Al-Kharaj: Journal of Islamic Economic and Business
Volume 7 (4), 2025
P-ISSN: 2686-262X; E-ISSN: 2685-9300

Evaluation of Operational Efficiency of Conventional and Sharia Rural Credit Banks (BPR) in Solo Raya Using Data Envelopment Analysis

Wahid Nur Hasan[1], Imronudin[2], Muhammad Sholahudin[3]
Master of Management Program, Faculty of Economics and Business
Universitas Muhammadiyah Surakarta, Indoneisa
Email: P100230035@student.ums.ac.id[1], Imr179@ums.ac.id[2], ms24@ums.ac.id[3]

***Keywords**: Operational Efficiency, Rural Credit Banks, BPRS, Data Envelopment Analysis (DEA), Financial Performance*

Abstract

This study aims to analyze and compare the operational efficiency of conventional Rural Credit Banks (BPR) and Sharia Rural Credit Banks (BPRS) operating in the Solo Raya area during the period 2020 to 2024. Using the Data Envelopment Analysis (DEA) method, this study measures the technical efficiency level of each bank and identifies the main factors that affect their performance. The input variables used include total assets, operating costs, third-party funds, and employee expenses, while the output variables consist of operating income, credit/financing distribution, and net profit. The results of this study show that there are significant variations in efficiency between BPR and BPRS, with operational scale, cost discipline, and financial structure as the main determining factors. This study contributes to the literature on microbanking efficiency in Indonesia and offers empirical evidence and practical recommendations for bank management and regulators in improving operational strategies and financial sustainability.

INTRODUCTION

Rural Credit Banks (BPR) play a strategic role in Indonesia's financial system as providers of financing for the micro and small sectors. Both conventional and sharia BPRs play an active role in expanding financial access for communities that are not yet reached by general banking services. In the Solo Raya area, which consists of seven districts/cities in Central Java Province, there are 65 conventional BPRs and 8 Sharia BPRs (BPRS) that are active as of 2023 (OJK, 2023). However, the operational performance of BPRs in this region still faces serious challenges related to efficiency, marked by fluctuations in profitability and high operational cost ratios (BI, 2023).

The issue of operational efficiency is important because it can affect the sustainability of BPRs as microfinance institutions. Efficiency is not only a matter of cost savings, but also reflects the institution's ability to manage inputs to produce optimal outputs. In the context of microfinance, the efficiency of BPRs is highly correlated with the capacity for productive financing to local MSMEs. Therefore, systematic and quantitative measurement of efficiency is important, especially to identify units that need operational improvements or service strategy adjustments (Kismawadi & Junaidi, 2018).

Table 1. Performance of Rural Banks

Performance Values in Billions of Rupiah and Performance Ratios in Percentages (%)

Indicator	2020	2021	2022	2023	2024
LDR (%)	**75.44**	**73.67**	**75.83**	**76.56**	**77.28**
Total Credit	110,770	116,580	129,294	140,788	148,896
Fundraising	123,745	135,256	146,110	158,749	192,669
Core Capital	23,079	22,983	24,388	25,142	27,442
NPL (%)	**7.22**	**6.72**	**7.89**	**9.87**	**10.95**
Non-Current Credit	7,995	7,836	10,202	13,890	16,266

Total Credit	110,770	116,580	129,295	140,791	148,488
ROA (%)	**1.87**	**1.78**	**1.74**	**1.00**	**1.46**
L/R Current Year	2,901	3,005	3,169	1,944	2,978
Total Assets	155,075	168,443	182,302	194,984	204,676
ROE (%)	**16.40**	**15.77**	**15.39**	**8.74**	**12.79**
L/R Current Year	2,901	3,005	3,169	1,944	2,978
Paid-in Capital	15,008	16,144	17,440	18,914	19,816
General Reserve	2,686	2,914	3,151	3,335	3,465

Sumber: ojk.go.id (2024)

The LDR ratio of BPR/BPRS has remained relatively stable at around 73–77% over the past five years. The increase in total credit from IDR 110.77 trillion (2020) to IDR 148.90 trillion (2024) is in line with the increase in fund collection from IDR 123.74 trillion to IDR 192.66 trillion. This LDR stability reflects relatively good liquidity balance, although third-party fund growth must be balanced with maintained credit distribution quality (Ramadhan et al., 2017).

The NPL ratio shows a significant upward trend from 7.22% (2020) to 10.95% (2024). The growth in non-performing loans from IDR 7.99 trillion to IDR 16.27 trillion indicates serious challenges in credit risk management. High NPLs have been proven to reduce bank profitability and lower customer confidence.

ROA declined from 1.87% (2020) to 1.00% (2023), before recovering to 1.46% (2024). This fluctuation is in line with the decline in net profit in 2023 (Rp1.94 trillion) before rising again in 2024 (Rp2.97 trillion).

According to research by Ismail et al (2021), operational efficiency and asset quality are the dominant factors influencing ROA in Indonesian banking. ROE declined from 16.40% (2020) to 8.74% (2023), then rose to 12.79% (2024). This decline indicates pressure on profitability despite a continuous increase in core capital from IDR 23.08 trillion to IDR 27.44 trillion. A study by Arifin et al (2020) that a decline in ROE can occur when capital growth is not accompanied by a proportional increase in net profit.

A sharp increase in NPLs amid credit growth indicates that BPR/BPRS face significant credit risk. The decline in ROA and ROE reflects pressure on profitability, which may be caused by increased operating expenses, a decline in asset quality, and suboptimal resource management efficiency. Research by Berger and Mester (1997) in the context of international banking, as well as Staub et al. (2010), confirms that high operational efficiency contributes positively to a bank's financial performance.

In production economics, efficiency is explained theoretically through Frontier Theory, which was first introduced by Farrell (1957). This theory states that the technical efficiency of a unit can be measured by comparing it to the efficiency frontier, which is the maximum output limit of the available input combination. In this context, units that are right on the frontier are considered efficient, while those below it are considered inefficient (Jessica et al., 2022). Pengukuran efisiensi berbasis teori frontier dapat dilakukan dengan pendekatan parametrik (Stochastic Frontier Analysis/SFA) maupun non-parametrik, seperti Data Envelopment Analysis (DEA) (Hadini & Wibowo, 2021).

DEA is a non-parametric method widely used in evaluating the efficiency of the service sector, including the banking industry, because it can handle various inputs and outputs simultaneously without the need to determine the form of the production function. The BCC (Banker, Charnes, Cooper) approach in DEA is used to accommodate variable returns to scale (VRS) conditions, which are highly relevant to rural banks that have different business scales (Wasiaturrahma et al., 2020). This method allows for a comparison of efficiency between Decision Making Units (DMUs), such as between conventional and Islamic rural banks, based on their input-output ratios. With this approach, it is possible to determine which rural banks are efficient and

which are not, as well as to formulate recommendations for performance improvement (Fuad, 2023).

Several previous studies have applied DEA to assess banking efficiency in Indonesia. According to (Ramadhan et al., 2017), only about 30% achieved maximum technical efficiency. Meanwhile, Rusydiana et al (2021) revealed that conventional rural banks (BPR) were more efficient than Islamic rural banks (BPRS) in Indonesia during the 2016-2020 period. Anggraeni et al (2023) added that digitization and asset size significantly influence the variation in BPR efficiency in Central Java. However, these studies have not specifically examined the Solo Raya area as a whole.

