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The impact of the covid-19 pandemic on the efficiency performance of Islamic Banks in Indonesia: A two-stage data envelopment analysis approach

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Abstract

Additionally, resilience to crises makes Islamic banking one of the leading solutions to overcoming the economic crisis. This research aims to analyse the level of performance of Islamic banking in Indonesia and determine factors, including the impact of the COVID-19 pandemic during the 2011-2022 period, using 11 Islamic commercial banks in Indonesia. The analysis method used is DEA Two Stage, with secondary data from the financial reports of each Islamic commercial bank. The input variables are fixed assets, labour costs, and third-party funds. The output variables are the amount of financing provided and operational income. The research results explain that no Islamic commercial banks in Indonesia achieved optimal efficiency during the research period. Then, the efficiency level of Islamic commercial banks in Indonesia fluctuated yearly during the research period. Furthermore, the COVID-19 pandemic has impacted the efficiency level of Islamic commercial banks in Indonesia. In the potential improvement analysis, know that the most significant source of inefficiency is the output variable: the amount of financing provided. The results of the benchmarking analysis found Islamic commercial banks with the most references, where the year most referred to was 2021-2022.

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Introduction

The financial sector is essential for real economic growth nationally and globally (Abduh & Chowdhury, 2012; Grassa & Gazdar, 2014; Masrizal et al., 2022). In this context, the financial system influences the level of savings and then allocates to various types of investment, such as technology, human resources, physical capital, and others. The better the financial system performs its functions, the more significant its contribution to economic growth (Supartoyo et al., 2018). However, the Covid-19 pandemic phenomenon, which began to spread massively at the end of 2019, especially in Indonesia, was able to cause severe shocks not only in the social or health sectors but also spread to the financial sector and threatened the position of the financial market, especially the banking industry which is one of the crucial actors in the financial sector, especially the banking industry (Diana et al., 2021; Mai et al., 2023; Nicola et al., 2020).

This, of course, impacts economic growth, considering that the banking industry has a significant role in the economy both on a micro and macro scale (Fadhlullah, 2015). From a macroeconomic perspective, banking is a tool for determining monetary policy. At a micro level, through its intermediation function, especially in lending, banks become the primary source of financing for both individuals and companies (Siringoringo, 2012). This situation occurs because the primary function of banking, namely intermediation as the party that collects funds from the community and channels them back to the community, as well as providing other services in the form of banking services, does not run optimally (Verawaty et al., 2017). Arafat et al. (2021) explain that the COVID-19 pandemic has affected banks' profitability. Non-performing loans from banks rose by 250 basis points because the loan holder's business needed much liquidity. Loans provided to the aviation, tour operators, hotels, retail and property sectors, and construction industries have become problematic. Most of these industries are in a stage of stagnation, and their holders cannot repay their loans. This ultimately affects the profitability and stability of the banking sector.

One of the actors in the banking industry is Islamic banking, which is believed to be more resilient than conventional banks during times of crisis, including during the Covid-19 pandemic (Mai et al., 2023). Islamic banking faces three possible risks due to the pandemic: financing risk, decline in asset value, and tightening liquidity (Hasan, 2020). Financing risk refers to the risk of default by borrowers, which has increased due to the economic impact of the pandemic, and decreased demand for credit due to decreased economic activity can also affect the performance of Islamic banking. One reason is that Islamic banks are more exposed to small and medium enterprises (SMEs), microfinance, and retail loans, especially in Asia. The pandemic has hit these sectors hard, leading to a higher risk of default (Oxford Business Group, 2020).

Furthermore, the decline in asset values due to the spread of the COVID-19 pandemic caused a global economic collapse, especially in the tourism, hospitality, and manufacturing industries. This can reduce the value of assets owned by Islamic banking, such as property or shares in companies, and harm the bank's financial position. Then, regarding the risk of tight liquidity, uncertain economic conditions due to the COVID-19 pandemic can cause Islamic banking to experience a decrease in liquidity, especially if customers make large withdrawals of funds. This can cause Islamic banking difficulty in fulfilling its obligations, such as paying deposit interest or issuing new financing (Hasan, 2020).

In Indonesia, Islamic banking continues to show significant development. According to data from the Financial Services Authority (OJK) in 2019, the total profit recorded from Islamic Commercial Banks was 3,442 billion in 2016, 4,032 billion in 2017, and 5,757 billion in 2018. In September 2019, Islamic Commercial Bank profits reached 7,833 billion. This data shows that Islamic commercial banks are promising because their profits increase. The OJK report

2019 also reported the contribution of Islamic commercial banks in financing (or in conventional banks known as loans), where total funding in 2016 reached 177,482 billion with an NPF (Non-Performing Financing) level of 7,834.

