

The impact of Covid-19 on the banking industry efficiency: Comparison between Indonesia and Malaysian banks

Ririn Riani¹, Ihsanul Ikhwan²

¹Tazkia University, Bogor, Indonesia

²International Islamic University of Malaysia (IIUM), Selangor, Malaysia

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Corresponding author:

Ririn Riani
ririnriani43@gmail.com

Author's email:

Ihsanulikhwan1997@gmail.com

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Center for Islamic Economics Studies
and Development, Faculty of Business
and Economics, Universitas Islam
Indonesia

Abstract

Purpose – This study aims to measure and compare the efficiency of Islamic and conventional banks in Indonesia and Malaysia, from 2015 to 2020.

Methodology – Data Envelopment Analysis (DEA) was employed as a research method for measuring efficiency. The DEA results are also used to identify input or output variables that must be improved if the Decision-Making Unit (DMU) needs to improve efficiency in form of potential improvement.

Findings – This study shows that Covid-19 had an impact on decreasing the efficiency level of Indonesian and Malaysian Banks. This study also shows that Indonesian Banks are relatively efficient compared to Malaysian Banks. Nevertheless, Islamic bank is more affected by Covid-19 compared to conventional. In addition, the most important variable performance to be improved by banks during the Covid-19 pandemic is total financing.

Implication – It can be used as a guideline for both nations to improve their shortcomings in each type of bank and to strengthen the banking system during economic downturns in order to speed up the recovery process.

Originality – This is the initial study to examine the banking efficiency of Indonesia and Malaysia during the covid pandemic-induced economic crisis. As a result, it is expected to capture the impact of the covid-19 epidemic on banking efficiency.

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Introduction

The existence of the Covid-19 pandemic has caused the failure of several sectors and exacerbated global economic conditions. This pandemic not only disrupts public health but also destroys various industries including the tourism industry, and aviation and the most affected are companies including MSMEs which cause unemployment. The impact of the Covid-19 pandemic on the economic downturn is reflected in the decline in several macroeconomic indicators, including aggregate production, supply, savings, investment, trade flows, and employment. Another sector that is also disrupted by the presence of Covid-19 is the financial institution sector, including banking. This pandemic has affected bank operations (Hidayat et al., 2021).

Academics and policymakers are interested in learning more about how the Covid-19 pandemic affects financial markets and institutions, as well as the real economy. Economic growth is stimulated by a well-functioning banking system. The drop in bank lending could be due to a

decrease in loan supply or a decline in loan demand (Çolak & Öztekin, 2021). To prevent the disease from spreading, governments implement lockdown measures, which unintentionally push individuals and businesses into solvency and liquidity problems (Bartik et al., 2020). As a result, the pandemic resulted in a sudden and exogenous increase in borrowers' credit risk all over the world.

The main source of funds for banks, both Islamic banks and conventional banks is funds from depositors (Hidayat et al., 2021). Depositors' funds are used to increase bank capacity in terms of financing bank operations and profit for shareholders. However, Islamic banks have different principles from conventional banks. Today, banks cannot easily raise funds from the public and companies due to the pandemic. The presence of Covid-19 affects borrowers' ability to repay loans. The volume of unpaid credit will continue to increase, this will reduce bank liquidity, increase Non-Performing Loans (NPL) and the burden of credit decline, as well as reduce bank income and capital (Hardiyanti & Aziz, 2021). Therefore, banks continue to strive to survive and maintain their efficient performance. Various policies issued by governments in various countries aim to maximize banking efficiency so that they can be more optimal in realizing financial prosperity and economic equity, especially in the era of the Covid-19 pandemic, where most countries in the world are affected (Jamaruddin & Markom, 2020).

Efficiency is a crucial issue for banks because it can measure bank performance (Sarifuddin et al., 2015). The Bank tries to manage its performance in order to achieve a level of efficiency to be more competitive. Competitive banks will help developing countries and accelerate economic recovery in times of economic uncertainty. So that the higher the level of banking efficiency of a country, the more sustainable growth will also be. This is very crucial, especially during the current pandemic, especially for developing countries that still depend on the performance of their banks to channel funds productively.

Drawn by rapid developments even during the recent global financial crisis, researchers and policymakers around the world are making comparative assessments of several countries using various metrics of bank performance. Given the differences in terms of regulation, policy, and direction of performance, their capacity in dealing with the Covid-19 outbreak will be different. Therefore, information about bank efficiency that compares between countries is important, thus enabling policymakers to formulate appropriate and sound policies to guide their banking industry (Karim, 2015).

In recent decades, there has been a rapid increase in Islamic banking, and the importance of this sector to the economies of several countries (Johnes et al., 2014). So it is important to have a greater understanding of efficiency and its drivers. Islamic banking activities are experiencing rapid development internationally in the Middle East, South Asia, and Southeast Asia (Yahya et al., 2012). Southeast Asia is becoming an important part of the Islamic world's finances given its rapid and sustainable growth (Pantas, 2021). Indonesia and Malaysia are two countries that encourage the growth of the Islamic banking and finance industry in Southeast Asia (Ghozali et al., 2019). There are similarities in the political economy of Indonesia and Malaysia, where both countries are trying to develop a banking structure under the dual banking system, where the sharia and conventional sectors operate in tandem (Prasetyo et al., 2020).

The study of the efficiency of the banking sector has become an important part of the banking literature, both with parametric and non-parametric techniques. Most studies have been conducted using the DEA method to evaluate bank efficiency in various countries. Sun and Cang (2011) explore the role of risk in determining the cost efficiency of international banks in emerging Asian markets. Karim (2015) examined evidence concerning the efficiencies of banks in four ASEAN countries to analyze cost competitiveness for commercial banks in each case country. Furthermore, Sarifuddin et al. (2015) further studied the efficiency performance of the selected ASEAN country's banking sectors namely Malaysia, Indonesia, and Thailand during the global financial crisis.

Several studies examining the comparative efficiency between Islamic banks and conventional banks show that Islamic banking is still less effective in various countries than conventional banks (Al-Khasawneh et al., 2012; Rozani & Rahman, 2013; Abbas et al., 2016). In contrast, Sakti & Mohamad (2018) show that from 2008 to 2012, Islamic banks in Indonesia were more efficient than conventional banks. Similar findings are also shown by Ahmad and Luo (2010), a comparative

analysis of the efficiency of Islamic banks and conventional banks in Europe. The findings show that Islamic banks are considered more efficient than conventional banks.

It is evident that Islamic banks is becoming increasingly crucial for the global banking business, particularly for the global economic recovery following Covid-19, as the Islamic banking industry grows (Boubaker et al., 2022). In 2020, Bangladeshi Islamic banks predominantly financed commerce and trade investment, two sectors badly damaged by the Covid-19 pandemic (Miah et al., 2021). A similar condition was discovered in the Middle East and North Africa (MENA) region by Hassan et al. (2021). They argue that, although the region's Islamic banks are struggling owing to low oil prices, Covid-19 has exacerbated the crisis, leaving some banks utterly cash-depleted. Other research, such as Beck et al. (2013) and Farooq and Zaheer (2015), has found that Islamic banks are more resilient to financial shocks (such as the AFC or the GFC) than LS. To put it another way, investment banks are projected to recover faster than regular banks. Elnahass et al. (2021), Rehman et al. (2021), and Demirgüç-Kunt et al. (2021) have all claimed that Islamic banks are less affected by the pandemic and hence respond better to the Covid-19 crisis than conventional banks for these reasons.

We investigate the two types of bank efficiency from the period before the coronavirus crisis as well as the period during the crisis. Previous studies have examined the relationship between banking efficiency, but especially during normal times. The novelty in the analysis used in this paper is that we focus our empirical analysis on countries with large Muslim populations, where these countries adopt dual banking systems. We assume the degree of competition between the Islamic and conventional banking sectors and calculate (using a non-parametric approach) and directly compare the efficiency of 30 Islamic banks with 42 conventional banks in Indonesia and Malaysia over the 2015-2020 period (the period that includes the start of the Covid-19 pandemic).

