
Measuring Bank Efficiency in the ASEAN Economic Community

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Abstract

The organization of local banks in this region will change with the advent of the ASEAN Economic Community (AEC) on December 31st, 2015. The process of financial deregulation has given bank management a motivation to concentrate on increasing efficiency, particularly in the area of competition. Utilizing Data Envelopment Analysis (DEA) software version 2.1, it looked into whether the AEC's banking system has been more efficient between 2017 and 2019.

Three approaches are introduced to measure bank efficiency – the intermediation approach, the production approach, and the income-based approach. Graphs are diagrammed by using the results of its approach to posit and show the bank's competitiveness with two axes. The results suggest that Malaysian banks were relatively more efficient rather than other banks. The outlook for the Malaysian banking system remains stable, together with strong capital and liquidity because of government support. It could be concluded that the robust banks derived from government policy.

Keywords: Efficiency, DEA, AEC

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Introduction

The AEC Blueprint 2025 has been created as ASEAN's new master plan for economic integration for the following ten years since the foundation of AEC 2015. The three strategic goals of financial sector integration—financial integration, financial inclusion, and financial stability—are covered by the AEC Blueprint 2025. Financial integration exhibits the benefits of higher competition and efficiency. Businesses and individuals have more access to potential banking service providers in an integrated market. It is anticipated that integration will increase domestic banks' ability to compete in the region's financial services market. The ability of ASEAN banks to provide their goods and services in any ASEAN member state should therefore be unrestricted.

Financial inclusion will be accomplished by providing a wider community with financial goods and services that eases convenience in life, providing aid for families and businesses to be more resilient, ranging from reaching long-term objectives to withstanding unanticipated events. Individuals, involving in activities such as entrepreneurship, education and health investment and risk management for financial longevity, are more likely to utilize other financial services, such as credit and insurance. This can enhance their overall quality of life. All participants in the economy possess the capacity and competence to access formal financial services.

Generally, financial stability and bank stability highly benefit from financial inclusion. The third strategic goal of financial stability is the absence of system-wide events of financial system dysfunction (crises). This occurs because the banks are in charge of delivering the majority of financial services to individuals and businesses in any country, as Ahamed and Mallick (2019) claim that the empirical data demonstrates the positive association between higher financial inclusion and individual bank stability. This gives banks more leverage and creates a stronger market, encouraging banks to innovate and discover new methods to increase productivity, offering clients higher-quality services. This implies both fairness and increased efficiency in the distribution of resources throughout the economy (Barth & Miller, 2018; BOT, 2022)

Each nation has been developing tools and methods to facilitate the free flow of goods and services among AEC members, increasing economic efficiency in the region by removing or reducing existing trade barriers and establishing minimum regulatory requirements across the member states as part of the AEC's Financial Liberalization program. The community's integration was intended to harmonize the laws and promote competition in the financial and other service sectors, particularly in the banking industry. Economic experts believe that people can easily access financial services and innovations in an environment where banks are fiercely competitive. Spreads in interest rates will likely encourage both an increase in the demand for loans for investments and an increase in the international mobilization of savings. On the other hand, banks are usually distinguished by very high levels of governmental regulations and controls in every nation that stifled competition and upheld the protection of the banking environment.

Several earlier research papers explained the ASEAN banking industry's readiness situation to demonstrate the countries' readiness to uphold their commitments to the ASEAN Framework Agreement (ADB, 2013; Wai-Mun, Teck-Heang, & Cai-Lian, 2011; Vora-Sittha, 2016). However, regional integration does reveal both beneficial and negative consequences for the nation's banking industry. Any country's future is greatly influenced by its banking

industry, which is also seen as a major factor in the success of the economy. The efficiency and performance of banks are essential in their central role of maintaining the financial stability of the nation. Banking plays a significant role in the economy since it offers essential services to both consumers and companies. The main purpose of banking organizations is to generate revenue through its role as a middleman between surplus and deficit units, promoting financial inclusion and increasing the bank's competitiveness, remaining crucial to its contribution to the domestic and global payment systems.

While this is happening, competition can boost inspiration and enhance performance. According to a meta-analysis of organizational performance, the financial and market results should be used to measure it (Luo et al., 2012). The resource-based theory of competitive advantage contends that the long-term success of any business is dependent upon the firm's internal resources, the firm's capabilities in using those resources to develop a competitive advantage over competing options, and the firm's innovation contributing to the financial performance of the firm in a market upon comparing performance across organizations belonging to a dissimilar context (Grant, 1991). Organizational efficiency is the act of accomplishing the same thing while using fewer resources, such as less time and less money, to achieve the same goal. Organizational performance is described as a business's ability to produce desired results with a minimum expenditure of resources. Banks control their performance by making them more efficient in various scenarios with the available resources. To prepare for a new stage of regional economic integration, banks work harder and more efficiently.

The examination of financial ratios has been used to describe bank performance based on accounting and capital market data, as efficiency and competence cannot be immediately evaluated. The performance of a bank's operations is frequently assessed using accounting-based metrics, including Return on Equity, Return on Assets, Net Interest Margin, Cost to Income Ratio, and others. Zhu (2000) criticized the analysis of bank performance, done mainly through financial indices are, an unsatisfactory measure of performance because the banking sector plays an increasingly critical role in the development of the financial system. However, when compared to the other methods developed by economists, the accounting ratio analysis alone has certain drawbacks (Milenkovic et al., 2002). For each country, several models were created to assess the level of competition and efficiency such as the Lerner index (De Lange van Bergen, 2006), the structure, competition, profitability, and efficiency model, the Cournot model, the Boone indicator (Bikker & van Leuvensteijn, 2008; Boone, 2001, 2008; van Leuvensteijn et al., 2008, 2010), the Panzar-Rosse model (Rosse & Panzar, 1977; Panzar & Rosse, 1982, 1987) and other models. According to Bikker (2010), the research result showed that assessing the performance of banks was difficult and that indicators varied greatly in quality. As a result, the expert view needed to be adjusted for these numerous indirect measures in the form of simple indicators or complicated models. With the progression in operational research techniques, the DEA is currently one of the most popular research techniques for analyzing the efficiency of organizations (Kedžo & Sjauš, 2021; Henriques et al., 2020; Wu, Yang, & Liang, 2006)

A few studies have been conducted to compare the robustness of the bank performance produced by different methodologies, and numerous techniques have been proposed to quantify bank efficiency. The majority of earlier research addressed the efficiency of large banks compared to smaller banks in country-specific, not cross-country, comparisons of banks (Paradi, Sherman, & Tam, 2018; Jansen, Berg, & Førsund, 1991). As a result, the Data Envelope Analysis (DEA), which has been intensively researched over the past two decades,

was suggested as a way to quantify bank efficiency. Mostly due to the efficiency ratio, the DEA measures how successful banks reduce costs and maximize revenues while turning inputs into outputs. Enhancing the outputs of the decision-making units is the primary goal of the DEA application (DMU). The analyses' main objective is to offer a solid foundation for decision-making.

The determination of bank efficiency in the area was the research problem covered here. The determination of bank efficiency was estimated using various methodologies that the other research issue covered. Therefore, it was intriguing to show which bank was positioned on the grid with the best efficiency.

This study's initial goal was to evaluate and compare the efficiency of banks in the AEC region between 2017 and 2019. Among the chosen nations in the AEC region, a bank's efficiency is defined as an intermediation entity that provides excellent products and services to obtain its revenue or profitability (DEA). It is possible to demonstrate whether or not the efficiency result scores produced by various frontier models are consistent with the results of the DEA that are being employed by applying the various techniques. In the second stage, the bank skills in three heterogeneity elements were determined and compared using the DEA result ratings. The graph was defined by mapping, which highlights their market position, acting as a tool that was used to compare them to competitors. A bank was made to stand out from its rivals in the marketplace using the competitive positioning technique. A bank's profitability can be increased by using this marketing technique. By enhancing the corporate image and setting the company apart from its rivals, this positioning approach seeks to boost sales.

