Efficiency of Islamic Banks Using Data Envelopment Analysis (DEA) in Indonesia, 2007-2010

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Abstract

The purpose of this study is to analyze the efficiency level of Islamic Banks (Bank Muamalat Indonesia, Bank SyariahMandiri, Bank Mega Syariah) in Indonesia through the input-output variables that correspond to the economic theory of the years 2007-2010, using the method of *Data Envelopment Analysis* (DEA). There are five important variables in this research that the input variables of bank is operating costs (I_1), labor costs (I_2) and banking services (I_3), while the output variables is total deposits(O_1) and deposits (O_2).

Key words: Efficiency, *Data Envelopment Analysis* (DEA) and Islamic Banks

Introduction

In 1998, an important event occurred in Indonesian economy. This event looked like a *Black Tuesday (malaise)*, which marks the beginning of the world economic recession on October 29, 1929 will always be remembered. Where, in just a year's time dramatic changes occur. Economic accomplishments achieved in two decades, so it sinks.

During the first nine months of 1998 was the worst period in the Indonesian economy. Crisis had been running six months during 1997, growing worse dramatically. The impact of the crisis began to be felt by the real the community, the world of business. International Monetary Fund (IMF) began to intervene since October 1997, but proved unable to immediately improve the economic stability and the rupiah. Indonesia's economic crisis even listed as the worst in Southeast Asia.

During the economic crisis, Islamic banking is still unable to meet the relatively better performance compared to conventional banking. It can be seen from the relative low of financing problems (*non performing loan*) on Islamic banking and there was no *negative spreads* in operating activities. It happens because the rate of return on sharia bank does not refer to the interest rates happen, but according to *the principle of revenue*. Thus Islamic banks can carry out their activities without being distracted by the interest rate increase happens, until Islamic banking can provide investment capital to the relative cost of capital is lower than conventional banks to the community.

The development of Islamic banking supported by the government, with released some laws and regulations, among them UU No. 7 years 1992 and amended with UU No. 10

years 1998. At 1999 issued UU No. 23 years 1999 concerning Bank Indonesia, which authorizes the Bank Indonesia to be able to also carry out its work based on Islamic principles.

Efficiency is one of the performance parameters which theoretically is one of the underlying performance of the entire performance of an organization. The ability to generate maximum output with existing input is a measure of the expected performance. At the time of measurement of efficiency is done, banks are faced with conditions of how to get the optimal output level with the existing level of inputs, or get the minimum input level with a certain level of output. With it identifies the allocation of inputs and outputs, can be analyzed further to look at the causes of inefficiencies.

Efficiency in the banking sector is one of the performance parameters are quite popular, widely used as a response to the difficulties in calculating measures of bank performance. Sometimes, the calculation of the rate of profit showed a good performance, not included in the criteria for "healthy" or achievement of the regulations. As known, the banking industry is the most regulated industry by the regulations as well as a performance measure of the banking world. *Capital Adequacy Ratio* (CAR), *Reserve Requirements*, *Legal Lending Limit* and the credibility of the management of the bank is an example of the rules as well as a performance criteria in the banking world.

Specification of Problem
1. How to rate the efficiency of Islamic Banks (BUS) in Indonesia at 2007 until the year 2010 (not including UUS and BPRS)?
2. Are the factors that cause inefficiency in Indonesian Islamic Banks?

Research Aim
1. To analyze the efficiency of Islamic banking in Indonesia through the input-output Islamic banking.
2. To analyze factors causing differences in the efficiency of the Indonesian Islamic banking.

Literature review
Efficiency
Calculation of technical efficiency has been carried out by Farell (1957) in Tim Coelli paper that describes a simple measure of the efficiency of the company by calculating various inputs used for production.

Farell proposes efficiency consists of two components: technical efficiency that reflects the company's ability to produce maximum output from a set of predetermined inputs, and allocative efficiency that reflects the company's ability to use a variety of inputs in optimal proportions, where each input is determined price level and production technology.