Our approach reveals new insights into the efficiency of both types of banking in times of crisis. First, we find that the average efficiency level of Bank Indonesia and Malaysia (both conventional and sharia) fluctuated during the study period. The efficiency level of Indonesian and Malaysian banks as a whole showed an increasing trend from 2017 to 2019 but decreased in 2020. These results confirm that the Covid-19 pandemic has significantly affected bank performance, in terms of efficiency. Further, a breakdown of the overall efficiency of banks using DEA, however, reveals some fundamental differences between the two types of banks. In particular, this study finds that the efficiency level of Islamic banks is higher than conventional banks in the last 3 years. Even though in previous years it was seen that the efficiency of Islamic banking scores was lower. This provides an explanation for why the results of previous studies give seemingly contradictory results.

The research will be structured as follows. The research's background and objectives are discussed in chapter 1, chapter 2 examines the theoretical basis that supports banking efficiency research and summarizes previous studies, and chapter 3 describes the data and research methodologies employed in this study. The analysis and discussion of these findings will be described in Chapter 4. The conclusion and some recommendations based on the research findings and analysis, are included in the last chapter.

Literature Review

Efficiency is becoming a key indication for the banking sector's contribution to a country's financial system stability (Devi & Firmansyah, 2020). According to Mirzaei and Moore (2014), industries that rely significantly on bank financing will grow quicker and be boosted by the emergence of new businesses in nations with effective banking systems. In fact, King and Levine (1993) were the first to propose that studying bank efficiency would lead to financial system stability in the 1990s. Another empirical study by Lucchetti et al., (2001) asserts that bank efficiency is related to economic growth. Efficiency at the bank will demonstrate the bank's ability to maximize production using existing resources (Hendrawan & Nasution, 2018).

Economic theory identifies two types of efficiency: economic efficiency and technical efficiency (Kalirajan & Shand, 1999). The functions of economic efficiency and technical efficiency are distinct. In general, technical efficiency is used to evaluate a commercial entity's performance, whereas economic efficiency is used to examine macroeconomic conditions. Comparing the input

to the output is a method of determining the amount of efficiency. The Data Envelopment Analysis (DEA) method is commonly used to assess technological efficiency.

The crisis resulting from the Covid-19 outbreak has had a severe impact on all pillars of the business, resulting in reduced revenue and cash flow problems. In general, Covid-19 has altered banking behavior preferences in minimizing the demand for bank loans, since banks will be more cautious of defaults or poor loans, which can exacerbate situations in difficult times. Many researchers compare Islamic and conventional banks using a range of bank performance criteria, drawn by their fast growth even during the recent global financial crisis (Farandy et al., 2017; Isik & Uygur, 2021; Loong et al., 2017). Although the comparison is between Islamic banks, conventional banks are also measured against one another. As a result, more research on Islamic banks and conventional banks is required to reveal the competitiveness of Islamic banks.

These mixed results, according to Miah and Uddin (2021), are due to variances in the concepts, operations, and characteristics of Islamic banks and conventional banks. For example, because Islamic banks are governed by Islamic law (shariah), they are only involved in interest-free financing products that follow profit-and-loss sharing and markup rules (Ikra et al., 2021; Shah et al., 2021). In this regard, data suggests that Islamic banks are better capitalized and less hazardous than conventional banks (Beck et al., 2013; Bourkhis & Nabi, 2013; Majeed & Zainab, 2021), despite the fact that their profitability is likely to be lower (Majeed & Zainab, 2021).

Puspitasari et al. (2017) use the maqashid shariah approach to examine the efficiency of Islamic banking in Indonesia and Malaysia. Individual education, justice creation, and welfare achievement are used to measure the efficiency variable in this study. The study spans the years 2011 to 2015 and employs data envelope analysis (DEA). According to the findings, there are three (3) Islamic banks in Malaysia that achieve maximum efficiency. Thus, Rani and Kassim (2020) investigate and compare the efficiency of Islamic banks in Indonesia and Malaysia using data envelopment analysis (DEA) and an intermediation approach from 2012 to 2018. According to the findings, the technical efficiency of Islamic banks in Indonesia was 77.4 percent with a stability score of 0.034, which was significantly higher and more stable than Malaysian banks, which had a technical efficiency of 75.1 percent with a stability score of 0.169. Further, Yulita and Rizal (2016) use the DEA (Data Envelopment Analysis) method to assess the efficiency of sharia banking in Malaysia and Indonesia from the first quarter of 2011 to the fourth quarter of 2014. According to the research, the overall level of efficiency of sharia banking in Malaysia and Indonesia is fluctuating. According to the findings, sharia banking in Indonesia is more efficient than sharia banking in Malaysia; however, there are no significant differences between the two. The reasons for this inefficiency are deposits, total financing, fixed assets, and personnel costs. However, operational income is the most efficient variable for both countries.

Yahya et al., (2012) investigate the efficiency levels of Malaysian banks in order to compare the two banking systems. Both banking systems have nearly equal average efficiency scores. While there is a significant difference in the level of efficiency of both banking systems in 2006, there is no significant difference in the levels of efficiency of both banking systems in 2007 and 2008. The findings show that Islamic banking institutions can compete and be on par with their conventional counterparts. Despite the fact that Islamic banks are constrained by Islamic tenets in their operations, they can maintain performance comparable to conventional banks.

Understanding how the Covid-19 outbreak affects financial markets and institutions, and thus the real economy, is critical research for academics and policymakers. Because a healthy banking system promotes economic growth. Credit risk is the main risk faced by banks. This risk arises due to default by the counter-party. The collapse of the banking industry was strongly influenced by credit risk, which was the result of the increasing level of non-performing loans (Waemustafa and Sukri, 2015). Credit quality issues can lead to bank failure or a severe loss of capital and net value. As a result, the bank's growth prospects and capacity to compete with other domestic and international banks could be affected (How et al., 2005).

Johnes et al., (2014) state that many skeptics assume that the practices of Islamic banks and conventional banks are identical. Waemustafa and Sukri (2015) argues that credit risk in both Islamic and conventional banks are influenced by internal and external factors. The theory explains

that bank assets are dominated by loans, while liabilities consist of deposit payables. Where the mismatch in assets and liabilities will contribute to liquidity risk and credit risk. Kolapo et al., (2012) stated that poor lending practices, inappropriate credit policies, low capital and liquidity risk, weaknesses in credit assessment, poor loan guarantees, limited institutional capacity, volatile interest rates, insufficient central bank supervision, and government intervention all contribute to credit risk. Waemustafa and Sukri (2015) found that liquidity affects the failure of Islamic banks and conventional banks.

Because conventional and Islamic banks have fundamental differences in terms of business structures and corporate governance, their abilities to handle the Covid-19 outbreak will be different. Mollah and Zaman (2015) revealed that Islamic banks were more shock-resistant and better protected during the 2008 global financial crisis than conventional banks. Shariah has different survival rates compared to its conventional counterparts. Moreover, recent studies (Abdelsalam et al., 2022; Elnahass et al., 2022) have proven that It is true that the two types of banks have a different impact on bank stability. However, it is questionable whether the earlier findings will hold up under the pressure of Covid-19, and whether the Islamic banking model will be able to remain strong and resilient enough to mitigate the turmoil. Given the reduction in the bank's outputs due to Covid-19, this study can suggest the optimal adjustments in terms of their inputs so that their efficiency can be preserved by examining the drop in the efficiency of Islamic and conventional banks from the period before and during the Covid-19 pandemic.

Research Methods

This study uses a quantitative non-parametric approach, Data Envelopment Analysis (DEA). This method was originally developed by Charnes et al. (1978) and later expanded by Banker et al. (1984) to measure the efficiency of the Decision-Making Unit (DMU). In the efficiency literature, DEA is commonly used to measure the technical efficiency, including the efficiency of financial institutions (Sharma et al., 2013). DEA method can also provide information about the DMU (in this study is Indonesian and Malaysian Banks) that do not use efficient inputs and causes of inefficiencies, both in input and output variables. Last, this method can generate information on how much input and output must be adjusted to have a maximum relative efficiency value. According to Wu et al. (2006), DEA is one of the methods commonly used by researchers. This method is able to produce efficiency scores that reflect input and output variables (Yildirim, 2015).

