Islamic bank efficiency: an efficiency method with SFA

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Abstract

Judging from the financial ratios, the performance of Islamic banking in Indonesia was remarkably stable both before and during the Covid-19 pandemic. However, another thing is whether this condition could make Islamic banks continue to work effectively. This study aimed to measure the cost efficiency of Islamic commercial banks in Indonesia quarter I of 2019 – quarter IV of 2020 and analyze the influencing factors in cost efficiency. The study used a saturated sampling technique with a total sample of 14 Islamic commercial banks, while the efficiency level was determined using the Stochastic Frontier Analysis (SFA) method. It turns out that PT. Bank Muamalat Indonesia Tbk. has the highest efficiency value of 0.9284. Several banks with an efficiency value of more than 0.5 are PT. Bank Aceh Syariah, PT. Bank BNI Syariah, and PT. Bank Mega Syariah. In this study, only inflation variables affect efficiency. In contrast, bank size, Return on Assets (ROA), Net Operating Margin (NOM), Non-Performing Financing (NPF), Financing to Deposit Ratio (FDR) variables, Capital Adequacy Ratio (CAR), Gross Domestic Product (GDP), and the rupiah exchange rate don't affect the efficiency. Overall, all the company's internal variables and environmental variables affect efficiency.

Keywords: *Cost efficiency, Islamic bank, Stochastic Frontier Analysis*

JEL Classification: [D24, E58, G21]

INTRODUCTION

Islamic finance is becoming increasingly important today because of its significant benefits (Diallo & Gundogdu, 2021; Shah et al., 2021). Especially the Islamic banking industry, which is growing rapidly. Bitar et al. (2017) stated that the Islamic financial industry worldwide had experienced significant growth since 25 years ago compared to conventional banking. At the same time, the S&P Global Ratings estimates that the financial industry will grow 10% -12% in 2021-2022 (S&P Global Ratings, 2021). The increasing growth of Islamic Banking has generated debate among policymakers and economists about the sustainability and performance of Islamic Banking (Majeed, 2021).

The first Islamic banking in Southeast Asia was formed in 1983 in Malaysia by Bank Islam Malaysia Berhad (Ghozali et al., 2019). Meanwhile, in Indonesia, the existence of Islamic banks was initiated in the 1980s through various discussions with the theme "Islamic Banks as Pillars of Islamic Economics," which was later supported

through the 1988 Banking Deregulation Policy Package (Pakto 88). Finally, in 1992 the Indonesian Ulema Council (MUI) established the first Indonesian sharia bank, PT. Bank Muamalat Indonesia (BMI). Since its first inception, there have been many changes. A series of policies were carried out to improve the performance of Islamic banks, with the enactment of several laws such as (i) Law No. 21 of 2008 concerning Islamic Banking, (ii) Law No. 19 of 2008 concerning Securities, State sharia certificate (Sukuk). This series of policies provided a legal umbrella and indirectly increased Islamic financial market activities (OJK, 2017).

Islamic banking in Indonesia has continued to grow since the enactment of Law No. 21 of 2008 concerning Islamic Banking. To date, the number of Sharia banks has increased to 11 entities. Islamic banking in Indonesia is one of the leading indicators of developing the Islamic financial economy. As an intermediary institution, banking operations are highly dependent on the community's economic conditions, especially amid the current Covid-19 pandemic, which has caused the government to issue several policies that impact the community's economy, indirectly affecting the Islamic banking's economic condition.

Economic conditions can be viewed from macroeconomic factors, such as Gross Domestic Product (GDP), inflation rates, and exchange rates. In 2019, Indonesia's GDP was deemed stable at 5.06 at the beginning of 2019 and fell at the end of the year to 4.96. It continued to decline until the 2nd quarter of 2020 to -5.32 and rose 3.13 points at the end of 2020 to -2.19 due to the impact of the Covid-19 pandemic. Not much different from GDP, inflation in Indonesia also fluctuated. In early 2019, inflation was recorded at 2.48 and continued to decline to 0.8 points at the end of 2020. Meanwhile, the Rupiah's exchange rate against the Dollar was not much different. In the middle of 2020, the Rupiah was recorded to depreciate up to Rp deeply. 16.6367,-/USD, hampering all economic activities.

The Covid pandemic has impacted financial stability and bank resilience, which depend on the bank's performance (Demir & Danisman, 2021). Even according to Elnahass et al. (2021), this pandemic has had a global impact on banking. Regarding banking performance, the pandemic affects some aspects of banking activities, such as savings. People will use existing funds for consumption rather than saving in banks. Apart from financing, people tend to have difficulty returning their loans to the bank. Of course, this situation has affected the growth of Return on Assets (ROA), Net Operating Margin (NOM) income, financing such as Financing to Deposit Ratio (FDR), Non-Performing Financing (NPF), and asset quality of Capital Adequacy Ratio (CAR). However, the research results of Shamshur and Weill (2019) state that increasing bank efficiency can encourage access to credit because the efficiency of large banks is significantly related to lower credit costs.

The Islamic financial system can increase bank financial stability and resilience to financial crises' effects (Rashid et al. (2017). In addition, the Global Financial Crisis (GFC) has focused attention on Islamic banking as an alternative business model for banking (Asmild et al., 2019). During a crisis, the research results by Parisi et al. (2021) show that the efficiency of Islamic banks is higher than conventional banks. Likewise, Yusuf et al. (2021) state that the efficiency of Islamic banks tends to be higher. This result is not in line with Miah & Sharmeen (2015), which shows that conventional banks are more efficient in managing costs than Islamic banks. Based on statistics, the growth of total financing and third-party funds (TPF), Islamic banking is still sound, where financing growth is at 7.15% with TPF growth of 9.74%. Although the growth of Islamic banks is considered quite good, this condition certainly causes banks to be more

careful in extending credit to the public, especially with limited inputs. Islamic banking is expected to be able to reduce the number of non-performing financing amid policies related to restructuring to ease creditors in settling their obligations.

The concept of the 'efficient frontier' is a central concept in the production economy, where the measurement is more stringent when compared to the measurement of financial ratios (Emrouznejad & Yang, 2018). According to Rabbaniyah & Afandi (2019), the efficiency performance parameters can show the company's entire performance. Efficiency is crucial for the proper functioning of the banking system (Martens et al., 2021; Rashid et al., 2020c). Meanwhile, Mohamed et al. (2020) confirm a gap between a bank's actual level of technical efficiency and its potential level.

