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An Analysis of the Performance of Regional Development Banks (RDB) in Indonesia: Stochastic Frontier Analysis Approach

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Abstract: The dominance of the banking sector shows that the banking industry plays an important role in driving the economy in Indonesia. As part of the national banking industry, Regional Development Banks (RDB) are required to contribute to the economy through optimal performance. One of the important indicators in measuring company performance, including in the banking industry, is the level of efficiency. Efficiency in the banking industry can be observed from a micro and macro perspective, which leads to the ability of banks to survive in conditions of increasingly fierce competition in technology-based products and services, as well as the ability of banks to allocate financial resources to increase investment activities that can stimulate the economy. Therefore, this study examined the level of cost and profit efficiency of the RDB industry in Indonesia for the 2011–2020 period, as well as the internal and external variables that affect RDB inefficiency using Stochastic Frontier Analysis (SFA). The results show that there are no RDB's efficient in cost and profit. Furthermore, the variables capital adequacy ratio and technology investment impact on increasing cost and profit efficiency, opposite with non-performing loan. Therefore, to optimize the xRDB's cost and profit efficiency, the main thing that must be done includes managing and improving good quality loans as well as optimizing idle funds.

Keywords: Regional Development Bank (RDB); cost efficiency; profit efficiency; SFA

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1. Introduction

One of the key sectors that drives the Indonesian economy is the banking sector. The dominance of the banking sector in the national financial industry shows that the banking sector holds an all-important role in maintaining stability and establishing sustained economic security. One of the national banking industry categories that is expected to drive the national economy is the regional banking industry, or Regional Development Banks (RDB). However, in the middle of the dominance of the banking sector on the national economy, various studies state that the existence of RDBs in the national economy, especially the regional economy, is still relatively low (see Alfriska and Haryani 2011; Fettry et al. 2018; Lisdayanti et al. 2013; Salim et al. 2015).

According to the Indonesian Financial Service Authority (OJK 2015), the contribution of RDB to regional development is still low, which is reflected in the relatively small share of productive credit, which only reached 26%. Inadequate governance, human resources, risk management, and infrastructure have triggered an increase in non-performing loans. Hence, RDBs need to transform to fix these structural weaknesses and strengthen organizational foundations so that they are able to grow and compete in order to play a greater role in the economy in the future.

Intermediary performance of RDBs observed from the loan-to-deposit ratio (LDR) tends to record a lower score compared to the national banking industry. Non-performing loans of RDBs tend to be higher than the national banking industry. While the capital performance of RDBs observed from the capital adequacy ratio (CAR) is considered adequate,

it is still too low to support business expansion and increase RBD's competitiveness in the national financial industry. This statement is also supported by Rose and Hudgins (2013). They state that each bank must have a minimum amount of capital to fulfill its basic functions, namely: first, as a reserve fund in the event of financial and operational losses; second, as the funds needed to regulate and operate a financial company before other sources of funds are raised; third, as a strength and guarantee to the community that the bank has sufficient capital as a financial institution; fourth, by having sufficient capital, banks can develop new supporting services and facilities; and fifth, capital serves as a growth manager and helps ensure that growth is sustainable over the long term. Based on the function of bank capital, the more capital the better the bank's growth, even though the bank's capital has exceeded the rules set by the authorities or by the central bank.

The soundness level of bank performance also has been regulated in several policies, both OJK and Indonesian Bank policies, related to bank performance which includes summarizing the ideal bank soundness ratios with percentages and ratings, as in OJK regulation number 14/SEOJK.03/2017 concerning the commercial banks' soundness level assessment.

Furthermore, the profitability performance of RBDs observed from the return on assets (ROA) ratio has tended to decline in recent years. This could be influenced by an increase in the operating expenses to operating income ratio which results in a decrease in net interest margin (Financial Authority Services). These lead to a conclusion that RDB's operational activity is largely dominated by high-interest funding sources that can affect the overall RDB income and performance if not managed properly.

The insignificant impact of RDBs on the national banking industry is also evident from the performance of RDB's market share which is relatively low in the national banking industry. The low market share of RDBs indicates that RDBs are relatively non-competitive against national banking performance in general. As a matter of fact, as one of the regional financial institutions, the existence of RDBs in the regional economy plays a very strategic role, especially in stimulating the regional economy through the provision of financial products and services that are tailored to the social and economic characteristics of each region in which the RDB operates. In addition, the role of RDBs as financial advisors and local government fund managers is one of the factors that solidify the strategic and fundamental role of RDBs in the regional economy.

One of the important indicators in measuring company performance, including in the banking industry, is the level of efficiency. Efficiency in the banking industry can be observed from a micro and macro perspective, which leads to the capacity of banks to survive amidst increasingly fierce product and service competition, as well as the capacity to allocate financial resources to improve investment activity that can spur the economy (see Berger and Mester 1997).

Another study on the profit efficiency performance of the banking industry in Indonesia revealed that even though banking in Indonesia, in general, is not yet efficient, RDBs show better profit efficiency levels than other banking categories tested. This is due to RDBs having a high net interest margin (NIM) with low non-performing loans (NPL) (see Muazaroh et al. 2012).