These two efficiency components are combined to generate a total economic efficiency. Initial rationale on the measurement of the efficiency of Farell analysis with respect to where the input space, which focuses on an input-reducing focus. This method is called *input-orientated measures*.

Input Orientated Measure
Farrell illustrates his idea by using a simple example with the case of a particular firm that uses two inputs (x1 and x2) to produce a single output (y) with an assumption of constant returns to scale (CRS). If a company has used a certain number of input represented by point P, to produce one unit of output, then technical inefficiency production of the

companies represented by the distance QP which is the sum of all inputs can be proportionally reduced or reduced without lead to a reduction in output that can be produced. These indicators are usually written mathematically as a percentage which is the ratio of the QP/0P , which is a depiction of the percentage of the input can be reduced . Level of technical efficiency (TE) of the company in general is measured by using the ratio values:

$$TE = 0Q/0P \qquad (1)$$

The equation will be the same as the equation 1 is QP/0P, where values range between zero and one, and because it produces an indicator of the degree of technical efficiency of the the company. Value one implies that the the company has achieved efficient conditions fully. For example, point Q has achieved technical efficiency because it is located on the efficient isoquant curve.

Figure 1. Technical Efficiency and Allocative Efficiency
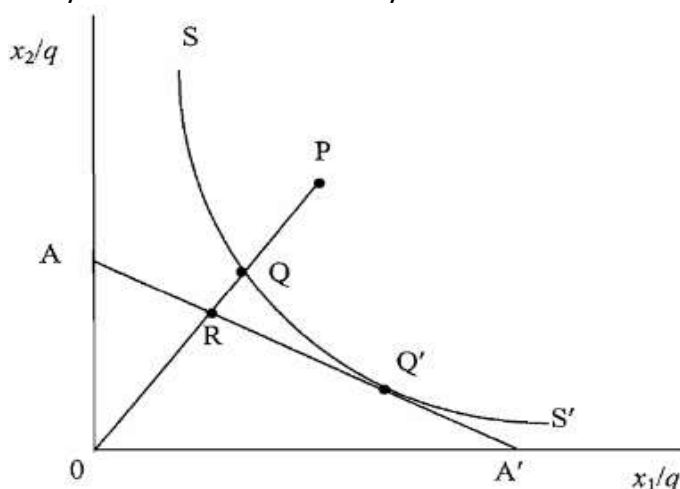
Where: x1 = the first input, x2 = the second input, q = the output.

If the ratio of input prices (in Figure 2.1 is represented by the line AA') is also known, then the point is allocative efficient production can also be calculated. Level of allocative efficiency (AE) of a company oriented to the point P can be defined as the ratio of:

$$AE = 0R/0Q \qquad (2)$$

Where the distance RQ reflect the reduction in production costscan be obtained when the production level is at point Q 'which is allocative efficiency (and technically), different from the point Q is technical efficient, but allocatively inefficient.

Total economic efficiency is defined as the ratio of:

$$EE = 0R / 0P \qquad (3)$$

Where the distance from point R to point P can also be interpreted in terms of cost reduction. Note that efficient products technically and allocatively provide meaning has achieved efficiency of the overall economy.

$$TE \times AE = (0Q/0P) \times (0R/0Q) = (0R/0P) = EE \qquad (4)$$

Where all third measurement is the area that is worth between zero and one.
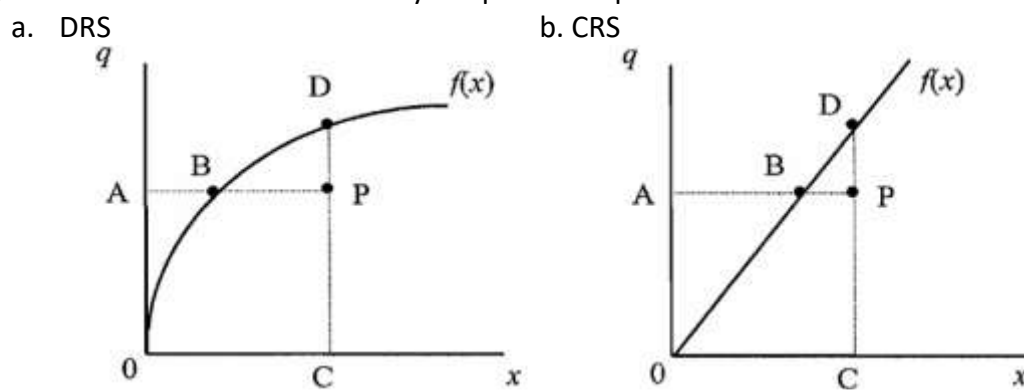
Output-Orientated Measures

