Economics Development Analysis Journal Vol (1) (2022)

Economics Development Analysis Journal

http://journal.unnes.ac.id/sju/index.php/edaj

Analysis of Communication Satellite Utilization Indonesian Banking

Daffa Rizqi Prayudya[1], [2]Firmansyah✉

Departement of Economics, Faculty of Economics and Business, Diponegoro University

Article Information

History of Article
Received October 2021
Accepted December 2021
Pusblished February 2022

Keywords:
Satellite, efficiency, Data Envelopment Analysis, Malmquist, Tobit model

Abstract

Space technology keeps innovating and giving us the benefit to make our life easier, including satellite banking. However, BRI become the first bank that own satellite and claims it could improve efficiency. Therefore, this research aims to look at the efficiency of selected banks in Indonesia and its productivity growth on efficiency by the satellite ownership. We also want to examine if the ownership of the satellite could impact bank efficiency. Methods that will be used are divided into two steps, which are DEA and Tobit regression. The result of this research shows us that bank BRI achieves the highest efficiency and productivity growth, compared with other selected banks. The ownership of satellites also has a positive significant impact on bank efficiency. It could be implied that owning satellite for banks is beneficial, policymakers should increase budget spending and other banks could own satellite.

✉ Corresponding author :
Address: Fadulty of Economics and Business, Diponegoro University, Jl. H. Prof. Soedarto, SH, Tembalang, Semarang 50275
E-mail: firmansyah@live.undip.ac.id

ISSN 2252-6560

INTRODUCTION

In the last decade, technology keeps evolved with various innovations that make human life easier, including the space sector. The usage of space technology starts from the behalf of the military until it is commercialized into the household and firm usage (Weinzierl, 2018). Nowadays we could utilize space technology such as telephone, television, weather forecast, and the internet, including banking transactions that were later considered as financial technology (fintech) (Schrogl et al., 2015). Fintech helps the banking industry to keep innovating and improve its efficiency (Wang et al., 2021). One of the innovations in the banking industry is the usage of telecommunication satellites. The innovation of satellite banking has the potential to solve weak coverage problems, especially in remote areas (Goel, 2013). Being banks that initiate that innovation, PT. Bank Rakyat Indonesia Tbk (BRI). has the initiative by launching their telecommunication satellite, thus making it become the first bank that owns a satellite (Bank BRI, 2020). BRI claims that owning a satellite will promote cost efficiency, also able to broaden its network coverage into a remote area in Indonesia (Dorimulu, 2016).

However, no literature about banking efficiency specifically mentioned the cost related to the telecommunication satellite as an input in their model. For example, a reference used deposits, operating cost, the number of equipment software programs as their input (Stoica et al., 2015). Wasiaturrahma et al., (2020) used profit sharing, channeled loans, and the general cost as the input. Operational staff, number of business personnel, branch office rent, and operating expenses used by Shyu & Chiang (2012). Fixed assets, staff expenses, and interest expenses (Li, 2020). Direct operating expenses and loan loss provisions (Aggelopoulos & Georgopoulos, 2017). In conclusion, they used the cost as an input in broader terms, and none of them used a specific measure of the cost related to the satellite.

Given the gaps of the previous paragraph that show the non-existence of previous works of literature that discuss costs related to telecommunication satellites, this research aims to give a comparison between the bank that owned satellites with a bank that rented satellites. This research will be conducted in two steps. In the first step, we will use Data Envelopment Analysis (DEA) to calculate the efficiency, followed by the second step, we use Tobit regression to explain which variable affects the bank efficiency. The result will give the policymaker a better understanding of the satellite ownership impact, which later could be used in the decision-making of whether to own or rent satellites.

This research will be divided into four sections. This section as an introduction will explain the foundation of this research concept. The second section will explain the data and methods that will be used. Third section will result and discussion. Lastly, fourth section consist of conclusion, limitation, future research guidance, and policy implication followed by its recommendation.