In contrast, 2017 total financing was 189,789 billion, with an NPF level of 9,030. Meanwhile, total financing in 2018 was 202,298, with an NPF level of 6,597. Of the various funding provided, the MSME sector dominates the use of financing with total funding of 248 billion in 2016, 286 billion in 2017, 320 billion in 2018, and 344 billion in September 2019. The amount of financing continues to increase every year even though the amount is far more than expected. The role of Islamic banking is slowly contributing to it.

Considering the impact of the COVID-19 pandemic phenomenon, especially on Islamic banking, this research aims to examine the performance of Islamic banking in Indonesia and its determining factors, including the impact of the COVID-19 pandemic. Measuring bank efficiency and performance is an important task not only for policymakers and bank managers but also for researchers. Efficiency measurements are intended to help assess the impact of the pandemic on the banking sector, identify areas that need improvement, and increase bank competitiveness and customer confidence (Arafat et al., 2021; Mai et al., 2023). Several empirical studies discuss measuring the efficiency of Islamic commercial banks in Indonesia, including Hasan's (2020) analysis of the impact of the COVID-19 pandemic on Islamic banks in Indonesia during the pandemic. Effendi & RS (2020) analysed the impact of COVID-19 on Islamic banks; Sholihah (2021) analysed the efficiency of the financial performance of the Indonesian banking sector during the pandemic; Diana et al. (2021) analysed the financial performance of Indonesian Sharia banking during the Covid-19 pandemic; Ihsan & Hosen (2021) analysed the performance of Bank BNI Syariah during the Covid-19 pandemic; Notalin et al. (2021) analysed the impact of the Covid-19 pandemic on the level of efficiency of financial performance of Islamic commercial banks in Indonesia. This research aims to analyse the level of performance of Islamic banking in Indonesia and its determining factors, including the impact of the COVID-19 pandemic for the 2011-2022 period using the DEA Two Stage.

Literature Review

Islamic banking is different from conventional banking (Sholihah, 2021). In conventional bank operations, conventional banks obtain funds from the public through savings, deposits, and current accounts and then allocate these funds in the form of credit or financing to parties in need. Meanwhile, in the Islamic banking system, transactions are carried out based on Islamic principles, and the bank is responsible for the investment results. Apart from that, another term for Islamic Bank is Sharia banking or interest fee banking, which means that a banking system in its operational activities does not apply interest (riba), speculation (maisir), and ambiguity (gharar). Banking itself is a very vital sector of the global economy. In the economic context, financial institutions play an essential role in carrying out the intermediation function, namely collecting funds from the public and channelling them for productive investment in various sectors (Diana et al., 2021). However, the Covid-19 phenomenon hampers the role of banking.

The crisis faced by Indonesia during the COVID-19 pandemic differed from the crises in 1998 and 2008. At the beginning of 2020, economic growth in Indonesia and the world is improving than the previous year. However, when the COVID-19 outbreak emerged in December 2019 in Wuhan, China, the entire world economy, including financial markets, experienced a collapse. To overcome this crisis, the first step must be to build infrastructure in hospitals, including personal protective equipment (PPE), doctors, nurses, and health workers. China contributes 20% of global component supplies. If production in China stops, global production will be disrupted, known as a supply shock.

On the other hand, China, the Asian production centre, requires raw materials and

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supporting materials from various Asian countries. China also needs to import palm oil and coal from Indonesia. If China experiences an outbreak, demand for goods from Indonesia will decrease, so palm oil and coal prices will also fall because exports to China will decrease (Hasan, 2020).

The impact of the COVID-19 pandemic has been significant in the financial sector, especially in Islamic banking in Indonesia, and especially in Islamic Commercial Banks, which face various challenges. One of the impacts that Islamic commercial banks feel is on their financial performance and business activities, which impacts the efficiency level of Islamic commercial banks in Indonesia. The COVID-19 pandemic has created uncertainty and reduced public confidence in economic stability, thus affecting the performance and growth of Islamic Commercial Banks in Indonesia. Islamic Commercial Banks must handle these various challenges effectively and efficiently to ensure business continuity and future sustainability of the Islamic banking industry (Notalin et al., 2021). Therefore, measuring efficiency is one of the essential things that banks must do to see the extent to which business units use their resources as optimally as possible.

Efficiency in a financial context is a concept that measures how well-invested input produces output (Belanès et al., 2015). The expected performance of a process is the ability to produce maximum output by utilising available input (Hosen & Muhari, 2013). In production, a process is considered technically efficient if the output is maximum using a minimum amount of input (Jatmiko, 2017). Archer (2010) states that efficiency can be measured by how much time, energy, and expertise is needed to achieve specific goals. Customers tend to choose more efficient banks because they incur fewer transaction costs than inefficient banks. Banks with high efficiency are relied on by customers to obtain profitable results, so authorities and banks need to maintain bank efficiency. There are several ways to increase efficiency, such as increasing the concentration and profitability of microfinance institutions and increasing loan amounts (Bos & Millone, 2015).

