banking operational activities.

The results of the SFA calculation, referring to the three technical efficiency equations, are conducted by observing the values of technical efficiency between 0-1 where 0 indicates inefficiency and 1 indicates efficiency. This study is conducted considering the presence of heteroscedasticity when measured by financing, liabilities, deposits, and capital.

The Result of Technical Efficiency Calculation in Islamic Commercial Banks

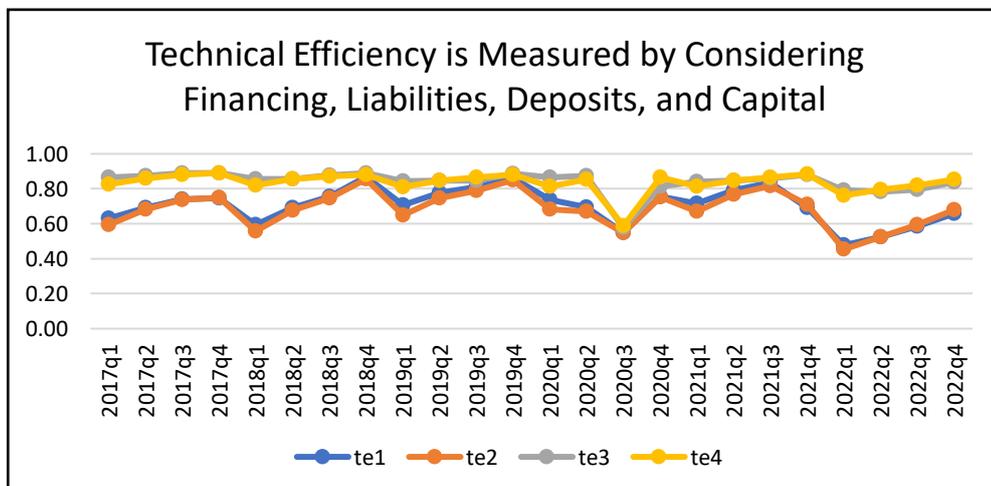


Figure 5
Technical Efficiency measured by considering financing, liabilities, deposits and capital

In Figure 5, the results of the analysis of technical efficiency measured by considering the heteroskedasticity of financing, liability, third party fund and capital are presented. It can be explained that the measurements through these four variables are as follows:

TE 1 = measurement of technical efficiency considering the heteroskedasticity of financing

TE 2 = measurement of technical efficiency considering the heteroskedasticity of liability

TE 3 = measurement of technical efficiency considering the heteroskedasticity of third-party funds

TE 4 = measurement of technical efficiency considering the heteroskedasticity of capital

TE 1 shows technical efficiency measured by considering the heteroskedasticity of financing where there is fluctuation in efficiency values that are less stable from 2017-2022. This is due to the influence of the national economic situation indicated based on constant prices. This can be seen from the financing efficiency in 2021 quarter 4 which increased until the end of 2022 quarter 4 in line with the increase in constant prices by 5.31% in 2022.

TE 2 shows technical efficiency considering the heteroskedasticity of liabilities, which also shows fluctuation that is less stable from 2017-2022. Similar to te1, however, the fluctuations in te2 are influenced by financing and are interrelated with liabilities.

TE 3 shows the value of technical efficiency measured by considering the heteroskedasticity of third-party funds (DPK). te3 indicates fluctuating technical efficiency but moves at almost the same or more stable efficiency level. However, in 2020 quarter 3, there was a decrease in efficiency to 0.58 in line with the economic situation at that time experiencing the Covid-19 pandemic crisis. This caused financing in the form of DPK to decline due to weakened economic turnover.

TE 4 shows the value of technical efficiency measured by considering the heteroskedasticity of capital, which shows a more stable balance from 2017-2019 because generally, the core capital of ICB comes from bank owners and has almost the same value every quarter. However, it began to fluctuate in 2020-2022 and significantly decreased in 2020 quarter 3 at 0.59, caused by the Covid-19 pandemic crisis leading bank owners to reduce capital due to declining trust in banks.

