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Bank Branch Closure Assessment Using DEA

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Abstract

The downward trend in the number of commercial bank offices is driven by the bank's efforts to shift banking transactions from physical branch to digital channels in order to improve efficiency. In prioritizing the branch closure, bank needs to define the appropriate method used in the analysis. This case study is intended to identify the parameter to determine the prioritization of bank branch office closure. This study uses a non-parametric approach of Data Envelopment Analysis (DEA) to examine the efficiency and productivity change of branch offices at one of the large bank in Indonesia. The one-stage DEA was used to generate the relative efficiency score, and the input-oriented Variable Return to Scale (VRS) assumption is adopted in data analysis based on the production approach. The Malmquist Productivity Index was also adopted to measure the total factor productivity change. The DEA result shows that a number of closed branches in 2019 and 2020 were actually considered efficient, with increasing productivity, compared to many other inefficient branches. The efficiency and productivity score can be further used by the bank's management to evaluate the upcoming branch closure as well as the overall branches efficiency.

Key words : Data Envelopment Analysis (DEA), Bank Branch, Efficiency Analysis, Productivity, Banking.

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INTRODUCTION

The era of technological disruption is slowly but surely impacting the financial industry, especially banking. In terms of products, banks began competing to create products and services that are driven by changes in people's lifestyles due to technological development. Ease of access to the financial world also changes the pattern of customer transactions. Some banking services, that were initially carried out through face-to-face services at bank branch offices, began to be abandoned and turned into digital transactions. In response to that phenomenon, bank intensively seeks to optimize their products and services previously carried out at branch offices. The physical office existence of a bank is starting to be less necessary with the transfer of customer banking transactions through digital services. By reducing the need for direct interaction with customers through physical branch offices, the banks began to adjust the needs of their respective branch offices since the physical branch is now considered as the costliest channels of the bank.

According to statistical data released by Financial Services Authority (2020), the number of branch offices for the commercial bank category since 2016 continues to experience negative growth from year to year. The growth in 2018 has decreased by 2% compared to the position in 2017. For the state-owned bank category, a downward trend in the number of branch offices began to appear in 2018. There was a decrease in the number of branch offices by 409 branches, which is 667 branches decreased the total number of commercial banks compared to 2017. The downward trend in the number of commercial bank offices is driven by the bank's efforts to improve efficiency in order to reduce operational costs. The bank in this case study also became one of the banks that closed their branch offices in 2018 and 2019. In 2018, 5 branch offices were closed, and for 2019, there were 41 micro branch offices closed. The closure of these branch offices is part of the bank's operational efficiency efforts to increase bank profits.

The bank's management currently using financial and non-financial parameters to identify the branches that are prioritized to be closed, to then put some qualitative considerations in determining the final decision on branch closure. Some parameters used in the initial selection stage are the distance between branch offices, contribution margins, funds, and loans generated by the branch. However, the problem that often arises is that the existing parameters (branch distance, contribution margin, funding, and loan), cannot identify the branch performance rank because they are not necessarily indicate a consistent value. Most importantly, the current method has not reflected the efficiency level of the branch.

According to Cooper et al. (2007), one approach that is considered effective in measuring performance in many service industries that have complex input-output relationships is Data Envelopment Analysis. There have been many studies of data envelopment analysis using bank branches as decision-making units (DMU). Based on Paradi et al. (2018), one of the main areas where DEA has been applied in the financial services industry is the measurement of bank branch efficiency. DEA can measure the relative efficiency level of the branch office, which in turn will produce a ranking of all units studied. This rating then indicates how efficient (or inefficient) a branch is compared to other branches. This result can be utilized by the bank's senior management in the decision-making process, which is to enrich the branch office closure analysis.

This study aims to identify the parameters used by the bank regarding branch closure objective, the relative efficiency of the branch offices, and how it can help the decision-making analysis. Also, the Malmquist Productivity Index (MPI) was adopted to measure the total change of the productivity factor of the branch. The efficiency and productivity measurement are expected to become a useful tool for the management of the bank in evaluating and analyzing the branch performances and as a ranking tool for branch closure prioritization.