We can use two methods to calculate the efficiency of Islamic banks: parametric and non-parametric. One of the parametric methods that can be used is the Stochastic Frontier Approach (SFA), while the non-parametric method that can be used is Data Envelopment Analysis (DEA) (Sun et al., 2023; Miah & Sharmeen, 2015). The SFA method has advantages over other methods because it first involves a disturbance term representing measurement error, disturbance, and exogenous shock. In addition, it allows hypothesis testing using statistics because environmental variables are easy to treat and identify outliers (Coelli, 2005). The statement is supported by Nguyen & Pham (2020), which aimed to examine the differences between parametric and non-parametric methods in measuring bank efficiency. They used the methods of Stochastic Frontier Analysis (SFA) and Data Envelopment Analysis (DEA). This study shows that the cost efficiency obtained with the Stochastic Frontier Analysis (SFA) model is more consistent than the cost efficiency with the Data Envelopment Analysis (DEA) model. So in this study, the Stochastic Frontier Analysis (SFA) model is used to measure efficiency. Sakouvogui (2020) compared DEA and SFA in banking in America. The results show that the cost efficiency measures of homogeneous SFA and DEA are substantially higher on average over time than heterogeneous US banks.

Research on efficiency using the SFA method can be used to examine banking performance, among others was done by Tri & Anh (2020) on 26 Vietnamese domestic banks through intermediation and a production approach. The study aimed to determine input and output variables, the results of which showed an efficiency value of 0.8. These results are not much different from the research by Wang et al. (2019). The latter showed that the efficiency of Vietnam's banking sector was between 0.8 to 0.9, and bank loans have a significantly negative effect on cost efficiency.

Another study related to efficiency by Chaity et al. (2021) found a relationship between bank efficiency regarding corporate governance guidelines and the extent of earnings management practices in the banking industry. The study results show that the efficiency level of banks in Bangladesh has an average of 80.84%. Besides that, the research results also show that bank efficiency is not affected by asset growth, bank size, or economic conditions.

Octrina & Mariam (2021) revealed that only two of eleven Islamic banks have an efficiency value close to 1. Besides, based on the influence test, the factors affecting Islamic banking’s efficiency in Indonesia comprised bank size, Financing to Deposit Ratio (FDR), Capital Adequacy Ratio (CAR), and Non-Performing Finance (NPF), while other variables had no effect. The bank efficiency level can be enhanced by increasing competition in the banking industry.

Hadhek et al. (2018) conducted a study on profit efficiency in 37 Islamic banks in 15 countries during 2005-2014, aiming to compare the efficiency level among various Islamic banks using input variables, such as labor, funds, physical capital, price of

labor, fund, and physical capital. Meanwhile, the output variables in the study were net loans and other earnings assets. In addition, another objective of their research was to determine explanative factors causing inefficiency and reducing profit efficiency by using variables such as macroeconomic variables (GDP per capita, inflation rate, population density) and efficiency determinants (size, capital adequacy, profitability, credit risk, operational costs). The results of this study indicated that the average level of profit efficiency was 25.7%, meaning that inefficient use of the bank's input would reduce profits by 74.3%, and only credit risk did not affect the Islamic banks' profit efficiency.

Furthermore, the hypothesis testing panel results showed that total savings significantly and positively affected financing and operational costs. In contrast, other operational costs had a positive and insignificant effect. By using a different t-test, it showed that there was no difference in the efficiency level comparison between Islamic banks and SBUs. This result aligns with Rabbaniyah & Afandi (2019), which showed no significant difference between the average efficiency value of Islamic banks' foreign exchange and non-foreign exchange during 2010-2016.

Kustanti & Indriani (2016) conducted a comparative analysis of 10 Islamic banks' efficiency and 5 SBUs during 2010-2014 using the SFA method. The study results indicated that total assets positively and significantly affected total financing. Meanwhile, operating costs nor labor costs did not affect total financing. The results showed no significant difference between the Islamic banks' and SBUs' efficiency, which was 0.43994 and 0.47654 for Islamic banks and SBUs, respectively. This value indicated the inefficient Islamic banking in Indonesia. These results do not align with Chowdhury's research (2022), which shows that Islamic banks are better in terms of overall technical efficiency when compared to commercial banks.

Sufian & Kamarudin (2015) examined the Islamic banks' efficiency in Southeast Asian countries operating in Malaysia, Indonesia, and Brunei Darussalam. This study investigated the potential internal (bank-specific) and external (macroeconomic and industry-specific) factors affecting Islamic banks' income efficiency. Empirical findings revealed that income efficiency had a more significant influence on profit efficiency. It revealed that bank size, asset quality, capital, liquidity, and management quality significantly affected the domestic Islamic banks' income efficiency operating in Malaysia, Indonesia, and Brunei Darussalam during the study period.

Another study by Khalifaturofi'ah (2021) showed that the bank's cost efficiency in Indonesia has a negative effect on bank's financial performance. The Capital Adequacy Ratio (CAR) and Loan to Deposit Ratio (LDR) have a positive effect on Return on Assets (ROA) and Net Interest Margin (NIM). Meanwhile, financial ratios proxied by Non-Performing Loans and Equity to Total Assets have a negative effect on Return on Assets and Return on Equity. Another research by Khalifaturofi'ah (2018) states that there is no effect of profit and cost efficiency on the level of profitability of Islamic banks.

Recently, there has been a multitude of studies related to banking efficiency. Based on Ikra et al. (2021), the efficiency literature on Islamic banking has increased since 2008. However, no further research has yet discussed how Islamic banking efficiency is amid the current pandemic and the factors affecting its efficiency. Based on this rationale, it is necessary to conduct a study related to Islamic banks' performance conditions, which can be viewed from how efficiently Islamic banks manage inputs to produce some outputs. It is crucial since research on the cost efficiency of Islamic banks during the pandemic has not been carried out. Therefore, the study's primary purpose

was to determine the Islamic banks' efficiency in Indonesia during the pandemic by using the Stochastic Frontier Analysis (SFA) test and analyzing its influential factors.

Microeconomic theory (consumer and producer theory) initiates the concept of efficiency theory (Monica et al. 2020). The producer theory tends to minimize costs and maximize profits. In this theory, the term production frontier line shows the relationship between the company's input line (representing the use of technology) and output (representing the maximum output level). Analysis of financial institutions can use a frontier approach, in which the frontier efficiency of a financial institution is measured based on the financial institution's performance relative to the estimated performance of the "best" financial institution in the industry, provided that the financial institution faces the same market conditions. According to Octrina & Mariam (2021), a company is considered efficient if it can maximize the output of its inputs.