Table 4
Descriptive Statistical Analysis of Technical Efficiency

Variables	Observation	Mean	Std.Dev	Min	Max
TE 1	296	0,706	0,438	0	0,969
TE 2	296	0,689	0,415	0	0,964
TE 3	296	0,842	0,269	0	0,978
TE 4	296	0,835	0,239	0	0,962

Measurement TE 1 has a minimum efficiency value of 0 and a maximum of 0.969, with an average efficiency of 0.706 and a standard deviation of 0.438. Efficiency values approaching 1 indicate high efficiency in financing ratios. The

highest technical efficiency measured from the financing side was 0.969, which occurred at Bank Muamalat Indonesia in the second quarter of 2018.

TE 2 has a minimum efficiency value is 0 and the maximum is 0.964, with an average of 0.689 and a standard deviation of 0.415, lower than the measurement on the financing side. The highest technical efficiency measured from the liabilities side was obtained by Bank Muamalat Indonesia in the second quarter of 2018.

TE 3 has a minimum efficiency value is 0 and the maximum is 0.978, with an average of 0.842, higher than the measurements from the financing and liabilities sides. However, with a standard deviation of 0.269, which is lower than the measurements from the financing and liabilities sides. The highest efficiency measurement on the deposit side also occurred at Bank Muamalat Indonesia in the second quarter of 2018.

TE 4 has a minimum efficiency value is 0 and the maximum is 0.962, with an average of 0.830, which is high compared to measurements from the financing and liabilities sides but still lower than the measurement from the deposit side. A standard deviation of 0.239 indicates no significant difference between measurements

from the deposit and capital sides. The highest efficiency value was also obtained by Bank Muamalat Indonesia in the second quarter.

The four different measurements show the highest efficiency in the same bank, namely Bank Muamalat Indonesia (BMI) in the second quarter of 2018, because during that period BMI experienced a very high increase in bank profits, tripling the highest among all BUS at that time. According to sources from Bank Muamalat Indonesia (2018), this increase in profit is due to an increase in commission-based income or fee-based income (fbi), especially from the sale of securities, which significantly contributed to the increase in bank's operational profit. (Bank Muamalat Indonesia, 2018)

Economies of Scale Analysis in Islamic Banking in Indonesia

From the regression analysis of panel data on economies of scale using STATA/MP 17.0 software, the result can be rewritten by simplifying the four digits after the decimal point.

Table 1
The Result of the Stochastic Frontier Analysis

Independent Variables	Model-1	Model-2	Model-3	Model-4	Model-5	Model-6	Model-7	Model-8
	Coefficien							
t	t	t	t	t	t	t	t	t
financing	1.048				-0.173			
	(0.0668)				(0.286)			
l2financing	-0.148**				-0.005			
	(0.0742)				(0.569)			
liability		-0.050				-0.065		
		(0.561)				(0.715)		
l2liability		0.613				-0.050		
		(0.520)				(0.530)		
ldeposit			8.711				0.034	
			(6.613)				(0)	
l2deposit			-0.701**				0.002	
			(0.416)				(0.104)	
lcapital				-66.48***				-0.048
				(23.61)				(0)
l2capital				2.287***				-0.002
				(0.794)				(0.042)
Covid					1.103**	1.027	-9.263	-4.086
					(0.644)	(1.257)	(21.09)	(12.87)
NPF					-0.104	0.043	0.063	0.062
					(0.132)	(0.070)	(0.054)	(0.165)
constant	-2.374	8.633	-37.34	461.6***	-0.223	7.316	-1.923	-0.245
	(0)	(0)	(28.60)	(173.3)	(0.503)	(0)	(2.765)	(0)

observations	296	296	296	296	296	296	296	296
Number of Firm1	14	14	14	14	14	14	14	14

standard errors in parentheses
*** p<0.05, *p<0.1

Sources: Author Estimation (2024)

Table 3, it can be observed in Model 1 that diseconomies of scale occur when the independent variable is financing (Ifinancing), with a coefficient of the squared variable (I2financing) of -0.148. This indicates that as the level of financing increases, the level of technical inefficiency (TI) increases until reaching a certain peak and then decreases. In other words, technical efficiency (TE) decreases until a certain level and then increases.

Model 2, it is shown that economies of scale do not occur when the independent variable is liabilities (liability), and the coefficient of the squared variable (I2liability) does not have a significant effect on the level of technical inefficiency (TI).

Model 3 indicates that diseconomies of scale occur when the independent variable is deposits (deposit), with a coefficient of the squared variable (I2deposit) of -0.701. This suggests that as the level of deposits increases, the level of technical inefficiency (TI) increases until reaching a certain peak and then decreases. In other words, technical efficiency (TE) decreases until a certain level and then increases.