RESEARCH METHODS

The first step of this research started with the measurement of bank efficiency. We will use DEA analysis because it can overcome multiple input and output regardless of its functional frontier form, thus it is used in financial institutions applications (Banker et al., 2010; Curi et al., 2013; Curi & Vivas, 2015; Fukuyama & Weber, 2010; Juo, 2014). DEA calculation will be conducted using DEAP Version 2.1 software.

This research took the period of 2013 - 2019 in this research because BRI start to operate its satellite in 2016 so the period could be divided into pre and post satellite ownership. Decision Making Unit (DMU) that will be used is the top 10 banks by biggest assets in September 2019 consisting of Bank Mandiri, BRI, BNI, Bank BCA, Bank BTN, Bank CIMB Niaga, Bank Panin, Bank Danamon, Bank BTPN, and Bank Maybank. The consideration of sorting Decision Making Unit (DMU) based on bank assets is those banks could have huge macroeconomic

implications, either from their "Too Big Too Fail" attributes or their contribution to economic growth (Lay, 2020; Ma & Nguyen, 2021). Those banks will be divided into two group, which is BRI alone as the satellite owner, the rest of the banks as the satellite tenant

The selection of the banks number has also met the criteria for determining the amount of DMU for DEA. Various studies show that the number of DMUs in DEA must be sufficient so it won't lose the power of discrimination in terms of the number of efficient and inefficient technical units (Khezrimotlagh, 2015). To fulfill that requirement, Golany & Yaakov (1989) argue that DMU must be greater than 2 x (2(input)+2(output)). Also, due to the assumption of self-ownership of communication satellites, banks are expected that they can reduce the required inputs, input orientation will be used in the DEA (Coelli, 1996).

Input that will be used in this research is labor cost and bank communication cost, while output is third-party funds and credit. All of those variables are divided by total assets respectively to avoid calculation bias due to the magnitude of each DMU (Altunbas et al., 2001; Kurnia, 2004; Muliaman D. Hadad, Wimboh Santoso, Dhaniel Ilyas, 2003).

Constant Return to Scale (CRS) is used to determine the technical efficiency, so it could show us how much percentage that needed to achieve efficiency in constant ratios (Coelli, 1996). Technical efficiency also could be used to determine Malmquist Productivity Index (MPI) as the parameter to determine productivity growth (Camanho & Dyson, 2006). CRS model equation can be seen in the equation below:

$$\begin{aligned} &\max_{\mu,v} \ \sum_{k=1}^{p} \mu_k y_{k0} \\ &\text{s.t.} \quad \sum_{i=1}^{m} v_i x_{i0} = 1 \\ &\qquad \sum_{k=1}^{p} \mu_k y_{kj} - \sum_{i=1}^{m} v_i x_{i0} \le 0 \quad j = 1, \dots, n \\ &\qquad \mu_k \ge \varepsilon, v_i \ge \varepsilon \qquad k = 1, \dots, p \\ &\qquad\qquad\qquad\qquad i = 1, \dots, n \ \dots\dots\dots (1) \end{aligned}$$

The variable x_{ij} is the number of i-th type inputs from the j-th DMU, and y_{kj} is the number of k-type outputs from the j-th DMU. If the result is closer to 1, then it tends to be efficient. Otherwise, if the result is closer to 0, then it tends to be inefficient (Coelli, 1996)

Variable Return to Scale (VRS) model also will be used to determine pure technical efficiency, so it could show us the percentage that is needed to achieve efficiency in scale ratios (Coelli, 1996). Pure technical efficiency also could be used in the MPI model to determine total factor productivity change (Bjurek, 1996). The VRS equation can be seen in the equation below:

$$\begin{aligned} &\max_{\mu_k,v_i} \ \sum_{k=1}^{p} \mu_k y_{k0} - \mu_0 \\ &\text{s.t.} \quad \sum_{i=1}^{m} v_i x_{i0} = 1 \\ &\qquad \sum_{k=1}^{p} \mu_k y_{kj} - \sum_{i=1}^{m} v_i x_{i0} - \mu_0 \le 0 \quad j = 1, \dots, n \\ &\qquad \mu_k \ge \varepsilon, v_i \ge \varepsilon \qquad k = 1, \dots, p \\ &\qquad\qquad\qquad\qquad i = 1, \dots, n \ \dots\dots (2) \end{aligned}$$