There are three concepts to measure the financial institution's efficiency which are (Berger & Mester, 1997): 1) Cost efficiency calculates how close bank fees are to the "best practice" of the fees to produce the same number of outputs under the same conditions; 2) Standard profit efficiency measures how close a bank is to generate the maximum possible profit by considering a certain level of input and output prices 3) Alternative profit efficiency is measured by how close the bank is to obtain the maximum profit based on its output level rather than its output price.

Economic performance is an economic condition with limited resources but can obtain optimal production, considering the resulting costs and benefits of different decisions (Alothman, Al-Mahish, 2020). Cost efficiency consists of two components, i.e., allocative and technical efficiency (Anwar, 2019). According to Coelli et al. (2005:263), allocative efficiency measures a company's ability to use inputs at a certain price. In contrast, technical efficiency measures its ability to obtain a maximum output with a certain input level. The combination of these two components forms economic efficiency.

Furthermore, non-parametric methods include Total Factor Productivity (TFP) and Data Envelopment Analysis (DEA). According to Rabbaniyah & Afandi (2019), one of the differences between these two methods is that the parametric method includes random errors while the non-parametric method does not. Based on the explanation above, the SFA method is used in this study.

The determination of cost efficiency ranges from 0 to 1, where one indicates a bank is the most efficient, while 0 indicates the least efficient (Silva et al. 2018; Apriyana et al. 2015). The components of inefficiency and random error of the composite error are described by assuming their distribution. Inefficiency is assumed to be one-sided (generally half-normally distributed), while random error is assumed to be two-sided (generally normally distributed) (Berger and Mester (1997). Based on Wang et al.(2019), to calculate the cost function, one can use the formula: $\ln TCit = \ln C(yit,wit)+\varepsilon it$. $\ln TCit$ refers to the total cost, $\ln C(yit, wit)$ denotes the cost function, yit is the output variable, and wit describes the input variable.

There are two approaches used to identify the relationship between output and input variables in calculating efficiency, i.e., the intermediation approach (introduced by Sealey and Lindley in 1977) and the production approach (introduced by Cobb and Douglas in 1928) (Apriyana et al. 2015). The intermediation approach sees banks as intermediary institutions for financial services. It assumes banks are intermediaries by hiring workers and capital to collect deposit funds to be used as loans and other earnings assets. Then, the production approach assumes the banks' activities produce services and see them as workers and capital users to provide savings and loans.

Most studies state that choice variables influence efficiency measures (Zaabouti et al., 2016). Therefore, various input-output variables are used, including variables that affect efficiency. But in this study, the variables will refer to Anwar's research. The cost components used in this study are total costs. According to Anwar (2014), total costs are operational and non-operational.

Furthermore, the intermediation approach determines this study's output and input variables because it considers the bank's primary role as an intermediary institution. The input variables used are: 1) The cost of funds is the total cost of the deposit divided by the total deposit; 2) The price of labor is the total cost of labor divided by total assets; 3) The price of capital, which is non-profit sharing cost divided by fixed assets. Meanwhile, the output variables in this study consist of 1) total financing, which is the total financing in all sectors of each Islamic commercial bank at the end of the month; 2) Securities and investment is the total investment in securities and all placements of each Islamic commercial bank at the end of the month; 3) Each Islamic commercial bank earns other revenue at the end of the month.

The bank size variable is used to describe the size of a bank (Hadhek et al. (2018). In this study, the bank size is determined using core capital. According to Octrina and Mariam (2021), the use of core capital to determine the bank size is due to the minimum limit of core capital in Bank Indonesia Regulation No. 14/26/PBI/2012. Based on the Financial Services Authority (POJK) Regulation Number 21/POJK.03 2014, core capital consists of two types, i.e., primary and additional core capital. The primary core capital includes paid-in capital and additional reserve capital. Islamic banks must provide a core capital of at least 6% of the Risk-Weighted Assets (RWA) and a minimum of 4.5% of the RWA.

Profitability ratios determine a company's ability to generate profits concerning revenues, operating costs, assets, and equity (Uddin et al., 2022). Melicher & Norton (2016) define Return on Assets (ROA) as a ratio describing how a company earns profits on its assets. A company can generate a return on its assets by two basic strategies: offering low prices and low-profit margins to seek high sales volume. The second one sells high-quality goods and relies on high-profit margins but low sales volume. According to Mahardika (2015), ROA is the ratio between net income and total assets.

Net Operating Margin (NOM) is the ratio between net profit and total bank income. The higher this ratio, the better the bank's performance in utilizing its resources for optimum profit (Mahardika, 2015). NOM constitutes the bank's profitability ratio. The stability of NOM value must be maintained to remain stable. A low NOM value indicates a low profitability value or low profits obtained. On the other hand, a high NOM value indicates a high profitability value, which means large profits are earned (Suryanto & Susanti (2020).

Mahardika (2015) defines Non-Performing Financing (NPF) as the ratio Islamic banks use to calculate non-performing financing and total financing. NPF is divided into two, which are NPF Net and NPF Gross. The difference lies in the Allowance for Earning Assets Losses (PPAP). The Gross NPF does not include PPAP in the calculation, while the net NPF does. The higher the ratio indicates the poorer performance of Islamic banks in channeling their financing. According to Suryanto & Susanti (2020), NPF can be used to see the financing risks Islamic banks face since they finance customers. The greater this risk, the greater the financing risk the Islamic bank bears, and vice versa.

The Financing to Deposit Ratio (FDR) measures Islamic banks' ability to meet short-term obligations (Suryanto & Susanti, 2020). In other words, FDR indicates a bank's ability to repay withdrawals made by depositors by relying on financing it has carried out as a source of liquidity. In addition, the Financing to Deposit Ratio (FDR) is a ratio used to compare the number of funds a bank has collected from customers and channeled to financing to customers in need (Mahardika, 2015). If this ratio reaches 100%, it means that 100% of the bank's funds are used to finance needy customers.

The Capital Adequacy Ratio (CAR) is also known as the Minimum Capital Adequacy Ratio (MCAR) (Wardiyah, 2019). The amount of bank's CAR is determined based on the amount of capital it owns and the amount of Risk-Weighted Assets (RWA) managed by the respective bank.

