THE EFFICIENCY OF ISLAMIC BANK IN MALAYSIA AND INDONESIA: AN ANALYSIS OF DEA

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UNIVERSITI UTARA MALAYSIA
APRIL 2025

Pusat Pengajian Perniagaan Islam
ISLAMIC BUSINESS SCHOOL
كلية إدارة الأعمال الإسلامية
Universiti Utara Malaysia

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ABSTRACT

Islamic banking efficiency depends on a number of factors, including competition with conventional banks, regulatory frameworks, and business policies. There has to be an adequate methodological framework to ensure that efficiency is measured correctly to achieve a proper picture of bank performance. The present study takes into account the efficiency of Indonesian and Malaysian Islamic banks from 2006 to 2023, employing Data Envelopment Analysis (DEA) to estimate Technical Efficiency (TE), Pure Technical Efficiency (PTE), and Scale Efficiency (SE). 24 Islamic banks, 12 from each of two countries, were studied to evaluate financial performance, operating effectiveness, and efficiency trends. The results show considerable variations in banking efficiency across the two countries. In Malaysia, Islamic banks have shown consistent improvements in efficiency, with TE rising from 0.73 in 2006 to 0.97 in 2023. Most banks, including ALI, CITI and MBI maintained optimal levels of efficiency throughout reflecting good management and scale operations. Conversely, Indonesian Islamic banking sector experienced greater volatility, with TE declining significantly between 2015 and 2017 to a low of 0.58 in 2017. However, there has been a recovery trend since 2018, indicating efforts to enhance operating efficiency. While Malaysia's banks benefited from stable regulatory frameworks and market maturity, Indonesian banks faced challenges related to scale inefficiencies and fluctuating financial conditions. The study contributes to understanding efficiency dynamics in Islamic banking and offers insights for policymakers, regulators, and banking institutions. It emphasizes the importance of effective asset management, operational strategies, and regulatory policies in sustaining efficiency. However, limitations such as data availability, external economic influences, and methodological constraints are acknowledged.

Keyword: Islamic Bank, Efficiency, Data Envelopment Analysis

ABSTRAK

Kecekapan perbankan Islam bergantung kepada beberapa faktor, termasuk persaingan dengan bank konvensional, rangka kerja kawal selia dan dasar perniagaan. Perlu ada rangka kerja metodologi yang mencukupi untuk memastikan kecekapan diukur dengan betul untuk mencapai gambaran prestasi bank yang betul. Kajian ini mengambil kira kecekapan bank Islam Indonesia dan Malaysia dari 2006 hingga 2023, menggunakan Analisis Penyelubungan Data (DEA) untuk menganggarkan Kecekapan Teknikal (TE), Kecekapan Teknikal Tulen (PTE), dan Kecekapan Skala (SE). 24 bank Islam, 12 dari setiap dua negara, telah dikaji untuk menilai prestasi kewangan, keberkesanan operasi, dan trend kecekapan. Keputusan menunjukkan variasi yang besar dalam kecekapan perbankan di kedua-dua negara. Di Malaysia, bank Islam telah menunjukkan peningkatan yang konsisten dalam kecekapan, dengan TE meningkat daripada 0.73 pada 2006 kepada 0.97 pada 2023. Kebanyakan bank, termasuk ALI, CITI dan MBI mengekalkan tahap kecekapan optimum sepanjang mencerminkan pengurusan dan operasi skala yang baik. Sebaliknya, sektor perbankan Islam Indonesia mengalami turun naik yang lebih besar, dengan TE merosot dengan ketara antara 2015 dan 2017 kepada paras terendah 0.58 pada 2017. Walau bagaimanapun, terdapat trend pemulihan sejak 2018, menunjukkan usaha untuk meningkatkan kecekapan operasi. Walaupun bank-bank Malaysia mendapat manfaat daripada rangka kerja pengawalseliaan yang stabil dan kematangan pasaran, bank-bank Indonesia menghadapi cabaran yang berkaitan dengan ketidakcekapan skala dan keadaan kewangan yang berubah-ubah. Kajian ini menyumbang kepada pemahaman dinamik kecekapan dalam perbankan Islam dan menawarkan pandangan untuk penggubal dasar, pengawal selia dan institusi perbankan. Ia menekankan kepentingan pengurusan aset yang berkesan, strategi operasi dan dasar kawal selia dalam mengekalkan kecekapan.

Kata Kunci: Bank Islam, Kecekapan, Analisis Penyelubungan Data

ACKNOWLEDGMENT

In the name of Allah, the Most Gracious, the Most Merciful. All praise and gratitude I offer to Allah, who has given me the strength, ability, and ideas to complete this research. I would like to express my appreciation to my supervisor, Dr. Mohamad Yazid bin Isa for his guidance, encouragement, and willingness to support and guide me throughout the completion of this research. I would also like to thank him for his enthusiasm. Without his guidance, I would not have been able to complete this project paper successfully.

I would also like to express my deepest gratitude to BIB (Beasiswa Indonesia Bangkit)-LPDP for the extraordinary opportunity provided through this scholarship. This support has enabled me to pursue further education and develop my professional skills. This opportunity would not have been possible without the commitment of BIB (Beasiswa Indonesia Bangkit)-LPDP in supporting the development of Indonesian human resources. I am determined to utilize the knowledge and experience gained to make a positive contribution to society and the progress of the nation. Once again, thank you for this extraordinary opportunity.

Not forgetting my parents, Mubasyir Nur and Mar'atus Sholihah for their prayers and continuous moral and mental support in completing this research. To all my siblings and everyone who took part in making this paper project a success, Hanik, Masrur, Shofi, Maisya and Azzam for their understanding and support as well as for their unlimited love and support, without which I would not be who I am today. Special thanks to my colleagues Athia and Alya, college friends and everyone who has helped me in this research directly or indirectly. Your support and ideas are greatly appreciated. May Allah guide and protect you in all your endeavors. Thank you.

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LIST OF ABBREVIATION

DEA	:	Data Envelopment Analysis
TE	:	Technical Efficiency
PTE	:	Pure Technical Efficiency
SE	:	Scale Efficiency
RM	:	Ringgit Malaysia
RP	:	Rupiah Indonesia

CHAPTER 1

INTRODUCTION

1.1 Background of Study

The past few decades, Islamic financial institutions, particularly Islamic banks, have emerged as a significant sector within global finance. While the idea of Islamic banking gained traction in the 1960s, the principles and practices underlying this system have been present since the inception of Islam (Ben Mohamed et al., 2021). The global Islamic finance sector is expanding immensely. This is evident from the figures reported by the Islamic Financial Services Board (IFSB) in 2023, which put the Islamic finance sector in a position to grow from assets of USD 150 billion in the 1990s to USD 3.25 trillion as of the end of 2022. This expansion is driven by the increasing number of countries all over the world, both Muslim majority countries and non-Muslim majority countries, which are engaged in the development of Islamic financial institutions in their own countries.

Southeast Asia is increasingly influencing the world of Islamic finance, having grown consistently and at a rapid rate (Ghozali et al., 2019). Indonesia and Malaysia are the main drivers in formulating the Islamic finance industry in Southeast Asia. Both countries have emerged as leaders in the industry (Priyono Puji Prasetyo et al., 2020). Indonesia and Malaysia are alike in political economies since both nations strive To create a dual banking and financial system is to develop a system that operates two

different types of banking models simultaneously that allows Islamic and conventional sectors to operate side by side (Pantas et al., 2021).

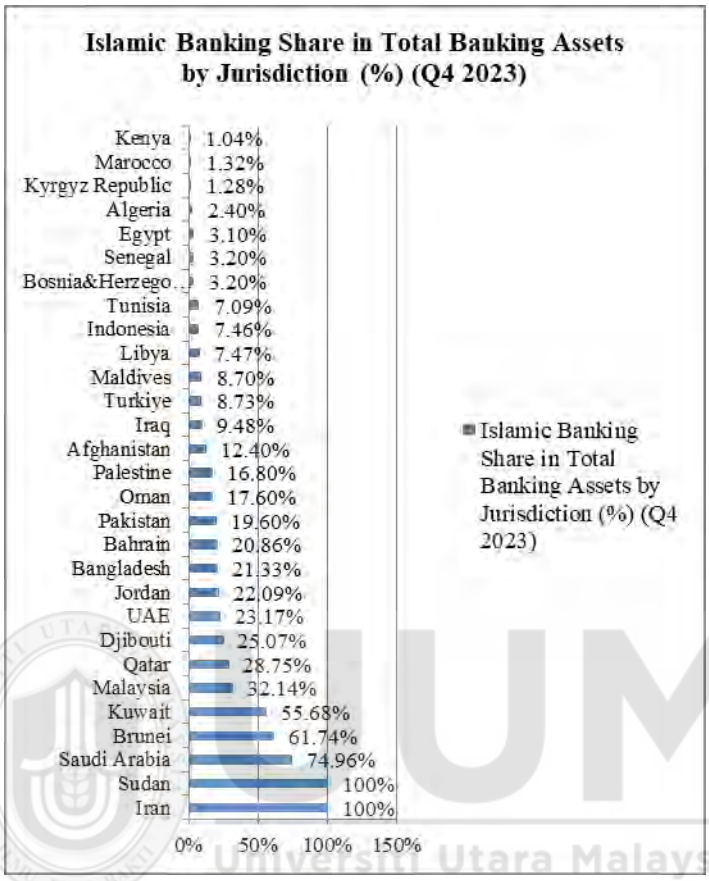


Figure 1.1
Total Islamic Banking Assets
Source : Islamic Financial Service Board, 2024

According to IFSB data, the countries that rank first as the largest contributors of Islamic banking assets in the world are Iran and Sudan, followed by Malaysia, which ranks eleventh globally with a percentage of 32.14%. Malaysia is one of the leading countries in Southeast Asia, boasting some of the largest Islamic banking assets globally, while Indonesia ranks 21st as a contributor to global Islamic banking assets with a percentage of 7.46% (Islamic Financial Service Board, 2024). This indicates that the efficiency levels of Islamic banks in Indonesia and Malaysia are likely to differ when viewed from the perspective of the significantly varying asset sizes. According to Islamic Financial Country Index (IFCI), 2023 Malaysia ranks second

with an index score of 81.93 after Saudi Arabia, while Indonesia is in third place with an index score of 81.49. It is no surprise that Malaysia and Indonesia are considered the driving forces behind the development of the Islamic banking industry among countries in Southeast Asia (Ghozali et al., 2019). This factor makes it interesting to use Indonesia and Malaysia as research subjects to assess the efficiency levels of Islamic banks in each country.

Financial institutions are currently developing very rapidly, demonstrating the increasing competition among existing financial institutions, both banks and non-banks. Therefore, a banking institution must take steps to develop strategies that enable it to compete (Shidqie & Wardana, 2022). Therefore, it is important for financial institutions to manage their organizations as efficiently as possible to ensure their sustainability.

The rapid development of financial institutions today reflects the increasing competition among financial entities, both banking and non-banking. This competition is not only occurring domestically but also on a global scale, driven by financial innovation, digitalization of services, and the emergence of financial technology (fintech), which has significantly transformed the financial industry landscape.

In this increasingly competitive environment, banking institutions are required to develop strategies that not only enhance their competitiveness but also strengthen

their business sustainability. Such strategies include addressing a broad range of issues that include service maximization, efficiency in operations, and financial product diversification in an attempt to adapt the increasing sophisticated needs of customers.

Efficiency of operations is one of the key foundations for financial institutions growth and sustainability. The inefficient banks in terms of utilizing resources such as credit management, operating expenses, and risk management can experience declines in performance that can adversely impact profitability in the long term. Because of this, efficiency analysis methods such as Data Envelopment Analysis (DEA) are usually used to study how efficiently a financial institution is utilizing its inputs and outputs.

1.2 Problem Statement

Malaysia is a country that ventures to represent Southeast Asia and holding the highest Islamic financial assets with a 32.14% of the share of Islamic banking assets followed by Indonesia being second at 7.46% (Islamic Financial Service Board, 2024). It implies that Islamic financial institutions, especially Islamic banking institutions in Malaysia and Indonesia, have been successful. However, in many studies by Miftahurrohman, (2019), Puteh et al, (2018) reported that Islamic banks in ASEAN (Association of Southeast Asian Nations) are less efficient. Additionally, based on the study by Pantas et al (2021) reported that Indonesia and Malaysia Islamic banks are not yet efficient. Kosasih (2021), Rasnawijaya (2019), Puspita & Shofawati (2018) and Pambuko (2016), concluded the same research result that

Indonesian Islamic banks are inefficient. However, based on research works conducted by Erlina (2020), Fitroh (2020), and Afifah & Darwanto (2019) Islamic banking in Malaysia and Indonesia are efficient. Due to the different result of these studies, there is a necessity to carry out further research on the efficiency of Islamic banks in Malaysia and Indonesia as an update to the study. There is a need for an efficiency analysis because is efficiency factors are not considered, it will have a tremendous impact on the profitability of the banks.

