The efficiency of Malaysian Islamic banks: Intermediation, production and operating approach

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Abstract

The Malaysian Islamic banking industry holds one of the top three market shares for global Islamic banking assets. Apparently, a dual banking system involving conventional and full-fledged Islamic banks are currently operating in Malaysia. The main objective of this study is to evaluate and compare the efficiency of conventional-owned Islamic banks and full-fledged Islamic banks using three banking approaches. To achieve this objective, information from the annual reports of 15 Islamic banks were utilised from 2011 to 2018. The findings provided mixed evidence subject to the different approaches of DEA methodology. Full-fledged Islamic banks outperformed conventional-owned Islamic banks in the intermediation approach, while conventional-owned Islamic banks outperformed in the production and operating approaches. The findings provide inputs for banks to increase their competency at the managerial level and for policymakers to sustain the growth momentum of the industry.

Introduction

The banking sector, as part of financial institutions (FI), plays an important role in financial development through its financial activities- collecting deposits from surplus and providing funds to the deficit (Chowdhury & Haron, 2021; Karim & Chowdhury, 2021). Concurrently, Islamic banking and finance (IBF) are exhibiting continuous growth globally, recording a double-digit growth (14%) from 2019 to 2020, with $2.88 trillion in total assets globally, out of which Islamic banking constitutes 69% ($1.99 trillion) of the total asset (ICD-Refinitiv, 2020). Islamic Finance Development Indicator (IFDI) (2020) has projected $2.44 trillion in global Islamic banking assets by 2024. Malaysia was ranked top in the IFDI market list and held the third position in global Islamic banking assets in 2019 (ICD-Refinitiv, 2020). Based on the IFDI (2020) report, the Islamic finance market will continue to grow, led by countries such as Malaysia, Indonesia and the GCC countries.

Malaysia, like any other Muslim country, with the exception of Iran and Somalia, operates a dual banking system (Nugrohowati et al., 2020), i.e., Islamic and conventional (Ahmad & Prentice, 2019). In relation to Islamic banks (IBs), the Organization of Islamic Countries (OIC) established an Islamic bank in 1974, the Islamic Development Bank (IDB) (Cerovic et al., 2017) with the objective to stimulate the economic growth of Islamic countries by supporting Shariah-compliant funds (Cerovic et al., 2017). Nevertheless, the consolidation between the conventional and Islamic banking sectors in the OIC faced new challenges following the Covid-19 pandemic (ICD-Refinitiv, 2020). Simultaneously, the banks face dwindling lending demand, increasing non-performing loans, and lesser profit margins (ICD-Refinitiv, 2020).

Malaysia began their Islamic banking sector with the establishment of Bank Islam (BIMB) in 1983 (Ariff, 2017). In 1993, Bank Negara (central bank) granted conventional banks to operate Islamic banking windows to offer interest-free banking facilities (Ariff, 2017). Presently, both locally owned and foreign-owned IBs in Malaysia carry out banking activities according to parallel

rules and regulations covering operation, products and services, and promotions (Ariff, 2017; Chowdhury, Al Masud et al., 2020). Thus, banks being the intermediaries, the efficiency of the banking sector is imperative to the economic performance of a country, hence the efficiency of IBs (Azad et al., 2017).

The main purpose of this study is to evaluate the Malaysian IBs' efficiency due to several reasons; first, the strong growth of Islamic banking assets experienced over the years; second, the mechanisms of both conventional and Islamic banking differ with regard to the products and services; third, IBs are less productive than conventional banks because of restrictions on operations and business levied on IBs (see, e.g., Ahmad and Prentice, 2019), and finally, many past studies analysed banking efficiency only by certain approach despite banking efficiency should be analysed by various approaches (intermediary, production and operating/profit-oriented), for conclusive findings. Furthermore, there is a scarcity of efficiency studies on Malaysian IBs comparing the full-fledged and conventional-owned IBs as well as between local and foreign-owned IBs using the three approaches.