The study of overall economic behavior is called macroeconomics (Hasyim, 2017). It encompasses currency exchange rates, recessions, the economy's output of goods and services, the balance of payments, output growth rates, inflation, and unemployment rates. Macroeconomics explains the demand and supply (aggregates) that determine economic activity, the main economic problems, policies, and government intervention in overcoming economy-related problems. Macroeconomic policy is divided into three domains, which are fiscal policy (taxes and government spending), monetary policy (interest rates), and supply-side policies (income policy).

Macroeconomics studies the aggregate activities of households, firms, and markets (Piros & Pinto, 2013). Macroeconomics is focused on national aggregates, such as total investment, total consumption, aggregate consumption of household goods and services, and interest rates. The nation's aggregate output and income, labor productivity, price levels, and inflation rates are examples of macroeconomic analysis. Mankiw (2017) states that macroeconomics studies the economy as a whole. The purpose of macroeconomics is to explain the economic changes that occur in households, firms, and markets simultaneously.

The gross domestic product is the most visible macroeconomics, which measures a country's total income. Based on the explanation above, macroeconomics is the study of economic behavior. This study considers GDP, inflation, and exchange macroeconomic variables.

The healthy or bad of a nation's economy can be seen through the Gross Domestic Product (GDP) (Mankiw, 2017). It calculates two variables at a time, i.e., total income per capita in the economic system and total spending on the economy's output of goods and services. GDP is the market value of all final goods and services produced in a country in a given period. According to Melicher & Norton (2016), GDP is a country's output of goods and services achieved over a certain period, usually one year. An increase in GDP over time measures the economic growth in a country.

Piros & Pinto (2013) propose that inflation is a continuous increase in prices at the overall price level in an economic system. The inflation rate is the percentage change in the price index. Investors follow a country's inflation rate closely because it can help infer the state of its economy and that unexpected changes in inflation can result in changes in monetary policy with a significant and direct impact on prices.

The difference between nominal Gross Domestic Product (GDP) and real GDP is caused by increased goods prices, as so-called inflation (Hasyim, 2017). The inflation rate is the percentage increase in prices over a certain period. The higher the inflation rate, the higher the price of goods in the market. Therefore, inflation is less desirable for each individual; even when prices rise, income increases. Inflation can be influenced by economic and political instability in a country, unreasonable public demand, excessive

money supply, and increased production costs. According to Mankiw (2017), inflation is a condition where prices increase at all economic price levels. Over time, inflation is regarded as an economic problem because it causes an increase in various kinds of costs in society. Thus, maintaining inflation as low as possible is the goal of various economic regulators worldwide. Based on the explanation above, inflation is an economic condition with an increase in the overall price level in an economic system.

The exchange rate has two meanings, i.e., nominal and real exchange rates (Mankiw, 2017). The former refers to the exchange rate at which a person can trade a country's currency with the currency of another, while the latter refers to the rate at which a person can trade goods and services from one country with goods and services from other countries. Meanwhile, Melicher & Norton (2016) state that the exchange rate is the price of one currency against the value of other currencies. An increase or decrease in exchange rates can affect the cash flows of multinational companies. Based on the explanation above, the exchange rate has two meanings: nominal and real exchange rates. The nominal exchange rate is the price of a country's currency against other countries' currencies. In contrast, the real exchange rate is the price of goods and services in one country against that of others.

METHODS

This study is descriptive and causal research. This study uses a purposive sampling technique to select the data with the criteria: Islamic commercial banks that consistently publish financial reports during the period and Islamic commercial banks that are not in the merger acquisition or liquidation process. The data in this study is a combination of time series and cross-section data with a total sample of 11 banks. The research period extended from the 1st quarter of 2019 to the 4th quarter of 2020. The research model is as follows:

$$CE_{it} = \alpha_0 + \beta_1 LNSIZE_{it} + \beta_2 ROA_{it} + \beta_3 NOM_{it} + \beta_4 NPF_{it} + \ln\beta_5 FDR_{it} + \ln\beta_6 CAR_{it} + \beta_7 GDP_t + \beta_8 INFL_t + \beta_9 RATE_t + \varepsilon_{it}$$

Note:

CE_{it} = efficiency estimation of cost-I at period-t.
$\beta_1 LNSIZE_{it}$ = core capital logarithm
$\beta_2 ROA_{it}$ = Return on Asset
$\beta_3 NOM_{it}$ = Net Operating Margin (NOM)
$\beta_4 NPF_{it}$ = Non Peforming Financing (NPF)
$\ln\beta_5 FDR_{it}$ = Financing to Deposit Ratio (FDR)
$\ln\beta_6 CAR_{it}$ = Capital Adequacy Ratio (CAR)
$\beta_7 GDP$ = Gross Domestic Product (GDP)
$\beta_8 INFLt$ = inflation
$\beta_9 RATE_t$ = exchange rate
ε_{it} = error

RESULT AND DISCUSSION

Result

In the descriptive statistical analysis, the total cost was used as a component variable for the cost efficiency assessment using the SFA method. Later, the Price of Funds (POF), Price of Labor (POL), and Price of Capital (POC) were processed as input variables. The total financing, securities investment, and other revenue as output variables of the efficiency test. Table 1 describes the descriptive statistical results using efficiency input and output variables.

Table 1. Description of efficiency

	Mean	Std. Dev.	Maximum	Minimum
Total cost (million Rupiah)	1,327,478	1,679,456	9,272,387	10,203
Total financing (million Rupiah)	6,574,974	7,910,635	30,150,027	0.0000
Securities investment (million Rupiah)	16,655,861	20,717,001	83,787,968	0.0000
Other revenue (million Rupiah)	40,759,98	111,231,5	799,886	0.0000
Price of funds (PoF)	6.476846	10.66152	69.4901	0.0000
Price of labor (PoL)	0.012959	0.011112	0.068	0.0022
Price of capital (PoC)	0.995067	1.833874	8.074	0.0000

Source: data processing, 2021

The variable of total cost indicates the operational scale of Islamic commercial banks. The total cost has an average value of Rp1,327,478 billion, with the lowest value of IDR 10.203 billion, attributed to PT. Bank Aladin Syariah Tbk. In the first quarter of 2019, the bank did not issue a profit-sharing distribution. Meanwhile, the highest total cost value was obtained by PT. Bank Syariah Mandiri, accounting for Rp. 9,272,387 billion in the fourth quarter of 2019, which breaks down to Rp. 6,220.194 billion for other operating expenses and Rp. 3,052.193 billion used for profit-sharing distribution. It shows that PT. Bank Syariah Mandiri has large operating expenses, while the total financing variable has an average value of IDR 6,574,974 billion. The lowest value is 0, owned by PT. Bank Aladin Syariah Tbk. in the first quarter of 2019 due to a halt in financing activities. The highest total financing value was IDR 30,150,027 billion, carried out in the fourth quarter of 2020 by PT. Bank Syariah Mandiri.

