

Technical and Scale Efficiency Employing Data Envelopment Analysis: Empirical Evidence from Islamic Public Banks in Indonesia

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ABSTRACT

Technical and scale efficiency was estimated to conduct the present research in the Islamic Public Banks in Indonesia. A non-parametric approach through data envelopment analysis (DEA) is employed. The data are obtained from the quarterly-published report of the Central Bank (Bank Indonesia) that covers the period from January 2011 to March 2015 with 10 Islamic public banks as the sample of the research using intermediation approach. The results showed that the mean technical efficiency were found to be 72.9% during the entire quarters for all Islamic public banks and the technical inefficiency (TIE) was due to pure technical inefficiency (PTIE) compare to scale inefficiency (SIE). The operations have been operated in optimum scale relatively. However, the fullest exploitation of resources leads to managerial of inefficiency. Thus, the Islamic finance experts are highly demanded to lead the poor financing portfolio management.

Keywords: Technical efficiency, Scale efficiency, Islamic public banks, Data envelopment analysis.

JEL classification: C14, D61, G21.

1. INTRODUCTION

Since the existence of Islamic banks, it becomes the alternative system of viable that offers various aspects thus the whole parts of the world look up upon this. The fulfillment of Muslims needs is developed by the time of its growing Muslims number and the Islamic banking was accepted universally so after. In the area of banking and finance since 1963, Islamic banking is recognized with its fastest growing with the first opening in Egypt and the rapid growth showed after around the world after taking the first step. Today, in over 75 countries, there are over 300 Islamic finance institutions. Middle east and Southeast Asia become the centre of Islamic banking as the biggest hubs which are concentrated in the Bahrain and Malaysia mainly. As it grows, the Islamic banking system has been appeared in Europe and United States as well (Sufian et al. 2008).

In 1992, Islamic banks was first established that more than twenty years Islamic banking has been growing in Indonesia and has shown good performance compare to its counterpart, conventional banking (Zuhroh et al. 2015). Bank Indonesia as the central bank and financial services authority have provided Islamic banking statistics from 2005 to 2013 (see Table 1), it indicates a significant increase of Islamic banks in Indonesia both Islamic public banks and Islamic business unit. Islamic public bank is the bank that apply Islamic principles for its transaction and it stands as its own bank, while Islamic business unit is a conventional bank that provide Islamic principle (*sharia*) transaction under their operation. After the global crisis in 2008, numerous companies went bankrupt, but unexpectedly Islamic public banks in Indonesia grew rapidly after that time, resisted from its global crisis. On the other hand, the Islamic business unit has decreased which means that the conventional banks had been suffered from the global crisis effect.

Table 1: Development of Islamic Banks in Indonesia

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Islamic Public Banks	3	3	3	5	6	11	11	11	11
Islamic Business Unit	19	20	26	27	25	23	24	24	23

Source: Indonesian Islamic Banking Statistics

As the number of the banks was increased, the performance of the Islamic banks was increased as well. Table 2 explained about the financial indicators, in which; total assets, depositors fund, and financing in the Islamic public banks and Islamic business unit. The total assets was increased year by year from 20,880 billion IDR in 2005 to 242,276 billion IDR in 2013. It indicates rapid growth of total asset for 25.16%. The indicators of depositors fund are demand deposits of *wadia* account, saving deposits of *wadia* and *mudharaba* account, and time deposits of *mudharaba* account. Those indicators increased for 24.85% from 15,584 in 2005 to 183,534 billion IDR in 2013. Moreover, it divides into 6 contracts of financing, namely; *mudharaba*, *musharaka*, *murabaha*, *istishna*, *ijarah*, and *qardh* that indicates rapid growth for 25.94%.

Table 2: Financial Indicators of the Islamic Banks in Indonesia

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Assets	20,880	26,722	36,538	49,555	66,090	97,519	145,467	195,018	242,276
Depositors Fund	15,584	20,672	28,012	36,852	52,271	76,036	115,415	147,512	183,534
Financing	15,232	20,445	27,944	38,195	46,886	68,181	102,655	147,505	184,122

Sources: Indonesian Islamic Banking Statistics (in Billion IDR)

Referring to the explanation above, measuring its efficiency is necessary because of its rapid growth. Hence, the measurement of efficiency level is increasingly needed in order to understand the optimization of all resources. Depositor and funder are the customers of Islamic banks, therefore it is expected to provide better benefit to them as the society. The tighter competition among the banking industry become urgent thing to measure the efficiency whether the Islamic banks are able to compete or even survive in a long term (Firdaus & Hosen 2013).