Islamic banking efficiency also influenced on several factors, and among them is the effect of conventional banking on the financial performance of Islamic banks, which is a primary issue in Islamic finance research, especially in Malaysia and Indonesia. Since both Islamic and conventional banks usually compete in the same financial markets and serve the same customer bases, competition and interaction between the two banks could significantly influence the performance of Islamic banks.

Islamic banks are competing with conventional banks for the same customer base, especially when it comes to retail banking products such as personal loans, mortgages, and savings accounts. The conventional banks pay higher interest and have more products, and this may restrict Islamic banks from securing customers who have been accustomed to conventional banking products. Such competition could put pressure on Islamic banks to enhance their products, with the result of increased costs, reduced profitability, or even reduced market share for Islamic banks.

The effect of conventional banking on the financial results of Islamic banks is multifaceted and rich. While Islamic banks have certain distinct advantages, such as being able to capture a niche clientele of Shariah-compliant consumers, they are severely confronted by conventional banks on competition, pricing, risk, and regulatory forces. To compete, Islamic banks in Malaysia, Indonesia, and the rest of the world must innovate and simplify their business models while maintaining their ethical values but maximizing their bottom lines.

Malaysia is ranked among the most developed Islamic finance markets in the world. It has developed with a comprehensive and robust regulatory framework for Islamic banking that includes the Islamic Financial Services Act (IFSA) 2013, among specialized financial institutions like the Central Bank of Malaysia (Bank Negara Malaysia), to propel the growth and stability of the sector. Malaysia's Islamic banking has been in operation for over three decades, and some of the significant milestones include the establishment of Bank Islam Malaysia in 1983, introduction of Islamic financial products, and the emerging trend of sukuk (Islamic bonds).

Malaysian Islamic banking industry is highly developed with excellent penetration in urban and rural regions. Islamic banks are highly integrated into the financial system, and Shariah-compliant products have excellent availability in all areas of financial services, including retail banking, corporate finance, and investment products.

Even though Indonesia is the world largest Muslim-majority country, its Islamic banking sector is younger and less mature. Indonesian Islamic banking started officially with the arrival of Bank Muamalat in 1992, and other Islamic banks appeared in the early 2000s. The sector has, nevertheless, faced some issues with the maturity of infrastructure, regulatory consistency, and people's awareness of Islamic financial products. The market penetration by the Islamic banks is lower than in Malaysia, and the regulatory environment has been evolving but is still catching up with Malaysia's advanced framework.

Despite being the largest Muslim-majority nation, Indonesia's Islamic banking sector has had slower growth. Islamic banks have limited market share, especially in comparison to conventional banks. Public awareness and understanding of Shariah-compliant finance products are still developing, and there is a lack of robust consumer education. The sector is still working on expanding its presence, particularly in rural areas and non-traditional markets.

Islamic banking has a significant share of the overall banking market in Malaysia. As of recent reports, the Islamic banking sector's share of total banking assets has exceeded 30% in Malaysia. This reflects a high degree of market penetration, where Islamic financial services are available for almost every type of consumer and business need. The government's proactive policies, such as the establishment of a Sukuk market and the promotion of Islamic finance globally, have also helped expand the reach of Islamic banking services. Malaysia's Islamic banks have also penetrated various financial products, including Islamic mortgages, investment funds, insurance

(takaful), and corporate financing. This diverse product offering has made Islamic banking accessible to a wide range of customers, including individuals, corporations, and government entities.

On the other hand, the market share of Islamic banking in Indonesia is modest. Despite the humongous Muslim population base, Islamic banking assets are at a paltry 5-6% of the total assets of the banking sector. The traditional banks dominate the market, and Islamic banking remains a niche product in everybody's mind. While the Indonesian government has taken steps to increase Islamic finance's share, such as issuing sukuk and supporting Islamic banks, the market penetration remains limited, especially in comparison to Malaysia.

Islamic financial products in Indonesia are more concentrated in specific areas, primarily in those areas with a Muslim majority. However, the lack of overall financial information about Shariah-compliant products from the general public and the limited availability of Islamic banking branches in rural or under-served communities are barriers to further market penetration.

Consumer awareness of Islamic banking in Malaysia is prevalent due to extensive educational campaigns, government support, and the extensive reach of Shariah-compliant products. Islamic finance is being considered ethical and socially responsible finance, and not just Islamic finance, but also for the non-Muslim communities in Malaysia. Besides that, the maturity of the market has also established

a high degree of sophistication in the products offered by the Islamic banks, from consumer banking products to complex corporate financing. Islamic finance is an integral part of the country's financial system, with many consumers actively looking for Shariah-compliant products. Such wide acceptance of customers has driven the growth and diversification of the Islamic banks in Malaysia and made it profitable.

On the other hand, consumer awareness and information on Islamic banking in Indonesia remain in the developing stage. Indonesians are yet to be adequately informed about the benefits and Shariah-compliant nature of the products. Though there is tremendous market potential, there remain problems in correcting misconceptions about Islamic finance and creating consumer confidence. Although Indonesia's Islamic banks have attempted to sell Islamic finance by advertising and working with partners, they are as yet far short of achieving their Malaysian counterparts' mainstream popularity.

The government of Malaysia has also been highly supportive of Islamic finance and has established a target to position Malaysia as a global Islamic finance hub. These policies and steps like the Labuan International Business and Financial Centre, establishment of Islamic Banking and Finance Institute Malaysia (IBFIM), and Sukuk issuances have all contributed towards building and establishing the sector. Furthermore, there is also a welcoming regulatory environment in Malaysia for Islamic banking because there are clear guidelines established by Bank Negara Malaysia and Shariah Advisory Councils. With the initiative of the government to

maintain and further Islamic finance, there has been a stable and conducive ground for Islamic banks to expand and gain foreign and local investments.

While Indonesia has also taken steps to build up Islamic finance, such as passing the Islamic Banking Law in 2008 and establishing a national Shariah board, the degree of government backing has not been as firm or long-standing as in Malaysia. There is a need for stronger legislative reforms to further improve the regulatory framework of Islamic banks and create a more favorable environment for its growth. The government also is trying to boost Islamic finance, but Indonesia still lags behind Malaysia.

Malaysia's Islamic banking sector is backed by an exceptionally advanced infrastructure, including strong digital banking platforms, internet banking facilities, and financial technology (FinTech) innovations. These technologies have allowed Islamic banks to provide enhanced access to financial services, especially for urban consumers, and helped develop Islamic finance.

In Indonesia, Islamic banking infrastructure is less developed and most Islamic banks still lag in adopting digital banking, low rural penetration of mobile banking, and lower financial inclusion. Efforts are being initiated to fill this gap, yet the Islamic banking technological infrastructure in Indonesia is relatively nascent versus Malaysia.

The integration of Islamic banking into the overall financial culture of Malaysia has also led to increased customer loyalty. For certain customers, using the services of Islamic banks is as much a religious or personal choice as it is a financial one. This cultural alignment leads to increased market penetration and opportunity for growth.

Even though Indonesia has an enormous number of Muslims, it is more segmented in its perspective regarding Islamic finance, and not all segments of the population are aware of the benefits of Islamic finance or remain loyal to conventional banks. Thus, Islamic banks have a tougher time in developing the same level of loyalty and trust among customers.

The difference in the degree of market penetration and maturity of Malaysia and Indonesia's Islamic banking sector is attributed to various factors including regulatory environments, awareness, government support, and infrastructural development. Malaysia has a well-integrated and developed Islamic banking sector in the financial system, while Indonesia's sector is at the developing phase. As the Indonesian Islamic banks are poised to maintain their expansion and the regulatory environment is strengthened, there is ample opportunity for development, yet Malaysia's mature market will continue to serve as the model for the region.

1.3 Research Questions

The following research questions are based on the issues described in the problem statement section:

1. What is the Islamic banking performance in Malaysia and Indonesia based on the asset and income?
2. What is the efficiency level of Islamic bank in Malaysia?
3. What is the efficiency level of Islamic bank in Indonesia?

1.4 Research Objectives

This research highlights the following objectives:

1. To explain Islamic banking performance in Malaysia and Indonesia based on the asset and income
2. To investigate efficiency level of Islamic bank in Malaysia
3. To investigate efficiency level of Islamic bank in Indonesia

1.5 Significance of the Study

This research provides benefits to interested parties as follows:

Researchers and Academician

It provides a useful resource for scholars and researchers looking to delve deeper into the efficiency of Islamic financial institutions. By examining various operational aspects, it sheds light on how they operate, their unique principles, and their performance. Additionally, when integrated with the elements affecting the effectiveness of Islamic banking in Indonesia and Malaysia, it gives some indication of performances of these institutions and explores synergy for Islamic banks in Malaysia and Indonesia.

Islamic Banking

This study aims to enhance the operational effectiveness of Islamic banking institutions and by addressing challenges such as regulatory constraints, market competition, and limited awareness of Islamic financial products, these solutions can empower banks to streamline their processes, adopt best practices, and ultimately improve their efficiency. Through proposed solutions discussed in this study, Islamic banking can manage and more optimal in carrying out their work so as to achieve efficiency in line with company expectations. This study also can provide benefits for institutions, especially banks, to find out what influences banking efficiency as a consideration in decision making.

Practitioner

The results gained from this research have the potential to play a significant role in assisting financial institutions to increase their operational efficiency and profitability. By determining the key factors affecting the efficiency of Islamic banks, the study provides a roadmap to decision-makers to implement measures that enhance performance.

1.6 Scope of the Study

The purpose of this study is to establish the performance of Islamic banks in Indonesia and Malaysia. It seeks to establish the determinants that affect such banks and potential development prospects for the industry of Islamic banking in the two countries. For this, the study employs a systematic analysis of the annual reports for some of the Islamic banks operating in Indonesia and Malaysia. It facilitates an

effective overall evaluation of their performance, financial status, and operational efficiency.

By examining such reports, the research will not just determine the current position of Islamic banking efficiency but also its driving force, such as regulatory framework, market conditions, and managerial techniques. The research will extend to consider growth and development prospects for the Islamic banking sector in the light of Indonesia's and Malaysia's own socio-economic contexts. Lastly, this comprehensive analysis will give valuable information about the performance of Islamic banks in both countries and inform strategies for enhancing their performance and deepening their penetration in the financial industry.

1.7 Definition of Key Terms

1.7.1 Islamic Bank

Islamic bank is an organization that offers banking services and products which comply with Islamic law. It is not only intended to offer financial services but also offer services that are ethically and morally sound which also serve the greater economic and social good of society (Hanic & Smolo, 2023).

1.7.2 Efficiency

Efficiency refers to optimizing resources to achieve the best possible outcomes, particularly in a business context. It implies to monitor and check performance markers and assess where a firm can function best with a desire to reduce costs without sacrificing profit maximization (Horvat et al., 2023).

1.8 Organization of the Thesis

Chapter One highlights on introduction, problem statement, research question, research objective, research scope, research significance, the definition of key terms, and thesis organization. Chapter Two focuses on efficiency which discusses on the concept of efficiency. This chapter also reviews some literatures on efficiency of banks and banking industry. In Chapter Three, the research methodology and research design will be elaborated in addressing the objectives of the study The research findings will be covered in Chapter Four and Chapter Five concludes by summarising the research findings, research contributions, limits, and future research suggestions.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

This section addresses the literature of bank efficiency and the review of noting key concepts of bank efficiency, the methodology used and findings of the previous studies.

2.1 Underlying Theory

Koopmans (1951) formally defined technical efficiency: A producer is technically efficient if an increase in any output requires a decrease in at least one other output or an increase in at least one input, and if a decrease in any input requires an increase in at least one other input or a decrease in at least one output. Thus, an technically inefficient producer can either produce the same outputs with less of at least one input or can produce more of at least one output with the same inputs.

Debreu (1951) and Farrell (1957) suggested a measure of technical efficiency. With an input-conserving orientation, their measure is (one minus) the maximal equiproportionate (i.e., radial) contraction of all inputs that is feasible with fixed technology and outputs. With an output-augmenting orientation, their measure is the maximal radial expansion in all outputs that is feasible with a given technology and inputs. In either orientation, a value of unity indicates technical efficiency because no radial adjustment is feasible, and a value different from unity indicates the extent of technical inefficiency.

Banking efficiency refers to the capability of financial institutions to maximize resource utilization in offering services like loans and deposits at low costs. Banking efficiency can be measured along various dimensions, mainly technical efficiency, cost efficiency, and revenue efficiency. Technical efficiency examines the ability of a bank to convert inputs into outputs, cost efficiency examines the ways of minimizing costs without altering the levels of output, and revenue efficiency examines the ability to maximize revenue in relation to costs incurred (Ikra et al., 2021).

The DEA is applied for efficiency estimations under CRS (Constant Return to Scale) or TE (Technical Efficiency), VRS (variable return to scale) or PTE (Pure Technical Efficiency) and SE (Scale Efficiency) or CRS/VRS assumptions.

Constant Return to Scale (CRS) is a model developed by Charnes, Cooper dan Rhodes (Model CCR) in 1978. The basis of this model is that if input is increased by a factor of "a," then output will be raised by the same factor of "a." In other words, the ratio of input to output is fixed.