The variable of securities investment has an average value of Rp. 16,655.861 billion. In this variable, the highest value is at Rp. 83,787.968 billion was attributed to PT. Bank Mandiri Syariah in the fourth quarter of 2020. It shows that the bank had the largest investment in current accounts, savings, and deposits during this period compared to other Islamic commercial banks.

Furthermore, the lowest value of this variable is owned by PT. Bank Aladin Syariah Tbk. with a value of 0 in the third quarter of 2019. The other revenue variable has an average value of IDR 40,759.98 million. PT. Bank Syariah Mandiri owned the highest value of IDR 799.886 billion in the fourth quarter of 2020, indicating the excellent bank's capability to obtain other profits. The lowest value of this variable is owned by PT. Bank Aladin Syariah Tbk., i.e., 0 in the first quarter of 2019, which shows that the bank has difficulty earning other income.

The variable of fund price has a mean of 6.476846, with the highest value of 69.4901 attributed to PT. Bank Victoria Syariah in the second quarter of 2020. It shows that the bank has a much higher total cost of deposits than the deposits it owned, indicating its poor performance in obtaining deposits from customers. Furthermore, the lowest value of this variable is owned by PT. Bank Aladin Syariah Tbk. in the first quarter of 2020, with a value of 0. It shows that the bank did not perform deposit activities, leading to no deposit costs incurred. The price of labor variable has a mean of 0.012959 and a standard deviation of 0.011112, with the smallest value of 0.0022 obtained by PT. Bank Panin Dubai Syariah Tbk. in the first quarter of 2020. It is because very low total labor costs it incurred compared to the total assets it owned.

Furthermore, the largest value of 0.068 was obtained by PT. Bank BTPN Syariah Tbk. in the fourth quarter of 2019. It shows pretty high labor costs the bank incurred compared to others. The variable of the price of capital has a mean value of 0.995067 and a standard deviation of 1.833874. The maximum value of this variable is 8.074, owned by PT. Bank BRI Syariah Tbk. in the second quarter of 2019. Meanwhile, the

lowest value is 0, owned by PT. Bank BTPN Syariah, Tbk. and PT. Bank Aladin Syariah Tbk. since it did not finance other than share the lease financing results.

Using Frontier 4.1., if the value of the SFA result is close to 1, it indicates that a bank is more efficient in using inputs to produce some outputs. On the other hand, the closer the value to 0 indicates that the Islamic commercial bank is inefficient. Table 2 presents the assessment result of Islamic commercial banks' efficiency.

Table 2. Islamic banks' efficiency assessment results

No	Bank name	Assessment result
1	PT. Bank Aceh Syariah	0.5861
2	PT. BPD NTB Syariah	0.3004
3	PT. Bank Muamalat Indonesia Tbk.	0.9284
4	PT. Bank Victoria Syariah Tbk.	0.1180
5	PT. Bank BRI Syariah Tbk.	0.1328
6	PT. Bank BJB Syariah	0.2499
7	PT. Bank BNI Syariah	0.7840
8	PT. Bank Mega Syariah	0.5337
9	PT. Bank Panin Dubai Syariah Tbk.	0.3368
10	PT. Bank Syariah Bukopin	0.2010
11	PT. Bank BCA Syariah Tbk.	0.3061
12	PT. Bank BTPN Syariah Tbk.	0.3498
13	PT. Bank Aladin Syariah Tbk.	0.1125
14	PT. Bank Syariah Mandiri	0.2065
Mean efficiency		0.5858

Source: data processing, 2021

Table 2 presents the results of the efficiency assessment of Islamic commercial banks for the quarter I of 2019 – quarter IV of 2020. It shows that PT. Bank Muamalat Indonesia Tbk. had the highest efficiency value of 0.9284. It indicates that it used inputs (price of funds, price of labor, and price of capital) to produce outputs (total financing, securities investment, and other revenue) very well compared to other Islamic commercial banks in the same period. Several banks had a higher efficiency value of more than the average of 0.5858, such as PT. Bank Aceh Syariah with a value of 0.5861, PT. Bank BNI Syariah had a value of 0.7840, while 11 other banks were below the average.

The multicollinearity test was used to determine a linear relationship between independent variables in the regression.

Table 3. Lagrange Multiplier test results

	LNSIZE	ROA	NOM	NPF	FDR	CAR	GDP	Inflation	Exchange Rate
LNSIZE	1								
ROA	0.009857	1							
NOM	0.172529	0.727887	1						
NPF	-0.14322	-0.5447	-0.39811	1					
FDR	-0.12316	0.216453	-0.02114	-0.11032	1				
CAR	-0.19727	0.209008	0.021248	-0.02556	0.118979	1			
GDP	-0.05726	0.057845	0.07615	0.012313	0.079401	0.056075	1		
Inflation	-0.05465	0.062013	0.051902	0.028994	0.032298	0.017657	0.850294	1	
Exchange Rate	0.011416	-0.05837	-0.08416	0.018782	-0.07813	-0.06165	-0.10671	0.026099	1

Source: data processing, 2021

Generally, the multicollinearity test hypothesizes that H_1 indicates multicollinearity exists while H_0 does not. If it has a correlation coefficient value less than 0.9, H0 is accepted. Based on Table 3, each independent variable used in this study has a correlation coefficient value of <0.9. Therefore, H0 is accepted, and we can conclude no multicollinearity in this study.