Previous studies have not explicitly compared the efficiency of conventional and Islamic rural banks in the Solo Raya area, even though this region has a fairly complex and diverse microeconomic structure. In addition, no DEA approach has been applied in a comparative context across different types of banking operations (conventional vs. Islamic) in geographically homogeneous areas. The absence of local analysis has resulted in a lack of empirical basis for formulating policies to improve the efficiency of regional rural banks. In fact, local contexts such as the characteristics of MSMEs, regional density, and the level of financial literacy of the community have a significant impact on the operational efficiency of microfinance institutions (Wendha & Alteza, 2020).

This study seeks to answer the following questions: How efficient are conventional and Islamic rural banks in Solo Raya when measured using the DEA-BCC (VRS) approach? What are the determining factors that influence efficiency variations between institutions? This analysis is expected to provide a comprehensive and accurate mapping of rural bank efficiency to support policies aimed at strengthening local banking.

If this issue of efficiency is ignored, the consequences will not only be a decline in BPR profitability, but also the resilience of the microfinance sector at the regional level. Poor efficiency will reduce the capacity of BPRs to channel credit to the productive sector, increase the risk of non-performing loans, and reduce public confidence. Macroeconomically, this can slow down the achievement of financial inclusion targets and widen the gap in access to banking between regions.

Therefore, further research is needed to evaluate the efficiency of rural banks and rural bank cooperatives at the regency/city level and provide strategic solutions to overcome various existing challenges. With a more systematic and integrated approach, microbanking can become a key instrument in overcoming poverty and promoting sustainable economic development, especially in the Solo Raya area, which has great potential but has not been fully utilized efficiently.

LITERATURE REVIEW

Theory and Measurement of Efficiency

Efficiency is a fundamental concept in economics and performance management, indicating how optimally an entity uses resources to produce a given output (Koiri & Erdkhadifa, 2022). In the context of microfinance institutions such as Rural Credit Banks (BPR) and Sharia Rural Credit Banks (BPRS), operational efficiency is a key indicator in assessing the extent to which institutions can perform their financial intermediation functions effectively, especially given limited resources such as capital, labor, and operational network (Wasiaturrahma et al., 2020). Efficiency is generally divided into three types: technical efficiency, allocative efficiency, and economic efficiency. Among the three, technical efficiency is the main focus in banking studies because it is directly related to the internal productivity of institutions in converting inputs into outputs (Hayati & Putri, 2020).

Technical efficiency is defined as an institution's ability to produce maximum output from a given amount of input, or conversely, to use the minimum amount of input to achieve the expected level of output (Ningsih et al., 2023). In the context of BPR and BPRS, output variables typically include total financing, operating income, and net profit, while inputs consist of assets, operating expenses, and third-party funds. The level of technical efficiency reflects managerial quality and the effectiveness of operational processes. If technical efficiency is low, banking institutions risk

experiencing operational imbalances that could ultimately impact their profitability and sustainability (Anggraeni et al., 2023).

Rural Credit Bank (BPR)

The Rural Credit Bank (BPR) is a banking institution that plays a role in promoting financial inclusion and equal access to financing, particularly in the micro and small sectors. BPRs have more limited characteristics and business scope than commercial banks, but play an important role in the national financial system as regulated by Law No. 10 of 1998 on Banking (Ratno, 2020).

According to OJK Regulation Number 62/POJK.03/2020, BPR business activities include collecting funds from the public in the form of time deposits, savings, and other similar forms. Providing credit to the public, particularly the micro, small, and medium enterprises (MSMEs) sector. As well as placing funds in Bank Indonesia Certificates (SBI), interbank deposits, and government securities that meet OJK requirements.

Sharia Rural Banks (BPRS) are financial institutions that carry out banking functions based on Islamic sharia principles. BPRS operate under the regulation of Law No. 21 of 2008 concerning Sharia Banking, with supervision from the Financial Services Authority (OJK) and the Sharia Supervisory Board (DPS). BPRS business activities include collecting funds through wadiah and mudharabah contracts, distributing funds through murabahah, musyarakah, mudharabah, ijarah, and qardh contracts. BPRS does not engage in interest-based activities and is prohibited from accepting deposits in the form of current accounts (Syafirmansyah et al., 2024).

Efficiency Measurement Methods

In studies of the operational efficiency of financial institutions, Data Envelopment Analysis (DEA) is the most commonly used non-parametric method. DEA measures the relative efficiency of a decision-making unit (DMU) based on input-output ratios. This method does not require an explicit production function and can handle various types of inputs and outputs simultaneously (Charnes et al., 1978). In the banking sector, DEA has become a popular tool due to its flexibility in evaluating the technical efficiency of various banks with different scales and orientations (Koiri & Erdkhadifa, 2022).

The DEA model was first developed by Charnes, Cooper, and Rhodes (CCR) with the assumption of Constant Return to Scale (CRS). This model assumes that changes in input will cause changes in output in the same proportion. However, this assumption is often not appropriate for small units such as BPR and BPRS, which do not always operate at an optimal scale. Therefore, Banker, Charnes, and Cooper later developed the Variable Return to Scale (VRS) model or DEA–BCC model, which takes into account changes in scale in the production process (Hasan & Muhammad, 2023).

Hypothesis Development

Differences in Efficiency between Conventional Rural Banks and Islamic Rural Banks

Operational efficiency reflects a bank's capability to manage inputs such as third-party funds, fixed assets, and operating costs to generate outputs in the form of income and financing. It describes how effectively a financial institution utilizes its resources to achieve optimal performance. In microfinance institutions, including Bank Perkreditan Rakyat (BPR) and Bank Pembiayaan Rakyat Syariah (BPRS), efficiency serves as a crucial indicator of competitiveness and sustainability (Wibowo et al., 2025).

Uula et al (2023) found that the technical efficiency of microfinance institutions varies based on organizational structure, management system, and operational framework. Institutions with better managerial control and adaptive systems achieve higher efficiency levels. Differences in governance mechanisms, human resources, and technology adoption also create variations in efficiency among rural banks. Hidayat et al (2020) stated that rural banks in Indonesia show diverse

levels of efficiency influenced by management strategy and types of financial services offered. Each institution's operational focus determines its ability to manage costs and maximize productivity.

Conventional BPRs and Islamic BPRSs operate under different financial and managerial systems. Conventional banks use an interest-based approach emphasizing profit maximization and cost control. Islamic banks apply profit-and-loss sharing principles guided by Sharia law. These operational differences affect cost structures, risk management, and overall efficiency outcomes. The diversity of operational systems and management principles in BPRs and BPRSs leads to measurable differences in efficiency performance.

H1: There is a significant difference in operational efficiency between conventional BPRs and BPRSs.

Bank Assets Affect Efficiency Levels

The size of a bank's assets reflects the capacity and ability of financial institutions to manage funds and bear operational risks. Banks with larger assets generally have economies of scale that allow them to reduce average operating costs through the use of technology, product diversification, and internal process efficiency (Uula et al., 2023). The larger the assets, the greater the opportunity for banks to invest in more efficient information systems and risk management, thereby increasing productivity and operational efficiency.

Istinfarani and Azmi (2020) research found that asset size has a significant effect on technical efficiency and scale efficiency in small banks in rural areas. This finding is in line with Wendha and Alteza (2020), who stated that large asset scale enables banks to achieve higher efficiency through optimal resource management. In addition, Hadini and Wibowo (2021) confirmed that banks with larger total assets tend to have higher operational efficiency because they can reduce fixed costs and lower the distribution of operating costs per unit.