The first step to using DEA is choosing the appropriate input and output variables used. Once the variables are identified for a set of DMUs, we begin to construct the production possibility set, within which the DMUs operate. The production possibility set contains all the correspondences of input and output vectors that are feasible. Let denote the set as T , so that:

$$\Omega = \{(x, y) \in \mathfrak{R}_+^{m+s} \mid x \text{ can produce } y\} \tag{1}$$

Then, an input set $L(y)$ is the subset of all input vectors $x \in \mathfrak{R}_+^{m+s}$, and a production set $P(x)$ is the subset of all output vectors $y \in \mathfrak{R}_+^{m+s}$, which are obtained from x . The input and output sets are therefore defined respectively as:

$$L(y) = \{x \mid (x, y) \in \Omega\} \text{ or } L(y) = \{x \mid y \in P(x)\} \tag{2}$$

$$P(x) = \{y \mid (x, y) \in \Omega\} \text{ or } P(x) = \{y \mid x \in L(y)\} \tag{3}$$

Suppose that n firm producing s outputs $(Y_i, i = 1, 2, \dots, s)$ with m inputs $(X_i, i = 1, 2, \dots, m)$. The shadow output and input prices are $(\mu_r, r = 1, 2, \dots, s)$ and $(v_i, i = 1, 2, \dots, m)$. So for the unit K , they use the input bundle $Xk = (Xk_1, Xk_2, \dots, Xk_m)$ to produce $Yk = (Yk_1, Yk_2, \dots, Yk_m)$. The linear "fractional" programming problems are set up as:

$$\max AP_k = \frac{\mu Y_k}{v Y_k} = \frac{\sum_{i=1}^s \mu_{rk} Y_{rk}}{\sum_{i=1}^m v_{ik} X_{ik}} \tag{4}$$

However, the value is maximized subject to two restrictions. The first is that the shadow prices must be non-negative. Second, no unit has an input or output bundle that causes the overall average productivity to be greater than 1. Mathematically, it can be denoted as:

$$AP_j = \frac{\sum_{k=1}^s \mu_{rk} Y_{rk}}{\sum_{i=1}^m v_{ik} X_{ik}} \leq 1, \text{ where } \mu_{rk} \geq 0 \tag{5}$$

There will be many sets of shadows prices that satisfy these conditions, but the software (MaxDEA 8) can be used to find the one set that maximizes AP_k . The software normally simplifies this problem to ensure a solution by multiplying each shadow price by an appropriate scaling factor, λ which simplifies the search for solutions. It also implies the constant return to scale (RTS) assumption since the relationship between the input and output bundles also does not change. Because $\sum_i^m v_{ik} X_{ik} = 1$, then the clever choice of λ is:

$$\lambda = \frac{1}{\sum_i^m v_{ik} X_{ik}} \text{ subject to } AP_j = \sum_r^s \lambda \mu_{rk} Y_{rk} - \sum_i^m \lambda v_{ik} X_{ik} \leq 0 \text{ and } \sum_i^m \lambda v_{ik} X_{ik} = 1 \tag{6}$$

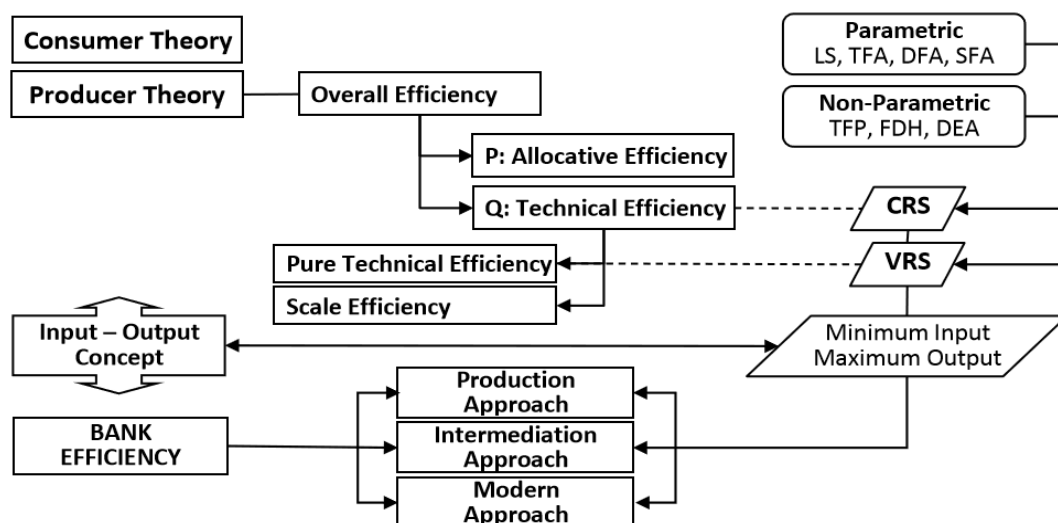
There are two DEA models which are frequently employed, namely Charnes, Cooper, and Rhodes (CCR) model and the Banker, Charnes, and Cooper (BCC) model, introduced in the year 1984 (Coelli et al., 2005). The primary distinction between the CCR model and the BCC model is the treatment over the return to scale. The CCR model assumes that the production technology satisfies the property of Constant Return to Scale (CRS). The constant return to Scale (CRS) assumes that every increase in a certain percentage of input will be proportionally followed by an increase in output with the same percentage. In other words, additional input of x times will increase the additional output of x times. Charnes et al., (1978) assumed that Ω to be convex and proposed the convex estimator $\hat{\Omega}$ of Ω as the CCR model, as follow:

$$\hat{\Omega} = \{(x, y) \mid x \geq X\lambda, y \leq Y\lambda, \lambda \geq 0\} \tag{7}$$

However, this assumption is only applicable if the observed DMU operates on the optimal scale. In reality, some DMUs may work under their optimum scale, some may function at the stage of Increasing Return to Scale (IRS) and others may be Decreasing Return to Scale (DRS). Therefore, inefficiency may result from an inappropriate scale as well as an unsuitable mixture of the variables. To anticipate it, Banker et al. (1984) relaxed the assumption of CRS by allowing production technology to be Variable Return to Scale (VRS), namely the BCC model. VRS produces Technical Efficiency (TE), also known as Pure Technical Efficiency (PTE). The VRS approach assumes that the additional input of x times may not produce an additional output of exactly x times, thus it can be smaller or greater than x times. Mathematically, the BCC model is modified easily from the CCR model by adding the convexity constraint $1' \lambda = 1$ in the Ω CRS model, where:

$$\hat{\Omega} = \{(x, u, y) \mid x \geq X\lambda, u = U\lambda, y \leq Y\lambda, 1' \lambda = 1, \lambda \geq 0\} \tag{8}$$

Briefly, the DEA method can be explained by the figure 1.



Source: Ascarya and Yumanita (2006)

Figure 1. DEA Model

This study focuses on analyzing the efficiency of 72 banks in Indonesia and Malaysia (both conventional and sharia) in the 2015-2020 period. In selecting the research period, we took 2015 data based on the availability of datasets from the annual reports from Bank Indonesia and Malaysia respectively, while in 2020 we took to capture the extent to which Covid-19 could affect banking efficiency. The case study details consist of 30 Indonesian banks (14 sharia & 16 conventional banks) and 42 Malaysian banks (16 sharia & 26 conventional banks). The input variables used in this study are fixed asset, labor cost, and third-party funds, whereas the output variable are total financing and operating revenues. All of the data related to the input and output variables used in this study were obtained from the annual reports or financial statements of each bank. Following are the variable defenitons on this study.

