



Data Envelopment Analysis Approach for Efficiency Comparison of Banking System

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ABSTRACT

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This study aims to calculate the level of banking efficiency that needs to be known to be associated with the performance of the banking management macro and micro variable. So banking industry in practice can arrange a program to increase efficiency and to anticipate the influence of anything that can makes banking will be lost. Bank with a good the efficiency in general is able to provide good service for customer. Efficiency of bank usually set pricing with the form of the high interest margin. The variables input used in this research is amount of labor. And the output to calculate efficiency are interest income of the money and the amount of funds which has been distributed. Then, comparing two different principle banking between bank syariah mandiri and bank mandiri. By using the method of measurement efficiency with DEA CCR, in two banks was efficient in some specified time. And then using DEA aggressive appears that the efficiency that tends to look the differences between DMU from both banks. From the, observation bank Syariah mandiri is much better because it can reach efficiency 12nd DMU. If calculating unefficiency that bank syariah mandiri also is better than bank mandiri.

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1. Introduction

Based on legal form, form of ownership and type, bank ownership has an influence on the level of capital receipts and the profitability of the bank itself. As it is known that Indonesia itself has banking financial institutions under State-Owned Enterprises. Banking institutions with the status of State-Owned Enterprises include the State Savings Bank (BTN), Bank Rakyat Indonesia (BRI), Bank Mandiri, and Bank Nasional Indonesia (BNI). Based on the results of research on Indonesian banking consumers conducted by Marketing Magazine and Frontier Consulting Group, consumer confidence in the government in the banking sector is still very high, it is proven that one of the banks in the State-Owned Enterprises consecutively receives awards as a bank with satisfaction high consumer. Economic activity in a country cannot be separated from the role of investment, as the role of investment is as the main benchmark in economic growth activities. Investment can be in the form of real and non-real, one form of non-real investment that determines the amount of increase in national income is the role of consumer investment in financial institutions.

Referring to the banking statistics report issued by Bank Indonesia, total bank assets generally reach half of the asset value of national banking institutions in addition to banking business units that

are not state-owned with total third party funds collected in recent years. The high total amount of Third Party Funds in all commercial banks and sharia business units reflects the banking intermediary function that has been well implemented.

TABLE 1.
COMPOSITION OF COMMERCIAL BANK THIRD PARTY FUNDS (IN BILLION Rp)

Information	Dec 2015	Dec 2016	Dec 2017	Feb 2018	Feb 2019
Total TPF	4,413,058	4,836,758	5,289,377	5,255,301	5,600,412
Rupiah	3,665,444	4,091,634	4,541,406	4,518,359	4,797,480
Foreign currency	747,612	745,124	747,971	736,442	802,932

Based on Table 1 regarding data on the collection of Third Party Funds, in general, it shows that the total value of TPF for each period has increased. In theory, intermediary institutions are institutions that receive funds which then channel funds to those who need funds. How much funds are received will show the performance of banks in channeling the amount of funds that have been collected.

TABLE 2.
COMPOSITION OF INDONESIAN GENERAL BANKING PERFORMANCE ACTIVITIES (IN BILLION Rp)

Year	Total Funds Disbursed
2015	4092.104
2016	4,413,414
2017	4,781,931
2018	5,368,012
2019 - February	5,267,444

The total credit disbursement of the Indonesian banking sector as a whole shows an improved level of performance over the years, when compared with the amount of third party funds collected with the total performance made in addition to the allocation of retained funds and other investments in legitimate banks. The disbursed funds have increased every calculation period. The Indonesian banking industry in recent years during the calculation period based on banking statistics published by the Financial Services Authority has indeed experienced an increase in public trust.

TABLE 3.
BANKING INDICATORS BANK MANDIRI (CONVENTIONAL) (IN %)

Indicator	2018	2017	2016	2015	2014
ROA	3.17%	2.72%	1.95%	3.15%	3.57%
ROE	16.23%	14.53%	11.12%	23.03%	25.81%
NIM	5.52%	5.63%	6.29%	5.90%	5.94%
BOPO	66.48%	71.78	80.94%	69.67%	64.98%

Based on banking indicators in terms of performance, conventional independent banks have high profitability ratios, the efficiency ratio at independent banks as reflected in the BOPO value shows a low value, far from the normal indicator, which is below 70-80%, based on research conducted by Dadan Muljawan in 2014 that One of the determinants of banking efficiency is shown by the BOPO value which has normal or efficient indicators when the ratio is far below 70-80%. To see how efficient its performance activities are in this study, Bank Mandiri in 2018 had a performance figure of 66.48%, but in the previous year, Bank Mandiri's level of performance efficiency decreased by 71.78%. The market share of independent banks which is expanded to the market share of Islamic banking activities also makes banking indicators by making comparisons between conventional independent banks and Islamic independent banks.