Thus, the larger the total assets owned by a bank, the greater the bank's ability to optimize costs and available resources to achieve better operational efficiency. Therefore, the following hypothesis is formulated:

H2: Bank assets have a significant positive effect on the level of operational efficiency.

Operating Cost Structure Affects Efficiency

The theory of intermediation efficiency explains that banks, which act as financial intermediaries, are required to be able to optimally convert inputs (such as funds, labor, and assets) into outputs (such as credit and interest income) (Suleman et al., 2019). However, when operating costs increase disproportionately to the income generated, the bank's ability to perform its intermediary function will decline. In other words, high operational costs are a major obstacle to bank operational efficiency because they erode profitability and reduce room for business development.

Wahyudi (2021) shows that an increase in the BOPO (Operating Expenses to Operating Income) ratio and efficiency ratio has a significant negative effect on Return on Assets (ROA), which means that the higher the operating expenses, the lower the bank's efficiency and profitability. This is reinforced by quarterly data from the Financial Services Authority (OJK) regarding BOPO, LDR, NPL, and ROA indicators at Regional Development Banks in Central Java, which show that BOPO has a significant negative effect on ROA (Wibowo et al., 2025). Thus, an increase in operational expenses has been proven to suppress the efficiency and profitability of regional banks.

In the context of Islamic banking in Indonesia and Malaysia, Andiansyah (2020) found a similar relationship, namely that BOPO has a negative impact on ROA, indicating that operational cost inefficiency is not only a problem for conventional banks but also for Islamic banks. This condition reflects that cost structure control is a key factor in maintaining the efficiency of the banking system as a whole. Considering these empirical findings, it can be concluded that the higher

the operational cost structure, the lower the level of efficiency achieved by banks. Therefore, the researchers formulated the following hypothesis:

H3: The operational cost structure has a negative and significant effect on bank operational efficiency.

The Effect of Operational Efficiency on Net Profit

Operational efficiency describes the extent to which a bank is able to optimize the use of its resources to produce maximum output. An efficient bank will be able to reduce operating costs, minimize waste, and allocate assets and third-party funds productively. Thus, the level of operational efficiency is one of the key factors that determine a bank's ability to generate net profit. The more efficient a bank is in managing its internal resources, the greater the potential for increased profitability.

According to Wasiaturrahma et al (2020) productive efficiency has a positive relationship with financial indicators such as Return on Assets (ROA) and net profit, indicating that increased efficiency directly contributes to improved financial performance. This is also in line with Ash-Shiddiqy (2019), who asserts that high operational efficiency strengthens a bank's financial position through increased profit margins and reduced unproductive operating costs.

Research by (Ramadhan et al., 2017) shows that technically efficient rural banks have higher profit levels than inefficient banks. This finding is reinforced by Hadini and Wibowo (2021), who state that efficiency measured using the Data Envelopment Analysis (DEA) approach can be used as a predictive indicator of banking financial performance. In other words, DEA is capable of measuring a bank's ability to optimally convert inputs (costs and resources) into outputs (revenue and profit). In the context of Rural Credit Banks (BPR) and Sharia Rural Credit Banks (BPRS), operational efficiency plays a very important role because these two types of banks face limitations in scale and resources. Therefore, their ability to achieve high efficiency is a major determinant in maintaining profitability amid competition and cost pressures. Based on this theory and empirical findings, it can be concluded that the higher the level of operational efficiency of a bank, the greater the net profit that can be generated. Therefore, the researchers formulated the following hypothesis:

H4: The level of operational efficiency has a positive and significant effect on the net profit of BPR and BPRS.

Research Framework

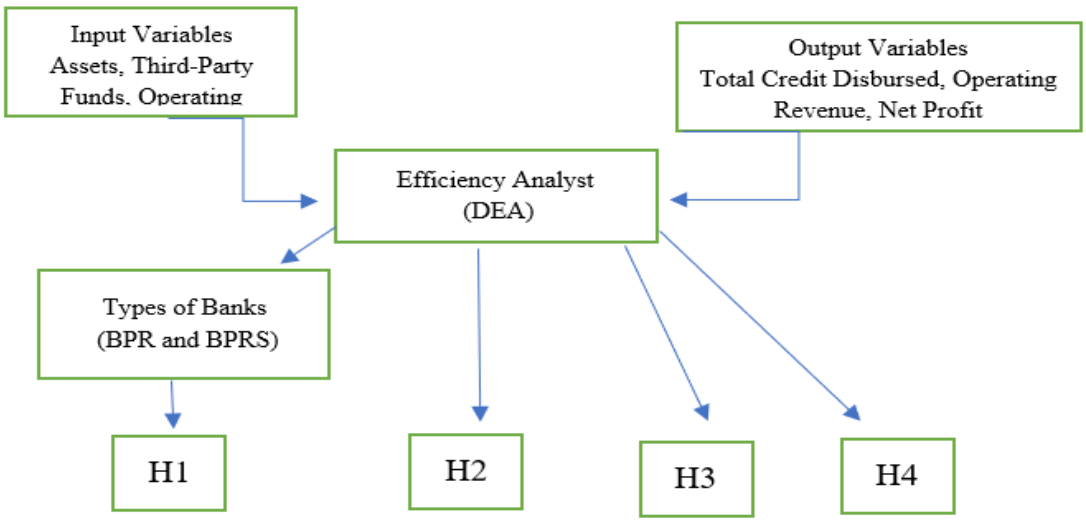

Figure 1. Conceptual Framework

RESEARCH METHOD

This study is a descriptive quantitative study with a non-parametric approach. This approach is used to evaluate and compare the operational efficiency between conventional Rural Credit Banks (BPR) and Sharia Rural Credit Banks (BPRS) in the Solo Raya area.

The main analysis method used in this study is Data Envelopment Analysis (DEA). DEA is a method of measuring the relative efficiency of decision-making units (DMUs) based on the inputs and outputs used in their operational processes. This method is used to assess how efficient a bank is in converting inputs into outputs compared to other banks in the same group.

This type of research is classified as a comparative study, as it compares two groups of financial institutions, namely conventional BPR and BPRS, in terms of operational efficiency. In addition, this research is also ex post facto in nature, as the data used comes from previously published historical financial reports.

This study aims to provide an objective and measurable description of the efficiency level of each bank and to test the hypothesis regarding differences in efficiency, the influence of assets, operational costs, and profits on operational efficiency.

The population in this study is all conventional Rural Credit Banks (BPR) and Sharia Rural Credit Banks (BPRS) operating in the Solo Raya area, which includes Surakarta, Sukoharjo, Klaten, Boyolali, Karanganyar, Wonogiri, and Sragen, which have complete financial reports from 2019 to 2024. The sample in this study consists of all BPRS, but BPR are divided into several categories to become samples, so that the samples that are the object of this study are as follows:

a. All BPR registered on the OJK website located in the Solo Raya area.
b. All BPR that have complete financial reports from 2020 to 2024 located in the Solo Raya area.
c. Based on available data, there are 65 BPRs and 8 BPRSs operating in the Solo Raya area.
d. The total sample is 73 samples of BPR and BPRS data.

According to Sugiyono (2019), a sample is a portion of a population whose characteristics are to be studied and is considered representative of the entire population. Since the population size is known, 65 BPRs and 8 BPRSs were purposively selected to ensure that the available data was complete and representative.