The research study is set up as follows: A summary of the study's difficulties and research goals are displayed in Section 1. The theoretical underpinnings and prior research on bank efficiency are reviewed in Section 2. Following the presentation of three distinct DEA methodologies in Section 3, the section creates a useful map that delineates the market's perimeters where the profitability DEA scores are indicated in the grid. Section 4 presents various DEA results, after which two graphs were produced. The findings and conclusion are discussed in Section 5.

Theoretical Background

Efficiency can be defined as the outputs to inputs ratio. A lower input-to-output ratio—or a higher output-to-input ratio—reflects comparatively higher efficiency. The physical input-to-output ratio paired with the cost-per-output ratio is used differently in comparison to its analysis by the simple efficiency. As a result, we would need to consider the inputs' relative values and costs when weighing them. Especially in in-service businesses, the relative weights required to evaluate inputs and outcomes are frequently absent. Additionally, when there are many inputs and outputs, ratio analysis may not be appropriate and could be deceptive. The DEA can be thought of as a tool to measure relative performance for service providers without access to these weights.

By utilizing concepts and techniques from the economic model of the production frontier and the production possibility set, Farrell (1957) built the DEA and used them to define technical and efficient allocation, as well as to measure relative inefficiencies. For twenty years, the fundamental strategy was not frequently applied. Assuming no random errors,

Charnes, Cooper, and Rhodes (1978), also known as the CCR model, applied the linear programming model to the observational data to find the frontier, which can then be used to assess the efficiency of each production unit. This was how the DEA was originally introduced in 1978. When compared to other units operating under the same conditions, efficient units are those that generate a specific number of outputs or more, while using a specific number of inputs or the same number of inputs or fewer inputs to generate a specific number of outputs on their efficient frontier and the units that fail to qualify as such are identified as inefficient units. The DEA efficient score is determined relative to the other units being taken into account, rather than by an absolute criterion. Any unit in the study that measures efficiency has an efficiency rate of 1, which must not exceed 1 and is placed on the frontier. Inside the less-than-1 frontier is where the inefficient unit is located. The models can be used to determine ways to enhance the unit's input/output characteristics. The goal of a DEA study is to identify target input and output values for an inefficient unit, rather than just calculating the efficiency rate of the units under consideration.

The DEA model is a very efficient benchmarking method that managers may use to look into and assess their operations. Making each inefficient unit as efficient as possible can save a variety of costs and resources, as demonstrated by the DEA (best practice). The DEA data has improved the efficiency of underperforming units, resulting in decreased operating expenses, and increased profitability. The actual data used for the evaluation is used to construct the output of the DEA production equation. A given unit's DEA efficiency score is determined relative to the other units being taken into account, not by an absolute criterion.

The model (CCR) entails the assumption of the constant return to scale and later enables the evaluation of variable returns to scale and scale economies. Four different returns to scale assumptions—constant return to scale (CRS), variable return to scale (VRS), non-increasing returns to scale (NIS), and non-decreasing return to scale—are used to derive the efficient frontier (NDS). If a proportionate increase or decrease in inputs and outputs moves a unit either alone, it shows constant returns to scale. When the hypothetical unit it is compared to exhibits either constant or declining returns to scale, a unit that is not on the frontier is said to have non-increasing returns to scale (DRS).

The definition of non-decreasing returns to scale is the same. The VRS score measures pure technical efficiency (PT), whereas a unit that is efficient under the assumption of constant returns to scale is both technologically and operationally efficient. A unit that is efficient under the assumption of variable returns to scale is regarded as being technologically efficient.

This method is extensively used in both engineering and pure science to assess how well a machine performs on the number of resources it uses. Although the fundamental DEA has advanced more quickly in recent years (Lovell, 1993; Seiford, 1996), some researchers have criticized the method for being non-statistical (Simar & Wilson, 2000) and relying on data from a specific distribution rather than econometric approaches, which posit specific parametric expressions to model the frontier. The model disregards the slacks and takes into account radial inefficiency. According to Casu and Molyneux's (2003) study, this approach falls short of explaining all of the variations in the computed efficiencies, and this unaccounted-for variation combines with the regression residuals, which hurts statistical inference. It has been asserted that the method permits the estimate of confidence intervals for the efficiency measures as well as the bias of the efficiency estimators.

However, several studies utilizing DEA have examined the efficiency of various service and industrial companies, particularly in the banking sector. Several banks around the world have had their production efficiency and performance reviewed during the past few decades (Al-Tamimi, 2006; Angelidis & Lyroudi, 2006; Casu & Molyneux, 2003; Galagedera & Edirisuriya, 2004; Pasiouras, Sifodaskalakis, & Zopounidis, 2007; Saad & Moussawi, 2009; Suseno, 2008; Susuki & Sastroswito, 2011; Usman et al., 2010).

In general, bank efficiency refers to the institution's capacity to provide outputs (products and services) with a minimum amount of input (resources). The banking sector is incredibly complicated. To satisfy customers, banks must be more profitable, have bigger cash flows, and provide better prices and services. Chortareas, Girardone, and Venturi (2012) claim that the conventional DEA model has been used to assess the efficiency of the European banking sector between 2000 and 2010.

Despite their popularity and years of research, several frequently asked topics in the studies of the banking industry—what should be used to determine the relative inputs or outputs, and at what level should the bank be examined—remain unanswered. For instance, several models have come under fire for converting variables into inputs and outputs that differ in the number of variables included: some models were built with two variables, while other models proposed three variables (Cooper, Seiford, & Tone, 2006; Henriques et al., 2020). Different inputs and outputs are important to compare studies that have used similar approaches become evident. In addition, there is a mixture of different two-stage DEA models in the previous studies (Henriques et al., 2020), and the research result revealed that the two-stage model can be categorized into ten classifications. Besides the classification mentioned above, bank efficiency can also be categorized into X-efficiency measures.

In the banking services sector, there are three approaches to measure bank efficiency: through intermediation, production, and income-base or profitability. The first strategy is known as the intermediation technique. Banks typically handle intermediation tasks—such as facilitating money transfers from depositors to borrowers and managing the interest rate margin for bank performance—from the surplus units to the deficit units. Thus, the intermediation technique, which Sealey and Lindley (1977) presented, was cited and used in all works of literature on measuring banks' efficiency with DEA.

The second approach, called the production approach, was put up by Benston (1965) in 1965 and focused on banks as an organization that produced a range of financial products through transactions and provided services. The bank's mission is to satisfy the aspirations of its stakeholders, reflect its values of social responsibility, ethics, and sustainability, while providing cutting-edge and innovative banking products and services for all clients, both locally and internationally, integrating successful teams, techniques, and technology that keep up with modern advancements into their organization.

A bank was examined as a producer of profit components in a third way, known as the income-based approach, was presented by Drake, Hall, and Simper (2006) because profitability is the bank's ultimate goal. The main sources of income for banks are interest and fee income (outputs), which are produced by using inputs. The NIM (net interest margin), investment portfolio, loan portfolio quality, loan loss provision, and cost components can all be used to determine a bank's profit efficiency. These activities make up the largest groups of incomes and expenses on bank income statements, which affects the profit of the banks.

Since the DEA analysis is frequently employed in the banking sector, it is significant to note that, in the past analysis, several research publications examined various methodologies depending on the researcher's interest. The intermediation method, which analyzes the variables that affect how efficiently a bank performs its intermediate role, is the most popular one. Additionally, there are other studies on bank efficiency in various countries, including the United States, France, Germany, Spain, Japan, China, Malaysia, and Thailand. However, the number of cross-country comparisons remains very low. In a different study, Wang et al. (2014) examined the efficiency of sixteen banks in China by measuring Chinese commercial banks using two DEA models (the intermediation approach and the profitability method).

