

FINANCIAL AND SOCIAL EFFICIENCY ON INDONESIAN ISLAMIC BANKS: A NON-PARAMETRIC APPROACH

Aam Slamet Rusydiana¹ and Lina Marlina²

¹Sharia Economic Applied Research & Training (SMART), Indonesia, aamsmart@gmail.com

²University Tasikmalaya, Indonesia, linamarlina@unsil.ac.id

ABSTRACT

This paper explores financial and social efficiency in one assessment framework. In order to measure efficiency level of Islamic Banking Industry, this study uses Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH) methods. The results show that the level of financial efficiency of Islamic banks in Indonesia from 2013 to 2018 tends to decrease. On the contrary, the level of social efficiency of Islamic banks in Indonesia has a tendency to increase. Furthermore, the value of social efficiency of Islamic banks in Indonesia was relatively lower compared to the value of financial efficiency. Within the Financial-Social Efficiency Quadrant framework, the study classified two Islamic banks in quadrant 1, three in quadrant 2, two in quadrant 3, and four in quadrant 4. It is imperative for Islamic banks that are in the low level of 'social efficiency' to develop a policy to keep in line with the five factors of maqashid sharia apart of maintaining efficiency in order to reach *maslahah*. For the regulators, the social efficiency measurement framework could be an alternative in considering Islamic bank performance beyond financial efficiency.

Keywords: Financial Efficiency, Social Efficiency, DEA, FDH, Islamic Bank.

JEL Classification: D61; G21; P49.

Article history:

Received : September 5, 2019

Revised : September 19, 2019

Accepted : October 22, 2019

Available online : November 1, 2019

<https://doi.org/10.21098/jimf.v5i3.1154>

I. INTRODUCTION

1.1 Background

The Islamic banking industry development in Indonesia shows a relatively good development, although it seems slow. Based on sharia banking statistics in June 2019, the number of Islamic banking reached 14 Islamic Commercial Banks, 20 Islamic Business Units, and 164 Islamic Rural Banks with a total network of 2,266 offices throughout Indonesia (Financial Service Authority/Otoritas Jasa Keuangan, 2019).

Meanwhile, according to the Global Islamic Finance Report 2018, the Islamic finance industry in Indonesia is ranked sixth in the world after Malaysia, Iran, Saudi Arabia, UAE, and Kuwait. The index value of the Indonesian Islamic finance industry in 2018 is 24.13 on a scale of 100 and ranks sixth in the world (GIFR, 2018). However, Indonesia is still relatively unable to exploit the existing potential related to the Islamic finance economy.

The growth of Islamic banks is not much better when compared to the increase in the market share of Islamic banks themselves. The slow growth of Islamic banking which is currently only 5.9% of market share in the banking industry in Indonesia (OJK, 2019) is a phenomenon to evaluate the overall level of efficiency of Islamic banking in Indonesia. On the other hand, the issues related to efficiency serve as a channel in banking competition and generally affect banking stability (Schaeck and Cihak, 2014; Kasman and Carvallo, 2014), which is then important to be elaborated deeper. Various kinds of obstacles, ranging from competition factors to conversion of Islamic business units into Islamic commercial banks in that a great deal of investment value must be spent, consequently complicate conventional banking.

In assessing efficiency level, Data Envelopment Analysis (DEA) is relatively used more frequently to measure the level of technical efficiency and economies of scale of the banking industry and other financial institutions. Such an analysis is consistent with the research conducted by Rani et al. (2017), Kamarudin et al. (2016); Ozdemir (2013); Shahreki (2012); and Tsolas and Dimitris (2012), as well as Rusydiana (2018a, 2018b), Rusydiana & Sanrego (2018), and Rusydiana & Firmansyah (2017).

Islamic banks as intermediary should be able to allocate funds collected from third parties by way of channeling their funds into a more productive sector to produce a maximum output. Thus, efficiency will be created. The efficiency in question is technical efficiency, one that maximizes output with existing costs. A company is said to be technically efficient if it can produce more output by using a certain amount of input compared to other companies (Yotopulas and Lau, 1973).

Although the study of efficiency is not a hot topic now, the current condition requires researchers to revisit studies on efficiency, especially in Islamic banks in Indonesia. Ultimately, this is important for management and policy makers to consider whether Islamic banking in Indonesia could effectively provide benefits. Therefore, such a study must be conducted on efficiency through a financial and social efficiency approach. Through an analysis of financial efficiency, we could see the management's ability to determine its input and output to minimize costs and maximize income. Through social efficiency, we could evaluate the role of the Islamic banking industry in social function and the benefit of society in general.

1.2. Objective

Some studies conducted to measure Islamic bank performance used various frameworks of frontier efficiency. For the example, studies by Hadhek et al. (2018), Ali et al. (2016), and Abdul-Majid et al. (2011) used the parametric approach, while Kamarudin et al. (2017), Nafla and Hammas (2016), and Wahid (2016) used the non-parametric method, as well as Ascarya et al. (2008) and Rahmawati (2015) combining both parametric and non-parametric approaches. However, the studies did not explicitly address the issue of cost-saving strategies within the framework of social efficiency measurement. Therefore, the present study aims to measure financial and social efficiency in one assessment framework that is financial-social efficiency quadrant (FSEQ). This paper refers to Gutierrez-Goiria (2017) that measures the performance of financial institutions using social efficiency perspective.

II. LITERATURE REVIEW

2.1. Background Theory

Efficiency comes from the concept of microeconomics, i.e., the theory of producers. Production theory attempts to maximize profits or minimize costs from the point of view of the producer. In this regard, a production frontier curve illustrates the relationship between the input and output of the production process. The production frontier curve represents the maximum level of output from each use of inputs that represents the use of technology from a company or industry (Ascarya and Yumanita, 2007).

In the economic theory, two types of efficiency include economic efficiency and technical efficiency. While economic efficiency relates to the macroeconomic picture, technical efficiency relates to the microeconomic picture. Measurement of technical efficiency is only for techniques and operational relationships in the process of using input to output. In this context, the term efficiency in DEA refers more to the definition of technical efficiency, which is the relationship between input and output in a business unit.

Meanwhile in the company perspective, three types of efficiency are identified: technical efficiency, allocative efficiency, and economic efficiency. Technical efficiency reflects the company's ability to achieve optimal output levels using certain input levels. This efficiency measures the production process in producing a certain number of outputs using minimal input. In other words, a production process is considered technically efficient if the output of an item can no longer be increased without reducing the output of other goods.

A process can be considered efficient if various businesses have been carried out to achieve maximum output, both in terms of quantity and quality. An activity can also be called efficient if with input at a minimum able to reach a certain output. Oscar (2008) then divides efficiency into several parts, including technical efficiency, cost efficiency, scale efficiency, and allocation efficiency. Technical efficiency is the process of converting input into output. Such a concept only applies to internal technical relations between input and output. A company is considered economically efficient if it can minimize production costs to produce certain outputs in the general technological level and market price level (Farrell,

1957). Ascarya et al. (2008) explained the frontier approach is more superior due to the use of this technical program or statistics to reduce the effect of the difference of input price and other exogenous factors in influencing the observed performance. Frontier approach is divided into two kinds: parametric approach and non-parametric approach. Stochastic Frontier Approach (SFA), Thick Frontier Approach (TFA), and Distribution Free Approach (DFA) are kinds of parametric approaches, while Data Envelopment Approach (DEA) and Free Disposal Hull (FDH) are kinds of non-parametric approaches.

Data Envelopment Analysis (DEA) is preferable when measuring the degree of efficiency and productivity. DEA is widely used to measure the level of technical efficiency, scale of economic and industrial banks and financial institutions. Such an analysis fits with the research of Rani et al. (2017), Kamarudin et al. (2008), Ozdemir (2013), Shahreki (2012); and Tsolas and Dimitris (2012).

An activity can be called efficient if the effort has been done to provide maximum output quantitatively and qualitatively. An activity can also be said to be efficient if a minimum effort can achieve a certain output. Oscar (2008) divides efficiency into several parts: technical efficiency, scale efficiency, cost efficiency, and allocation efficiency. Technical efficiency is the process of converting inputs into outputs. This concept applies only to internal technical relationships between inputs and outputs. A company is considered economically efficient if it can minimize the production costs to produce certain output within common technology level and market price level (Farrell, 1957, Ramanathan, 2003).

Because Islamic economic and financial concepts have a relatively dual function: serving social and economic/financial purposes, there is debate among those who focus on the financial side, and those who focus on social aspects. Institutionalists focus more on the financial aspects and are relatively concerned about independence and sustainability. On the other hand, people on welfare claim that the Islamic banking and financial industry must be 'pro poor' first, and then profitability becomes a further concern.

The truth is that although the goal of Islamic banking is to allow access to funds for anyone, especially middle-low income people, they will not be able to achieve these goals without sustained profitability. Therefore, it can be concluded that Islamic banks must be efficient in both aspects to achieve the goal of "two dimensional efficiency".

Broadly speaking, two types of approaches are commonly used for measuring the level of frontier efficiency: parametric and non-parametric. The Stochastic Frontier Approach (SFA) approach, Thick Frontier Approach (TFA) and Distribution Free Approach (DFA) are parametric approaches, while those that include non-parametric approaches are Data Envelopment Approach (DEA) and Free Disposal Hull (FDH).