Islamic banks market share in Indonesia cannot be compared to the conventional banks since it's only 5%, while conventional banks have much higher market share because they have been performed many years earlier before Islamic banks. The total assets of conventional bank develop by the time of existence as well as the total assets of Islamic banks. However, it will still be smaller since conventional bank has bigger amount in term of total assets in the beginning (Havidz & Setiawan 2015b). Thus, the market segment become a rational indicator. To fulfill the operational efficiency of Islamic banks is needed in order to face rational market. Through the improvement of efficiency in Islamic bank, it will affect the improvement of return to depositor. As the consequence of this condition, it will trigger the partnership between the investors with Islamic banks in which they are not only hoping on the islamic financial system, but also giving better return. Additionally, efficiency is an important thing for the customer since the more efficient bank tend to have lower service expense (Fries & Taci 2005).

This research has a main purpose of estimating the technical and scale efficiency. The employment of non-parametric approach during the first quarter 2011 to the first quarter 2015 in the Islamic banks in Indonesia. Technical efficiency (TE) is decomposed into pure technical efficiency (PTE) and scale efficiency (SE) that allowed by DEA. The insight of the inefficiency sources could be provided and determine whether the operation of its banks in the most productive scale size (MPSS). The consolidation, diversification, and rationalization of banking sector are expected to be assessed through the estimation of pure technical and scale efficiency on the operational of Islamic banking efficiency (Batchelor & Wadud 2004). It estimates the frontier of best practices of bank that can be used as a reference for other banks in order to increase their efficiency. Data Envelopment Analysis (DEA) method is preferred because small dataset is one of the requirements, the assumptions on the inefficient distribution are not required and decision-making units (DMU) as the functional form particularly to determine the most efficient based on its data. However, the shortcoming of this approach is that assuming the data being free from the measurement error and quite sensitive to outliers (Mongid & Tahir 2010). The following sections are maintained as follows; section 2 literature review by referring to the previous

research, section 3 methodology and data to describe its data, sample, and sources employment, section 4 results and discussion, and will be concluded in the section 5.

2. LITERATURE REVIEW

Efficiency studies have been numerous in the banking field especially in the US and European markets over recent years. However, it is still in its infancy in term of Islamic banking (Sufian 2007). There are two groups in classifying the performance of banking field. The first group is using traditional financial ratios that is also known as parametric approach by comparing the results between Islamic and Conventional banks in some previous studies. The second group is focusing on banks' efficiency that utilize frontier analysis known as non-parametric approach. This group usually subdivided into i) efficiency in the Islamic banks studies, ii) efficiency in the Conventional banks studies, iii) comparative efficiency studies between Conventional and Islamic banks (Bader et al. 2008). This research is focusing on utilizing frontier analysis non-parametric approach by applying Data Envelopment Analysis (DEA) in the Islamic banks due to the fact that it is not possible to mention the entire banks.

Yudistira (2004) employed non-parametric approach using Data Envelopment Analysis (DEA) to measure technical, pure technical, and scale efficiency among 18 Islamic banks. The first result proved the inefficiency in term of overall efficiency suggesting small inefficiency for only over 10% among 18 Islamic banks and if it is compared to the conventional counterparts it will be quite low. The global crisis that happened in 1998 to 1999 in which the sample of this research suffered from that condition, but then performed very well after difficult periods. Mergers are encouraged for Islamic banks since it is categorized into small up to medium diseconomies scale.

Hassan (2006) investigates the Islamic banks around the world through panel data in 1995 - 2001 to measure the relative efficiency by employing two kinds approaches, namely parametric approach, particularly cost and profit efficiency and Data Envelopment Analysis (DEA) as its non-parametric approach, particularly cost, technical, allocative, scale efficiency and pure technical. It is revealed that approximately 13% higher of scale inefficiency compare to pure technical inefficiency which is only 5% approximately in the Islamic banks as the second approach result. Due to scale inefficiency as output related becomes the technical inefficiency major source instead of pure technical inefficiency as input related.