Several empirical studies discuss the efficiency or performance of Islamic banks in Indonesia during the COVID-19 pandemic. Previous research explains that the impact of COVID-19 on Islamic banking can be analysed in terms of three possible risks: financing risk, asset damage, and tight profit-sharing systems. Compared to conventional banks, Islamic banking is more flexible in dealing with the economic crisis caused by the COVID-19 pandemic. The national banking system has predicted problems due to the COVID-19 outbreak. On the other hand, Islamic banks have the advantage of profit sharing theory, thereby increasing their effectiveness in overcoming the crisis. The dominance of Islamic banks during these difficult times is an excellent opportunity to strengthen their market share. In addition, Islamic banks can face risks, such as providing loans, deteriorating asset quality, and tight profit sharing (Hasan, 2020).

Other research explains that some of the indicators of Islamic bank resilience are Return on Assets (ROA), non-performing finance (NPF), and financing to deposit ratio (FDR) during the pandemic period from July 2019 to June 2020, and based on the analysis results it shows that ROA has decreased significantly, while NPF and FDR were still within safe limits (Effendi & RS, 2020). Based on measuring the efficiency of the financial performance of the banking sector in Indonesia, the average level of efficiency of the banking sector, both Conventional Commercial Banks and Islamic Commercial Banks, faced a substantial decline during the COVID-19 pandemic. This is due to the decline in income from raising funds and disbursing financing while banking operational costs continue to increase for the company's daily operational needs (Sholihah, 2021).

Based on a comprehensive review of multiple studies on the operational efficiency of Islamic banking in Indonesia, it is evident that there needs to be a significant gap in

understanding the implications of the COVID-19 pandemic on the efficiency and overall performance of Islamic banking in the country. There is a critical need for further research using advanced analytical methods such as the DEA Two-Stage method and Tobit regression to address this gap. This research aims to contribute to the existing body of knowledge and provide a deeper understanding of the challenges and opportunities faced by Islamic banking in the context of the COVID-19 pandemic in Indonesia.

Methodology

Data

The data used in this research is secondary data. Secondary data was obtained from the financial reports of each Islamic Commercial Bank in Indonesia. The income statement and balance sheet are two financial reports that are examined. This report details several financial items that can be used by this study's input and output variables. The panel data used in this study covers the six years 2017 to 2022 and includes 11 Islamic Commercial Banks in Indonesia. The method used in this research is the DEA Two Stage.

Furthermore, using an intermediation approach, selecting input and output variables to measure efficiency uses the Data Envelopment Analysis (DEA) method in the first stage. The input variables used in this analysis are operational costs, third-party funds, and fixed assets. Then, operational income and the amount of financing provided are the output variables used. Next, in the second stage, the dependent variable analysed using the Tobit model to analyse the factors that influence the efficiency level of an Islamic commercial bank in Indonesia is the DEA measurement result score. Meanwhile, the independent variables are dummy variables, such as the COVID-19 pandemic and macro inflation.

Data Envelopment Analysis (DEA)

Data Envelopment Analysis (DEA) is used to measure the efficiency and productivity of business units. This method uses a quantitative descriptive approach that does not depend on specific parameters. DEA was first developed by Charnes, Cooper, and Rhodes in 1978 and then refined by Banker, Charnes, and Rhodes in 1984. Based on this, the DEA technique has two core models: the Charnes, Cooper, Rhodes (CCR) model, which follows the Constant Return to Scale (CRS) assumption. This model assumes that changes in the output value of the DMU produced are constant and the production function is constant (the same). Second, the Return to Scale variable is in line with the Banker, Charnes & Rhodes (BCR) (VRS) (VRTS) model. Unlike the first model, the second model assumes that every change in the DMU output value differs from every change in a specific input value. As a result, not all inputs will produce the same output value. This study contrasts the CRV and VRS models to describe banking activities and assess efficiency. Sharma et al. (2013) explain that the DEA approach is used to measure technical efficiency, including the efficiency of financial institutions, in various empirical investigations related to efficiency. In addition, the results of the DEA approach analysis can provide information regarding decision-making units (DMU) that are inefficient in utilising input and the factors that cause this inefficiency. DEA techniques can determine the values of input or output variables that must be met or changed to maximise efficiency.

Furthermore, in evaluating efficiency using the DEA method, there are two main orientations: input orientation (input-oriented) and output orientation (output-oriented). In an input-oriented model, efficiency is measured by maintaining output at the same level while input is reduced. Meanwhile, in the output-oriented model, efficiency is measured by maintaining input at the same level while output increases (Akbar, 2009). In this research, the orientation used is output-oriented. The analysis results get an efficiency score between 0 and 1 or 100% in DEA. A DMU with a score of 100% shows that the DMU is efficient, and the

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lower the DMU score, the more it shows that the DMU is inefficient. According to Hadini & Wibowo (2021), there are several benefits to using Data Envelopment Analysis (DEA), namely being able to test cases with complex relationships between input and output that cannot be resolved with other analytical methods. In addition, DEA can measure efficiency by using variable input and output in a company.

