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Future Business Journal 3 (2017) 33–46
www.elsevier.com/locate/fbj

Assessing the domestic and foreign Islamic banks efficiency: Insights from selected Southeast Asian countries

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Received 5 August 2016; received in revised form 19 January 2017; accepted 30 January 2017
Available online 10 February 2017

Abstract

The objective of this study is to examine the technical efficiency (TE) and the decomposition of pure technical efficiency (PTE) and scale efficiency (SE) of domestic and foreign Islamic banks from the selected Southeast Asian Countries. The sample comprised of 29 domestic and foreign Islamic banks from Malaysia, Indonesia and Brunei over the period of 2006–2014. This study employ the Data Envelopment Analysis (DEA) method to measure banks' efficiency. In addition, the parametric (*t*-test) and non-parametric (Mann-Whitney [Wilcoxon] and Kruskall-Wallis) tests also performed to examine the difference in the efficiency of the foreign and domestic Islamic banks. The results indicate that the domestic Islamic banks have exhibited higher efficiency levels compared to their foreign bank peers. In addition, the empirical findings from this study seem to suggest that the domestic Islamic banks have exhibited a higher efficiency levels for all three efficiency measures and consistent with home field advantage theory. The findings of this study are expected to contribute significantly to the regulators or policymakers, Islamic banking itself, investors and existing knowledge on the operating performance of the Islamic banking sector.

JEL Classifications: G21; D24

Keywords: Islamic banks; Efficiency; Data envelopment analysis; Malaysia; Indonesia; Brunei

1. Introduction

According to Kamarudin, Sufian, and Nassir (2016) Islamic and conventional banks operate on different principles. Among others the Islamic banking system prohibits interest (*Riba'*) and substitutes it with the principle of Profit and Loss Sharing (PLS) and is based on *Syari'ah* rules (Ariff, 1988; Ariff, 2006). Despite differences in principles, Islamic banks share the same objective as their conventional bank peers i.e. to enhance shareholders'

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☆Peer review under responsibility of Faculty of Commerce and Business Administration, Future University.

http://dx.doi.org/10.1016/j.fbj.2017.01.005

value or wealth creation through profit maximization (Olson & Zoubi, 2008). To remain competitive Islamic banks have to efficiently utilize their scarce resources so as to attain the most optimal profit level. Therefore, it would be reasonable to expect Islamic banks strive to be profit efficient.

Southeast Asian countries especially Malaysia, Indonesia and Brunei are one of the largest concentration Muslims in the world. There were approximately 61.4%, 88.1%, and 51.9% of Muslim population in Malaysia, Indonesia and Brunei respectively (Pew Research Center, 2011). Khan and Bhatti (2008) reported that Southeast Asia represent as one of the central hubs of Islamic banking and finance.

Islam has greatly influenced the economic growth of these countries in last three decades. Islamic financial institutions such as Islamic banks are well-established and operating efficiently. The efficient Islamic banking industry contributed to the stability of the financial system and better able to withstand negative shocks (Venardos, 2005). Given the rapid development of the Islamic banking sector, it is reasonable to expect that the performance of Islamic banks has become the center of attention among Islamic bank managers, stakeholders, policymakers, and regulators.

Despite its humble beginning, Islamic banks have blossomed throughout the world. The Islamic banking system has today become more competitive compared to the conventional banking system. At present, Islamic banks have presence in more than 75 countries, from Malaysia to Bahrain to Europe and the U.S. Qorchi (2005) reported that the number of Islamic financial institutions has quadrupled to more than 300 institutions over the past three decades. Total assets of Islamic financial institutions are estimated to be US$250 billion and are projected to be increase at about 15% rate per year, three times the rate of conventional banks. According to Ghafour (2007), the size of the world Islamic banking industry assets is estimated to have grown in excess of $265 billion from merely hundreds of thousands of dollars in the 1970s.

Given the rapid development of the Islamic banking sector, it is reasonable to expect that the performance of Islamic banks has become the center of attention among Islamic bank managers, stakeholders, policymakers, and regulators. Berger and Humphrey (1997) point out that studies focusing on the efficiency of financial institutions have become an important part of banking literature since the early 1990s. Furthermore, Berger, Hancock, and Humphrey (1993) suggest that if banks are efficient, they could expect improvement in profitability levels, better prices and service quality for consumers, and greater amounts of funds intermediated.

Although considerable developments in the Islamic banking sectors worldwide, very few attention has been given on the efficiency of its operations. Instead of focusing on the Islamic banks' expansion, it is better to examine their efficiency level to ensure their improvement sustainability. Therefore, the ultimate objective of this study is to examine the efficiency of foreign and domestic Islamic banks in Malaysia, Indonesia and Brunei over the period of 2006–2014. Furthermore, this paper focuses on the question whether the efficiency of foreign banks differs from domestic Islamic banks. Why would the efficiency of a foreign bank differ from the efficiency of domestic bank? According to Lensink, Meesters, and Naaborg (2008) and Demirguc-Kunt and Huizinga (2000) there are two important reasons for this. First, foreign banks may be less subject to domestic credit allocation rules than domestic banks. Second, domestic banks may have informational advantages relative to foreign banks.

By employing a non-parametric Data Envelopment Analysis (DEA) method, we analyze the technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE) of foreign and domestic Islamic banks in Malaysian, Indonesia and Brunei over the period of 2006 to 2014. In addition to DEA, this study performs a series of parametric (*t*-test) and non-parametric (Mann-Whitney [Wilcoxon] and Kruskall-Wallis) tests to examine whether the foreign and domestic banks are drawn from the same population.