Sufian et al. (2008) investigated by applying DEA method in MENA and some Asian countries to measure Islamic banks efficiency that covers the period from 2001 to 2006. It is suggested that the technical efficiency score of Islamic banks in MENA countries is higher than their counterpart Asian Islamic bank. The outweighs was scale inefficiency of pure technical efficiency in the banking sector of MENA and Asian countries.

Rahman and Rosman (2013) measure the efficiency of Middle Eastern and North African (MENA) countries that includes Gulf Cooperation Council countries as well as Asian countries using DEA technique based on intermediation approach in 63 selected Islamic banks covering 2006 to 2009 for its study period. The study found that scale of their operations resulted as the main source of technical inefficiency among the Islamic banks. High score of pure technical efficiency is indicating in which the management of banks to maintain the cost control and output maximization to have better efficiency by using the inputs regardless of scale effects.

Řepková (2014) employed DEA window analysis approach to examine the efficiency of the Czech banking during 2003-2012 utilizing input oriented model. The results indicate that the average efficiency under constant return to scale reached 70-78% and average efficiency under variable return to scale reached 84-89%. The comparison result of CCR and BCC model proved that the average score of Pure Technical Efficiency (VRS) is higher than Technical Efficiency (CRS). Based on the fact that this results is caused of BCC model decomposes inefficiency of production units into two components: the pure technical inefficiency and the inefficiency to scale.

Shahid et al. (2010) held a research of efficiency comparison between Islamic and Conventional banks in Pakistan from 2005-2009 by applying DEA model to measure CRS and VRS approach. The results of Technical Efficiency (TE) show that Conventional banks for both modes perform better than their counterpart Islamic banks since conventional banks have been operate for more than four decades and improving its technology by the time. On the other hand, the lack of awareness and short market operations stand out as the main reasons of its limitation in Islamic banks of Pakistan.

Zeitun and Benjelloun (2013) Zeitun and Benjelloun (2013) estimated the efficiency measurement using DEA analysis with 12 Jordanian banks as the sample; three of them are Islamic banks from 2005 through 2010. In order to measure the relative efficiency, they used CRS and VRS assumptions and the results show that there are only few Jordanian banks were efficient in term of technical efficiency which means they could not manage their financial resources

efficiently to generate profit. Furthermore, there are also few banks in few years as well performed in the scale of pure technical efficiency.

Sillah and Harrathi (2015) conducted the measurement of efficiency in the two types of banks, namely Islamic and Conventional banks by taking the samples from Gulf Cooperation Council (GCC) countries using DEA during the period 2006-2012. The findings indicates low efficiency level of operation in both Islamic and Conventional banks under constant returns to scale, while exhibit higher efficiency level under variable returns to scale. Further, the Conventional counterparts appear to be more efficient than Islamic banks both CRS and VRS.

As this research presented Islamic Public Banks in Indonesia as the sample, there are some previous researches focusing in Indonesian banks as well, such as; Mongid and Tahir (2010) measured the scale and technical efficiency in the Indonesian Rural Banks that covers the period from 2006 until 2007 of DEA employment and it is suggested that scale efficiency is higher than technical efficiency based on its degree. When the production is below its production frontier may leads to overall inefficiency. An application of Two-Stage DEA regarding the technical efficiency of Indonesian Commercial bank by Soetanto (2012) suggested that technical efficiency could be improved by 10.5% on average and pure technical inefficiency dominating the scale inefficiency. Firdaus and Hosen (2013) discussed about the 10 Islamic Public Banks in Indonesia using Data Envelopment Analysis from the second quarter 2010 to the fourth quarter 2012. In which, they found in general that there was fluctuate trend during the period of the study. The highest average indicated by Bank Muamalat Indonesia, while the lowest average efficiency indicated by Bank Victoria Syariah which are 93.82 and 72.12 respectively when they measured the bank individually. An efficiency study by comparing the conventional and Islamic banks in Indonesia by Havidz and Setiawan (2015a) indicated that some resources are being wasted (CRS assumption) and the banks' managers were not able to use the given resources (VRS assumption). Moreover, Havidz and Setiawan (2015b) held a further study regarding bank efficiency that revealed the scale inefficiency is the major source of technical inefficiency rather than pure technical inefficiency in the Islamic banks in Indonesia.