Based on the elaboration above, this study aimed to respond to the inconsistencies in studies on the efficiency of the regional banking industry in terms of cost and profit. In addition, the urgency of this study is largely based on the scope of profit and cost efficiency by taking into account the digital platform ownership factor in the RDB industry. This is because, in carrying out their operations, RDBs are facing fierce competition from both the banking industry and non-banking industry amidst the rapid growth of financial technology. Therefore, this study becomes even more important to contribute to the development of RDBs to achieve the goal of a highly competitive banking industry which contributes to the national and regional economy. Furthermore, this study is expected to provide a recommendation for stakeholders in determining the direction of policy, especially in identifying the main sources of inefficiency that can reduce the performance of RDBs.

2. Theoretical Framework

In general, costs are categorized into accounting costs and economic costs. Accounting costs include recorded expenses, depreciation, and bookkeeping. The economic cost refers to the definition of opportunity cost (opportunity cost) which is the cost of inputs given to maintain current resources. In other words, economic costs are costs paid from the use of the current input that will be paid on the use of the next input. One way to distinguish between these two views is to consider how the costs of various inputs (labor, capital, and entrepreneurial services) are defined under each system. Furthermore, the company that carries out the production process aims to maximize profit. The method is used by the company to have inputs and outputs with the sole purpose of maximizing economic profit, which is the difference between total revenue and total economic costs. Next is the economic profit function (economic profit function) which describes the company maximizing profit (Nicholson and Snyder 2017).

Furthermore, efficiency is a characteristic in the production process in addition to capacity, effectiveness, and flexibility. Efficiency is a measure to show how well economic resources are used in the production process to produce output (Gasperz 2011). According to Porcelli (2009), efficiency is one part of the overall assessment of the company's performance which is classified based on effectiveness and efficiency. As a financial sector, the banking business also has a goal to achieve profit by maximizing revenue and making efficiency in costs to be incurred. This needs attention by taking into account the level of efficiency both in terms of input and output. The measurement of profit efficiency has taken into account inefficiency both from the input side and the output side. The difference is that the measurement of cost efficiency emphasizes more on the input side where the inefficiency from the output side may be the same or can be greater than the input side's inefficiency (Berger and Mester 1997).

The advantages of using profit efficiency include allowing the measurement of inefficiencies in the output side equal to the inefficiency measurement based on the input side and reducing the problems associated with specifying and measuring input and output variables (Berger et al. 1993).

Various literature on efficiency in the banking sphere often features non-parametric approach Data Envelopment Analysis (DEA) (see Anouze and Bou-Hamad 2019; Hendrawan 2020; Henriques et al. 2018; Kumar 2018; Lúpi 2019; Othman et al. 2016; Titko et al. 2014). In performing estimation, the DEA method is considered less informative because it does not take into account error components that need to be considered in observing dynamic economic phenomena (see Kasim and Baten 2015; Silva et al. 2017; Zuhroh et al. 2015). To accommodate this situation, another approach is used to measure levels of efficiency, namely the Stochastic Frontier Analysis (SFA) approach, where its estimation process takes into account statistical noise of the inefficiency effect (see Sharif et al. 2019). In addition, this approach is also deemed better since its measurement is based on economic optimization rather than technical optimization (see Wardhani and Mongid 2019).

In Indonesia, the kinds of literature on efficiency in the banking industry largely focus on commercial banks (see Anwar 2019; Kadang 2018; Mongid and Muazaroh 2017; Putri and Rusmita 2020; Subandi and Ghozali 2013; Widiarti et al. 2015) rather than regional banks. A study on efficiency among RDBs was conducted, among others (Abidin 2009; Puspasari 2020; Sutanto 2015; Zahra and Darwanto 2019), assessing the efficiency performance of RDBs using the Data Envelopment Analysis (DEA) method. The results of the study show that the majority of RDBs are still unable to reach optimal efficiency levels. Another study demonstrates that there is not a single RDB in Java that has a total asset greater than the RDB outside Java which has the title of the most efficient RDB in Indonesia (Sparta 2017).

3. Method

3.1. Data

This study employed published financial data from 27 Regional Development Banks throughout Indonesia for a period of 10 years comprising interest costs, operating costs

other than interest, other productive assets, total loans/financing provided, labor costs, physical capital costs, fixed assets, and inventory, total third party funds, profit before taxes, as well as variables used to determine the level of inefficiency of profits and costs in RDB, consisting of bank size, capital adequacy ratios, liquidity ratios, credit risk, and digital platform ownership. The details of the variables in this study are described in Table 1.

Table 1. Data description.

Variable	Description
	Cost and Profit Variables
Cost (Tc)	Total cost of interest and non-interest.
Profit (π)	Profit before tax.
Labor cost (Btk)	Ratio of wage per total asset.
Capital physical cost (BM)	Ratio of capital cost per total fixed capita.
Funding cost (BD)	Ratio of funding cost per total funding cost.
Actives (A)	The investment of bank in domestic and foreign currency in the form of security, placement, which include commitments and concessions in administrative accounts.
Output (Y)	The amount of money based on a loan agreement between the bank and other part.
	Inefficiency Variables
Bank Size (Fzise)	Represents the amount of reserve funds owned by the bank, capital adequacy.
Capital Adequecy Ratio(car)	The amount of reserve funds owned by the bank, capital adequacy.
Loan to Deposit Ratio(ldr)	Ratio of loans compared to third funds (DPK) which includes current accounts, savings and time deposits excluding interbank funds.
Non-Performing Loan (npl)	Ratio of the number of non-performing loans or loans with collectability of 3 (three) to 5 (five) with the total loans disbursed.
Technology Investment (ti)	Technology investment cost which consists of investment in technology supporting services such as SMS banking, mobile banking, and/or internet banking which is stated in billions of rupiah.