The article begins with a brief review of related studies. Section 3 discusses on the methods employed in the study and variables employed in the panel regression analysis. We present the empirical findings in Section 4. The article concludes and provides discussions on the policy implications in Section 5.

2. Review of literature review

Despite considerable developments in the Islamic banking sector, there have been very limited studies done focusing on the efficiency of Islamic banks. To date, empirical evidence examining the performance of the Islamic banking sector focuses more on the profitability with the help of financial ratios and are constrained by the time span and the number of Islamic banks (Rahim, Bakar & Ganapathy, 2015). However, studies that address the efficiency of

foreign and domestic Islamic banks from Malaysia, Indonesia and Brunei are scanty. Therefore, before go further, we should understand the theories of efficiency and ownership of the banking sectors.

2.1. Theoretical framework on efficiency and ownership

Lensink et al. (2008) suggested that a foreign bank is usually defined as a bank of which more than 50% of the shares are owned by non-domestic residents. This indicates that a bank may be a domestic bank in one country, but a foreign bank everywhere else. For example, Citibank is a domestic bank in the US but it will be regarded as a foreign bank in all other countries.

Isik and Hassan (2002) studied the impact of different ownership and organizational structures on the efficiency of the Turkish banking industry over the period 1988 to 1996 by using a series of parametric and non-parametric techniques. They found that the foreign banks operating in Turkey were relatively more efficient rather than their domestic counterparts, while private banks were found to be more efficient relative to public banks for all efficiency measures.

Havrylchyk (2006) summarized that foreign banks in transition and developing markets show higher efficiency than their domestically-owned counterparts. On the other hand, foreign banks in developed countries show another way around.

There are two theories suggested by Berger, DeYoung, Genay, and Udell (2000) namely global advantage and home field advantage theory. The global advantages theory implies the foreign banks might benefit from competitive advantages relative to their domestically-owed peers. Foreign banks could exercise more advanced technologies due to a stiff home market competition. They also have an active market for corporate control in the home country and have access to an educated labor force that is able to adapt new technologies. Besides, Havrylchyk (2006) also discovered similar findings that foreign banks could produce higher profit due to the modern information technologies and better risk management.

Meanwhile, home field advantage theory states that foreign banks suffer some disadvantages when compared to domestic banks. Foreign banks are assumed to perform worse than domestic banks due to lower revenue (revenue inefficient) or higher costs (cost inefficient) in offering the same financial services. Hymer (1976) also pointed out that the foreign firms are likely to face competitive disadvantages relative to national firms because the latter are well informed about their country's economy, language, laws and politics. Therefore, this leads to the hypothesis that foreign banks suffer more from bad institutional framework in the host country rather than domestic banks.

2.2. Efficiency of Islamic banking Sector

Aghimien, Kamarudin, Hamid, and Noordin (2016) investigate the efficiency level of 43 Gulf Cooperation Council (GCC) banks on technical efficiency (TE), pure technical efficiency (PTE) and scale efficiency (SE) over the period from 2007 until 2011. PTE and SE represent the potential factors that influence the efficiency of the GCC banks. By using the DEA approach, on average, the results show that many GCC banks are operating within an optimal scale of efficiency. Nevertheless, the results also show managerial inefficiency in the use of resources. Furthermore, the results indicate that, while the larger banks (the 22 largest) tend to operate at constant returns to scale (CRS) or decreasing returns to scale, the smaller banks (the 21 smallest) are susceptible to operate at either CRS or increasing returns to scale.

Kamarudin et al. (2016) provides new empirical evidence on the revenue efficiency of Islamic and conventional banks with the impact of country governance. The empirical analysis is confined to Islamic and conventional banks operating in the Gulf Cooperation Council (GCC) countries banking sectors during the period of 2007 to 2011 using DEA method. They conclude that Islamic banks operating in the GCC countries banking sectors have been relatively less efficient compared to their conventional bank counterparts on all three efficiency measures (statistically significant at the 1% level in all cases). The empirical findings to a certain extent concur with the results from the earlier study by Srairi (2010) which finds that Islamic banks have been relatively less efficient compared to their conventional bank peers. The empirical findings from this study clearly suggest that Islamic banks have been generating low revenues relative to the costs incurred resulting in a high wastage of inputs. As a consequence, Islamic banks in the GCC countries have exhibited a lower profit efficiency compared to their conventional bank peers due to the lower revenue efficiency.

Havid and Setiawan (2015) examined the efficiency of Indonesian Islamic banks over the period of 2008–2014 by employing DEA. They suggested that technical inefficient (TIE) of Islamic banks is due to scale inefficient. Yildirim (2015) who examined efficiency and productivity of Islamic banks in Malaysia and Turkey over the period of 2010–2014 found that TE level of Islamic banks in Malaysia and Turkey are not always increasing. He suggested that scale inefficiency is the major reason for TIE and Islamic banks are not operating on an optimal scale.

Rahman and Rosman (2013) further the investigation of TE study of Islamic banks in MENA and Asian countries over the period of 2006–2009. They found that Islamic banks operated at the wrong scale and cause TIE. Subsequently, Islam, Rahman, and Hasan (2013) compared the TE of Islamic banks of Southeast Asia and South Asia over the period of 2009–2011 by using DEA. They found that the efficiency of Southeast Asian Islamic banks was higher than South Asian Islamic banks. They suggested that the smaller size of the Islamic banks in Southeast Asia, the more efficient the banks in generating outputs from inputs.