Measurement of efficient technically input-oriented, basically aimed to answer a question: "How much input quantity can be reduced proportionately without changing the output quantities produced?" In other words, "How much quantity of output can be added

without changing the quantities of inputs used?". This so-called *output-oriented measure*, is the inverse of the *input-oriented measure*.

The difference between the input and output-oriented measures can be illustrated by using a simple example that consists of one input and one output, illustrated on a production function with technologies that are decreasing returns to scale are represented by ƒ (x), and an inefficient company which operates at the point P. Farrell describes the input-oriented measure of technical efficiency (TE) is equal to the ratio AB/AP, while the output-oriented measure of technical efficiency is represented by the ratio of CP/CD.

Measurement-oriented input and output will produce the same value of the measurement of technical efficiency, if it is in conditions *constant returns to scale* (CRS), but if it is in conditions *decreasing returns to scale* (DRS), TE measurement values will not be the same result. In the case of *constant returns to scale* (CRS) that AB/AP = CP/CD, to the point P is not efficient (Farell and Lovell, 1978) in Coelli, et al (2005).

Figure 2.Measurement of Efficiency Output and Input Oriented and Return to Scale

a. DRS   b. CRS

Sources: Farell (1957) and Lovell (1978) in Coelli, et al

Measurement of the output-oriented efficiency levels can be analyzed in a case where the production function involves two kinds of output (q1 and q2) and a single input (x). If we assume *constant returns to scale* condition, it can be represented by a technological level of unit production possibility curve in two-dimensional form. This example is illustrated in Figure 2, where the line ZZ 'is a unit production possibility curve and point A it can be likened to a company that is not efficient. Note that A as inefficient in this case is below the curve because ZZ' represent limit or the highest point of the line production possibilities.

Figure 3.Technical and Allocative Efficiency of the Output-Oriented Approach
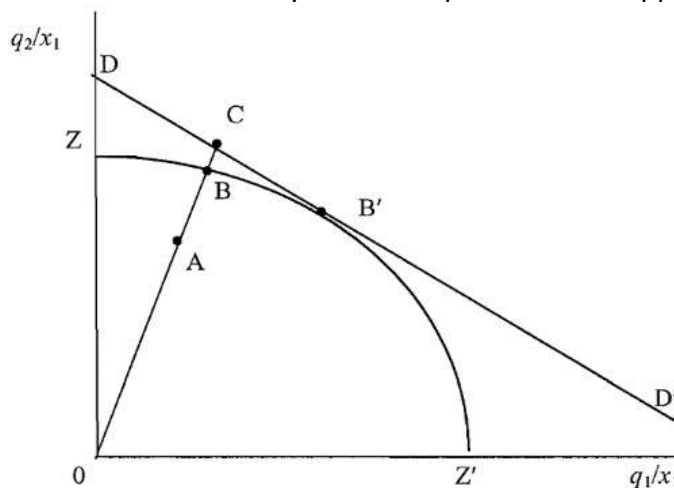
Sources: Farell (1957) and Lovell (1978) in Coelli, et al

Farrell describes the measures of output-oriented efficiency can be defined as illustrated in Figure 2, where the distance A to B represents technical inefficiency, which shows the sense that the amount of output can be increased without the need for additional input. Therefore, a measurement of output-oriented technical efficiency is a ratio:

TE= 0A/0B $\qquad$ (5)

with revenue efficiency (RE) which is the ratio:

RE = 0A/0C $\qquad$ (6)

If obtained information about the price, it can be described a curve isorevenue the line DD 'and allocative defined as,

AE = 0B/0C $\qquad$ (7)

Where there is a increasing revenue interpretation, which in the case of input-oriented efficiency measurement, similar to the interpretation of the reduction in costs (cost reducing) in conditions that are allocative inefficiencies. Furthermore, overall economic efficiency can be defined as the result of two measurements of technical efficiency and allocative efficiency.