Previous studies on banking efficiency, including DEA, were carried out to measure the efficiency of the bank compared to other banks as shown by Paradi, J. C., & Zhu, H. (2013). As for the branch level, the efficiency measurement was usually used as a tool for bank management in measuring the efficiency of their branch offices in order to increase its performance. As the novelty of this research, instead of measuring the potential of improvement, this case study is intended to indicate inefficient branches to be further analyzed for branch closure decision-making process.

The efficiency and productivity are two interrelated concepts, where high productivity is the result of high efficiency. Efficiency can be defined as the ability to produce a certain output using the least possible input. Conversely, productivity is the ability to produce the maximum output using certain input, so that the greater the output produced from certain input, the higher the level of productivity of the intended input. According to Farrell (1957) economic efficiency consists of technical efficiency and allocative efficiency. Technical efficiency is a condition where companies can maximize output with certain input. Whereas allocation efficiency is a condition where the company can utilize its input optimally with a certain level of output.

There are several methods that can be used to measure the performance of an organization, which can also be applied to the banking industry, one of which is through ratio analysis. Ratio analysis is an approach traditionally used by various industries to measure the performance of each unit, and the company itself. But Ross, et al (2019) further explained that the ratio analysis has some weaknesses, one of which is the inability to say which ratio is most important, and what level of ratio can be said to be high or low. In addition, the weakness of the ratio approach in measuring the level of efficiency is its difficulty in being able to determine which units to be the most efficient, and less efficient, when compared to several units within the same industry.

Another approach which was later developed and used to measure the performance of financial institutions is frontier efficiency, where a financial institution is assessed through how its performance is relative to the performance of the best financial institutions in the same industry (Bauer, Berger, Ferrier, & Humphrey, 1998). Frontier analysis and ratio analysis can be said as an analytical method that can be used on analysis and research. The difference is that ratio analysis can be said to be partial, whereas frontier analysis is more comprehensive and more objective in measuring relative performance of companies in similar industry.

The frontier analysis consists of non-parametric approach and parametric approach. Asmare & Begashaw (2018) describe a nonparametric approach as a method that uses linear programming to measure the relative efficiency of several decision-making units (DMUs) by identifying the optimal mix of input and output that are grouped based on their performance. On the other hand, the parametric approach uses the stochastic frontier production function where the deviation from the production function is considered as random error (noise) and inefficiency. In their research, Quaranta et al (2018) stated that Data Envelopment Analysis (DEA) is currently the most common approach to be used by academics in evaluating the level of efficiency.

The decision-making process is applied in almost all aspects of life, from individuals to the organization or company level. All decisions are made in order to reduce a problem at the time, so that the decisions are needed to achieve the desired goals. Decision making according to Salusu (2015) is the process of choosing an alternative course of action according to the situation, to resolve organizational problems. In order to make a decision, it must be assumed that the individual has all relevant information about the available alternative (Edwards, 1954).

Some prerequisites for making a good decision are clearly identify the objectives or outcome you want to achieve, gather as many information you can to assess your options, elaborate several possible choices in accordance with your values, interest and abilities, reflect the possible outcomes of each course of actions, and elaborate several possible choices in accordance with your values, interest and abilities (Vasilescu, 2011)

METHOD

Based on the data obtained, this study is intended to measure the level of efficiency of a bank's branches relative to similar branches, in this case the micro branches. In this case study, we observed one of the largest banks in Indonesia, with thousands of branches across Indonesia. Data Envelopment Analysis (DEA) is used as a method for calculating the ratio of output and input for all branches compared in a population, through the value of technical efficiency. DEA was chosen as a research method because there have been many studies using DEA in analyzing the level of efficiency at banks, especially at the branch office level.