Tobit Model

In this stage, the Tobit model is used to analyse the determinant factors in Indonesia's Islamic commercial bank efficiency level. After obtaining the efficiency value in the first stage using the DEA method, this value will be analysed using several independent variables to evaluate the influence of these variables on the efficiency level (second stage). The Tobit method was chosen because the data used in this research is censored data, where the value of the dependent variable (namely efficiency or EF) is limited to the value range of 0 to 100. If the Ordinary Least Square (OLS) method is used to analyse this data, the regression results will be biased and inconsistent. Therefore, the Tobit method, more appropriate to the characteristics of censored data, was chosen as an alternative for regression analysis in the second stage (Pambuko, 2016).

The Tobit method assumes that the independent variable has an unlimited range of values (non-censored). In contrast, the dependent variable is a censored variable whose value is limited to a specific range. In addition, the Tobit method requires that all variables (both independent and independent) are measured accurately, that there is no autocorrelation, heteroscedasticity, or perfect multicollinearity, and that the mathematical model used is appropriate. In research in the social and economic fields, data structures often have a response variable with a value of zero for most observations, while for other observations, the value varies. This kind of data structure is called censored data (Firdaus & Hosen, 2014).

Results and Discussion

Descriptive statistics of Islamic commercial banks in Indonesia

Table 1 represents descriptive statistics of Islamic commercial banks' input and output variables in Indonesia from 2011 to 2022, i.e., fixed assets, operational expenses, third-party funds, output, amount of financing provided, and operating income.

Table 1. Descriptive Statistics of Islamic Commercial Banks

Variabel	Mean	Min	Max	Std.Dev
Input				
Fixed assets	Rp16.179.169,10	Rp0,00	Rp508.119.348,00	Rp76.806.361,82
Operational Expenses	Rp7.002.962,93	Rp1.537,00	Rp203.111.186,00	Rp31.838.753,67
Third-party funds	Rp243.294.333,17	Rp1,00	Rp19.306.864.295,00	Rp1.809.227.771,32
Output				
Amount of Financing Provided	Rp379.100.720,59	Rp54,00	Rp15.489.074.411,00	Rp1.903.818.971,52
Operating Income	Rp39.181.431,04	Rp17.995,00	Rp1.237.433.583,00	Rp181.434.800,76

Efficiency panel for Islamic commercial banks in Indonesia

Table 2. Efficiency Panel

Years/Type of Efficiency	Mean	Min	Max	Std.Dev
Panel A (2011)				
TE	0,095	0,011	0,212	0,060
PTE	0,244	0,015	1,000	0,307
SE	0,672	0,114	1,000	0,319
Panel B (2012)				
TE	0,110	0,014	0,242	0,072
PTE	0,286	0,041	1,000	0,342
SE	0,621	0,084	0,999	0,326
Panel C (2013)				
TE	0,110	0,017	0,200	0,048
PTE	0,224	0,049	0,605	0,159
SE	0,647	0,235	0,999	0,337
Panel D (2014)				
TE	0,116	0,016	0,237	0,060
PTE	0,207	0,060	0,472	0,132
SE	0,648	0,230	1,000	0,334
Panel E (2015)				
TE	0,114	0,018	0,204	0,055
PTE	0,187	0,066	0,414	0,092
SE	0,660	0,181	1,000	0,314
Panel F (2016)				
TE	0,100	0,018	0,172	0,041
PTE	0,174	0,049	0,385	0,097
SE	0,659	0,156	0,983	0,264
Panel G (2017)				
TE	0,106	0,020	0,246	0,058
PTE	0,202	0,040	0,423	0,113
SE	0,614	0,144	0,984	0,288
Panel H (2018)				
TE	0,207	0,025	1,000	0,265
PTE	0,303	0,113	1,000	0,249
SE	0,626	0,144	1,000	0,289
Panel I (2019)				
TE	0,203	0,062	1,000	0,257
PTE	0,313	0,120	1,000	0,241
SE	0,633	0,141	1,000	0,288
Panel J (2020)				
TE	0,116	0,058	0,248	0,050
PTE	0,223	0,071	0,422	0,098
SE	0,613	0,160	0,951	0,275
Panel K (2021)				
TE	0,303	0,068	1,000	0,334

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Years/Type of Efficiency	Mean	Min	Max	Std.Dev
PTE	0,719	0,140	1,000	0,314
SE	0,428	0,108	1,000	0,337
Panel L (2022)				
TE	0,374	0,080	1,000	0,375
PTE	0,696	0,191	1,000	0,337
SE	0,515	0,136	1,000	0,342
Panel M (All Years)				
TE	0,163	0,011	1,000	0,205
PTE	0,315	0,015	1,000	0,291
SE	0,611	0,084	1,000	0,318

Table 2 shows the efficiency panel for Islamic commercial banks in Indonesia. Based on Table 2, the efficiency of Islamic commercial banks in Indonesia fluctuates yearly. Based on the average Technical Efficiency (TE), Pure Technical Efficiency (PTE), and Scale Efficiency (SE) scores at Islamic commercial banks in Indonesia, the lowest TE score was in 2011, with a value of 0.095, and the highest TE score was in in 2022 with a value of 0.374. The lowest average PTE score was in 2016, with a value of 0.174, and the highest was in 2021, with a value of 0.719. Furthermore, the lowest average SE value was in 2021, with a value of 0.428, and the largest was in 2011, with a value of 0.672.