Deprins, Simar and Tulkens (1984) first introduced the Free Disposal Hull method, better known as FDH, which were then popular as alternatives to the DEA model. Deprins et al. (1984) measured the level of labor efficiency at the post office. His research entitled "Measuring labor-efficiency in post offices" became the first reference for this Free Disposal Hull method approach.

FDH is different from DEA where it eliminates the assumption of convection in the production frontier curve. FDH is a non-parametric efficiency measurement technique that is considered a generalization of DEA. The FDH model does not require the convex frontier estimate. Frontier estimation method is a mathematical approach that serves to determine best-practice firms, which is the company whose performance lies on the frontier curve line.

2.2. Previous Studies

DEA development and efficiency in general, is actually very dynamic with evidenced from the DEA extension and the many developing models. The following is a general description and extension of the development of the measurement model of frontier efficiency that the author identified.

Tabel 1.
Development of Analysis of Frontier Efficiency Measurement Model

No	Model	Year	Writers	Type
1	Stochastic Frontier Approach als77	1977	Aigner, Lovell, Schmidt	Parametric
2	SFA Model mvb77	1977	Meeusen & van den Broeck	Parametric
3	Data Envelopment Analysis CCR	1978	Charnes, Cooper, Rhodes	Nonparametric
4	SFA Model stev80	1980	Stevenson	Parametric
5	SFA Model mlti	1981	Pitt & Lee	Parametric
6	Malmquist Productivity Index	1982	Caves, Christensen, Diewert	Nonparametric
7	DEA Model BCC	1984	Banker, Charnes, Cooper	Nonparametric
8	Free Disposal Hull [FDH]	1984	Deprins, Simar, Tulkens	Nonparametric
9	SFA Model fe	1984	Schmidt & Sickles	Parametric
10	SFA Model regls	1984	Schmidt & Sickles	Parametric
11	DEA Additive Model	1985	Charnes, Cooper, Golany, Seiford, Stutz	Nonparametric
12	DEA Window Analysis	1985	Charnes, Clarke, Cooper, Golany	Nonparametric
13	DEA Assurance Region [DEA-AR]	1986	Thompson, Singleton, Thrall, Smith	Nonparametric
14	DEA Cross Efficiency	1986	Sexton, Silkman, Hogan	Nonparametric
15	DEA Facet Model	1988	Bessent, Bessent, Elam, Clark	Nonparametric
16	SFA Model mlti	1988	Battese & Coelli	Parametric
17	SFA Model fecss	1990	Cornwell, Schmidt, Sickles	Parametric
18	SFA Model kumb90	1990	Kumbhakar	Parametric
19	DEA Cone Ratio	1990	Charnes, Cooper, Huang, Sun	Nonparametric
20	TFA [Thick Frontier Approach]	1991	Berger & Humphrey	Parametric
21	SFA Model bc92	1992	Battese & Coelli	Parametric
22	Fuzzy DEA	1992	Sengupta	Nonparametric
23	DFA [Distribution Free Approach]	1993	Berger	Parametric
24	SFA Model fels	1993	Lee & Schmidt	Parametric
25	DEA Super Efficiency	1993	Andersen & Peterson	Nonparametric
26	SFA Model bc95	1995	Battese & Coelli	Parametric
27	Network DEA	1996	Fare & Grosskopf	Nonparametric
28	Hierarchical/Nested Model DEA	1998	Cook, Chai, Doyle, Green	Nonparametric
29	Bootstrapped DEA	1998	Simar & Wilson	Parametric

Tabel 1.
Development of Analysis of Frontier Efficiency Measurement Model (Continued)

No	Model	Year	Writers	Type
30	DEA Russell Measure [ERM]	1999	Pastor, Ruiz, Sirvent	Nonparametric
31	Imprecise Data [IDEA]	1999	Cooper, Park, Yu	Nonparametric
32	Parallel Model DEA	2000	Cook, Hababou, Tuenter	Nonparametric
33	Dynamic DEA	2000	Fare & Grosskopf	Nonparametric
34	DEA Slack Based Measure [SBM]	2001	Tone	Nonparametric
35	Meta Frontier	2003	Rao, O'Donnel, Battese	Nonparametric
36	Context-Dependent DEA	2003	Seiford & Zhu	Nonparametric
37	SFA Model gre03	2003	Greene	Parametric
38	SFA Model tfe	2005	Greene	Parametric
39	SFA Model tre	2005	Greene	Parametric
40	Game Cross Efficiency	2008	Liang, Wu, Cook, Zhu	Nonparametric

Since Charnes first introduced it, the development of the DEA (assuming CRS, producing technical efficiency or TE) model has varied greatly (Cooper & Rhodes, 1978). Malmquist index serves to measure the level of productivity of DMU (Caves et al. 1982). Then, the second DEA model, BCC assuming VRS (Banker, Charnes & Cooper, 1984) was introduced, producing pure technical efficiency or PTE, where TE divided by PTE would produce scale efficiency or SE. In the same year, Deprins et al. (1984) introduced another nonparametric model (FDH) to analyze intertemporal efficiency, Charnes et al. (1985) introduces DEA window analysis. Sexton et al. (1986) then propose DEA cross efficiency to avoid the problem of DEA value relativity. Andersen and Peterson (1993) introduce superefficiency DEA model that allows a maximum value of more than 1. Until the more dynamic DEA model introduced by Fare and Grosskopf (2000) and the slack based measure DEA are more suitable for input-output data in a varied form.

Meanwhile, for parametric models, there are at least 15 Stochastic Frontier Approach (SFA) models with variant assumptions, including the earlier SFA model (Aigner et al., 1977; Meeusen & van den Broeck, 1977; and Stevensen, 1980) to the more recent one introduced by Green (2005) with the truncated random effect (SFA-tre) model. Other parametric models such as Thick Frontier Approach (Berger and Humphrey, 1991) and Distribution Free Approach (Berger, 1993) are introduced.

III. METHODOLOGY

3.1. Data

The population in this study is Islamic banks in Indonesia from 2013 to 2018 were as many as eligible 11 banks, including: 1) Bank Syariah Mandiri (BSM); 2) Bank Muamalat Indonesia (BMI); 3) Bank Rakyat Indonesia Syariah (BRIS); 4) Bank Negara Indonesia Syariah (BNIS); 5) Bank Mega Syariah (MegaS); 6) Panin Dubai Syariah Bank (PaninS); 7) Bank Jabar Banten Syariah (BJBS); 8) Bank Syariah Bukopin (BukopinS); 9) BCA Syariah (BCAS); 10) Bank Maybank Syariah Indonesia (MaybankS); and 11) Bank Victoria Syariah (VictoriaS).

We exclude three other Islamic banks due to the completeness of the data. BTPN Syariah spin off to full-fledge Islamic bank in 2014, while BPD Aceh and BPD NTB converted in 2015 and 2018. This research is a quantitative study using secondary data obtained from annual financial reports from each banks. Some aggregate data related to financial ratios, such as Operating Cost per Operating Income (OCOI/BOPO), ROA, and ROE of Islamic banks, are taken from Sharia banking statistics OJK.

3.2. Model Development

In this study, the variables used to analyze financial efficiency are input variables consisting of deposits, labor costs, and general and administrative costs, while the output variable consists of total financing and operating income. Meanwhile, variables used to analyze social efficiency are input variables consisting of third-party funds, labor costs, and general and administrative costs. As far as output variables are concerned, they consist of financing for small businesses (small business loans/KUK) and social funds/virtues. The use of deposits and financing in input-output because this study uses an intermediation approach. This study modifies the intermediation approach to better reflect Islamic bank activities, as also adopted by Ascarya and Yumanita (2008) and Sufian (2006). The selection of input-output variables for the financial efficiency approach refers to the study of Sufian (2006) and Rusydiana (2018a). Meanwhile, the selection of input-output variables for the social efficiency reflects the works of Gutierrez-Goiria et al. (2017) and Widiarto & Emrouznejad (2015) with some modifications. Table 2 explains each input and output variable used in this study.