The DEA method was created as a performance evaluation tool for the activities of the Decision-Making Unit (DMU). The relative efficiency of a DMU is then defined from the weighted amount of output divided by the weighted amount of the input. The benefit of using DEA in measuring efficiency is its ability to identify units used as references that can help assess the causes and solutions to inefficiencies, which can be used for managerial decision making. In the case where input and output vary, efficiency is calculated by transforming the variation into a single input and output. This is done by determining the appropriate weighting. Efficiency is then measured from the weighted output divided by the weighted input. The measure of efficiency in DEA is obtained by comparing output with input, so that the maximum efficiency value is 1. A ratio number of 1 (or less than 1) shows that the bank is efficient (or inefficient) in producing the maximum level of output from each input.

In measuring efficiency using DEA, there are two models that can be used. The first one is Constant Return to Scale (CRS) that was first introduced by Charnes, Cooper, and Rhodes (thus known as the CCR model) in 1978, with input orientation, where each DMU will be compared with all DMUs in the sample with the assumption that internal conditions and external DMU is the same. According to Casu & Molyneux (2003), the CRS model is only suitable for use when all DMUs operate at an optimal scale, consequently if some DMUs do not operate at an optimal scale, it will result in inappropriate technical efficiency due to inappropriate scale efficiency. This model is relatively more appropriate to be used in analyzing performance in manufacturing companies. The other model of DEA is Variable

Return to Scale (VRS), first introduced by Banker, Charnes, and Cooper (thus known as the BCC model), which is a development of the constant return to scale model. In this model, it is assumed that the company does not or has not yet operated at an optimal scale, so that the addition of inputs by x times will not produce output that increases by x times, thus can be smaller or larger. This model is relatively more appropriate to be used in analyzing performance efficiency in service companies, including banks.

The DEA model used in this study uses the Variable Return to Scale (VRS) approach. By using VRS approach, the technical efficiency used in this study is the Pure Technical Efficiency. In addition, this study also uses input orientation in looking at efficiency as a reduction in the use of inputs to produce output in a certain amount. The input orientation is chosen by looking at the banking industry, in this case the bank branch office, where the manager has control over operational costs. The VRS approach with input orientation according to Banker, Charnes, and Cooper (1984) can be formulated as follows:

Min θ

Subject to:

$$\sum_{j=1}^{n} x_{ij}\lambda_j \leq \theta x_{io}, \quad (1)$$

$i=1,2,\ldots, m,$

$$\sum_{j=1}^{n} y_{rj}\lambda_j \geq y_{ro}, \quad (2)$$

$r= 1,2,\ldots,s,$

$$\sum_{j=1}^{n} \lambda_j = 1, \quad (3)$$

$\lambda j \geq 0, \quad j = 1,2,\ldots,n,$

Where θ is technical efficiency, if <1 = inefficient, 1 is efficient; X_{ij} is the value of the ith input from unit *j*; y_{rj} is the value of rth output from unit *j*; λj = the *intensity variable* of unit *j.*

The program used in this study to measure the efficiency of the branch office is the Data Envelopment Analysis Computer Program (DEAP) version 2.1 which includes 3 (three) main options in DEA calculation: DEA Model based on CRS and VRS standards, which include calculations of technical efficiency (TE) and scale efficiency (SE); extension of the standard model to cover cost efficiency and allocative efficiency; and DEA Malmquist Model for panel data in measuring changes in total factor productivity (TFP), technological change, technical efficiency change, and scale efficiency change.

The DEAP version 2.1 program can include DEA calculations both input oriented and output oriented. This study uses DEAP with the input oriented standard VRS DEA model, and the Malmquist model to see changes in productivity from the panel data used. The Malmquist Index is used as a method for processing panel data, where productivity changes can be measured from each DMU.

Another aspect of DEA is the Malmquist Productivity Index (MPI), especially when focusing on aspects of inefficiency in nonparametric methods. Measuring changes in productivity is an important aspect to consider when dealing with inefficiency conditions in a financial institution, where productivity is expected to change along with innovations in technology and banking regulation. This can be captured through Malmquist Total Factor Productivity (TFP) which is the measurement of productivity involving factors of production (Raphael, 2013). Banks can be said efficiently operated when it is found to be in a frontier position, which the shift from the production frontier is called technical change.