Table 1. Input and Output Variables Defenition

Input variables	
Fixed asset	Total asset minus the accumulated depreciation for Indonesian banks, and total property and equipment for Malaysian banks
Labor cost	Total labor costs incurred
Third-party funds	total deposits from customer
Output variables	
Total financing	Total bank income from lending (conventional banks) and financing (Islamic banks)
Operating revenues	Bank's profit obtained from the income accumulation of fund management by banks

Since one of the goals of this study to compare the banking performance based on its type (sharia and conventional), intermediation approach considered to be used. According to Ascarya et al. (2010), compared to production and modern approach, intermediation approach more appropriate to be applied for Islamic banking since this approach views bank as an intermediary institutions. This approach describes the activities of banking as an intermediary in transforming the money from the third-party into the money lent to borrowers (Ascarya et al., 2010). The selection of input-output variables is in line with Sufian (2009), Ascarya and Yumanita (2009), and Rusydiana and Marlina (2019).

Results and Discussion

The table below will show the efficiency level of 72 Indonesian and Malaysian Banks during the 2015-2020 period using Data Envelopment Analysis (DEA) with Variable Return to Scale (VRS) assumptions. The result will be displayed through an efficiency score with a range of 0-1. A score of 1 describes the bank's ability to manage its input and output variables optimally. Meanwhile, if the efficiency scores are further away from 1, it can be indicated that the bank is inefficient or has not optimal in managing its input and output variable. The efficiency scores after data processing using MAXDea.8 can be seen in the Table 1.

Table 1. Efficiency Scores of Indonesian Banks

Indonesian Banks	2015	2016	2017	2018	2019	2020
Bank Aceh Syariah	0,48	0,20	0,64	0,68	0,64	0,56
Bank BNI Syariah (BSI)	0,74	0,73	0,79	0,69	0,67	0,58
Bank BPD Nusa Tenggara Barat Syariah	1,00	0,90	1,00	1,00	0,73	0,73
Bank BRI Syariah (BSI)	0,92	0,95	0,94	1,00	0,98	1,00
Bank BTPN	0,81	0,74	0,70	0,84	0,88	0,85
Bank Central Asia (BCA)	0,95	0,93	0,92	0,95	0,98	1,00
Bank CIMB Niaga	0,66	0,70	0,69	0,67	0,68	0,59
Bank Danamon	0,93	0,97	0,96	1,00	1,00	0,92
Bank DBS	0,53	0,72	0,74	0,53	0,70	0,76

Indonesian Banks	2015	2016	2017	2018	2019	2020
Bank DKI	0,64	0,81	0,62	0,67	0,60	0,55
Bank HSBC	1,00	0,90	0,56	0,59	0,69	0,56
Bank Jabar Banten Syariah	0,84	0,71	0,65	0,64	0,66	0,64
Bank Mandiri	1,00	1,00	0,96	1,00	1,00	0,91
Bank Maybank Indonesia	0,70	0,71	0,78	0,76	0,78	0,68
Bank Mega	0,81	0,79	0,77	0,73	0,71	0,83
Bank Mega Syariah	0,62	0,70	0,72	0,64	0,70	0,80
Bank Muamalat Syariah	0,86	0,70	0,69	0,58	0,56	0,51
Bank Negara Indonesia (BNI)	0,91	0,91	0,88	0,89	0,89	0,89
Bank OCBC NISP	0,54	0,60	0,62	0,61	0,63	0,61
Bank Panin	0,68	0,77	0,74	0,83	0,80	0,89
Bank Panin Dubai Syariah	1,00	0,80	0,74	0,64	0,70	0,80
Bank Permata	0,63	0,62	0,68	0,56	0,60	0,58
Bank Rakyat Indonesia (BRI)	1,00	1,00	0,99	0,97	1,00	0,94
Bank Syariah Bukopin	0,91	0,82	0,73	0,80	0,80	0,85
Bank Syariah Mandiri (BSI)	0,78	0,79	0,84	0,82	0,81	0,78
Bank Tabungan Negara (BTN)	0,84	0,90	0,84	0,90	0,78	0,77
Bank Tabungan Pensiunan Nasional Syariah	0,86	0,85	0,30	0,38	1,00	0,94
Bank Victoria Syariah	0,74	0,58	0,65	0,69	0,72	0,77
BCA Syariah	0,35	0,36	0,35	0,35	0,41	0,45
Maybank Syariah Indonesia (PT Bank Net Syariah)	0,97	0,69	0,65	1,00	1,00	1,00
Average	0,79	0,76	0,74	0,75	0,77	0,76

Table 2. Efficiency Scores of Malaysian Banks

Malaysian Bank	2015	2016	2017	2018	2019	2020
Affin Bank Berhad	0,47	0,36	0,34	0,33	0,33	0,35
Affin Islamic Bank Berhad	0,41	0,57	0,60	0,55	0,63	0,63
Al Rahji Banking and Investment Corporation	0,33	0,29	0,25	0,27	0,29	0,26
Alliance Bank Malaysia Berhad	0,50	0,49	0,54	0,55	0,56	0,55
Alliance Islamic Bank Berhad	0,47	0,51	0,58	0,44	0,58	0,53
AmBank Berhad	0,87	0,66	0,72	0,79	0,76	0,69
AmBank Islamic Berhad	0,99	1,00	0,97	0,90	0,76	0,69
Bangkok Bank Berhad	0,37	0,23	0,37	0,40	0,37	0,42
Bank Islam Malaysia Berhad	0,48	0,51	0,53	0,52	0,54	0,51
Bank Muamalat Malaysia Berhad	0,34	0,39	0,41	0,45	0,41	0,43
Bank of America Malaysia Berhad	0,53	0,47	0,51	0,50	0,51	0,63
Bank of China Berhad	0,28	0,29	0,28	0,29	0,31	0,31
BNP Paribas Malaysia Berhad	0,22	0,37	0,50	0,33	0,09	0,21
China Construction Bank Berhad	0,50	0,56	0,31	0,40	0,39	0,40
CIMB Bank Berhad	0,75	0,86	0,86	0,81	0,87	0,88
CIMB Islamic Bank Berhad	0,65	0,68	0,66	0,71	0,76	1,00
Citibank Berhad	0,80	0,82	0,96	0,92	0,91	0,79
Deutsche Bank Malaysia Berhad	0,19	0,22	0,40	1,00	0,45	0,41
Heong Long Islamic Bank Berhad	0,57	0,53	0,54	0,59	0,61	0,61
Hong Leong Berhad	0,31	0,38	0,52	0,55	0,56	0,57
HSBC Amanah Malaysia Berhad	0,73	0,71	0,69	0,78	0,72	0,62
HSBC Bank Malaysia Berhad	0,39	0,25	0,26	0,28	0,36	0,33
India International Bank Berhad	1,00	0,72	0,89	0,97	1,00	1,00
Industrial and Commercial Bank of China Berhad	0,46	0,36	0,46	0,49	0,47	0,47
J.P Morgan Banking Berhad	0,54	0,54	0,67	0,52	0,69	0,95
Kuwait Finance House Berhad	0,27	0,29	0,37	0,37	0,37	0,32
Malayan Banking Berhad	0,94	1,00	1,00	0,99	1,00	1,00
Maybank Islamic Berhad	1,00	1,00	1,00	1,00	1,00	1,00
Mizuho Bank Berhad	0,30	0,64	0,41	0,71	0,55	0,90
MSBS Bank Berhad	0,54	0,62	0,36	0,72	0,79	0,70
MUFG Bank Berhad	1,00	0,74	0,81	0,46	0,24	0,30
OCBC Al-Amin Bank Berhad	0,55	0,56	0,65	0,49	0,53	0,39

Malaysian Bank	2015	2016	2017	2018	2019	2020
OCBC Bank Berhad	0,36	0,54	0,43	0,42	1,00	0,41
Public Bank Berhad	0,88	0,95	1,00	0,97	1,00	0,99
Public Islam Bank Berhad	0,81	0,68	0,67	0,66	0,65	0,68
RHB Bank Berhad	0,46	0,56	1,00	0,58	0,47	0,63
RHB Islamic Bank Berhad	0,68	0,75	0,75	0,77	0,76	0,76
Standard Chartered Bank Malaysia Berhad	0,64	0,70	0,31	0,46	0,63	0,62
Standard Chartered Saadiq Berhad	0,92	1,00	0,86	1,00	0,95	0,60
Sumitomo Mitsui Banking Corporation Malaysia	0,48	0,57	0,48	0,53	0,41	0,43
The Bank of Nova Scotia Berhad	1,00	0,92	0,90	0,86	0,94	1,00
United Overseas Bank Bhd	0,44	0,36	0,37	0,36	0,36	0,36
Average	0,58	0,59	0,60	0,61	0,61	0,60

Based on the table above it can be seen that there is only one DMU that gets maximum efficiency level, namely Maybank Islamic Berhad. Maybank Islamic Bank Berhad achieve a constant score of 1 during a 6-years observation. The second-largest score is Malayan Bank Berhad with an efficiency average of 0.99, then following by Bank Mandiri and BRI with the score of 0.98 respectively. While Al Rahji Banking and Investment Cooperation get the lowest average score of 0.28, followed by Bank of China Berhad and BNP Paribas Malaysia Berhad with a score of 0.29 respectively.