Table 4. t-test results

Variable	Coefficient	Prob.
C	-0.000739	0.9982
Bank size	0.0017	0.5840
ROA	-0.000392	0.6597
NOM	0.001039	0.1208
NPF	0.002626	0.1590
FDR	0.0819+e7	0.8257
CAR	-0.00000340	0.7757
GDP	0.000743	0.3451
Inflation	-0.019314	0.0001*
Exchange rate	0.013072	0.7009
Adj R-squared	0.244949	
F-statistic	5.001101	
Prob(F-statistic)	0.000014	

Source: data processing, 2021
Note: *significance level = 5%

Table 4 shows the effect of each independent variable on the dependent variable. Based on the table, only inflation affects the efficiency of Islamic banks with a value of 0.0001 or less than 0.05. Inflation has a significant effect, and the coefficient is negative on efficiency. It indicates that Islamic commercial banks' inflation and efficiency values inversely correlate. High inflation will affect economic conditions, reducing people's demand for saving and financing. The increase in inflation also affects the increase in the prices of goods and services, which indirectly increases the operational costs of Islamic banking and reduces its cost-efficiency

Furthermore, the probability value (F-statistic) of 0.000014, which is less than 0.05, indicates that all independent variables, i.e., bank size, ROA, CAR, NOM, NPF, FDR, inflation, GDP, and the exchange rate simultaneously have a significant effect on efficiency.

Discussions

Based on the efficiency test results with the SFA method using the Frontier 4.1 application, during the first quarter of 2019 to the fourth quarter of 2020, the value of PT. Bank Muamalat Indonesia Tbk. is close to 1 with a value of 0.9284. This result indicates the bank, as the first Islamic commercial bank in Indonesia, can use its inputs and outputs very well. Furthermore, several banks with an efficiency value of more than 0.5 are PT. Bank Aceh Syariah, PT. Bank BNI Syariah, and PT. Bank Mega Syariah with 0.5861; 0.7840; and 0.5337, respectively. This result shows that the three Islamic commercial banks are pretty good at using their inputs and outputs but need to optimize the management of their inputs and outputs to produce better efficiency values. Meanwhile, ten other Islamic commercial banks in Indonesia almost fell into inefficiency and have increased and optimized their inputs or outputs to enhance efficiency values. The research result aligns with Octrina & Mariam's (2021) for 2011 – 2019.

Based on the hypothesis test results, the bank size, ROA, NOM, NPF, FDR, and CAR variables do not partially affect efficiency since the probability values are 0.5840; 0.6597; 0.1208; 0.1590; 0.8257; and 0.7757, respectively, or greater than 0.05. Therefore, those variables have no significant effect on efficiency. The study results align with research conducted by Muttaqin et al. (2020), which revealed that CAR and NPF had no significant effect on efficiency. Similarly, the research by Octrina and Mariam (2021) found that ROA and NOM had no significant effect on efficiency. However, the results of this study are not in line with those study results since, based on these research results, NPF, FDR, and CAR variables affect efficiency.

Based on the results of hypothesis testing, the probability value of the GDP and exchange variables have values of 0.3451 and 0.7009, respectively, or greater than 0.05. It explains that the GDP environmental variables GDP and exchange rate have no partially significant effect on efficiency. Meanwhile, inflation has a value of 0.0001 or less than 0.05, meaning that the inflation variable has a partially significant impact on efficiency. Inflation significantly affects efficiency, and the negative coefficient indicates that inflation and the efficiency value of Islamic commercial banks have an inverse correlation. Inflation is one of the benchmarks the Bank Indonesia refers to whether to incline or decline the BI-rate (credit interest rate). If inflation is high, Bank Indonesia will lower the BI rate to reduce money circulation in the community and vice versa. The decrease/increase in the BI rate indirectly causes Islamic commercial banks to adjust the price of financing and other products that may affect their efficiency. These study results align with those of Octrina & Mariam (2021), which revealed that GDP and the exchange rate did not affect efficiency. However, this research does not align with their study because they revealed that inflation did not affect efficiency. The results of this study are also in line with the research conducted by Hadhek et al. (2018), which found that inflation had a partial effect on efficiency.

The hypothesis test results show that bank-specific variables, such as bank size, ROA, NOM, NPF, FDR, CAR, and variables of the economic environment, i.e., GDP, inflation, exchange rate, have probability values (F-statistic) of 0.000014 < 0.05, indicating that all independent variables (bank-specific variables and variables of economic environment) affect efficiency simultaneously.

These study results align with the research by Octrina & Mariam (2021), which showed that independent variables (bank-specific variables and variables of the economic environment) simultaneously affect cost efficiency. Furthermore, this research is also in line with Hadhek et al. (2018) findings, stating that variables of the economic environment (GDP and inflation) affected efficiency.

CONCLUSIONS AND RECOMMENDATIONS

Conclusion

Based on the results of analysis discussions on the Indonesian Islamic banks' efficiency assessment during the first quarter of 2019 – fourth quarter of 2020 using the Stochastic Frontier Analysis of Frontier 4.1. Before and during the Covid-19 pandemic, it shows that Bank Muamalat Indonesia has the highest efficiency level, almost reaching a value of 1. It is an efficient Islamic commercial bank, while the others still need improvement in input optimization to generate outputs. Inflation is the only variable significantly affecting Indonesia's Islamic banks' efficiency. Overall, the specific variables of bank size (bank size, ROA, NOM, NPF, FDR, CAR) and variables of economic environment (GDP, inflation, exchange rate) have a significant effect on the

Sharia/Islamic banks' efficiency in Indonesia for the first quarter of 2019 – fourth quarter of 2020.

Recommendation

Based on these findings, it is expected that the Indonesian government sustains to encourage Islamic commercial banks through various regulations to develop. Islamic banks must consider efficiency matter in managing their inputs and outputs. Banks with a small operational scale should merge to enhance their core capital and operational scale. Islamic banks can also improve their Net Operating Margin (NOM) to amplify their profitability value and increase Financing to Deposit Ratio (FDR) to meet short-term obligations. Hence, they can survive and continue to grow in the future. This research has limitations in the diversity of data, the research period, and the number of research objects. It is hoped that further research can increase the research period and analyze the efficiency of Islamic banks after the pandemic.

REFERENCES

Al Parisi, S., Fahmi, I., & Andati, T. (2021). Efficiency VS the Maqasid Shariah Index: A Comparatif Study of Conventional and Islamic Banks in Indonesia. *Jurnal Aplikasi Bisnis dan Manajemen* (JABM). 7(2), 255. https://doi.org/10.17358/jabm.7.2.252

Alothman, S., & Al-Mahish, M. (2020). How Banks' Resources at the Retail Level Affect Their Output?. *Journal of Asian Finance, Economics and Business*, 7(12), 853-861. https://doi.org/10.13106/jafeb.2020.vol7.no12.853.