According to Fare et al (1992), there are five indexes that can be produced in each year, which are technical efficiency change (effch), technological change (techch), pure efficiency change (pech), scale efficiency change (sech), and total factor productivity change (tfpch). The Malmquist index is a measurement of the total factor productivity change (Tfpch) for a certain period, which illustrates the company's performance in a specific period. If the value generated is greater than 1, then the company is successful in increasing productivity. Meanwhile, if the value produced is less than 1, then the company has a decreased productivity. If the value produced is equal to 1, the company has managed to maintain the previous level of productivity.

To describe the relationship between input and output in the banking industry, Berger and Humphrey (1997) stated that two approaches can be used, production approach and intermediary approach. The production approach defines bank as company that uses capital and labor to produce different categories of deposit accounts and loan accounts, while total costs are all operational costs used to produce these outputs. In intermediary approach, the core activity of a bank is intermediation, where banks buy financial assets from surplus units (such as the business sector, government and households), to be distributed to deficit economic units. The inputs used include labor costs, capital operating costs, and payment of interest on deposits. While the measured output is in the form of loans (loans), and financial investment. In the intermediation approach, all costs have been included without excluding interest costs, and deposits are categorized as input rather than as output.

In general, the appropriate inputs are all measurement need to be reduced by the DMU, while the outputs are all measurement that need to be increased (Paradi & Zhu, 2013). Furthermore, Paradi & Zhu explained that the first step in determining input and output variables was to identify all input and output variables related to the study. Based on data availability, screening can be done either through preliminary judgment or statistical tests to have the most relevant variables. In addition, in determining the input-output variable it is also necessary to focus on variables that are affected by the unit head (Aggelopoulos & Georgopoulos, 2017).

Input and output variables used in this study refer to the production approach, which uses 2 input variables and 4 output variables, that can be described in table 1.

Table 1. Input & Output Variables

Input Variable	Output Variable
General & Administration Cost	Funding
Labor Cost	Retail Loan
	Net Revenue
	Fee-based Income

Source: Variables determined based on the interview with bank's management

RESULTS AND DISCUSSION

To make sure that the data available can be used in the DEA model, we must first identify whether it meets the requirements of positivity and isotonicity. Based on the data in table 2, it appears that there are no negative values for all the variables. In addition, based on the correlation test results (table 3), it appears that all variables have a positive correlation, thus the DEA method can be further used.

Table 2. Descriptive analysis of the observed data

Variable	Amount of data	Mean	Minimum	Maksimum
2017				
DPK	402	7,261,458,534	649,201,442	25,329,303,998
Retail Credit	402	21,014,228,975	1,797,943,431	154,670,593,371
Fee-based Income	402	340,804,320	19,741,686	1,554,609,293
Net income	402	2,293,186,934	341,068,764	9,821,249,031
BUA	402	345,087,537	59,310,258	1,212,462,773
BTK	402	740,976,173	188,966,593	7,071,032,316
2018				
DPK	402	9,285,849,791	1,929,281,499	34,199,332,784
Retail Credit	402	26,189,861,715	5,448,720,030	144,405,939,959
Fee-based Income	402	588,877,317	91,696,037	2,172,520,054
Net income	402	2,448,512,072	769,945,843	10,826,474,506
BUA	402	291,244,823	13,958,040	1,071,218,027
BTK	402	915,316,220	356,256,309	7,238,308,553