Sufian, Noor, and Majid (2008) perform an analysis on the efficiency of Islamic Banks using empirical evidence from the MENA (Middle East and North Africa) and Asian Countries. By using the Data Envelopment Analysis (DEA) method, they estimate three different types of efficiency measures, namely TE, PTE and SE. The result shows that pure technical inefficiency (PTIE) outweighs scale inefficiency (SIE) in the Islamic bank. Although the Islamic banks have been operating at a relatively optimal scale of operations, they are managerially inefficient to exploit their resources to the fullest.

Sufian (2007) investigates the efficiency of the domestic and foreign Islamic banks in Malaysian banking sector. This study employed the DEA methodology to identify the differences of TE, PTE and SE between domestic and foreign Islamic banks. The results from the DEA suggest that Malaysian Islamic banks efficiency declines in 2002 before it recovers slightly in years 2003 and 2004. The domestic Islamic banks are more efficient compared to the foreign Islamic banks, albeit marginally. The source of inefficiency of Malaysian Islamic banks in general has been scale, suggesting that Malaysian Islamic banks have been operating at the wrong scale of operations.

Sufian and Kamarudin (2015) examined the revenue efficiency of 15 domestic Islamic banks and 6 foreign Islamic banks operating in Southeast Asian countries specifically Malaysia, Indonesia and Brunei over the period of 2006–2011 by using DEA. The results showed that revenue efficiency on domestic Islamic bank is higher compared to foreign Islamic banks.

Rahim et al. (2015) examined cost, revenue and profit efficiency of 17 Islamic banks in Malaysia over the period of 2008–2009 based on four categories including domestic bank-backed, stand-alone domestic, foreign bank backed and stand-alone foreign. They found that domestic bank-backed Islamic banks were the most efficient while the stand-alone Islamic were the least efficient. They suggested that domestic bank-backed Islamic banks have the opportunity to leverage on its conventional banks. However, foreign bank-backed Islamic banks have limited branch network and need to expand on its own in order to reach the potential customers.

The above literature reveals the following research gaps. First, the majority of these studies have mainly concentrated on the Islamic banks from the numerous developed and developing countries. Second, empirical evidence on the efficiency ownership of foreign and domestic banks, particularly the Islamic banking sector, is scarce. Finally, very few has been published on the TE, PTE and SE on the foreign and domestic Islamic banks from Southeast Asia Countries. In the light of these knowledge gaps, the present paper seeks to provide new empirical evidence on the TE, PTE and SE on the foreign and domestic Islamic banks from Malaysia, Indonesia and Brunei Islamic banking sectors.

3. Methodology

3.1. Data collection

This study is an attempt to examine the TE, PTE and SE of foreign and domestic Islamic banks in Malaysia, Indonesia and Brunei over the period of 2006–2014. The source of financial data is collect from the BankScope database produced by the Bereau van Dijk which provides banks' balance sheets and income statements. The samples are selected on the basis that the bank has Islamic banking operations within the period of study and also on the basis of data availability. All currencies are converted to US dollars (USD) for the purpose of comparability. It includes 23 domestic Islamic banks and 6 foreign Islamic banks. Domestic Islamic banks are referred to the head office of Islamic banks located within the country. While, foreign Islamic banks are referred to the head office of

Islamic banks located outside the country. Table 1 indicates the list of Foreign and Domestic Islamic banks in this study.

3.2. Data Envelopment Analysis

The non-parametric Data Envelopment Analysis (DEA) method was employed with the variable returns to scale (VRTS) model in this study, to measure input-oriented TE of banks. In addition, the other technical efficiency decompositions namely pure technical and scale efficiencies are also investigated at this stage in order to identify the factors that may influence the banks' technical efficiency. There are numerous studies employed this method to measure the efficiency of the banking sectors such as Kamarudin, Nordin, and Nasir (2013), Kamarudin, Nordin, Muhammad and Hamid, (2014a), Kamarudin, Nasir, Yahya, Said, and Nordin (2014b) and Sufian, Kamarudin, and Noor (2014).

3.3. The Variable Returns to Scale Model

This study employed the DEA under the model of VRTS by adding the convexity constraint in the CRTS model: $N1'\lambda = 1$ (Coelli, Prasada-Rao, & Battese, 1998):

$$\begin{aligned} &\min_{\theta,\lambda}\ \theta, \\ &\text{subject to}\quad -y_i + Y\lambda \geq 0, \\ &\qquad\qquad \theta x_i - X\lambda \geq 0, \\ &\qquad\qquad N1'\lambda = 1 \\ &\qquad\qquad \lambda \geq 0, \end{aligned} \tag{1}$$

where:

Table 1
List of Foreign and Domestic Islamic banks. Source: Bank Negara Malaysia (2015), Bank Indonesia (2015) and Autoriti Monetari Brunei Darussalam (2015).

No.	Domestic Islamic Banks	No.	Foreign Islamic Banks
1	Affin Islamic Bank Berhad	1	Al Rajhi Banking & Investment Corporation (Malaysia) Berhad
2	Alliance Islamic Bank Berhad	2	Asian Finance Bank Berhad
3	AmIslamic Bank Berhad	3	HSBC Amanah Malaysia Berhad
4	Bank Islam Brunei Darussalam Berhad	4	Kuwait Finance House (Malaysia) Berhad
5	Bank Islam Malaysia Berhad	5	OCBC Al-Amin Bank Berhad
6	Bank Muamalat Malaysia Berhad	6	Standard Chartered Saadiq Berhad
7	CIMB Islamic Bank Berhad		
8	EONCAP Islamic Bank Berhad		
9	Hong Leong Islamic Berhad		
10	Maybank Islamic Berhad		
11	PT Bank BRI Syariah		
12	PT Bank Jawa Barat Banten Syariah		
13	PT Bank Maybank Syariah Indonesia		
14	PT Bank Mega Syariah		
15	PT Bank Muamalat Indonesia Tbk		
16	PT Bank Panin Syariah		
17	PT Bank Syariah BNI		
18	PT Bank Syariah Bukopin		
19	PT Bank Syariah Mandiri		
20	PT Bank Victoria Syariah		
21	PT BCA Syariah		
22	Public Islamic Bank Berhad		
23	RHB Islamic Bank Berhad		

$N1$ is a $N \times 1$ vector of ones.

