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The influence of interest rate risk on efficiency in rural banks: The moderating role of loan distribution

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ABSTRACT

Interest rate fluctuations lead to movements in both rural banks' lending and savings rates. These movements can result in interest rate risk affecting the efficiency of rural banks. The continuity of rural banks is vital because they are one of the financial institutions that funding financing for small and medium enterprises (SMEs). Thus, this study aims to analyse the influence of interest rate risk on the efficiency of rural banks in Indonesia from 2014 to 2018. Moreover, this study also investigates the role of the loan distribution as a moderating variable of the relationship between interest rate risk and efficiency. This research applies two stages of analysis. The first stage of analysis is estimating the efficiency score using Data Envelopment Analysis (DEA). The second stage measures the relationship between interest rate risk and efficiency and the role of loan distribution as a moderating variable using Tobit Regression. The regression analysis shows that interest rate risk has a positive and significant effect on efficiency. In addition, the loan distribution can enhance the relationship between interest rate risk and efficiency.

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INTRODUCTION

The movement of interest rates can affect interest rate risk, affecting bank efficiency (Sun & Chang, 2011). High-interest rate risk can affect the amount of funds allocated in the form of loans and other investments. Bank Perkreditan Rakyat (BPR), a rural bank, is a microfinance institution distributing financing to small and medium enterprises (SMEs). This financing can assist SMEs to improve their performance.

A decrease in Indonesian rural banks' operating expenses from 2015 to 2019 indicated an increase in their efficiency. Indonesian rural banks' operating expenses ratio decreased from 81.59% to 80.74% in 2019 (Indonesia Financial Service Authority, 2019). Hence, the downward trend in the value of operating expenses ratio could also indicate the increase in the efficiency of rural banks. This circumstance also indicates an increase in rural banks' operating income or a decrease in their operating expenses. However, the operating expenses ratio was higher than 80%, meaning that rural banks could face inefficiency problems.

Generally, rural banks in Indonesia have higher interest rates on deposits and loans compared to commercial banks. The average rural banks' deposit rate decreased from 3.33% in 2015 to 8.16% in 2019

(Indonesia Financial Service Authority, 2019). However, this rate was higher than commercial banks deposit rate, which was about 2.27% to 6.92% in 2019 (Indonesia Financial Service Authority, 2019). On the other hand, rural banks charged their borrowers lending rates of 22.38% to 29.52% in 2019 (Indonesia Financial Service Authority, 2019). Meanwhile, commercial banks' lending rates in 2019 were about 9.90% to 11.62%% (Indonesia Financial Service Authority, 2019). Therefore, rural banks need to compete with commercial banks, especially in lending, in which commercial banks offer more competitive lending rates. It can cause fluctuations in income received from interest rate differences. The higher the interest rate income fluctuation, the higher the interest rate risk, affecting bank efficiency.

Table 1 shows that the level of rural banks' loan distribution increases by 43% from Rp 68,391 (in billion rupiahs) in 2014 to 98,220 (in billion rupiahs) at the end of 2018 (Indonesia Financial Service Authority, 2018). An increase in the amount of loan distribution can increase the amount of interest income received by rural banks (Rohmadani & Cahyono, 2016). It, in turn, can also impact the movement of rural bank interest rate risk. However, high loan distribution potentially increases non-performing loans. According to Indonesia Financial Service Authority (2018), rural banks' non-performing loan ratio experienced an increase from 4.41% in 2013 to more than 6% at the end of 2018.

Table 1.
Loan distribution, deposit rate, and lending rate of rural banks in Indonesia from 2014-2018

Year	Loan Distribution (in billion rupiahs)	Deposit Rate	Lending Rate		
			Working Capital	Investment	Consumption
2014	68,391	4.56%	24.45%	25.88%	25.50%
2015	74,807	5.17%	29,52%	26.26%	26.24%
2016	81,684	3.95%	28,12%	25.07%	25.44%
2017	89,482	3.71%	26,81%	24.09%	24.17%
2018	98,220	3.44%	25,73%	23.58%	23.22%

The amount of loans distributed by rural banks not only can affect interest rate risk but also the level of bank efficiency (Dewi & Budiasih, 2013). Increasing the amount of rural banks' lending can increase interest income, reduce the operating expenses ratio, and increase efficiency. On the other hand, an increase in loan distribution can also increase the number of non-performing loans, increasing the monitoring cost. The increase in monitoring costs can increase bank operational costs, increasing the bank's operating expense ratio. An increase in the operating expenses ratio can be indicated as a decrease in the level of efficiency.