The evidence provided by the current study is important for all stakeholders of IBF. Specifically, IB managers enable to identify their strengths and weaknesses at the operational level, hence helping them to improve their strategic plan to enhance productivity, profitability and market share. Policymakers may use the findings to provide adequate regulations and directions toward growing the assets of Islamic banking. Lastly, the results of this study contribute to the IBs' present literature precisely by shedding light on the mechanism of Islamic principles on the performance of IBs. This study is structured as follows, a review of literature on banking theories, efficiency, Malaysian IBs' efficiency, data and methodology, results, discussion, and conclusion.

Literature Review

Theoretical background

Werner (2014) stated that there are three typical banking theories observed in the banking literature - credit creation, the financial reserve, and the intermediation theory. The credit creation model enlightens the role of money creation in loans disbursement and accounting operations; the financial reserve theory explains how the banking system creates money collectively, whereas in the financial intermediation theory, banks being the intermediaries, function as a medium to collect deposits and lend out those deposits to benefit from the interest spread (Ravn, 2019; Werner, 2016).

Banks' Efficiency and DEA

Sherman and Zhu (2006) reported that the productivity of the banking industry is mainly measured by its effectiveness and efficiency. Effectiveness refers to the ability of a bank to achieve its objectives, while efficiency indicates how well a bank utilises its input (I) for output (O).

Generally, efficiency is described by the ratio of O over input I, with a higher (O) over the unit of (I) representing a better efficiency (Cooper et al., 2007), while optimum efficiency represents maximum (O) per unit of (I) (Sherman and Zhu, 2006). Idiosyncratically, efficiency signifies the relative performance of DMUs (decision-making units) (Azad et al., 2017). Further, the efficiency measurement assists bank managers to measure banks' performance, hence improving what they are lacking (Mostafa, 2007). Sherman and Zhu (2006) stated banks' inefficiency is contributed by factors such as management's incapacity, technical, socio-economical and managerial issues. Most importantly, efficiency assessment points out the strength and weaknesses of the resource allocation of the banks. Concurrently, banking efficiency has been commonly, extensively and broadly studied for the last few spans.

With regards to efficiency, Sherman and Zhu (2006) divided efficiency into four segments, i.e., technical efficiency (TE) - measures the capability of the financial institution to produce actual (O) given its limited resources, price efficiency - the enhancement of efficiency using cheaper (I), scale efficiency - an optimal production level to be achieved, and allocative efficiency - measures the optimal mixture of diverse (I) to produce (O). Further, Cooper et al. (2007) explained technical

efficiency indicates a firm's capability to maximise (O) given (I); or minimising (I) given equal (O); while allocative efficiency suggests the ideal process of (O) and (I)at a certain price. Othman et al. (2016) stated efficiency could also be referred to as X-efficiency, i.e., computing a firm's (O) by means of suitable (I).

Literature documented two types of efficiency measurement approaches: non-parametric and parametric (Alam et al., 2021; Berger & DeYoung, 1997), with TE the commonly used measurement for the banking sector. Within the non-parametric approach, DEA, which is an efficiency frontier technique, is broadly used to measure banking performance (Alam et al., 2021). For instance, DEA was applied to examine the efficiency of British commercial banks (Ouenniche & Carrales, 2018), banks in the USA (Kwon and Lee, 2015), and worldwide banking efficiency (Ahmad & Prentice, 2019; An et al., 2019; Banya & Biekpe, 2018; Chowdhury et al., 2020; Chowdhury & Haron, 2021; Henriques et al., 2018; Kamarudin et al., 2019; Tamatam et al., 2019).