Islamic commercial banks efficiency score in ındonesia

Table 3. Average Islamic Commercial Banks Efficiency Score in Indonesia

DMU	CRS	VRS	SE
PT Bank Aceh Syariah	0,042	0,220	0,257
PT Bank Jabar Banten Syariah	0,092	0,194	0,605
PT Bank Mega Syariah	0,085	0,319	0,389
PT Bank Muamalat Syariah	0,137	0,486	0,290
PT Bank Panin Dubai Syariah	0,199	0,357	0,743
PT Bank Syariah Bukopin	0,144	0,158	0,913
PT Bank Tabungan Pensiunan Nasional Syariah	0,062	0,358	0,252
PT Bank Victoria Syariah	0,206	0,277	0,884
PT BCA Syariah	0,130	0,166	0,849
PT BPD West Nusa Tenggara Syariah	0,302	0,533	0,599
PT Maybank Syariah Indonesia (PT Bank Net Syariah)	0,390	0,396	0,945

Table 3 shows Indonesia's Islamic commercial bank's efficiency score. Based on Table 3, no Islamic commercial bank in Indonesia has achieved maximum efficiency (1,000), whether based on CRS or VRS assumptions. However, if we look at the highest score on the CRS assumption, Maybank Syariah Indonesia has the highest average efficiency score, namely 0.390. Meanwhile, the bank with the lowest average efficiency based on the CRS assumption is Bank Aceh Syariah. Furthermore, based on VRS assumptions, the bank with the highest average efficiency score is BPD West Nusa Tenggara Syariah, with a value of 0.533, followed by Bank Muamalat, with a value of 0.486. Meanwhile, the bank with the lowest average efficiency score based on the VRS assumption is Bank Syariah Bukopin.

Efficiency trends in ıslamic commercial banks in Indonesia

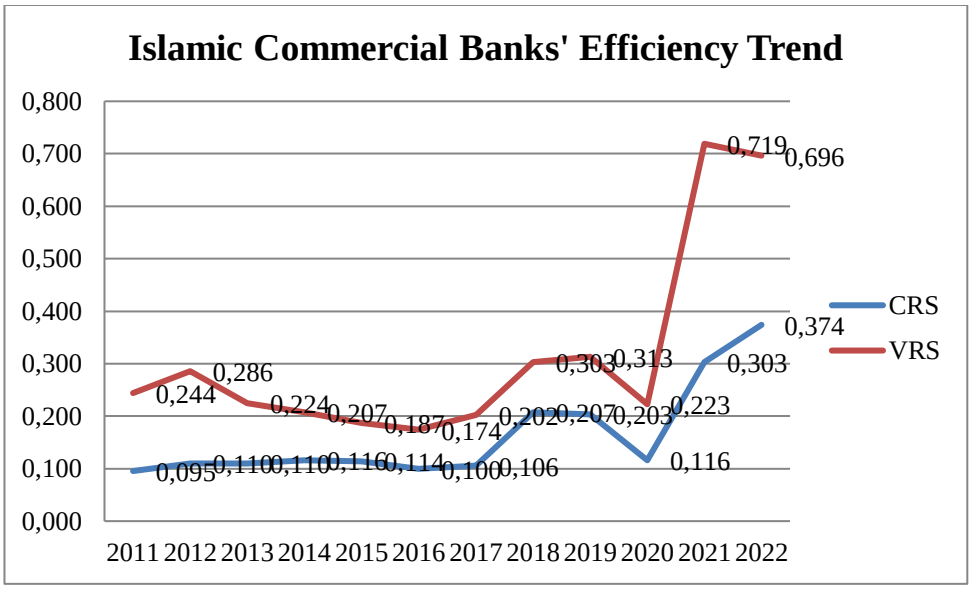

Figure 1. Islamic Commercial Banks' Efficiency Trends in Indonesia

Figure 1 provides information regarding Islamic commercial banks' efficiency trends in Indonesia during the 2011-2022 research period. The efficiency level of Islamic commercial banks in Indonesia fluctuates yearly and tends to increase in the final period. Generally, the efficiency trends in the CRS and VRS assumptions have almost the same pattern. The efficiency level experienced a slight increase in 2012, then decreased in the following period until 2017. From 2018 to 2019, the efficiency level again experienced a reasonably high increase, but in 2020, Islamic commercial banks' efficiency decreased significantly.