Variable Return to Scale (VRS) is a model developed by Banker, Charnes dan Cooper (Model BCC) in 1984, which is an extension of the CCR model. This model assumes that increases in input and output are not proportional, meaning that an increase in input by a factor of "a" will not result in an increase in output by the same factor of "a." (Machmud & Rukmana, 2010).

The CCR model is employed to calculate technical efficiency (TE), whereas the BCC model estimates pure technical efficiency (PTE). From these, scale efficiency (SE) can be calculated, representing the potential productivity gain from being at an efficient size for a decision-making unit (DMU). The interdependence of these measures of efficiency is TE divided by PTE (Ben Mohamed et al., 2021).

2.2 Efficiency Concept

The concept of banking efficiency refers to the ability of financial institutions to optimize the use of their resources in order to produce maximum outputs, typically the services offered to customers, such as loans and deposits, at the lowest costs (Ganefi et al., 2024). Bank efficiency can be quantified by a number of dimensions, mainly technical efficiency, cost efficiency, and revenue efficiency. Technical efficiency is concerned with the ability of a bank to use inputs to produce outputs, cost efficiency is concerned with minimizing costs while producing a given level of output, and revenue efficiency is concerned with producing maximum revenue in terms of the costs incurred (Ikra et al., 2021).

Efficiency is simply the ability to utilize all resources to achieve the best outcome, particularly in an enterprise such as the banking industry. Efficiency involves the measurement and analysis of performance indicators to determine the effectiveness of a company, focusing on minimizing cost while maximizing profitability. Efficiency is the process of carrying out an evaluation that tries to understand the performance results of a business, for instance, the banking industry, so that it can operate at low costs but with high profits. There has been an increase in financial institution

efficiency literature, with numerous scholars implementing parametric and non-parametric methodologies. Data Envelopment Analysis (DEA) is a non-parametric method to calculate a relative output ratio for each input unit (Cvetkoska & Savić, 2017).

One of the common methods employed in the measurement of bank efficiency is Data Envelopment Analysis, by which comparative efficiency of multiple banks can be achieved based on the idea of establishing a "frontier" of best performance. DEA calculates the efficiency with which a bank uses inputs such as labor, capital, and overheads to produce desired outputs such as loans and profit, measuring the level of efficiency. Such studies employing DEA have found that traditional and Islamic banks can be managed efficiently or inefficiently depending on the corresponding operational settings and prevailing market conditions at stake (Miah & Sharmeen, 2015).

Research has indicated that Islamic banks, which are run on the principles of Shariah, can have certain efficiency traits than conventional banks. For instance, Islamic banks typically have unusual regulatory mechanisms that can influence their efficiency during operation, for instance, satisfying both Shariah regulations and those of conventional banks. Such nuances may result in complexity in their pursuit of efficiency, as proof indicates Islamic banks have lower efficiency ratings than their traditional counterparts in some instances (Miah & Sharmeen, 2015).

Other research indicates that Islamic banks can become highly efficient, particularly in finance markets where their ethical investment practice attracts more clients who are keen on socially responsible banking services (Ikra et al., 2021). Such growing client preference can enhance service quality, which is an efficiency dimension aimed to be optimized by banks as well. While expanding the financial system, the flow of technological breakthroughs and innovation in banking products continues to stay at the centre of improving both Islamic and traditional banking institutions' efficiency (Ganefi et al., 2024).

In conclusion, understanding the notion of efficiency in banking is critical when determining how effectively banks deploy their resources to offer services. Comparing Islamic and conventional banks using several dimensions of efficiency assists in the determination of best practices and areas to improve that would support overall performance and stability in the financial sector.

2.3 Islamic Banking

Islamic banking, referred to as Islamic finance or Shariah-compliant finance, encompasses a variety of financial activities that strictly follow Shariah, or Islamic law. This system is designed not only to provide financial services but also to ensure that those services are ethically and morally sound according to Islamic principles. Two fundamental principles of Islamic banking are the sharing of profits and losses, and the prohibition of interest (riba) on both collection and payment. In Islamic finance, the idea of risk-sharing is essential where Islamic banking strictly prohibits any form of interest. This is rooted in the belief that money itself should not generate

profit without effort or risk. By adhering to these guidelines, Islamic banks not only fulfil their financial roles but also contribute to the overall well-being of society, aligning economic activity with moral values (Hanic & Smolo, 2023).

Islamic banking, a financial system rooted in the principles of Islamic law (Sharia), is distinct from the conventional banking system in that it prohibits interest (riba) and emphasizes ethical investment practices. The foundational concept of Islamic banking is to promote fairness in financial transactions and to ensure that all operations comply with Shariah principles, which aim to foster justice, transparency, and mutual benefit between parties involved in financial dealings (Abdurroziq et al., 2022).

One of the core tenets of Islamic banking is the prohibition of riba, which encompasses not only traditional forms of interest but also any gain that does not correspond to a real risk or contribution of effort. Islamic financial instruments are designed to operate on principles of profit and loss sharing, where financial returns are based on actual economic output and performance rather than on fixed interest rates (Ramadhani & Bilen, 2024). Moreover, Islamic banks engage in financing that is ethically and socially responsible, avoiding investments in industries considered haram (forbidden) under Islamic law, such as those involved in gambling, alcohol, or weapons industries (Abdulrahim, 2018).

The structure of Islamic banking includes various contracts that facilitate different types of financing, such as Mudarabah (profit-sharing), Murabaha (cost-plus

financing), Ijarah (leasing), and Sukuk (Islamic bonds) (Fahamsyah et al., 2023). These contracts are inherently designed to ensure that the transactions involved are equitable and just, thereby upholding the maqasid al-Shariah, which focuses on preserving wealth, life, intellect, descent, and religion (Abdurroziq et al., 2022). The presence of a Shariah Supervisory Board within Islamic banks serves to ensure compliance with these principles, offering guidance on product developments and operations (Ramadhani & Bilen, 2024).

Furthermore, Islamic banks have demonstrated a growing presence in the global financial landscape. They aim to provide services not only to Muslims but also to a broader audience, including non-Muslims who may be drawn to the ethical dimensions and social responsibility aspects associated with Islamic banking (Abduh et al., 2013). As such, the Islamic banking sector has been expanding, introducing various financial products that integrate ethical considerations while also achieving competitive advantages within dual banking systems, where they exist alongside conventional banks (Uula et al., 2023).

In conclusion, Islamic banking serves as a unique financial ecosystem aligned with ethical and Shariah-compliant practices. By establishing a framework that emphasizes equitable financial practices, avoidance of exploitative interest, and social responsibility, the Islamic banking model presents valuable alternatives for both Muslim and non-Muslim consumers seeking responsible banking solutions.

2.4 Islamic Windows Banks

The Islamic window banks began when Bank Negara Malaysia (BNM) or the Central Bank of Malaysia introduced the "Interest-Free Banking Scheme" in 1993, where traditional banks can offer Islamic banking products to clients. The scheme has proven successful in Malaysia and has boosted Islamic banking assets to RM94.6 billion, which amounted to 8% of Malaysian banking assets in 2012 (Abdul-Majid et al., 2011b). Islamic windows have been established in Indonesia since the promulgation of Law no. 10 of 1998. Due to stronger legal basis, some traditional banks have established Islamic window banks because commercial banks can diversify income by conducting businesses in Islamic, conventional, or both (Hasan & Risfandy, 2021).

Conventional banks, such as Bank Mega, Bank Mandiri, Bank BNI, Bank BRI, and so on, started Islamic windows (i.e., Bank Mega Syariah, Bank Mandiri Syariah, Bank BNI Syariah, and Bank BRI Syariah) venturing into the Islamic banking sector that, at that time, only had Bank Muamalat Indonesia as a single player. Because the operation of Islamic window banks depends on assets and funds of its traditional parent bank, Islamic window banks can be more efficient compared to fullfledged Islamic banks (Salami & Adeyemi, 2017).

Traditional banks have a separate Islamic Banking department in order to manage Islamic window banks business. Islamic window banks' business operations and Islamic banking portfolios are reflected in the parent's principal financial report.

Traditional banks need to create committees with Islamic banking professionals to decide the suitability of the products provided with Islamic principles, and it needs to be reported periodically (Abdul-Majid et al., 2011a).

2.5 Islamic Banking in Malaysia

Islamic banking in Malaysia has operated for more than 30 years when Islamic Banking Act was gazette in 1983, which provided an opportunity for the country to establish its first Islamic bank. Following this, with the liberalization of the Islamic financial system, the Islamic banking industry in Malaysia has grown significantly. At the end of 2022, the total assets of Malaysia's Islamic banking sector reached approximately RM1,316.2 billion, equivalent to US$298.9 billion. The Islamic banking industry's share of total financing in the financial system increased from 44.5% in 2022 to 45.6% in 2023 (bnm.gov.my).

Currently, Islamic banks in Malaysia continue to grow rapidly with innovative products and various innovative Shariah instruments. Malaysia also places strong emphasis on the development of human resources to accompany the growth of the Islamic financial industry, ensuring that the Islamic financial sector remains in good condition. The regulatory framework set by BNM (Bank Negara Malaysia) has successfully positioned Malaysia as one of the countries with the most advanced Islamic banking markets in the world (*bnm.gov.my*). Quoted from Bank Negara Malaysia Central Bank of Malaysia, (2020) Currently, Malaysia has 16 Islamic banks. In fact, by 2020, Malaysia's Islamic banking sector accounted for 11.1% of the global

Islamic banking assets, according to data from IFSB (*Islamic Financial Service Board*) 2020.

Islamic banking in Malaysia has established itself as a prominent player in both the regional and global financial markets. Its development can be traced back to the early 1980s, when the Bank Islam Malaysia Berhad was established in 1983 following the introduction of the Islamic Banking Act (Asni, 2019). This foundational legislation facilitated the coexistence of Islamic and conventional banks, allowing the former to operate according to Shariah principles while also providing an alternative financial avenue for Muslim consumers and businesses. By the late 20th and early 21st centuries, Malaysia was a preeminent global hub of Islamic finance, ranking third in the size of Islamic banking market globally, just after Iran and Saudi Arabia (S. W. Chong et al., 2019).

Malaysian Islamic banking has also been stable and increasing significantly, in most instances outpacing that of traditional banking in growth rates. The growth of the Malaysian Islamic finance industry has been spectacular, even reportedly increasing at a faster rate than the traditional banking industry (Labanieh et al., 2019). The country has 16 banks with Shariah-compliant banking products whose regulation is overseen by Bank Negara Malaysia, the central bank. The system has a mix of full-fledged Islamic banks and Islamic windows in conventional banks, leading to a competitive market that caters to distinctive consumer needs based on Islamic financial concepts primarily the prohibition on riba, gharar and maysir (Anwa et al., 2021).

Islamic banking integration has not only solidified the finance sector but also aimed to help in the economic growth of Malaysia. Based on empirical research, it is noted that Islamic banking financing impacts the country's economic growth, especially the development of small and medium-sized enterprises (Ledhem & Moussaoui, 2024). Islamic bank-funded companies will tend to be more operationally effective compared to those founded on conventional sources of finance (Anwa et al., 2021). Furthermore, the Islamic finance system is ideally positioned to be in line with sustainable development goals, facilitating ethical investment strategies that are Shariah-compliant (Amran et al., 2017).

Despite these advances, challenges persist, particularly in relation to the legal and regulatory environments for Islamic finance. Shariah compliance problems and dispute resolution between Islamic financial institutions and their clients are significant areas of ongoing research and concern. In a move to enhance the legal environment for Islamic finance transactions, reforms would be necessary to further cement Malaysia's role as a hub for Islamic financial services worldwide (Engku Ali & Oseni, 2017).

The Islamic banking sector in Malaysia is a notable example of successful integration of religious principles within a contemporary financial framework. Its growth trajectory not only reflects the increasing demand for Shariah-compliant products but also emphasizes its role in fostering economic development. As the

sector continues to evolve, addressing the complexities of governance, compliance, and consumer education will be crucial for sustaining its growth and efficacy.

2.6 Islamic Banking in Indonesia

The Indonesian Ulema Council (MUI) formed a group to establish an Islamic bank in Indonesia in 1990. After several discussions, the first Islamic bank in Indonesia, PT Bank Muamalat Indonesia (BMI), was officially established and began operations on May 1, 1992. Initially, the first Islamic bank did not receive optimal attention in the national banking sector. In 1998, the government amended Law No. 7/1992 to Law No. 10/1998, which outlined a dual banking system consisting of conventional and Islamic banks, marked by the establishment of other Islamic banks. By 2008, the government enacted Law No. 21 of 2008, which specifically regulates Islamic Banking. The implementation of this legal framework provided an opportunity for the national Islamic banking industry to grow at a faster pace (*Sejarah Perbankan Syariah*, ojk.go.id).