Malaysian Islamic Banks' Efficiency

Despite the growth of global IBs' assets, prior studies were mostly focused on the efficiency of conventional banks (Wanke et al., 2016), with little focus given to IBs in Malaysia (Sufian et al., 2014). Samad (1999) was the first who evaluated the efficiency performance between conventional windows and full-fledged IBs and found full-fledged IBs were less efficient than conventional Islamic windows in terms of managerial efficiency between 1992-1996. Similarly, Abdul-Majid et al. (2011) found a high productivity level among the full-fledged IBs but lower compared to conventional windows in the period 1996-2002. Meanwhile, Salami and Adeyemi (2015) reported lower efficiency for full-fledged IBs that transformed from conventional windows.

Tahir et al. (2009) discovered that the commercial banks in Malaysia recorded higher TE from 2000 to 2006. They also reported that the local banks were less efficient in cost management and operating at the incorrect scale compared to foreign-owned banks. Consequently, San et al. (2011), Azad et al. (2017), and Kamarudin et al. (2019) argued that foreign-owned IBs were more efficient compared to locally-owned IBs. Basri et al. (2018) nonetheless conveyed that locally-owned IBs had higher efficiency compared to foreign-owned IBs between 2005-2014. Likewise, Wanke et al. (2016) depicted a lower efficiency level for foreign-owned IBs than locally-owned IBs. They cited cultural and regulatory barriers imposed on foreign banks as the contributing factor to the inefficiency.

The above discussions hence provided sufficient evidence on the need for further research on the Malaysian Islamic banking industry. Furthermore, Islamic banking in Malaysia is a standalone and independent entity that needs to be evaluated for its efficiency without having to compare with conventional banks due to the different modus operandi and business principles. Moreover, prior findings formed a significant gap among IBs' efficiency levels in Malaysia. Having said that, this study intends to lay out empirical evidence to fill the gaps in the literature on efficiency related to Malaysian IBs.

Research Methods

This study examines the efficiency of Malaysian IBs utilising the Data Envelopment Analysis (DEA) methodology for the period 2011-2018 based on production, intermediation, and operating approaches. The following scores, i.e., technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE), are to be generated using the methodology.

DEA was firstly introduced by Farrell (1957) and later developed by Charnes et al. (1978). Production theory is the basis of this technique that exhibits the single (I and O) in terms of ratio (O/work hour) (Cooper et al., 2007; Sherman & Zhu, 2006). The DEA measures the efficiency level by employing multiple (O and I) (Cooper et al., 2007) for decision-making units (DMUs) (Klimberg et al., 2009) as well as several (I and O) in multiple DMUs (Sherman & Zhu, 2006). Two mechanisms of DEA are found in the banking efficiency literature, i.e., CRS as CCR implies a single set of efficiency scores (TE) for DMU in each period, and VRS as BCC signifies the level and

source of inefficiency by disintegrating the TE (Othman et al., 2016). The current study employed both models (CCR and VRS) to assess the efficiency of IBs.

Two types of CCR models were used in the literature; namely, output-oriented aims to maximise (O) by utilising exact (I), while the input-oriented, concentrates on lowering (I) to produce exact (O) (Cooper et al., 2007; Ramanathan, 2007). K DMUs set and every DMUk produces n dissimilar (O) by means of dissimilar (I) that are signified as x_{ik} (I) and y_{rk} (O). Computation of linear programming of CCR-output-oriented model presented as follows;

$$Max \sum_{r=1}^{n} u_{rk} \, y_{rk}$$

$$Such \sum_{i=1}^{m} v_{ik} \, x_{ik} = 1;$$

$$\sum_{r=1}^{n} u_{rk} y_{rk} - \sum_{i=1}^{m} v_{ik} x_{ik} \leq 0; \; K = 1,2,\dots,K$$

$$u_{rk} v_{ik} \geq 0; r = 1,2,\dots,A; \; i = 1,2,..B \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(Model 1)}$$

Model 1 presents the ratio of the weighted sum of (O) to the weighted sum of (I), with the variables' weights optimum values u_r and v_i to be programmed based on the CCR model. In other words, the maximum ratio of the weighted sum of (O) to the weighted sum of (I) is the most efficient DMU (DMUE). DEA identifies the DMUEs and sets them on the efficient frontier line. Refer to the following for further details on DEA (Cooper et al., 2007; Klimberg et al., 2009; Sherman & Zhu, 2006).