As previously mentioned, and demonstrated by the literature analysis, little research has compared different nations, particularly in the AEC region, where the majority of studies focused on individual countries' banks. The example of the abundant literature that focused on individual countries' banks includes researchers such as Sufian (2007) that examined Singapore's banking efficiency and its relation to stock returns; Tahir, Bakar and Haron (2009) explored and evaluated the efficiency of Malaysian Banks using DEA; Soetanto and Ricky (2011), for instance, investigated the efficiency of Indonesian commercial banks; Ngo and Nguyen (2012) evaluated the efficiency and productivity of Thai banks in 2007-2010; Sharma, Ow-jariyapithak, Dasri, Van Brecht and Sahakijpicharn (2021) reviewed the impact of corporate governance on firm efficiency by analyzing Thai banking companies; Tanwar, Seth, Vaish and Rao (2020) analyzed the efficiency of the Indian banking sector, using the DEA to conduct the analysis of comparative models. After searching in Google Scholar, there are research studies across Asian countries that utilize the DEA technique for analyzing bank efficiency (Thoraneenitiyan, & Avkiran, 2009; Wahyudi, 2018; Sarifuddin, Ismail, & Kumaran, 2015; Chowdhury & Haron, 2021; Banna et al., 2019). The majority of the publications described the bank's efficiency following the financial crisis between 1997 and 2004. Being that these studies focused on the past, it is important to use, examine, and compare bank efficiency with recent data. Furthermore, there are rare papers that explored bank efficiency for AEC integration (Nailah & Rusydiana, 2020; Syadullah, 2018; Vora-Sittha, 2016).

The methodological claim states that comparative studies also evaluate the determinants of bank efficiency by using some statistical techniques to analyze the influence of various country-specific and environmental factors on bank efficiency, for example- Tobit regression analysis (Casu & Molyneux, 2003), the Panel regression analysis (Sufian & Majid, 2007), and the Malmquist index technique of productivity changes (Ngo & Nguyen, 2012). This paper examines whether the AEC banking system's productivity efficiency has increased to handle the emergence of a single market by using the DEA to estimate productivity. It also posits the competitiveness scores of 15 banks for the period between 2017 to 2019 by plotting the DEA scores along with the categorial axis X and Y to show its position. It may provide a more accurate depiction of bank strength.

In general, different models' inputs and outputs differ (Henriques et al., 2020; Holod & Lewis, 2011). Input amounts have frequently been chosen as the main deciding factors in investigations. In the explicit specification and measurement of banks' inputs and outputs, there is no ideal option (Berger & Humphrey, 1997). The literature review states that the DEA has been used to assess cost, technical, and profit efficiency. Intermediation, production, and income-based approaches are the three methods used to gauge bank performance. It is worth

highlighting that this study combines all three approaches; according to Henriques, Sobeiro, Kimura, and Mariano's (2020) paper, it is the research gap in the literature.

Methodology

Sample Size

The Global Competitiveness Publication, a yearly report released by the World Economic Forum, was used to choose the Country Sample. According to the studies, the member nations of the AEC rose in rank from 2017 to 2019 in the following order: Singapore, Malaysia, Thailand, Indonesia, Philippines, Brunei, Vietnam, Cambodia, and Laos (no data available for Myanmar). Out of a group of ten members, Indonesia, Malaysia, Singapore, and Thailand were chosen as four members. This is because its competitiveness is higher than that of other remaining member states. The ranking result was shown accordingly: (World Economic Report, 2017-2019)

Table 1 Competitiveness Ranking of ASEAN Member States.

Country	2017	2018	2019
Indonesia	36	45	50
Malaysia	23	25	27
Singapore	3	2	1
Thailand	32	38	40
Philippines	56	56	64
Vietnam	55	77	67
Brunei	na	56	56
Cambodia	94	110	106
Lao, PRD	137	112	113
Myanmar	na	na	na

The top five banks in each nation (apart from Singapore, which only has three local banks) were then chosen for analysis because their websites offered easy access and reasonable prices for downloading their financial statements. As a result, the financial statements of 18 banks were examined between 2017 and 2019 by using the non-parametric DEA approach to determine whether efficiency levels had increased and converged. Indonesia, Malaysia, Singapore, and Thailand are the four related nations in the AEC region, as was described in the preceding section. Table 2 contains the 18 observed statistics, which represent the top banks by nation.

Table 2 Observation Banks and Data.

Country	Bank	Abbreviation
1. Indonesia	1. Bank Mandiri	PTM
	2. Bank Rakyat Indonesia	PTR
	3. Bank Central Asia	BCA
	4. Bank Danamon Indonesia	PTD
	5. Bank Tabungan Negara	BTN
2. Malaysia	1. Maybank	MAY
	2. CIMB Bank Berhad	CIMB
	3. Public Bank Berhad	PUB
	4. Hong Leong Bank Berhad	HBL
	5. Bank Simpanan Nasional	BSN
3. Singapore	1. Overseas Chinese Banking Corporation	OCBC
	2. DBS Bank Limited	DBS
	3. United Overseas Bank	UOB
4. Thailand	1. Bangkok Bank	BBL
	2. Siam Commercial Bank	SCB
	3. Krung Thai Bank	KTB
	4. Kasikorn Bank	KB
	5. The Government Savings Bank	GSB

The information was gathered from the financial statements of their banks, which were obtained during the course of the consecutive years from 2017 to 2019 and included a total of 54 observations. There are three DEA ways for assessing efficiency scores, as was stated in the previous sections. To address the research issue, this study compared the DEA ratings by using all available techniques.

DEA Methodology

Table 3 Three Approaches to Banks Efficiency.

Approach	Input	Output
1. Intermediation (Sealey & Lindley, 1977)	Personnel Expense Equity Deposits	Loans Investments
2. Production (Benston, 1965)	Personnel Expense Equity Total Expense	Deposit Loans
3. Income-based (Berger & Mester, 2003; Drake et al., 2006; Leightner & Lovell, 1988)	Personnel Expense Operating Expenses Loan Loss Provision	Net Interest Income Non-Interest Income

To study and compare the efficiency of each observed decision-making unit, the financial statements of sample banks were looked at and the pertinent information was retrieved. Table 3 examined the input, output, and efficiency variables for the banks. A variable's component served as a single theory-designated strategy.

The intermediation concept views banks as financial intermediaries that generate loans and investments using staff costs, equity, and deposits. Output measurements include the value of loans and investments. In terms of the production approach, banks are seen as financial productions that use resources like human costs, equity, and overall costs to generate a variety of deposits and loans. Finally, under the income-based technique, banks operate as financial entities that generate money for their investors through interest and fee-based income by using a variety of resources, such as operational costs, personnel costs, and loan loss reserves. Upon conducting the research on the organizational efficiency and financial sustainability of banks, the first two methods are used. The last technique is utilized to assess the cost efficiency that brings in revenue for the bank.

The DEA software version 2.1 is used to explore the performance scores using three different methods. The information was taken from the non-consolidated income statement and balance sheet data for the years 2017 through 2019. All data was converted to US dollars at the rates in effect on December 31 of each year, with US dollars serving as the reference currency. The size of the assets varies considerably from one to another. Since national barriers are thinning and they must complete their balance sheets by worldwide accounting standards, it is claimed that there is no prejudice resulting from various accounting procedures.

Results

The First Stage:

The outcomes of the DEA efficiency study about the AEC common border are presented in this section. By combining the data set for the banks in each of the four nations included in the observation, scores are calculated using various methodologies. These findings make it possible to compare any nation's banks to the same benchmark. The efficient scores for the entire test are shown in Table 4.

Table 4 The Efficient Scores.