3. METHODOLOGY, DATA OBJECT AND RESEARCH VARIABLES

The data of this research was obtained from the website of Indonesian Central Bank (Bank Indonesia) using quarterly published data from the first quarter 2011 to the first quarter 2015. The sample of this research is covering the 10 Islamic Public Banks, namely; Bank Muamalat Indonesia (BMI), Bank Syariah Mandiri (BSM), Bank Mega Syariah (BMS), Bank Negara Indonesia Syariah (BNIS), Bank BCA Syariah (BCAS), Bank Rakyat Indonesia Syariah (BRIS), Bank Jabar Banten Syariah (BJBS), Bank Panin Syariah (BPS), Bank Syariah Bukopin (BSB), and Bank Victoria Syariah (BVS).

As acknowledged by the common research, variables selection in efficiency study may give significant impact to the results (Sufian et al. 2008). However, it remains contentious issues among researchers when defining and measuring the inputs and outputs as banking function since the typical of banks are multi-input and multi-output firms. Thus, it is necessary to decide the nature of technology banking (Sufian 2007). Those two types of typical banking may lead to different approaches depend on the objectives of the study. Referring to the literature of banking, there are two main approaches as common measure, particularly production and intermediation approaches (Sealey & Lindley 1977).

Applying production approach is necessary when the bank is treated as services provider of firm. Using capital and labour as inputs, it is expected to produce loans (financing) and deposits. On the other hand, intermediation approach is defined as performing the role of intermediary among the depositors and borrowers to transfer the surplus units of assets to its deficit units by the banks (Zeitun & Benjelloun 2013). As for branch efficiency studies, the most suitable approach might be production approach since the bank branches basically engaged to customer documents process and funds of bank (Berger & Humphrey 1997). The outputs that usually used are number of issued cards, loans, financial products, number of open accounts, and other variables in this approach. Since lack of data, this approach is rarely used (Efendic 2009). Thus, this research employed intermediation approach since it was most widely approach that being applied practically and the function of bank in this research is as intermediation between the borrowers and depositors.

In order to conduct intermediation approach, input-oriented is the first type of analysis that examines the possibility of reducing the employing input amount without reducing the output level and output-oriented as the second type of analysis examines to increase its output level by utilizing the input level that has been provided as much as possible the (Efendic 2009). This research used input-oriented analysis with three input variables that has been employed by Havidz and Setiawan (2015a & 2015b), such as; deposits, fixed assets, and operational expenses and two output variables, such as; financing and operational income (see table 3).

Table 3: Summary of Variables Employed in the DEA Model

Variables		Mean	Minimum	Maximum	Std. Dev.
Input					
Deposit	x1	11,727,662	167,816	57,582,673	16,030,201
Fixed Asset	x2	309,071	2,896	2,807,628	479,651
Operational Expense	x3	486,425	3,075	4,252,868	708,769
Output					
Financing	y1	12,334,056	47,150	195,871,428	20,373,149
Operational Income	y2	953,604	8,795	6,851,461	1,372,468

Note: Upon author's request detailed is available (In Million IDR)

3.1 Data Envelopment Analysis

Islamic Public Banks are employed as the sample in this research in which categorized into small industry of banking sector in Indonesia where it leads to apply standard economic methods as the scope. Further, the advantage of using DEA is that the data will work fine with small sample size (Sufian 2007). Charnes, Cooper, and Rhodes (henceforth CCR) introduced an effective tool have been proven in identifying empirical frontiers as well as relative efficiency evaluation, namely Data Envelopment Analysis (DEA) in 1978 (Zhu 2009). A technique of non-parametric is commonly known as DEA is the most suitable method for small sample that collected in common outputs and inputs which referring to decision making units (DMUs) and weighted output in maximum ratio is obtained to its weighted inputs. It means that by the given inputs used could produce more outputs is categorized as efficient production. Every similar DMU ratio, should be scored as less than or equal to its unity in term of its weight for the determined ratio (Charnes et al. 1978).