This study uses secondary data. The secondary data sources used in this study are the financial reports of BPR and BPRS in the Solo Raya area for the period 2020 to 2024. Secondary data is data sourced from documents or reports published by the Financial Services Authority (OJK). In addition, this study also uses data from literature or academic texts as reference materials related to the research problem. The financial report data collected includes information related to:

a. Total Assets: The value of assets owned by BPR and BPRS.
b. Operating Expenses to Operating Income (BOPO): An indicator of operational efficiency.
c. Third Party Funds (DPK): The amount of funds successfully collected from the public, used as input in the DEA model to reflect fund collection capabilities.
d. Credit/Financing Distribution: Total credit (for BPR) and financing (for BPRS) distributed, used as one of the outputs in efficiency measurement.
e. Operating Income: All income derived from the bank's main operational activities, used as one of the output variables in DEA analysis.
f. Net Profit: Used as an output variable in DEA analysis and as a dependent variable to test the effect of efficiency on profitability.

This data will be processed using the Data Envelopment Analysis (DEA) method to measure the operational efficiency level of each bank. Furthermore, the efficiency measurement results will be used in statistical analysis, such as difference test analysis (for H1 and H2) and linear regression or panel regression analysis (for H3, H4, and H5), to test the effect of independent variables on bank efficiency and profitability.

In the context of measuring banking industry efficiency using the Data Envelopment Analysis (DEA) method, variables are classified into two groups, namely input variables and output variables, including:

1. Input Variables: Total Assets, Third Party Funds (DPK), and Operating Expenses
2. Output Variables: Total Loans Disbursed, Operating Income, and Net Profit

The data source comes from annual financial reports obtained through the official website of the Financial Services Authority (OJK), namely www.ojk.go.id, specifically in the Banking Publication and Statistics menu. The data accessed includes balance sheets, income statements, and other operational information relevant to measuring efficiency using the Data Envelopment Analysis (DEA) approach.

Data Envelopment Analysis (DEA) is a non-parametric technique used to measure the technical efficiency of Decision Making Units (DMUs), which in this context are Rural Credit Banks (BPR) and Sharia Rural Credit Banks (BPRS). DEA is very useful for comparing efficiency between units that convert inputs into outputs, without assumptions about the form of a particular production function (Destiani et al., 2023). This technique accommodates the simultaneous use of multiple inputs and outputs to assess the relative performance of each DMU (Alam, 2018).

In this study, DEA was used to assess the technical efficiency of BPR and BPRS in the Solo Raya area during 2020–2024, considering input variables such as assets, third-party funds, and operating expenses, as well as output variables such as total loans disbursed, operating income, and net profit. The selection of these variables refers to previous efficiency studies in the micro and Islamic banking sectors (Syaifuddin, 2019).

This study uses an output-oriented approach with the Constant Return to Scale (CRS) assumption. This approach assumes that an increase in input will result in an increase in output in the same proportion, making it suitable for use in units operating on a similar scale. The CRS approach is commonly used in banking studies where the scale structure is considered homogeneous (Hayati & Putri, 2020) Output-oriented DEA was chosen because the bank's main objective is to maximize output from available resources

RESULTS AND DISCUSSION

Results

This study uses secondary data from BPR and BPRS financial reports covering the following input and output variables:

- Input: Operating Expenses, Total Assets, and Capital
- Output: Total Financing, Operating Income, and Net Profit

The sample consists of 73 banks divided into conventional BPR and BPRS. Efficiency scores were calculated using the DEA model with the Variable Return to Scale (VRS) approach, considering the heterogeneity of bank scales.

Table 2. Descriptive Statistics of Input and Output Variables for BPR and BPRS in Solo Raya
Research Year 2020–2024 (in thousands of rupiah)

	Indicator	*Mean*	*Max*	*Min*
Input	Beban Operasional	16,118,245	90,099,981	524,110
	Total Aset	17,574,168	101,582,018	696,393
	Modal	2,488,759	29,187,289	(5,375,099)
Output	Jumlah Pembiayaan	15,057,399	76,874,270	790,184
	Pendapatan Operasional	145,604,889	889,969,611	7,003,584
	Laba Bersih	18,206,734	102,561,534	(191,779)

Source: Output of RStudio software compiled by the author (2025)

In terms of input variables, the operating expenses of BPR and BPRS in the Solo Raya area show significant variation, ranging from IDR 524 million to IDR 90 billion, with an average

of around IDR 16.1 billion. This reflects differences in the scale of operational activities and efficiency of expense management in each bank. Total assets also show a wide range, from IDR 696 million to IDR 101.5 billion, with an average of IDR 17.5 billion, indicating differences in the size and capacity of the assets owned by banks.

Capital shows an anomaly with a minimum negative value of IDR –5.37 billion, indicating that there are banks that experience capital shortages or negative equity positions in certain periods. The average capital is recorded at IDR 2.48 billion, while the maximum value reaches IDR 29.1 billion, illustrating the variation in capital levels between banks (Hidayat & Azizah, 2021). The variable financing amount has an average of IDR 15 billion, with a minimum value of IDR 790 million and a maximum of IDR 76.8 billion, reflecting differences in the ability to expand financing to the public.

In terms of output, operating income shows a very high figure compared to other variables, with an average of IDR 145.6 billion, a minimum value of IDR 7 billion, and a maximum of nearly IDR 890 billion. This indicates a significant difference in income achievement between BPR and BPRS, which can be influenced by business activity volume and business strategy. For the net profit variable, there is an average of IDR 18.2 billion, with the highest value reaching IDR 102.5 billion. However, the minimum net profit value is negative at IDR -191 million, which indicates that there are banks that recorded losses during the observation period.

The high variability of all variables indicates heterogeneity among banks in terms of scale, operational efficiency, and financial performance. This situation is in line with the results of previous studies that show differences in efficiency and profitability between BPR and BPRS, which are influenced by asset management, financing strategies, and the institutional characteristics of each bank.

Overall, the descriptive statistics table shows significant variations in the structure and operational efficiency of BPR and BPRS in the Solo Raya area during the 2020–2024 period. Banks with higher efficiency levels are generally supported by strong capital, stable assets, and optimal operating income, indicating healthier and more structured financial management.

Conversely, banks that show losses or negative capital tend to have limitations in financing expansion, operational cost efficiency, and the ability to earn net profits, which can be caused by weak governance, high cost structures, or suboptimal financing strategies (Wasiaturrahma et al., 2020). This disparity reflects differences in competitiveness among banks, which can be influenced by business scale, management quality, and regulatory policy support.

Table 3. Efficiency Levels of BPR and BPRS in Solo Raya Research Year 2020–2024 (in thousands of rupiah)

Bank Password	Year 2020	Year 2021	Year 2022	Year 2023	Year 2024
600677	0.9754059	0.9676816	0.8928918	0.8486165	0.8538121
600057	1	0.9534386	0.9427673	0.8415072	0.7941454
600689	0.8700117	0.8470004	0.844766	0.8635905	0.7056458
600697	0.9122123	0.9029448	0.9052837	0.9468125	0.8148791
600687	0.6989623	0.8145956	0.9039499	0.9995033	0.7976364
601474	1	0.8953264	0.9036608	0.8980946	0.7891502
602593	0.9123795	0.9014864	0.8157976	0.8887488	0.8645222
600550	0.7053333	1	0.8527811	0.7593027	0.5249773
600670	0.9628531	0.9430251	0.9463854	0.9301083	0.7236702
600078	0.9318703	0.9165041	0.9201151	0.9025709	0.773886
600693	0.9489714	0.9580658	0.9425488	1	0.8894412
601462	0.979392	0.9380762	0.9091538	0.917134	0.7608919
602546	0.892283	0.8964696	0.9089171	0.9190196	0.5363029
600027	0.7429287	0.8270062	1	0.789533	0.8131331