Based on the description above, rural banks, as financial institutions providing financing facilities for small and medium enterprises (SMEs), are vulnerable to interest rate risk. This interest rate risk also affects the efficiency level of rural banks; an increase in interest rate risk may decrease the level of efficiency of rural banks, while a decrease in the level of interest rate risk may increase the efficiency of rural banks (Sun & Chang, 2011; Zeineb & Mensi, 2014). Inefficiency in rural banks leads to a decline in their performance and the cessation of BPR operations. It may impact SMEs as one of the business sectors receiving financing facilities from rural banks. The rural banks' loan distribution level in Indonesia can also affect the risk of interest rates and efficiency. The amount of loan distribution may affect the amount of bank net interest income, affecting efficiency. Therefore, it is necessary to research the effect of rural banks' interest rate risk on efficiency.

Many previous studies have discussed the relationship between loan distribution and efficiency (Dewi & Budiasih, 2014; Febrianto, 2013; Kuncahyono, 2016). Furthermore, the relationship between interest rate and loan distribution have also been analysed by some previous researchers (Rohmadani & Cahyono, 2016; Haryanto & Widyarti, 2017; Khotimah, 2019). However, few studies discussed loan

distribution as a moderating variable in the relationship between interest rate risk and efficiency. Thus, the main contribution of this research is to investigate the role of loan distribution as a moderating variable in the relationship between interest rate risk and efficiency of rural banks in Indonesia.

The first section of this study explains the research background. In the second section, this research describes the theoretical basis and previous studies of the relationship between interest rate risk and efficiency and the role of loan distribution as a moderating variable. Next, the third section of this study discusses the methodology. It is followed by a section discussing the analysis results and their explanation. Finally, this study ends with the conclusion and suggestions.

LITERATURE REVIEW

Efficiency concept

The efficiency concept was introduced by Farel (1957), comparing the number of output and input. Efficiency consists of technical efficiency, allocative efficiency, and economic efficiency. Technical efficiency is the company's ability to maximise output from available inputs (Cummins & Rubio-Misas, 2006). Technical efficiency consists of pure technical efficiency and scale efficiency. Allocative efficiency is how to combine various inputs to produce various outputs. On the other hand, economic efficiency is a combination of technical efficiency and allocative efficiency. The efficiency score is in the range of 0-1. The decision-making unit (DMU), which has an efficiency score of 1, operates efficiently.

The relationship between risk and efficiency

The relationship between risk and efficiency can be explained through the bad management hypothesis. According to the bad management hypothesis, banks producing low efficiency are caused by poor management (Berger & DeYoung, 1997). Referring to this hypothesis, banks that cannot control and manage their spending will face the problem of low efficiency. Banks that can maximise their sources of funds and loan distribution can reduce the difference between rate sensitive assets and rate sensitive liabilities. This circumstance can decrease interest rate risk and increase efficiency. Previous researches have discussed a lot about the effect of interest rate risk on efficiency. Kwan & Eisenbeis (1997) analysed the relationship between interest rate risk and efficiency in several banks in the United States from 1986 to 1995. They found that interest rate risk impacts efficiency. Meanwhile, Sun & Chang (2011) analysed the influence of interest rates on efficiency in several countries in Asia from 1998 to 2008. They found that interest rate risk affects efficiency. Zeineb & Mensi (2018) researched the relationship between risk and efficiency in Islamic banks in the Gulf Cooperation Council Countries (GCC) from 2004 to 2013 and found a relationship between risk and efficiency. Cheng et al. (2018) discussed the influence of operational risk on the efficiency of the Taiwan Banking industry. Their findings showed that operational risk impacts efficiency.

Based on the above theory and several previous studies, risk influences efficiency. Therefore, this study hypothesises that interest rate risk has an influence on efficiency.

The role of loan distribution as a moderating variable in the relationship between interest rate risk and efficiency

Dewi & Budiasih (2013) analysed the influence of loan distribution on efficiency in Tabanan Regency from 2010 to 2014. The study's results showed that loan distribution has a negative influence on efficiency. Febrianto (2013) analysed the relationship between efficiency and loan distribution at commercial banks listed on the Indonesia Stock Exchange (BEI) from 2009 to 2012. Febrianto (2013) found that efficiency does not affect loan distribution.

Meanwhile, Kuncahyono (2016) also analysed the relationship between efficiency and loan distribution of commercial banks listed on BEI from 2010 to 2014. Kuncahyono (2016) revealed that efficiency has a negative relationship with loan distribution. On the other hand, Haryanto & Widyarti (2017) examined the effect of efficiency on lending to commercial banks listed on BEI from 2012 to 2016. They found that loan distribution has a negative and significant influence on efficiency.