Anwar, M. (2014). *Bank Efficiency and Lending Propensity : Evidence From Commercial Banks In Indonesia*. [Doctoral dissertation, University of Leicester]. https://leicester.figshare.com/articles/thesis/Bank_efficiency_and_lending_propensity_evidence_from_commercial_banks_in_Indonesia/10138298

Anwar, M. (2019). Cost efficiency performance of Indonesian banks over the recovery period: A stochastic frontier analysis. *Social Science Journal*, *56*(3), 377–389. https://doi.org/10.1016/j.soscij.2018.08.002

Asmild, M., Kronborg, D., Mahbub, T., & Matthews, K. (2019). The Efficiency Patterns of Islmaic Banks During the Global Financial Crisis: The Case of Bangladesh. *The Quarterly Review of Economics and Finance*, 74, 67-74. https://doi.org/10.1016/j.qref.2018.04.004

Berger, A. N., & Mester, L. J. (1997). Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions?. *Journal of Banking and Finance*, *21*(7), 895–947. https://doi.org/10.1016/S0378-4266(97)00010-1

Bitar, M., Hassan, M. K., & Walker, T. (2017). Political Systems and the Financial Soundness of Islamic Banks. J*ournal of Financial Stability*. 31, 18-44. https://doi.org/10.1016/j.jfs.2017.06.002

Chaity, N.S. & Islam, K.M.Z. (2022). Bank efficiency and practice of earnings management: a study on listed commercial banks of Bangladesh. *Asian Journal of Accounting Research*, 7(2), 114-128. https://doi.org/10.1108/AJAR-09-2020-0080.

Chowdhury, M.A.M., Haron, R., Sulistyowati, K. & Al Masud, M.A. (2022). The efficiency of commercial banks in Indonesia. *International Journal of Economic Policy in Emerging Economies*. 15(2-4), 280-302. https://doi.org/10.1504/IJEPEE.2022.121346

Coelli, T. J., Rao, D. . P., O'Donnell, C. J., & Battese, G. E. (2005). *An Introduction to Efficiency and Productivity Analysis* (Second Ed.). Springer. https://doi.org/10.1007/b136381

Demir, E., & Danisman, G. O. (2021). Banking Sector Reactions To COVID-19: The Role of Bank-Specific Factors and Government Policy Responses. R*esearch in International Business and Finance.* 58(12), 1-15. https://doi.org/10.1016/j.ribaf.2021.101508

Diallo, A. T., & Gundogdu, A. S. (2021). *Sustainable Development and Infrastructure: An Islamic Finance Perspective*. Palgrave Macmillan. https://doi.org/10.1007/978-3-030-67094-8.

Elnahass, M., Trinh, V.Q. & Li, T. (2021). Global Banking Stability in the Shadow of Covid-19 Outbreak. *Journal of International Financial Markets, Institutions and Money*. 72, 101322. https://doi.org/10.1016/j.intfin.2021.101322.

Emrouznejad, A., & Yang, G.l., (2018). A survey and analysis of the first 40 years of scholarly literature in dea: 1978–2016. *Socio-Economic Planing Science*. 61, 4–8. https://doi.org/10.1016/j.seps.2017.01.008

Ghozali, M., Azmi, M.U. & Nugroho, W. (2019). Perkembangan Bank Syariah Di Asia Tenggara: Sebuah Kajian Historis. Falah: *Jurnal Ekonomi Syariah*. 4(1). 44-55. https://doi.org/10.22219/jes.v4i1.8700.

Hadhek, Z., Frifita, M., & Lafi, M. (2018). The Determinants of Cost Efficiency of Islamic Banks using SFA Approach. *International Journal of Economics and Financial Issues*, *8*(168), 20–29. https://doi.org/10.32479/ijefi.6996

Hasyim, A. I. (2017). *Ekonomi Makro*. Jakarta: Kencana.

Ikra, S.S., Rahman, M.A., Wanke, P. & Azad, M.A.K. (2021). Islamic banking efficiency literature (2000–2020): a bibliometric analysis and research front mapping. *International Journal of Islamic and Middle Eastern Finance and Management*, 14(5), 1043-1060. https://doi.org/10.1108/IMEFM-05-2020-0226

Khalifaturofi'ah, S.O. (2018). Cost Efficiency, Total Assets, and Profitability: Evidence from Islamic Bank. *Jurnal Keuangan dan Perban*kan, 22(4), 769-778. https://doi.org/10.26905/jkdp.v22i4.2218

Khalifaturofi'ah, S.O. (2021). Cost efficiency, Innovation and Financial Performance of Banks in Indonesia. *Journal of Economic and Administrative Sciences*. https://doi.org/10.1108/JEAS-07-2020-0124.

Kustanti, H., & Indriani, A. (2016). Analisis Perbandingan Efisiensi Bank Umum Syariah (BUS) dan Unit Usaha Syariah (UUS) dengan Metode Stochastic Frontier Analysis (SFA) Periode 2010-2014. *Jurnal Studi Manajemen Organisasi*, *13*(2), 140-148. https://doi.org/10.14710/jsmo.v13i2.13405

Mahardika, D. P. (2015). *Mengenal Lembaga Keuangan*. Bekasi: Gramata Publishing.

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

Mankiw, N. G. (2017). *Principles of Economics*, (8th ed.). Cengage Learning.

Martens, W., Yapa, P., Safari, M., & Watts, S. (2021). The Influence of Earnings Management on Bank Efficiency: The case of Frontier Markets. *Heliyon*. 7(10), e08232. https://doi.org/10.1016/j.heliyon.2021.e08232

Melicher, R. W., & Norton, E. A. (2016). *Introduction to Finance* (16th ed.). John Wiley & Sons.