600674	0.8559355	0.7998905	0.7894075	0.8099501	0.5780122
600138	1	0.9638566	0.9841423	1	0.7493482
601371	0.9713702	1	0.9935717	1	0.8183304
600087	0.7867369	0.6471077	0.7530398	0.7488591	0.6466228
601414	0.7835584	0.8428768	0.8082959	0.6830931	0.5979928
600679	1	0.9956345	0.949744	0.9292016	0.7288203
601378	0.7932326	0.8159658	0.7235214	0.625394	0.3755038
600683	0.8961216	0.895511	0.8692309	0.8769785	0.7148615
601457	0.9943802	1	0.8221661	1	1
600086	1	0.8638834	0.8893176	0.8872871	0.735224
600122	0.8686545	0.6970378	0.6689958	0.8043805	0.758936
601430	0.9668751	0.9491346	0.819524	0.7980908	1
601578	1	1	0.9917326	1	0.9034604
601440	0.8359439	0.8363657	0.8618643	0.8966708	0.6897119
601456	0.9697877	0.9047404	0.9481073	0.8808054	0.6803914
600853	1	0.9946643	0.9713542	0.8223082	0.8972888
600220	0.9288129	0.9173362	0.9392303	0.9716691	0.9043559
600672	0.9740274	0.9327461	0.8840421	0.8251411	0.6606528
601777	0.9507626	0.8980642	0.8509895	0.8568233	0.769964
600586	0.897188	0.8757266	0.7167695	0.7266959	0.7033188
601424	0.8335218	0.8107598	0.7904351	0.8129263	0.7865238
601686	0.9660847	0.9353129	1	1	0.9103552
600110	0.9403814	0.8241705	0.7676562	0.8131132	0.6842861
601390	0.8020946	0.8342651	0.8579447	0.8632401	0.8380412
601372	0.915874	0.8664273	0.8901238	0.8931781	0.6700062
601404	1	1	0.9957885	0.9152767	0.7064791
601545	1	0.9830919	0.9137968	0.8711457	0.8698289
601544	0.9585486	0.9146735	0.7653037	0.8748304	0.7665671
600681	0.8800814	0.8180035	0.8025524	0.6091151	0.6890661
602615	0.9226759	0.9235235	0.7364948	0.7223442	0.9156046
601464	1	1	0.968453	0.9633342	0.766426
600318	0.8978883	0.8793031	0.8564387	0.8658675	0.8640766
600400	0.9564201	0.8640622	0.8191278	0.8019699	0.8255425
600658	0.9297101	0.9214394	0.852178	0.9216623	0.9202934
600668	0.8948022	0.8999051	0.8981385	0.959438	1
600691	0.960972	0.9086621	0.8506435	0.7620589	0.6926359
601389	0.9338058	1	1	1	1
601439	1	0.9001657	0.799875	0.8214226	0.8227076
601450	0.8999038	0.9306195	0.9561258	0.9610044	0.9811244
601461	0.9193259	0.8638804	0.8285769	0.7881413	0.7459051
601591	0.8950155	0.8764971	0.9805914	0.9120065	0.93051
602009	0.9904795	0.8977153	0.8140423	0.7616909	1
600095	0.8615933	0.8679127	0.8779405	0.8918384	0.9124514
601425	0.8573856	0.8241846	0.8420798	0.9093982	0.8661712
601576	0.9750469	0.9643788	0.9976978	1	1
600660	0.9334355	0.9233914	0.939874	0.9447772	0.9510713
600666	1	0.9549946	0.9300194	0.9222379	0.9369817
601412	0.8965432	0.8888293	0.9296217	0.9490812	0.8867303

601595	0.9594665	0.9298817	0.9455078	0.9499313	0.9106673
601418	1	0.9880943	0.8931983	0.9162063	0.9273972
600685	1	0.9557669	0.9671454	0.9679911	0.9244241
620142	0.8081391	0.9874218	1	0.85217	1
620159	0.8320995	0.8951801	0.973553	0.9028768	0.927271
620137	0.6648202	0.9341558	0.9300484	1	0.9694113
620125	1	0.9853768	0.9985133	0.9569928	0.9485753
620122	0.9493348	0.8461267	0.8294558	0.7078693	1
620171	1	1	1	0.9711643	0.8115929
620124	0.9789311	0.9541435	0.9632967	0.958048	1
620154	0.8403873	0.8354385	0.7276262	0.5546843	0.6613205

Source: Output from RStudio software compiled by the author (2025)

Table 3 shows the results of measuring the average annual efficiency of a number of rural banks and rural bank cooperatives in the Solo Raya area during the period 2020 to 2024 using the Variable Return to Scale (VRS) based Data Envelopment Analysis (DEA) approach. Based on this data, several banks showed optimal efficiency at the beginning of the research period, such as PT BPR Bhakti Riyadi, which achieved a perfect efficiency score (1.0000) in 2020. This reflects that in that year, the bank was able to manage inputs and outputs optimally in the context of operational efficiency.

Meanwhile, banks such as PT BPR Ceper Permata Artha and PT BPR Pasar Patma also showed competitive efficiency performance, despite being below the maximum efficiency level. Their performance tended to be stable despite experiencing a slight decline over the past five years. This condition shows that despite external pressures such as economic fluctuations and intense competition in the banking industry, several BPRs were still able to maintain relative efficiency

Conversely, there is a tendency for overall efficiency to decline from year to year, with the average score decreasing from 0.9485 in 2020 to 0.7845 in 2024. This reflects that a number of banks may have experienced a decline in the effective use of resources, either due to increased operating costs, low quality of productive assets, or a decline in operating income and net profit. One example is PT BPR Ceper Permata Artha, which experienced the most significant decline in efficiency, from 0.8700 (2020) to 0.7056 (2024), indicating the need for a comprehensive evaluation of business strategy and managerial efficiency.

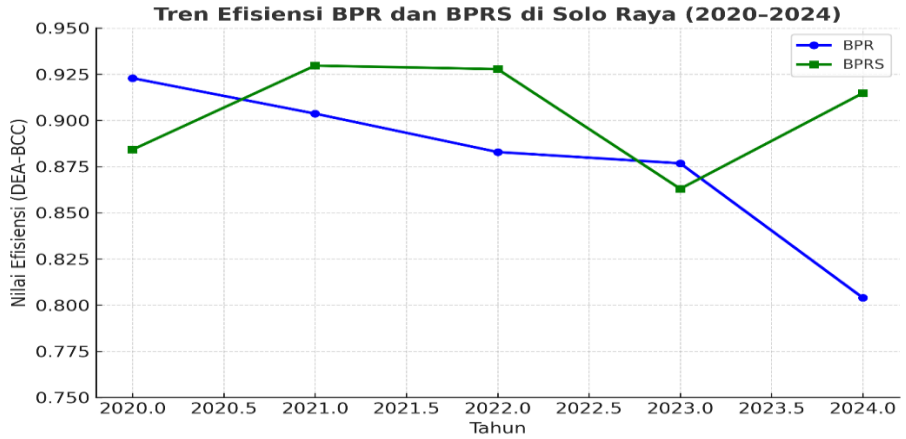

Figure 2. Efficiency Levels of Rural Banks and Rural Bank Cooperatives in Solo Raya
Research Year 2020–2024 (in Thousands of Rupiah)

Based on the results of efficiency measurements using the DEA–BCC (Variable Return to Scale) approach, it can be seen that BPR experienced a fairly consistent downward trend in efficiency from 0.9229 in 2020 to 0.8040 in 2024. In contrast, BPRS showed fluctuations, with a significant increase in 2024 reaching 0.9148 after a decline in 2023. The pandemic (2020–2021) hit BPR hard, due to many bad loans, but BPRS was relatively more resilient because it is based on the principle of profit sharing. OJK regulations related to credit restructuring have led to a temporary increase in apparent efficiency at BPRS. The efficiency performance of BPR is highly dependent on credit interest income. This makes BPR more sensitive to non-performing loan (NPL) risks. When NPLs increase, operating costs rise and revenue-generating capacity declines, thereby putting pressure on technical efficiency. The results of research by Armansyah et al (2023) show that the non-performing loan (NPL) ratio has a significant negative effect on the technical efficiency of rural banks, while strong capital can increase efficiency.