TABLE 4.

BANKING INDICATORS BANK MANDIRI SYARIAH (IN %)					
Indicator	2018	2017	2016	2015	2014
ROA	0.88	0.59	0.59	0.56	0.04
ROE	8.21	5.72	5.81	5.92	0.94
NIM	6.56	7.35	6.75	6.54	6.22
BOPO	90.68	94.44	94.12	94.78	100.6

Based on the indicator ratio of Bank Mandiri Syariah, it is shown that the BOPO value owned is far from efficient, having an BOPO number of more than 70-80%. With the BOPO ratio widening far from the actual figure, banks can be considered as wasteful banks so that the risk system for credit is also getting higher, causing bank coercion to create more frequent bank reserves. Research conducted by (Ar Royyan Ramly, 2016) by measuring the level of efficiency in banking shows that efficiency and productivity growth are within the 2002 limit of 12 efficient banks.

The operational sustainability of the banking sector is seen to depend on the ability of each banking institution to maintain high competitiveness. In Indonesia itself, when viewed by including the value of the challenge, banking institutions must be able to maintain a tight competitiveness. As it is known that the implementation of the Asean Economic Community (MEA) since 2015 has made each banking institution have a relatively high sense of challenge in the banking world. Through the magnitude of the level of banking efficiency depending on the nature of the macro and micro, the factors that determine the level of banking efficiency are market interest rates, labor, price levels and many other factors. (Karsinah, 2014)

The value of the level of performance in banking activities is reflected in the performance of the company, to increase the level of efficiency in banking activities the strategy carried out by banking management is to focus on the human resources owned. (Titko & Jureviciene, 2014) Banking conditions in achieving the right target work plan. The increase in the performance burden is also influenced by the increase in the number of employees owned, as is the case with the reflection of the production theory which states that the higher the number of inputs used in this case the efficiency of banking performance is reflected by when an increase in the number of employees occurs, it is also followed by an increase in the value of bonuses, salaries and insurance. (Ertay, T., Ruan, 2005) Work so that it will increase the reserve burden of the company. This means that the greater the use of labor input, the more efficient it will be, especially in dealing with the business strategy of banking competition institutions, especially in facing the era of digitalization and human capital management. (Sipangkar & Sihaloho, 2020)

It is necessary to know the level of banking efficiency in relation to the performance of banking management in processing macro and micro variables so that banks in practice can sub-program to increase efficiency and anticipate the effects that throw banks into losses. (John Doyle, 1994) In calculating the level of banking efficiency involves institutional variables related to the direct risks faced by banks in global economic conditions. Banks with good efficiency scores are generally able to provide good services to their holding customers and third parties at more competitive rates. (Yannick et al., 2016) Efficient banks usually set *pricing* in the form of high *interest margins*. High *interest margins* are generally not profitable for customers due to the high transaction costs provided. One of the indicators for assessing banking efficiency using DEA is the financial statements of the banks concerned. (Zhou et al., 2018)

The input variables in banking that are used for DEA techniques in calculating banking efficiency are, among others, the number of workers indicating the magnitude of the human resource factor in the development of banking management, the amount of third party funds as a mandatory and main indicator in factoring banks as intermediary institutions. (Dsilva Winfred Rufuss et al., 2018) The output in the efficiency level analysis used is interest income from the released funds and the amount of funds that have been disbursed by comparing two banking institutions with different principles between Bank Mandiri Syariah and Bank Mandiri Conventional. (Řepková, 2015)

As for other conditions, based on the assessment of Top Brands in Indonesia, Bank Mandiri Syariah and Bank Mandiri Conventional in recent years show different conditions. Bank Mandiri Syariah has always been in the Top Brand Banking in Indonesia. In fact, Bank Mandiri experienced a different condition where there was a decline in the last few years. In the early years of 2012 to 2015, Conventional Bank Mandiri was still in the ranks of the top banking brands. However, in the following year until now Conventional Bank Mandiri actually experienced a decline. Meanwhile, sharia independent banks are very consistent in being ranked 1 or 2 of the top banking brands in Indonesia. This is quite an interesting thing, because there is a *ranking gap* that occurs between Islamic independent banks and conventional independent banks.