CCR model is an estimation of operating in optimum scale by the bank which one input could produce one output is known as CCR model, namely constant return to scale (CRS) assumption and produces technical efficiency (TE). However, during the operational process may be disturbed by external factors that leads the lacking performance of DMU or banks which could not operate in optimum scale as well as managerial inefficiency factors, known as variable return to scale (VRS) assumption (Havidz & Setiawan 2015b). An extended study of CRS assumption to VRS assumption is introduced by Banker et al. (1984) regarding pure technical efficiency (PTE). As an advance study of technical and pure technical efficiency, if there is differences score between TE and PTE particularly its DMU, then it indicates of scale efficiency existence (SE=TE/PTE).

Table 4: Envelopment Models

Frontier Type	Input-Oriented
CRS (TE)	$\text{min } \theta - \epsilon (\sum_{i=1}^m s_i^- + \sum_{r=1}^s s_r^+)$ subject to $\sum_{j=1}^n \lambda_j x_{ij} + s_i^- = \theta x_{io} \quad i = 1, 2, \dots, m;$ $\sum_{j=1}^n \lambda_j y_{rj} - s_r^+ = y_{ro} \quad r = 1, 2, \dots, s;$ $\lambda_j \geq 0 \quad j = 1, 2, \dots, n.$
VRS (PTE)	Add $\sum_{j=1}^n \lambda_j = 1$
NIRS (SE)	Add $\sum_{j=1}^n \lambda_j \leq 1$
NDRS (SE)	Add $\sum_{j=1}^n \lambda_j \geq 1$
Efficient target	$\left\{ \begin{array}{l} \theta^* x_{io} - s_i^{*-} \quad i = 1, 2, \dots, m \\ y_{ro} = y_{ro} + s_r^{*+} \quad r = 1, 2, \dots, s \end{array} \right\}$

Source: (Zhu 2009)

4. RESULTS AND DISCUSSIONS

Bank efficiency results will be discussed in this section by applying non-parametric approach with small data on Data Envelopment Analysis (DEA), hereafter will be written as DEA, in the ten Islamic Public banks in Indonesia. It is categorized into three DEA efficiency measures, those are; technical efficiency (TE), pure technical efficiency (PTE), and scale efficiency (SE). Discussions section are divided into criteria of efficiency assessment based on average scores of each Islamic Public Banks and efficiency of the Islamic Public Banks in Indonesia.

4.1 Criteria of efficiency assessment based on average scores of each Islamic Public Banks

The average scores of efficiency will be utilized in order to show the efficiency level of 10 Islamic Public Banks during the period of 2011 in the first quarter until 2015 in the first quarter. It is defined as fully efficient when the score of efficiency is 1, while less than 1 is determined as inefficient. In order to rank the bank, it is necessary to measure individually the average efficiency score based on the criteria (see Table 5).

Table 5: Criteria and Efficiency Score of Islamic Banking in Indonesia

Criteria of Efficiency	Score
High efficient	0.81 - 1
Medium efficient	0.60 - 0.80
Low Efficient	0.40 - 0.59
Inefficient	< 0.40

Source: (Hidayat 2014)

Based on table 5, the criteria of efficiency is divided into four groups; high, medium, low and inefficient with certain range scores of each classes. Thus, it is easily to rank the Islamic Public Banks individually in order to examine and understand the efficient level were reached for each efficiency measurements. Table 6 will describe the overall average score and ranking of each Islamic Public Banks during the first quarter of 2011 to the first quarter 2015 based on the criteria of efficiency.

Table 6: The Overall Average (Mean) Score and Ranking of Islamic Public Banks

Islamic Public Banks	Overall Average (Mean) Score			Ranking		
	TE	PTE	SE	TE	PTE	SE
Bank Muamalat Indonesia	0.71	0.91	0.78	6	1	7
Bank Syariah Mandiri	0.64	0.82	0.78	10	4	7
Bank Mega Syariah	0.74	0.74	0.99	5	8	1
BNI Syariah	0.66	0.71	0.95	9	9	3
Bank BCA Syariah	0.69	0.78	0.88	7	6	6
BRI Syariah	0.68	0.73	0.94	8	7	4
Bank Jabar Banten Syariah	0.77	0.81	0.97	3	5	2
Bank Panin Syariah	0.80	0.83	0.97	2	3	2
Bank Syariah Bukopin	0.83	0.84	0.99	1	2	1
Bank Victoria Syariah	0.76	0.83	0.92	4	3	5