EE= (0A/0C) x (0A/0B) x (0B/0C) = TE x AE $\qquad$ (8)

Research Method
Object Research

Objects involved in this study, namely Islamic Banks (BUS) in Indonesia during 2007-2010.

Types and Sources of Data

The study used secondary data in the form of financial statements of Islamic banks published by Bank Indonesia and the literature relating to banking efficiency. The source of the data in this study consists of Bank Indonesia, as an institution that publish all financial data of Bank Indonesia including Islamic Banking, literature and documents relating to efficiency.

Population and Sample

The population in this study is the only Islamic Banks are based on sharia principles, including banks on Islamic principles that Islamic Banks (BUS), Islamic Business Unit (UUS), and the Islamic rural banks (BPRS). In this study only examines the Islamic Banks (BUS). The consideration is that Islamic Banks are central to the Islamic Business Unit (UUS) so a study of parent already includes the business units, and superior performance when compared to the BPRS.

The samples Islamic Bank (BUS) used in this study is that Islamic banks have been established in or before 2007 and have financial statements during 2007-2010. It can be seen from the method, the determination of the samples belong to the purposive sampling technique, which sampling technique with specific considerations (generally adapted to the purpose and research problems).

Method of Analysis

In this study using quantitative analysis methods, which in the form of data management inputs and outputs are taken from the balance sheet, income statement and retained earnings are owned by each bank. In this analysis using Data Envelopment Analysis (DEA) is a method that has been standardized as a tool for measuring the performance of an activity unit, where the processing using DEAP 2.1 software. In addition, researchers also use MS Excel as a software support tool.

1. *Measurement of Technical Efficiency Bank*

   Measurement of technical bank model based on the assumption of frontier approach is divided into two types, which:

   a. CCR DEA model (Charnes-Cooper-Rhodes, 1978).

      The assumptions used in this model is *Constan Return to Scale* (CRS). Some linear program is transformed into ordinary linear program is primal or dual, as follows:

      Maximize $\qquad h_s = \sum_{i=1}^{m} u_i y_{is}$

      restriction or constraints functions:

      $$\sum_{i=1}^{m} u_i y_{ir} - \sum_{j=1}^{n} v_j x_j r \leq 0; \quad r = 1, \ldots, N$$

      $$\sum^{n}_{j=1} v_j x_{js} = 1 \qquad \text{where} \quad u_i \text{ and } v_j \geq 0; \quad j=1$$

      Where Uo can be positive or negative.

      As explained above, that the researchers used the software DEAP 2.1 in the calculation of the level of efficiency so researchers do not need to perform manual calculations.

Results and Discussion

Efficiency is one reflection of the performance of the banking, where a bank is said to have a high performance if it can improve its efficiency by the use of appropriate variables to provide maximum results. Calculation of technical efficiency of Islamic banking with the DEA analysis is using two input variables, namely operating costs and labor costs. Output variables include total deposits, time deposits, and bank services. The calculation and description of the DEA analysis is divided into three types of banks, namely Bank Muamalat, Bank Syariah Mandiri, and Bank Mega Syariah.

DEA accounting system in this study, if the Islamic banking in a period of a frontier (is efficient) value assumed 100% efficiency, while the inefficient value between 0% and 99%. Efficiency division input output unit, namely the value of efficiency units partially input output of a production process in a period.