Model 4 shown that economies of scale occur when the independent variable is capital (Icapital), with a coefficient of -66.48 and a coefficient of the squared variable (I2capital) of 2.287. This indicates that as the level of capital increases, the level of technical inefficiency (TI) decreases. However, at a certain peak, it then increases. In other words, technical efficiency (TE) increases until a certain level and then decreases.

Model 5, it is shown that the variables covid and NPF affect economies of scale when the scale of operations is measured by financing. This indicates that the disruption caused by covid affects economies of scale in Islamic banking. This is shown by the non-significant regression coefficient on the scale of operations variable in

Model 5 when the covid and NPF variables are included as control variables.

Models 6 to 8, it is indicated that economies of scale do not occur when the independent variables financing (financing), liabilities (liability), deposits (deposit), and capital are influenced by control variables covid and NPF, and their squared coefficients are not significant. This indicates that the influence of the control variables covid and NPF renders economies of scale invalid in Islamic banking.

CONCLUSION AND RECOMMENDATION

Conclusion

Based on the analysis conducted regarding the influence of economies of scale in Islamic commercial banks (ICB), the following conclusions can be drawn:

1. The average cost efficiency level in ICB ranging from 0.69 to 0.84 generally indicates that it is still far from the maximum efficiency level of 1.0. The highest efficiency occurs at Bank Muamalat Indonesia in the second quarter of 2018.
2. Diseconomies of scale occur in ICB when the scale of operations is measured by the level of financing. This means that as the level of financing increases, the efficiency level decreases and then increases at a certain point.
3. There are no economies of scale in ICB when the scale of operations is measured by the level of liabilities. This indicates that the efficiency level in ICB is not significantly related to the amount of liabilities.
4. Diseconomies of scale occur in BUS when the scale of operations is measured by the level of Third Party Funds (DPK). This means that as the level of DPK increases, the efficiency level decreases and then increases at a certain point.

5. Economies of scale occur in ICB when the scale of operations is measured by the level of capital. This indicates that as the level of capital increases, the efficiency level increases according to the amount of capital of each bank.
6. Covid-19 affects economies of scale when the scale of operations is measured by financing.

This study has limitations, including incomplete sampling of Islamic commercial banks due to limited data availability, and the results of the study using the SFA method may be affected by the addition or subtraction of samples, leading to changes in the research findings. Therefore, it is recommended that future research related to economies of scale and banking efficiency explore other sectors to compare the results with previous studies.

REFERENCES

- Afandi, A., Suhel, S., & Syathiri, A. (2023a). Analisis Efisiensi Bank Umum Syariah di Indonesia (Studi Kasus Metode Stokastik Frontier). *Ekonomi, Keuangan, Investasi Dan Syariah (EKUITAS)*, 4(3), 869–876. <https://doi.org/10.47065/ekuitas.v4i3.2756>
- Afandi, A., Suhel, S., & Syathiri, A. (2023b). Analisis Efisiensi Bank Umum Syariah di Indonesia (Studi Kasus Metode Stokastik Frontier). *Ekonomi, Keuangan, Investasi Dan Syariah (EKUITAS)*, 4(3), 869–876. <https://doi.org/10.47065/ekuitas.v4i3.2756>
- Amalo, F. (2007). Analisis Efisiensi Teknis dan Skala Ekonomi Industri Perbankan Syariah di Indonesia. In *Java*.
- Anwar, M. (2019). Cost efficiency performance of Indonesian banks over the recovery period: A stochastic frontier analysis. *Social Science Journal*, 5(3), 377–389. <https://doi.org/10.1016/j.soscij.2018.08.002>
- Ascarya, & Yumanita, D. (2006). *Comparing the Efficiency of Islamic and Conventional Banks in Malaysia and Indonesia* (Vol. 18).
- Ascarya, & Yumanita, D. (2008). *Comparing the Efficiency of Islamic Banks in Malaysia and Indonesia*. 11.
- Ascarya, Yumanita, D., Achsani, N. A., & Rokhimah, G. S. (2010). Measuring the Efficiency of Islamic Banks in Indonesia and Malaysia using Parametric and Nonparametric Approaches. In *SBP-IRTI* (Vol. 18).
- Atmawadhana, A. (2006). *Analisis Efisiensi Bank Umum Syariah dan Bank Konvensional yang Memiliki Unit Usaha Syariah di Indonesia, Setelah Pemberlakuan Undang-Undang No.10 Tahun 1998 Tentang Perbankan (Pendekatan Data Envelopment Analysis)*.
- Belotti, F., Daidone, S., Ilardi, G., & Atella, V. (2012). Stochastic frontier analysis using Stata. In *The Stata Journal*.
- Berger, A. N., & Humphrey, D. B. (1997). Efficiency of financial institutions: International survey and directions for future research. In *European Journal of Operational Research* (Vol. 98).
- Brown, R. W. (1977). *Study of economies of scale in the savings and loan industry*. <https://scholarworks.umt.edu/etd>
- Candra, S., & Yulianto, A. (2015). Analisis Rasio Keuangan Terhadap Tingkat Efisiensi Bank Umum Syariah (Two Stage SFA). In *AAJ* (Vol. 4, Issue 4). <http://journal.unnes.ac.id/sju/index.php/aaaj>