BANK	Intermediation			Production			Income-based		
	2017	2018	2019	2017	2018	2019	2017	2018	2019
MALAYSIA									
BSN	1.000	1.000	1.000	0.701	0.777	0.959	0.489	0.513	0.918
CIMB	0.686	0.704	0.740	0.593	0.67	0.922	0.890	0.852	1.000
HLB	1.000	1.000	1.000	1.000	1.000	1.000	0.763	0.740	1.000
MAY	1.000	0.908	1.000	0.809	0.752	0.769	0.930	0.984	1.000
PUB	1.000	1.000	1.000	0.923	1.000	1.000	1.000	1.000	1.000
INDONESIA									
BCA	0.743	0.758	0.737	0.513	0.578	0.679	1.000	1.000	1.000
BTN	0.474	0.492	0.475	0.391	0.472	0.527	0.986	1.000	1.000
PTD	0.415	0.411	0.408	0.297	0.342	0.342	0.982	0.975	0.872
PTM	1.000	1.000	1.000	1.000	1.000	1.000	0.778	0.756	0.967
PTR	0.674	0.706	0.660	0.419	0.454	0.431	0.970	0.976	0.940
SINGAPORE									
DBS	0.882	0.894	0.869	0.523	0.618	0.618	0.705	0.698	0.841
OCBC	0.808	0.844	0.799	0.475	0.531	0.559	0.810	0.825	0.880
UOB	0.800	0.813	0.827	0.544	0.617	0.617	0.900	0.916	1.000
THAILAND									
KBAN									
K	0.814	0.878	0.952	0.655	0.685	0.728	0.873	0.864	1.000
KTB	0.980	0.961	0.877	0.885	0.789	0.800	0.755	0.753	0.843
SCB	0.939	1.000	1.000	0.608	0.727	0.727	0.931	1.000	0.990
GSB	1.000	1.000	1.000	1.000	1.000	1.000	0.650	0.649	0.748
BBL	0.913	1.000	0.960	0.512	0.582	0.588	0.881	0.888	0.874

Overall, the findings indicate a fairly high average efficiency rating. Most Malaysian banks exhibit superior performance as an intermediation function in the "Intermediation" column, where they also received the best overall efficiency score (1). BSN, HLB, and PUB have demonstrated efficiency in the study's intermediation components over the course of several years. The DEA score of PTM, an Indonesian bank, is 1, making it the most efficient bank in the intermediary role. Additionally, the best efficient score (1) in this dimension was displayed by the GSB-savings bank of Thailand.

Three banks—the Malaysian HLB, the Indonesian PTM, and the Thai GSB—achieved a production technique, an efficient score of 1 over three years, according to DEA scores. Meanwhile, in the years 2018 and 2019, HUB achieved an efficient score.

The income-based strategy was the third efficiency frontier. Only two banks, PUB and BCA, were located in Malaysia. During the study period, BCA consistently displayed the highest efficiency score (1). BTN from Indonesia received the highest rating from 2018 to 2019. In contrast, CIMB, HLB, and MAY from Malaysia, along with UOB from Singapore, had achieved the highest rating for efficiency in 2019.

It can be concluded that Malaysian banks are capable of serving the AEC region's international financial sector and have been operating efficiently. Only GSB in Thailand can consistently achieve both intermediation and production frontiers, but it does so at a substantially lower level than other members when using the income-based strategy. Surprisingly, none of the Thai commercial banks achieved these three efficiency thresholds.

Similar to GSB in Thailand, PTM in Indonesia ran across two efficiency frontiers and was unable to cross the profitability frontier. Throughout the study period, BCA performs best in the income-based approach. Additionally, throughout 2018–2019, BTN was able to pay for the income-based approach.

Surprisingly, in Singapore, no other Singaporean bank but UOB was able to reach an efficient frontier within a string of years in 2019. UOB was in the income-based frontier.

Figure 1-3 compared the efficiency score of 18 banks from 2017 to 2019.

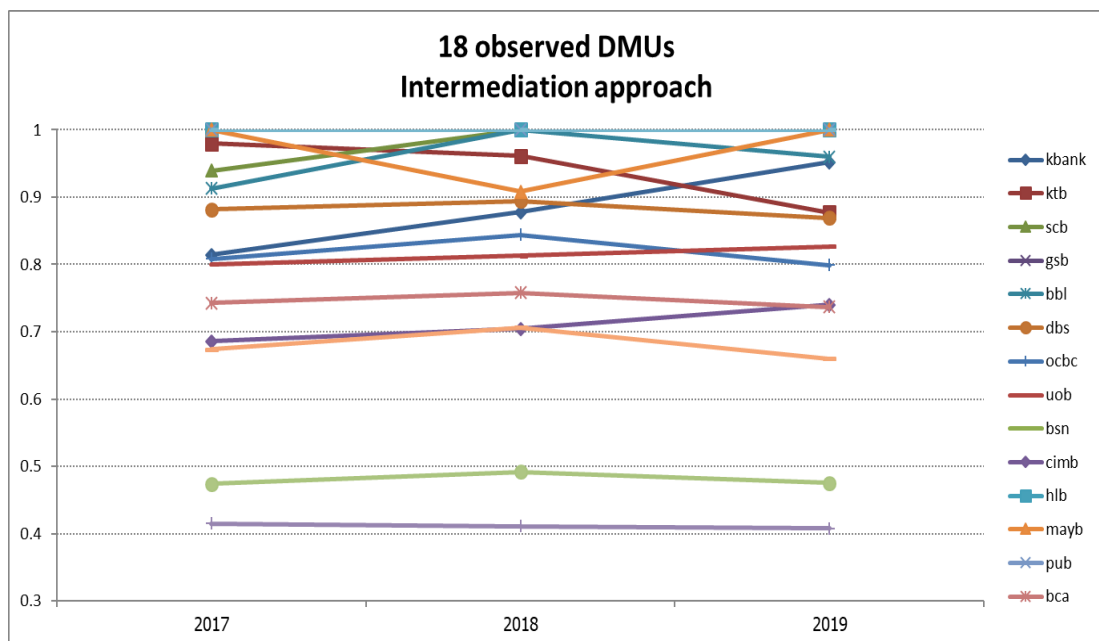


Figure 1 DEA Results - the Intermediation Frontier.

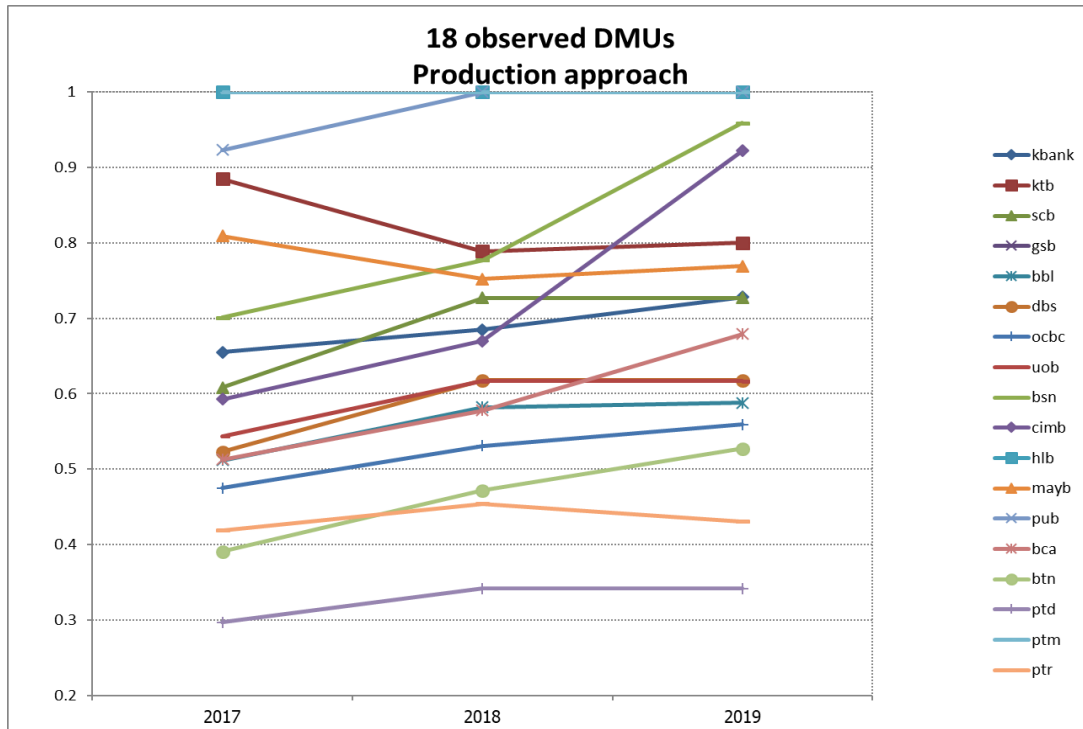


Figure 2 DEA Results - the Production Frontier.