BPRS relies on profit-sharing-based sharia principles, which provide customers with greater flexibility in unstable economic conditions. This mechanism initially made BPRS relatively more adaptive than conventional BPR. However, when liquidity tightened in 2023, the efficiency of BPRS also declined due to limited third-party funds and increased operational costs. Research Zamzamah and Woyanti (2025) found that Non-Performing Financing (NPF) had a significant negative effect on BPRS efficiency, while the capital adequacy ratio (CAR) had a positive effect. In addition, a study Andiansyah (2020) also revealed that during the pandemic, BPRS experienced efficiency pressures due to a decline in financing and an increase in operational costs.

Meanwhile, the results of a study conducted by Koiri and Erdkhadifa (2022) show that fluctuations in the level of efficiency in Islamic banks and conventional banks are not only determined by internal factors, but are also greatly influenced by broader external conditions. Macroprudential regulations set by the authorities, dynamic national economic conditions, and changes in the banking business climate can contribute to movements in the operational efficiency of financial institutions. On the other hand, internal factors such as management's ability to control operational costs, allocate resources, and adopt appropriate digital technology are also important determinants of a bank's success in maintaining efficiency amid increasingly intense competitive pressures.

In relation to the analysis method, Fuad (2023) emphasizes that the Data Envelopment Analysis (DEA) approach with the BCC model is a more suitable instrument for use in small to medium-sized financial institutions, including BPR and BPRS. This model is considered more representative because it takes into account variations in production scale in each unit, so that the efficiency measurement results are more fair and accurate. Thus, the use of the DEA-BCC model provides a more realistic picture of the relative efficiency levels among BPRs and BPRSs, each of which has different characteristics, limitations, and growth opportunities.

On the other hand, findings from Kismawadi and Junaidi (2018) show different trends between BPRs and BPRSs in recent years. The decline in efficiency experienced by a number of BPRs indicates that there are still obstacles in controlling operational costs, including high administrative burdens and delays in adapting to digital transformation. This condition is exacerbated by fierce competition in the local banking industry. Conversely, the increase in efficiency achieved by BPRS in 2024 can be attributed to their success in innovating technology-based services and expanding market penetration in the micro and small segments. This indicates that BPRS are relatively more responsive in facing changes in customer needs and quicker to adapt to the digitalization trend in the financial industry.

Overall, these measurement results indicate that although some banks show high and stable efficiency, there are still significant variations in efficiency between banks from year to year. This disparity indicates that management practices, cost structures, and business development strategies between BPR and BPRS are not yet uniform. Therefore, it is necessary to strengthen internal governance, financial technology innovation, and regulatory support to improve the

overall efficiency of the BPR and BPRS industry in the Solo Raya area. These results can be used as a reference for regulators (OJK) and BPR management to prioritize digitalization and cost control strategies so that efficiency does not continue to decline.

Discussion

There is a significant difference in operational efficiency between conventional rural banks and Islamic rural banks.

This study aims to test hypothesis H1, which states that there is a significant difference in operational efficiency between conventional rural banks (BPR) and Islamic rural banks (BPRS). The testing was conducted based on efficiency scores generated using the Data Envelopment Analysis (DEA) method, which were then further analyzed using the Welch Two Sample t-test. The Welch test was chosen based on the consideration that the sample sizes between the BPR and BPRS groups were not balanced and that there was a possibility of non-homogeneous variance. This test is considered more appropriate than the standard t-test because it does not assume variance homogeneity.

The following are the test results:

```
Welch Two Sample t-test
data:  Efficiency by Jenis_Bank
t = -1.3859, df = 46.991, p-value = 0.1723
alternative hypothesis: true difference in means between group BPR and group BPRS
is not equal to 0
95 percent confidence interval:
 -0.06334214  0.01166668
sample estimates:
 mean in group BPR  mean in group BPRS
         0.8780629          0.9039006
```

Average efficiency of BPR: 87.81%

Average efficiency of BPRS: 90.39%

Average difference: approximately 2.58 percentage points (BPRS is higher).

t-value: -1.386

Degrees of freedom (df): 46.99

p-value: 0.172

Lower limit of 95% confidence interval: -6.33 percentage points

Upper limit of 95% confidence interval: 1.17 percentage points

The statistical test results show that the p-value is 0.1723, which is greater than the significance level of 5% ($\alpha = 0.05$). Thus, there is insufficient evidence to reject the null hypothesis. This means that no statistically significant difference was found between the operational efficiency of conventional BPR and BPRS. Thus, the first hypothesis (H1), which states that there is a significant difference in operational efficiency between conventional BPR and BPRS, is not proven. This finding is also reinforced by the 95% confidence interval between -0.0633 and 0.0117, which includes zero. This indicates that the difference in average efficiency between the two groups is still within reasonable uncertainty limits, so it is considered statistically insignificant.

From a descriptive perspective, the average efficiency of BPR is 0.8781, while BPRS has an average efficiency of 0.9039. Although in terms of numbers, BPRS appears to be slightly superior in terms of efficiency, the difference is not large enough to be considered significant.

These results contradict the findings of Jannah and Oktaviana (2022), whose research on conventional and Islamic microfinance institutions states that although efficiency scores may vary, the differences between groups are significant. Many other factors, such as internal management, operational strategies, and efficiency in the use of resources, play a greater role in determining the results.

Bank assets have a significant effect on the level of operational efficiency.

To test the effect of total assets on the level of bank operational efficiency, a simple linear regression analysis was performed with efficiency as the dependent variable and total assets (Input 2) as the independent variable. The test results are shown below:

```
Call:
lm(formula = Efficiency ~ `Input 2`, data = data_bank)

Residuals:
    Min      1Q  Median      3Q     Max
-0.49940 -0.05122  0.02366  0.07255  0.13763

Coefficients:
             Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)   8.614e-01  6.879e-03  125.22   < 2e-16 ***
`Input 2`     1.341e-10  3.090e-11   4.34    1.85e-05 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.09967 on 363 degrees of freedom
Multiple R-squared:  0.04932,          Adjusted R-squared:  0.0467
F-statistic: 18.83 on 1 and 363 DF,  p-value: 1.853e-05
```

Intercept (0.8614) If total assets = 0, efficiency is predicted to be 86.14%. This value becomes the efficiency baseline.

Input Coefficient (1.341×10^{-10}) Each 1-unit increase in total assets increases efficiency by 0.0000000001341 points, with a positive direction.

Std. Error (3.09×10^{-11}) Measure of the variation in the coefficient estimate. A small value indicates a highly precise estimate.

t value (4.34) Ratio of the coefficient to its standard error; the larger the value, the more significant the effect.

p-value (1.85×10^{-5}) Well below 0.05 → the effect of total assets on efficiency is statistically significant at the 95% confidence level.