Analysis of Islamic Banks Efficiency Level Average Annual

1. Bank Muamalat

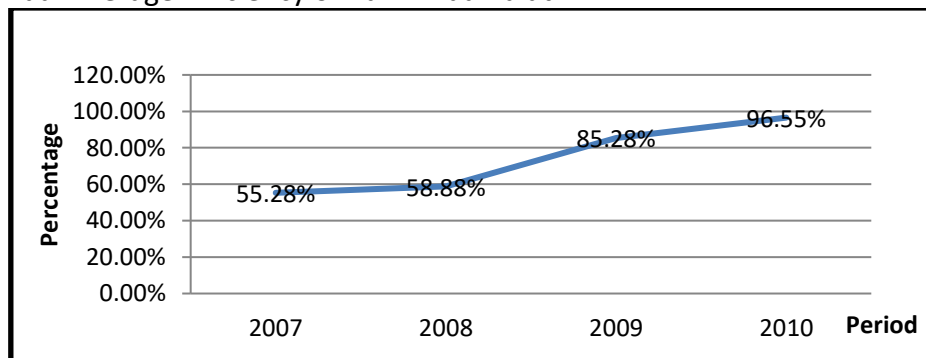**Figure 4.** Annual Average Efficiency of Bank Muamalat

Figure 4 shows that in 2007, the average level of efficiency is 55.28% for Bank Muamalat. This shows that on average in the Bank Muamalat has achieved the efficiency at 55.28%, and at 44.72% for inefficiency. This means that during periods of 2007 t0 2010 the Bank Muamalat was not performing its primary function.

In 2008, the average efficiency rate of Bank Muamalat increased slightly to 58.88%, indicating that the average efficiency of Bank Muamalat has increased by 3.60% from the previous year and have done inefficiency at 41.12%, although increasing the efficiency of the Bank Muamalat in 2008 still had not reached the average level of efficiency. In 2009, the average efficiency rate of Bank Muamalat experienced a significant increase at 26.40% from the previous year, namely at 85.28%. This means that the average year of Bank Muamalat is about 14.72% in-efficiency rate.

In 2010, the average efficiency rate of Bank Muamalat back an increase at 11.27% from the previous year, namely at 96.55%. This means that the Bank Muamalat has done inefficiency at 3:45%.

With an average annual rate at 73.99% from 2007 to 2010, the average efficiency of Bank Muamalat has been able to perform its primary function well.

Bank Syariah Mandiri
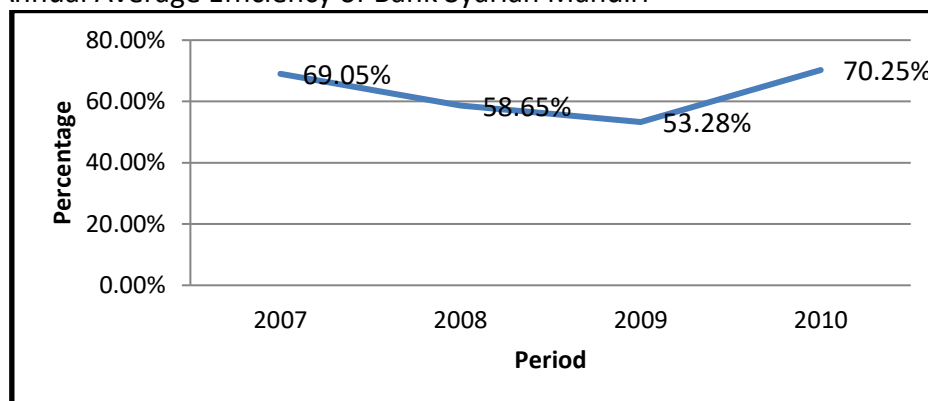**Figure 5.** Annual Average Efficiency of Bank Syariah Mandiri

Figure 5 shows that in 2007, the average rate of Bank Syariah Mandiri efficiency reached 69.05%. This indicated that the Bank Syariah Mandiri has been done in the average efficiency of 69.05%, and 30.95% for inefficiency. Average level of efficiency that reaches the percentage indicated that average each of Bank Syariah Mandiri has not been doing its primary function as a good bank.