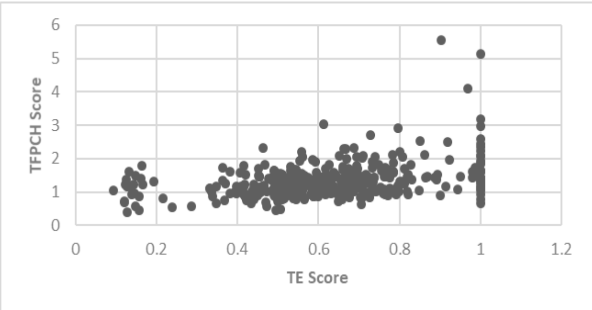
Source: data statistics

Table 3. Correlation coefficient of input & output variable

2017	DPK	Retail Credit	Fee-based Income	Net income	BUA	BTK
DPK	1.000					
Retail Credit	0.491	1.000				
Fee-based Income	0.475	0.462	1.000			
Net income	0.674	0.881	0.533	1.000		
BUA	0.357	0.450	0.463	0.536	1.000	
BTK	0.290	0.442	0.284	0.399	0.650	1.000
2018	**DPK**	**Retail Credit**	**Fee-based Income**	**Net income**	**BUA**	**BTK**
DPK	1.000					
Retail Credit	0.457	1.000				
Fee-based Income	0.390	0.410	1.000			
Net income	0.662	0.799	0.489	1.000		
BUA	0.185	0.113	0.108	0.217	1.000	
BTK	0.192	0.290	0.176	0.236	0.480	1.000

Source: data statistics

The technical efficiency scores are intended to get the relative efficiency of the branch compared to other branches. By applying the production approach of DEA method, the VRS technical efficiency score of 402 branches observed show that in 2017, there were 28 efficient branches (TE score = 1), which means 6.97% of the branches in the 'closed branch category' were efficient branches. A total of 374 micro branches (93.03%) are considered inefficient (TE score less than 1), which shows that most of adjacent branches are inefficient. It validates the management strategy to close branches that were near one another. In 2018, the number of efficient branches increased by 25%, with 367 branches still in the inefficient category. In addition, The Malmquist productivity score (TFPCH) indicates an increased productivity in 2018 compared to 2017, which shows the ability of branches to manage inputs and outputs more efficient. In 2018, there were 303 branches with TFPCH score more than 1, with DMU 394 had the highest score of 5.564. The branch distribution in Figure 1 also illustrates most branches are inefficient, with TE score range of 0.4 to 0.8. It also shows that most branches had an increased productivity in 2018.



Source: processed data

Figure 1. Scatterplot of branches based on TE Score and TFPCH score

Based on the measurement of 402 branches, a further analysis conducted on the 41 closed branches in 2019, and 28 closed branches in 2020. In this analysis, we also included the branch's contribution margin, which was used as the existing parameter by the management. Based on the analysis on 41 closed branches in 2019 (table 4), we can conclude that there was one efficient branch (DMU 8), with increased productivity (TFPCH score = 1.649). In addition, DMU 8 showed a positive contribution margin, which indicates that DMU 8 still made profit to the bank. Most branches also showed positive contribution margin, where two branches (DMU 10 and DMU 26) showed significant contribution margin (more than 2 billion rupiahs).

Table 4. Efficiency Score and Contribution Margin of 2019 Closed Branch

No.	DMU	Technical Efficiency		Productivity		Contribution Margin
		2017	2018	2018	Inc/Dcr	2018
1	1	0.46	0.128	0.407	Decrease	(2,140,934,574)
2	2	0.493	0.676	1.656	Increase	1,269,405,030
3	3	0.191	0.127	1.158	Increase	(2,485,730,185)
4	4	0.626	0.671	1.168	Increase	368,523,645
5	5	0.573	0.346	0.653	Decrease	(444,044,344)
6	6	0.588	0.406	1.075	Increase	741,904,203
7	7	0.526	0.796	2.902	Increase	1,774,786,295
8	**8**	**0.922**	**1**	**1.649**	**Increase**	**181,301,416**
9	9	0.505	0.581	1.176	Increase	463,793,062
10	10	1	0.669	1.046	Increase	2,339,559,295
11	11	0.632	0.587	0.882	Decrease	590,900,884
12	12	0.525	0.732	1.899	Increase	691,169,769
13	13	0.579	0.66	1.664	Increase	1,477,372,293
14	14	0.752	0.693	1.678	Increase	502,218,256
15	15	0.678	0.42	0.855	Decrease	375,267,408