VRS Model

The CRS model was extended by Banker et al. (1984), named DEA VRS (Othman et al., 2016). Albeit, VRS is moderately parallel to the CRS model, while it halts the calculation to assess (O) deficits and (I) extravagances (Ji & Lee, 2012). The VRS method was adopted to posit the reason for inefficiencies for IBs throughout the study period. Two measurement indicators, pure technical efficiency (PTE), highlights the management competency and scale efficiency (SE), which demonstrates the potential utilisation of resources (Basri et al., 2018). The VRS model is presented in Model 2:

$$Max_{u_r v_i} P_d = \frac{\sum_{r=1}^{n} u \, y_{dr} - u_0}{\sum_{i=1}^{m} v \, x_{di}}$$

$$Subject \; to, \frac{\sum_{r=1}^{n} u_r y_{dr} - u_0}{\sum_{i=1}^{m} vx_{di}}$$

Is < 1 \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots\dots \text{(Model 2)}

Where,
P_d = efficiency of dth DMU
u_0 = positive or negative or 0 (Scalar free sign)

Data Collection and Selection of Variables

Total sixteenth (16) IBs are presently in operation, and fifteenth (15) banks were chosen due to the availability of data gathered from the banks' annual reports and their websites for 2011 until 2018. Eleven (11) IBs are associated with conventional-owned, while the remaining four (4) are standalone or full-fledged IBs. Further, five foreign-owned and ten locally-owned Ibs have existed in the data sample. To conduct the DEA analysis, DEAP 2.1 software was applied.

It is crucial to select appropriate inputs and outputs for DEA (Ji & Lee, 2012). A researcher must select the (I) that affect (O), reflecting the efficiency of management and firms (Ji & Lee, 2012). Past literature could not provide a census on the selection of (I) and (O). To address this issue, production, intermediation and operating approaches were identified (Panah et al., 2014). The classical theory relates to the operating approach, while the intermediation and production approaches were rooted in the traditional macroeconomic theory (Panah et al., 2014). Table 1 presents the descriptive statistics of variables.

Table 1. Descriptive Statistics (Variables)

Variables	2018	2017	2016	2015	2014	2013	2012	2011
Deposits	604,661	524,681	460,789	433,421	411,079	293,650	259,456	212,044
Capital	66,293	56,380	51,476	39,953	36,312	33,738	34,254	30,085
Labour	2,329	1,157	1,063	1,051	594	568	1,915	1,696
Interest expense	19,971	15,779	14,478	14,190	11,825	10,309	9,134	6,536
Other expense	5,516	5,137	5,047	4,595	4,325	4,072	3,428	2,444
Financing	619,609	534,077	484,864	439,313	388,055	335,035	280,961	234,650
Investments	103,055	100,573	81,812	77,217	76,088	65,580	61,078	51,743
Interest revenue	41,777	451,745	32,458	31,104	28,780	26,075	3,428	2,444
Non-interest revenue	988	112	-75,922	61	-65	-301	19,448	103

Production Approach

Banks as FI produces several services to serve their customers-depositors and account holders (Benston & Smith, 1976), emphasising depositors' transactions and providing documents (Benston, 1965). More so, both non-financial and financial banks are included in this approach (Azad et al., 2017). This approach hence is useful for measuring the efficiency of Malaysian banks (Azad et al., 2017; Hamid et al., 2017). The current study uses labour, capital and distributable income as (I) and investments, deposits and financing as (O), following past literature.

Intermediation Approach

Banks, as a financial intermediary- gather funds from surplus to lend to deficits (Malim & Masro, 2018; Panah et al., 2014). Kwan (2003) reported intermediation approach is broadly used to measure banking efficiency, including banking efficiency in Malaysia (Ahmad & Prentice, 2019; Kamarudin et al., 2019). Batchelor (2005) presented a framework for IBs' financial intermediation, exhibited in Figure 1. This study treated deposits, labour and capital as (I), and financing and investments as (O).