3.2. Methodology

The unbalanced panel dataset was used for estimating stochastic production function with the inefficiency effect. The efficiency literature can be divided in two branches: the parametric and non-parametric methods. The two most popular estimation methods which deal with efficiency measurement are data envelopment analysis (DEA) and stochastic frontier analysis (SFA). The DEA is representative of the non-parametric method involving a linier programming model. DEA develops a non-parametric piece-wise surface or frontier which is determined by the most efficient producers over the dataset. However, DEA is a deterministic model because efficiency is measured as the distance to this frontier without involving a statistical nose (Charnes et al. 1978).

SFA is a regression-based approach and assumes a function of cost, profit, and specific distribution for the error terms. The stochastic frontier approach is used because of the inherent stochastic process in this work (Aigner et al. 1977; Meeusen and Van Den Broeck 1977). The SFA model which estimates with Frontier 4.1, particularly cross-sectional data, was expressed based on the original models of Aigner et al. (1977) and Meeusen and Van Den Broeck (1977). The stochasticity of the cost function takes the following form:

$$\begin{aligned} LnTC_{it} = {} & \beta_0 + \beta_{w1} ln(w_{1i}) + \beta_{w2} ln(w_{2i}) + \beta_{w3} ln(w_{3i}) + \beta_k ln(y_i) + \beta_A ln(A_i) \\ & + \tfrac{1}{2}\beta_{w11} ln(w_{1i})^2 + \tfrac{1}{2}\beta_{w22} ln(w_{3i})^2 + \tfrac{1}{2}\beta_{w33} ln(w_{3i})^2 \\ & + \beta_{w1y} ln(w_{1i}) ln(y_i) + \beta_{w2y} ln(w_{2i}) ln(y_i) + \beta_{w3y} ln(w_{3i}) ln(y_i) \\ & + \beta_{w1y} ln(w_{1i}) ln(A_i) + \beta_{w2y} ln(w_{2i}) ln(A_i) \\ & + \beta_{w3y} ln(w_{3i}) ln(A_i) + u_k Trend + \tfrac{1}{2} u_k (Trend)^2 \\ & + \beta_{w1k} (Trend) ln(w_{1i}) + \beta_{w2k} (Trend) ln(w_{2i}) + \beta_{w3k} (Trend) ln(w_{3i}) \\ & + \beta_{yk} (Trend) ln(y_i) + \beta_{Ak} (Trend) ln(A_i) + v_{aTC} + u_{aTC} \end{aligned} \quad (1)$$

Furthermore, the translog stochasticity of the profit function takes the following form:

$$\begin{aligned} ln\left[(\pi) + \left|\pi^{min} + 1\right|\right] &= \beta_0 + \beta_{w1} ln(w_{1i}) + \beta_{w2} ln(w_{2i}) + \beta_{w3} ln(w_{3i}) + \beta_k ln(y_i) \\ &+ \beta_A ln(A_i) + \tfrac{1}{2}\beta_{w11} ln(w_{1i})^2 + \tfrac{1}{2}\beta_{w22} ln(w_{3i})^2 \\ &+ \tfrac{1}{2}\beta_{w33} ln(w_{3i})^2 + \beta_{w1y} ln(w_{1i}) ln(y_i) + \beta_{w2y} ln(w_{2i}) ln(y_i) \\ &+ \beta_{w3y} ln(w_{3i}) ln(y_i) + \beta_{w1y} ln(w_{1i}) ln(A_i) \\ &+ \beta_{w2y} ln(w_{2i}) ln(A_i) + \beta_{w3y} ln(w_{3i}) ln(A_i) + u_k Trend \\ &+ \tfrac{1}{2} u_k (Trend)^2 + \beta_{w1k} (Trend) ln(w_{1i}) \\ &+ \beta_{w2k} (Trend) ln(w_{2i}) + \beta_{w3k} (Trend) ln(w_{3i}) \\ &+ \beta_{yk} (Trend) ln(y_i) + \beta_{Ak} (Trend) ln(A_i) + v_{a\pi} + u_{a\pi} \end{aligned} \tag{2}$$

From the cost and profit function (Equations (1) and (2)), the total cost is Tc, w is input, the total active is A, the total output I Y, and u_i is defined as:

$$u_{it} = d_0 + d_1 Fsize_{it} + d_2 car_{it} + d_3 ldr_{it} + d_4 npl_{it} + d_5 ti_{it} \tag{3}$$

Even in a full-parameter model, the SFA model is difficult to estimate due to numerical and statistical instability in an infinite sample (Sari 2019). It necessitates the use of a precise parametric function form. A generalized log-likelihood test is therefore employed to choose the appropriate stochastic cost and profit function. The core model will be translog cost and profit function. In this study, the null hypothesis includes hicks-neutral technological progress ($\beta_{nt} = 0$), no-technological progress ($\beta_t = \beta_{tt} = \beta_{nt} = 0$), and a Cobb-Douglas function ($\beta_{nk} = \beta_t = \beta_{nt} = \beta_{tt} = 0$). In addition, when the coefficient of the inefficiency function is zero ($\gamma = \delta_0 = \delta_k = 0$), there will be an inefficiency effect function where γ is the inefficiency function's variance. If $\gamma = 0$, the standard cost and profit function will be used, with exogenous variables directly incorporated in the model.