- Candra, S., & Yulianto Jurusan Akuntansi, A. (2015). Accounting Analysis Journal Analisis Rasio Keuangan Terhadap Tingkat Efisiensi Bank Umum Syariah (Two Stage SFA). In *AAJ* (Vol. 4, Issue 4). <http://journal.unnes.ac.id/sju/index.php/aaaj>
- Culyer, A. J., & Newhouse, J. P. (2000). *Handbook of Health Economics Volume 1A*.
- Damar, N. D., Kumaat, R. J., & Mandei, D. (2021). Analisis Tingkat Efisiensi Bank Umum Di Indonesia Periode 2013:Q1-2018:Q4. In *Jurnal Berkala Ilmiah Efisiensi* (Vol. 21, Issue 7).
- Darlis, V., & Utary, D. T. (2022). *Determinan Efisiensi Bank Umum Syariah di Indonesia dengan Profitabilitas sebagai Pemoderasi*. 17(1), 20–39. <https://akuntansi.pnp.ac.id/jam>
- Dewi, I. R., & Fianto, B. A. (2020). Efisiensi Bank Syariah Asean Tahun 2013-2013: Two-Stage Stochastic Frontier Analysis. *Jurnal Ekonomi Syariah Teori Dan Terapan*, 7(3), 585. <https://doi.org/10.20473/vol7iss20203pp585-601>
- Dewi, K., & Siauwijaya, R. (2016). *Analisis Efisiensi Teknis Perbankan Di Indonesia* (Vol. 13, Issue 2).
- Edward, M. Y., & Anwar, A. Z. (2015). *Analisis Efisiensi Perbankan Syariah di Indonesia Periode 2010-2013*. 12.
- Gre, F. (2012). *Credit Unions and Commercial Banks over the Business Cycle*.
- Hadad, M. D., Santoso, W., Mardanugraha, E., & Illyas, D. (2003). *Pendekatan Parametrik Untuk Efisiensi Perbankan Indonesia*.
- Humphrey, D. B. (1990). *Why do Estimates of Bank Scale Economies Differ?*
- Humphrey, D. B. (1991). *Productivity in Banking and Effects from Deregulation*.
- Humphrey, D. B. (2009). *Payment Scale Economies, Competition, And Pricing*. <http://www.ecb.europa.eu>
- Jacewitz, S., Kravitz, T., & Shoukry, G. (2020). *Economies of Scale in Community Banks*.
- Karimah, S., Novianti, T., & Effendi, J. (2016). *Kajian Efisiensi Bank Umum Syariah di Indonesia Efficiency of Islamic Bank in Indonesia*. 4(1), 33.
- Kristin, A. P. (2019). Analisis Determinan Efisiensi Bank Umum Syariah Indonesia Dengan Variabel Moderating Profitabilitas. *MALIA: Journal of Islamic Banking and Finance*, 3(1).
- Kumbhakar, S. C., Wang, H.-J., & Horncastle, A. P. (2015). *A PRACTITIONER'S GUIDE TO STOCHASTIC FRONTIER ANALYSIS USING STATA*.
- Kurniati, E. (2016). *Skala Ekonomi, Produktivitas dan Bank Syariah di Indonesia*.
- Marsondang, A., Purwanto, B., & Mulyati, H. (2019). Pengukuran Efisiensi Serta Analisis Faktor Internal dan Eksternal Bank yang Memengaruhinya Measurement of Efficiency and Analysis of Bank Internal and External Factors that Affect It. *Jurnal Manajemen Dan Organisasi (JMO)*, 10(1), 48–62.
- Novarini. (2007). *Efisiensi Unit Usaha Syariah Dengan Metode Stochastic Frontier Analysis (SFA) Derivasi Fungsi Profit Dan BOPO*.
- Pambuko, Z. B. (2016). Determinan Tingkat Efisiensi Perbankan Syariah Di Indonesia: Two Stages Data Envelopment Analysis. In *CAKRAWALA: Vol. XI* (Issue 2).
- Prastyo, A., Setyo, P., Wahyudi, T., Ec, M., Ekonomi, F., & Bisnis, D. (n.d.). *Analisis Tingkat Efisiensi Perbankan Konvensional Dan Syariah Di Indonesia: Pendekatan Stochastic Frontier Analysis (SFA)*.
- Putri, M. R., & Sukmaningrum, P. S. (2020). Pengukuran Produktivitas Bank Umum Syariah Di Indonesia Dengan Indeks Malmquist. *Jurnal Ekonomi Syariah Teori Dan Terapan*, 7(7), 1264. <https://doi.org/10.20473/vol7iss20207pp1264-1275>