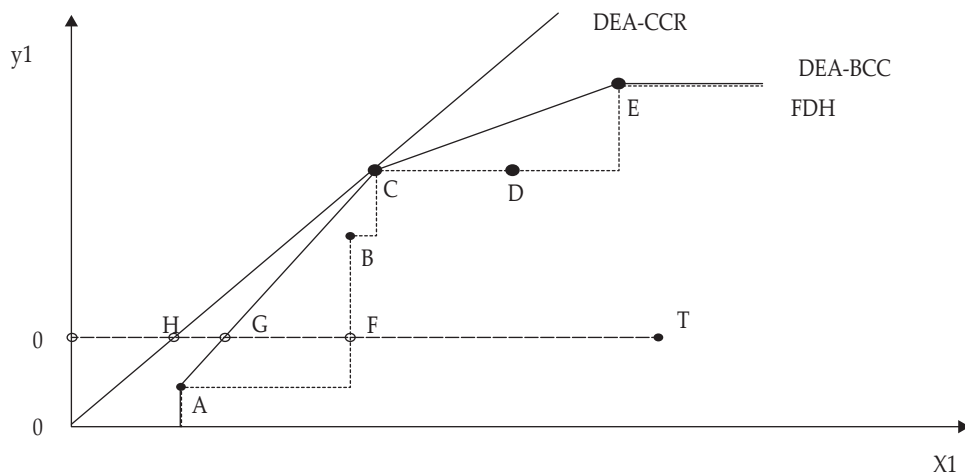
Table 2.
Input and Output Variables

	FINANCIAL EFFICIENCY	SOCIAL EFFICIENCY
Input variables	Deposits (DPK) (X1)	Deposits (DPK) (X1)
	Labor Costs (X2)	Labor Costs (X2)
	Administrative Costs (X3)	Administrative Costs (X3)
Output variables	Total financing (Y1)	Financing for SMEs (Y1)
	Operating income (Y2)	Social funds (Y2)

3.3. Method

This study will use three models of nonparametric efficiency measurements. The first is the DEA-CCR models, and then the two DEA BCC models are then compared with the Free Disposal Hull (FDH) model. The following is a comparison between the frontier curve for the assumptions of the two main and most commonly used DEA models, DEA CCR (1978), and the DEA BCC (1984) model, and then compared with the FDH model (1984).

Figure 1.
Frontier Non-parametric Deterministic Curve



The following is a comparison of the two DEA models and FDH models. It is assumed there is n DMU (decision making units), each of them producing s output by consuming m input. More formally, the DMU is denoted by input and output (x_j, y_j) where $x_j = (x_{1j}, \dots, x_{mj})$ and $y_j = (y_{1j}, \dots, y_{sj})$.

$\theta_k^* = \min \theta$
subject to:

$$-\sum_{j=1}^n x_{ij} \lambda_j + x_{ik} \theta \geq 0 \quad i = 1, \dots, m$$

$$\sum_{j=1}^n y_{rj} \lambda_j \geq y_{rk} \quad r = 1, \dots, s$$

$$\lambda_j \geq 0 \quad j = 1, \dots, n \quad (\text{DEA-CCR})$$

$$e \lambda_j = 1 \quad j = 1, \dots, n \quad (\text{DEA-BCC})$$

$$\lambda_j \in \{0, 1\} \quad j = 1, \dots, n \quad (\text{FDH})$$

The FDH name mainly reflects the meaning of 'free disposal' (free disposal) and can be considered a model whose linear combination coefficient are limited to 0 or 1, $\lambda_j \in \{0, 1\}$.

The method used in this research is Data Envelopment Analysis (DEA) and Free Disposal Hull (FDH). DEA is a nonparametric method using a linear program model to calculate the ratio of output and input ratios for all units being compared. The advantage of using DEA is that this approach does not require explicit specifications of the shape of the function and only requires a little structure to form its efficiency frontier. However, weaknesses may also arise, as it is self-identifier and near self-identifier. Farrel (1957) first developed the DEA approach by measuring the technical efficiency of one input and one output into multi-input and multi-output.

Efficiency analysis was carried out in twofold. The first calculation of efficiency is with the CRS or CCR approach, as was introduced by Charnes et al. (1978), producing technical efficiency (TE). The second calculation of efficiency is with the

VRS or BCC approach, as was first introduced by Banker et al. (1984), producing pure technical efficiency (PTE). The CCR model represents (the multiplication of) pure technical and scale efficiencies or $TE = PTE \times SE$, while BCC model represents pure technical efficiency only. Therefore, the relative scale efficiency is a ratio of CCR model and BCC models (Ascarya et al. 2008).

In this research, analysis was carried out in the following steps. First, we estimated the level of technical and pure technical efficiency using the Data Envelopment Analysis (DEA) model and then calculated efficiency score using Free Disposal Hull approach. Furthermore, the DEA method is widely applied to measure the level of technical efficiency, scale, and economies of the banking industry and financial institutions (Coelli et al 2005; Cooper 2010; Ozdemir 2013; Shahreki 2012; Tsolas and Dimitris 2012). Now, DEA has also begun to be widely used in measuring the level of efficiency of non-bank institutions, such as hospitals, universities, tax offices, manufacturing units, including non-profit institutions.

Several studies related to FDH, both theoretical and applied, have been carried out. For studies that are more theoretical in nature, can be found in the researches conducted by Tulkens (1993), Bardhan, Bowlin, Cooper and Sueyoshi (1996), De Borger, Ferrier and Kerstens (1998), Thrall (1999), Park, Simar and Weiner (2000), Cherchye, Kuosmanen and Post (2001) and Green and Cook (2004). Meanwhile, a more applied FDH study in several industries can be seen in the studies conducted by De Borger and Kerstens (1996), Wang, Song and Cullinane (2003), Geys and Moesen (2009), and Sanei and Chatghayeh (2013).

IV. RESULTS AND ANALYSIS

4.1. Financial Efficiency

The following table describes the results of the efficiency values both financially and socially through three approaches namely CRS, VRS and FDH. For the first table, it explains that the value of financial efficiency of Islamic commercial banks in Indonesia in 2013 to 2018 relatively decreased. In the CRS approach for example, the average value of Islamic bank financial efficiency in 2013 was 0.76, and then slightly decreased in 2015 to 0.75 and back down in 2016 to 0.72. The average value of Islamic bank financial efficiency in Indonesia in 2018 through the CRS approach is 0.65.

In the VRS approach, which is the second model, BCC DEA, the average value of Islamic bank financial efficiency in 2013 was 0.95, then declined slightly in 2014 to 0.93 and rose again in 2015 to 0.94. The average value of Islamic bank financial efficiency in Indonesia in 2016 by the VRS approach was 0.92. In 2018 toward the end of the study, the efficiency of Islamic banks was 0.85.

Finally, through the free disposal hull (FDH) approach, the average value of Islamic bank financial efficiency is relatively higher than the CCR and BCC models. As it appears, it could be because the FDH frontier curve is relatively looser in its assumptions with its non-convex form of production frontier. In 2013, the average value of Islamic bank financial efficiency was 0.99, then declined slightly in 2014 and 2015 to 0.97 and 0.96 respectively, and rose again in 2016 to 0.97 and again fell in 2017 to 0.94. The average value of Islamic bank financial efficiency in Indonesia in 2018 through the FDH approach is 0.89.

As far as the results are concerned, it can be concluded that the level of financial efficiency of Islamic banks in Indonesia from 2013 to 2018 tends to decrease. If we further analyze the financial ratios of Islamic banks in Indonesia over the past 10 years, we can see that the OCOI of Islamic banks was higher than conventional banks' OCOI since 2012. Islamic bank ROA also has been sharply declining since 2013. Furthermore, the efficiency figures generated from the CRS approach are relatively smaller when compared to the other two approaches. Generally, the efficiency score of CCR model (CRS) for each DMU will not exceed the efficiency score of BCC model (VRS). This is because BCC model evaluates each DMU 'locally' rather than 'globally' (Jemric and Vujcic, 2002; Ascarya et al. 2008). In other words, the results of CRS, which are always, lower than VRS show low scale efficiency or SE below 1.00. Meanwhile FDH models tend to produce high efficiency scores. This is understandable because indeed the FDH frontier curve is relatively looser in its assumptions with its non-convex form of production possibility frontier (PPF) (Deprins et al, 1984).

Table 3.
Financial Efficiency of Islamic bank 2013-2018 with 3 Model

FINANCIAL EFFICIENCY	2013			2014			2015		
	CRS	VRS	FDH	CRS	VRS	FDH	CRS	VRS	FDH
BSM	0.71	1.00	1.00	0.65	1.00	1.00	0.65	1.00	1.00
BMI	0.73	1.00	1.00	0.66	1.00	1.00	0.67	0.98	0.99
BRIS	0.60	0.95	0.99	0.57	0.91	1.00	0.58	0.85	0.89
BNIS	0.69	0.98	1.00	0.69	0.99	1.00	0.76	1.00	1.00
MegaS	0.82	1.00	1.00	0.89	1.00	1.00	0.65	0.87	0.89
PaninS	0.78	0.83	0.98	0.86	1.00	1.00	0.80	0.92	1.00
BJBS	0.74	0.92	0.98	0.74	0.93	0.97	0.89	1.00	1.00
BukopinS	0.84	0.94	1.00	0.78	0.92	1.00	0.83	0.91	0.93
BCAS	0.83	1.00	1.00	0.89	0.90	1.00	0.77	0.86	0.91
MaybankS	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
VictoriaS	0.62	0.87	0.98	0.62	0.63	0.67	0.61	1.00	1.00
MEAN	0.76	0.95	0.99	0.76	0.93	0.97	0.75	0.94	0.96
FINANCIAL EFFICIENCY	2016			2017			2018		
	CRS	VRS	FDH	CRS	VRS	FDH	CRS	VRS	FDH
BSM	0.63	1.00	1.00	0.65	1.00	1.00	0.67	1.00	1.00
BMI	0.71	1.00	1.00	0.7	1.00	1.00	0.65	0.91	0.93
BRIS	0.58	0.85	0.91	0.52	0.72	0.83	0.55	0.77	0.84
BNIS	0.73	1.00	1.00	0.72	0.99	0.99	0.69	0.97	1.00
MegaS	0.55	0.76	0.95	0.55	0.72	0.85	0.56	0.71	0.82
PaninS	0.77	0.90	1.00	0.88	1.00	1.00	0.71	0.81	0.95
BJBS	0.85	1.00	0.92	0.75	0.91	0.97	0.63	0.84	0.85
BukopinS	0.90	0.99	1.00	0.70	0.83	0.95	0.78	0.86	0.89
BCAS	0.71	0.81	0.96	0.69	0.81	0.89	0.68	0.78	0.84
MaybankS	0.87	1.00	1.00	0.66	1.00	1.00	0.59	1.00	1.00
VictoriaS	0.61	0.87	0.97	0.77	0.83	0.87	0.64	0.66	0.71
MEAN	0.72	0.92	0.97	0.69	0.89	0.94	0.65	0.85	0.89

4.2. Social Efficiency

A perspective of social efficiency explores Islamic commercial banks in Indonesia. The following table illustrates that the value of social efficiency of Islamic commercial banks in Indonesia in 2013 to 2018 was relatively different in results from the three nonparametric efficiency models of CRS, VRS and FDH, but shows the same tendency of increased efficiency.