Furthermore, the generalized likelihood ratio statistic equation was used to identify the appropriate production function, which can be written as follows:

$$\lambda = -2[l(H_0) - l(H_1)] \tag{4}$$

where the log-likelihood statistic of the sub-variable production function represents as $l(H_0)$, and the log-likelihood statistic of the cross-log cost and profit function represents as $l(H_1)$. Given that the null hypothesis is accurate, the test statistics have an χ^2 distribution with degree of freedom equivalent in the limitations to the number of parameters. The test statistics have a mixed χ^2 distribution, and under the null hypothesis, the critical value for this test is acquired from Table 1 of Kodde and Palm (1986). The statistical overview of all factors addressed previously is presented in Table 2.

Table 2. Descriptive statistics.

Variables	Unit	Obs	Mean	SD	Min	Max
Cost and Profit Variables						
Cost (Tc)	*(ln) million rupiah*	265	13.98	0.85	11.53	16.23
Profit (p)	*(ln) million rupiah*	265	12.51	2.09	0.00	14.57
Labor cost (Btk)	*(ln)ratio*	265	−3.76	0.28	−5.44	−2.95
Capital physical cost (BM)	*(ln)ratio*	265	1.36	0.46	−0.07	2.38
Funding cost (BD)	*(ln)ratio*	265	−3.37	0.89	−5.60	−1.87
Actives (A)	*(ln) million rupiah*	265	15.10	0.93	12.96	17.45
Output (Y)	*(ln) million rupiah*	265	15.99	0.89	13.25	18.31
Inefficiency Variables						
Bank Size (Fzise)	*(ln) million rupiah*	265	16.41	0.88	13.95	18.71
Capital Adequecy Ratio (car)	*ratio*	265	20.61	4.73	9.01	35.47
Loan to Deposit Ratio (ldr)	*ratio*	265	88.82	16.16	7.52	128.43
Non-Performing Loan (npl)	*ratio*	265	2.61	2.26	0.15	15.03
Technology Investment (ti)	*(ln) million rupiah*	265	7.67	4.31	0.00	15.85

Note: Mean = arithmetical average; SD = standard deviation; Min = minimum; Max = maximum; the estimates of cost and profit variables are the natural logarithm.

4. Result

Tests on the performance of RDBs in this study included the level of efficiency both in terms of cost and profit through testing the null hypothesis of whether RDBs in Indonesia are efficient in terms of both cost and profit. The first stage of this study was to select the best efficiency function equation model using the likelihood test of the translog and sub-translog models consisting of the Hick-Neutral, No Technological Progress, Cobb-Douglass, and No Technical Inefficiency models, where the null hypothesis, which is the sub-translog model, is appropriate for this study. The results of the likelihood test are as follows:

Based on Table 3, the null hypothesis for all sub-translog models is rejected. So, the best estimation model that can be used in this study is the translog model. The results of the estimation of the level of cost and profit efficiency in all RDBs observed using the translog model are as follows:

Table 3. Frontier models of stochastic cost and profit hypothesis testing.

Model	df	χ^2	*Cost Efficiency*		*Profit Efficiency*	
			λ	Conc.	λ	Conc.
Hick-Neutral	5	13.28	131.90	H_0 Rejected	1284.48	H_0 Rejected
No Tech. Progress	7	16.81	23.41	H_0 Rejected	1339.36	H_0 Rejected
Cobb-Douglas	18	23.21	132.83	H_0 Rejected	1368.17	H_0 Rejected
No Inefficiency	5	19.70	119.56	H_0 Rejected	104.92	H_0 Rejected

Note: Calculation of λ from the generalized likelihood ratio statistic. Using critical values of Mix χ^2 at α = 1 percent. (This critical value is taken from Table 1 of Kodde and Palm (1986)).

Table 4 presents the value of cost and profit efficiency for each RDB. The results of the estimation of cost and profit efficiency of 27 RDBs in Indonesia show that, on average, RDBs have been efficient both in terms of cost and profit with an average efficiency value of 1.01 and 1.23. This shows that throughout the observation period, namely 2011–2020, RDBs have been able to achieve cost and profit efficiency in carrying out their operational activities. The next stage was to test the effect of inefficiency in the cost and profit function. The effect of inefficiency was carried out by testing the null hypothesis that there is no inefficiency effect in the cost and profit function model using the likelihood ratio test value. The results of the effect of inefficiency testing are presented in Table 4.

Table 4. Cost and profit efficiency score.