The CRS model reflects (multiplication) technical efficiency and scale efficiency. The VRS model only reflects technical efficiency. Therefore, relative scale efficiency is the ratio of technical and scale efficiency (Ascarya & Yumanita, 2006). Scale efficiency can be seen in the equation below:

$$S_k = q_k, \text{CRS} \,/ q_k, \text{VRS} \quad \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (3)$$

S_k is the efficiency of the DMU scale in the equation, while qk is the efficiency value of the DMU. The value Sk =m1 illustrates that the DMU operates at the best scale efficiency measure. Sk value of less than one illustrates that there is still a scale inefficiency in the DMU.

We use the MPI to measure company productivity. According to Camanho & Dyson 2006), the Malmquist Productivity Index is a measurement of changes in productivity over time and multi-factor. These results are a total factor productivity change. These results can be seen in the equation below:

$$\begin{aligned} \text{MTFP}_K &= \frac{\text{MO}_k(y_t, y_{t+1}, x_k)}{\text{MI}_k(y_k, x_t, x_{t+1})} \\ &= \frac{E_k^o(y_{t+1}, \frac{x_k}{E_k^o(y_t, x_k)})}{E_k^I(y_k, \frac{x_t}{E_k^o(y_k, x_{t+1})})}, \ \dots\dots\dots\dots\dots\dots\dots\dots\dots\dots (4) \end{aligned}$$

Where *k*, *l*, *x*, *y* are represent of first bank, second bank, bank input, and bank output, respectively. While MO and MI are represent

input and output quantity index of Malmquist. The equation above illustrates the ratio between the output index and the Malmquist input index. The productivity index value > 1 illustrates that there is an increase in productivity (*growth*). An index value of <1 illustrates the level of productivity decreases (*decline*), An index value of 1 illustrates no change in the level of productivity (*stagnant*).

In the second step, this research will use Tobit regression to determine which variables that could affect banks efficiency. Tobit regression will be suitable to estimate this model because bank efficiency extracted from DEA has a value that is limited to upper bound and lower bound (Tobin, 1985; Yang et al., 2019). Moreover, if we estimate a limited value dependent variable using Ordinary Least Squares (OLS), it could create bias estimation due to the distortion in distribution and its homoskedasticity (Jackson & Fethi, 2000).

DEA has a non-free and limited value from 0 to 1, therefore, the Tobit model is the best in estimating efficiency. The model used is following Tobin (1985), which is a variable that has both lower and upper limits. The Tobit model emphasizes that the maximum likelihood method is used to estimate the model parameters when the dependent variable is limited (Yang et al., 2019). Calculations using OLS will lead to the estimation of biased parameters because OLS assumes a normal distribution of error, variables, and homoscedasticity (Jackson & Fethi, 2000). The Tobit model for DMU0 can generally be defined as follows:

$$y_0^* = \beta' x_0 + \varepsilon_0$$
$$y_0 = y_0^* \text{ if } y_0^* > 0 \text{ , and}$$
$$y_0 = 0, \text{ if not} \quad \text{..... (5)}$$

$\varepsilon_0 \sim N(0, \sigma^2)^3$, x_0 dan β is a vector of explanatory variables and unknown parameters. It is a latent variable and the efficiency score of DEA (Stavarek, 2003). The maximum likelihood function notated in L is maximized to solve β and σ based on observations of explanatory variables and DEA efficiency scores (Jackson & Fethi, 2000). It can be chosen in the equation below:

$$L = \prod_{y_0=0}(1 - F_0) \prod_{y_0^*=0} \frac{1}{(2\prod \sigma^2).^{\frac{1}{2}}} \times e^{-[\left(\frac{1}{2\sigma^2}\right)](y_0 - \beta x_0)^2}$$