This approach forms a convex hull of intersecting planes which envelope the data points more tightly than the CRTS conical hull and thus provides TE scores which are greater than or equal to those obtained using the CRTS model.

3.4. Calculation of Scale Efficiencies

TE scores obtained from a CRTS DEA can be divided into two components, one due to SIE and one due to the PTIE. This may be completed by conducting both a CRTS and a VRTS DEA upon the same data. If there is a different in two TE scores of DMU, it indicates that the DMU has SIE and the SIE could be measured from the difference between the VRT'S TE (PTE) score and CRTS TE (TE) score (Coelli et al., 1998). Although the SE measure will provide information concerning the degree of inefficiency resulting from the failure to operate with CRTS, it cannot provide the information as to whether a DMU is operating in an area of increasing returns to scale (IRTS) or decreasing returns to scale (DRTS). This may be determined by running an addition DEA problem with non-increasing returns to scale (NIRTS) imposed. This can be done by altering the DEA model in Eq. (1) by substituting the $N1'\lambda = 1$ restriction with $N1'\lambda \leq 1$, to provide:

$$\min_{\theta,\lambda} \ \theta,$$

Table 2
Summary statistics of variables input and output in the DEA model (in million USD). Sources: Bankscope database and authors' own calculations..

	Mean	Min	Max	SD
Inputs				
Domestic Islamic Banks 2006–2014				
Total Deposits (x_1)	4453.127	0.001	38,981.431	5567.432
Total Labour (x_2)	26.168	0.001	137.506	29.914
Total Capital (x_3)	15.934	0.001	204.799	27.971
Foreign Islamic Banks 2006–2014				
Total Deposits (x_1)	1648.545	0.001	3856.366	962.415
Total Labour (x_2)	11.760	0.173	34.923	9.692
Total Capital (x_3)	5.474	0.001	21.049	5.609
All Islamic Banks 2006–2014				
Total Deposits (x_1)	3780.027	0.001	38,981.431	5018.015
Total Labour (x_2)	22.710	0.001	137.506	27.189
Total Capital (x_3)	13.423	0.001	204.799	24.923
Outputs				
Domestic Islamic Banks 2006–2014				
Total Loans (y_1)	3128.885	13.436	30,823.806	4228.154
Total Investments (y_2)	767.048	0.001	4983.785	972.805
Foreign Islamic Banks 2006–2014				
Total Loans (y_1)	1176.216	0.001	3006.438	806.426
Total Investments (y_2)	265.779	0.001	1224.378	242.510
All Islamic Banks 2006–2014				
Total Loans (y_1)	2660.244	0.001	30,823.806	3797.070
Total Investments (y_2)	646.744	0.001	4983.785	882.064

Notes: x1: Total deposits (deposits and short term funding), x2: Labour (personnel expenses), x3: Physical capital Physical capital (interest income on loans and other interest income on loans), y1: Loans (total of short-term and long-term loans), y2: income (gross interest and dividend income).

$$\begin{aligned} \text{subject to} \quad & -y_i + Y\lambda \geq 0, \\ & \theta x_i - X\lambda \geq 0, \\ & N1'\lambda \leq 1 \\ & \lambda \geq 0, \end{aligned} \tag{2}$$

Therefore, the nature of the scale inefficiencies, due to either IRTS or DRTS could be determined by the difference between the NIRTS TE and VRTS TE score where:

If the VRTS TE @ PTE $\neq$ NIRTS TE, then DMU is operating at IRTS.

IF the VRTS TE @ PTE = NIRTS TE, then DMU is operating at DRTS.

3.5. Inputs, outputs definition and the choice of variables

It is commonly acknowledged that the choice of variables in efficiency studies significantly affects the results. The problem is compounded by the fact that variable selection is often constrained by the paucity of data on relevant variables. The cost and output measurements in banking are especially difficult because many of the financial services are jointly produced and prices are typically assigned to a bundle of financial services. Two approaches dominate the banking theory literature: the production and intermediation approaches (Sealey & Lindley, 1977).

Under the production approach, pioneered by Benston (1965), banks are primarily viewed as providers of services to customers. This approach has primarily been employed in studying the efficiency of bank branches. Under the intermediation approach, financial institutions are viewed as intermediating funds between savers and investors. Generally, various of the studies that examine the efficiency on banking sectors mostly adopted the intermediation approach such as, Sufian and Kamarudin (2014), Sufian, Kamarudin, and Noor (2012) and Sufian, Kamarudin, and Noor (2013). In our case, the intermediation approach is used where Islamic banks produce services through the collection of deposits and other liabilities and in turn these funds are invested in productive sectors of the economy, yielding returns uncontaminated by usury (*riba'*).