Observation	Cost Efficiency	Profit Efficiency	Observation	Cost Efficiency	Profit Efficiency
RDB 1	1.02	1.00	RDB 15	1.01	1.23
RDB 2	1.01	1.03	RDB 16	1.02	1.10
RDB 3	1.01	1.15	RDB 17	1.01	1.61
RDB 4	1.02	1.00	RDB 18	1.02	1.42
RDB 5	1.01	1.02	RDB 19	1.01	1.22
RDB 6	1.01	1.01	RDB 20	1.00	1.14
RDB 7	1.01	1.00	RDB 21	1.03	1.17
RDB 8	1.01	1.38	RDB 22	1.01	1.00
RDB 9	1.01	1.33	RDB 23	1.01	1.48
RDB 10	1.02	1.35	RDB 24	1.01	1.17
RDB 11	1.01	1.04	RDB 25	1.01	1.44
RDB 12	1.04	1.03	RDB 26	1.03	1.09
RDB 13	1.01	1.00	RDB 27	1.02	1.03
RDB 14	1.01	1.06	**Average**	**1.01**	**1.23**

Model 1 in Table 5 represents cost and inefficiency functions. The coefficients of *Fsize* and *ldr* are no different with the null hypothesis. Furthermore, the coefficients of *car* and *ti* have negative sign and significantly decreasing cost inefficiency. The coefficient of *npl* is

positive and statistically significant. Meanwhile, the profit coefficients (Model 2) of *Fsize* and *ldr* are not statistically significant. Besides that, the coefficients of *car* and *ti* have a statistically significant impact on profit inefficiency. Otherwise, the coefficient of *npl* has a significant impact on increasing inefficiency.

Table 5. Stochastic cost and profit frontier maximum-likelihood estimation.

Variables	Coefficients			
	Model 1		Model 2	
	Cost and Profit Function			
Constant	−1.64		133.68	
	(3.32)		(2.09)	
Btk	2.23	*	−18.93	*
	(0.92)		(3.18)	
BM	2.75	*	8.58	*
	(0.54)		(3.07)	
BD	−0.95	*	−10.56	*
	(0.29)		(2.41)	
A	−0.69	***	−7.78	*
	(0.37)		(1.62)	
Y	1.87	*	15.22	*
	(0.44)		(1.27)	
Btk^2	0.18		−1.72	
	(0.14)		(1.05)	
BM^2	−0.14	***	1.95	***
	(0.08)		(0.63)	
BD^2	0.20	*	−1.42	*
	(0.04)		(0.27)	
BtkA	−0.23	*	−1.32	*
	(0.08)		(0.50)	
BMA	−0.06	*	0.09	
	(0.08)		(0.65)	
*BD*A*	−0.02		−1.00	
	(0.03)		(0.29)	
BtkY	0.14		2.08	
	(0.10)		(0.49)	
BMY	−0.10		−0.74	
	(0.07)		(0.60)	
BDY	0.13	*	1.25	
	(0.03)		(0.29)	
t	0.05		−2.33	
	(0.08)		(0.65)	
t^2	0.00		0.02	
	(0.00)		(0.03)	
Btkt	−0.01		0.12	
	(0.02)		(0.14)	
BMt	0.01		0.23	
	(0.01)		(0.08)	
BDt	−0.01	*	−0.09	*
	(0.00)		(0.04)	
At	−0.02	**	0.03	**
	(0.01)		(0.09)	
Yt	0.01		0.09	
	(0.01)		(0.08)	

Table 5. *Cont.*

Variables	Coefficients			
	Model 1		Model 2	
	Inefficiency function			
Constant	−0.53		15.84	
	(1.06)		(5.24)	
FSize	0.06		−1.12	
	(0.07)		(0.29)	
car	−0.01	***	−0.18	***
	(0.01)		(0.02)	
ldr	0.00		0.01	
	(0.00)		(0.01)	
npl	0.06	*	0.27	*
	(0.01)		(0.05)	
ti	−0.01	*	−0.00	***
	(0.01)		(0.02)	
sigma-squared	0.03	*	1.73	*
	(0.01)		(0.16)	
gamma	0.86	*	0.00	*
	(0.11)		(0.00)	
log likelihood function	178.04		−447.09	
LR test of the one-sided error	119.56		104.92	

* Significance at 1 percent; ** Significance at 5 percent, *** Significance at 10 percent.

5. Discussion

The efficiency of RDBs in terms of cost and profit can be answered through several facts, namely: (1) the majority of RDBs' operational activities are low-risk portfolios, e.g., consumption loans for the civil service staff as well as interbank fund placements; (2) the majority of RDBs third-party funds were low-cost funds sourced from local government funds, thereby increasing net interest margin (NIM); and (3) the majority of RDBs' operational scope is limited to regional areas and has not yet reached other areas outside their respective provinces.

Several independent variables in the observed study play a role in increasing or decreasing the inefficiency of RDBs both in terms of cost and profit. In terms of cost and profit, the coefficient firm size (*Fsize*) has no effect in increasing or decreasing RDB inefficiency. The impact of firm size has been widely debated on efficiency. This result confirms that cost and profitability initially increase with size and then decline for bureaucratic and other reasons. There is no prior expectation on the impact of this variable on bank profitability (Tan 2016).

The coefficient of the capital ratio (*car*) variable has a negative sign and a significant decreasing cost and profit inefficiency. This research confirms that *car* can improve bank performance. This is because the *car* is closely related to the portfolio of productive asset quality and the allowance of impairment losses. On the other hand, there is research which states that the capital adequacy ratio has no effect on the level of efficiency (Sari and Saraswati 2017).