Where:

$$F_0 = \int_{-\infty}^{\beta x_0/\sigma} \frac{1}{(2\prod)^{1/2}} e^{-t^2/2} dt \quad \text{.....(6)}$$

The results showing that banks are 100% efficient are y = 0 and the results show that banks are inefficient (y> 0). F_0 is the standard normal distribution function evaluated on $\beta x_0/\sigma$

We compile the Tobit model below to find out the factors that influence technical efficiency in banking. This research uses the value of technical efficiency in calculating DEA CRS. The Tobit model will be used is:

$$TE_{it} = \beta_0 + \beta_1 \ln Asset_{it} + \beta_2 ROA_{it} + \beta_3 ROE_{it} + \beta_4 CAR_{it} + \beta_5 NPL_{it} + \beta_6 D_{1\,it} + \varepsilon \quad (7)$$

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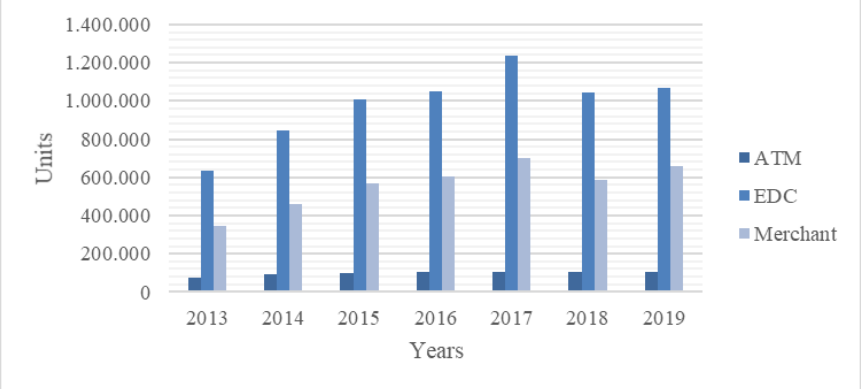

Figure 1. Card-based Payment Development in Indonesia
Source: Compilation of Bank Indonesia Statistics Data

TE on the left side represents technical efficiency from prior DEA analysis. While lnAsset, ROA, ROE, CAR, NPL, and D represent log Total Asset, Return on Asset, Return on Equity, Capital Adequacy Ratio, Non-Performing Loan, and Dummy of satellite ownership, respectively. Lastly, ε represents error. Using Tobit Model, this research will be using panel data with common effect.

RESULTS AND DISCUSSION

Banking industry is considered as a data-driven business. Data utilization is required to manage their massive customer for Know Your Customer (KYC), Anti Money Laundering or Countering the Financing of Terrorism (AML/CFT), ATM activities, point of sales, profiling, etc (Pérez-Martín et al., 2018) . Those data also called as a big data.

Big data able to help bank to exctract customer data, thus able to make faster decision. Data utilization also could mitigate their risk. To cater all of those necessity, banks needs the technology that able to transfer the data in wholesale and quick. Therefore, communication satellite is needed to handle that huge data

Communication salellites has some advantages such as coverage, weather resilient, and huge bandwith. Those advantages can't be benefited with terestial communication (e.g. fiber optic). Data with large bandwidth will be received by VSAT through each transponder on the satellite (Schrogl et al., 2015; Viens, 2019)

Banking industry is using satellites as their means of operations to enhance their communication infrastructure so it could reach the remote area. Also, the satellite has a contribution to ensuring the connectivity of the banking data. Moreover, card-based payment system such as Automated Teller Machine (ATM), Electronic Data Capture (EDC), and online merchants are keeping growing as we can see in the Figure 1. Hence, the banking industry tries to improve its infrastructure capability, but also efficiency.