Source: proceed by author

Based on the average efficiency score of each Islamic Public Banks, there is only one bank categorized as high efficient with the average score 83%, namely Bank Syariah Bukopin. Meanwhile, the remaining 9 banks are categorized as medium efficient, which Bank Panin Syariah as the highest medium with the average score 80% and Bank Syariah Mandiri as the least medium efficient with the average score 64%, among the medium efficient level in term of Technical Efficiency (TE). There are 6 banks categorized into high efficient. An average score of 91% revealed as the highest efficient by Bank Muamalat Indonesia and Bank Jabar Banten Syariah as the lowest high efficient with the average score 81%, among the high efficient level. Thus, the remaining 4 banks are categorized in the medium efficient, which Bank BCA Syariah as the highest medium efficient with the score 78% and Bank Negara Indonesia Syariah as the lowest medium efficient with the average score 71%, in term of Pure Technical Efficiency (PTE). Lastly, there are 8 banks categorized as high efficient in term of Scale Efficiency (SE). Bank Syariah Bukopin and Bank Mega Syariah as the highest efficient with same average score 99%, while Bank BCA Syariah as the lowest high efficient with the average score 88%. The remaining two banks, Bank Muamalat Indonesia and Bank Syariah Mandiri are categorized as medium efficient with same average score 78%. It indicates different result with Firdaus and Hosen (2013) when they measured the bank individually. They revealed Bank Victoria Syariah as the lowest average efficiency with the score 71.12. On the other hand, the highest average score determined by Bank Muamalat Indonesia with the score 93.82. This difference result due to different measurement of the research.

It is interesting to note the case in Indonesia regarding the two Islamic public banks in Indonesia, namely Bank Syariah Mandiri and Bank Muamalat Indonesia reveals that scale inefficiency (SIE) was a major source of pure technical inefficiency (PTIE), it is suggested that they were operated in small scale efficient or even too large due to the scale of non-optimal operations. The total assets of Bank Muamalat Indonesia and Bank Syariah Mandiri found to be larger compare to the other Islamic public banks in this research, hence with its larger assets they found difficulty to fulfill the optimal scale of operations. Meanwhile, the results of the remaining 8 Islamic public banks, namely Bank Mega Syariah, Bank Negara Indonesia Syariah, Bank Central Asia Syariah, Bank Rakyat Indonesia Syariah, Bank Jabar Banten Syariah, Bank Panin Syariah, Bank Syariah Bukopin, and Bank Victoria Syariah, suggest scale inefficiency (SIE) is dominated by pure technical inefficiency (PTIE) since the operating costs were managerially inefficient and the utilization of its resources is not on the fullest one. Those 8 Islamic public banks are categorized into developing Islamic public banks since the total assets are much lower compare to Bank Muamalat Indonesia and Bank Syariah Mandiri, thus it is expected to those banks to adjust its Islamic financial sytem rapidly so that they could manage well the banking operational.

4.2 Efficiency of the Islamic Public Banks in Indonesia

Technical efficiency (TE) is discussed in this section concerning Islamic Public Banks in Indonesia applying DEA method and the components are decomposed into pure technical efficiency (PTE) and scale efficiency (SE). Table 7 presents the mean efficiency scores of the Islamic Public Banks for all banks quarter 1 2011 to the quarter 1 2015. The mean technical efficiency results seems to suggest an increasing trend on the period of the first quarter until the fourth quarter 2011, but declining during the first quarter 2012 and again increasing during the second quarter to the fourth quarter 2012, which continously happended the same trend over the quarters. The Islamic Public banks have fluctuation trend which each first quarter started to be lower to higher efficient at the end of quarter.

As it is shown from table 7 that the mean technical efficiency during the entire quarters for all banks is 72.9%, its input is wasted for 27.1% averagely. The production of Islamic Public Banks in Indonesia can produce using 72.9% of the used of inputs amount for the same outputs amount entirely. As technical efficiency is decomposed into pure technical efficiency (PTE) and scale efficiency (SE), the results revealed that scale inefficiency (SIE) is dominated by pure technical inefficiency (PTIE) during all the quarters in each year except for quarter 4 2011 and 2014 since scale efficiency was lower than pure technical efficiency. The results implication of this research explain the manager performance was inefficient due to the exploitation of resources cannot be achieved fully. However, the operations have performed on optimum scale.