The Islamic banks are modelled as multi-product firms producing three inputs and two outputs (refer Table 2). According to Cooper, Seiford, and Tome (2002), there is a rule required to be complied with in order to select the number of inputs and outputs. The rule of thumb which could provide guidance is $n \geq \max\{m \times s, 3(m+s)\}$.

where, n is the number of DMUs; m is the number of inputs; and s is the number of outputs. Therefore, three inputs and two outputs are chosen. Total deposits (x1), labour (x2) and capital (x3) are selected as input measures whereas loans (y1) and investments (y2) are selected as output measures. Table 2 indicates the inputs and outputs for Islamic banks in Malaysia, Indonesia and Brunei.

4. Empirical results

Before proceeding with the discussion of DEA results, this study first tested the rule of thumb on the selection of inputs and outputs variables suggested by Cooper et al. (2002). Since the total number of DMUs (29 banks) in this study is more than the numbers of inputs and outputs variables (3 inputs x 2 outputs @ 3 [3 inputs + 2 outputs]), the selection of variables are valid since it complies with the rule of thumb and allows the efficiencies of DMUs to be measured.

This section will discuss on the TE change of the domestic and foreign Islamic banking sector that is measured by the DEA method and its decomposition into PTE and SE components. In the event of the existence of SIE, this study could provide evidence on the nature of the returns to scale of each bank.

According to Isik and Hassan (2002), constructing an annual frontier specific to each year is more flexible and more suitable than estimating a single multiyear frontier for the banks in the sample. Based on the earlier studies, for the purpose of the study, separate annual efficiency frontier for each year is more preferable. Therefore, there were nine separate frontiers (2006–2014) constructed for the study. According to Isik and Hassan (2002), the principal advantage of having panel data is the ability to observe each bank more than once over a period of time. The issue is also critical in a continuously changing business environment due to the technology of a bank that is most efficient in one period may not be the most efficiency in another. In addition, it also may reduce the problems related to the lack

of random error in DEA by allowing an efficient bank in one period to be inefficient in another, assuming that the errors owing to luck or data problems are not consistent over time (Isik & Hassan, 2002; Sufian et al., 2008).

4.1. Efficiency of the Domestic Islamic Banking Sectors

Table 3 illustrates the mean efficiency scores of the *Domestic Islamic* banks for the years 2006 (Panel 1), 2007 (Panel 2), 2008 (Panel 3), 2009 (Panel 4), 2010 (Panel 5), 2011 (Panel 6), 2012 (Panel 7), 2013 (Panel 8) and 2014 (Panel 9) and All Years (Panel for All). The results seem to suggest that the domestic Islamic banks' mean TE has

Table 3
Efficiency scores for domestic Islamic banks from 2006 until 2014.

Efficiency measures	Mean	Min	Max	SD
Panel 1: Domestic Islamic Banks 2006				
Technical Efficiency	0.887	0.575	1.000	0.157
Pure Technical Efficiency	0.926	0.647	1.000	0.129
Scale Efficiency	0.955	0.782	1.000	0.082
Panel 2: Domestic Islamic Banks 2007				
Technical Efficiency	0.944	0.691	1.000	0.106
Pure Technical Efficiency	0.990	0.888	1.000	0.032
Scale Efficiency	0.952	0.761	1.000	0.089
Panel 3: Domestic Islamic Banks 2008				
Technical Efficiency	0.766	0.369	1.000	0.214
Pure Technical Efficiency	0.885	0.561	1.000	0.136
Scale Efficiency	0.857	0.482	1.000	0.164
Panel 4: Domestic Islamic Banks 2009				
Technical Efficiency	0.879	0.595	1.000	0.132
Pure Technical Efficiency	0.921	0.601	1.000	0.119
Scale Efficiency	0.954	0.773	1.000	0.072
Panel 5: Domestic Islamic Banks 2010				
Technical Efficiency	0.721	0.367	1.000	0.219
Pure Technical Efficiency	0.806	0.387	1.000	0.185
Scale Efficiency	0.888	0.521	1.000	0.132
Panel 6: Domestic Islamic Banks 2011				
Technical Efficiency	0.814	0.444	1.000	0.191
Pure Technical Efficiency	0.907	0.469	1.000	0.145
Scale Efficiency	0.899	0.577	1.000	0.146
Panel 7: Domestic Islamic Banks 2012				
Technical Efficiency	0.784	0.359	1.000	0.236
Pure Technical Efficiency	0.885	0.470	1.000	0.169
Scale Efficiency	0.877	0.507	1.000	0.167
Panel 8: Domestic Islamic Banks 2013				
Technical Efficiency	0.847	0.539	1.000	0.148
Pure Technical Efficiency	0.908	0.598	1.000	0.134
Scale Efficiency	0.935	0.775	1.000	0.086
Panel 9: Domestic Islamic Banks 2014				
Technical Efficiency	0.876	0.654	1.000	0.133
Pure Technical Efficiency	0.957	0.702	1.000	0.075
Scale Efficiency	0.914	0.723	1.000	0.106
Panel for All: Domestic Islamic Banks All Years				
Technical Efficiency	0.828	0.359	1.000	0.187
Pure Technical Efficiency	0.905	0.387	1.000	0.141
Scale Efficiency	0.910	0.482	1.000	0.127

been on a fluctuation trend (refer Fig. 1) from 88.7% in year 2006 but finally declining to 87.6% in year 2014. The decomposition of TE into its PTE and SE components suggests that SIE dominates PTIE of domestic Islamic banks during all years except for the years 2006, 2009, 2010 and 2013. These years are excluded due to the higher in SE rather than PTE.