BRI become the pioneer in banking industry that has its own satellite. In 2016, BRI launched their own satellite namely "BRISat". That satellite is on Slot Orbit: 150,5 BT with 36 C-Band and 9 Ku-Band transponders. With those specification, BRI could cover whole Indonesia, Southeast Asia, and Asian Eastern Sea (Bank BRI, 2017; SSL, 2016).

Table 1. The Amount of ATM in Indonesia

Bank	2013	2014	2015	2016	2017	2018	2019
BRI	18292	20792	22792	24292	24684	22684	19184
Mandiri	11514	15444	17388	17461	17766	17376	18291
BCA	14048	16694	17081	17207	17658	17778	17928
BNI	11163	14071	16070	17056	17966	18311	18659
BTN	1504	1830	1830	1830	1.964	2.126	2159
CIMB Niaga	2956	3272	3364	3865	4500	4500	4500
Panin	965	1.009	1.023	981	967	964	1009
Danamon	1483	1473	1454	1431	1396	1433	1345
BTPN	84	94	107	154	207	227	227
Maybank	1524	1530	1.605	1.633	1.606	1.609	1571

Source: Compilation of respective banks financial statement, 2021

Table 2. Percentage growth of bank communication cost in Indonesia

Bank	2014	2015	2016	2017	2018	2019
BRI	37.5%	0.3%	13.1%	-5.0%	-10.3%	-4.3%
Mandiri	11.4%	11.6%	3.0%	3.5%	9.1%	7.2%
BCA	29.8%	47.5%	30.0%	25.4%	19.3%	18.3%
BNI	22.7%	19.1%	-0.6%	-2.4%	9.8%	5.9%
BTN	46.7%	-5.1%	7.2%	21.4%	0.0%	-7.9%
CIMB Niaga	-27.3%	-16.4%	61.6%	21.1%	-23.2%	-7.0%
Panin	10.5%	-0.5%	150.0%	-58.5%	1.2%	-1.7%
Danamon	-1.4%	-10.9%	-19.9%	3.0%	-9.7%	-11.6%
BTPN	-14.1%	17.3%	17.7%	12.5%	-33.9%	16.5%
Maybank	0.6%	20.9%	-15.7%	17.0%	-7.1%	2.5%

Source: Compilation of respective banks financial statement, 2021

The reason behind satellite purchase is it could lead to more efficient communication (up to 50 percent of communication cost reduction), also to able cater the needs of BRI for reaching the remote area (Daniel, 2016; Indonesia Investment, 2014). Its necessity can be seen from the fact that BRI has the most ATM in Indonesia compared with the other banks (See Table 1).

Based on Table 2., the ownership of satellite is also reflected in the reduction of communication cost. BRI has their communication cost reduced from 2017 to 2019, consistently. The time span of communication cost reduction is aligned with the post-launching of their satellite. This is implying that communication satellite could effectively improve efficiency by reducing communication cost. Even though BNI, BTN, CIMB Niaga, Panin, Danamon, BTPN, and Maybank also has reduced communication cost, they don't have any consistency or pattern like BRI.

However, those tables are not enough as proof that BRI become more efficient due to the satellite ownership, or the driver of bank efficiency is the satellite ownership itself. Further analysis is needed to become a comprehensive result. Hence the next paragraph will analyze through second-step analysis, which is DEA analysis and Tobit regression.

First, we will examine the result from DEA analysis. TE, PTE, and SE are represent technical efficiency, pure technical efficiency, and scale efficiency, respectively. Due to the usage of TE in the next Tobit regression, we focus from the result of TE. It can be implies that BRI Bank has become more efficient after owning and operating its communication satellite.

It can be seen from the TE that increased from 2016, the year when BRI own and operates its satellite. The TE not only increase, but it reaches TE=1 while other banks only reach TE>1. This is implied that BRI is more efficient than other banks. However, there is a decrease of BRI's TE in 2019. But, the decrease in 2019 still make BRI more efficient than other banks. On average, each group of banks show BRI bank are more efficient than other banks that rent satellites (See Figure 2.). Result of DEA analysis can be concluded that BRI as the satellite owner is more efficient than other banks.