It also can be seen that the efficiency scores of Indonesian and Malaysian Banks fluctuated every year. The overall average efficiency scores of both banks in the 2015-2020 period are 0.67. The average efficiency of all Indonesian banks in the study period is 0.76, while Malaysian banks is are 0.59. However, if it is measured annually, the averages show an interesting rate. The scores of the Indonesian and Malaysian Banking industries showed a decrease from 2015 to 2017. Then sharply increase into 2019, and decrease again in 2020, when the Covid-19 pandemic become spread to both Indonesia and Malaysia. The Covid-19's impact would most likely be felt first on banks' income statements in the short term (Sakouvogui & Guilavogui, 2022). If current economic conditions remain and borrowers are unable to repay their debts, banks may be forced to fully recognize loan losses and write down capital value in the long run. Furthermore, if repayments fall behind, banks may get troubled due to the risk of non-performing loans and, in the worst-case scenario, bank runs. Cecchetti and Schoenholtz (2020) stated that the Covid-19 turmoil has raised major concerns regarding the resilience of the banking sector to maintain efficiency in the intermediation role. He discovered evidence that institutional characteristics and the type of banking business model utilized by Islamic banks and conventional banks mitigated the effects of Covid-19 on banking stability. He also discovers that Islamic banks have a greater risk profile.

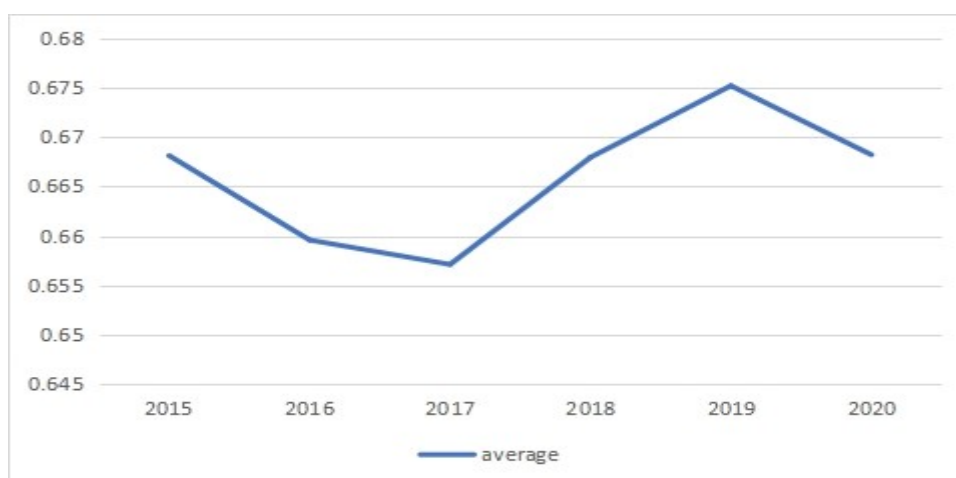


Figure 2. Average Efficiency Trend

Various innovations need to be carried out by Indonesian as well as Malaysian Banks to increase their performance, especially in terms of efficiency. Some innovations such as financial technology, digitalization, mobile services, and others are needed in order to facilitate their

customer in this COVID-19 pandemic era. In the long term, increased customer engagement enables banks to be more efficient and cost-effective.

Efficiency Comparison of Indonesian and Malaysian Bank

Furthermore, a comparison will be made on bank efficiency based on the country, Indonesia and Malaysia. This comparison is made by looking at the average efficiency value of Indonesian and Malaysian banks each year, during a 6-year study period. The comparison can be seen in the following graph:

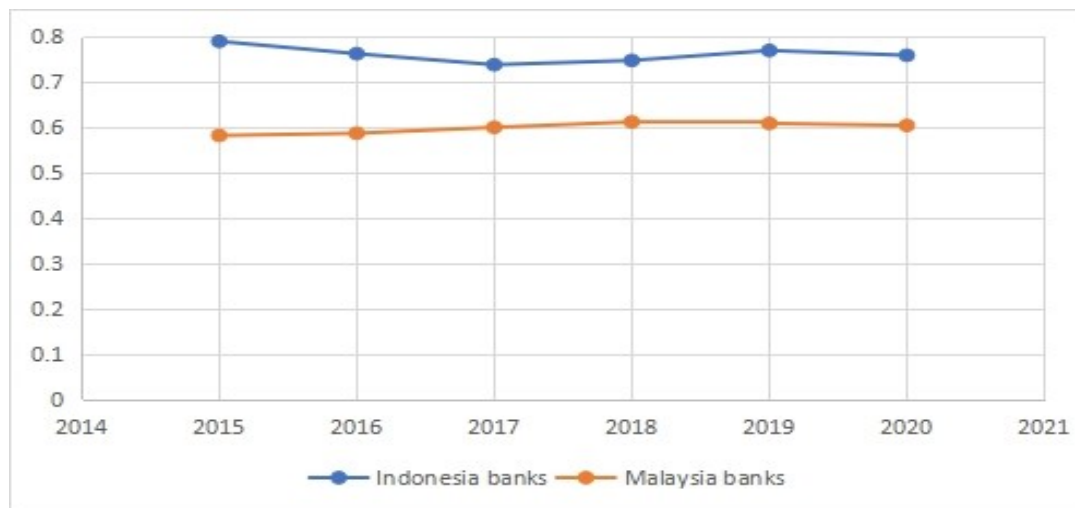


Figure 3. Efficiency Comparison of Indonesian and Malaysian Bank

Based on figure 3, the efficiency value of Indonesian Banks is higher than Malaysian Banks. The result of this analysis is in line with the study conducted by Rani and Kassim (2020), and Pantas et al. (2021). This study contrast with research conducted by Hosen and Mohari (2018). While, Indonesian and Malaysian Banks showed a similar pattern during the research period, where there was a decrease in the average efficiency value from 2019 to 2020 or during the Covid-19 pandemic era.

Efficiency Comparison of Conventional and Islamic Banks

The next analysis will compare the efficiency performance of conventional and Islamic banks in the Indonesian and Malaysian Banking industries. This comparison is made by looking at the average value of the combination between Indonesia and Malaysia's Conventional and also Islamic banks each year.

Based on the figure 4, it can be concluded that the efficiency level of Islamic banks is higher than conventional banks, especially in the previous 3 years. The result of this analysis is in line with Musa et al. (2020), Nafla and Hammas (2016), and Parsa (2020) where Islamic banks are considered more efficient than conventional banks. The difference between these two types of industry is basically the point of Sharia compliance requirements. Islamic banking needs to protect every transaction carried out from things that are prohibited in Islamic law, such as usury, gambling, and obscenity, so the performance should be more stable than conventional banks. The lower agency problems faced by Islamic banks as a result of risk-sharing features in bank intermediation, according to Beck et al. (2013), resulting in cheaper monitoring and screening expenses. Johnes et al. (2014) utilize a sophisticated meta-frontier approach to estimate both Islamic banks and conventional banks common efficiency frontiers. They discover that Islamic banks are more efficient, however this is contingent on the frontier specifications. Bitar et al. (2017) also produce efficiency factors that show that Islamic banks have greater efficiency factors. Islamic banks have greater cost efficiency scores on a risk-adjusted basis (Safiullah and Shamsuddin, 2019).