In the CRS approach, the DEA CCR model, the average value of Islamic bank social efficiency in 2013 has a low value of 0.33. Then it experienced an increase in 2014 to 0.48 and slightly increases again in 2015 and 2016 to 0.51. The average value of Islamic bank social efficiency in Indonesia in 2017 and 2018 by the CRS approach was 0.49.

In the VRS approach, which is the second model, BCC DEA, the average value of Islamic bank social efficiency in 2013 was 0.56, and increased slightly in 2014 to 0.57. The value of efficiency increased dramatically in 2015 to 0.76 and fell back in 2016 to 0.70. At the end of the VRS approach observation period, the average value of Islamic bank social efficiency in Indonesia in 2018 was 0.68.

Finally, based on the free disposal hull (FDH) approach, the average value of Islamic bank social efficiency is relatively higher than DEA model. In 2013, the average value of Islamic bank social efficiency was 0.89. It then increased in 2014 to 0.95 and fell back in 2015 and 2016 to 0.92 and 0.85 respectively. At the end of 2018, Islamic bank social efficiency value was 0.94. If seen, the trend of social efficiency of Islamic bank in Indonesia increased from 2013 to 2018.

Ultimately, it can be concluded that in contrast to the decreasing value of financial efficiency, the level of social efficiency of Islamic banks in Indonesia from 2013 to 2018 has a tendency to increase. Comparatively, the value of social efficiency of Islamic banks in Indonesia in the period 2013-2018 was relatively lower compared to the value of financial efficiency. Another important finding is that the average efficiency of the FDH model is higher than the efficiency of the BCC (VRS) and CCR (CRS) models.

Table 4.
Social Efficiency of Islamic Bank 2013-2018 with 3 Model

SOCIAL EFFICIENCY	2013			2014			2015		
	CRS	VRS	FDH	CRS	VRS	FDH	CRS	VRS	FDH
BSM	0.51	0.51	1.00	1.00	1.00	1.00	0.55	1.00	1.00
BMI	0.54	0.63	1.00	0.50	0.51	1.00	0.47	0.66	1.00
BRIS	0.33	0.34	1.00	0.35	0.35	1.00	0.66	0.98	1.00
BNIS	0.54	0.57	1.00	0.66	0.67	1.00	0.62	0.74	1.00
MegaS	0.46	0.49	1.00	0.56	0.60	1.00	0.71	0.72	1.00
PaninS	0.24	0.31	0.76	0.57	0.59	0.54	0.02	0.03	0.12
BJBS	0.03	0.04	0.20	0.37	0.37	1.00	0.49	0.50	1.00
BukopinS	0.29	0.29	1.00	0.15	0.55	0.87	1.00	1.00	1.00
BCAS	0.02	1.00	1.00	1.00	1.00	1.00	0.71	0.78	1.00
MaybankS	0.50	1.00	1.00	0.07	0.33	1.00	0.05	1.00	1.00
VictoriaS	0.20	1.00	0.81	0.05	0.29	1.00	0.28	1.00	1.00
MEAN	0.33	0.56	0.89	0.48	0.57	0.95	0.51	0.76	0.92

Table 4.
Social Efficiency of Islamic Bank 2013-2018 with 3 Model (Continued)

SOCIAL EFFICIENCY	2013			2014			2015		
	CRS	VRS	FDH	CRS	VRS	FDH	CRS	VRS	FDH
BSM	0.71	1.00	1.00	0.55	0.97	1.00	1.00	1.00	1.00
BMI	0.39	0.52	0.94	0.47	0.70	1.00	0.41	0.54	0.86
BRIS	0.67	1.00	1.00	0.71	1.00	1.00	0.71	1.00	1.00
BNIS	0.60	0.73	1.00	0.63	0.73	1.00	0.54	0.65	1.00
MegaS	0.92	0.92	1.00	1.00	1.00	1.00	0.85	0.89	0.93
PaninS	0.02	0.03	0.12	0.02	0.03	0.72	0.12	0.22	0.92
BJBS	0.23	0.23	0.24	0.13	0.14	0.16	0.20	0.20	0.92
BukopinS	1.00	1.00	1.00	0.70	0.71	1.00	0.49	0.50	1.00
BCAS	0.71	0.74	1.00	0.65	0.65	1.00	0.44	0.45	0.68
MaybankS	0.10	0.64	1.00	0.23	1.00	1.00	0.22	1.00	1.00
VictoriaS	0.22	0.92	1.00	0.25	1.00	1.00	0.43	1.00	1.00
MEAN	0.51	0.70	0.85	0.49	0.72	0.90	0.49	0.68	0.94

4.3. Financial-Social Efficiency

In this research, the Islamic commercial banks are grouped into four quadrants based on categories of levels of financial efficiency and social efficiency, i.e. *high* and *low*¹. Quadrant 1 includes Islamic commercial banks that have a high level of financial and social efficiency, which can be considered as the best Islamic banks compared to other quadrant groups.

On the other hand, Quadrant 4 is a group of sharia commercial banks with equally low financial and social efficiency values. A collection of Islamic commercial banks in this group can be considered as Islamic banks that require an increase in performance from both values. The good side is that the Islamic bank group in this quadrant is expected to be able to reach the potential for increasing efficiency levels in the future.

Table 5.
Islamic Bank Financial Efficiency in Indonesia 2013-2018

FINANCIAL EFFICIENCY	2013	2014	2015	2016	2017	2018
BSM	0.71	0.65	0.65	0.63	0.65	0.67
BMI	0.73	0.66	0.67	0.71	0.70	0.65
BRIS	0.60	0.57	0.58	0.58	0.52	0.55
BNIS	0.69	0.69	0.76	0.73	0.72	0.69
MegaS	0.82	0.89	0.65	0.55	0.55	0.56
PaninS	0.78	0.86	0.80	0.77	0.88	0.71
BJBS	0.74	0.74	0.89	0.85	0.75	0.63
BukopinS	0.84	0.78	0.83	0.90	0.70	0.78
BCAS	0.83	0.89	0.77	0.71	0.69	0.68
MaybankS	1.00	1.00	1.00	0.87	0.66	0.59
VictoriaS	0.62	0.62	0.61	0.61	0.77	0.64
MEAN						0.65

Table 6.
Islamic Bank Financial Efficiency in Indonesia 2013-2018

SOCIAL EFFICIENCY	2013	2014	2015	2016	2017	2018
BSM	0.51	1.00	0.55	0.71	0.55	1.00
BMI	0.54	0.50	0.47	0.39	0.47	0.41
BRIS	0.33	0.35	0.66	0.67	0.71	0.71
BNIS	0.54	0.66	0.62	0.60	0.63	0.54
MegaS	0.46	0.56	0.71	0.92	1.00	0.85
PaninS	0.24	0.57	0.02	0.02	0.02	0.12
BJBS	0.03	0.37	0.49	0.23	0.13	0.20
BukopinS	0.29	0.15	1.00	1.00	0.70	0.49
BCAS	0.02	1.00	0.71	0.71	0.65	0.44
MaybankS	0.50	0.07	0.05	0.10	0.23	0.22
VictoriaS	0.20	0.05	0.28	0.22	0.25	0.43
MEAN						0.49

Quadrant 2 includes Islamic banks (BUS) that have a high value of financial efficiency, but on the other hand low social efficiency. A collection of Islamic public banks in this group can be considered as Islamic banks with the ability to transform inputs into good output in terms of finance in general, but not good at generating social performance.

The quadrant 3 includes the Islamic banks that have a low value of financial efficiency, but a relatively high value of social efficiency. This collection of Islamic public banks in quadrant 3 can be considered Islamic banks with high social-empowerment capabilities, but is relatively weak in transforming input into general financial output.