No.	DMU	Technical Efficiency		Productivity		Contribution Margin
		2017	2018	2018	Inc/Dcr	2018
16	16	0.476	0.558	2.2	Increase	892,429,655
17	17	0.426	0.336	1.015	Increase	153,194,838
18	19	0.629	0.739	2.055	Increase	733,566,905
19	20	0.465	0.687	2.315	Increase	401,386,836
20	21	0.641	0.506	1.547	Increase	176,302,699
21	22	0.634	0.631	1.489	Increase	330,072,265
22	23	0.518	0.615	1.31	Increase	611,116,489
23	24	0.519	0.503	1.259	Increase	957,377,475
24	25	0.754	0.894	1.519	Increase	865,318,647
25	26	0.95	0.792	1.116	Increase	2,017,410,491
26	27	0.695	0.623	1.096	Increase	274,215,364
27	28	0.664	0.421	0.755	Decrease	(188,452,130)
28	29	0.67	0.608	1.278	Increase	755,127,991
29	30	0.636	0.613	1.452	Increase	537,726,891
30	31	0.628	0.452	1.135	Increase	611,925,279
31	32	1	0.505	0.499	Decrease	617,047,874
32	33	0.586	0.776	1.433	Increase	607,725,861
33	34	0.57	0.559	1.546	Increase	1,385,057,402
34	35	0.75	0.673	1.398	Increase	1,221,180,765
35	36	0.909	0.731	1.316	Increase	1,110,449,450
36	125	0.547	0.417	0.909	Decrease	612,435,392
37	188	0.549	0.532	1.633	Increase	872,719,278
38	191	0.511	0.658	0.791	Decrease	410,652,993
39	225	0.667	0.529	0.914	Decrease	1,326,658,693
40	396	0.539	0.396	0.952	Decrease	207,556,500
41	402	0.664	0.585	1.036	Increase	813,691,434

Source: Processed data

Of the 28 branches closed in 2020 (table 5), there were 3 efficient branches. Besides that, DMU 58, DMU 83, and DMU 89 also had an increased productivity as shown by their TFPCH score. Most branches also showed positive contribution margin, where DMU 314 shows the highest contribution margin with 5.6 billion rupiahs.

Table 5. Efficiency Score and Contribution Margin of 2020 Closed Branch

No.	DMU	Technical Efficiency		Productivity		Contribution Margin 2018	
		2017	2018	2018	Inc/Dcr	2018	2019
1	18	0.668	0.497	0.886	Decrease	813,691,434	1,219,770,625
2	44	0.916	0.735	1.323	Increase	1,371,543,311	1,050,926,664
3	57	0.754	0.624	0.983	Decrease	2,548,677,006	2,748,891,056
4	**58**	**0.893**	**1**	**1.319**	**Increase**	**1,390,969,906**	**1,004,702,588**
5	75	0.718	0.514	1.185	Increase	1,326,505,177	2,764,677,995

No.	DMU	Technical Efficiency		Productivity		Contribution Margin 2018	
		2017	2018	2018	Inc/Dcr	2018	2019
6	**83**	**1**	**1**	**1.047**	**Increase**	**3,887,666,494**	**2,589,798,601**
7	**89**	**1**	**1**	**1.316**	**Increase**	**3,368,769,085**	**2,931,987,580**
8	137	0.575	0.694	1.29	Increase	205,310,670	1,196,036,052
9	199	0.956	0.92	2.505	Increase	518,842,278	1,546,267,857
10	208	0.549	0.728	2.695	Increase	(329,489,207)	1,295,903,636
11	233	0.853	0.582	1.128	Increase	292,322,480	1,850,009,894
12	251	0.724	0.588	1.228	Increase	700,770,492	1,590,012,235
13	258	0.644	0.553	1.205	Increase	1,069,917,312	1,531,236,836
14	268	0.511	0.46	1.172	Increase	442,799,737	1,675,436,924
15	272	0.518	0.486	1.336	Increase	1,457,237,769	2,372,799,477
16	290	0.711	0.485	1.435	Increase	1,340,570,723	1,832,322,008
17	292	0.656	0.672	0.981	Decrease	963,381,253	2,124,505,784
18	294	0.59	0.5	1.282	Increase	995,424,777	1,874,651,639
19	301	0.614	0.553	1.925	Increase	737,297,146	1,503,701,812
20	314	0.725	0.767	1.454	Increase	4,804,273,533	5,600,612,535
21	322	0.607	0.656	1.056	Increase	845,745,572	1,413,423,046
22	331	0.395	0.38	1.622	Increase	2,974,750,221	4,385,110,546
23	333	0.552	0.441	1.234	Increase	1,206,363,558	3,069,216,873
24	338	0.207	0.147	1.489	Increase	(1,344,531,869)	(296,107,651)
25	347	0.685	0.55	1.06	Increase	924,203,483	2,360,604,828
26	357	0.697	0.544	0.992	Decrease	148,687,023	1,035,837,630
27	369	0.494	0.408	1.155	Increase	348,058,140	1,532,063,019
28	391	0.874	0.67	2.008	Increase	1,218,391,683	2,449,568,516