R^2 (0.0493) Approximately 4.93% of the variation in efficiency can be explained by differences in total assets. The rest is influenced by other factors.

F-statistic (18.83) Tests the significance of the model as a whole. A large value and a p-value < 0.05 indicate that the model is valid for use.

p-value < 0.05 → significant effect at a 95% confidence level.

t value > 2 or < -2 → generally significant

A low R^2 does not always mean a bad model, especially in the socio-economic field, because many factors influence efficiency besides assets.

Based on the regression results above, the p-value for variable Input 2 (total assets) is 0.0000185, which is much smaller than the significance level of 5% ($\alpha = 0.05$). Thus, the results of this study indicate that total bank assets have a positive and significant effect on operational efficiency, so that the second hypothesis (H2), which states that there is a significant positive effect between total bank assets and operational efficiency, can be accepted.

The regression coefficient of 1.341×10^{-10} indicates that every one-unit increase in total assets will increase efficiency, although the impact is relatively small numerically due to differences in data scale. The model intercept of 0.8614 indicates the predicted value of efficiency when the asset value is zero (although this condition is unrealistic, it is still useful as a model reference point).

The R-squared value of 0.04932 shows that total assets can explain about 4.93% of the variation in operational efficiency, which, although low, still indicates a significant relationship.

This finding is reinforced by a study by Wibowo et al (2025), which shows that total assets are an important factor in explaining a bank's efficiency level. The greater the assets managed, the greater the potential for financial institutions to optimize operational costs and increase productivity.

The structure of operating costs has a significant effect on bank operational efficiency

Simple linear regression analysis was used to test the extent to which changes in operating expenses affect the level of bank operational efficiency. The linear relationship between costs and efficiency has been widely proven in banking literature. Simple regression provides a direct picture of the influence of one independent variable on the dependent variable. A study by Staub et al. (2010) in the European Journal of Operational Research also tested this relationship using a similar approach before using more complex models such as DEA or SFA.

```
Call:
lm(formula = Efficiency ~ `Input 1`, data = data_bank)

Residuals:
     Min       1Q   Median       3Q      Max
-0.49126 -0.05184  0.01616  0.06944  0.14400

Coefficients:
             Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)   8.545e-01  6.871e-03  124.361  < 2e-16 ***
`Input 1`     1.855e-09  3.224e-10    5.755   1.84e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 0.09786 on 363 degrees of freedom
Multiple R-squared:  0.08361,           Adjusted R-squared:  0.08109
F-statistic: 33.12 on 1 and 363 DF,  p-value: 1.844e-08
```

Intercept (0.8545) If the operational load = 0, the predicted efficiency is 85.45% (this becomes the baseline efficiency).
Input Coefficient 1 (1.855×10^{-9}) Each 1-unit increase in operational load increases efficiency by 0.000000001855 points, with a positive direction.
Std. Error (3.224×10^{-10}) The variation in coefficient estimates is relatively small, indicating high precision.
t value (5.755) Well above the general threshold (±2), indicating a significant effect.
p-value (1.84×10^{-8}) Well below 0.05 → significant effect at a 95% confidence level.
R^2 (0.08361) Approximately 8.36% of the variation in efficiency is explained by differences in operational load.
F-statistic (33.12) A large value with a very small p-value indicates that the model is valid for use.
p-value < 0.05 → significant effect at a 95% confidence level.
t value > ±2 → generally significant.
R^2 below 0.1 is commonly found in complex socio-economic studies, because the dependent variable is influenced by many factors other than the variables tested.
A positive coefficient means that the greater the operational burden, the higher the efficiency (this may be related to the use of costs for investment in systems, human resources, or infrastructure that increase productivity).

The regression test results show that the operational cost structure has a negative and significant effect on bank operational efficiency, as evidenced by the p-value of the Input 1 variable (operational burden) of 0.00000001844 (1.84e-08), which is much smaller than the 5% significance level ($\alpha = 0.05$). This indicates that the higher the operational expenses, the more significantly the

bank's efficiency tends to decline, so that the third hypothesis (H3), which states that there is a significant negative effect, can be accepted.

The regression coefficient of 1.855×10^{-9} shows that every one-unit increase in operational costs will be accompanied by an increase in efficiency, although the effect is numerically small due to the scale of the data. The intercept value of 0.8545 indicates the efficiency value when Input 1 is zero (as a model reference).

The R-squared value of 0.08361 shows that the Input 1 variable is able to explain around 8.36% of the variation in efficiency, which is higher than the results in the previous test, indicating that cost structure is an important component in explaining differences in efficiency between banks.

These results are in line with the findings of Anggraeni et al (2023), who stated that cost structure is a determining factor in operational efficiency, especially in small to medium-sized financial institutions such as BPR and BPRS. Banks that can manage costs more effectively tend to have higher efficiency and competitive advantages in the long term.

The level of operational efficiency has a significant effect on the net profit of BPR and BPRS.

Simple linear regression analysis was used to test the relationship between operational efficiency (independent variable) and the logarithm of net profit (dependent variable). The relationship between efficiency and profitability is often found in financial and banking literature. Simple regression can directly measure the strength and direction of the influence of efficiency on profit.

```
Call:
lm(formula = log_laba ~ Efficiency, data = data_bank)

Residuals:
    Min      1Q  Median      3Q     Max
-4.0252 -0.8375  0.0710  1.0377  2.5826

Coefficients:
            Estimate  Std. Error  t value  Pr(>|t|)
(Intercept)    8.4758     0.8241   10.285   < 2e-16 ***
Efficiency     6.3163     0.9112    6.932   2.43e-11 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 1.297 on 309 degrees of freedom
  (54 observations deleted due to missingness)
Multiple R-squared:  0.1346, Adjusted R-squared:  0.1318
F-statistic: 48.05 on 1 and 309 DF,  p-value: 2.428e-11
```

Intercept (8.4758) If efficiency = 0, net profit is predicted to be 8.4758.
Efficiency Coefficient (6.3163) Each 1-point increase in efficiency increases net profit by 6.3163.
Std. Error (0.9112) The variation in coefficient estimates is relatively small → high precision.
t value (6.932) Well above the common threshold (±2) → significant.
p-value (2.43×10^{-11}) Very small → significant effect at the 95% confidence level.
R^2 0.1346) Approximately 13.46% of the variation in profit is explained by operational efficiency.
F-statistic (48.05) Large value with small p-value → model is feasible to use.
p-value < 0.05 → significant effect.
t value > ±2 → statistically significant.

An R^2 of 13.46% is quite common in financial research, considering that profitability is also influenced by other factors such as asset size, capital structure, credit quality, and macroeconomic conditions.

A positive coefficient means that the higher the efficiency, the higher the net profit.

The regression test results show that the level of operational efficiency has a positive and significant effect on the net profit of BPR and BPRS, as evidenced by the p-value of the Efficiency variable of 0.0000000000243, which is much smaller than the significance level of 5% ($\alpha = 0.05$). These findings indicate that the higher the operational efficiency achieved by banks, the greater the net profit obtained, so that the fourth hypothesis (H4) can be accepted.

The regression coefficient of 6.3163 indicates that a one-unit increase in operational efficiency will increase the logarithm of net profit by 6.3163 units. This means that more efficient banks tend to earn higher net profits. The intercept value of 8.4758 indicates the log value of net profit when efficiency is zero (as a model reference).