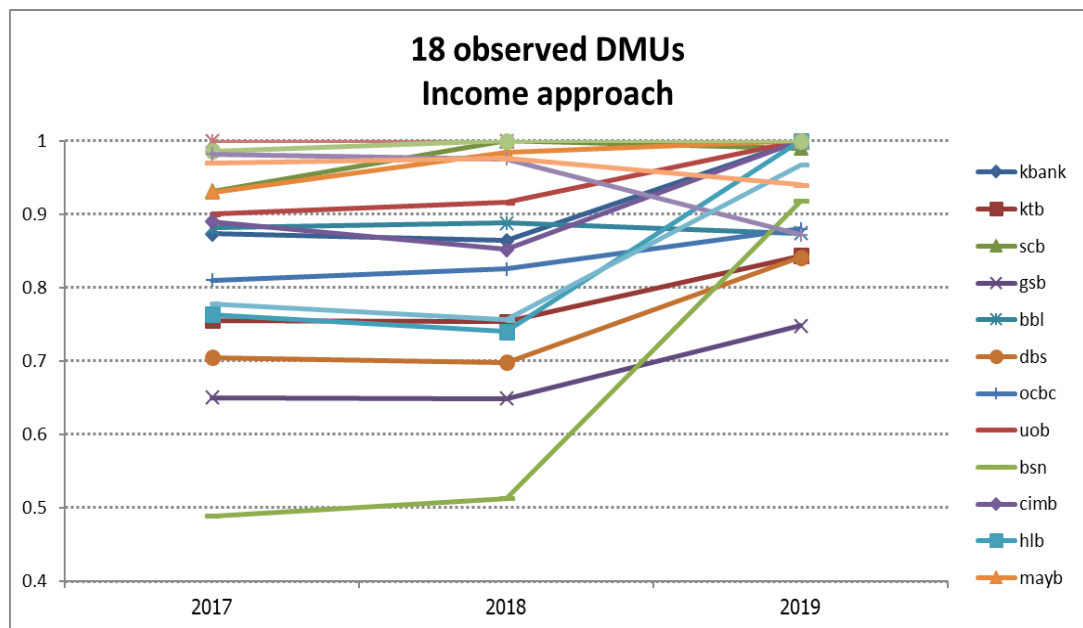


Figure 3 DEA Results - the Income-based Frontier.

The outcomes of decomposition based on the intermediation technique are shown by the nation in Figure 4-7.

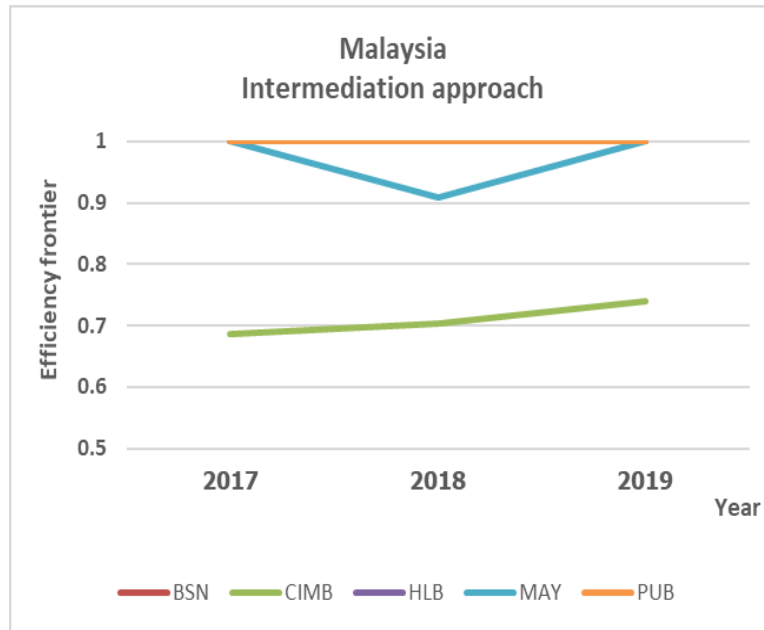


Figure 4 Intermediation – Malaysia.

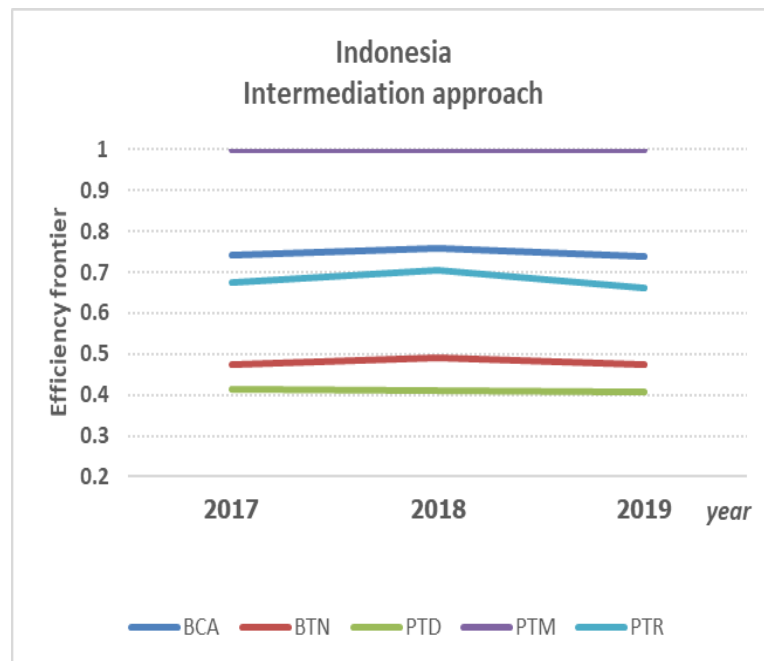


Figure 5 Intermediation – Indonesia.

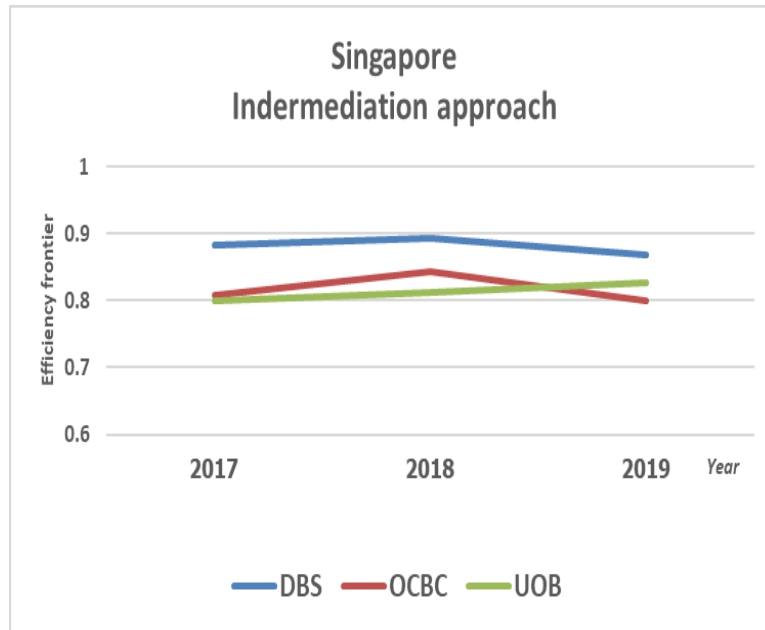


Figure 6 Intermediation – Singapore.