Islamic banking in Indonesia has experienced rapid and significant growth. This is also evidenced by the annual increase in the number of Islamic bank branches. According to data from the Islamic Banking Statistics published by Otoritas Jasa Keuangan (OJK) in 2020. It was recorded that there were 14 Islamic Commercial Banks (BUS) with a total of 1,922 branches. Meanwhile, in 2019, the number of Islamic Commercial Bank branches was 1,885 (Otoritas Jasa Keuangan (OJK), 2020).

Indonesia Islamic Commercial Banks also registered the highest growth of total assets each year. From the figures announced in the Islamic Banking Statistics, in 2018 the total assets of Indonesian Islamic Commercial Banks averaged 298,044 billion IDR and continued to increase up to 323,438 billion IDR in 2019. As of January 2020, the total assets of Indonesian Islamic Commercial Banks were 346,373 billion IDR. Also, this can be observed in the ROA (Return on Assets) ratio for the Indonesian Islamic Commercial Banks. It was 1.28% in 2018, rose to 1.73% in 2019, and at the beginning of 2020, the ROA ratio was 1.88% (Otoritas Jasa Keuangan, 2020).

Indonesian Islamic banking has evolved significantly since the establishment of Bank Muamalat Indonesia in 1992, opening the country's Sharia-compliant financial sector. It is the result of a complex blend between Sharia finance principles and the international economic climate as it responds to the need of mainly Muslim citizens, as well as challenges encountered while incorporating Sharia rules into the financial system. Islamic banking institutions have, in the last two decades, diversified their portfolio of products and services, such as financing, investment, and insurance products specifically designed to meet the needs of customers looking for Sharia-compliant products (Dahrani & Nainggolan, 2023).

The role of Islamic banking in contributing to the economic growth of Indonesia is of wide interest and debate among researchers. While some studies show that financing by Islamic banks contributes to economic growth specifically in Islamic-compliant sectors, others find that its effects are contingent on macroeconomic factors as well as the financial system's maturity phase. Empirical evidence indicates that Islamic

bank financing is positively correlated with economic growth in the long run, with short-run effects possibly being weaker. The structural characteristics of Islamic banking, such as its unique financing structures like Murabahah and Mudharabah, also influence their general economic impacts, with these differences manifesting across geographic regions and economic sectors (Anwar, 2024).

Despite the growth in Islamic financial institutions and products, Islamic banking still has a restricted market share compared to conventional banks, limiting its overall economic footprint (Putri et al., 2023). Literature shows that in the early 2020s, Islamic banks still held only a small portion of the overall banking assets of Indonesia, with potential for increased growth and reach. Public awareness and understanding of Islamic banking principles are the primary drivers of this variation, as many potential customers may remain unaware or lack access to optimize Sharia-compliant financial products (Hartanto et al., 2023).

2.7 Efficiency Measurement

In the Islamic economic perspective, the concept of efficiency is aligned with sharia aims to preserve and achieve Maqasid Syariah, which is the protection of wealth (Sari, 2015). The fundamental concept of efficiency is to avoid all forms of waste, as explained in Surah Al-Israa, verses 26-27. The verse explains that being wasteful and spending wealth in an unreasonable manner, exceeding what is necessary, is prohibited and disliked by Allah SWT (Az-Zuhaili, 2016). If a person works diligently and carefully, they will achieve optimal results. Based on the

explanations from the Qur'an and Hadith mentioned above, when related to the concept of efficiency in Islamic banking, it becomes essential for the management of Islamic banks to manage their operations in order to minimize costs as much as possible, so they can maximize profits with reasonable expenditures.

The level of efficiency can be measured using DEA (Data Envelopment Analysis), which is a mathematical programming technique for DMU (Decision Making Unit) that is used when conditions are not optimal. (R. Hidayat, 2011). Abidin dan Endri (2009) explains that it is one of the methods for measuring efficiency using a linear programming model to calculate the ratio of input and output variables for the units being compared within a population. The score obtained is relative for each unit, depending on the efficiency level of other units in the sample. The results for each unit in the sample are considered to have no negative efficiency level, with values limited between 0 and 1, where a score of 1 indicates perfect efficiency.

The CCR model considers that each Decision-Making Unit (DMU) produces with the assumption of constant returns to scale (CRS). The BCC model considers every Decision-Making Unit (DMU) runs under the assumption of variable returns to scale (VRS) to compute technical efficiency. Technical Efficiency (TE) is a combination of Pure Technical Efficiency (PTE) and Scale Efficiency (SE) expressed as TE = PTE × SE. Scale efficiency is a by-product of dividing technical efficiency with constant returns to scale (CRS) by technical efficiency with variable returns to scale (VRS) (Ikhwan & Riani, 2023).

SE = CRS/VRS

Banking efficiency using the DEA method has been extensively studied to provide feedback on the performance of various financial institutions, especially Islamic banks. Nailah & Rusydiana (2020) conducted research on stability and Islamic banking efficiency in ASEAN using the DEA window analysis method. The most stable and efficient bank among other Indonesian Islamic banks was BRI Syariah became the most stable and effective bank among other Indonesian Islamic banks. Rusydiana & Marlina (2019) compared Indonesian Islamic banks' social and financial efficiency. Findings were that there was a decline in financial efficiency while social efficiency during the period of 2013-2018 continued to rise. Islamic bank performance even improved in financing activities of a lesser scale compared to conventional banks.

Bahrini (2016) tested the technical efficiency of MENA Islamic banks during and after the global financial crisis using a bootstrap DEA approach to eliminate estimation bias. The results revealed that overall, the banks were technically inefficient, with inefficiency being predominantly technical in nature, as opposed to scale. tested the determinants of Islamic bank efficiency changes. They indicated that an optimally functioning bank in a specified time period may not work as well under different circumstances, describing the dynamic nature involved with the shift in efficiency with altering business conditions (Sufian & Akbar Noor Mohamad Noor, 2009).

Wahyudi & Azizah (2018) performed a comparative study on banking efficiency in the ASEAN-5 countries using the DEA approach, discovering that banks in each

country exhibited relatively high efficiency levels. Rodoni et al. (2017) investigated the Islamic banking industry in Indonesia, Malaysia, and Pakistan in terms of productivity and efficiency using DEA and the Malmquist index. The research discovered varying levels of efficiency across nations, and those in Malaysia and Pakistan indicated best practice in terms of efficiency.

Studies by Miftahurrohman (2019), Puteh et al, (2018) reported that Islamic banks in ASEAN (Association of Southeast Asian Nations) are less efficient. Additionally, based on the study by Pantas et al (2021) reported that Indonesia and Malaysia Islamic banks are not yet efficient. Puspita & Shofawati (2018), Pambuko (2016), Kosasih (2021) and Rasnawijaya (2019) concluded the same research result that Indonesian Islamic banks are inefficient. However, based on research works conducted by Erlina (2020), Fitroh (2020), and Afifah & Darwanto (2019) Islamic banking in Malaysia and Indonesia are efficient. Because of the inconclusive results of the previous studies, a further study on the efficiency of Malaysian and Indonesian Islamic banks is required to provide updated information. Efficiency needs to be analyzed because neglecting efficiency matters could have a remarkable impact on the banks' profitability.

Kadri et al. (2016) noted that pure technical efficiency outshone scale efficiency in a paper on 44 Islamic banks operating in 14 countries, with the implication that resource utilization management was efficient over the period from 2004 to 2011. Similarly, research conducted by Hidayat et al. (2021) found that risk and operational efficiency adjustments might enhance the financial performance of Islamic banks by a

huge margin, pointing out the interconnectedness of such measures. This was the repetition of this theme of efficiency's impact on financial sustainability within Slimen research, where comparative GCC region Islamic bank and conventional bank analyses emphasized the need for increased financial efficiency (Ben Slimen et al., 2022).

Moreover, several studies have investigated the determinants that influence the Islamic banking efficiency changes. Sufian and Noor found that the efficiency of Islamic banks in MENA and Asian nations varied over time and was led by a series of determinants from management practices to market conditions (Sufian & Akbar Noor Mohamad Noor, 2009). Addressing the issues of governance, Mezzi (2018) pointed out that the structure and independence of boards played a key role in achieving higher efficiency in Islamic banks in Malaysia and the GCC countries in particular, where economies of scale took on increased relevance. The governance aspect also connects with the moral foundations of Islamic finance, as Erfani and Vasigh (2018) also added that the moral framework renders the Islamic banks distinct from traditional banks, which affects their operational efficiency and profitability.

The impact of the external economic factors, such as the global financial crisis, has also been of high interest in various studies. For instance, Samad (2018) examined the impact of the crisis on the efficiencies of Islamic banks in Malaysia, finding that although Islamic banks were impacted, they still recorded acceptable performance levels compared to conventional banks. This resilience can be partially attributed to the ethical banking concepts of Islamic finance of risk-sharing and asset-backed

financing that can minimize some of the adverse effects that are typically borne by traditional banking methods during financial crises (Erfani & Vasigh, 2018).

2.8 Summary Chapter

In conclusion, this chapter provides a comprehensive analysis of bank efficiency in Malaysia and Indonesia with focusing on the DEA method.

CHAPTER 3

RESEARCH METHODOLOGY

3.0 Introduction

This chapter highlights the methodology, data collection, statistical sampling analysis for this study.

3.1 Research Design

This study utilise DEA to assess Islamic bank efficiency using secondary data based on annual report Islamic bank in Indonesia and Malaysia. The steps for data analysis:

1. Financial information extracted from Islamic bank's 2006–2023 financial statements in Malaysia and Indonesia
2. Run DEA: TE, PTE and SE.
3. Investigate efficiency level of Islamic bank and Islamic banking industry in Indonesia and Malaysia.
4. Compare efficiency performances between Islamic banking industry in Indonesia and Malaysia.

3.2 Population and Sampling

The following population in this study explained in table 3.1

Table 3. 1
List of population Islamic bank

No	Islamic Bank Indonesia
1	Bank Aceh
2	Bank Jabar Banten Syariah
3	Bank Mega Syariah

4	Bank Muamalat Indonesia
5	Bank Panin Dubai Syariah
6	Bank Syariah Bukopin
7	Bank Syariah Indonesia
8	Bank Tabungan Pensiunan Syariah Nasional
9	Bank Victoria Syariah
10	BCA Syariah
11	BPD Nusa Tenggara Barat Syariah
12	Maybank Syariah Indonesia
No	Islamic Bank Malaysia
1	Affin Islamic Bank Berhad
2	Al Rajhi Banking Investment Corporation (Malaysia) Berhad
3	Alliance Islamic Bank
4	AmBank Islamic Berhad
5	Bank Islam Malaysia Berhad
6	Bank Muamalat Malaysia
7	CIMB Islamic Bank Berhad
8	Citibank Berhad
9	Hong Leong Islamic Bank Berhad
10	HSBC Amanah Malaysia Berhad
11	Kuwait Finance House (Malaysia) Berhad
12	Maybank Islamic Berhad
13	MBSB Bank Berhad
14	OCBC Al-Amin Berhad
15	Public Bank Islamic Berhad
16	RHBI Islamic Bank Berhad
17	Standard Chartered Saadiq Berhad

For this study, the samples used are Islamic banks from Malaysia and Indonesia. Each uses 12 institutions. The selection of the sample is due to the availability of data and the adequacy of the number of observations that have met the minimum number of observations in the DEA method, namely using a total of 24 institutions with a period used from 2006 to 2023 for Islamic banks in Malaysia and 2013 to 2023 for Islamic banks in Indonesia.

3.3 Data Collection Procedure

Financial information employed in this study are taken from Malaysian and Indonesian Islamic bank annual financial reports from 2006 through 2023. There are several essential steps in data collection procedures. Initially, concerned financial reports are gathered from the official banks' websites, central banks' publications, and regulatory agencies such as Bank Negara Malaysia (BNM) and Otoritas Jasa Keuangan (OJK) in Indonesia. Second, financial indicators on bank efficiency, such as profitability measures, asset quality, liquidity, and operating performance, are extracted and sorted in an organized manner. Third, data verification is conducted by cross-checking figures from various sources to test for consistency and accuracy. Finally, the compiled dataset is cleaned and formatted for further statistical analysis to ensure that it is aligned with the study's objectives and methodology.

3.4 Research Framework

A research framework is a road map or direction set for academic study and it offers the potential of a study path. This is made possible by outlining the expected steps that such a research study will take. Conceptual framework in accounting for instance, attempts to investigate the subject, character, goal, and scope of general financial reporting as well as the attributes that financial data ought to possess (Deegan, 2005). Efficiency is fundamentally about optimizing resources to achieve the best possible outcomes, particularly in a business context such as the banking industry. It involves evaluating and analyzing performance metrics to determine how effectively a company operates, with a focus on minimizing costs while maximizing profitability. The efficiency measurement used is the DEA technique.

This study calculates the level of efficiency of Islamic banking in Indonesia and Malaysia using data envelopment analysis with CRS (Constant Return to Scale) or TE (Technical Efficiency), VRS (variable return to scale) or PTE (Pure Technical Efficiency) and SE (Scale Efficiency) or CRS/VRS assumptions.