Operating Approach

This approach considers banks as a business entity that makes revenue and incur cost in performing their business activities (Panah et al., 2014). Subsequently, it is also named the profit-oriented or revenue-based approach that contemplates revenue factors, such as income (interest and non-interest) as (O) while expenditure (personal and interest expenses) as (I) (Avkiran, 2000).
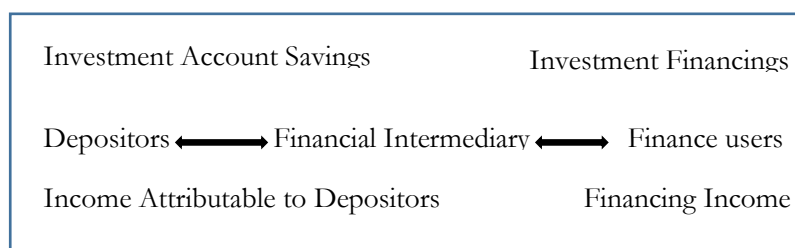

Figure 1. Financial Intermediation (Islamic Banks)
Source: Batchelor (2005

Accordingly, this study uses labour costs, distributable income for depositors and others (interest expenses), and other operating expenses as (I) and interest revenue and other comprehensive income as (O).

Although most prior studies applied a single approach for efficiency calculation, presently banking sector involves not only intermediation but also enhancing their business activities in other aspects, such as providing value-added products and services to help consumers with a service fee (Haron et al., 2020). Therefore, it is noteworthy to measure and compare the efficiency scores of Malaysian IBs through different approaches (Azad et al., 2017). Table 2 presents the descriptions of variables employed.

Table 2. Description of Variables

Variables	Descriptions
Deposits from depositors	Customers' deposits
Labour expenses	Wages and salaries
Capital invested	Equity (total)
Loans disbursement	Financing and advances
Interest expenses (charges)	Distributable income to depositors and others
Other (operating) expenses	Total operating expenses less personal expenses
Interest income	Distributable income (total)
Non-Interest related income	Other comprehensive income
Investments	Investment involves trade, sale, maturity, subsidiaries, groups, properties.

Results and Discussion

This study first grouped the banks, presented in Table 3. A significant deviation in TE scores is observed between the three approaches. The intermediation approach presented the highest TE, while the lowest was reported by the production approach. However, there is no significant difference in TE between the operating and intermediation approach.

Table 3. CRS (TE) Findings from All Approaches

Category	2018	2017	2016	2015	2014	2013	2012	2011	2011-2018
Production									
IBs	0.741	0.686	0.69	0.694	0.664	0.49	0.827	0.597	0.671
LocIBs	0.773	0.682	0.651	0.677	0.665	0.458	0.862	0.453	0.652
FrgnIBs	0.678	0.693	0.77	0.73	0.663	0.554	0.756	0.832	0.71
FullFIs	0.52	0.716	0.541	0.676	0.663	0.329	0.539	0.377	0.545
COIs	0.774	0.61	0.696	0.64	0.604	0.518	0.883	0.618	0.668
Intermediation									
IBs	0.724	0.828	0.779	0.882	0.689	0.718	0.566	0.589	0.723
LocIBs	0.746	0.778	0.826	0.838	0.714	0.788	0.596	0.509	0.724
FrgnIBs	0.595	0.825	0.589	0.702	0.415	0.389	0.358	0.507	0.548
FullFIs	0.641	0.956	0.637	0.902	0.758	0.611	0.564	0.892	0.745
COIs	0.754	0.782	0.831	0.875	0.664	0.757	0.566	0.478	0.713
Operating									
IBs	0.597	0.739	0.586	0.808	0.607	0.695	0.728	0.853	0.702
LocIBs	0.743	0.784	0.625	0.856	0.635	0.763	0.715	0.853	0.747
FrgnIBs	0.304	0.649	0.509	0.713	0.553	0.558	0.755	0.854	0.612
FullFIs	0.519	0.591	0.505	0.908	0.591	0.608	0.641	0.796	0.645
COIs	0.625	0.793	0.616	0.772	0.614	0.726	0.759	0.874	0.722