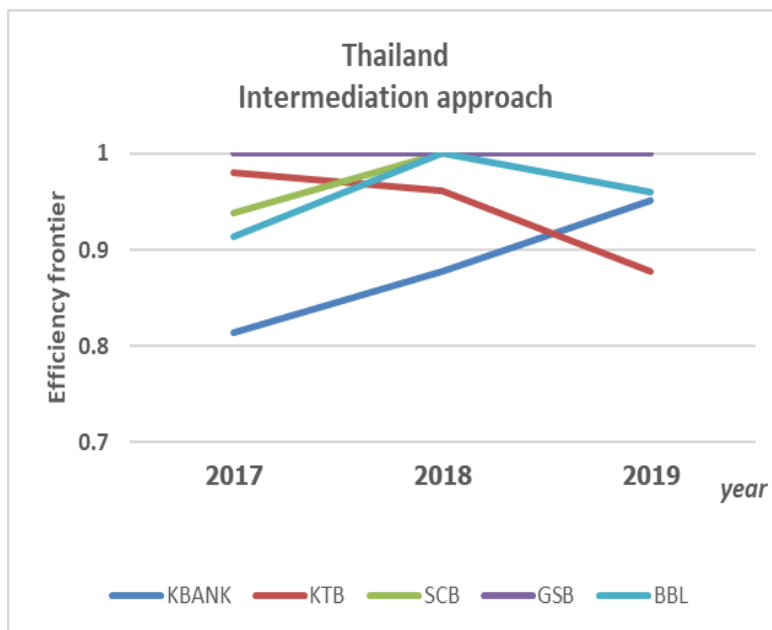


Figure 7 Intermediation – Thailand.

The findings of decomposition based on country-specific manufacturing methods are shown in Figure 8-11.

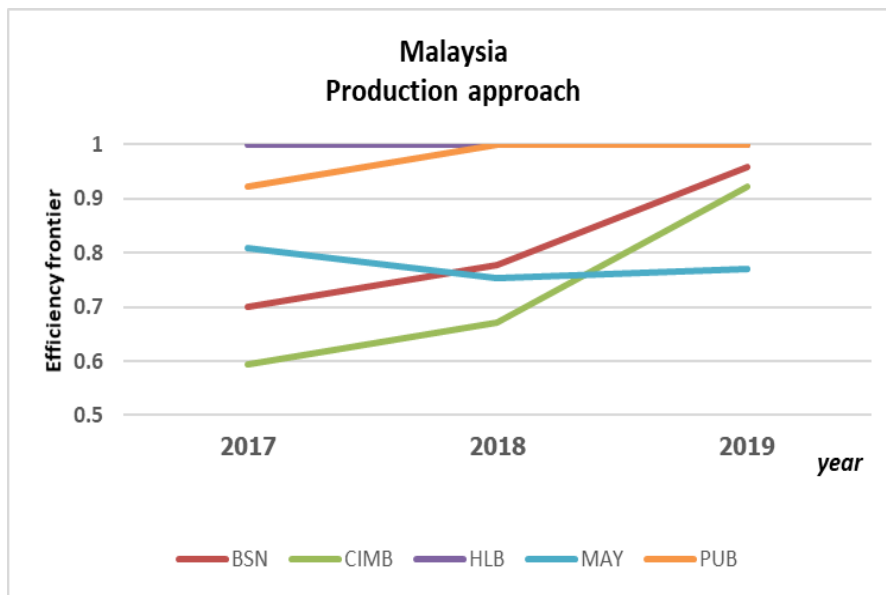


Figure 8 Malaysia – Production.

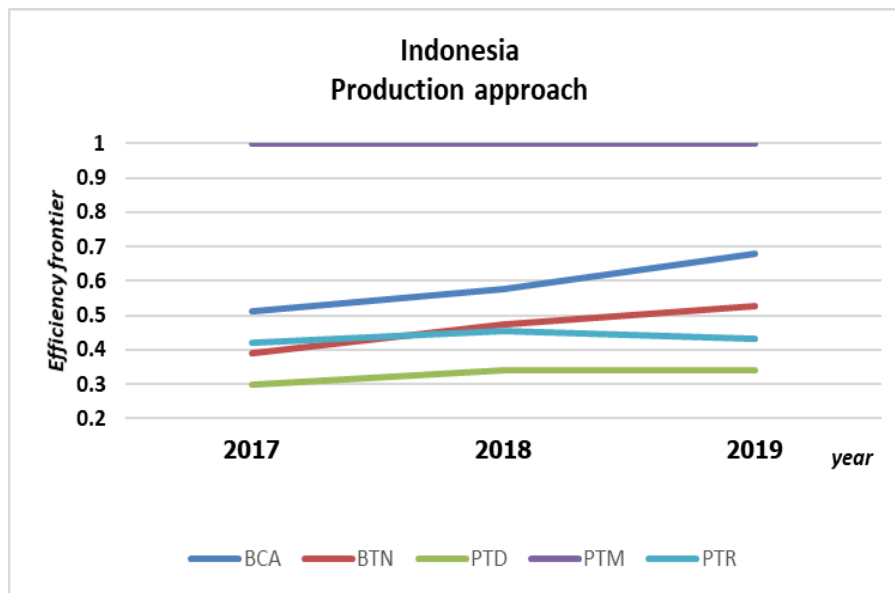


Figure 9 Indonesia – Production.

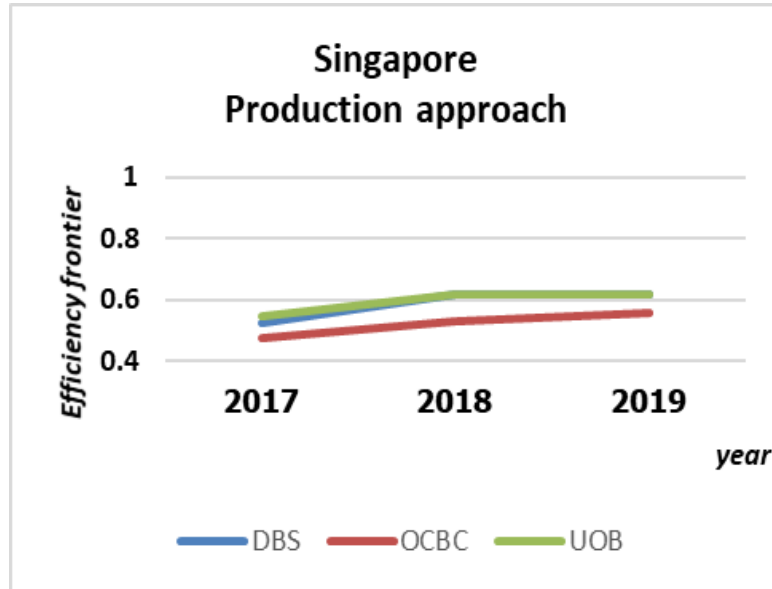


Figure 10 Singapore – Production.

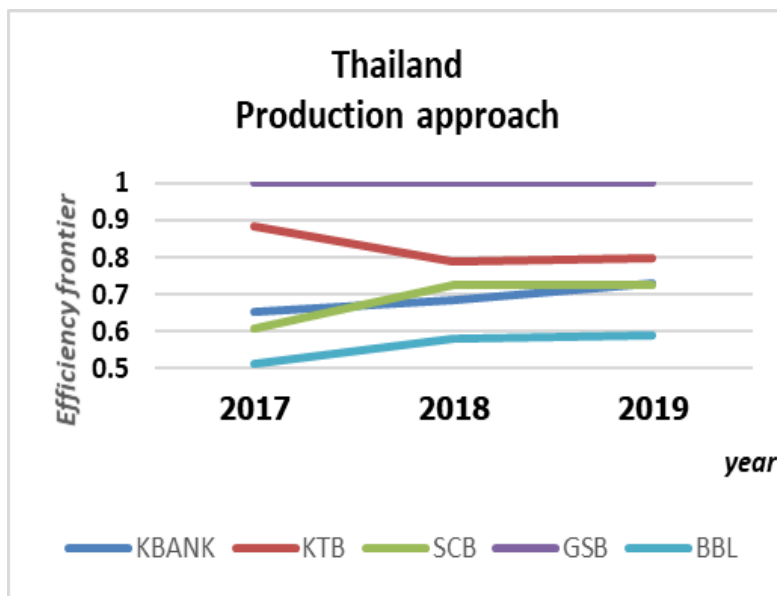


Figure 11 Thailand – Production.

The outcomes of decomposition using the income-based approach are shown for each country in Figure 12-15.