Source: Processed data

Based on the analysis above, we can see that the efficiency measurement can enrich the existing method used by the bank's management. The current quantitative method (as describe in table 6) can be modified in order to generate a more comprehensive analysis on branch closure.

Table 6. Comparison Analysis

No.	Factors	Bank's Existing Assessment	Using Efficiency Parameter
1	Preliminary Screening	Branch distance	Branch distance
2	Quantitative Analysis		
	Variable	Funding, Retail Loan, Contribution Margin, and NPL ratio	*Output:* Funding, Retail Loan, Fee-based Income, Net Revenue. *Input:* G&A cost and Labor cost
	Variable weight	No specific weight applied	Weighted output and input
	Efficiency	No efficiency assessment	Generate efficiency score
	Ranking capability	Difficult to rank branches based on existing assessment	Applicable to rank branches based on relative efficiency score

No.	Factors	Bank's Existing Assessment	Using Efficiency Parameter
3	Qualitative Analysis Exclusion	*Applicable to both method* - Branch role to run specific government program - Comply the obligation to maintain branch distribution across nation by the regulator.	
	Other Strategic Consideration		
4	Additional feature		Provide slack information

CONCLUSION

The bank's existing parameter in deciding the branch closure hasn't reflect the efficiency measurement to answer the primary objective of the branch closure itself. The bank's quantitative parameter can be enriched by applying the efficiency assessment to produce the relative efficiency of each branch based on the defined criteria. Based on the results of the analysis in the previous section, it appears that of all closed branches in 2019 and 2020, there are actually a few efficient branches with increased productivity included. It shows that the bank's existing method made it possible to close, as a matter of fact, an efficient branch. Therefore, in order to minimize this possibility occurs in the future, the efficiency measurement can be adopted as a parameter to enrich the decision-making process of the bank's management, so that the final decision will be more comprehensive.

Previous studies on bank efficiency analysis were carried out to measure or evaluate the operational performance of the bank. They wanted to see the level of bank efficiency, and compare it between bank categories, such as state-owned banks, private banks, conventional banks, sharia banks, and so on. As for the branch level, the efficiency analysis using the DEA is used as a tool for bank management in measuring the efficiency of their branch offices.

With the efficiency measurement results, management can see the condition that most of the adjacent micro branches are inefficient. Therefore, branch closure can indeed be an option to increase the overall level of bank efficiency. Furthermore, the results of the analysis can provide an overview regarding branch efficiency ratings, as an additional information for the management evaluation for the upcoming branch closure analysis. It is undeniable that the decision of branch closure is not simply based on efficiency analysis, or other financial ratios, but also requires a qualitative analysis from the management to assess the feasibility of branch closure. Therefore, a systematic analysis method can enrich those analysis in the decision-making process. In addition, this method can be further used by bank's management in evaluating the performance of other branches, not only micro branches, to identify the level of branch operational efficiency as well as potential improvement.

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