Furthermore, there has been an improvement in the efficiency of Islamic commercial banks in Indonesia. This is shown in the 2021 period when the efficiency of Islamic commercial banks again increased significantly. Under the CRS assumption, the efficiency level continues to increase until the end of the period and becomes the highest efficiency level during the research period. Meanwhile, according to the VRS assumption, in the 2022 period, the efficiency level will decrease even though the decrease in efficiency is relatively small.

Efficiency of ıslamic commercial banks in Indonesia during the covıd-19 pandemic

The emergence of the COVID-19 pandemic at the end of 2019, until it began to spread massively in Indonesia at the beginning of 2020, caused quite a big shock to the Indonesian economy, especially the financial sector, which is the banking industry. Figure 2 shows the efficiency of Islamic commercial banks in Indonesia during COVID-19, from 2019 to 2021. The pandemic began to spread massively in Indonesia, significantly impacting the efficiency of Islamic commercial banks. This is shown in the diagram, where, in 2020, there was a significant decrease in efficiency, both in the CRS and VRS assumptions. Then, Islamic commercial banks' efficiency began to improve, as shown by increasing Islamic commercial banks' efficiency from 2021 to 2022. However, especially with the VRS assumption, the efficiency level in the 2022 period experienced a relatively small decline.

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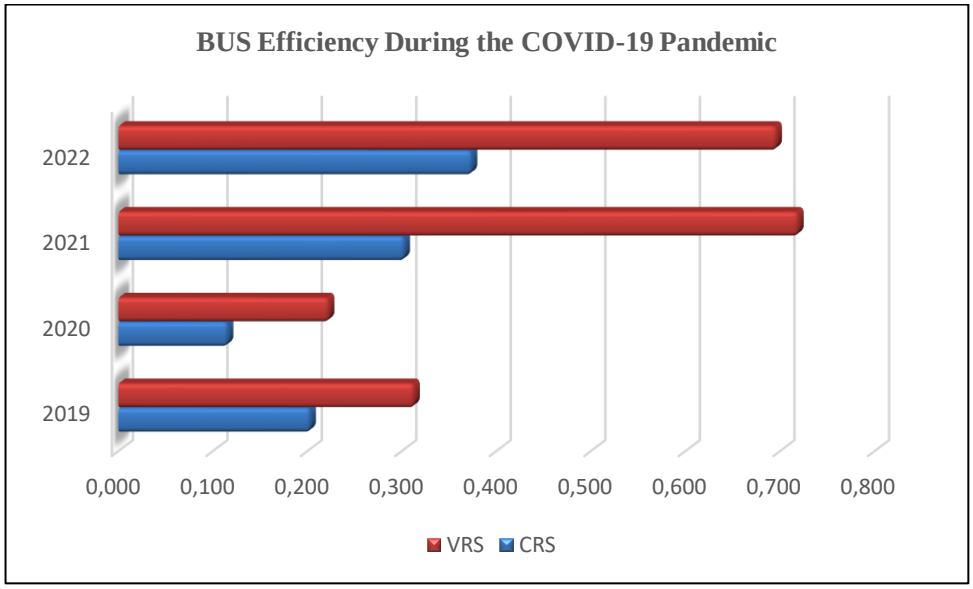

Figure 2. Islamic Commercial Banks' Efficiency During the COVID-19 Pandemic

Potential ımprovement

DEA analysis produces the efficiency level of the unit being analysed and potential improvements or potential improvements to obtain values that must be improved to achieve optimal efficiency levels. Through the potential improvement analysis, we can determine what variables need to be optimised. This analysis uses the last year of observation, which is analysed separately from other periods, to get an idea of the value that must be achieved.

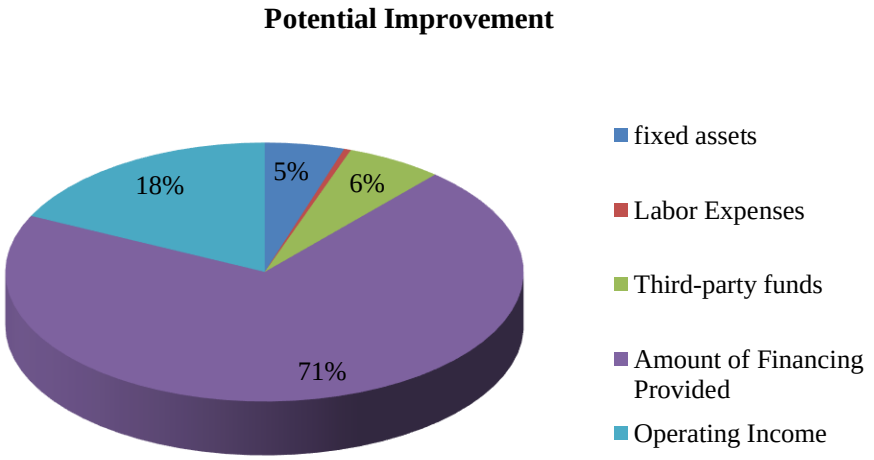

Figure 3. Potential Improvement

Figure 3 shows the potential improvement of Islamic commercial banks in Indonesia. Figure 3 provides general information regarding input and output variables and sources of Islamic commercial banks' inefficiency in Indonesia. Input variables that cause inefficiency in Islamic commercial banks in Indonesia come from fixed assets and third-party funds. Furthermore, the output variable sources of Islamic commercial banks' inefficiency in Indonesia are the amount of financing provided and operational income. Based on the potential improvement