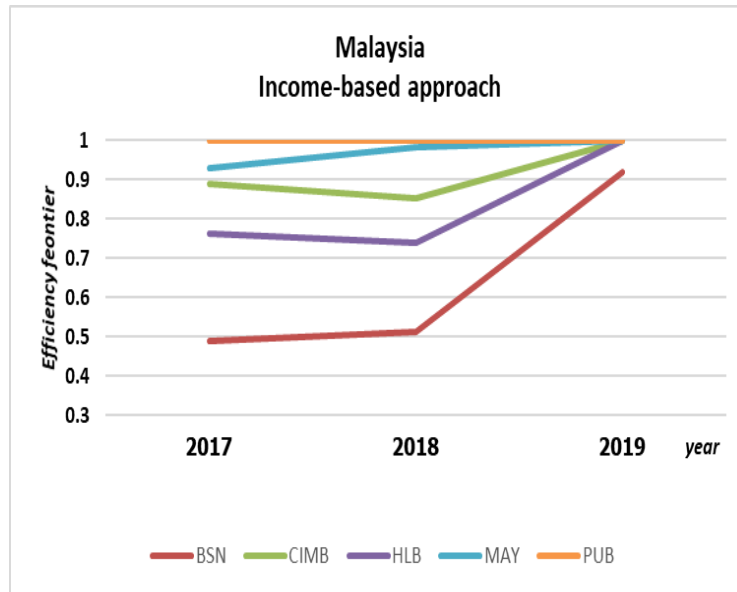


Figure 12 Malaysia - Income-based.

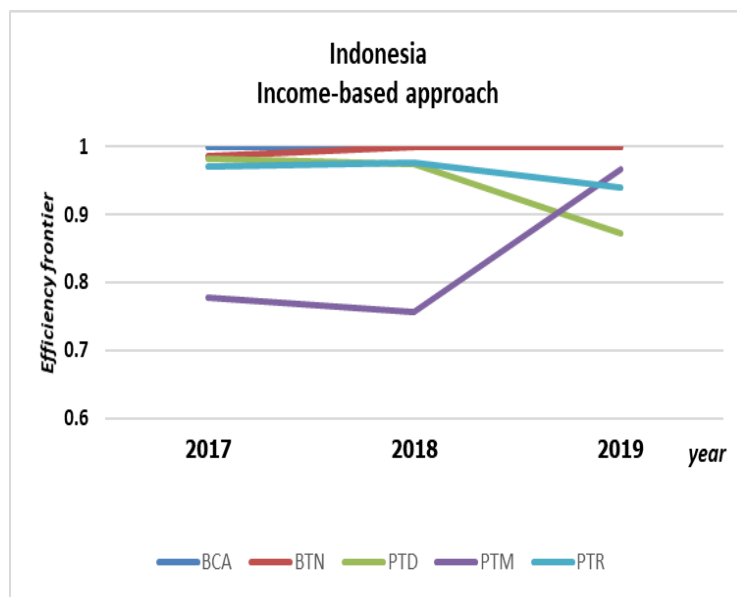


Figure 13 Indonesia - Income-based.

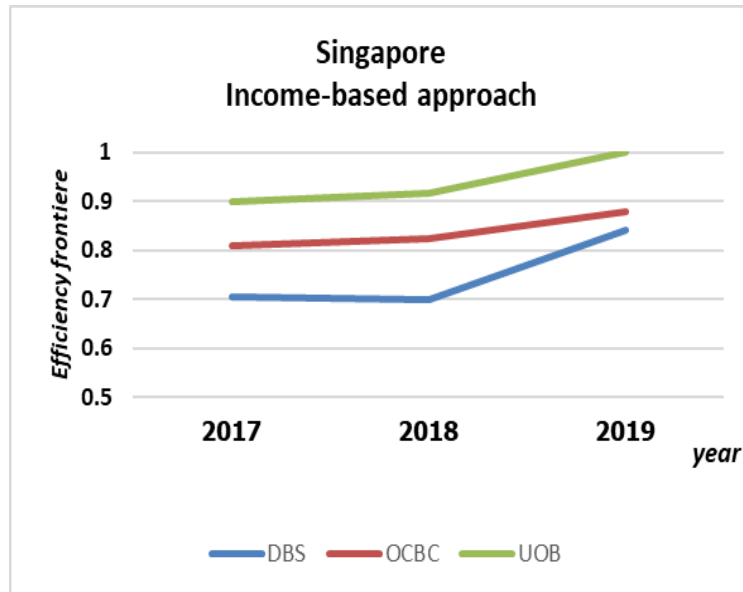


Figure 14 Singapore - Income-based.

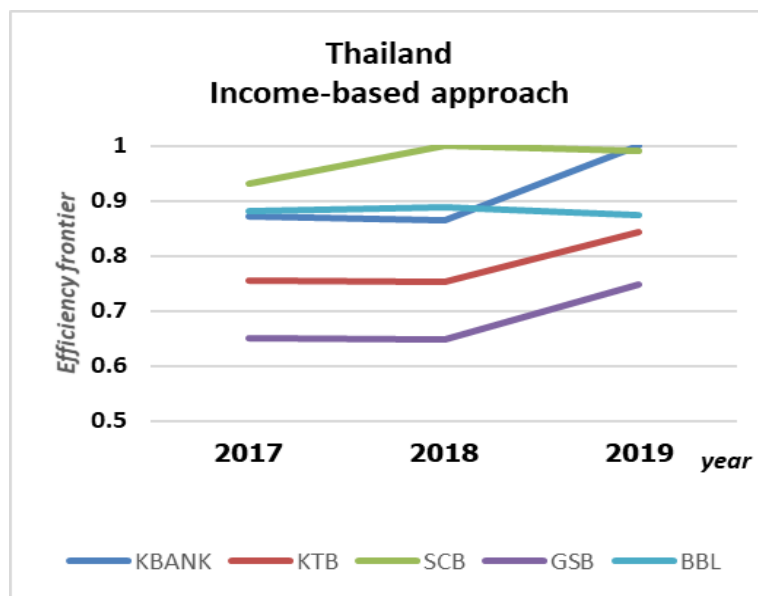


Figure 15 Thailand - Income-based.

The Second Stage

Defining the bank's competitive variable and determining the distinctive value were the preliminary steps of the second stage. Profitability is the primary objective of the most efficient competitive framework for evaluating bank robustness, hence it was recommended as the X-axis. The Y-axis shows intermediate and production scores. This is illustrated in the two charts below.