The results of this research found to be the same with Soetanto (2012) that domination of scale inefficiency was due to pure technical inefficiency in which banks' managers were not able to use the given sources. The Islamic public banks in Indonesia was first established in 1992 and due to the opening of Islamic banks and windows, the employees of its Islamic bank was hired from the conventional banks and they held a training regarding Islamic financial system to be applied in the Islamic banks. This is to say that lack understanding and knowledge of Islamic financial system leads to poor financing portfolio management. Thus, the experts of Islamic finance are highly demanded in the Islamic public banks in Indonesia for them to lead and improve the shortage of performace of bank inefficiency. It differs from the previous research that mostly scale inefficiency was the major source of pure technical inefficiency since the sample and range of data are different.

Table 7: Efficiency Scores of the 10 Islamic Public Banks

Efficiency Measures	Mean	Minimum	Maximum	Std. Dev.
All Banks Quarter 1 2011				
Technical Efficiency	0,593	0,429	0,833	0,148
Pure Technical Efficiency	0,685	0,478	1,000	0,191
Scale Efficiency	0,877	0,697	0,997	0,101
All Banks Quarter 2 2011				
Technical Efficiency	0,700	0,517	1,000	0,135
Pure Technical Efficiency	0,773	0,591	1,000	0,134
Scale Efficiency	0,908	0,785	1,000	0,089
All Banks Quarter 3 2011				
Technical Efficiency	0,813	0,692	1,000	0,114
Pure Technical Efficiency	0,901	0,717	1,000	0,093
Scale Efficiency	0,906	0,732	1,000	0,111

All Banks Quarter 4 2011				
Technical Efficiency	0,882	0,731	1,000	0,093
Pure Technical Efficiency	0,953	0,831	1,000	0,067
Scale Efficiency	0,928	0,736	1,000	0,092
All Banks Quarter 1 2012				
Technical Efficiency	0,577	0,444	0,731	0,106
Pure Technical Efficiency	0,667	0,466	0,901	0,155
Scale Efficiency	0,880	0,706	0,999	0,109
All Banks Quarter 2 2012				
Technical Efficiency	0,686	0,581	0,766	0,062
Pure Technical Efficiency	0,747	0,581	0,851	0,079
Scale Efficiency	0,923	0,771	0,999	0,078
All Banks Quarter 3 2012				
Technical Efficiency	0,785	0,718	0,850	0,049
Pure Technical Efficiency	0,855	0,754	0,937	0,068
Scale Efficiency	0,923	0,766	0,996	0,088
All Banks Quarter 4 2012				
Technical Efficiency	0,834	0,712	0,954	0,076
Pure Technical Efficiency	0,903	0,728	1,000	0,084
Scale Efficiency	0,929	0,720	0,994	0,086
All Banks Quarter 1 2013				
Technical Efficiency	0,602	0,454	0,762	0,111
Pure Technical Efficiency	0,671	0,455	0,849	0,131
Scale Efficiency	0,906	0,710	0,999	0,109
All Banks Quarter 2 2013				
Technical Efficiency	0,673	0,540	0,819	0,102
Pure Technical Efficiency	0,740	0,565	0,951	0,107
Scale Efficiency	0,912	0,749	0,997	0,093
All Banks Quarter 3 2013				
Technical Efficiency	0,767	0,650	0,911	0,069
Pure Technical Efficiency	0,835	0,751	1,000	0,076
Scale Efficiency	0,923	0,764	0,998	0,084
All Banks Quarter 4 2013				
Technical Efficiency	0,850	0,745	1,000	0,080
Pure Technical Efficiency	0,915	0,784	1,000	0,077
Scale Efficiency	0,932	0,781	1,000	0,081
All Banks Quarter 1 2014				
Technical Efficiency	0,613	0,473	0,800	0,117
Pure Technical Efficiency	0,665	0,475	0,952	0,152
Scale Efficiency	0,932	0,757	0,997	0,085
All Banks Quarter 2 2014				
Technical Efficiency	0,702	0,519	0,936	0,126
Pure Technical Efficiency	0,762	0,655	1,000	0,120
Scale Efficiency	0,923	0,759	0,998	0,087