Nevertheless, the interesting finding has been discovered during the period 2005 to 2014 where the results from all years (Panel for All) suggest that, domestic Islamic banks have exhibited that the inefficiency of TIE could be attributed mainly to PTIE (9.5%) rather than SIE (9%). The result reported that mean TE 82.8%% with input waste of 17.2%. The results on TE suggests.

Thus, the results imply that domestic Islamic banks could have produced the same amount of outputs with only 82.8% of the amount of inputs used. In another word, domestic Islamic banks could have reduced their inputs by 17.2% and still could have produced the same amount of outputs. Overall the results imply that during the period of study, although the domestic Islamic banks were more scale efficient operating, they were mainly operating at the managerially inefficient in controlling costs.

4.2. Efficiency of the Foreign Islamic Banking Sectors

Table 4 illustrates the mean efficiency scores of the *foreign Islamic* banks for the years for all years 2006 to 2014. The results (refer Fig. 2) seem to suggest that the mean of TE for foreign Islamic banks has been on a increasing trend from 35.4% to 71.2% during the year 2006 to 2007, decreased to 59.8% during the year 2008, before increasing again to 67.6% in year 2009. In year 2010, TE level decreasing to 66.5% and increasing to 76.1% during 2011. However, although the level of TE in 2012 reducing by 3.2%, foreign Islamic banks could manage to enhance their TE level to 92% in 2014. The decomposition of TE into its PTE and SE components suggests that PTIE dominates SIE of foreign Islamic banks for all years excluding for the years 2006 and 2009. The both years are excluded due to the higher in PTE rather than SE.

The results for all banks in all years (Panel for All) have, in general, confirmed the earlier findings the managerial inefficiency is the dominant factor influencing foreign Islamic banks efficiency. Over the all period 2006 to 2014, the results from Panel for All suggest that, foreign Islamic banks have exhibited mean TE 71.6% with input waste of 28.4%. The decomposition of the TE into its PTE components suggests that the inefficiency could be attributed mainly to PTIE (16%) rather than SIE (15.8%).

Therefore, the results documented that the foreign Islamic banks can produced the same amount of outputs with only 71.6% of the amount of inputs used or they may reduced their inputs by 28.4% to produced the same amount of outputs. Generally the results exhibited the foreign and domestic Islamic banks are behave similarly since the level of TE is contaminated by the inefficiency of managerial (PTIE) over the years 2006 to 2014.

4.3. Efficiency of Domestic Islamic vs. Foreign Islamic Banks

Table 5 shows the summary of TE, PTE and SE scores for each foreign and domestic Islamic banks in Malaysia, Indonesia and Brunei over the period of 2006–2014. The empirical findings seem to indicate that the domestic Islamic banks have exhibited higher mean TE (82.8% vs. 71.6%), PTE (90.5% vs. 84%) and SE (91% vs. 84.2%)

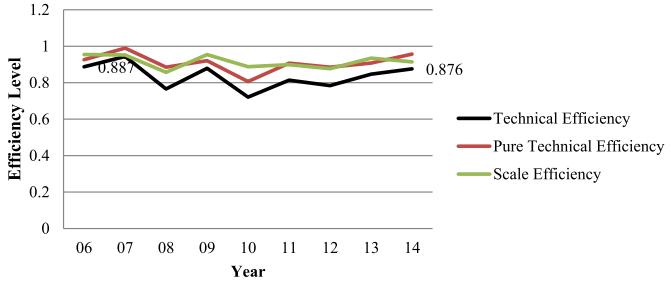

Fig. 1. Trend of efficiency level for Domestic Islamic Banks 2006–2014.

Table 4
Efficiency scores for foreign Islamic banks from 2006 until 2014.

Efficiency measures	Mean	Min	Max	SD
Panel 1: Foreign Islamic Banks 2006				
Technical Efficiency	0.354	0.001	1.000	0.560
Pure Technical Efficiency	0.733	0.198	1.000	0.463
Scale Efficiency	0.438	0.001	1.000	0.511
Panel 2: Foreign Islamic Banks 2007				
Technical Efficiency	0.712	0.168	1.000	0.471
Pure Technical Efficiency	0.772	0.341	1.000	0.373
Scale Efficiency	0.829	0.494	1.000	0.290
Panel 3: Foreign Islamic Banks 2008				
Technical Efficiency	0.598	0.137	1.000	0.302
Pure Technical Efficiency	0.761	0.190	1.000	0.313
Scale Efficiency	0.786	0.424	1.000	0.204
Panel 4: Foreign Islamic Banks 2009				
Technical Efficiency	0.676	0.417	0.876	0.197
Pure Technical Efficiency	0.926	0.741	1.000	0.117
Scale Efficiency	0.749	0.417	0.996	0.260
Panel 5: Foreign Islamic Banks 2010				
Technical Efficiency	0.665	0.432	1.000	0.207
Pure Technical Efficiency	0.797	0.616	1.000	0.144
Scale Efficiency	0.839	0.467	1.000	0.200
Panel 6: Foreign Islamic Banks 2011				
Technical Efficiency	0.761	0.600	1.000	0.173
Pure Technical Efficiency	0.815	0.656	1.000	0.151
Scale Efficiency	0.931	0.837	1.000	0.068
Panel 7: Foreign Islamic Banks 2012				
Technical Efficiency	0.729	0.516	1.000	0.174
Pure Technical Efficiency	0.807	0.623	1.000	0.133
Scale Efficiency	0.898	0.749	1.000	0.100
Panel 8: Foreign Islamic Banks 2013				
Technical Efficiency	0.843	0.801	0.914	0.050
Pure Technical Efficiency	0.905	0.819	0.986	0.062
Scale Efficiency	0.935	0.820	0.996	0.071
Panel 9: Foreign Islamic Banks 2014				
Technical Efficiency	0.920	0.830	1.000	0.076
Pure Technical Efficiency	0.955	0.900	1.000	0.041
Scale Efficiency	0.963	0.874	1.000	0.054
Panel for All: Foreign Islamic Banks All Years				
Technical Efficiency	0.716	0.001	1.000	0.258
Pure Technical Efficiency	0.840	0.190	1.000	0.199
Scale Efficiency	0.842	0.001	1.000	0.222

levels relative to their foreign Islamic bank counterparts. In essence, the empirical findings seem to indicate that domestic and foreign Islamic banks have not fully utilized the inputs efficiently to produce the same outputs.