The coefficient of liquidity performance (*ldr*) has no have effect in increasing or decreasing RDBs' inefficiency. It will be confirmed that if the value of *ldr* is too high, banks do not have sufficient liquidity to meet their obligations to customers and increase the risk of total credit. On the other hand, if the *ldr* is too low, it means that banks have sufficient liquidity but lower interest income. Purwoko and Sudiyanto (2013) in their research showed that *ldr* had no effect on banking performance. The coefficient of credit risk (*npl*) has a positive sign and significance, statistically increasing inefficiency. This is because the increase in the *npl* also increases the reserve cost of improving the asset quality from credit or financing activities (Liang et al. 2017).

The end of the variable is technology investment (*ti*) is significant and has a negative effect on cost and profit inefficiency. This means that the presence of *ti* can improve banking performance. The development of technology is believed to be able to provide benefits in terms of cost efficiency, operational flexibility, and optimization of resources for banks. The paradigm shift of the transformation to digital platforms can be utilized for a competitive advantage. This strategy will achieve customer bonding. This bond will encourage customer engagement in different ways in order to approach customer relationships that create purchasing decisions, interactions, and participation in the sustainability of the banking industry (Hax 2010; Hendriyani and Raharja 2018). Although, in general, RDBs have invested in technology to support their operational activity, most RDBs have not been able to utilize their technology optimally. This is because most RDBs have not been fully able to optimize fee-based income from transactional services through optimizing the use of technology. In other words, the majority of RDBs still operate in the traditional way where their income is dominated by interest income from consumer loans.

6. Conclusions

This study was conducted to examine the performance of RDBs in terms of cost and profit efficiency as well as to test the variables that affect increasing or decreasing cost and profit inefficiency in RDBs. This was done by using input and output variables consisting of the price of labor cost, the price of the cost of physical capital, the price of the cost of funds, the amount of credit/financing provided, other productive assets, as well as internal and external variables that affect the performance of RDBs consisting of bank (firm) size, capital adequacy, liquidity ratios, credit risk, and digital platform ownership that were represented by the amount of technology investment in 27 regional banking industries in Indonesia for 2011–2020 using the Stochastic Frontier Analysis (SFA) method.

The results of the analysis show that all RDBs in Indonesia have been efficient both in terms of cost and profit with an average efficiency value of 1.01 for cost efficiency and 1.23 for profit efficiency. This is because the majority of RDBs' operational activities are low-risk portfolios such as consumer loans for the civil service staff as well as interbank fund placements, the majority of RDBs third-party funds are low-cost funds sourced from local government funds thus RDBs tend to have a high NIM ratio, and the limited operational scope of the RDB most of which only operate in the province where the RDB is located.

Meanwhile, the results of testing the effects of cost and profit inefficiency from the variables used show that the firm size (*Fsize*) variable has a significant effect on reducing profit inefficiency. The effect of the firm size (*Fsize*) variable on profit inefficiency is due to it being closely related to third-party funds where the majority of RDBs are supported by local governments funds which are placed in a low-interest account. The capital ratio (*car*) has a significant effect on reducing cost inefficiency and increasing profit inefficiency at different levels (10% and 1%). The effect of the capital ratio (*car*) variable on cost and profit inefficiencies is due to its relation to the productive asset quality portfolio and the CKPN which is part of the capital component. The NPL also has a significant effect in increasing cost inefficiency and reducing profit inefficiency at the same level (1%). This is because credit risk (*npl*) is closely related to CKPN reserve management policies which have a direct effect on RDBs' costs and revenues. However, the technology investment variable only has a significant effect in decreasing cost inefficiency. This is because the majority of RDBs still operate traditionally where the majority of their income is still dominated by interest income, especially from the consumption of loans. In addition, in carrying out their operational activities, the majority of RDBs have not been able to optimize their technology so they have not been able to provide an optimal transactional experience for customers amid fierce competition in the digital financial industry.

To optimize RDBs' cost and profit efficiency, the main thing that must be done includes managing and improving good quality loans as well as optimizing idle funds. Low-interest funding activities, set up through optimizing the management of the current account saving account (CASA) ratio, are also necessary to maintain profitability. Furthermore,

investment in technology needs to be carried out to increase competitiveness during industrial development, as well as increase effectiveness and efficiency and can be an alternative income if running optimally.

7. Limitations and Future Research Directions

This study has a few limitations. Firstly, the observation only focused on RDBs in Indonesia which only consists of 27 banks. Then, the main focus was to compare the score of cost and profit efficiency between RDBs. Secondly, this study focused on internal factors which impact cost and profit efficiency. In other studies, external factors are included in cost and profit function and efficiency. Future research should compare the efficiency of Indonesian Banks. The study samples are all banks in Indonesia, so the position of RDBs is only known in a national context. Future research should include external factors that support cost and profit efficiency.

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References

Abidin, Zaenal. 2009. Kinerja Efisiensi Teknis Bank Pembangunan Daerah: Pendekatan Data Envelopment Analysis (DEA). *Jurnal Akuntansi Dan Keuangan* 11: 21–29. [CrossRef]

Aigner, Dennis, C. A. Knox Lovell, and Peter Schmidt. 1977. Formulation and Estimation of Stochastic Frontier Production Function Models. *Journal of Econometrics* 6: 21–37. [CrossRef]

Alfriska, Malinda, and Sri Haryani. 2011. Regional Development Banks Performance in Indonesia. In *The First International Credit Union Conference on Social Microfinance and Community Development, BKCU Kalimantan-Gunadarma University*. Depok City: Universitas Gunadarma.