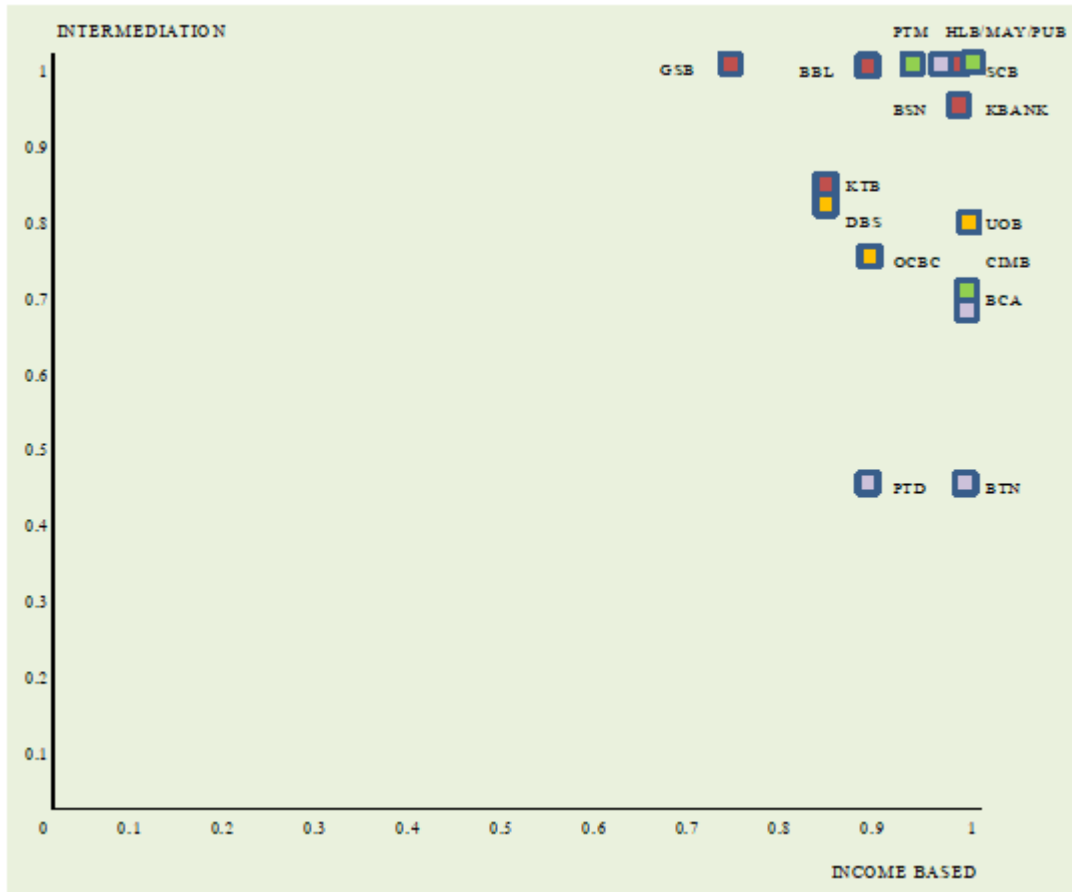


Figure 16 Competitiveness Position Model 1 (Income-based and Intermediation).

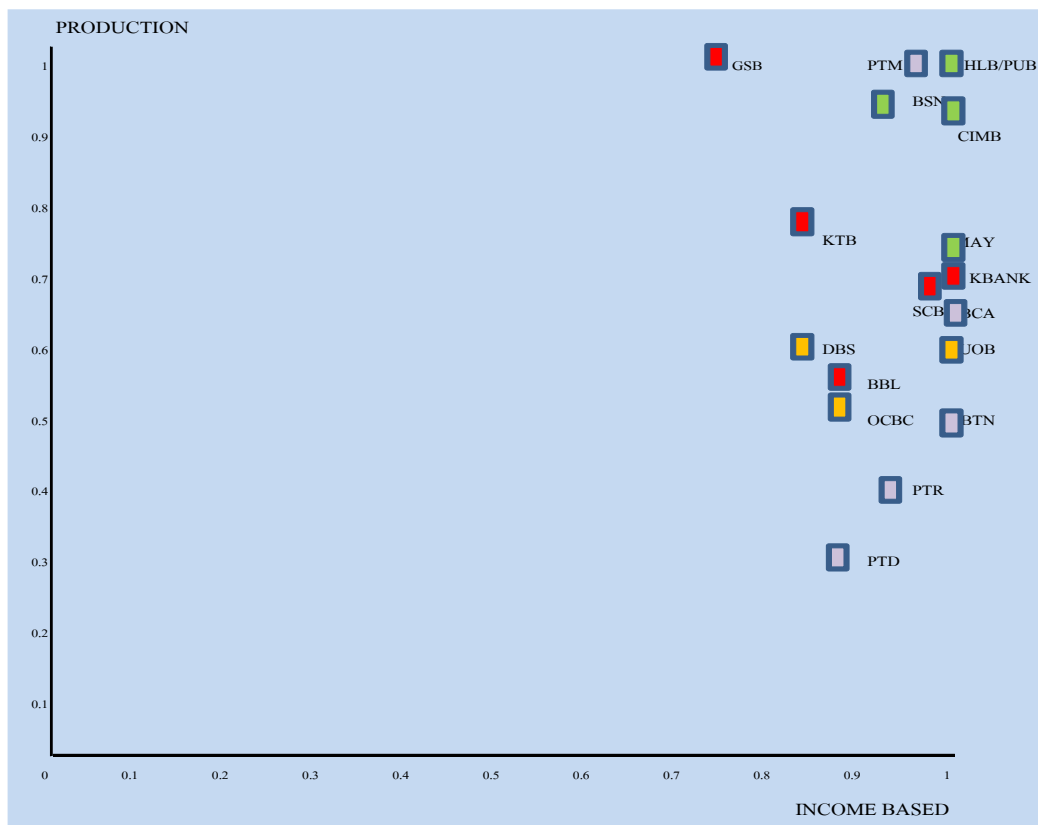


Figure 17 Competitiveness Position Model 2 (Income-based and Production).

The first chart (Figure 16) used an income-based score on the X-axis and an intermediation score on the Y-axis. The second chart (Figure 17) used an income-based score on the X-axis and a production score on the Y-axis. Two graphs displaying the efficiency scores for 2019 were presented. The observed samples' efficient scores were plotted into two images. Revenue remains a crucial success factor for the sustainability of a business. Without profitability, no company unit can survive for very long; as a result, the income-based score was represented in two graphs. The comparative competitiveness portrait is displayed in Figures 16-17.

Conclusion

In conclusion, the rankings show that Malaysian banks performed well during the examined time when compared to three different frontier approaches. The names CIMB, HLB, MAY, and PUB are arranged on a grid of 1-1 in the two graphs. The results of several different approaches demonstrate that Malaysia has a stronger banking system than other countries in the AEC region.

According to the literature review, the Malaysian government attempted to push for bank mergers. As a result of the bank merger policy's implementation, the level of bank efficiency has grown (Ab-Rahim, Nd-Nor, & Ramlee, 2012). In theory, the government policy also intends to strengthen banks so they can compete effectively through innovation.

The Malaysian central bank has also consistently promoted and maintained monetary and financial stability. By maintaining the soundness of financial institutions and the resilience of the financial infrastructure to withstand adverse economic cycles and shocks, the Malaysian central bank hopes to prevent significant disruptions to the intermediation process, and maintain public confidence in the financial system after the Asian financial crisis, with the Bank Negara Malaysia releasing itself from the responsibility of supporting a reliable and efficient financial system in Malaysia. This is generally accomplished through the regulations and supervision imposed by authorized financial institutions, preserving the dependability of important payment and settlement systems, and actively promoting the development of efficient fiscal markets.

Most AEC banks are considered to have additional room to increase their competitiveness in light of the DEA results based on their efficiency rankings. More competition is being driven by several causes, including raising the equity capital ratio to improve credit quality and asset management efficiency. When trying to increase competition in the banking industry, authorities should consider financial infrastructure and public policy tools rather than concentrating on a single factor (Claessens, 2009).

However, this empirical study is the first to provide a fundamental analysis of the banking sectors in the AEC region. The results should be taken into consideration carefully due to several limitations. This research did not go into further detail to pinpoint critical factors influencing bank efficiency. Additionally, several national factors are taken out due to the assumption that there are no country-specific obstacles. Now, longer-term bank monitoring is required for future studies. Future studies may include longer sampling periods to ensure that the results for the determinant of bank efficiency are more accurate and reliable. Future research on bank efficiency is advised to look at technical efficiency, scale efficiency, and allocative efficiency. Financial institutions may also be a part of future research.

According to the DEA score, foreign corporations are the top achievers. Given the recent statement for regional integration in the financial sectors, Thai banks should aim to compete not only in the domestic market, but also in the regional and global banking markets. The findings indicate that more foreign banks are classified in the most efficient group than Thai banks, which are positioned in the less efficient category. The government and domestic bank management should continue to work together in this area to maximize the utilization of existing available resources.

The study's conclusions have significant policy implications. As a result of the move to liberalize the banking industry, more foreign banks entered the local banking market, rather than Thai banks growing abroad. The presence of more foreign banks in the market is likely to promote banking competition, diversify the financial services industry, and support Thailand's economic growth. To increase the banking sector's competitiveness, policies must be modified to ensure diversity and the ability to function effectively on a global frontier. In other words, Thai banks should strive to compete against their foreign bank rivals both inside and outside of their own country. They should be allowed to do so and have access to international banking markets.

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