TABLE 5.
TOP BRANDS OF BANKING

Year	Top Brands Indonesia		Ranking	
	BSM	Mandiri Bank	BSM	Mandiri Bank
2012	38.2%	17.7%	1	2
2013	27.3%	16.0%	2	3
2014	32.9%	17.5%	1	3
2015	27.4%	14.6%	2	3
2016	31.5%	7.4%	1	-
2017	26.1%	7.6%	1	-
2018	27.6%	9.2%	1	-
2019	21.2%	9.0%	2	-

Based on the explanation on the background, it is interesting to conduct an analysis of the efficiency level of each bank which is differentiated based on the system, namely Conventional Bank Mandiri and Syariah Mandiri Bank with the *Data Envelopment Analysis method approach*.

2. Methods

The data used in the analysis for this research is data in the banking system that uses 2 main variables, namely input variables and output variables. For conventional Bank Mandiri, the variables of the number of workers and the amount of third party funds/loan deposit ratio (LDR) are included in the input variables. Meanwhile, the output variables used for the analysis include the variables of net interest income and loans. The data to be analyzed for Bank Syariah Mandiri, the input variables include the number of workers and the amount of financing deposit ratio (FDR). The output variables used for the analysis are the income variable for distribution of funds and the loan variable.

2.1 Input Variable

a. Labor

According to the basic labor law No. 14 of 1969, a manpower is anyone who is able to do work both inside and outside the employment relationship in order to produce goods and services to meet the needs of people's lives. Meanwhile, according to Law no. 13 of 2003 concerning Manpower, the definition of manpower is anyone who is able to do work to produce goods and or services both to meet their own needs and for the community. In this case, the workforce is an important role in the banking sector. With the right number of personnel, the processes in the banking system, both conventional and sharia, will work optimally so that it is possible for the banking system to be efficient. The main task in banking is how to be able to allocate human resources in this case, namely the workforce so that they can be optimally. In the end, the performance will also work very well.

b. Loan Deposit Ratio

Loan to Deposit Ratio can be explained as the ability of banks to use credit as a source of liquidity to repay a certain amount of funds made by depositors in the bank through deposits or called depositors. (Dewi et al., 2016) The risk that is owned by the Bank when repaying the withdrawal of funds made by the depositor is when a number of funds owned by the depositor are withdrawn at any

time and on the other hand, the borrowed funds are not returned by the user of the funds. In other words, the LDR ratio is a tool to measure the liquidity aspect of a bank. The formula used to measure the LDR ratio is as follows:

$$\text{LDR Ratio} = (\text{Loans Granted} / \text{Funds Received}) \times 100\%$$

c. Funding to Deposit Ratio

In Islamic banking, the loan to deposit ratio is better known as the financing to deposit ratio (FDR). Financing to Deposit Ratio is a comparison between the financing provided by the bank and third party funds that have been successfully mobilized by the bank. (Harfiah et al., 2016) This ratio is used to measure the extent to which loan funds are sourced from third party funds. Bank Indonesia stipulates that the amount of the Financing to Deposit Ratio should not exceed 110%. The FDR ratio can be calculated by the following equation:

$$\text{FDR Ratio} = (\text{Financing Disbursed} / \text{Third Party Funds}) \times 100\%$$

2.2 Output Variable

a. Disbursement of Funds

One of the functions of the bank is to distribute funds. Efforts made by banks are that funds collected from the community are channeled so that they do not settle. Efforts to channel funds, namely assisting the implementation of national development and equitable development, also failed to materialize. To fulfill this objective, the bank also functions as a channel for funds to the public who need financial services from the institution. The distribution of funds by banks is carried out by providing various credit facilities. By utilizing these facilities, the community is expected to be able to prosper their lives and generate businesses to support national development.

b. Loan

The definition of a bank loan or credit is a bank product where the bank provides a certain amount of money to be lent to customers, with interest. Based on the loan agreement on loan products, customers are required to pay off the loan debt along with the interest in stages over a certain period of time. (SINGH et al., 2021)

2.3 Data Envelopment Analysis Aggressive

Data Envelopment Analysis Aggressive is the development of the non-parametric DEA CCR method. The development of the DEA CCR is reviewed based on the condition of the constraint function that "forces" the function based on the input value of 1. (Erdkhadifa & Sunaryo, 2013) So that the aggressive DEA method is more flexible where the results of the calculation of the efficiency value can be worth more than one and prioritize the peer-evaluation scheme where the measurement of the efficiency of a DMUs is also measured from the value of other DMUs which is used as a constraint function as well. In summary, (Al-Refaie & Al-Tahat, 2011) formulate the aggressive DEA model as follows.