In 2008, average efficiency rate of Bank Syariah Mandiri has decreased until 58.65%, indicating that average efficiency of Bank Syariah Mandiri a decline at 10.40% from the previous year and have done inefficiency at 41.35%, by declining efficiency. This shows that the Bank Syariah Mandiri in 2008 has not yet reached average level of efficiency. In 2009, average efficiency rate of Bank Syariah Mandiri by back 5.37% decrease from the previous year, namely 53.28%. This means that that average year of Bank Syariah Mandiri inefficiency at 46.72%. In 2010, it has achieved an efficiency at 100%.

With an average annual rate of 70.25%, it can be seen that until 2010 that average efficiency of Bank Syariah Mandiri has been able to perform its primary function well although declining in 2008 and in 2009.
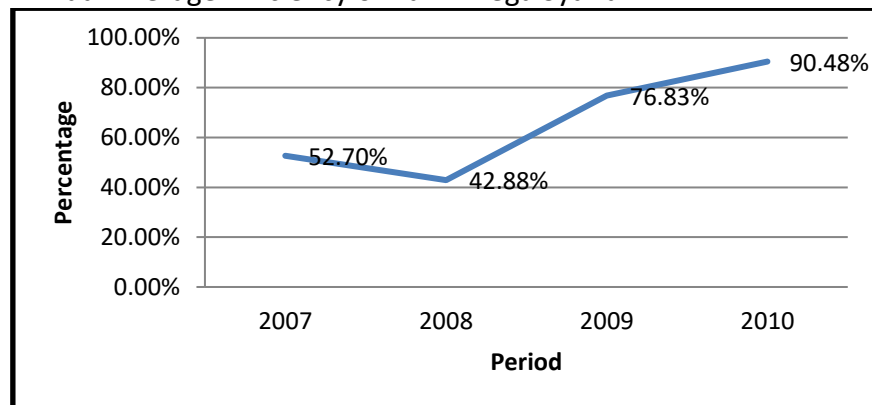
Bank Mega Syariah

Figure 6. Annual Average Efficiency of Bank Mega Syariah

Figure 6 shows that in 2007, average rate of Bank Mega Syariah efficiency reached at 52.70%. This indicated that average efficiency of Bank Mega Syariah has done at 52.70%, and at 47.30% for inefficiency. Average level of efficiency that reaches the percentage indicated that average each of Bank Mega Syariah is not perform its primary function as a good bank.

In 2008, the average efficiency rate of Bank Mega Syariah has decreased until 42.88%, this means that the average efficiency of Bank Mega Syariah declining at 9.82% from the previous year and have done inefficiency at 57.12%, Bank Mega Syariah in 2008 has not reached a good level of average efficiency.

In 2009, the average efficiency rate of Bank Mega Syariah efficiency has increased very much from the previous year at 42.88% becoming at 76.83%. This means that year the average Bank Mega Syariah doing inefficiency of 23.17% and the Bank Mega Syariah has reached the level of efficiency of the annual average.

In 2010, the average efficiency rate of Bank Mega Syariah again experienced a significant increasing in the amount of 13.65% from the previous year, namely at 90.48%. So in the Bank Mega Syariah has done inefficiency by 9.52%. At this year's Bank Mega Syariah has achieved an average rate increase of efficiency due to previous years. With an average annual rate at 65.72%, it can be seen that until 2010, the average Bank Mega Syariah has not been able to perform its primary function well.

Analysis of Islamic Banks Efficiency Per-Quarter

1. Bank Muamalat

Table 1.

Value Efficiency of Bank Muamalat With the Calculation of DEA Assumption of VRS

Period	Output-or VRS eff	Period	Output-or VRS eff
Maret-07	100.00%	Maret-09	100.00%
Juni-07	58.30%	Juni-09	100.00%
Sept-07	39.10%	Sept-09	54.30%
Des-07	23.70%	Des-09	86.80%
Maret-08	100.00%	Maret-10	100.00%
Juni-08	62.90%	Juni-10	86.20%
Sept-08	43.40%	Sept-10	100.00%
Des-08	29.20%	Des-10	100.00%

From the Table above, the trend decline in the efficiency of per-quarter Bank Muamalat can be seen clearly, where the highest average occurred in March 2007, March 2008, March 2009, June 2009, March 2010, September 2010 and December 2010 with a degree average efficiency at 100% with the assumption that at the beginning of March Inefficiency rate reaches 100% and the lowest occurred during the period of December 2007 and December 2008 at a level of efficiency respectively 23.70% and 29.20%.