analysis, if Islamic commercial banks in Indonesia want optimal efficiency, fixed assets must be reduced by 5% and third-party funds by 6%. Then, the operational income output variable needs to be increased by 15%, and the amount of financing provided increased by 71%. The most significant cause of inefficiency in Islamic commercial banks in Indonesia comes from the output variable: the amount of financing provided.

Benchmarking

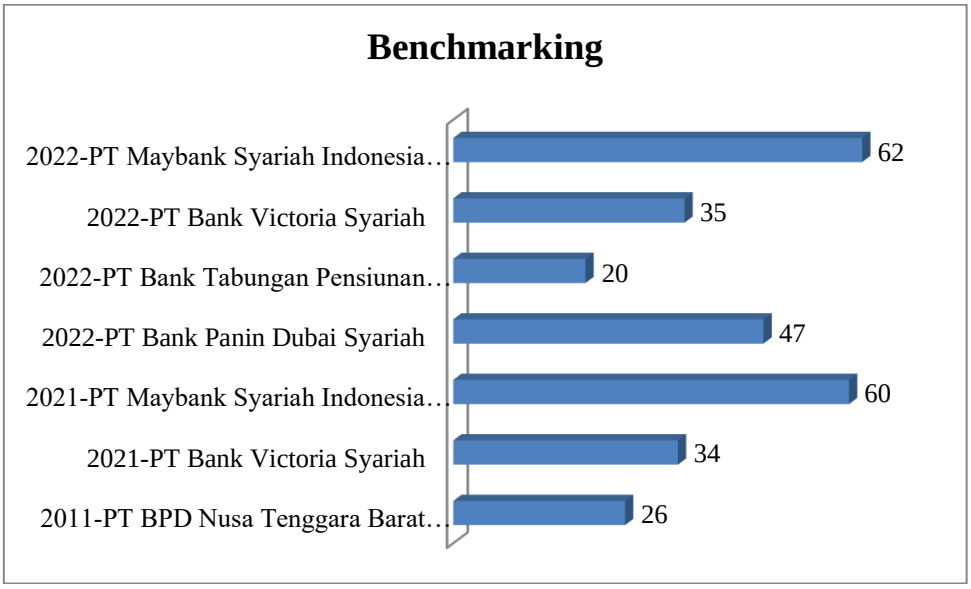

Figure 4. Benchmarking Islamic Commercial Banks in Indonesia

Figure 4 explains benchmarking, showing Islamic commercial banks in Indonesia as a reference for other banks, especially for banks that have yet to reach optimal efficiency levels. Based on frontier analysis, it was found that Maybank Syariah, in the 2021-2022 period, was the bank with the most referrals, totalling 122. Then, the bank with the subsequent most referrals was Bank Victoria Syariah for the 2021-2022 period, with 69 referrals. This was followed by Bank Panin Dubai Syariah 2022 with 47 referrals, PT BPD NTB with 26 referrals, and Bank Tabungan Pensiunan with 20 referrals. This explains that, individually, BUS in Indonesia shows efficient conditions, and it can be concluded that, in general, bank efficiency in 2021-2022 shows good conditions when compared to efficiency in previous years. This is because many banks are references in the 2021-2022 period.

Tobit regression results

The results of DEA efficiency calculations do not consider the factors influencing it. Therefore, a second stage analysis measures the factors influencing Islamic commercial banks' efficiency in Indonesia. The second analysis of this research uses the Tobit model. The Tobit model is used because the dependent variable is an efficiency value between 0 and 1. The results of processing the Tobit model with Eviews 10 are shown in Table 4. These factors were tested for their influence on the value of Islamic commercial banks' efficiency. This influence analysis uses the overall technical efficiency score results as the dependent variable. The results of Tobit processing show that the total asset factor significantly negatively influences Islamic commercial banks' efficiency. In contrast, total operational costs have a significant favourable influence on the overall technical efficiency of Islamic commercial banks.