Anouze, Abdel Latef M., and Imad Bou-Hamad. 2019. Data Envelopment Analysis and Data Mining to Efficiency Estimation and Evaluation. *International Journal of Islamic and Middle Eastern Finance and Management* 12: 169–90. [CrossRef]

Anwar, Mokhamad. 2019. Cost Efficiency Performance of Indonesian Banks over the Recovery Period: A Stochastic Frontier Analysis. *Social Science Journal* 56: 377–89. [CrossRef]

Berger, Allen N., and Loretta J. Mester. 1997. Inside the Black Box: What Explains Differences in the Efficiencies of Financial Institutions? *Journal of Banking and Finance* 21: 895–947. [CrossRef]

Berger, Allen N., Diana Hancock, and David B. Humphrey. 1993. Humphrey. Bank efficiency derived from the profit function. *Journal of Banking & Finance* 17: 317–47.

Charnes, Abraham, William W. Cooper, and Edwardo Rhodes. 1978. Measuring the efficiency of decision making units. *European Journal of Operational Research* 2: 429–44. [CrossRef]

Fettry, Sylvia, Hamfri Djajadikerta, and Gery Raphael Lusanjaya. 2018. Accelerating Transformation Program in Indonesian Regional Development Banks: The Importance of High-Quality Information. *Journal of Accounting Research, Organization and Economics* 1: 1–25. [CrossRef]

Gasperz, Vincent. 2011. *Ekonomi Manajerial (Managerial Economics)*. Cetakan Kedelapan/Edisi Revisi. Bogor: Penerbit Vinchristo Publication.

Hax, Arnoldo C. 2010. *The Delta Model: Reinventing Your Business Strategy*. New York: Springer.

Hendrawan, Riko. 2020. Assessing Bank' s Efficiency in Indonesia Using Data Envelopment Analysis (DEA). *Test Engineering and Management* 81: 2755–63.

Hendriyani, Chandra, and Sam'un Jaja Raharja. 2018. Analysis building customer engagement through e-CRM in the era of digital banking in Indonesia. *International Journal of Economic Policy in Emerging Economies* 11: 479–86. [CrossRef]