Furthermore, Rohmadani & Cahyono (2016) investigated the effect of the net interest margin of commercial banks in Sidoarjo city on loan distribution from 2004 to 2015. Their analysis results revealed that the net interest margin has a negative effect on loan distribution. Khotimah (2019) examined the effect of interest rates on rural banks' loan distribution in Indonesia from 2014 to 2017. The results showed that interest rates influence the level of lending. Meanwhile, Rini (2019) examined the effect of interest rates on lending to BPR Hasamitra Makassar. Rini (2019) found that interest rates have a positive effect on loan distribution.

Based on previous research, the level of loan distribution can affect interest rate risk. In addition, the level of loan distribution can also affect bank efficiency. Therefore, this study also hypothesises that loan distribution moderates the relationship between interest rate risk and efficiency.

METHOD

This study uses two stages of analysis. The first analysis looks for the value of the dependent variable, namely the level of efficiency of rural banks in Indonesia using the Data Envelopment Analysis (DEA). Upon generating the efficiency score from the DEA calculation, the next step is to analyse the effect of interest rate risk on efficiency and analyse the role of loan distribution as a moderating variable using the Tobit regression.

This study used secondary data obtained from BPR financial reports published on the website of the Financial Services Authority (OJK). The research period was from 2014 to 2018. This period was chosen as the basis for the research because this period was the transition period for the banking authority from Bank Indonesia to OJK.

The population of this study consisted of rural banks in Indonesia; the samples for this study were selected using proportionate strata sampling. Samples were taken from 33 provinces in Indonesia. Each province produced different samples according to the total number of rural banks in the province. The number of samples was determined based on Krejcie & Morgan's (1970) table. The total population of rural banks in Indonesia in 2014 was 1,643, and the number of samples required was 313 rural banks. The calculation for determining the number of samples is as follows:

$$\frac{\text{Total number of rural banks in province}}{\text{Total of rural banks population in Indonesia}} \times \text{number of samples required}$$

Table 2 contains the variables used in this study. This study uses one dependent variable, namely the level of efficiency. Based on Table 2, the dependent variable is measured using DEA calculations. The level of efficiency using the DEA compares the output variables, namely total rural banks loan and investment, with input variables, namely total third-party savings, labour costs, and total fixed assets. The independent variable in this study is interest rate risk, measured by the gap ratio. This ratio is calculated by dividing rate sensitive assets and rate sensitive liabilities into total assets (Kwan & Eisenbeis, 2017). The moderating variable in this study is the level of loan distribution, measured by the amount of loans extended by rural banks (Rohmadani & Cahyono, 2016; Khotimah, 2019; and Rini, 2019).

This study also uses control variables consisting of size, capital, and profitability. The first control variable is size, measured by total assets. Some previous studies revealed a relationship between size and efficiency (Haryanto, 2018); Henriques et al., 2018). Capitalisation also becomes a factor affecting efficiency

(Bitar et al., 2018; Bace & Ferreira, 2020). This variable is estimated by the ratio of equity to total assets. In addition, profitability is measured using return on assets (ROA).

Table 2.
Variable description

Variable	Measurement	Previous Studies
Dependent Variable Efficiency	The efficiency score is generated by DEA calculations using the intermediation approach and variable return to scale (VRS). DEA variable input consists of: 1. Total deposits 2. Labour costs 3. Total fixed assets DEA variable output consists of: 1. Loans 2. Investments	Candra and Yulianto (2015); Saraswati (2016); Prayitno (2018)
Independent Variable Interest Rate Risk	Gap ratio = (Rate Sensitive Assets – Rate Sensitive Liabilities) / Total Assets	Kwan & Eisenbeis (1997)
Moderating Variable Loan Distribution	The logarithm of total loan distribution	Rohmadani & Cahyono (2016); Khotimah (2019); Rini (2019)
Control Variables		
Size	The size of the company, measured by the logarithm of total assets	Haryanto (2018); Henriques et al. (2018)
Capitalisation	Capitalisation, estimated by equity divided to total assets	Bitar et al. (2018); Bace & Ferreira (2020)
Profitability	Profitability, predicted by return on assets	Wijesiri et al. (2017)