With an average per-quarter at 73.99%, it can be seen that until 2010, the average efficiency of Bank Muamalat has been able to perform its primary function well despite the efficiency drop in the period of December 2007 to December 2008.

Bank SyariahMandiri

Table 2.

Value Efficiency of Bank SyariahMandiri With the Calculation of DEA Assumption of VRS

Period	Output-or VRS eff	Period	Output-or VRS eff
Maret-07	100.00%	Maret-09	100.00%
Juni-07	49.20%	Juni-09	48.90%
Sept-07	100.00%	Sept-09	35.00%
Des-07	27.00%	Des-09	29.20%
Maret-08	90.00%	Maret-10	100.00%
Juni-08	63.50%	Juni-10	100.00%
Sept-08	42.50%	Sept-10	100.00%
Des-08	38.60%	Des-10	100.00%

From the Table above, the trend decline in the efficiency of per-quarter Bank Syariah Mandiri can be seen clearly, where the highest average occurred in March 2007, September 2007, March 2009, March 2010, June 2010, September 2010 and December 2010 with

average efficiency rate of 100% with the assumption that at the beginning of March Inefficiency rate reaches 100% and the lowest occurred during the period of December 2007 and December 2009 with the level of efficiency of respectively 27.00% and 29.20%.

With an average per-quarter of 70.24%, it can be seen that until 2010, the average Bank Syariah Mandiri has been able to perform its primary function well despite the drop in the period December 2007 and December 2009.

2. Bank Mega Syariah

Table 3.

Value Efficiency of Bank Mega Syariah With the Calculation of DEA Assumption of VRS

Period	Output-or VRS eff	Period	Output-or VRS eff
Maret-07	100.00%	Maret-09	64.10%
Juni-07	51.10%	Juni-09	58.10%
Sept-07	35.70%	Sept-09	85.10%
Des-07	24.00%	Des-09	100.00%
Maret-08	83.90%	Maret-10	100.00%
Juni-08	38.20%	Juni-10	100.00%
Sept-08	25.50%	Sept-10	61.90%
Des-08	23.90%	Des-10	100.00%

Table 3 shows that the trend decline in the efficiency of per-quarter Bank Mega Syariah can be seen clearly, where the highest average occurred in March 2007, December 2009, March 2010, June 2010 and December 2010 with an average efficiency rate of 100% with the assumption that at the beginning of March Inefficiency rate reaches 100% and the lowest occurred during the period of December 2007, September 2008 and December 2008 with a level of efficiency respectively 24.00%, 25.50% and 23.90%.

With an average per-quarter of 65.72%, it can be seen that until 2010, the average efficiency of Bank Mega Syariah Mandiri is less able to perform its primary function well despite the drop in the period December 2007, September 2008 and December 2008.

Conclusions and Recommendation
Conclusion

From the analysis of the efficiency of the average annual Islamic Banking in Indonesia in the period 2007 to 2010 is known best efficiency levels, namely Bank Muamalat Indonesia amounted to 73.99 %. Then followed by Bank Syariah Mandiri amounting to 70.25 % . Bank Mega Syariah last position by 65.72 % .

Recommendation

For Islamic Banking :

The input variable operating costs , labor costs and banking services, as well as output variables, namely total deposits during periods of inefficient banks to be tailored to the target so that the operating conditions more efficient and can provide good service for the community.

CEOs should pay attention to important variables that lead to an inefficiency of banks, namely by increasing the productivity of banks in operation.

For the next researcher :

This study is a far from perfection, then it is advisable for the next researcher to use the data banks a longer period in order to analyze the Islamic banking efficiency and profitability.

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