Figure below shows the comparison of DEA analysis between bank owners and satellite tenants in Indonesia and comparison of productivity through MPI at satellite owner and tenant banks.

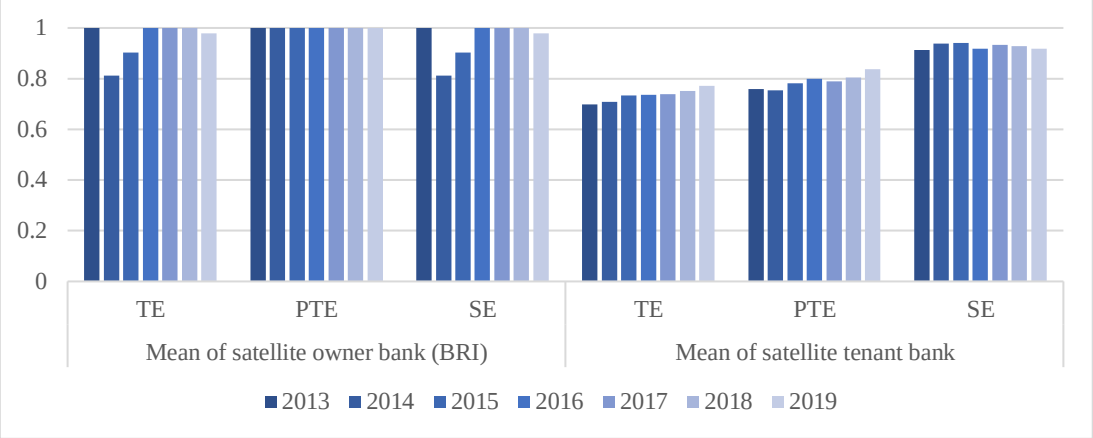

Figure 2. Comparison of DEA analysis between bank owners and satellite tenants in Indonesia
Source: Source: Data Processed, 2021

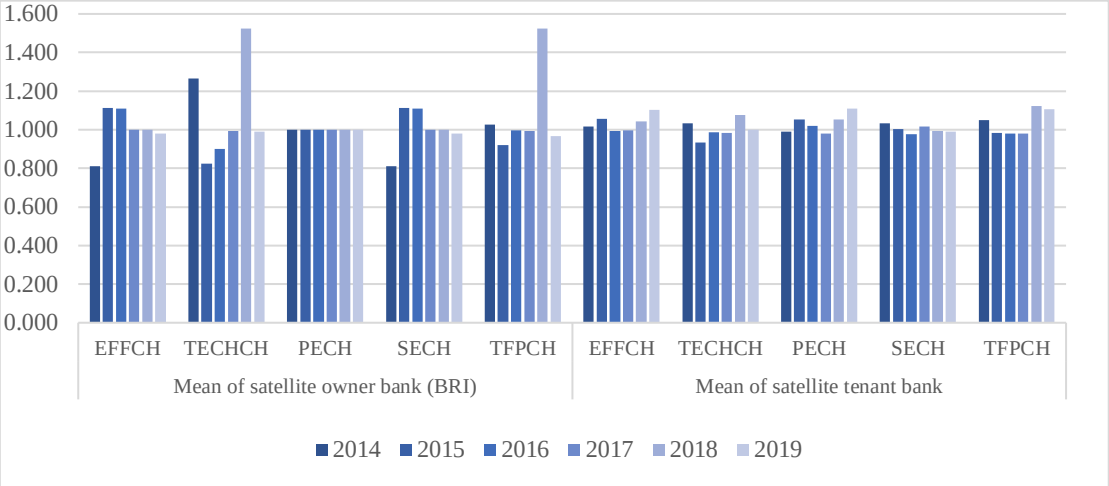

Figure 3. Comparison of productivity through MPI at satellite owner and tenant banks
Source: Source: Data Processed, 2021