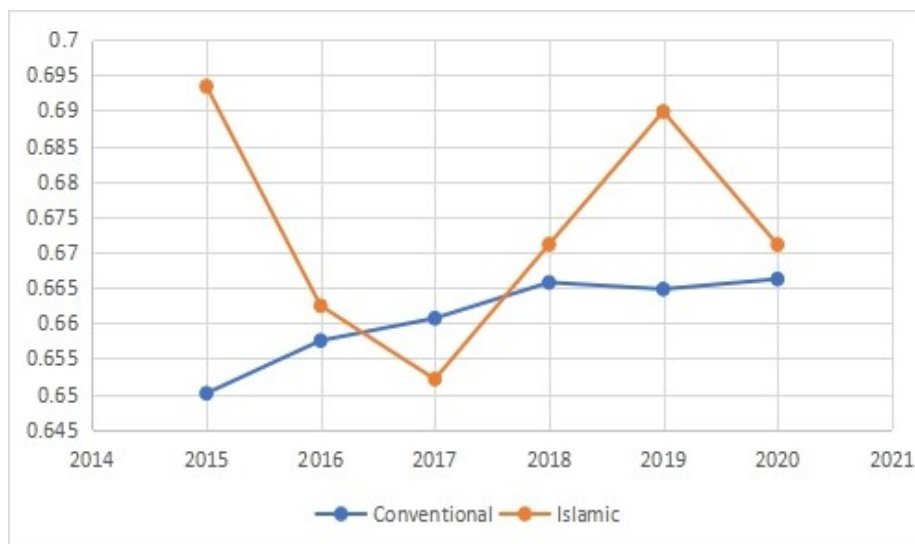


Figure 4. Efficiency Comparison of Indonesian and Malaysian Bank

However, in terms of covid effect, Islamic banks were significantly affected by the Covid-19 pandemic. It can be seen from the steep decline in the efficiency level of Islamic banking between 2019 and 2020. According to Wijana and Widnyana (2022) The vulnerability of Islamic banking was highlighted during the Covid-19 pandemic, when the pandemic impacted extremely important variables for Islamic banking, such as liquidity (the ability of Islamic banking to meet short-term obligations) and profitability (the ability of Islamic banking to profit).

Potential Improvement

Besides being able to produce efficiency values, the DEA method can also produce potential improvements or the level of improvement needed to achieve optimal efficiency values. So, it can be known which variables need to be optimized. Analysis of potential improvement was examined using the last year of observation and was carried out separately from previous years, to describe the real value that must be achieved. This analysis is comparing the projection value to the real value or current data available. The difference between projection and real values indicates the level of inefficiency that occurs to variables that need to be corrected by Islamic banks and conventional banks. The results of the measurement of potential improvement can be seen in the Figure 5.

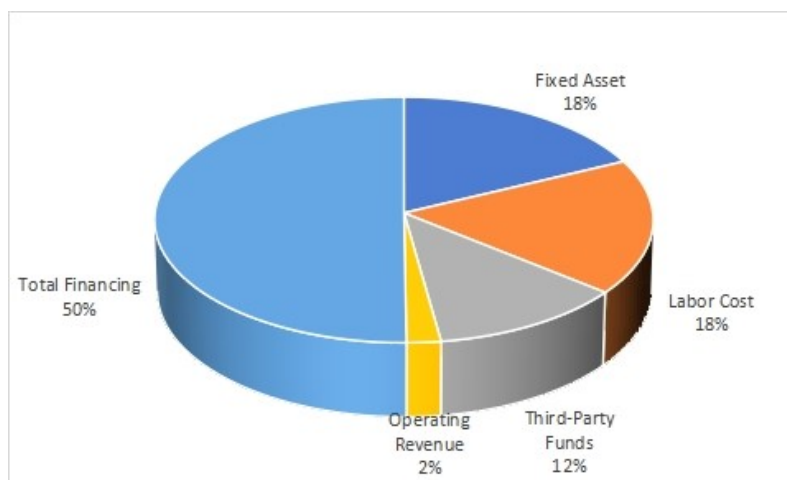


Figure 5. Potential Improvement Analysis

Based on the potential improvement analysis, it can be seen that the main cause of inefficiency in Indonesian and Malaysian Banks is not optimum yet the achievement of the output variable, especially total financing. This variable is contributed to more than half of the source of

inefficiency. This means that banks that are not yet efficient should increase the amount of their financing by 50% from the existing amount to achieve an efficient performance. Then, to increase the efficiency level, banks also needed to optimize the use of the fixed asset by 18%, labor costs by 18%, third-party funds by 12%, and increasing the operating revenue by 2%.

Conclusion

The result of this study shows that the average efficiency level of Indonesian and Malaysian Banks (both conventional and Islamic) fluctuated throughout the study period from 2015 to 2020. Interestingly, this study found that the efficiency level of Indonesian and Malaysian Banking overall showed an increasing trend from 2017 until 2019 but decreased in 2020. DEA also confirms that Indonesian banks are more efficient than Malaysian banks during the Covid-19 pandemic, despite the fact that both exhibit a declining trend. The results also indicate that Islamic banks decided to be more efficient on average than conventional banks. Maybank Islamic Berhad is the bank with the highest efficiency scores according to the DEA, while Al Rahji Banking and Investment has the lowest. However, in the period of 2020, the Islamic bank is more impacted by Covid-19 than the conventional bank.

With the disease as a whole and the associated preventative measures, the spread of Covid-19 is a global great shock. It was anticipated that the financial sector, particularly banks, would play a significant role in shock absorption in the immediate aftermath by providing crucial loans to the business sector and households. As with the input side, the practitioner recommendations include the need to improve the quality of human resources in banking and to innovate banking products in order to provide customers with a wider range of options for optimal financing distribution. In order to facilitate this on the output side, banks must implement a variety of policy measures to increase liquidity and boost credit flow. The potential impact of these countercyclical lending policies on the long-term stability of the banking systems and the extent to which they will be able to absorb this shock without losing resilience as a result of their improved capital positions since the global financial crisis are crucial policy concerns. Because the Covid-19 Pandemic is not yet over, additional research is required to continue this investigation by expanding data and information in the coming years. It is hoped that in the future, researchers will employ more reliable techniques, resulting in more precise findings.

Author Contributions

Conceptualization: Ihsanul Ikhwan
 Data curation: Ririn Riani
 Formal analysis: Ririn Riani
 Investigation: Ihsanul Ikhwan
 Methodology: Ihsanul Ikhwan
 Project administration: Ririn Riani
 Supervision: Ririn Riani
 Validation: Ririn Riani
 Visualization: Ihsanul Ikhwan
 Writing – original draft: Ririn Riani
 Writing – review & editing: Ihsanul Ikhwan

References

- Abbas, M., Azid, T., & Besar, M. H. A. H. (2016). Efficiency, effectiveness and performance profile of Islamic and conventional banks in Pakistan. *Humanomics: The International Journal of Systems and Ethics*, 32(1), 2-18. <https://doi.org/10.1108/H-09-2015-0058>
- Abdelsalam, O., Elnahass, M., Ahmed, H., & Williams, J. (2022). Asset securitizations and bank stability: evidence from different banking systems. *Global Finance Journal*, 51. <https://doi.org/10.1016/j.gfj.2020.100551>