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Table 4. Analysis of the Influence of the Tobit Model

Variabel	Coefficient	p-Value
COVID	-7.48658	**0.0895**
INF	8.67190	0.1691

Note: significant at 5% alpha. COVID=COVID-19 dummy variable, INF=inflation rate

Several findings were obtained based on the research results. First, Indonesia's Islamic commercial banks have not achieved optimal efficiency during the research period. Judging from the average score table, the efficiency level of Islamic commercial banks in Indonesia during the research period fluctuated yearly. Likewise, based on efficiency trends, which experienced fluctuations, there was a significant decline in 2019-2021, where in that year, the COVID-19 pandemic began to spread massively in Indonesia. However, the efficiency level tends to increase in the final research periods. The same thing is also explained in the analysis results during the COVID-19 pandemic, where the level of BUS efficiency at the beginning of the pandemic period, from 2019 to 2020, experienced a significant decline. Improvements in Islamic commercial banks' efficiency began in the following period. This explains that the pandemic has had quite an impact on the level of BUS efficiency in Indonesia.

This research supports Diana et al. (2021), explaining that the performance of Islamic banks in Indonesia experienced fluctuations during the COVID-19 pandemic. Likewise, Notalin et al. (2021) stated that the efficiency level of Islamic commercial banks during the pandemic experienced a decline due to a decrease in the level of income from the financing provided, which had an impact on hampered capital investment by third parties. Setyono et al. (2021) also expressed the same thing: the level of efficiency of Islamic banks has decreased due to the economic conditions experiencing turmoil during the pandemic, so that banks are required more to achieve their targets, especially in musyarakah and mudharabah financing. Other research also explains that Islamic banking is more affected by external conditions (COVID-19) than conventional banking (Shah et al., 2023).

Second, in the potential improvement analysis, it is known that the most significant source of inefficiency comes from the output variable, namely the amount of financing provided. To achieve optimal efficiency, fixed assets must be reduced by 5%, and third-party funds must be reduced by 6%. Then, the operational income output variable needs to be increased by 15%, and the amount of financing provided increased by 71%. The results of this research are relevant to research from Le et al. (2022) that the pandemic negatively influenced the growth of total assets and financing of the Islamic banking system. Pratomo and Ramdani (2021) also explained that COVID-19 harmed Sharia banks' performance in distributing financing funds or loans. Furthermore, a decrease in fund collection and credit distribution results in less-than-optimal profits and will ultimately affect the bank's efficiency (Ningsih & Mahfudz, 2020; Yasin & Fisabilillah, 2021).

Furthermore, benchmarking analysis shows that the bank most frequently referred by other banks is Maybank Syariah for the 2021-2022 period, with a total of 122 referrals. Then, Bank Victoria Syariah for the 2021-2022 period with a total of 69 referrals, followed by Bank Panin Dubai Syariah 2022 with a total of 47 referrals, PT BPD NTB with a total of 26 referrals, and the last is Bank Tabungan Pensiunan with a total of 20 referrals. It can be concluded that bank efficiency fluctuates yearly, and more banks become referrals in 2021-2022. This states that the bank's performance in those years was better than the previous year. Of course, it is challenging for Islamic commercial banks in Indonesia to operate professionally and accountably in managing their resources. The research explains that implementing good corporate governance in Islamic banks should refer to five principles: transparency, accountability, responsibility, and fairness (Faozan, 2013).

Conclusion

This research uses the DEA Two Stage to analyse the performance of Islamic banking in Indonesia and its determining factors, including the impact of the COVID-19 pandemic during the 2011-2022 period. Efficiency measurements in banking need to be carried out, especially in Islamic banking, to determine future policy direction. Based on the research results, Islamic commercial banks in Indonesia have not achieved optimal efficiency during the research period. Judging from the average score table, the efficiency level of Islamic commercial banks in Indonesia during the research period fluctuated yearly. Likewise, based on efficiency trends that experience fluctuations, the efficiency level tends to increase in the final research periods.

Furthermore, based on the results of the analysis during the COVID-19 pandemic, Islamic commercial banks' efficiency at the beginning of the pandemic period, namely from 2019 to 2020, experienced a significant decline. Improvements in Islamic commercial banks' efficiency began in the following period. This explains that the pandemic has impacted Islamic commercial banks' efficiency in Indonesia. Furthermore, in the potential improvement analysis, it is known that the most significant source of inefficiency comes from the output variable, namely the amount of financing provided. To achieve optimal efficiency, fixed assets and third parties must be reduced. Then, the operational income output variable needs to be increased, and the financing provided increases. Benchmarking analysis shows that Maybank Syariah is the bank most referred to by other banks for 2021-2022. Based on the results of the Tobit regression for the two-stage DEA, the COVID-19 pandemic had a significant impact on the performance of Islamic banks in Indonesia. Further research can include more than one country and implicate newer estimation techniques such as random forest, artificial neuron network, or lasso regression.

Author Contribution

Lina Marlina: Conceptor, Creating and designing analyses, Collecting data, Contributing data or analysis tools, and Writing paper.
Asep Saepulloh: Collecting data and Writing paper.
Sinta Verawati Dewi: Contributing data or analysis tools, and Perform analysis.
All authors have read and agreed to the published version of the manuscript.

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Declaration of Competing Interest

Author declare that have no conflict of interest

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