- Rabbaniyah, L., & Afandi, A. (2019a). *Analisis efisiensi perbankan syariah di Indonesia metode Stochastic Frontier Analysis* (Vol. 2).
- Rumiasih, N. A., & Enayatullah, H. (2018a). *Analisis Efisiensi Bank Syariah Mandiri Tahun 2010-2018 Dengan Pendekatan Stochastic Frontier Approach (SFA)*.
- Rumiasih, N. A., & Enayatullah, I. H. (2018b). *Analisis Efisiensi Bank Syariah Mandiri Tahun 2010-2018 Dengan Pendekatan Stochastic Frontier Approach (SFA)*.
- Rusydiana, A. S., Laila, N., & Sudana, S. (2019). Efisiensi dan produktivitas industri perbankan pada sistem moneter ganda di Indonesia. *Jurnal Siasat Bisnis*, 23(1), 50–66. <https://doi.org/10.20885/jsb.vol23.iss1.art5>
- Suhel. (2011). *Analisis Skala Ekonomis Pada Industri Perbankan Syariah Di Indonesia*.
- Suseno, P., & Suswadi. (2006). *Tingkat Efisiensi Industri Perbankan Syariah Di Indonesia*.
- Tarmidi, L. T. (2003). Krisis Moneter Indonesia : Sebab, Dampak, Peran IMF Dan Saran. *Buletin Ekonomi Moneter Dan Perbankan*, 1(4), 1–25. <https://doi.org/10.21098/bemp.v1i4.183>
- Wahyuni, S. (n.d.). *Mengukur Efisiensi Biaya Bank Syariah Menggunakan Stochastic Frontier Analysis Full Paper*.
- Yumanita, D., Achsan, N. A., & Rokhimah, G. S. (2008). *Comparing the Efficiency of Conventional and Islamic Banks in Indonesia using Parametric and Nonparametric Approaches* •.
- Yusniar, M. W. (2011a). Analisis Efisiensi Industri Perbankan di Indonesia dengan Pendekatan Data Envelopment Analysis (DEA) dan Faktor-Faktor yang Mempengaruhinya. *Analisis Efisiensi Industri Perbankan Di Indonesia Dengan Pendekatan Data Envelopment Analysis (DEA) Dan Faktor-Faktor Yang Mempengaruhinya, Vol.1 No.2*.
- Yusniar, M. W. (2011b). *Analisis Efisiensi Industri Perbankan Syariah di Indonesia dengan Pendekatan Data Envelopment Analysis (DEA) dan Faktor-Faktor yang Mempengaruhinya. 1*.
- Yusuf, M., & Muhajir. (2015). *Perhitungan Tingkat Efisiensi Bank Persero di Indonesia Periode 2015-2019 Dengan Pendekatan Non Parametrik Data Envelopment Analysis (DEA)*. <https://doi.org/10.24256>