Note: IBs = all Islamic banks, LocIBs = Locally-owned Islamic banks, FrgnIBs = Foreign-owned Islamic banks, FullFIs = Full-fledged Islamic banks, COIs= Conventional-owned Islamic banks. All the scores are the mean value of 15 banks.

The locally-owned IBs' highest TE was demonstrated in the operating approach, while the lowest is in the production approach, which differs from the past finding (Azad et al., 2017).

Surprisingly, the highest TE was recorded by foreign-owned IBs in the production approach, while the intermediation scored the lowest, which is opposed to the past finding (Azad et al., 2017). On the other hand, the intermediation approach showed the highest TE for the full-fledged IBs, during the operating approach for conventional-owned IBs. However, both conventional-owned and full-fledged IBs scored the lowest efficiency in the production approach; hence the difference between the different approaches was not too large.

In terms of periodical TE, IBs displayed a deviated efficiency within the study period – the highest (in 2012) and the lowest (in 2013) based on the production approach. In the intermediation approach, correspondingly, the highest and lowest scores were grasped in 2015 and 2012. The lowest score (in 2016) while the highest (in 2011) was recorded under the operating approach. Inconsistent scores were provided by the three approaches during the study period, while the intermediation approach exhibited comparatively better efficiency compared to the other approaches.

Nevertheless, stable TE was observed for locally-owned IBs from 2014 to 2018. The intermediate approach documented better efficiency from 2013 to 2018, while the operating approach presented unstable efficiency scores during the study period. Locally-owned IBs performed efficiently as intermediaries for managing surplus and deficit, in support of past findings (Basri et al., 2018). Foreign-owned IBs have proven to be more efficient than locally-owned IBs in the production approach, while unstable efficiency scores were depicted in the operating and intermediation approach during the study period. It can be assumed that, based on the production approach, foreign-owned IBs successfully strategised on creating and offering value-added products and services to their customers.

In all approaches, full-fledged IBs posited unbalanced efficiency scores during the study period. Although the intermediation approach indicates a slightly better utilisation of resources, the difference between scores was significant during the study period. Full-fledged IBs, therefore, upheld somewhat constant profitability during the study period. On the other hand, the intermediation approach exposed higher efficiency scores for some years for full-fledged IBs, reflecting their efficiency as intermediaries. Subsequently, conventional-owned IBs exposed reasonable average efficiency scores throughout all approaches. Even though a volatile trend was depicted in the efficiency scores for all approaches during the study period, the gaps in the scores were not too large. It can be elucidated that IBs are trying to maximise the utilisation of resources to sustain and enhance stability.

The overall results demonstrated the diverse trends of TE for all IBs during the study period. Among the approaches, better efficiency for IBs was driven under the intermediation approach. However, the operating approach is deemed to be better suited for locally-owned IBs and the production approach for foreign-owned IBs.

However, TE for all IBs was not consistent nor fully efficient, indicating the lack of management competency or optimal utilisation of resources. The results from the VRS model is, presented in Table 4, demonstrated a similar trend of inefficiency scores (both PTE and SE) for IBs (operating and production approach). SE showed a slightly better score than PTE (intermediation approach); however, the difference was not significant during the study period. Therefore, the findings confirmed the inefficiency in both managerial and optimal usage of resources by IBs in Malaysia. However, as intermediary FIs, IBs utilised their resources quite well but were inadequate in managerial operations.