- Al-Khasawneh, J. A., Bassedat, K., Aktan, B., & Darshini Pun Thapa, P. (2012). Efficiency of Islamic banks: case of North African Arab countries. *Qualitative Research in Financial Markets*, 4(2–3), 228–239. <https://doi.org/10.1108/17554171211252547>
- Ascarya, I., & Yumanita, D. (2008). Measuring the competitiveness of Islamic banking in Indonesian dual banking system. *Tazkia Islamic Finance and Business Review*, 3(2). <https://doi.org/10.30993/tifbr.v3i2.23>
- Ascarya, A., & Yumanita, D. (2009). Comparing the efficiency of Islamic banks in Malaysia and Indonesia. *Buletin Ekonomi Moneter dan Perbankan*, 11(2). <https://doi.org/10.21098/bemp.v11i2.237>
- 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. *International Center for Applied Finance & Economics (InterCAFÉ)*. https://www.researchgate.net/publication/304780316_Measuring_the_Efficiency_of_Islamic_Banks_in_Indonesia_and_Malaysia_using_Parametric_and_Nonparametric_Approaches
- Banker, R. D., Charnes, A., & Cooper, W. W. (1984). Some models for estimating technical and scale inefficiencies in data envelopment analysis. *Management Science*, 30(9), 1078–1092. <https://doi.org/10.1287/mnsc.30.9.1078>
- Bartik, A. W., Bertrand, M., Cullen, Z., Glaeser, E. L., Luca, M., & Stanton, C. (2020). The impact of Covid-19 on small business outcomes and expectations. *Proceedings of the National Academy of Sciences of the United States of America*, 117(30), 17656–17666. <https://doi.org/10.1073/pnas.2006991117>
- Beck, T., Demirgüç-Kunt, A., & Merrouche, O. (2013). Islamic vs. conventional banking: Business model, efficiency and stability. *Journal of Banking and Finance*, 37(2), 433–447. <https://doi.org/10.1016/j.jbankfin.2012.09.016>
- Boubaker, S., Le, T. D. Q., & Ngo, T. (2022). Managing bank performance under Covid-19: A novel inverse DEA efficiency approach. *International Transactions in Operational Research*. <https://doi.org/10.1111/ITOR.13132>
- Bourkhis, K., & Nabi, M. S. (2013). Islamic and conventional banks' soundness during the 2007–2008 financial crisis. *Review of Financial Economics*, 22(2), 68–77. <https://doi.org/10.1016/j.rfe.2013.01.001>
- Cecchetti, S., & K Schoenholtz (eds.). (2020). *Economics in the time of Covid-19*, CEPR Press, London. <https://cepr.org/chapters/contagion-bank-runs-and-covid-19>
- Charnes, A., Cooper, W. W., & Rhodes, E. (1978). Measuring the efficiency of decision making units. *European Journal of Operational Research*, 2(6), 429–444. [https://doi.org/10.1016/0377-2217\(78\)90138-8](https://doi.org/10.1016/0377-2217(78)90138-8)
- Coelli, T. J., Rao, D. S. P., O'Donnell, C. J., & Battese, G. E. (2005). *An introduction to efficiency and productivity analysis*. Springer. <https://link.springer.com/book/10.1007/b136381>
- Demirgüç-Kunt, A., Pedraza, A., & Ruiz-Ortega, C. (2021). Banking sector performance during the Covid-19 crisis. *Journal of Banking and Finance*, 133. <https://doi.org/10.1016/j.jbankfin.2021.106305>
- Devi, A., & Firmansyah, I. (2020). Efficiency determinant analysis in Islamic bank in Indonesia. *Muqtasid: Jurnal Ekonomi dan Perbankan Islam*, 11(2), 11–13. <https://doi.org/10.18326/.v11i2.104-116>
- Elnahass, M., Salama, A., & Trinh, V. Q. (2022). Firm valuations and board compensation: Evidence from alternative banking models. *Global Finance Journal*, 51, 100553. <https://doi.org/10.1016/j.gfj.2020.100553>

- 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>
- Farandy, A. R., Suwito, D. A., Dabutar, L. K., & Studies, D. (2017). Efficiency of Islamic banks in Indonesia: Data envelopment analysis. *International Journal of Economics, Management and Accounting*, 25(2), 337–354. <https://journals.iium.edu.my/enmjjournal/index.php/enmj/article/view/463>
- Farooq, M., & Zaheer, S. (2015). Are Islamic banks more resilient during financial panics? *Pacific Economic Review*, 20(1), 101–124. <https://doi.org/10.1111/1468-0106.12096>
- Ghozali, M., Azmi, M. U., & Nugroho, W. (2019). Perkembangan bank syariah di Asia Tenggara: sebuah kajian historis. *Falah: Jurnal Ekonomi Syariah*, 4(1), 44. <https://doi.org/10.22219/jes.v4i1.8700>
- Hardiyanti, S. E., & Aziz, L. H. (2021). The case of Covid-19 impact on the level of non-performing loans of conventional commercial banks in Indonesia. *Banks and Bank Systems*, 16(1), 62–68. [https://doi.org/10.21511/bbs.16\(1\).2021.06](https://doi.org/10.21511/bbs.16(1).2021.06)
- Hassan, M. K., Rabbani, M. R., & Abdulla, Y. (2021). Socioeconomic impact of Covid-19 in MENA region and the role of Islamic finance. *International Journal of Islamic Economics and Finance (IJIEF)*, 4(1), 51–78. <https://doi.org/10.18196/ijief.v4i1.10466>
- Hendrawan, R., & Nasution, A. A. (2018). Assessing banking profit efficiency using stochastic frontier analysis. *GATR Journal of Finance and Banking Review*, 3(4), 67–76. [https://doi.org/10.35609/JFBR.2018.3.4\(5\)](https://doi.org/10.35609/JFBR.2018.3.4(5))
- Hidayat, T., Masyita, D., Nidar, S. R., Febrian, E., & Ahmad, F. (2021). The effect of Covid-19 on credit and capital risk of state-owned bank in Indonesia: A system dynamics model. *WSEAS Transactions on Business and Economics*, 18, 1121–1136. <https://doi.org/10.37394/23207.2021.18.106>
- How, J. C. Y., Karim, M. A., & Verhoeven, P. (2005). Islamic financing and bank risks: The case of Malaysia. *Thunderbird International Business Review*, 47(1), 75–94. <https://doi.org/10.1002/tie.20041>
- 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*. Vol. 14 No. 5, pp. 1043-1060. <https://doi.org/10.1108/IMEFM-05-2020-0226>
- Isik, I., & Uygur, O. (2021). Financial crises, bank efficiency and survival: Theory, literature and emerging market evidence. *International Review of Economics and Finance*, 76. <https://doi.org/10.1016/j.iref.2021.07.016>
- Jamaruddin, W. N., & Markom, R. (2020). The application of fintech in the operation of Islamic banking. *Syariah and Law in Facing Covid-19: The Way Forward*, 3(1), 31–43. <https://insla.usim.edu.my/index.php/e proceeding/article/view/16>
- Johnes, J., Izzeldin, M., & Pappas, V. (2014). A comparison of performance of Islamic and conventional banks 2004-2009. *Journal of Economic Behavior and Organization*, 103, 1–15. <https://doi.org/10.1016/j.jebo.2013.07.016>
- Kalirajan, K. P., & Shand, R. T. (1999). Frontier production functions and technical efficiency measures. *Journal of Economic Surveys*, 13(2), 149–172. <https://doi.org/10.1111/1467-6419.00080>
- Karim, M. Z. A. (2015). Comparative bank efficiency across select ASEAN countries. *ASEAN Economic Bulletin*, 18(3), 289–304. <http://www.jstor.org/stable/25773688>