As for TE, the average domestic and foreign Islamic banks could only generate 82.8% vs. 71.6% of outputs, less than what it was initially expected to generate due to the higher level of efficiency in managerial. Hence, outputs is lost by 17.2% vs. 28.4% (TIE), indicating that the average domestic and foreign Islamic banks loses an opportunity to receive 21.4% vs. 29.1% more outputs given the same amount of resources. This result shows that the domestic Islamic banks are more managerial efficient in overall to controlling cost compare to the foreign Islamic banks since the level of the TE in the domestic Islamic banks are higher than foreign Islamic banks.

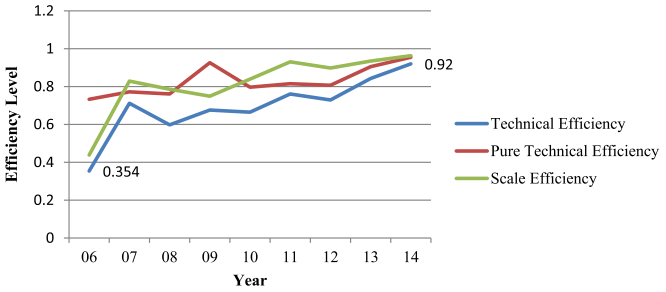

Fig. 2. Trend of efficiency level for Foreign Islamic Banks 2006–2014.

Table 5
Overall efficiency scores for Domestic vs. Foreign Islamic bank.

No.	Domestic Islamic Bank	TE	PTE	SE	No.	Foreign Islamic Bank	TE	PTE	SE
1	Affin Islamic Bank Berhad	0.752	0.762	0.986	1	Al Rajhi Banking & Investment Corporation (Malaysia) Berhad	0.630	0.712	0.833
2	Alliance Islamic Bank Berhad	0.965	1.000	0.965	2	Asian Finance Bank Berhad	0.487	0.750	0.668
3	AmIslamic Bank Berhad	0.949	0.978	0.970	3	HSBC Amanah Malaysia Berhad	0.838	0.901	0.932
4	Bank Islam Brunei Darussalam Berhad	0.478	0.528	0.904	4	Kuwait Finance House (Malaysia) Berhad	0.770	0.876	0.872
5	Bank Islam Malaysia Berhad	0.897	0.974	0.909	5	OCBC Al-Amin Bank Berhad	0.921	0.945	0.975
6	Bank Muamalat Malaysia Berhad	0.792	0.856	0.918	6	Standard Chartered Saadiq Berhad	0.722	0.905	0.814
7	CIMB Islamic Bank Berhad	0.899	0.950	0.947					
8	EONCAP Islamic Bank Berhad	0.831	0.892	0.928					
9	Hong Leong Islamic Bank Berhad	1.000	1.000	1.000					
10	Maybank Islamic Berhad	1.000	1.000	1.000					
11	PT Bank BRI Syariah	0.652	0.805	0.815					
12	PT Bank Jawa Barat Banten Syariah	1.000	1.000	1.000					
13	PT Bank Maybank Syariah Indonesia	0.938	1.000	0.938					
14	PT Bank Mega Syariah	0.860	1.000	0.860					
15	PT Bank Muamalat Indonesia Tbk	0.775	0.898	0.854					
16	PT Bank Panin Syariah	0.766	0.886	0.876					
17	PT Bank Syariah BNI	0.757	0.875	0.846					
18	PT Bank Syariah Bukopin	0.689	0.867	0.789					
19	PT Bank Syariah Mandiri	0.728	0.945	0.764					
20	PT Bank Victoria Syariah	1.000	1.000	1.000					
21	PT BCA Syariah	0.598	0.914	0.678					
22	Public Islamic Bank Berhad	0.860	0.870	0.988					
23	RHB Islamic Bank Berhad	0.864	0.927	0.934					
	Mean	**0.828**	**0.905**	**0.910**		**Mean**	**0.716**	**0.840**	**0.842**

For the SE, the results seem to suggest that the average domestic and foreign Islamic banks could only 91% vs. 84.2% of size efficient. Therefore, the both Islamic banks are lost the opportunity to generate 11% vs. 20.5% (SIE) more optimal outputs from the minimum level of inputs that may lead to the higher profit. The result state that the level of SE is higher in the domestic Islamic compared to the foreign Islamic banks. This implies that the domestic Islamic banks are more scale efficient than foreign banks to produce more outputs by utilize the less inputs to generate higher profit due to the optimal scale of operation.

Regarding PTE, the results indicate that on average domestic and foreign Islamic banks have utilized only 90.5% vs. 84% of the resources or inputs to produce the same level of outputs. On average, the both banks have wasted 9.5% and 16% (PTIE) of its inputs to produce the same level of outputs. Noticeably, the level of the PTE is higher in domestic Islamic banks rather than foreign Islamic banks. This indicates that the domestic Islamic banks are capable

Table 6
Robustness tests for efficiency scores of Domestic and Foreign Islamic banks 2006–2014.