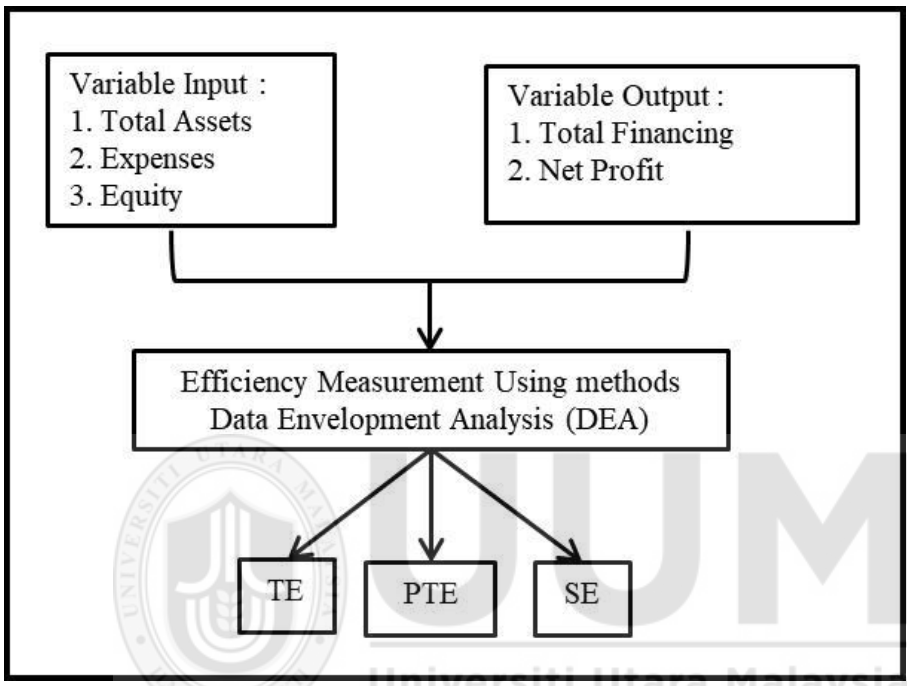


Figure 3.1
Resesarch Flow

Figure 3.1 illustrates the study's conceptual structure where three input variables and two output variables are analysed to measure the efficiency of Islamic banks in Malaysia and Indonesia by using DEA. From this analysis three models of efficiency level will be produced which are TE, PTE and SE.

3.5 Method

Data of Islamic banks from 2006 to 2023 will be utilized which involves 12 Malaysian Islamic banks and 12 Indonesian Islamic Banks that mention the detail in

table 3.2. The selected of sample based on availability data. This study has also achieved the minimum number of observations, which are 24 banks over 18 and 11 years with a total of 3 inputs and 2 outputs.

Table 3. 2
List of Islamic bank

No	Islamic Bank Indonesia
1	Bank Aceh
2	Bank Jabar Banten Syariah
3	Bank Mega Syariah
4	Bank Muamalat Indonesia
5	Bank Panin Dubai Syariah
6	Bank Syariah Bukopin
7	Bank Syariah Indonesia
8	Bank Tabungan Pensiunan Syariah Nasional
9	Bank Victoria Syariah
10	BCA Syariah
11	BPD Nusa Tenggara Barat Syariah
12	Maybank Syariah Indonesia
No	Islamic Bank Malaysia
1	Affin Islamic Bank Berhad
2	Alliance Islamic Bank
3	Bank Islam Malaysia Berhad
4	Bank Muamalat Malaysia
5	Citibank Berhad
6	Hong Leong Islamic Bank Berhad
7	HSBC Amanah Malaysia Berhad
8	Maybank Islamic Berhad
9	OCBC Al-Amin Berhad
10	Public Bank Islamic Berhad
11	RHBI Islamic Bank Berhad
12	Standard Chartered Saadiq Berhad

Mathematically Hidayati et al., (2017) it explains the general equation form of DEA as follows:

$$h_s = \frac{\sum_{i=1}^{m} u_i y_{is}}{\sum_{j}^{n} v_j x_{js}}$$

Keterangan :

h_s : efficiency of Islamic banks

m : total output of the Islamic bank

n : total input of the Islamic bank

y_{is} : the total output i used in the Islamic bank

x_{js} : the total input j used in the Islamic bank

u_i : the output i weight generated by the Islamic bank

v_j : the input j weight generated by the Islamic bank

The value of hs represents the efficiency of bank s, which is generally the ratio between the total output weights and the total input weights for each bank. The result of the efficiency calculation must be between 0 and 1, meaning that if the hs value is 1, the bank is considered efficient. If the h_s value is less than 1, it means the bank has not yet reached optimal efficiency. This calculation is performed relatively by comparing the efficiency of a bank. This approach can be input-oriented, focusing on reducing the amount of input without decreasing output, or output-oriented, aiming to increase output while keeping the input constant. Through this analysis, banks can identify their operational weaknesses and develop strategies to improve efficiency, such as service digitalization, cost optimization, and better risk management.

3.6 Technic of Data Analysis

The DEA is applied for efficiency estimations under CRS (Constant Return to Scale) or TE (Technical Efficiency), VRS (variable return to scale) or PTE (Pure Technical Efficiency) and SE (Scale Efficiency) or CRS/VRS assumptions.

1. *Constant Return to Scale* (CRS) is a model developed by Charnes, Cooper and Rhodes (Model CCR) in 1978. The basis of this model is that if input is increased by a factor of "a," then output will be raised by the same factor of "a." In other words, the ratio of input to output is fixed.
2. *Variable Return to Scale* (VRS) is a model developed by Banker, Charnes and Cooper (Model BCC) in 1984, which is an extension of the CCR model. This model assumes that increases in input and output are not proportional, meaning that an increase in input by a factor of "a" will not result in an increase in output by the same factor of "a." (Machmud & Rukmana, 2010).
3. The CCR model is employed to calculate technical efficiency (TE), whereas the BCC model estimates pure technical efficiency (PTE). From these, scale efficiency (SE) can be calculated, representing the potential productivity gain from being at an efficient size for a decision-making unit (DMU). The interdependence of these measures of efficiency is TE divided by PTE (Ben Mohamed et al., 2021).

a. Input Variables

Total Assets

Total assets refer to the complete sum of resources owned by an entity, which can be measured in monetary terms, at a specific point in time. This concept is crucial in accounting and financial reporting, as it provides insight into the financial health and operational capacity of a business (Staubus, 1973).

Expenses

Expenses refer to the costs incurred by an entity in the process of generating revenue. They are essential components of financial statements, particularly the income statement, where they are subtracted from revenues to determine net income (Braun, 2022).

Equity

Equity is defined as the residual in a company's assets after all liabilities have been deducted, representing the ownership held by shareholders, which primarily arises from their investments and the profits generated by the company. Equity can diminish due to withdrawals by shareholders, dividend distributions, or losses incurred by the company (Miles et al., 2013).

b. Output Variables

Total Financing

Total Financing refers to the overall funding raised by a business through funding, typically from financial institutions, which must be repaid within a specified time period plus a agreed payment or return. Total financing plays a major role in defining the financial status of an entity since it influences liquidity, leverage, and financial stability. In banking, total financing refers to

the amount of funds provided to customers via credit or Islamic financing that influences the profitability and risk of a bank. For businesses, excessive total financing is a sign of attempts at growth and business expansion but increases financial risk when not contained (Hijriani et al., 2024).

Net Profit

Net profit, also referred to in some contexts as net income or net earnings, is the amount of money left over after deducting total costs, expenses, and taxes from overall revenues. It's an important financial and profitability indicator of a business firm because it represents the level of profit actually accessible to equity holders and it's a key component in determining general business well-being (Happrabu & Ariyani, 2023).

Table 3.3
Input and output variable

Input variable	Total assets	(Alfina & Putra, 2021), (Ayu Puspitasari, 2017), (Marjanović et al., 2018), (Osuma et al., 2021), (Chatzoglou et al., 2010), (Bressan et al., 2021)
	Expenses	(Khan et al., 2017), (Vo & Nguyen, 2018), (Chatzoglou et al., 2010)
	Equity	(Wang et al., 2024), (Pambuko, 2016), (Sanati & Bhandari, 2024)
Output variable	Total financing	(Kamarudin et al., 2019), (Adeabah et al., 2019), (Laila et al., 2018), (Osuma et al., 2021), (Bressan et al., 2021)
	Net profit	(Dar et al., 2021), (Horvat et al., 2023), (Chatzoglou et al., 2010), (Kamarudin et al., 2019), (Bressan et al., 2021)

The input and output variables listed in Table 3.3 will be processed using MaxDEA software version 8 that can produce result Technical Efficiency, Pure Technical Efficiency and Scale Efficiency.

3.7 Summary Chapter

This chapter discusses methodology, the sampling techniques, data collection procedures, and statistical methods that are used. This research employs financial data downloaded from the annual reports of Islamic banks in Malaysia 2006 to 2023 and Indonesia for the period 2013 to 2023.

CHAPTER 4

RESULTS AND DISCUSSION

4.0 Introduction

This chapter discusses findings regarding input and output variables, the level of efficiency and Islamic banking industry and comparative analysis of the Islamic banking industry in Indonesia and Malaysia.

4.1 Descriptive analysis of input and output variable

The construction of grand frontier is created using data from 24 banks with 18 years observation and DEA is applied to assess the technical efficiency of each observation in the sample. The efficiency analysis is performed take into consideration of linear programming problems. Bank's efficiency score for each year is determined using the MaxDEA 8 software PTE and TE is calculated under both CRS and VRS, followed by the estimation of SE for all sample banks.

The analysis on the objective one can be presented in Table 4.1 and Table 4.2 below.

Table 4.1

Average of input and output variable of Islamic bank in Malaysia (in RM '000)

BANK	Asset			Income	
	Total Asset	Equity	Total Financing	Expense	Net Profit
AFI	16,138,789	2,378,834	11,704,070	138,909	78,534
ALI	8,661,388	1,076,446	6,802,649	89,376	69,901
BIMB	46,621,075	8,338,998	33,560,490	775,340	310,418
BM	20,461,725	4,958,892	13,213,603	317,450	113,826
CITI	5,090,896	1,377,539	1,397,971	69,478	89,135
HLI	24,265,722	2,665,705	18,294,953	136,974	200,281
HSBC	18,897,508	2,619,419	9,786,214	321,021	168,624
MBI	142,493,463	17,654,918	119,405,452	1,084,940	1,277,647
OCBC	10,547,492	2,499,332	7,758,554	124,492	85,689
PBI	42,585,660	4,419,163	33,775,324	290,406	364,301
RHBI	45,248,557	4,294,576	36,144,789	274,948	308,874
SCI	6,581,194	1,327,505	4,275,559	79,019	28,525

AFI : Affin Islamic Bank, ALI : Alliance Islamic Bank, BIMB : Bank Islam Malaysia Berhad, BM : Bank Muamalat Malaysia, CITI : Citibank Berhad, HLI : Hong Leong Islamic Bank Berhad, HSBC : HSBC Amanah Malaysia Berhad, MBI : Maybank Islamic Berhad, OCBC : OCBC Al-Amin Berhad, PBI : Public Bank Islamic Berhad, RHBI : RHBI Islamic Bank Berhad, SCI : Standard Chartered Saadiq Berhad.

Table 4.1 presents financial indicators for various Islamic banks in Malaysia, including total assets, equity, total financing, expenses, and net profit. Total asset represents the overall financial resources owned by a bank, including cash, loans, investments, and other assets that contribute to its operational capacity. Based on the data, MBI holds the highest total assets at RM142.49 billion, indicating its strong financial position and ability to provide extensive financing. BIMB, RHBI, and PBI follow with total assets exceeding RM40 billion, reflecting their significant market presence.

Equity is the net worth of a bank, represented as the portion of total assets retained by shareholders after subtracting liabilities. It reflects the financial strength and risk-absorbing ability of a bank. Based on the numbers, MBI has the highest equity of RM17.65 billion, which shows its sound capital base and financial solidity. BIMB RM8.34 billion, BM RM4.96 billion, and PBI RM4.42 billion also possess high equity levels to finance more activities. ALI RM1.08 billion and SCI RM1.33 billion, however, possess the lowest equity with a smaller base of capital which may be restrictive for the businesses to expand. A higher level of equity generally makes a bank more capable of losing money and satisfying regulatory capital rules, which matters to long-term financial soundness and well-being.

Total financing indicates the extent of funds released from banks to their customers and is one of the determinants of profitability and risk management. MBI has the highest total financing at RM119,405,452 with an asset ratio at 83.81%. It shows an

aggressive disbursement policy in credit. RHBI and PBI also yield more than 79% while CITI shows the lowest amount of total financing RM1,397,971 at a ratio of merely 27.47% showing that it has highly conservative policy. The banks with higher amounts of total financing would record higher net profits but proper risk management is crucial to avoid possible credit defaults. These differences in funding strategies highlight how each bank shapes its business model to manage risk, profitability, and growth.