Miah, M.D., & Sharmeen, K. (2015). Relationship between capital, risk and efficiency: comparative study between Islamic and conventional banks of Bangladesh. *International Journal of Islamic and Middle Eastern Finance and Management*, *8*(2), 203–221. https://doi.org/10.1108/IMEFM-03-2014-0027

Mohamed, E.B., Garoui, N. & Naoui, K. (2020). Do Optimistic Managers Destroy Firm Value?. *Journal of Behavioral and Experimental Finance*, 26, 100292. https://doi.org/10.1016/j.jbef.2020.100292

Monica, S.P., Bahrudin, M., & Nurmalia, G. (2020). Studi Komparatif Analisis Efisiensi Kinerja Perbankan Syariah Di Indonesia Antara Metode Data Envelopment Analysis (Dea) Dan Stochastic Frontier Analysis (SFA). *Fidusia : Jurnal Keuangan Dan Perbankan*, *3*(1), 48–66. https://doi.org/10.24127/jf.v3i1.468

Muttaqin, I., Rini, R., Ilham, A., & Fatriansyah, A. (2020). Efisiensi Bank Umum Syariah di Indonesia Dengan Pendekatan Three Stages Frontier. *Jurnal Akuntansi Dan Keuangan Islam*, *8*(2), 115–130. https://doi.org/10.35836/jakis.v8i2.119

Nguyen, P. H., & Pham, D. T. B. (2020). The cost efficiency of Vietnamese banks – the difference between DEA and SFA. *Journal of Economics and Development*, *22*(2), 209–227. https://doi.org/10.1108/jed-12-2019-0075

Octrina, F., & Mariam, A. G. S. (2021). Islamic Bank Efficiency in Indonesia: Stochastic Frontier Analysis. *Journal of Asian Finance, Economics and Business (JAFEB)*, *08*(01). https://doi.org/10.13106/jafeb.2021.vol8.no1.751

Otoritas Jasa Keuangan. (2017). *Sejarah Perbankan Syariah*. https://www.ojk.go.id/id/kanal/syariah/tentang-syariah/Pages/Sejarah-Perbankan-Syariah.aspx

Piros, C. D., & Pinto, J. E. (2013). *Economics For Investment Decision Makers Micro, Macro, and International Economics*. John Wiley & Sons.

Rabbaniyah, L., & Afandi, A. (2019). Analisis Efisiensi Perbankan Syariah di Indonesia Metode Stochastic Frontier Analysis. *Conference on Islamic Management, Accounting, and Economics (CIMAE) Proceeding, 2*, 200–211. https://journal.uii.ac.id/CIMAE/article/view/13149

Rashid, A., Muhammad, S.Y., & Khaleequzzaman, M. (2017). Does Islamic Banking Really Strengthen Financial Stability? Empirical Evidence from Pakistan. *International Journal of Islamic and Middle Eastern Finance and Management*. 10(2),130-148. https://doi.org/10.1108/IMEFM-11-2015-0137

Rashid, M.H.U., Zobair, S.A.M., Chowdhury, M.A.I., & Islam, A. (2020). Corporate Governance and Banks' Productivity: Evidence from the Banking Industry in Bangladesh. *Business Research 13*. 615–637. https://doi.org/10.1007/s40685-020-00109-x

Sakouvogui, K. (2020). A comparative Approach Of Stochastic Frontier Analysis and Data Envelopment Analysis Estimators: Evidence from Banking System. *Journal of Economic Studies*, 47(7), 1787-1810. https://doi.org/ 10.1108/JES-01-2019-0051

Shah, S. A. A., Sukmana, R., & Fianto, B. A. (2021). Integration of Islamic Bank Specific Risks and Their Impact on the Portfolios of Islamic Banks. *International Journal of Islamic and Middle Eastern Finance and Management*. 3(2), 201-305. DOI 10.1108/IMEFM-01-2020-0021

Shamshur, A., & Weill, L. (2019). Does Bank Efficiency Influence the Cost of Credit?. *Journal of Banking and Finance*. 105, 62-73. https://doi.org/10.1016/j.jbankfin.2019.05.002

Silva, T. C., Tabak, B. M., Cajueiro, D.O., & Dias, M. V. B. (2018). Adequacy of Deterministic and Parametric Frontiers to Analyze the Efficiency of Indian Commercial Banks. *Physica A: Statistical Mechanics and its Applications,* 506, 1016-1025. https://doi.org/10.1016/j.physa.2018.04.100

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

Sun, Y., Wang, D., Yang, F., & Ang, S. (2023). Efficiency Evaluation of Higher Education System in China: A Double Frontier Parallel DEA Model. *Computers and Industrial Engineering*. 176, 108979. https://doi.org/10.1016/j.cie.2023.108979

Suryanto, D. A., & Susanti, S. (2020). Analisis Net Operating Margin (NOM), Non Performing Financing (NPF), Financing to Debt Ratio (FDR) dan Pengaruhnya Pada Efisiensi Perbankan Syariah di Indonesia. *Jurnal Riset Akuntansi Dan Keuangan*, *8*(1), 29–40. https://doi.org/10.17509/jrak.v8i1.19331.

S & P Global Ratings (2020). Islamic finance outlook 2022 Edition. Dubai International Financial Centre. https://www.spglobal.com/ratings/en/research/pdf-articles/islamic-finance-outlook-2022-28102022v1.pdf

Tri, T. M., & Anh, N. P. (2020). Effect of Bank Merger on Efficiency using Stochastic Frontier Analysis: The Case of Vietnam. *International Journal of Advance Science and Technology*, *29*(105), 242–253. https://doi.org/10.31838/jcr.07.16.39

Uddin, M.N., Rashid, M.H.U., & Rahman, M.T. (2022). Profitability, Marketability, and CSR Disclosure Efficiency of the Banking Industry in Bangladesh. *Heliyon*, 8(11). https://doi.org/10.1016/j.heliyon.2022.e11904

Vo, X.V., & Nguyen, H.H. (2018) Bank restructuring and bank efficiency-The case of Vietnam. *Cogent Economics & Finance*. 6(1). https://doi.org/10.1080/23322039.2018.1520423

Wang, L.-W., Le, K.-D., & Nguyen, T.-D. (2019). Applying SFA and DEA in Measuring Banks Cost Efficiency in Relation to Lending Activities: The Case of Vietnamese Commercial Banks. *International Journal of Scientific and Research Publications (IJSRP)*, *9*(10), p9411. https://doi.org/10.29322/ijsrp.9.10.2019.p9411

Wardiyah, M. L. (2019). *Pengantar Perbankan Syariah*. Bandung: CV. Pustaka Setia.

Yusuf, A.A., Santi, N., Rismaya, E. (2021). The Efficiency of Islamic Banks: Empirical Evidence from Indonesia. *The Journal of Asian Finance, Economics and Business*, 8(4), 239-247. https://doi.org/10.13106/jafeb.2021.vol8.no4.0239

Zaabouti, K., Mohamed, E.B., & Bouri, A. (2016). Does oil price affect the value of firms? Evidence from Tunisian listed firms. *Frontiers in Energy*. 10, 1-13, https://doi.org/10.1007/s11708-016-0396-8.