Figure 2.
iB Quadrant based on Financial and Social Efficiency in 2018

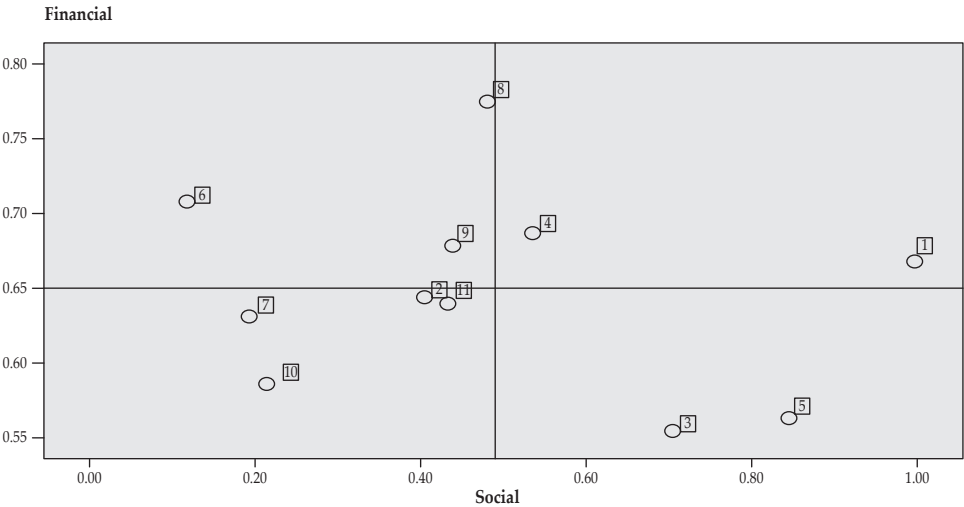


Figure 2 indicates a division of the group of Islamic commercial banks (BUS) based on the calculation of financial efficiency level (CRS) achieved in last period (year 2018) and its social efficiency, under two categories: financial efficiency figures (y) and average social efficiency values (x). In the DEA analysis, the last period is the most important period, especially in relation to the next potential improvement.

Information:

Quadrant 1 (High FinEfficiency, High SocEfficiency): BSM, BNIS

Quadrant 2 (High FinEfficiency, Low SocEfficiency): PaninS, BukopinS, BCAS

Quadrant 3 (Low FinEfficiency, High SocEfficiency): BRIS, MegaS

Quadrant 4 (Low FinEfficiency, Low SocEfficiency): VictoriaS, MaybankS, BMI, BJBS

In the Figure 2, it can be seen that in the 2018 study period or last year, there were 2 Islamic commercial banks in quadrant 1, there were 3 Islamic banks in quadrant 2, and 2 Islamic banks that entered into quadrant 3. Meanwhile, four Islamic banks are in the quadrant 4 category.

Quadrant group 1 is a category of Islamic bank that has a high level of financial and social efficiency. There are two Islamic commercial banks included in this category, namely Bank Syariah Mandiri (BSM) and BNI Syariah. BSM has a financial efficiency value of 67% and the value of social efficiency is 100%. BNI Syariah has a financial efficiency value of 69% and the value of social efficiency is 54%. A collection of Islamic banks in this group is considered a sharia bank with high financial and social efficiency values, or the best compared to other quadrants.

Quadrant group 2 is a category of Islamic bank that has a high level of financial efficiency but on the other hand has a low value of social efficiency. Islamic banks included in this category are Panin Syariah, Bukopin Syariah and BCA Syariah. Panin Syariah has a financial efficiency value of 71% but has a social efficiency value of only 12%. Bukopin Syariah has a financial efficiency value of 78% and the value of social efficiency is 49%. Meanwhile BCA Syariah has a value of financial efficiency of 68% and has a value of social efficiency of 44%. Therefore, these three banks are included in Islamic commercial banks with a high value of financial efficiency but are relatively low in value for social efficiency.

Quadrant group 3 is a group of Islamic commercial banks that have a low level of financial efficiency, but, on the other hand, have a relative high value of social efficiency. Two Islamic commercial banks fall into this category: BRI Syariah and Mega Syariah. BRI Syariah has a value of financial efficiency of 55% and the value of social efficiency of 71%. Meanwhile, Bank Mega Syariah has a financial efficiency value of 56% and the value of social efficiency of 85%. A collection of Islamic commercial banks in this group can be considered as Islamic banks that have a relatively low level of financial efficiency compared to the industry but are relatively high in social efficiency.

The last group of quadrants, quadrant 4, is the category of Islamic banks, which has a low level of financial efficiency and a low value of social efficiency. Four Islamic commercial banks fall into this category: Victoria Syariah, Maybank Syariah, BMI, and BJB Syariah. Victoria Syariah has a financial efficiency value of 64%, and the value of social efficiency is 43%. Maybank Syariah has a financial

efficiency value of 59% and the value of social efficiency of 22%. BMI has a financial efficiency value of 65% and the value of social efficiency of 41%. Meanwhile, BJB Syariah has a value of financial efficiency of 63% and the value of social efficiency of 20%. All Islamic banks in quadrant 4 are included as Islamic banks with relatively low financial and social efficiency values.

4.4. Analysis

The issues related to efficiency are very important. Efficiency become a channel between banking competitions and generally affects banking stability (Schaeck and Cihak, 2014; Kasman and Carvallo, 2014), and it is then important to be elaborated deeper. This also applies to the Islamic bank industry. The results show that the level of financial efficiency of Islamic banks in Indonesia tends to decrease from 2013 to 2018. If we compare the financial ratios of Islamic and conventional banks in Indonesia over the past 10 years, especially after the global financial crisis, we can see that the OCOI of Islamic banks is higher than conventional banks' OCOI since 2012. Such a fact is similar with the conditions of ROA, in that a decline in the performance of Islamic banks in Indonesia, especially in the post or second round crisis. That said, arguably Islamic banks in Indonesia are more affected by financial crisis. Kamarudin et al. (2016b) concluded that the impact of the financial crisis on the level of banking efficiency actually occurred after the crisis, not during a crisis, due to the time lag or time lapse until the impact begins to be felt in the financial and banking industries. (insert Figure 3)

Figure 3.
Islamic vs. Conventional Bank Financial Ratio (OCOI & ROA)

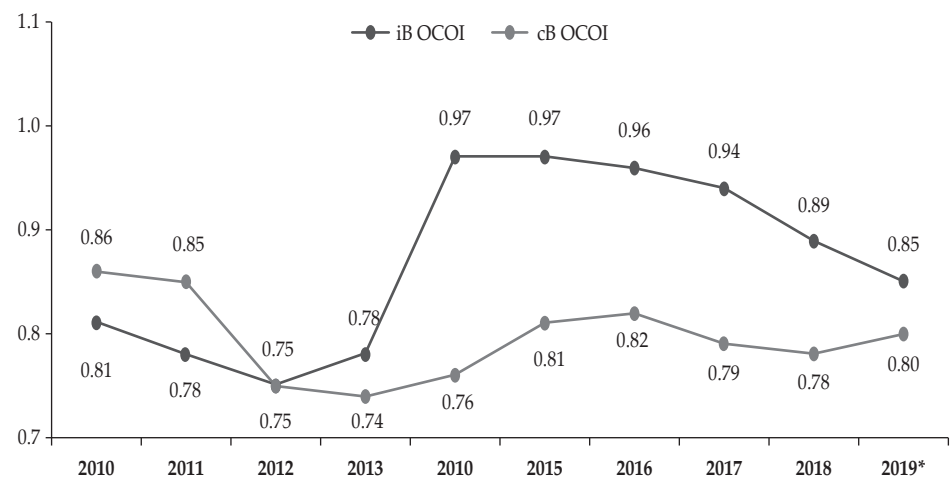
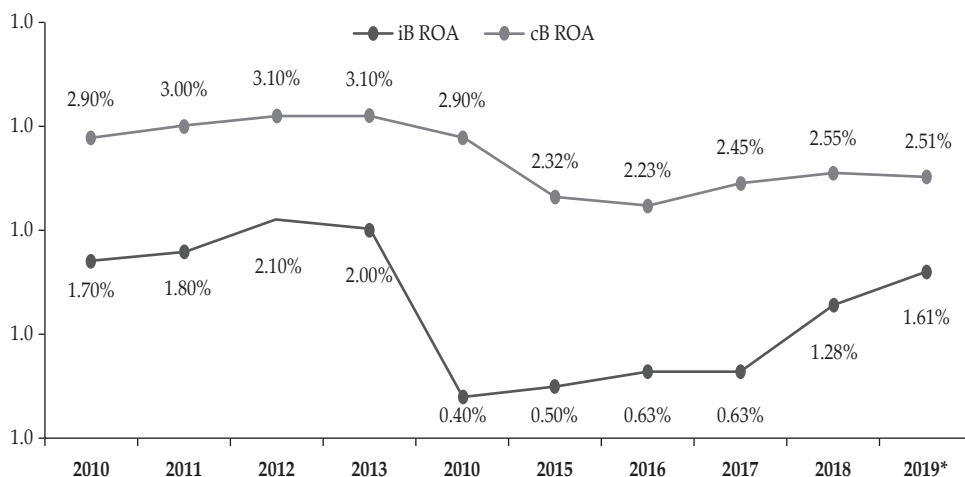


Figure 3.
Islamic vs. Conventional Bank Financial Ratio (OCOI & ROA) (Continued)



The results are relevant to Hidayati et al. (2017) that Islamic banks and Islamic business units in Indonesia did not function efficiently in its intermediation. Islamic commercial banks in Indonesia are able to optimize their resource inputs to produce outputs as an intermediary institution (Farandy et al., 2017). Ascarya and Yumanita (2007b) proved that the Islamic bank's production approach has a decreased technical efficiency, but has an increased scale efficiency because at that time the Islamic bank was quite aggressive in expanding the opening of new offices. However, the results of the present study are slightly different. The decline in the level of efficiency of Indonesian Islamic banking industry occurs due to vulnerability in global financial instability as well as from domestic source. In addition, a relatively high NPF level of Islamic banks could also contribute to this inefficiency. Expectedly, our results are in line with the findings of Zeitun and Benjelloun (2013) who examined the level of banking efficiency in developing economies. Their study concluded that the financial crisis had a significant impact on the level of bank efficiency. To improve the efficiency level, Islamic banks should continuously increase the amount of total deposits and financing volume and make it more efficient in generating profit (Pramuka, 2009). In this research, it is necessary to streamline labor and administrative costs, increase operational income and MSME financing to increase the level of efficiency of Islamic banks on a regular basis.