Expense refers to the total operation expense incurred by a bank, for example, interest charge, administrative cost, and other charges necessary to sustain business operations. Costly expenses will be evidenced by lesser profitability unless efficiently operated. Based on the details, MBI records the highest expense of RM1.08 billion, reflecting its enormous operations and huge financing operations. BIMB RM775.34 million, HSBC RM321.02 million, and BM RM317.45 million also carry massive expenses, likely due to their operating scale and cost burdens. SCI RM79.02 million, ALI RM89.37 million, and CITI RM69.47 million have the lowest expenses, indicating a low cost base. Cost management is crucial in maintaining profitability because excessive costs have the potential to suck net earnings dry even if revenue is posted at a high rate.

Net profit is the final income of a bank after deducting all expenses, for example, operating expenses, interest expense, and taxes. It is a key figure representing the profitability and financial performance of a bank. Among the numbers, MBI boasts

the largest net profit at RM1.27 billion, which reflects its stable financial status and efficient revenue generation. High net profit banks are PBI RM364.30 million, BIMB RM310.41 million, and RHBI RM308.87 million, which indicate good cost management and strong income streams. SCI has the lowest net profit of RM28.52 million, indicating higher operating costs or less revenue generation. Effective control over expenses while maximizing income is necessary in order to sustain long-term profitability and financial viability.

Table 4.2

Average of input and output variable of Islamic bank in Indonesia (in RP '000,000,000)

BANK	Asset			Income	
	Total asset	Equity	Total Financing	net profit	Expenses
Bank Aceh	20,713	13,548	4,763	352.35	1,133
Bank Jabar Banten Syariah	6,228	5,137	1,653	20.23	56.39
Bank Mega Syariah	10,094	8,345	2,899	145.32	24.19
Bank Muamalat Indonesia	57,914	47,583	16,848	47.68	1,565
Bank Panin Dubai Syariah	200.72	40.92	6339	71.42	82.18
Bank Syariah Bukopin	6,269	4,858	2,329	77.49	286
Bank Syariah Indonesia	124,219	92,798	30,662	1,465	4,071
Bank Tabungan Pensiunan Syariah Nasional	11,886	10,060	2,001	803.31	1,747
Bank Victoria Syariah	1,937.22	1,663.66	734	2.34	284.98
Bca Syariah	7,594.98	6,275.97	2,820.00	62.84	81.61
Bpd Nusa Tenggara Barat Syariah	8,849.74	5,612.75	4,603.00	172.52	85.32
Maybank Syariah Indonesia	163.87	22.81	104	1.61	7.18

Table 4.2 presents some key financial indicators of some Indonesian Islamic banks, including Total Assets, Expenses, Equity, Total Loans, and Net Profit. Total assets refer to the sum of the value of a bank's assets, for example, cash, investment, and financial holdings. Based on the data presented, Bank Syariah Indonesia Rp124,219 billion has the highest total assets, which indicates that it is a market leader in the Islamic banking sector. Bank Muamalat Indonesia Rp57,914 billion follows, reflecting its high market share. Other banks with high assets include Bank Aceh Rp20,713 billion and Bank Tabungan Pensiunan Syariah Nasional Rp11,886 billion. In contrast, Maybank Syariah Indonesia Rp163.87 billion and Bank Panin Dubai Syariah Rp200.72 billion have the lowest total assets, reflecting small operation scales. Total assets play a vital role in determining the ability of a bank to generate revenue and sustain growth in the competitive banking industry.

Equity is the value of the bank's ownership, which is assets minus liabilities. Bank Syariah Indonesia Rp92,798 billion is the highest equity bank in the data provided, with good financial strength and capital reserves. Bank Muamalat Indonesia Rp47,583 billion comes next, which has a solid capital base. These are Bank Tabungan Pensiunan Syariah Nasional Rp10,060 billion and Bank Mega Syariah Rp8,345 billion, both having significant equity underpinning their business growth. Maybank Syariah Indonesia Rp22.81 billion and Bank Panin Dubai Syariah Rp40.92 billion are, in contrast, with the lowest level of equity and, therefore, suggesting relatively fewer capital assets. Equity is crucial in determining how strong a bank is against financial shocks and is also able to its lending activities grow.

Total financing shows the amount of funds provided by banks to consumers and reflects one of the vital indicators for determining Islamic banking transactions. Among statistics provided, Bank Syariah Indonesia Rp30,662 billion holds the largest amount of total financing, representing its leading position in offering funds distribution. Bank Muamalat Indonesia Rp16,848 billion holds equally large finance value and represents its big footprint in Islamic finances. Few lower total financing banks, such as Bank Jabar Banten Syariah Rp1,653 billion and Bank Victoria Syariah Rp734 billion, portray a smaller span of operations. Maybank Syariah Indonesia Rp104 billion has the lowest total financing, which may illustrate a smaller funding portfolio or alternative strategy. Overall, total funding reflects the extent to which banks actively lend cash to clients and can serve as a measure of business growth and its contribution towards the economy.

Expenses are the total cost incurred by banks in their activities, including administrative, operating, and financing expenses. Bank Syariah Indonesia (BSI) has the largest expense of Rp4,071 billion, likely due to its large asset size and extensive operations. Bank Tabungan Pensiunan Syariah Nasional follows with Rp1,747 billion, reflecting its operating scale. Bank Muamalat Indonesia also records a huge cost of Rp1,565 billion, which is consistent with its huge financing activities. Banks like Maybank Syariah Indonesia Rp7.18 billion and Bank Victoria Syariah Rp284.98 billion, on the other hand, have relatively lower costs, possibly due to their lower scales of operations. Overall, the banks with huge assets and financing activities would have higher costs, but maintaining costs are still significant in maintaining profitability.

Net profit is a bank's financial outcome after subtracting all costs. The highest net profit Rp1,465 billion belongs to Bank Syariah Indonesia (BSI) supported by its biggest total assets in this data set. Bank Tabungan Pensiunan Syariah Nasional also shows good profitability Rp803.31 billion though it has moderate asset size. Several banks, like Bank Aceh Rp352.35 billion and BPD Nusa Tenggara Barat Syariah Rp172.52 billion, maintain moderate net profits, reflecting balanced financial management. Meanwhile, Maybank Syariah Indonesia Rp1.61 billion and Bank Victoria Syariah Rp2.34 billion have the lowest net profits, indicating potential operational challenges. Overall, higher assets and financing contribute to stronger profits, but operational efficiency remains key to financial success.

4.2 Result of Data Envelopment Analysis

4.2.1 Islamic Bank in Malaysia

Table 4. 3

Result of DEA of Islamic bank in Malaysia (Technical Efficiency, Pure Technical Efficiency and Scale Efficiency)

	TE																	
DMU	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
AFI	0.37	0.36	0.53	0.59	0.62	0.60	0.78	0.86	0.84	0.97	1.00	0.97	0.97	0.96	0.97	0.98	0.89	0.93
ALI	0.87	1.00	1.00	0.97	1.00	0.89	0.97	1.00	0.98	1.00	0.91	0.93	0.96	0.97	0.97	0.97	0.98	0.97
BIMB	1.00	0.66	0.89	0.52	0.79	0.71	0.79	0.88	1.00	1.00	1.00	0.93	0.98	0.96	0.98	0.97	0.88	0.92
BM	0.44	0.53	0.58	0.93	0.55	0.59	0.65	0.75	0.88	0.83	0.83	0.82	0.95	0.94	0.95	0.95	0.95	0.91
CITI	1.00	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HLI	1.00	0.87	0.73	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.94	0.99	0.98	1.00	0.98	1.00	1.00
HSBC	0.65	0.77	0.76	0.95	0.90	1.00	1.00	0.95	0.95	0.88	0.93	0.97	0.95	0.95	0.93	0.95	0.74	0.66
MBI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00
OCBC	0.59	0.64	0.78	0.58	0.76	0.75	0.88	1.00	0.92	0.98	1.00	0.74	0.95	0.95	0.93	0.95	1.00	1.00
PBI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.98	0.98	0.98	0.98	0.92	0.98
RHBI	0.54	0.74	0.80	0.70	0.88	0.85	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SCI	0.36	0.30	0.34	0.52	0.80	0.72	0.85	0.98	1.00	0.96	1.00	0.92	0.96	0.94	0.95	0.96	0.84	0.82

PTE

DMU	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
AFI	0.44	0.37	0.54	0.63	0.66	0.61	1.00	1.00	0.95	0.97	1.00	0.99	0.98	0.98	0.98	0.99	0.91	0.98
ALI	1.00	1.00	1.00	1.00	1.00	0.90	1.00	1.00	1.00	1.00	1.00	0.93	0.99	1.00	1.00	0.99	1.00	1.00
BIMB	1.00	0.97	1.00	0.52	1.00	0.79	0.91	1.00	1.00	1.00	1.00	1.00	1.00	0.96	1.00	0.98	0.92	0.93
BM	0.47	0.53	0.58	0.97	0.55	0.59	0.66	0.76	0.88	0.83	0.84	0.83	0.96	0.96	0.96	0.96	0.96	0.93
CITI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HLI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	0.99	1.00	0.99	1.00	1.00
HSBC	0.71	0.81	0.80	0.97	0.96	1.00	1.00	0.96	0.96	0.88	0.94	0.99	0.97	0.97	0.95	0.96	0.80	1.00
MBI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
OCBC	0.75	0.71	0.82	0.60	0.88	0.77	0.91	1.00	0.94	1.00	1.00	0.90	0.97	0.97	0.95	0.97	1.00	1.00
PBI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.98	0.98	0.98	0.94	0.98
RHBI	0.55	0.78	0.87	0.71	0.91	0.85	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SCI	0.97	0.33	0.35	0.58	0.88	0.72	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

SE

DMU	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
AFI	0.85	0.96	0.99	0.93	0.93	0.98	0.78	0.86	0.89	1.00	1.00	0.98	0.99	0.98	0.99	0.99	0.97	0.95
ALI	0.87	1.00	1.00	0.97	1.00	0.99	0.97	1.00	0.98	1.00	0.91	1.00	0.97	0.97	0.97	0.98	0.98	0.97
BIMB	1.00	0.68	0.89	1.00	0.79	0.89	0.86	0.88	1.00	1.00	1.00	0.93	0.98	1.00	0.98	1.00	0.95	0.99
BM	0.94	1.00	1.00	0.97	1.00	1.00	0.99	1.00	1.00	1.00	0.99	0.98	0.99	0.98	0.99	0.99	0.99	0.98
CITI	1.00	0.93	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
HLI	1.00	0.87	0.73	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.99	0.99	1.00	1.00	0.99	1.00	1.00
HSBC	0.91	0.96	0.94	0.98	0.93	1.00	1.00	0.99	1.00	1.00	0.99	0.98	0.99	0.98	0.98	0.98	0.93	0.66
MBI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00
OCBC	0.78	0.90	0.95	0.97	0.87	0.97	0.97	1.00	0.98	0.98	1.00	0.82	0.98	0.98	0.98	0.98	1.00	1.00
PBI	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.94	1.00	1.00	1.00	1.00	0.98	1.00
RHBI	0.98	0.95	0.91	0.99	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
SCI	0.37	0.91	0.97	0.90	0.91	0.99	0.85	0.98	1.00	0.96	1.00	0.92	0.96	0.94	0.95	0.96	0.84	0.82

AFI Bank experienced a significant increase in TE from 0.37 in 2006 to 0.93 in 2023. This improvement indicates better resource utilization and enhanced operational strategies. The bank's PTE reached 1.00 in several years, showing that inefficiencies were mostly due to scale rather than internal management. The bank's SE remained relatively stable around 0.95-1.00, indicating that it is approaching optimal operational scale.

ALI Bank demonstrated excellent efficiency performance, with TE and PTE consistently close to or reaching 1.00 almost every year. This suggests that the bank has optimal input-output management and has maintained operational efficiency. The stability in efficiency reflects a strong business strategy and effective resource management.

BIMB Bank experienced fluctuations in its TE, with a low point in 2009 (0.52). However, after 2013, TE stabilized and increased close to 1.00. The bank's PTE also showed an upward trend, indicating that previous inefficiencies were more related to scale rather than internal management. Through continuous improvements, the bank successfully enhanced its efficiency over the years.

BM Bank gradually improved its TE, particularly after 2012. Its technical efficiency continued to rise, reaching close to 1.00 in 2023. The bank's SE was also high, indicating that it has optimized its operational scale effectively. This improvement

shows that BM has successfully managed its resources and operational strategies more efficiently.

CITI Bank demonstrated perfect efficiency TE and PTE = 1.00 every year throughout the analysed period. This reflects that the bank has highly optimal operational strategies and resource management. By maintaining maximum efficiency, CITI stands out as one of the best-performing banks in this analysis.

HLI maintained stable technical efficiency, with TE and PTE reaching 1.00 in many years. However, in 2008, its efficiency slightly declined. Nevertheless, the bank managed to regain optimal efficiency in the following years. This indicates that HLI has a strong adaptability strategy to overcome operational challenges.