Henriques, Iago Cotrim, Vinicius Amorim Sobreiro, Herbert Kimura, and Enzo Barberio Mariano. 2018. Efficiency in the Brazilian Banking System Using Data Envelopment Analysis. *Future Business Journal* 4: 157–78. [CrossRef]
Kadang, Juliana. 2018. Factors influencing profit efficiency of banking in indonesia. *Journal of Developing Economies* 3: 1–9. [CrossRef]
Kasim, Maznah Mat, and Azizul Baten. 2015. Cost and Profit Efficiency of Banks: Stochastic Frontier Analysis vs Data Envelopment Analysis. *(APJB) Asia Pacific Journal of Business* 6: 1–16.
Kodde, David A., and Franz C. Palm. 1986. Wald criteria for jointly testing equality and inequality restrictions. *Econometrica: Journal of the Econometric Society* 54: 1243–48. [CrossRef]
Kumar, Pradeep. 2018. Market Power and Cost Efficiencies in Banking. *International Journal of Industrial Organization* 57: 175–223. [CrossRef]
Liang, Lien-Wen, Bor-Yi Huang, Chih-Feng Liao, and Yu-Ting Gao. 2017. The impact of SMEs' lending and credit guarantee on bank efficiency in South Korea. *Review of Development Finance* 7: 134–41. [CrossRef]
Lisdayanti, Agustya, Raycard Daniel, and Wanda Anindita. 2013. Efektifitas Kinerja Bpd Terhadap Pertumbuhan Ekonomi Daerah. *Prosiding PESAT* 5: 8–9.
Lúpi, Rua Miguel. 2019. *Evaluating the European Bank Efficiency Using Data Envelopment Analysis: Evidence in the Aftermath of the Recent Financial Crisis*. Cândida Ferreira REM Working Paper 0109-2019. Lisboa: REM—Research in Economics and Mathematics Evaluating the Europe.
Meeusen, Wim, and Julien Van Den Broeck. 1977. Efficiency Estimation from Cobb-Douglas Production Functions. *International Economic Review* 18: 435–44. [CrossRef]
Mongid, Abdul, and Muazaroh Muazaroh. 2017. The Efficiency and Inefficiency of the Banking Sectors: Evidence from Selected ASEAN Banking. *Jurnal Ekonomi Malaysia* 51: 119–31. [CrossRef]
Muazaroh, Tandelilin Eduardus, Suad Husnan, and Mamduh M. Hanafi. 2012. Determinants of Bank Profit Efficiency: Evidence From Indonesia. *International Journal of Economics and Finance Studies* 4: 163–73.
Nicholson, Walter, and Christopher M. Snyder. 2017. *Microeconomic Theory Basic Principles & Extensions*, 12th ed. Boston: Cengage Learning.
OJK. 2015. Program Transformasi BPD: Menjadi Bank yang Kompetitif, Kuat, dan Kontributif bagi Pembangunan Daerah. Available online: https://www.ojk.go.id/id/kanal/perbankan/berita-dan-kegiatan/publikasi/Pages/Program-Transformasi-BPD.aspx# (accessed on 8 March 2022).
Othman, Filzah Mohamed, Aiza Mohd-Zamil, Siti Zaleha, Abdul Rasid, Amin Vakilbashi, and Mozhdeh Mokhber. 2016. Data Envelopment Analysis: A Tool of Measuring Efficiency in Banking Sector. *International Journal of Economics and Financial Issues* 6: 911–16.
Porcelli, Francesco. 2009. Measurement of Technical Efficiency. A brief survey on parametric and non-parametric techniques. *University of Warwick* 11: 1–27.
Purwoko, Didik, and Bambang Sudiyanto. 2013. Faktor-faktor yang mempengaruhi kinerja bank (Studi empirik pada industri perbankan di Bursa Efek Indonesia). *Jurnal Bisnis dan Ekonomi* 20: 1.
Puspasari, Anneke. 2020. Bank Specific Factors Affecting the Efficiency of Regional Development Bank in Indonesia. *JIMFE (Jurnal Ilmiah Manajemen Fakultas Ekonomi)* 6: 171–86. [CrossRef]
Putri, Devy Ariesta, and Sylva Alif Rusmita. 2020. Analisis Tingkat Efisiensi Biaya Bank Umum Syariah Dengan Metode Stochastic Frontier Analysis Periode 2015–2018. *Jurnal Ekonomi Syariah Teori Dan Terapan* 7: 199–206. [CrossRef]
Rose, Peter S., and Sylvia Hudgins. 2013. *Bank Management & Financial Services*. New York: McGraw-Hill.
Salim, Sitti Raha Agoes, Yulinda Yulinda, and Khaira Amalia Fachrudin. 2015. The Study of Organization Development and Regional Bank Changing in Indonesia. *Journal of Management Research* 7: 317. [CrossRef]
Sari, Putri Zanufa, and Erwin Saraswati. 2017. The Determinant of Banking Efficiency in Indonesia (DEA Approach). *Journal of Accounting and Business Education* 1: 208–29. [CrossRef]
Sari, Dyah Wulan. 2019. The potential horizontal and vertical spillovers from foreign direct investment on Indonesian manufacturing industries. *Economic Papers: A Journal of Applied Economics and Policy* 38: 299–310. [CrossRef]
Sharif, Omar, Md Zobaer Hasan, Chang Yun Fah, and Mahboobeh Zangeneh Sirdari. 2019. Efficiency Analysis by Combination of Frontier Methods: Evidence from Unreplicated Linear Functional Relationship Model. *Business and Economic Horizons* 15: 107–25.
Silva, Thiago Christiano, Benjamin Miranda Tabak, Daniel Oliveira Cajueiro, and Marina Villas Boas Dias. 2017. A Comparison of DEA and SFA Using Micro- and Macro-Level Perspectives: Efficiency of Chinese Local Banks. *Physica A: Statistical Mechanics and Its Applications* 469: 216–23. [CrossRef]
Sparta. 2017. Analisis Pengaruh Efisiensi Dan Kecukupan Modal. *Jurnal Ekonomi Dan Bisnis* 20: 83–111.
Subandi, and Imam Ghozali. 2013. Determinan Efisiensi Dan Dampaknya Terhadap Kinerja Profitabilitas Industri Perbankan Di Indonesia. *Jurnal Keuangan Dan Perbankan* 17: 123–35.
Sutanto, Himawan Arif. 2015. Analisis Efisiensi Teknis Bank Pembangun. *Jejak* 8: 23–35. [CrossRef]
Tan, Yong. 2016. The impacts of risk and competition on bank profitability in China. *Journal of International Financial Markets, Institutions and Money* 40: 85–110. [CrossRef]
Titko, Jelena, Jelena Stankevičienė, and Natalja Lāce. 2014. Measuring Bank Efficiency: DEA Application. *Technological and Economic Development of Economy* 20: 739–57. [CrossRef]
Wardhani, Pratystya Ika, and Abdul Mongid. 2019. Strategies to Increase Production Efficiency in Indonesian Sharia Commercial Banks Using Stochastic Frontier Approach (SFA). *Journal of Economics, Business & Accountancy Ventura* 21: 379. [CrossRef]

Widiarti, Astoeti Wahjoe, Hermanto Siregar, and Trias Andati. 2015. The Determinants of Bank'S Efficiency in Indonesia. *Buletin Ekonomi Moneter Dan Perbankan* 18: 129–56. [CrossRef]

Zahra, Nabila, and Darwanto Darwanto. 2019. The Determinant of Banking Efficiency (Data Envelopment Analysis Based on Intermediation Approach). *Jurnal Ekonomi Pembangunan: Kajian Masalah Ekonomi Dan Pembangunan* 20: 87–99. [CrossRef]

Zuhroh, Idah, Munawar Ismail, and Ghozali Maskie. 2015. Cost Efficiency of Islamic Banks in Indonesia–A Stochastic Frontier Analysis. *Procedia–Social and Behavioral Sciences* 211: 1122–31. [CrossRef]