Table 7.
Potential Improvements of Financial (Top) and Social Efficiency (Bottom)

FIN-EFF min	2013	2014	2015	2016	2017	2018	Max	2013	2014	2015	2016	2017	2018
Deposits (X1)	-26.3	-26.5	-28	-28.1	-30.8	-36.8	X1	0.0	0.0	0.0	0.0	0.0	0.0
LaborCost(X2)	-42.5	-42.1	-32.2	-31.2	-34.6	-38.6	X2	-19.3	-17.7	-5.6	-3.8	-5.8	-4.7
AdmCost(X3)	-28.2	-33.9	-36.4	-36.7	-39.8	-44.6	X3	-2.5	-8.8	-10.2	-11.4	-12.4	-14.1
TotalFin(Y1)	3.93	5.8	0.0	0.0	0.0	16.8	Y1	38.5	41.8	37.7	42.6	47.2	48.8
OpsIncome(Y2)	8.69	5.2	25.7	22.6	21.46	21.9	Y2	45.3	41.5	53.3	48.1	66.4	59.6

SOC-EFF min	2013	2014	2015	2016	2017	2018	Max	2013	2014	2015	2016	2017	2018
Deposits (X1)	-74.5	-59.9	-49.5	-49.6	-51.7	-54.3	X1	-23.9	-12.4	-4.2	-4.5	-5.6	-4.9
LaborCost(X2)	-76.7	-61.2	-55.9	-53.8	-56.3	-54.8	X2	-30.5	-16.5	-11.6	-9.9	-11.8	-8.1
AdmCost(X3)	-69.7	-56.9	-54.9	-55.5	-55.4	-55.3	X3	-7.3	-13	-16.4	-16.3	-16.5	-15.4
MSMEFin(Y1)	26.4	28.7	22.7	3.7	4.1	4.5	Y1	69.6	68.5	68.2	64.7	62.5	59.4
SocialFund(Y2)	0.0	0.0	13.2	4.9	0.2	0.8	Y2	62.4	59.9	77.8	70.4	62.5	60.4

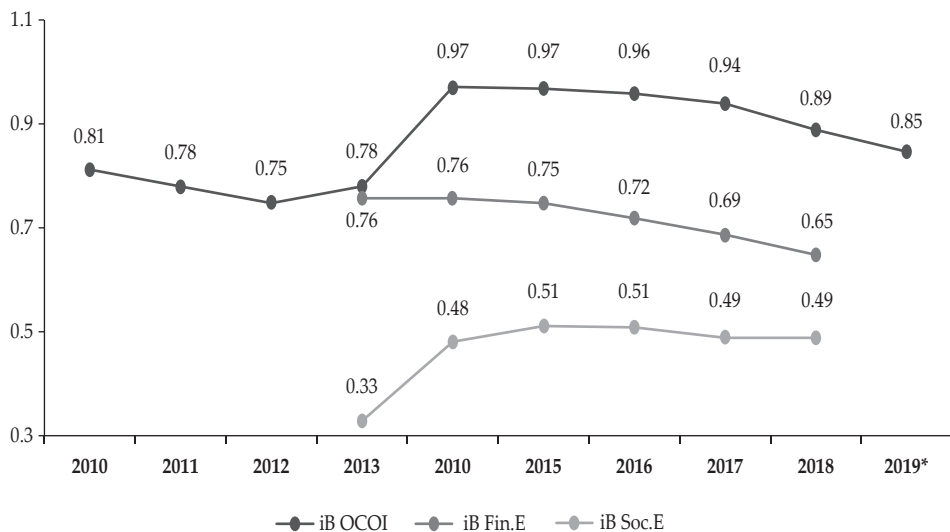
In 2013-2018, Islamic banks in financial efficiency suffered some weaknesses, including labor cost and administrative cost in input and operating income in output. Only in 2014 the weakness aspect of Islamic banks was on total financing in output (see Table 7, top). In general, the operational income of Islamic banks still needs to be increased relatively in order to be more competitive with conventional banks. Likewise, aspects of labor and administrative costs need to be saved and streamlined.

Meanwhile, Islamic banks in social efficiency have also suffered weaknesses in 2013-2018, including labor and administrative cost in input and MSME financing in output (see table 7, bottom). Only in 2013 and 2016, the weakness aspect of Islamic banks was on deposits in input (2013) and social funds in output (2016). In fact, financing for MSME has relatively greater risk compared to other portfolios.

As opposed to the decreasing value of financial efficiency, the level of social efficiency of Islamic banks in Indonesia from 2013 to 2018 had a tendency to increase. Anwar (2016) said that Islamic banks outperformed conventional banks in one model when taking into account micro, small and medium enterprises (MSME) financing as one of the output components in the model of DEA efficiency. Islamic banks have higher average small business financing portfolio than that of conventional banks.

Based on the findings of this research, the value of social efficiency of Islamic banks in Indonesia in the period 2013-2018 was relatively lower compared to the value of financial efficiency. Interestingly, the social efficiency of Islamic banks in Indonesia tends to increase. However, the results did not confirm the comparison between Islamic banks and conventional banks from the perspective of social efficiency. It would be more interesting if the two banks were compared. Some studies indicate that Islamic banks are relatively more efficient than conventional banks in Indonesia, as shown by their higher overall efficiency, as well as technical efficiency (Sakti and Mohamad, 2018; Ascarya et al. 2008; Omar et al. 2007).

Figure 4.
Comparison Between OCOI, Financial Efficiency and Social Efficiency



Note: * data June 2019.

In Figure 4, in general the value of Islamic bank financial efficiency in Indonesia decreased from 76% in 2013 to only 65% in 2018. Conversely, the value of social efficiency of Islamic banks in Indonesia increased relatively from 33% in 2013 to 49% in 2018. When compared with the average OCOI value of Islamic banks over the past 10 years, OCOI conditions reflect the value of social efficiency more so compared to the value of financial efficiency, especially after 2012. The increase in the value of social efficiency is directly proportional to the decline in Islamic bank OCOI in the same period.

Moreover, the integration of financial markets in the form of the Asian Economic Community necessitates intense competition between banks in Southeast Asia (Ajija et al., 2017). Besides conventional banking, Islamic banks will face the same challenges. Islamic banks also face an era of the enactment of Law 21 implementation about spin-off policy in 2023 (Al Arif et al. 2019). Therefore, it is necessary to have a reliable banking management within the framework of improving efficiency and the overall performance of Islamic banks in Indonesia. On the other hand, the authority needs to make the right policy to keep the banking industry more competitive, as Defung et al. (2016) state that the impact of regulatory reforms is generally positive and statistically significant to the efficiency level of Indonesian banking industry.

V. CONCLUSION AND RECOMMENDATION

5.1. Conclusion

This paper aims to assess the Islamic banks in Indonesia in two frameworks, financial and social efficiency using nonparametric approach. Financial efficiency of Indonesian Islamic banks has a downward trend from 2013 to 2018. It can be seen

from the average efficiency value of Islamic banks, both the CCR, BCC, and FDH model. The average technical efficiency of Islamic banks in Indonesia decreased from 0.76 in 2013 to 0.65 in 2018. Conversely, the value of social efficiency of Islamic banks in Indonesia tends to increase from year to year. In 2013 only 0.33 (CCR), the value of the social efficiency of Islamic Banks in 2018 was be 0.49. This shows that the social function of Islamic banks in Indonesia is getting better.

In general, the value of social efficiency of Islamic banks in Indonesia is relatively lower compared to the value of financial efficiency. Furthermore, the average efficiency value of the FDH model is higher than the efficiency of the BCC (VRS) and CCR (CRS) models due to the FDH frontier curve being relatively looser in its assumptions with its non-convex form of production possibility frontier.