Test groups						
	Parametric test		Non-parametric test			
	t-test		Mann-Whitney test		Kruskall-Wallis test	
Test statistics	t (Prb > t)		z (Prb > z)		χ^2 (Prb > $\chi^{2)}$	
	Mean	t	Mean rank	z	Mean rank	χ^2
Technical Efficiency						
Domestic Islamic Banks	0.828	2.778***	106.81	-2.789***	106.81	7.776***
Foreign Islamic Banks	0.716		80.51		80.51	
Pure Technical Efficiency						
Domestic Islamic Banks	0.905	2.137**	106.13	-2.566**	106.13	6.583**
Foreign Islamic Banks	0.840		82.66		82.66	
Scale Efficiency						
Domestic Islamic Banks	0.910	2.033**	106.04	-2.459**	106.04	6.046**
Foreign Islamic Banks	0.842		82.95		82.95	

Note: ***, ** and * indicate significance at the 1%, 5%, and 10% level respectively.

to utilize the minimum resources and involve with lower wastage of inputs rather than foreign Islamic banks because higher efficiency in the managerial purely.

In conclusion, the result shows that the level of TE for domestic Islamic banks are higher than foreign Islamic banks due to the similar problem where their PTIE outweighs SIE. In other words, although the domestic and foreign Islamic banks have been operating at a relatively optimal scale of operations, they were managerially inefficient to exploit their resources.

4.4. Robustness tests

After examining the results derived from the DEA method, the issue of interest now is whether the difference in the TE, PTE and SE of the domestic and foreign Islamic banks is statistically significant. Coakes and Steed (2003) suggest that the Mann-Whitney [Wilcoxon] is a relevant test for two independent samples coming from populations having the same distribution. The most relevant reason is that the data violate the stringent assumptions of the independent group's *t*-test. In what follows, we perform a series of robustness checks including parametric (*t*-test) and non-parametric (Mann-Whitney and Kruskall-Wallis) which suggested by Sufian and Kamarudin (2015) to obtain more robust results.

Table 6 shows the robustness tests. The results from the parametric *t*-test and non-parametric Mann-Whitney (Wilcoxon) test suggest that the domestic Islamic banks have exhibited a higher mean TE level than foreign Islamic bank peers ($0.828 > 0.716$) and significantly different at 1%. Likewise, the domestic Islamic banks have also exhibited a higher mean PTE ($0.905 > 0.840$) and SE ($0.910 > 0.842$) levels compared to foreign Islamic banks and significantly different at 5%. The results from the parametric *t*-test are further confirmed by the non-parametric Mann-Whitney (Wilcoxon) and Kruskall-Wallis tests.

Based on the results presented in Table 6, this study concludes that domestic Islamic bank is more efficient than foreign Islamic bank in these Southeast Asian countries since all tests shows those efficiencies are significant at 1% and 5%.

5. Conclusion

In this study, we examine the TE, PTE and SE of Islamic banks in selected Southeast Asian countries namely Malaysia, Indonesia and Brunei. This study examines 23 domestic Islamic banks and 6 foreign Islamic banks over the period of 2006–2014.

We discovered that domestic Islamic banks could have produced the same amount of outputs with only 82.8% of the amount of inputs used. In another word, domestic Islamic banks could have reduced their inputs by 17.2% and still could have produced the same amount of outputs. Overall the results imply that during the period of study, although the domestic Islamic banks were more scale efficient operating, they were mainly operating at the managerially inefficient in controlling costs.

Meanwhile, the foreign Islamic banks can produced the same amount of outputs with only 71.6% of the amount of inputs used or they may reduced their inputs by 28.4% to produced the same amount of outputs. Generally the results exhibited the foreign and domestic Islamic banks are behave similarly since the level of TE is contaminated by the inefficiency of managerial (PTIE).

In summary, this study found that domestic Islamic banks have exhibited higher TE, PTE and SE level than foreign Islamic banks in Malaysia, Indonesia and Brunei over the period 2006–2014 significance at 1% and 5% significance level. The result shows that the level of TE for domestic Islamic banks are higher than foreign Islamic banks due to the similar problem where their PTIE outweighs SIE. In other words, although the domestic and foreign Islamic banks have been operating at a relatively optimal scale of operations, they were managerially inefficient to exploit their resources.

The findings of this study provide the policy makers, banks' managers and investors an important insight on the performance of domestic and foreign Islamic banks. The policy makers may consider on a new rules and regulations in order to improve these Islamic banks efficiency. While, the manager of bank should consider improving the operations of Islamic banks to increase their market shares in Islamic banking industry. Furthermore, the investors and customers can easily make decisions for investing in Islamic banks based on their efficiency scores.

Due to its limitation, we would like to suggest that this study could be extended in a number of ways. Future researchers could consider measuring cost, revenue and profit efficiency of Islamic banks if the price data are available. In addition, researcher may employ the Malmquist Productivity Index for further investigation of changes of productivity in Islamic banks over the time.

Acknowledgements

We would like to thanks the editors and the anonymous referees of the journal for constructive comments and suggestions, which have significantly helped to improve the contents of the paper. Furthermore, special thanks to Fundamental Research Grant Scheme (FRGS) Vot No. 5524716 sponsored by Malaysian Ministry of Higher Education and Universiti Putra Malaysia Grant IPM Vot No. 9473700 sponsored by Universiti Putra Malaysia as an organizations that funded my research. The usual caveats apply.

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