MPI can be analyzed by deriving DEA result. EFFCH, TECHCH, PECH, SECH, and TFPCH are represent technical efficiency change, technological change, pure technical efficiency change, scale efficiency change, and total factor productivity change, respectively. We will focus on the TFPCH to examines the changes in total factor production. The frontier changes shown by TFPCH have fluctuated. BRI Bank showed a decrease in frontier to decline productivity in 2016. The Year 2016 is the first time for its communication satellites to operates. Both BRI (satellite owner) and other banks (satellite tenat) average shows that their productivity growth experienced growth in 2014-2019. This is because each TFPCH bank group has a value of more than one. We could not able to conclude the advantages of communication satellites on the MPI model. These advantages cannot be seen yet because the two groups of banks have productivity growth and are only has slight difference. (See Figure 3.)

In second step, from the Tobit regression result, Table 3. shows that bank size has a positive and significant effect on bank efficiency, which implies that the increment of assets will be followed by its efficiency. It has a strong influence since it has below 1 percent significance. Banks with high assets tend to have a great contribution towards efficiency. Also, high asset banks are likely to inherit more advanced technology, which means they could

operate with lower cost and obtain higher revenue.

Profitability has two implementations, which could either reduce or increase bank efficiency. ROA has a negative effect on efficiency, and ROE has a positive effect on efficiency. However, the one that has a significant result is ROE, which means it could be evidence that profitability has a positive impact on efficiency. Banks with good ROE imply that banks are efficiently managing their given equity to generate huge revenue. It also implies that Asset Liability Management (ALMA) of its banks is well maintained that it could operate efficiently

Capital that is reflected with CAR has a negative impact on bank efficiency. However, the result is not significant, which means it doesn't have a strong implication. It is a good sign because capital should have a positive impact on efficiency. CAR explains the ability of banks to provide funds to mitigate default risk, which means the banks efficiently manage their operations.

NPL also has a positive impact on efficiency, but it is not significant, which means doesn't have a strong implication. NPL should have a negative impact because it explains that banks failed to manage their credit. It also implies the risk of default, which make the banks carry the risky asset

Table 3. Tobit Model Regression Result

Variable	Coefficient	Std. Error	z-Statistic	Prob.
C	-1.18855	0.60678	-1.95878	0.0501
LNASSET	0.107086	0.033177	3.227677	0.0012
ROA	-0.17939	0.041644	-4.30761	0
ROE	0.018059	0.006401	2.8212	0.0048
CAR	-0.00589	0.009164	-0.64258	0.5205
NPL	0.053839	0.033218	1.620801	0.1051
D1	0.24124	0.09725	2.480615	0.0131

Error Distribution				
SCALE:C(8)	0.167542	0.01416	11.83216	0
Mean dependent var	0.756443	S.D. dependent var		0.248158
S.E. of regression	0.178061	Akaike info criterion		-0.506591
Sum squared resid.	1.965756	Schwarz criterion		-0.24962
Log likelihood	25.73067	Hannan-Quinn criter.		-0.404519
Avg. log likelihood	0.367581			

Source: Data Processed, 2021

Lastly, satellite ownership has a positive impact and is significant to bank efficiency. It is implied that owning a satellite could reduce the cost of communication, thus improving efficiency from the input side. Aside from that, banks could generate more revenue by renting the reserved transponder to other lessees.

The research results show consideration of banks owning a communication satellite. First, the result of DEA analysis shows from BRI technical efficiency that has more efficiency than other banks since 2016. It is also supported by the result that BRI has the highest efficiency average from 2013 – to 2019. Second, from the Tobit regression, it could be proved that indeed satellite ownership become the factor that influences banks efficiency and its significance (below 5 percent).