HSBC Bank also witnessed fluctuations of TE, particularly after 2021. Its TE declined to 0.66 in 2023, indicating possible external drivers affecting its operating efficiency. The SE of the bank also witnessed high volatility, which suggests that HSBC may face challenges in justifying its operating scale.

MBI Bank demonstrated 1.00 perfect efficiency nearly every year in terms of TE and PTE. This signifies that the bank is in a relative advantage in terms of managing its

resources and scale of operations. MBI is one of the best-performing banks in this analysis since it keeps its optimal efficiency.

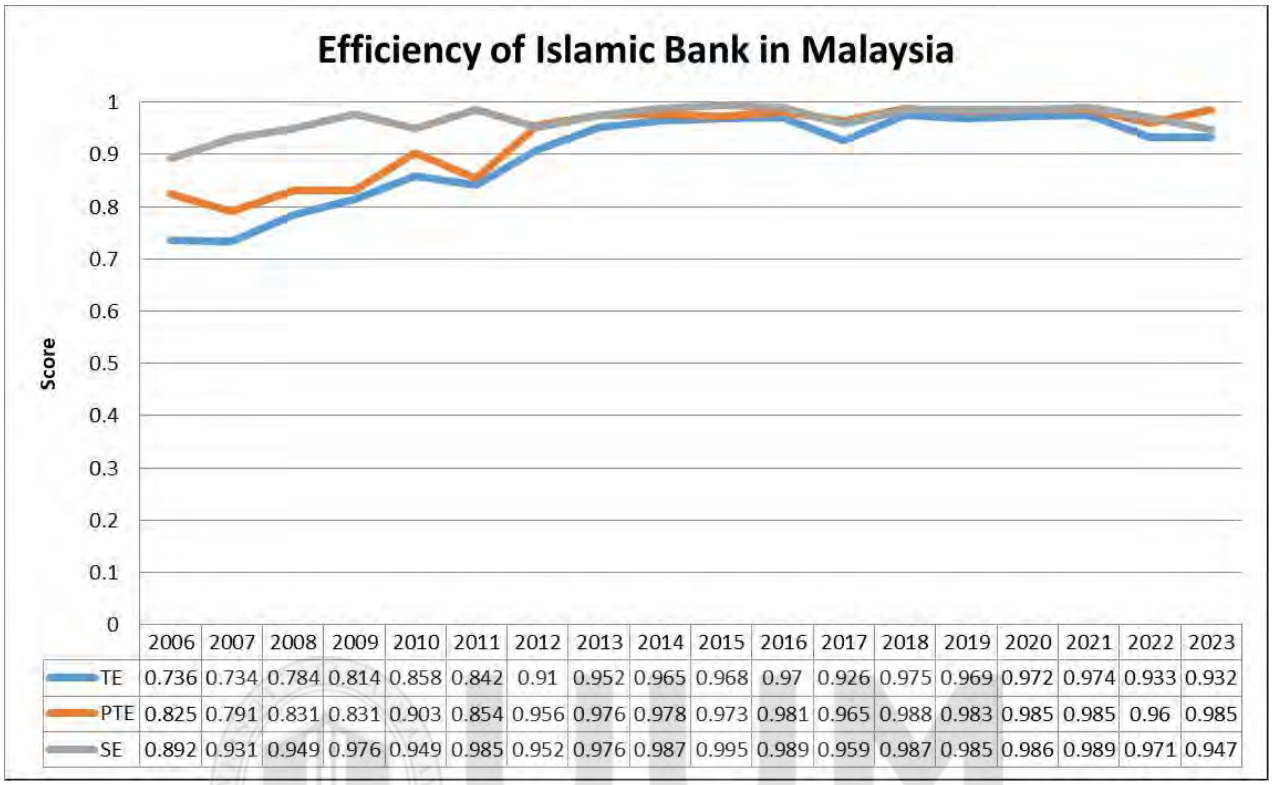
OCBC Bank registered a high TE growth from 0.59 in 2006 to 1.00 in 2023. This progress indicates improved management of operational scales and utilization of resources. The bank's PTE was also positively inclined, meaning that OCBC is growing more efficient in managing its inputs and outputs.

PBI Bank maintained perfect efficiency TE and PTE is 1.00 almost every year, demonstrating exceptional operational stability. With consistent efficiency, PBI is one of the banks with excellent resource management and business strategies.

RHBI Bank's TE grew tremendously from 0.54 in 2006 to 1.00 in 2023. The growth in TE reflects a better operating efficiency and scale optimization of business. With this achievement, RHBI is more competitive in the banking industry.

SCI Bank began with weak TE 0.36 in 2006 but improved significantly after 2012. SE and PTE of the bank also showed an upward trend, capturing scale and internal management efficiency gains. This suggests that SCI has, over recent years, made significant operating improvements.

4.2.2 Islamic Banking Industry in Malaysia



	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
TE	0.736	0.734	0.784	0.814	0.858	0.842	0.91	0.952	0.965	0.968	0.97	0.926	0.975	0.969	0.972	0.974	0.933	0.932
PTE	0.825	0.791	0.831	0.831	0.903	0.854	0.956	0.976	0.978	0.973	0.981	0.965	0.988	0.983	0.985	0.985	0.96	0.985
SE	0.892	0.931	0.949	0.976	0.949	0.985	0.952	0.976	0.987	0.995	0.989	0.959	0.987	0.985	0.986	0.989	0.971	0.947

Figure 4. 1

Efficiency level in Malaysia Islamic Banking Industry

Figure 4.1 presents three efficiency indicators TE PTE, and SE for Islamic banks in Malaysia from 2006 to 2023.

The blue line represented TE which starts at around 0.73 and further increases over the years, leaning towards around 0.97 from 2016 onwards. This indicates enhanced overall efficiency in Islamic banks in Malaysia, since the industry almost reached its optimum in subsequent years.

The orange line represents PTE, which indicates the effectiveness with which the resources are being utilized regardless of scale size. The PTE values fluctuate between approximately 0.79 in 2007 and increase steadily to approximately 0.98 in the following years. This indicates that the banks have continued to improve their technical efficiency and management of business over the years.

The grey line is for SE, and it begins at around 0.89, rising quickly to 0.94 in the early years and maintaining a high efficiency rate throughout most of the period under examination. This indicates that Malaysian Islamic banks have been operating at the optimal scale for most of the years included in the study.

The TE consistently increased, particularly from 2011 onward, indicating improved resource utilization. The PTE shows high and stable values after 2011, signifying effective management and operational efficiency. The SE remained consistently high, signifying that Malaysian Islamic banks have operated close to an optimal scale. These trends suggest a mature and well-optimized banking sector with strong management practices and efficient utilization of resources.

4.2.3 Islamic Bank in Indonesia

Table 4. 4

Result of DEA of Islamic bank in Indonesia (Technical Efficiency, Pure Technical Efficiency and Scale Efficiency)

	TE										
DMU	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Bank Aceh	1.00	1.00	0.83	0.39	0.11	0.53	0.48	0.60	0.31	0.45	0.38
Bank Jabar Banten Syariah	1.00	1.00	1.00	1.00	1.00	0.08	0.06	1.00	0.06	0.35	0.15
Bank Mega Syariah	0.36	0.21	0.03	0.32	0.05	0.15	0.12	0.42	1.00	0.77	0.51
Bank Muamalat Indonesia	0.50	0.23	0.35	0.11	0.09	0.04	0.01	0.01	0.01	0.03	0.01
Bank Panin Dubai Syariah	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bank Syariah Bukopin	0.17	0.24	0.18	0.35	0.07	0.02	0.01	0.01	0.77	0.37	1.00
Bank Syariah Indonesia	0.26	0.31	0.19	0.20	0.05	0.15	0.07	0.53	0.35	0.68	0.64
Bank Tabungan Pensiunan Syariah Nasional	0.00	0.33	0.57	1.00	0.13	1.00	1.00	1.00	1.00	1.00	0.76
Bank Victoria Syariah	0.25	0.34	0.33	0.23	0.05	0.13	0.02	0.01	0.07	0.15	0.12
Bca Syariah	0.44	0.18	0.35	0.29	0.15	0.47	0.29	0.44	0.22	0.86	1.00
Bpd Nusa Tenggara Barat Syariah	1.00	1.00	1.00	1.00	0.23	0.81	1.00	0.79	0.33	0.64	0.49
Maybank Syariah Indonesia	0.49	1.00	0.27	0.25	0.03	0.50	0.46	0.46	0.56	0.52	0.58

PTE

DMU	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bank Aceh	1.00	1.00	1.00	0.45	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bank Jabar Banten Syariah	1.00	1.00	1.00	1.00	1.00	0.18	0.16	1.00	0.17	0.60	0.20
Bank Mega Syariah	0.82	0.21	0.05	0.56	0.08	0.33	0.25	0.91	1.00	1.00	0.51
Bank Muamalat Indonesia	0.55	0.24	0.55	0.66	0.72	0.54	0.50	0.49	0.35	0.32	0.38
Bank Panin Dubai Syariah	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bank Syariah Bukopin	0.17	0.25	0.18	0.46	0.62	1.00	1.00	1.00	1.00	1.00	1.00
Bank Syariah Indonesia	0.33	0.38	0.28	0.24	1.00	1.00	1.00	0.61	0.36	0.80	0.76
Bank Tabungan Pensiunan Syariah Nasional	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bank Victoria Syariah	0.30	0.40	0.69	0.86	0.76	1.00	1.00	1.00	0.66	0.48	0.51
Bca Syariah	0.51	0.18	0.52	0.54	0.68	1.00	1.00	0.89	0.84	1.00	1.00
Bpd Nusa Tenggara Barat Syariah	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Maybank Syariah Indonesia	0.51	1.00	0.31	0.32	0.04	0.55	0.47	0.67	1.00	1.00	1.00

SE

DMU	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Bank Aceh	1.00	1.00	0.83	0.88	0.11	0.53	0.48	0.60	0.31	0.45	0.38
Bank Jabar Banten Syariah	1.00	1.00	1.00	1.00	1.00	0.44	0.37	1.00	0.34	0.59	0.73
Bank Mega Syariah	0.43	1.00	0.58	0.56	0.63	0.46	0.48	0.46	1.00	0.77	1.00
Bank Muamalat Indonesia	0.92	0.98	0.63	0.17	0.12	0.08	0.03	0.03	0.02	0.11	0.03
Bank Panin Dubai Syariah	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Bank Syariah Bukopin	1.00	0.97	1.00	0.76	0.12	0.02	0.01	0.01	0.77	0.37	1.00
Bank Syariah Indonesia	0.77	0.80	0.66	0.81	0.05	0.15	0.07	0.88	0.97	0.85	0.84
Bank Tabungan Pensiunan Syariah Nasional	0.00	0.33	0.57	1.00	0.13	1.00	1.00	1.00	1.00	1.00	0.76
Bank Victoria Syariah	0.85	0.84	0.48	0.27	0.06	0.13	0.02	0.01	0.11	0.31	0.25
Bca Syariah	0.86	1.00	0.68	0.54	0.22	0.47	0.29	0.49	0.26	0.86	1.00
Bpd Nusa Tenggara Barat Syariah	1.00	1.00	1.00	1.00	0.23	0.81	1.00	0.79	0.33	0.64	0.49
Maybank Syariah Indonesia	0.97	1.00	0.86	0.78	0.82	0.92	0.98	0.69	0.56	0.52	0.58

Table 4.4 shows TE, PTE, and SE data, the efficiency conditions of each bank during the period 2013-2023. Bank Aceh experienced fluctuations in efficiency during the 2013–2023 period. Although it had relatively high technical efficiency in the early years, its performance dropped significantly in 2016 and 2017. However, since 2018, the bank has shown improvements in SE and PTE, although its values have not yet fully stabilized.

Bank Jabar Banten Syariah demonstrated full efficiency from 2013 to 2017. However, in 2018 and 2019, there was a sharp decline in TE and PTE. After recovering in 2020, its efficiency declined again in 2021–2023, indicating operational strategy challenges that need to be addressed.

Bank Mega Syariah experienced fluctuating efficiency performance. From 2013 to 2017, its efficiency was low but showed improvements from 2018 to 2023. This increase is evident in the rising TE and PTE scores, indicating better management and resource optimization.

Bank Muamalat Indonesia showed a significant decline in efficiency. Since 2013, its technical and managerial efficiency has steadily decreased, with extremely low TE and PTE scores from 2019 to 2023. This indicates structural issues that must be urgently addressed for the bank to remain competitive.

Bank Panin Dubai Syariah is the only bank that maintained full efficiency TE, PTE, and SE = 1.00 throughout the 2013–2023 period. This consistency demonstrates effective management and a stable business strategy, making it a model for other Islamic banks.

Bank Syariah Bukopin had low efficiency from 2013 to 2017 but saw a significant improvement after 2018. This increase was mainly due to better PTE enabling it to achieve full efficiency in 2023.

Bank Syariah Indonesia showed a relatively positive trend, although it experienced fluctuations in some years. After a decline in 2017, its efficiency began to improve in 2018 and reached better stability in 2021–2023.