Similarly, locally-owned IBs conveyed less efficiency (PTE and SE) in the production approach. On the other hand, the intermediation approach was reported slightly better in SE and in the opposite direction by the operating approach (less efficient due to SE). Based on these findings, locally-owned IBs were not competent in either optimising the available resources or managerial competency as they could not achieve full efficiency (PTE or SE). Foreign-owned IBs also showed a similar trend (PTE and SE) in the production approach with equal inefficiency. Concurrently, the intermediation approach designated slightly better managerial competency than the optimal scale of resources. However, a reverse trend is observed in the operating approach, whereas the SE was better. The findings suggested that foreign-owned IBs were comparatively

better in optimising SE by being more efficient in utilising resources to produce higher outputs. This could be attributed to their global banking experience worldwide. On the other hand, locally-owned IBs showed slightly better managerial competency. Thus, the current findings are not in support of past findings (Basri et al., 2018).

Table 4. VRS Results for The Three Approaches

Bank'sGroup	2018		2017		2016		2015		2014		2013		2012		2011		2011-2018	
	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE	PTE	SE
Production																		
AIBs	0.8120	0.8460	0.7990	0.8680	0.8350	0.8050	0.8420	0.7770	0.8240	0.7990	0.6620	0.6510	0.8910	0.9070	0.7260	0.7230	0.7980	0.7970
LocIBs	0.8530	0.8460	0.7920	0.8180	0.8270	0.7630	0.8380	0.7430	0.8150	0.7920	0.6160	0.6030	0.8830	0.9600	0.6370	0.6810	0.7820	0.7830
FrgnIBs	0.730	0.8450	0.8150	0.8480	0.8530	0.8870	0.8490	0.8450	0.8420	0.8150	0.7530	0.7450	0.9090	0.8000	0.9500	0.8530	0.8380	0.830
FullFIs	0.6160	0.6120	0.8000	0.7160	0.5950	0.6940	0.7280	0.7190	0.6660	0.790	0.6320	0.4340	0.6310	0.6610	0.6360	0.4340	0.6630	0.6330
COIs	0.8270	0.8750	0.7260	0.8580	0.8690	0.7820	0.8170	0.7330	0.8210	0.7310	0.6150	0.6900	0.9290	0.9360	0.7210	0.8090	0.7910	0.8020
Intermediation																		
AIBs	0.910	0.7880	0.8930	0.8840	0.9090	0.8480	0.9180	0.9590	0.7190	0.8760	0.8640	0.8470	0.7300	0.7350	0.6820	0.8390	0.8380	0.8470
LocIBs	0.8190	0.8190	0.840	0.8160	0.8640	0.8730	0.8630	0.8960	0.7480	0.8060	0.9070	0.8040	0.6780	0.7640	0.5560	0.7970	0.7840	0.8220
FrgnIBs	0.9990	0.5960	0.8960	0.8920	0.8820	0.6770	0.7930	0.8950	0.4190	0.8720	0.6360	0.7340	0.6650	0.4740	0.6940	0.7390	0.7480	0.7350
FullFIs	0.920	0.7180	0.9680	0.9850	0.8650	0.7440	0.930	0.9660	0.7590	0.9930	0.7710	0.8370	0.6820	0.7540	0.9020	0.9890	0.850	0.8720
COIs	0.9060	0.8140	0.8660	0.8470	0.9260	0.8860	0.9130	0.9570	0.7050	0.8330	0.9890	0.8500	0.7470	0.7290	0.6020	0.7860	0.820	0.8380
Operating																		
AIBs	0.8170	0.7260	0.9090	0.8150	0.7030	0.8020	0.8730	0.9020	0.8060	0.7820	0.7850	0.8910	0.8410	0.8540	0.9410	0.9060	0.8350	0.8350
LocIBs	0.9610	0.7740	0.9650	0.8030	0.7380	0.8100	0.9150	0.8970	0.9210	0.6920	0.8460	0.9110	0.8550	0.8250	0.9650	0.8840	0.8960	0.8240
FrgnIBs	0.5280	0.6320	0.7980	0.840	0.6330	0.7840	0.7880	0.9110	0.5760	0.9640	0.6650	0.8520	0.8140	0.9110	0.8910	0.9500	0.7120	0.8560
FullFIs	0.9270	0.5550	0.7470	0.830	0.6470	0.6990	0.9700	0.9340	0.6940	0.8410	0.7870	0.7930	0.830	0.7820	0.9110	0.8770	0.8140	0.7890
COIs	0.7770	0.7890	0.9680	0.810	0.7230	0.8390	0.8370	0.8900	0.8460	0.7610	0.7850	0.9270	0.8460	0.8800	0.9510	0.9170	0.8420	0.8510