- King, R. G., & Levine, R. (1993). Finance and growth: Schumpeter might be right. *Quarterly Journal of Economics*, 108(3), 717–737. <https://doi.org/10.2307/2118406>
- Kolapo, T. F., Ayeni, R. K., & Oke, M. O. (2012). Credit risk and commercial banks' performance in Nigeria: A panel model approach. *Australian Journal of Business and Management Research*, 2(2), 31–38. http://ajbmr.com/articlepdf/aus_20_70i2n2a4.pdf
- Loong, F., Kamarudin, F., Sufian, F., & Naseem, N. A. M. (2017). Estimating efficiency in domestic and foreign Islamic banking and its determinants among three neighboring countries - Malaysia, Indonesia and Brunei. *International Journal of Economics and Management*, 11(1), 237–258. [http://www.ijem.upm.edu.my/vol11no1/\(13\)-Paper%2013%20Final-IJEM%2011\(1\),2017_Estimating%20Efficiency....pdf](http://www.ijem.upm.edu.my/vol11no1/(13)-Paper%2013%20Final-IJEM%2011(1),2017_Estimating%20Efficiency....pdf)
- Lucchetti, R., Papi, L., & Zazzaro, A. (2001). Banks' inefficiency and economic growth: A micro-macro approach. *Scottish Journal of Political Economy*, 48(4), 400–424. <https://doi.org/10.1111/1467-9485.00206>
- Majeed, M. T., & Zainab, A. (2021). A comparative analysis of financial performance of Islamic banks vis-a-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>
- Miah, M. D., Suzuki, Y., & Uddin, S. M. S. (2021). The impact of Covid-19 on Islamic banks in Bangladesh: A perspective of Marxian "circuit of merchant's capital. *Journal of Islamic Accounting and Business Research*, 12(7), 1036–1054. <https://doi.org/10.1108/JIABR-11-2020-0345>
- Mollah, S., & Zaman, M. (2015). Shari'ah supervision, corporate governance and performance: Conventional vs. Islamic banks. *Journal of Banking and Finance*, 58, 418–435. <https://doi.org/10.1016/j.jbankfin.2015.04.030>
- Musa, H., Natorin, V., Musova, Z., & Durana, P. (2020). Comparison of the efficiency measurement of the conventional and Islamic banks. *Oeconomia Copernicana*, 11(1), 29–58. <https://doi.org/10.24136/oc.2020.002>
- Nafla, A., & Hammas, A. (2016). Islamic Banks, Conventional banks and subprime crisis: Empirical evidence by using DEA approach. *Journal of Islamic Banking and Finance*, 4(1). <https://doi.org/10.15640/jibf.v4n1a2>
- Pantas, P. (2021). Islamic banking efficiency in Indonesia and Malaysia: Two stages data envelopment window analysis cointegration of stock market and exchange rate in Indonesia view project. *Al-Uqud: Journal of Islamic Economics*, 5(2), 234–249. <https://doi.org/10.26740/al-uqud.v5n2.p234-249>
- Parsa, M. (2020). Efficiency and stability of Islamic vs. conventional banking models: A meta frontier analysis. *Journal of Sustainable Finance and Investment*. <https://doi.org/10.1080/20430795.2020.1803665>
- Puji Prasetyo, P., Pantas, P. E., Jihadah Ashar, N., Riana Pertiwi, F., & Dahlan, A. (2020). Performance comparison of Islamic banking in Indonesia and Malaysia: Islamicity performance index approach. *Journal of Islamic Economics Perspectives*, 2(1), 92–103.
- Puspitasari, N., Rukmana, D. H., & Sukarno, H. (2017). Analysis of Islamic banking efficiency using maqashid syariah approach (study on Islamic banks in Indonesia and Malaysia). *GATR Journal of Finance and Banking Review*, 2(4), 01–07. [https://doi.org/10.35609/jfbr.2017.2.4\(1\)](https://doi.org/10.35609/jfbr.2017.2.4(1))
- Rani, L. N., Sukmaningrum, P.S., & Salleh, M. C. M. (2020). A comparative analysis of the productivity of Islamic banking in Indonesia, Malaysia and Brunei Darussalam during the period 2012-2017. *International Journal of Innovation, Creativity and Change*, 11(11), 470–491. https://api.elsevier.com/content/abstract/scopus_id/85083044283

- Rehman, S. U. (2021). Impact of the Covid-19 pandemic on Islamic bank indices of the GCC countries. *International Journal of Islamic Banking and Finance Research*, 7(1), 1–17. <https://doi.org/10.46281/ijibfr.v7i1.1381>
- Rozzani, N., & Rahman, R. A. (2013). Determinants of bank efficiency: Conventional versus Islamic. *International Journal of Business and Management*, 8(14). <https://doi.org/10.5539/ijbm.v8n14p98>
- Rusydia, A. S., & Marlina, L. (2019). Financial and social efficiency on Indonesian Islamic banks. *Journal of Islamic Monetary Economics and Finance*, 5(3), 579–602. <https://doi.org/10.21098/jimf.v5i3.1154>
- Safiullah, M., & Shamsuddin, A. (2019). Risk-adjusted efficiency and corporate governance: Evidence from Islamic and conventional banks. *Journal of Corporate Finance*, 55, 105-140. <https://doi.org/10.1016/j.jcorpfin.2018.08.009>
- Sakouvogui, K., & Guilavogui, M. G. (2022). How are the United States banks faring during the Covid-19 pandemic? Evidence of economic efficiency measures. *Open Economics*, 5(1), 11–29. <https://doi.org/10.1515/OPENEC-2022-0117>
- Sakti, M. R. P., & Mohamad, A. (2018). Efficiency, stability and asset quality of Islamic vis-à-vis conventional banks: Evidence from Indonesia. *Journal of Islamic Accounting and Business Research*, 9(3), 378-400. <https://doi.org/10.1108/JIABR-07-2015-0031>
- Sarifuddin, S., Ismail, M. K., & Kumaran, V. V. (2015). Comparison of banking efficiency in the selected ASEAN countries during the global financial crisis. *Prosiding Perkem*, 10, 286–293. https://www.ukm.my/fep/perkem/pdf/perkem2015/PERKEM_2015_3B3.pdf
- Shah, S. A. A., Sukmana, R., & Fianto, B. A. (2021). Efficiencies in Islamic banking: A bibliometric and theoretical review. *International Journal of Productivity and Quality Management*, 32(4), 458-501. <https://www.inderscience.com/info/inarticle.php?artid=114268>
- Sharma, D., Sharma, A.K. and Barua, M.K. (2013), Efficiency and productivity of banking sector: A critical analysis of literature and design of conceptual model. *Qualitative Research in Financial Markets*, 5(2), 195-224. <https://doi.org/10.1108/QRFM-10-2011-0025>
- Sufian, F. (2009). Determinants of bank efficiency during unstable macroeconomic environment: Empirical evidence from Malaysia. *Research in International Business and Finance*, 23(1), 54–77. <https://doi.org/10.1016/j.ribaf.2008.07.002>
- Waemustafa, W., & Sukri, S. (2015). Bank specific and macroeconomics dynamic determinants of credit risk in Islamic banks and conventional banks. *International Journal of Economics and Financial Issues*, 5(2), 476–481. <https://dergipark.org.tr/en/pub/ijefi/issue/31969/352147>
- Wijana, I. M. D., & Widnyana, I. W. (2022). Is Islamic banking stronger than conventional banking during the Covid-19 pandemic? Evidence from Indonesia. *Jurnal Ekonomi & Keuangan Islam*, 8(1), 125–136. <https://doi.org/10.20885/jeki.vol8.iss1.art9>
- Wu, D., Yang, Z., & Liang, L. (2006). Using DEA-neural network approach to evaluate branch efficiency of a large Canadian bank. *Expert Systems with Applications*, 31(1), 108–115. <https://doi.org/10.1016/j.eswa.2005.09.034>
- Yahya, M. H., Muhammad, J., & Hadi, A. R. A. (2012). A comparative study on the level of efficiency between Islamic and conventional banking systems in Malaysia. *International Journal of Islamic and Middle Eastern Finance and Management*, 5(1), 48–62. <https://doi.org/10.1108/17538391211216820>
- Yildirim, I. (2015). Financial efficiency analysis in Islamic banks: Pressacademia, 2(3), 289–289. <https://doi.org/10.17261/PRESSACADEMIA.2015312956>
- Çolak, G., & Öztekin, Ö. (2021). The impact of Covid-19 pandemic on bank lending around the world. *Journal of Banking and Finance*, 133. <https://doi.org/10.1016/j.jbankfin.2021.106207>