***Data envelopment analysis* (DEA)**

The use of DEA is considered more accurate in measuring efficiency than financial ratios (Prayitno, 2018). DEA is a non-parametric calculation. According to Gunawan & Utiyati (2013), in Sari & Widaninggar (2018), the first step in using DEA is determining the input and output variables. The second step is to prepare the input and output data from each decision-making unit (DMU). The next stage is to run a model with a VRS approach. The efficiency approach in this study used an intermediation approach. This method is considered in accordance with the characteristics of rural banks as intermediary institutions (Mulyadi, 2015; Wong & Deng, 2016; Naufal & Firdaus, 2017). DEA is also considered a better measure than the ratio method. According to Septiano & Widiharih (2010), the DEA can measure several input and output variables. The input and output variables have different measurement units, and the assumption of a functional relationship between the measured variables is not necessary. Efficiency can be achieved if the score generated by DEA is 1, indicating that the efficiency can be produced at 100%. Meanwhile, the efficiency score is below 1 or 100%, indicating that the unit of analysis is inefficient. The sample to be measured using DEA is called a DMU.

The VRS approach was used in this study. The VRS is considered suitable because rural banks have different input and output movements. The VRS introduced by Banker Charnes Cooper (BCC) in 1976 assumes that the amount of input does not determine the amount of output produced. The DEA calculation in this study used the output orientation approach. This approach is used when the DMU can still increase its output from the current input (Wong & Deng, 2016). This study applied this approach because rural banks are considered to be able to increase the number of outputs they currently have.

The efficiency scores generated under the VRS assumption (PTE) are higher than those computed under the CRS assumption (TE). The BCC model is as follows:

$P_B = n\{(\chi, y) \mid \chi \geq X\lambda, y \leq Y\lambda, e\lambda = 1, \lambda \geq 0\}$.....(1)

where: $X = (\chi_j) \in R^{m \times n}$ and $Y = (y_j) \in R^{s \times n}$

e = row vector with all elements unity

λ = column vector with all non-negative elements

χ = input data

y = output data

Moreover, the input-oriented BCC model is as follows:

(BCC_o) $\min_{\theta B \lambda} \theta_B$.....(2)

Subject to $\theta_B \chi_o - X\lambda \geq 0$

$Y\lambda \geq y_0$ $\quad e\lambda = 1$

$\lambda = 0.$

where θ_B is a scalar

Tobit regression

This study used the Tobit regression to measure the effect of interest rate risk on efficiency. Tobit regression was also used to measure the role of a moderator in the relationship between interest rate risk and efficiency of rural banks. This study used the Tobit regression because the dependent variable has a value between 0 and 1 (Abbas et al., 2016). Tobit regression produces a more accurate regression calculation than ordinary least square (OLS), which may bias the regression results.

This study used two Tobit regression equations. The first equation measured the effect of rural banks interest rate risk on efficiency:

$Efficiency_{it} = \beta_0 + \beta_1 Interest\ rate\ risk_{it} + \beta_2 Size_{it} + \beta_3 Capitalization_{it} + \beta_4 Profitability_{it} + \varepsilon_i$.....(1)

The second equation measured the effect of BPR interest rate risk on efficiency and the role of loan distribution as a moderating variable (MV).

$Efisiensi_{it} = \beta_0 + \beta_1 Interest\ rate\ risk_{it} + \beta_2 MV_{it} + \beta_3\ Interest\ rate\ risk_{it} * MV_{it} + \beta_4\ Size_{it} + \beta_5\ Capitalization_{it} + \beta_6\ Profitability_{it} + \varepsilon_{it}$ .....(2)

RESULT AND DISCUSSION

Table 3 presents that the mean or average efficiency calculated using DEA is 0.504. This value indicates that most rural banks in Indonesia are inefficient because they have an efficiency score of less than 1. The maximum value of efficiency is 1, and the minimum value is 0.167. Interest rate risk has a mean of 0.264. A positive interest rate risk indicates that the position of assets is higher than liabilities so that when interest rates increase, the net interest income can also increase. In contrast, if interest rates decrease, the net interest

income will also decrease.

The maximum value of interest rate risk is 0.801, while the minimum value is -0.31. The company's average size is the total assets of rural credit banks, which are Rp 7.68 billion, showing that most rural credit banks have assets on a small scale. The largest company size is Rp 226 billion, and the smallest company size is Rp 989 million. The average level of rural banks capitalisation is 0.212. Meanwhile, rural banks' highest level of capital is 0.807, and the lowest level of capital is -0.208. The average profitability of rural banks as measured by return on assets (ROA) is 0.0268 or 2.68%, while the minimum and maximum profitability values are 0.011 and 0.169, respectively. The average level of loan distribution for rural banks is Rp. 5.54 billion. Meanwhile, the highest level of loan distribution is Rp 19.4 billion, and the lowest is Rp 300 million.