$$\min \sum_{j=1}^n \left(v_{jt} \sum_{i=m}^m y_{ji} \right) - \sum_{k=1}^p \left(u_{kt} \sum_{i=m}^m x_{ki} \right) \quad (1)$$

$$\text{With constraint function} \quad \sum_{k=1}^p \left(u_{kt} \sum_{i=m}^m x_{ki} \right) = 1 \quad (2)$$

$$\sum_{j=1}^n v_{jt} y_{ji} - \sum_{k=1}^p u_{kt} x_{ki} \leq \delta; \quad \forall j \neq 0 \quad (3)$$

3. Results and Discussion

3.1 Result

This is statistics descriptive input variable and Bank Mandiri data output variables 2016-2018 years shown on Table 6

TABLE 6.
DESCRIPTIVE STATISTICS BANK MANDIRI VARIABLES

Statistics	Variable		
	LDR	Income	Loan
Mean	89,997	28141006	228463084
StDev	3.364	13474997	10556055
Minimum	85.86	10899470	213917794
Maximum	96.74	46294391	247286664
Range	10.88	35394921	33368870

Results analysis statistics descriptive showing size centering and size data spread shows that the average variable *loan deposit ratio* (LDR) of 89.997. Range Mark LDR variable is 10.88 where Mark maximum of 96.74 and minimum score of 85.86. Mark span relatively indicates standard deviation values that are not big that is of 3,364. As for results analysis income flower clean showing that average value of 28141006 with Mark maximum amounted to 46294391 and the minimum value is 10899470. Inequality Mark maximum and the minimum that enough big so that produce sufficient standard deviation value big i.e. 13474997. For Mark range on variable income flower clean at Bank Mandiri amounted to 35394921. Same condition also occurs in the variable loan where Mark maximum that is amounted to 247286664 and the minimum value is of 213917794. Sufficient range big that is amounted to 35394921 too impact to large standard deviation value i.e. 10556055. Whereas variable mean value Loans at Mandiri Bank of 228463084.

Following this results analysis descriptive data through size centering and dissemination of data in Islamic banks Independent .

TABLE 7.
DESCRIPTIVE STATISTICS SHARIA BANK MANDIRI VARIABLES

Statistics	Variable		
	FDR	Income	Loan
Mean	78.497	4517757	37024517
StDev	2,311	2222195	3465874
Minimum	73.92	1587650	32161787
Maximum	82.31	7976256	43015417
Range	8.39	6388606	10853630

Table 7 which explains about data characteristics of variable funding deposit ratio, income distribution funds, and loans at Islamic banks Independent . Analysis used for measure size data centering and size data dissemination. Results analysis descriptive show that the variable funding deposit ratio has the average value is 78.497. Whereas on FDR variable , value maximum of 82.31 what happened _ on quarterly second 2016 , while minimum value exists on 2018 the first quarter . Range that is not so far ie 8.39 show standard deviation value also relatively small of 2,311. Temporary on variable income distribution funds showing _that the average value of 4517757 with the largest data 7976256 and the smallest of 1587650. With range enough big so a large standard deviation value is also 2222195. On variable loan, compared with results description at Bank Mandiri , Sharia Bank independent have more average score low i.e. 37024517. Although still counted enough high, however variable loan the data more tend homogeneous compared to loan data at Bank Mandiri.

Results ratio efficiency from both banks are good Bank Mandiri Conventional and Islamic Bank independent with DEA CCR and DEA Aggressive methods are shown on table following this :

TABLE 8

Financial Performance Analysis of PT Bank BPD Yogyakarta Special Region During the Pandemic (Maria Regina Nansi)

COMPARISON OF EFFICIENCY VALUE					
Year	Quarter to -	DEA CCR		DEA <i>Aggressive</i>	
		BM	BSM	BM	BSM
2016	I	0.9125	0.7392	0.1500	0.4127
	II	0.9266	0.7006	0.2932	0.5027
	III	0.9124	0.7487	0.3828	0.6353
	IV	1	0.8105	0.5395	0.7820
2017	I	0.9578	0.8202	0.1539	0.4618
	II	0.9794	0.7947	0.3067	0.5799
	III	0.9651	0.8439	0.3746	0.7357
	IV	0.9962	0.9345	0.5285	0.8780
2018	I	0.9214	1	0.1501	0.6055
	II	0.9617	0.9390	0.2974	0.7308
	III	0.9991	0.9487	0.3616	0.8770
	IV	1	1	0.5171	1.0788