By having a communication satellite, banks could strengthen financial infrastructure

due to stronger networks coverage that has not been able to be covered by terrestrial networks. Aside from its coverage, communication satellites also give banks the opportunity to generate more income, especially from transponders. In case the banks already cover all of their necessity through satellite and still have a spare transponder, the remaining transponders could be leased to other parties. Therefore, it could add more income streams other than bank intermediation activities. Giannopapa (2015) also argues that investing in satellites could multiply the profits up to tenfold due to its utilization.

Indeed, the cost of investment in the satellite is huge. The cost to own a communication satellite is around 2.5 trillion rupiahs (Indonesia Investment, 2014). The huge investment cost could cause other banks to reconsider their decision to purchase satellite communications. If it is not backed with strong necessity, it could be a bad investment and greatly reduce bank profitability. However, BRI has its vision to consider satellite purchasing. One of them is aligned with the BRI goals, which is to increase the scope of financial services throughout Indonesia. Its effort is supported by the fact that BRI become the bank that has the most ATM and coverage (including remote areas). Aside from goals themselves, BRI also could increase their profitability due to the new income stream through transponder leasing. The data also could be more protected since the satellite is owned and managed by BRI itself.

However, the regulation itself could constrain the banks to maximize their satellite utilization. As stated in the UUD 1945 (constitution), banks function is limited to the intermediation function, which is to collect funds from the third party, then distribute them as credit. This means, commercializing the transponders could violate the regulation in Indonesia. If the regulation is too restricted, especially in this digital era, it could constrain the innovation from the banks. Nowadays, the development of banks is not only limited to intermediation function but also tries to maximize their non-interest and fee-based income (Trivedi, 2015). The regulators should keep their pace with the bank innovation, so it could not constrain banks innovation, but also could maintain financial stability.

CONCLUSION

The technology keeps innovating including space technology that could improve the banking industry, such as satellite banking. Among all banks, BRI becomes the pioneer of the satellite owner. However, no research discusses the role of satellite cost in their model when discussing banks efficiency. The result shows that BRI as the bank that owns satellites carries more efficiency and growth compared with other selected banks. The ownership of communication satellites also has a positive impact on bank efficiency. Aside from the satellite ownership, bank size and its profitability also have a positive impact.

This research has a limitation regarding the sample of the satellite owner banks. The limitation comes from the fact that BRI is the only bank that owns a satellite, the rest of the banks just renting. Therefore, some points could be used as future research guidance. First, there could be a possibility of increasing satellite owners in the banking industry, thus it needs to add more samples in the satellite owner to balance out the satellite tenant. Second, BRI effectively use its satellite in 2016, thus it is still possible to extend the span periods of the research.

There is also policy implication that could be extracted, followed by its recommendation. Owning a satellite implies that it could improve bank efficiency, also the result gives evidence that that bank that owns a satellite is more efficient. The recommendation will be divided into two strands. The first strands is for the policymaker, especially in Indonesia. The Ministry of Research and Technology / BRIN should increase budget priorities in the development of communications satellite research in Indonesia. It is expected that the development of communication satellite research can make Indonesia be an actor in space products. Also, the related stakeholders or policymakers could manage and supervise

communication satellites for banking through coordination between institutions such as the government, Bank Indonesia, and the Financial Services Authority. This research suggest that management and supervision must be carried out by certain institutions. It is because the satellite is a dual-use space product that is sensitive. After all, it can be used both for military purposes such as spies and commercial. Therefore, the use of space products such as satellites requires special arrangements

The second strands, the recommendation is delivered for the banking industry. The bank could buy their communication satellites with their capacity. Due to the costly satellite implementation, they could purchase the satellite through an interbank joint venture scheme to minimize the cost of implementation (if it does not violate the regulation). Moreover, evidence that BRI experienced reduced expenses could motivate other banks to adapt its strategy. Banks need to be efficient in terms of inputs because they have not reached the score TE=1. They should reduce their input so they could reach optimal efficiency levels. This efficiency can be increased by developing branchless banking and other technologies. The technology development aims to reduce costs incurred by banks so that input orientation efficiency can be achieved.

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