Table 3.
Descriptive Statistics

Variable	Observation	Mean	Minimum	Maximum
Efficiency	1574	0.504	0.167	1
Interest Rate Risk	1574	0.264	-0.310	0.801
Size (in million rupiahs)	1574	7,680,000,000	989,109	226,000,000,000
Capitalization	1574	0.212	-0.208	0.807
Profitability	1574	0.0268	0.011	0.169
Loan Distribution(in million rupiahs)	1574	5,540,000,000	300,000,000	19,400,000,000

Table 4 shows the Tobit regression results calculating the effect of interest rate risk on efficiency. Based on Table 4, interest rate risk has a positive and significant effect on efficiency. The *t*-statistic value is 19.17, and this value is significant at 1%. Meanwhile, firm size as a control variable has a positive and significant effect on efficiency. The t-statistic value of company size is 11.40, with a significance level of 1%. On the other hand, capital has a negative and significant effect on efficiency. The *t*-statistic value is -0.06 with a significance level of 10%. Profitability has a negative and significant effect on efficiency with a *t*-statistic value of -0.508, with a significant probability of 1%.

Table 4.
Tobit Regression

Variable	Coefficient	*t*-statistics
C	-0.341	-5.21***
Interest Rate Risk	0.554	19.17***
Size	0.041	11.40***
Capitalization	-0.002	-0.06
Profitability	-0.508	-4.07***

Note: (*) significant at 10%, (**), significant at 5%, and (***) significant at 1%

Table 5 shows the Tobit regression results of the effect of interest rate risk on efficiency and the role of loan distribution as a moderating variable. Interest rate risk has a positive effect on efficiency. The *t*-statistic value is 2.87, significant at 1%. Firm size has a positive and significant effect on efficiency, with a *t*-statistic value of about 10.07, while profitability has negative and significant effect on efficency.

Table 5.
Tobit Regression

Variable	Coefficient Estimates	*t*-statistics
C	-0.497	-5.66***
Interest Rate Risk	0.524	16.74***
Size	0.050	10.07***
Capitalization	0.029	0.68
Profitability	-0.539	-4.31***
Loan Distribution	-2.57e-10	-3.28***
Interest Rate Risk*Loan Distribution	4.26e-10	2.87***

Note: (*) significant at 10%, (**) significant at 5%, and (***) significant at 1%

The regression analysis results in Table 5 show that interest rate risk has an influence on efficiency. This positive influence also means that an increase in interest rate risk will increase efficiency, vice versa. An increase in interest rate risk indicates an increase in the differences between rate sensitive assets and rate sensitive liabilities of rural banks in Indonesia. The descriptive statistics in Table 3 show that the gap ratio's average value as an interest rate risk indicator is positive. This result also indicates that most rural banks in Indonesia have higher rate sensitive assets than their rate sensitive liabilities. Thus, the higher the rate sensitive assets, the higher the rural banks' revenue, which may increase efficiency. However, this result contradicts the bad management hypothesis, assuming that an increase in risk indicates that banks cannot manage their operations, potentially decreasing efficiency. Banks maximising their profits seek to increase their interest income. It makes banks try to maximise their rate sensitive assets, impacting increasing interest rate risk. Banks will try to increase the allocation of their sources of funds to increase interest income and cover their operational costs. It can ultimately increase efficiency. In addition, this result is consistent with Kwan & Eisenbeis (1997), Sun & Chang (2011), and Zeineb & Mensi (2014).

Loan distribution as a moderating variable can moderate the relationship between interest rate risk and efficiency. Loan distribution can enhance the relationship between interest rate risk and efficiency. The existence of loan distributions will increase rural banks' opportunity to generate interest income from the lending rate. This circumstance will increase rural banks' gap ratio as an indicator of interest rate risk. Thus, interest rate risk will increase, and it will also increase efficiency.

CONCLUSION

Fluctuation of interest may affect both rural banks deposit rate and lending rate. This circumstance will generate interest rate risk, which will influence efficiency. This study investigates the influence of interest rate risk on the efficiency of rural banks in Indonesia. The main contribution of this study is examining the role of loan distribution as a moderator in the relationship between interest rate risk and efficiency. The analysis results show that interest rate risk has a positive influence on efficiency. In addition, loan distribution can moderate the relationship between interest rate risk and efficiency. Besides interest rate risk, other risks that may affect rural banks' efficiency should be investigated further. Indeed, the existence of loan distribution also may influence banks' liquidity risk. Future studies can also examine the role of loan distribution as a moderator in the relationship between other risks and efficiency.

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