Results measurement efficiency with use DEA CCR method in both banks, system banking at Bank Mandiri and Islamic Bank independent reach efficient in some time certain. If noticed on table , application the DEA CCR method, which compares Mark efficiency both banks separately General Bank Mandiri more efficient compared to with Islamic Bank independent because close to efficiency value 1. If seen of the average inefficiency system banking at the bank , with using DEA CCR achieve enough value small which is 0.03898 . However Thing this no can Becomes something benchmark measuring that performance already walk optimally, because Mark efficiency too tend same. Whereas Mark demonstrated efficiency by Islamic Bank results independent have Mark more inefficiency big ie 0.1433. Although so , in fact enough result good shown with Mark inclined efficiency the more increase from quarterly first year 2016 to quarterly fourth year 2018. Application *Aggressive* DEA method looks that Mark inclined efficiency more seen difference between DMUs. Of the two banks observed , which shows system more banking good is a Sharia Bank independent because reach efficient in the 12th DMU. Meanwhile at Bank Mandiri no achieve efficient processes . On the side other , if measured from from Mark inefficiency that Islamic Banks independent also more good compared to with Bank Mandiri. Average value inefficiency in Islamic banks independent of 0.30988 more small compared to Bank Mandiri that is of 0.66205.

3.2 Discussion

The millennial era or what can be said as a new era of Indonesian industry entering the sophistication number 4.0, the banking industry is one of the main indicators in the economic development of a country. In particular, the banking industry is an industry that drives the engine of the economy as one of the main levers in the real investment sector. The development of the banking industry in Indonesia shows a relatively good trend on both sides of the banking industry, as it is known that the Indonesian banking industry has two different elements in its operational principles. Based on statistical reports, both sharia-based banking and conventional banking industries each have a tendency to have good numbers in their banking statistics, although each has the impression of being slow in its competition.

In the last five years, Indonesia's industry has experienced several movements, one of which is in the period of the Asean Economic Community which was realized in 2015, this period became a bit difficult for the beginner industry and especially for the Islamic banking industry. (Deliktas & Gürel Günel, 2016) The Islamic banking industry in research shows that the level of efficiency of the DEA CCR shows that the analysis of banking efficiency cannot be said to be overall efficient or not, but when viewed using the Aggressive DEA method, it shows that the overall efficiency of banking in detail, bank institutional management tries to carry out strategic accuracy in dealing with facts. that in the MEA (Asean Economic Community) era, the industry was faced with competing not only with internal competitors but also with foreign competitors. The difficulty at this time is none other than because competition with foreign competitors involves lower interest rates and higher profits when compared to the local banking industry in it. Moreover, Bank Syariah Mandiri, whose status is a government-owned company, but in principle adheres to the principles of Islamic finance which does not allow

interest offers, of course, it will be more difficult to compete with other competitors not only from Bank Mandiri with conventional principles.

Talking about the banking industry in Indonesia, Law Number 21 of 2008 states that there are three forms of Islamic banking in Indonesia, namely Islamic Commercial Banks, Sharia Business Units, and Sharia People's Financing Banks. Indonesia, in terms of research methods, in terms of the variables used in the number of workers, which refers to the number of banks and offices, seems to have not yet reached the optimal number. (Fitriasari et al., 2013) In the 2015 Islamic banking outlook, it was noted that the growth of Islamic banking experienced a sluggishness with a significant value. If we examine further, Islamic banks as a whole have a smaller market share value of 4.8% nationally compared to Islamic banking in general. When compared with Conventional Commercial Banks which in this study are represented by Bank Mandiri which has a red plate status or is owned by the State because most of its shares are owned by the State which also has a bank with sharia principles in terms of development and management of the same institution, but the development is far less than that of the conventional bank. not based on sharia. In line with the above case, seeing the level of competition in the banking industry is tight and as a country with a large population, Indonesia should be a pioneer and a mecca for Islamic finance in particular. The potential for large customers is due to the population with a Muslim majority as well as economic prospects that continue to be improved as well as the era of solid economic fundamentals, it is appropriate for Indonesia to become a country that has investment grade which increases investment interest in coming to the domestic financial sector.

4. Conclusions

The results of the DEA CCR analysis at Bank Mandiri show that the process reaches an efficient process in the fourth quarter of both 2016 and 2018. Meanwhile, the results of the DEA CCR analysis for Bank Syariah Mandiri achieve efficiency in the first quarter and fourth quarter of 2018. The results of the analysis with Aggressive DEA show that weighting in measuring the efficiency value at Bank Mandiri, the weighting on the loan variable does not contribute to the efficiency measurement results. In addition, meanwhile, the results of the analysis at Bank Syariah Mandiri were efficient when measuring performance in the fourth quarter of 2018.

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