All Banks Quarter 3 2014				
Technical Efficiency	0,809	0,630	1,000	0,100
Pure Technical Efficiency	0,879	0,805	1,000	0,073
Scale Efficiency	0,923	0,752	1,000	0,099
All Banks Quarter 4 2014				
Technical Efficiency	0,894	0,723	1,000	0,089
Pure Technical Efficiency	0,965	0,852	1,000	0,056
Scale Efficiency	0,928	0,723	1,000	0,096
All Banks Quarter 1 2015				
Technical Efficiency	0,616	0,417	1,000	0,186
Pure Technical Efficiency	0,662	0,425	1,000	0,184
Scale Efficiency	0,930	0,773	1,000	0,078
All Banks: All Quarters				
Technical Efficiency	0,729	0,417	1,000	0,147
Pure Technical Efficiency	0,799	0,425	1,000	0,153
Scale Efficiency	0,917	0,697	1,000	0,090

Source: proceed by author

5. CONCLUSION AND RECOMMENDATION FOR FUTURE RESEARCH

The main objectives of the research was focusing on Islamic Public Banks to determine the efficiency in Indonesia during the first quarter 2011 to the first quarter 2015. Charnes, Cooper, and Rhodes (CCR) introduced the first efficiency model in 1978 in which the bank could produce one output from one input, also known as constant return to scale (CRS) or technical efficiency (TE). On the other words, the banks could perform in optimum scale. However, since the operation of the banks could be affected by the external factors and managerial inefficient, then Banker, Charnes, Cooper (BCC) in 1984 introduced a new model as an extended study of CRS assumption, namely variable return to scale (VRS), also known as pure technical efficiency (PTE). Moreover, the score differences between TE and PTE particularly its DMU indicates as scale Efficiency (SE). Hence, the researcher estimates these three efficiency assumptions in this research. Therefore, data envelopment analysis (DEA) is an effective tool in identifying empirical frontiers as well as relative efficiency evaluation. The input variables are deposits, fixed asset, and operational expense; while the outputs are financing and operational income. There are 10 Islamic public banks in Indonesia as the sample of this research.

The results showed that Bank Syariah Bukopin was the highest efficient among other Islamic banks with the average score 83% in term of technical efficiency (TE), Bank Muamalat Indonesia as the highest efficient in term of pure technical efficiency (PTE) with the score 91% averagely, and there are two Islamic banks as the highest efficient in term of scale efficiency (SE), those are Bank Mega Syariah and Bank Syariah Bukopin with the score 99% averagely. Bank Muamalat Indonesia and Bank Syariah Mandiri revealing a domination of scale inefficiency (SIE) than pure technical inefficiency (PTIE), while the remaining 8 Islamic public banks suggested the inefficiency source was majoring by scale inefficiency (SIE), not pure technical inefficiency (PTIE). Total assets is approximately caused the bank inefficiency. Furthermore, the mean technical efficiency (TE) were found to be 72.9% during the entire quarters for all banks, suggested that inputs wasted 27.1% averagely. The technical inefficiency was due to Pure technical inefficiency (PTIE) compare to scale inefficiency (SIE). The results implication of this research explain the manager performance was inefficient due to the exploitation of resources cannot be achieved fully. However, the operations have performed on optimum scale. Thus, Islamic finance experts are highly demanded in the Islamic public banks in Indonesia for them to lead and improve the shortage of performace of bank inefficiency.

Due to the limitation of this research, the paper could be extended into several ways. Firstly, as the research scope could be extended by investigating the Islamic business unit of a conventional bank and Islamic rural bank and or comparing to the conventional banks in Indonesia. Secondly, investigate the cost, profit, and revenue efficiencies in order to be extended to determine the inter-temporal relationship between NPF and bank efficiency to test the hypotheses of bad

luck, bad management or moral hazard suggested by Berger and De Young (1997). Finally, intermediation approach and production function might be considered all along to determine the efficiency sector of Islamic banking.

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