Note: IBs = all Islamic banks, LocIBs = Locally-owned Islamic banks, FrgnIBs = Foreign-owned Islamic banks, FullFIs = Full-fledged Islamic banks, COIs= Conventional-owned Islamic banks.

Meanwhile, full-fledged IBs demonstrated a better efficiency (PTE) compared to SE in both production and operating approach. On the other hand, the intermediation approach designated those full-fledged IBs were not competent in managing their financial activities. However, conventional-owned IBs operated in a similar trend in relation to all approaches. The results unveiled a low level of managerial competency while improvement in the optimal scale of resources.

IBs were not competent in all approaches and reported a deviated efficiency level based on the approaches. Albeit, IBs individually confirmed a diverse and volatile efficiency level throughout the study period. Locally-owned IBs manifested a higher efficiency score compared to foreign-owned IBs in both intermediation and operating approach, which unveiled the better profitability and capitalisation of the banks (Sufian, 2007; Sufian & Kamarudin, 2015). Meanwhile, conventional-owned IBs revealed the competency in managing risk capacity, thus enhancing profitability, better than the full-fledged IBs.

The rationale for using different approaches is to picture the efficiency levels according to various approaches and to further identify the most suited approach for IBs in Malaysia. Besides, a single approach for banking efficiency measurement drives substandard benchmarking (Azad et al., 2017), which is confirmed by the findings of this study.

Implication and Conclusion

The main objective of this study is to measure and compare the efficiency levels of Malaysian IBs using the three different banking approaches, which are mostly ignored by past studies. The DEA was used to measure and compare the efficiency level and to ascertain the grounds for inefficiency. The results illustrated the better efficiency level of locally-owned IBs (operating approach) while foreign-owned IBs manifested a better role in adding value to the banking products and services, which could be contributed by their global banking experience. Henceforward, full-fledged IBs unfolded the improved efficiency as intermediaries. On the other hand, conventional-owned IBs unveiled their better efficiency through an operating approach.

The findings of this study unfolded several contributions- firstly, it provided brief theoretical and empirical evidence on the various banking approaches applied to the Malaysian IBs. In these consequences, the findings shed light on existing banking efficiency literature. Other than that, bank managers would find the findings useful in order to identify theirs underneath reasons for inefficiency to improve accordingly. Besides, the findings offer several approaches and their effective operational advantages on banking, especially in dealing with the current pandemic

situation (COVID-19). Through the operating and production approach, bank managers will be able to operate at an optimal scale. On the other hand, bank managers are exposed to the diverse benefits of different banking approaches; for example, the intermediation approach is the typical nature of banks in its capacity to convert deposits into investments. Meanwhile, the production approach enables banks to be more innovative in offering financial and non-financial products and services to customers.

The evaluation of banking efficiency is comprehensively related to the heterogeneity of the banks, i.e., diverse types of operation and business activities, making it a difficult task to describe banking variables for measuring efficiency. Similarly, it is not possible to detect all appropriate variables in the computation. This study only selected several variables based on past studies subject to data. In this regard, perhaps, the inclusion of other unobserved variables could provide comprehensive results. Future studies may adopt other related variables or extend the datasets. This study had only applied the DEA (non-parametric) as the methodology. Future studies may include parametric methods such as the SFA to compare the results based on different methods.

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