Based on categories of levels of financial efficiency and social efficiency, Islamic banks that fall into the first quadrant group with high financial and social efficiency values are: Bank Syariah Mandiri and BNI Syariah. Islamic banks that are included in the second quadrant group are those that have high financial efficiency values but have relatively low social efficiency scores, namely Panin, BSB and BCA Syariah. Islamic banks which are included in the third quadrant group with low financial efficiency values but have relatively high social efficiency include: BRI Syariah, and Bank Mega Syariah. Finally, the fourth quadrant Islamic bank with low financial and social efficiency values are: Victoria Syariah, Maybank, BMI and BJB Syariah.

5.2. Recommendation

For Islamic Bank Industry, a comprehensive understanding related to a good performance concept from financial and social aspects are needed. This comprehensive understanding reached in order to maintain the objectives of Islamic Banking, that not only profit would be the success measurement, but there are some others important measurement to rate the success of bank, related to social-maslahah perspective. For the regulator, this social efficiency measurement framework can be an alternative in looking at Islamic bank performance beyond financial efficiency. For academic perspective, efficiency analysis can be conducted by others method, so the result would be compared, and the data used must be updated in order to achieve the update research result. For further research, it is interesting to compare between the efficiency values of Islamic banks and conventional banks in Indonesia, from a financial perspective and especially social efficiency. Of course, taking into account the input and output variables that are appropriate for each perspective.

REFERENCES

- Abbasi, M., Jahanshahloo, G.R., Malkhalifeh, M.R., and Lotfi, F.H. (2014). Estimation of Congestion In Free Disposal Hull Models Using Data Envelopment Analysis. *The Scientific World Journal*, 2014, 1-9.
- Abdul-Majid, M., Saal, D.S., and Battisti, G. (2011). The Impact of Islamic Banking on the Cost Efficiency and Productivity Change of Malaysian Commercial Banks. *Applied Economics*, 43(16), 2033-2054.

- Ajija, S.R., Yasin, M.Z., and Albra, R. (2017). Indonesian Banking Efficiency: Transmission to the Financial Stability Confronting ASEAN Economic Community. *Jurnal Ekonomi Pembangunan*, 18(2), 183-193.
- Akhter, W., Raza, A., Akram, M. (2011). Efficiency and Performance of Islamic Banking: The case of Pakistan. *Far East Journal of Psychology and Business*, 2(2), 54-71.
- Al-Arif, M.N.R., Mufraini, M.A., Prabowo, M.A. (2019). Market Structure, Spin-Off and Efficiency: Evidence From Indonesian Islamic Banking Industry. *Emerging Market Finance & Trade*, 2019, 1-9.
- Ali, A., Hui, L., and Ali, A. (2016). Efficiency and Performance of Islamic Banking In Pakistan: A Stochastic Frontier Analysis. *International Journal of Economics, Finance and Management*, 5(2), 42-48.
- Al-Jarrah, I., & Molyneux, P. (2003). Cost Efficiency, Scale Elasticity and Scale Economies in Arabian Banking. *Financial Development in Arab Countries*, 25.
- Amin, G.R., and Shirvani, M.S.H. (2009). Evaluation of Scheduling Solutions in Parallel Processing using DEA FDH Model. *Journal of Industrial Engineering International*, 5(9), 58-62.
- Anwar, Mokhamad. (2016). The Efficiency of Banks In Indonesia: Sharia vs Conventional Banks. *Bulletin of Monetary, Economics and Banking*, 18(3), 307-332.
- Aragon, Y., Daouia, A., and Thomas-Agnan, C. (2006). Efficiency Measurement: A Nonparametric Approach. *Annales d'Economie et Statistique*, 82, 217-242.
- Ascarya, Yumanita, D., Achsan, N.A., and Rokhimah, G.S. (2008). Comparing the Efficiency of Conventional and Islamic Banks in Indonesia using Parametric and Nonparametric Approaches. Paper presented at University of Melbourne International Symposium and Conference on Islamic Banking and Finance: Ethics and Financial Practice in Global Perspective, Australia, November 19-20, 2008.
- Ascarya & Yumanita, D. (2008). Comparing the Efficiency of Islamic Banks in Malaysia and Indonesia. *Bulletin of Monetary, Economic and Banking*, 11(2), 95-119.
- Ascarya & Yumanita, D. (2007). Comparing the Efficiency of Islamic Banks in Malaysia and Indonesia. Paper presented at IIUM International Conference on Islamic Banking and Finance (IICiBF): Research and Development between Ideals and Realities. IIUM – Kuala Lumpur, 23-25 April.
- Ascarya and Yumanita, D. (2007b). Analisis Efisiensi Perbankan Syariah di Indonesia dengan Data Envelopment Analysis. *Tazkia Islamic Finance and Business Review*, 1(2), 1-32.
- Bader, M. K. I., Mohamad, S., Ariff, M., & Hassan, T. (2007). Cost Revenue, and Profit Efficiency of Conventional versus Islamic Banks: Financial Ratios Approach. *Review of Islamic Economics*, 11, 89-106.
- Bardhan, I., Bowlin, W.F., Cooper, W.W., and Sueyoshi, T. (1996). Models and measures for Efficiency Dominance in DEA: Part II: Free Disposal Hull (FDH) and Russel Measure (RM) approach. *Journal of the Operations Research Society of Japan*, 39, 333-344.

- Berger, A. N., & Humphrey, D. B. (1997). Efficiency of Financial Institutions: International Survey and Directions for Future Research. *European Journal Operational Research*, 98, 175–212.
- Berger, A. N., Hancock, D., & Humphrey, D. B. (1993). Bank Efficiency Derived from the Profit Function. *Journal of Banking and Finance*, 17, 317–347.
- Charnes, A., Cooper, W.W., and Rhodes, E. (1978). Measuring the Efficiency of Decision Making Units. *European Journal of Operation Research*, 2(6), 429–440.
- Cherchye, L., Kuosmanen, T., and Post, T. (2000). What is The Economic Meaning of FDH? A Reply to Thrall. *Journal of Productivity Analysis*, 13, 263–267.
- Cherchye, L., Kuosmanen, T., and Post, T. (2001). FDH Directional Distance Functions with An Application to European Commercial Banks. *The Journal of Productivity Analysis*, 15(3), 201–215.
- Coelli, T.I., Rao, D.S.P. and Battese, G.E. (1998). *Introduction to Efficiency and Productivity Analysis*. Kluwer Academic Publisher, Boston.
- Coelli, T.J, Rao, D.S.P., Prasada Rao, Christopher J. O'Donnel and G.E. Battese. (2005). *Introduction to Efficiency and Productivity Analysis*, (Second Edition). Kluwer Academic Publishers, Boston.
- Cooper, William W., Seiford, Lawrence M., and Tone, Koru. (1999). *A Comprehensive Text with Models, Application, References and DEA-Solver Software*. Kluwer Academic Publisher, Boston USA.
- Cooper, et al. (2002). *Data Envelopment Analysis*. Kluwer Academic Publisher, USA.
- Cooper, William W, Lawrance M. Seiford and Joe Zhu. (2010). *Handbook on Data Envelopment Analysis*. London: Springer.
- De Borger, B., and Kerstens, K. (1996). Cost Efficiency of Belgian Local Governments: A Comparative Analysis of FDH, DEA and Econometric Approach. *Regional Science and Urban Economics*, 26, 145–170.
- De Borger, B., and Kerstens, K. (1996). Radial and Nonradial Measures of Technical Efficiency: An Empirical Illustration for Belgian Local Governments using An FDH Reference Technology. *Journal of Productivity Analysis*, 7, 41–62.
- De Borger, B., Ferrier, G.D., and Kerstens, K. (1998). The Choice of a Technical Efficiency Measure on The Free Disposal Hull Reference Technology: A Comparison using US Banking Data. *European Journal of Operational Research*, 105(3), 427–446.
- Defung, F., Salim, R., and Bloch, H. (2016). Has Regulatory Reform had any Impact on Bank Efficiency in Indonesia? A Two-Stage Analysis. *Applied Economics*, 2016, 1–15.
- Deprins, D., Simar, L., and Tulkens, H. (1984). Measuring Labor-Efficiency in Post Offices, in Marchand, M., Pestieau, P., and Tulkens, H. (Eds). *The Performance of Public Enterprises—Concepts & Measurement*. Amsterdam, North-Holland, 243–267.
- Farandy, A.R., Suwito, D.A., and Dabutar, L.K. (2017). Efficiency of Islamic Banks in Indonesia: Data Envelopment Analysis. *International Journal of Economics, Management and Accounting*, 25(2), 337–354.
- Farrell, M.L. (1957). The Measurement of Productive Efficiency. *Journal of The Royal Statistical Society*, 120, 253–281.