Bank Tabungan Pensiunan Syariah Nasional saw a dramatic increase in efficiency after 2016. Before that year, its efficiency was very low, but from 2018 onwards, the bank managed to achieve full efficiency, maintaining this performance through 2023.

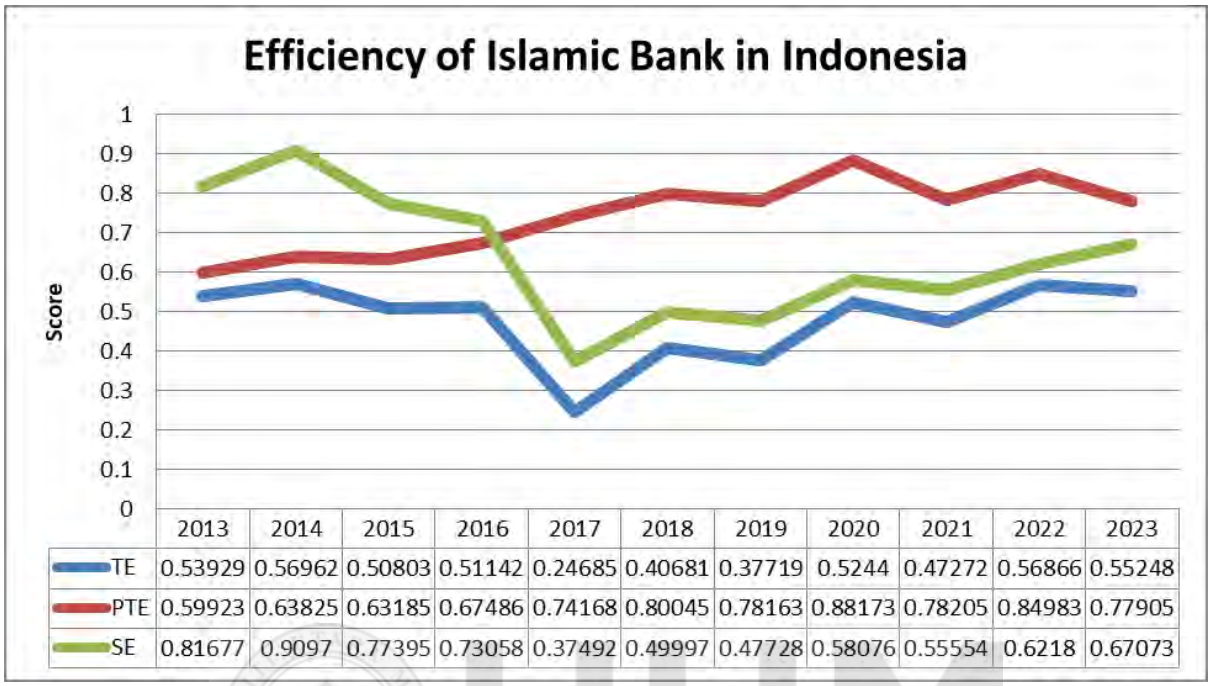
Bank Victoria Syariah faced efficiency challenges throughout the 2013–2023 period. Although there were improvements in managerial efficiency in certain years, overall, the bank has not been able to achieve stability in technical efficiency and operational scale.

BCA Syariah showed an improving efficiency trend since 2018. Previously, its efficiency fluctuated, but in 2022 and 2023, the bank achieved full efficiency, indicating better management and resource optimization.

BPD Nusa Tenggara Barat Syariah maintained full efficiency for most of the period, although it experienced slight declines in 2017 and 2021. Overall, the bank demonstrated stable performance and can serve as a model for operational efficiency.

Maybank Syariah Indonesia experienced a decline in efficiency in the mid period 2015–2017 but successfully recovered after 2018. By 2021–2023, its efficiency had reached optimal levels, demonstrating that the bank effectively implemented efficiency improvement strategies.

4.2.4 Islamic Banking Industry in Indonesia



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
TE	0.53929	0.56962	0.50803	0.51142	0.24685	0.40681	0.37719	0.5244	0.47272	0.56866	0.55248
PTE	0.59923	0.63825	0.63185	0.67486	0.74168	0.80045	0.78163	0.88173	0.78205	0.84983	0.77905
SE	0.81677	0.9097	0.77395	0.73058	0.37492	0.49997	0.47728	0.58076	0.55554	0.6218	0.67073

Figure 4. 2

Efficiency level in Indonesia Islamic banking industry

Figure 4.2 illustrates three efficiency indicators TE, PTE, and SE for the Islamic banking industry in Indonesia from 2013 to 2023. The efficiency of Islamic banks in Indonesia from 2013 to 2023 shows a fluctuating trend, TE represented by the blue line, exhibited a decline from 2014 to 2017, reaching its lowest point at 0.24685. This suggests that during this period, banks faced challenges in utilizing their resources effectively. However, from 2018 onward, there was a gradual recovery, with TE reaching 0.55 in 2023, indicating an improvement in overall efficiency.

PTE represented by the red line, remained relatively stable and consistently higher than TE throughout the period. This stability suggests that the banks performed

decently in managing their resources, but their inefficiencies were probably scale-based and not technical inefficiencies. The PTE values were close to 1.00 for most years, except in 2016 and 2017 when they dipped slightly.

SE as represented by the green line, dropped substantially between 2015 and 2017, hitting its lowest in 2017 at 0.37. That is, during this period, Islamic banks were below an optimal level of size, may be due to financial crises or lack of efficiency in using capacity. SE began to increase from 2018, however, with a trend towards capacity use increasing.

Overall, the efficiency of Islamic banks in Indonesia experienced a decline from 2015 to 2017, primarily due to a drop in scale efficiency rather than technical inefficiencies. This suggests that the banks were not operating at an optimal scale, impacting their TE. The gradual improvement after 2018 indicates a positive adjustment, reflecting possible improvements in management and operational processes. However, TE has not yet returned to its previous peak levels, signaling the need for further strategic improvements in operational scaling.

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.0 Introduction

This study aims to measure the level of efficiency of Islamic banks in Indonesia and Malaysia for the period 2006 to 2023 and this chapter presents the summary of the findings.

5.1 Summary of Result

In summary, the findings are presented based on the three objectives as follows:

5.1.1 Objective One

To explain Islamic banking performance in Malaysia and Indonesia based on the asset and income

The analysis highlights significant differences in financial strength, asset size, and profitability among the banks. MBI emerges as the strongest performer with the highest total assets, financing, and net profit, demonstrating its extensive market presence and financial resilience despite high expenses. BIMB, RHBI, and PBI also demonstrate good financial performance by employing their huge financing activities to earn strong profits. Conversely, small banks like CITI and SCI have a conservative

scale with minimal financing and profitability. Banks that have higher total financing tend to have more overall profitability, yet efficient cost control remains a vital element in preserving long-term financial stability.

The report highlights significant differences in financial positions among Indonesia's Islamic banks, with Bank Syariah Indonesia (BSI) being at the top for total assets, equity, financing, expenses, and net profit, upholding its market leading position. Bank Muamalat Indonesia and Bank Tabungan Pensiunan Syariah Nasional also exhibit solid financials, whereas smaller banks like Maybank Syariah Indonesia and Bank Victoria Syariah do so on a smaller level with less financing and profitability. Effective asset management, strategic funding, and cost efficiency become central aspects for long-term financial sustainability and success in the competitive Islamic banking sector.

5.1.2 Objective Two

To investigate efficiency level of Islamic bank and Islamic banking industry in Malaysia

The Malaysian Islamic banks' efficiency performance, 2006-2023, shows a consistent rise in all three measures in TE, PTE, and SE. TE started at approximately 0.73 and continued to rise consistently to approximately 0.97 from 2011, which shows better overall efficiency. PTE, being a measure of efficiency in the utilization of resources, also increased from 0.79 to nearly 0.97 in later years, showing consistent

improvements in technical efficiency and management activities. SE recorded rapid growth in the early years, recording 0.99 and maintaining high efficiency, which means that Malaysian Islamic banks have been able to operate efficiently at an optimal size. Overall, these trends indicate a significant improvement in the performance of Malaysian Islamic banks.

The steady increase in TE indicates increased use of resources, while consistent and high values of PTE indicate good management and operational efficiency. Besides, the consistently high SE values further confirm that banks have been at a best size all along. These points clearly suggest that Malaysia's Islamic banking sector has reached its maturity and optimal size stage, supported by effective management practices and efficient utilization of resources.

5.1.3 Objective Three

To investigate efficiency level of Islamic bank and Islamic banking industry in Indonesia.

Generally, the efficiency of Islamic banks in Indonesia from 2013 to 2023 was an erratic trend, where a decline between 2015 and 2017 was largely due to scale inefficiencies. TE reached its lowest in 2017, revealing difficulties in making use of resources, while SE also declined significantly, suggesting inefficient scale operations. However, PTE was relatively stable, showing internal management was not the primary reason but scaling operation inefficiencies.

Since 2018, TE and SE have slowly increased, reflecting better operating strategies and capacity utilization. Although this has been a step forward, efficiency levels are still lower than their pre-crisis peaks, reflecting the need for further strategic reform to increase scale efficiency to the fullest extent. Islamic banks in Indonesia must further enhance their operating frameworks and enhance resource allocation to enhance overall performance in order to ensure sustained growth.

5.2 Contribution of Study

This study contributes significantly to various stakeholders since it provides valuable information regarding the efficiency of Islamic financial institutions, and in this instance, the Islamic banks in Indonesia and Malaysia. To researchers and scholars, it is a valuable reference for comprehending the dynamics of operation and performance of Islamic banks with the view of developing theoretical frameworks and enhancing public knowledge on Sharia-compliant financial institutions. By comparing Indonesia and Malaysia's efficiency measures for Islamic banking, the study offers solutions to operational challenges, such as regulatory constraints and market competition, to improve banks' efficiency and decision-making processes. Lastly, for practitioners, the study offers a framework to optimize performance and profitability by determining influential factors that influence banking efficiency. Overall, this research enhances the effectiveness and sustainability of Islamic banking by utilizing better operational practices and decision-making.

5.3 Limitation of Study

There are several limitations of the study on Indonesian and Malaysian Islamic banks' efficiency that should be considered. In the first place, consistency and availability of financial data over the period from 2013 to 2023 can influence how precisely the efficiency can be identified, especially in the case of smaller banks with fewer reports. Secondly, even if the research makes a comparison between Islamic banking efficiency in both countries, it doesn't condition against the exogenous economic state of regulatory changes, macroeconomic conditions, or financial crises that can influence the banking performance variably. Moreover, the approach exclusively applies DEA and efficiency measures TE, PTE and SE and therefore may exclude other influential parameters like risk control, customer support, or technical innovation. Another restriction is the regulatory frameworks and market variability in Indonesia and Malaysia that will definitely affect bank operation and competition but are not investigated to any extent. Lastly, the findings from this study might not have any bearing on other countries with different financial climates and market situations. In spite of these limitations, the paper offers helpful information on trends and Islamic banking efficiency issues that can be the starting point for further research and policy-making.

5.4 Suggestion for Future Research

For future research on the efficiency of Islamic banks in Malaysia and Indonesia, the following suggestions can enhance the scope and applicability of conclusions. Firstly,

future research should cover a broader set of financial and non-financial variables, such as risk management, digitalization, and customer satisfaction, to provide a more comprehensive view of efficiency. Second, it would be appropriate to compare it with other countries that have developed Islamic banking systems, e.g., Saudi Arabia or the UAE, to understand the best practices and areas for improvement. In addition, other methodologies such as panel data regression, could enable assessment of wider determinants of efficiency.

5.5 Suggestion for Islamic Bank

To enhance efficiency and competitiveness, Islamic banks need to enhance risk management, adopt digitalization and financial technology (fintech) and develop more innovative Shariah-compliant financial products such as Islamic fintech and green sukuk. Enhancing the quality of services and customer education is also critical in enhancing loyalty. Further, regulatory requirements and Shariah compliance through collaboration with regulators and scholars are critical.

5.6 Suggestion for Policy Maker

Policymakers should support the regulatory framework for Islamic banking by promoting risk management practices, facilitating digitalization, and ensuring Shariah compliance of financial products. Enabling cross-border coordination with sizeable Islamic banking markets like Saudi Arabia and the UAE could enhance best practice adoption and operational efficiency. Investment in fintech and customer-oriented policies will drive innovation and market competitiveness. Lastly, combining policy

performance assessments based on data, such as panel data analysis, can provide additional insights to identify the main drivers of efficiency to inform more effective decision-making for sustainable development in the Islamic banking sector.

5.7 Conclusion

This study compares the efficiency and performance of Islamic banks in Indonesia and Malaysia during the period 2006-2023. Overall, the findings show that Islamic banking in Malaysia has reached a mature and stable level of efficiency, while Islamic banking in Indonesia is still at the developing phase with persistent inefficiency in operational and scale efficiency. In the future, every effort should be made to improve cost control, scale rationalization efforts, and formulating good strategic plans for competitiveness and long-term sustainability.

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