- Freixas, Xavier and Rochet, Jean-Charles. (2008). *Microeconomics of Banking* 2nd Edition, The MIT Press, Cambridge, Massachusetts, London, England.
- Geys, B., and Moesen, W. (2009). Measuring Local Government Technical (in) Efficiency: An Application and Comparison of FDH, DEA and Econometric Approaches. *Public Performance & Management Review*, 32(4), 499-513.
- Green, R., and Cook, W.D. (2004). A Free Coordination Hull Approach to Efficiency Measurement. *Journal of the Operational Research Society*, 55, 1059-1063.
- Gutierrez-Goiria, J., San-Jose, L., & Retolaza, J.L. (2017). Social Efficiency in Microfinance Institutions: Identifying How to Improve It. *Journal of International Development*, 29(2), 259-280.
- Hadhek, Z., Frifita, M., and Hamida, A. (2018). The determinants of Cost Efficiency of Islamic Banks using SFA Approach. *International Research Journal of Finance and Economics*, 168, 33-47.
- Hassan, M. K. (2006). The X-Efficiency in Islamic Banks. *Islamic Economic Studies*, 13(2), 49-78.
- Hidayati, N., Siregar, H., and Pasaribu, S.H. (2017). Determinant of Efficiency of the Islamic Banking in Indonesia. *Bulletin of Monetary, Economics and Banking*, 20(1), 29-47.
- Hussein, K. A. (2004). *Banking Efficiency in Bahrain: Islamic vs. Conventional Banks*: Islamic Development Bank, Islamic Research and Training Institute.
- Islamic Banker Association. (2018). *Global Islamic Finance Report 2018*.
- Jemric, I., and Vujcic, B. (2002). Efficiency of Banks in Croatia: A DEA Approach. *Croatian National Bank. Working paper*, 7 February 2002.
- Kamarudin, F., Sufian, F., Loong, F.W., and Anwar, N.A.M. (2017). Assessing the Domestic and Foreign Islamic Banks Efficiency: Insights from selected Southeast Asian countries. *Future Business Journal*, 3, 33-46.
- Kamarudin, F., Sufian, F., and Nassir, A.M. (2016). Does Country Governance Foster Revenue Efficiency of Islamic and Conventional Banks in GCC Countries? *EuroMed Journal of Business*, 11(2), 181-211.
- Kamarudin, F., Sufian, F., and Nassir, A.M. (2016b). Global Financial Crisis, Ownership and Bank Profit Efficiency in the Bangladesh's State Owned and Private Commercial Banks. *Contaduria y Administracion*, 61, 705-745.
- Kamarudin, et al. (2008). Assessing Production Efficiency of Islamic Banks and Conventional Bank Islamic Windows in Malaysia. *International Journal of Business and Management Research*, 1(1), 31-48.
- Kasman, A., and Carvallo, O. (2014). Financial Stability, Competition and Efficiency in Latin American and Caribbean Banking. *Journal of Applied Economics*, 17(2), 301-324.
- Leleu, H. (2009). Mixing DEA and FDH Models Together. *The Journal of the Operational Research Society*, 60(12), 1730-1737.
- Masoumi, M.M., Lotfi, F.H., and Mobasser, A.M. (2010). DEA and Multi-Objective Shortest Path Problems. *Contemporary Engineering Sciences*, 3(2), 53-62.
- Mehdiloozad, M., and Roshdi, I. (2012). Complete Closest-Target Based Directional FDH measures of Efficiency in DEA. *Journal of Optimization in Industrial Engineering*, 11, 53-61.

- Nafla, A., and Hammas, A. (2016). Islamic Finance, Financial Crisis, and Determinant of Financial Stability: Empirical Evidence throughout the Two Approaches. *Journal of Islamic Banking and Finance*, 4(1), 47-59.
- Omar, M.A., Majid, M.S.A., and Rulindo, R. (2007). Efficiency and Productivity Performance of the National Private Banks in Indonesia. *Gadjah Mada International Journal of Business*, 9(1), 1-18.
- Oscar, Yazar. (2008). *Health Care Benchmarking and Performance Evaluation: An Assessment using Data Envelopment Analysis*. Springer, Newton MA.
- Otoritas Jasa Keuangan. (2019). *Sharia Banking Statistics*, June 2019.
- Ozdemir, Asli. (2013). Integrating Analytic Network Process and Data Envelopment Analysis for Efficiency Measurement of Turkish Commercial Banks. *Banks and Bank Systems*, 8(2).
- Park, B.U., Simar, L., and Weiner, C. (2000). The FDH Estimator for Productivity Efficiency Scores: Asymptotic Properties. *Econometric Theory*, 16, 855-877.
- Pramuka, B.A. (2009). Assessing Profit Efficiency of Islamic Banks in Indonesia: An Intermediation Approach. *Journal of Economics, Business and Accountancy Ventura*. 14(1), 79-88.
- Rahmawati, R. (2015). The Cost Efficiency of Islamic Bank in Indonesia: A Stochastic Frontier Approach and Data Envelopment Analysis. *Bulletin of Monetary, Economics and Banking*, 17(4), 461-484.
- Rani, L., Rusydiana, A., and Widiastuti, T. (2017). Comparative Analysis of Islamic Bank's Productivity and Conventional Bank's in Indonesia period 2008-2016. In 1st International Conference on Islamic Economics, Business and Philanthropy (ICIEBP 2017), 118-123.
- Rusydiana, Aam S. (2018a). Indeks Malmquist untuk Pengukuran Efisiensi dan Produktivitas Bank Syariah di Indonesia. *Jurnal Ekonomi dan Pembangunan LIPI*, 26(1), 47-58.
- Rusydiana, Aam S. (2018b). Efisiensi dan Stabilitas Bank Umum Syariah di Indonesia. *Jurnal Akuntabilitas*, 11(2), 203-222.
- Rusydiana, Aam S., and Sanrego, Y.D. (2018). Measuring the Performance of Islamic banking in Indonesia: An Application of Maslahah Efficiency Quadrant (MEQ). *Journal of Islamic Monetary Economics and Finance*, 3(SI), 103-130.
- Rusydiana, Aam S, and Firmansyah, I. (2017). Efficiency versus Maqasid Sharia Index: An Application on Indonesia Islamic Bank. *Shirkah Journal of Economics and Business*, 2(2), 139-166.
- Sakti, M.R.P., and Mohamad, A. (2018). Efficiency, Stability and Asset Quality of Islamic vis-a-vis Conventional Banks: Evidence from Indonesia. *Journal of Islamic Accounting and Business Research*, doi.org/10.1108/JIABR-07-2015-0031.
- Sanei, M., and Chatghayeh, S.M. (2013). Using free Disposal Hull Models in Supply Chain Management. *International Journal of Mathematical Modelling & Computations*, 3(2), 125-129.
- Saoqi, A. A. Y. (2017). Analyzing the Performance of Islamic Banking in Indonesia and Malaysia: Maqasid Index Approach. *Jurnal Ekonomi Islam*, 8(1).
- Schaeck, K., and Cihak, M. (2014). Competition, Efficiency and Stability in Banking. *Financial Management*, Spring 2014, 215-241.

- Shahreki, Javad, Nazar Dahmardeh and Mohammad Ali Ghasemi. (2012). Efficiency Evaluation Bank Sepah Branches in Sistan and Baluchestan Province Using Data Envelopment Analysis. *Interdisciplinary Journal of Contemporary Research in Business*, 4(2).
- Sufian, F. (2006). The Efficiency of Islamic Banking Industry in Malaysia: Foreign Versus Domestic Banks, Paper, INCEIF Colloquium, Malaysia, April.
- Tauchmann, H. (2012). Partial Frontier Efficiency Analysis. *The Stata Journal*, 12(3), 461-478.
- Thrall, R.M. (1999). What is the Economic meaning of FDH? *Journal of Productivity Analysis*, 11, 243-250.
- Tsolas, Ioannis E. and Dimitris I. Giokas. (2012). Bank Branch Efficiency Evaluation by Means of Least Absolute Deviations and DEA. *Managerial Finance*, 38(8).
- Tulkens, H. (1993). On FDH Efficiency Analysis: Some Methodological Issues and Applications to Retail Banking, Courts and Urban Transit. *The Journal of Productivity Analysis*, 4, 183-210.
- Vincova, I.K. (2005). Using DEA Models to Measure Efficiency. *BIATEC*, 13, 24-28.
- Wahid, M. A. (2016). Comparing the Efficiency of Islamic and Conventional Banks Based on the Evidence from Malaysia. *Journal of Muamalat and Islamic Finance Research*, 13(1).
- Wang, T.F., Song, D.W., and Cullinane, K. (2003). Container Port Production Efficiency: A Comparative Study of DEA and FDH Approaches. *Journal of the Eastern Asia Society for Transportation Studies*, 5, 698-713.
- Widiarto, I., and Emrouznejad, A. (2015). Social and Financial Efficiency of Islamic Microfinance Institutions: A Data Envelopment Analysis Application. *Socio-Economic Planning Sciences*, 50, 1-17.
- Yotopolous, P.A., and L.J. Lau. (1973). A Test for Relative Economic Efficiency: Some Further Results. *American Economic Review*, 63(1), 214-223.
- Yudistira, D. (2003). Efficiency in Islamic Banking: An Empirical Analysis of 18 banks. Unpublished Paper, Leicestershire: Department of Economics, Loughborough University, UK.
- Zainal, N.S., and Ismail, M. (2010). Concept and Measurement of Efficiency: A Review. *Voice of Academia*, 5(1), 17-26.
- Zeitun, R. and Benjelloun, H. (2013). Efficiency of Banks and the Financial Crisis in a Developing Economy: The Case of Jordan. *Journal of Finance, Accounting and Management*, 4(1), 1-20.