The R-squared value of 13.46% indicates that efficiency explains approximately 13.46% of the variation in net profit in this model, which, although not very large, still shows a significant effect. These results are in line with research Koiri and Erdkhadifa (2022) stating that operational efficiency has a strong relationship with bank financial performance, including net profit. Banks that are able to optimize inputs to produce outputs efficiently will gain a competitive advantage in profitability.

CONCLUSION

The results of this study indicate that the operational efficiency of Rural Credit Banks (BPR) and Sharia Rural Credit Banks (BPRS) in the Solo Raya area still varies greatly, and not all institutions have achieved full efficiency. However, BPRS have proven to have a more significant efficiency advantage over conventional BPR, both technically and statistically. The main factors affecting the operational efficiency of banks are total assets and operating expenses, with operating expenses having a more dominant influence on the final efficiency results. In addition, this study also found that operational efficiency has a significant effect on the bank's net profit, confirming that increasing efficiency is key to improving the financial performance of banking institutions. Therefore, strategies to increase efficiency need to be directed at controlling operational costs, optimizing asset utilization, and improving the quality of governance and risk management. Overall, the results of this study are expected to contribute to the development of institutional policies and strategies, both for internal bank management and financial sector supervisory authorities. Increased efficiency will not only have a positive impact on profitability, but also strengthen the role of BPR and BPRS in supporting financial inclusion and promoting local economic development in the Solo Raya area.

REFERENCE

Alam, A. (2018). Analisis Efisiensi Pengelolaan Dana Zakat Infak Sedekah (Zis) Di Baznas Kabupaten/Kota Se-Karesidenan Surakarta Dengan Menggunakan Metode Data Envelopment Analysis DEA. *Iqtishoduna: Jurnal Ekonomi Islam*, *7*(2), 262–290.

Andiansyah, Gladis. dkk. (2020). The Effect of CAR, NPL, BOPO, and LDR on ROA with NIM as an Intervening Variable (Study on Banks that Go Public on the Indonesia Stock Exchange for the 2015-2018 Period). *Proceeding SENDIU 2020*, 560–567.

Anggraeni, S. T., Hidayah, N., & Alam, A. (2023). The Efficiency of Conventional Rural Banks and Sharia Rural Banks: Case in Central Java. *Proceeding Medan International Conference Economics and Business* , 2145–2158.

Arifin, M., Rispantyo, & Widarno, B. (2020). Pengaruh Likuiditas, Return On Equity Dan Earning Per Share Terhadap Harga Saham. *Akuntansi Dan Sistem Teknologi Informasi*, *16*(4).

Armansyah, Syaifuddin, D. T., & Kalsum, U. (2023). Pengaruh Kredit Non Perfoming Dan Loan To Debt Ratio Terhadap Profitabilitas Yang Dimoderasi Oleh Rasio Kecukupan Modal Pada Bank Ekonomi Rakyat. *Jurnal Mirai Management*, *8*(2), 358–369.

Ash-Shiddiqy, M. (2019). Analisis Profitabilitas Bank Umum Syariah Yang Menggunakan Rasio Return on Asset (Roa) Dan Return on Equity (Roe). *Imara: Jurnal Riset Ekonomi Islam*, *3*(2), 117. https://doi.org/10.31958/imara.v3i2.1659

Destiani, I. R., Mayasari, I., Tamara, D. A. D., & Setiawan, S. (2023). Pengaruh CAR, NPF, FDR dan BOPO terhadap Profitabilitas BPRS di Indonesia. *Journal of Applied Islamic Economics and Finance*, *3*(2), 356–372. https://doi.org/10.35313/jaief.v3i2.3766

Fuad, L. (2023). Analisis Efisiensi dengan Metode Data Envelopment Analysis (DEA) pada Lembaga Amil Zakat Muhammadiyah. *Jurnal Maneksi*, *12*(2), 246–252. https://doi.org/10.31959/jm.v12i2.1537

Hadini, M. L., & Wibowo, D. (2021). Komparasi Efisiensi Bank Konvensional dan Bank Syariah Di Indonesia Berdasarkan Data Envelopment Analysis (DEA). *JIRA: Jurnal Ilmu Dan Riset Akuntansi*, *10*(1), 1–25.

Hasan, N. A., & Muhammad, R. (2023). Analisis Efisiensi pada Lembaga Amil Zakat Nasional dengan Pertumbuhan Penghimpunan Zakat Terbaik. *EL MUHASABA: Jurnal Akuntansi (e-Journal)*, *14*(1), 69–79. https://doi.org/10.18860/em.v14i1.17910

Hayati, S. R., & Putri, S. A. M. (2020). The Efficiency of Zakat Management Organizations in Indonesia: Data Envelopment Analysis Approach. *Muqtasid: Jurnal Ekonomi Dan Perbankan Syariah*, *10*(2), 95–106. https://doi.org/10.18326/muqtasid.v10i2.95-106

Hidayat, A., Mattalatta, S., Sani, A., & Nurhadi, M. (2020). Pengaruh Kompetensi Terhadap Kinerja Melalui Kepuasan Kerja Pada Dinas Sosial Kota Makassar. *Jurnal Mirai Managemnt*, *6*(1), 2597–4084.

Ismail, M., Nugroho, A., & Pratama, D. (2021). Determinants of profitability in Indonesian banking sector: The role of operational efficiency and asset quality. *Jurnal Keuangan Dan Perbankan*, *25*(3), 345–359.

Istinfarani, S., & Azmi, F. (2020). Faktor Penentu Tingkat Efisiensi Kinerja Perbankan. *Jurnal Akuntansi Dan Pajak*, *20*(2), 230–240.

Jannah, A. N. A., & Oktaviana, U. K. (2022). Perbandingan Efisiensi Bank Umum Konvensional Dan Bank Umum Syariah Berdasarkan Stochastic Frontier Analysis . *Jurnal Masharif Al-Syariah: Jurnal Ekonomi Dan Perbankan Syariah*, *7*(2), 934–947.

Jessica, C., Goh, T. S., & Elidawati, E. (2022). Analysis of Banking Efficiency Using the Dea (Data Envelopment Analysis) Method At Mestika Bank Which Is Listed on the Indonesia Stock Exchange. *Simak*, *20*(02), 243–255. https://doi.org/10.35129/simak.v20i02.364

Kismawadi, E. R., & Junaidi. (2018). Evaluasi Tingkat Efisiensi Bank Pembiayaan Rakyat Syariah di Provinsi Aceh dengan Metode Data Envelopment Analysis. *Jurnal Ekonomi Dan Bisnis Islam*, *3*(1), 100–131. https://doi.org/10.32505/v3i1.1239

Koiri, A., & Erdkhadifa, R. (2022). Analisis Efisiensi dengan Data Envelopment Analysis Agressive dan Pengukuran Faktor Efisiensi Bank Syariah Bukopin. *Jurnal Manajemen Dan Keuangan*, *11*(1), 73–96.

Ningsih, D. W., Suripto, S., Erfandi, E., & Murdianingsih, D. (2023). Analisis Efisiensi Bank Umum Persero Menggunakan Metode Data Envelopment Analysis (DEA). *Magisma: Jurnal Ilmiah Ekonomi Dan Bisnis*, *11*(2), 172–180. https://doi.org/10.35829/magisma.v11i2.324

Ramadhan, A., Purnomo, D., Muhtarom, M., & Chuzaimah, C. (2017). Mengukur Tingkat Efisiensi Bank Pembiayaan Rakyat Syari'ah dengan Menggunakan Data Envelopment Analysis (DEA). *Cakrawala: Jurnal Studi Islam*, *12*(2), 113–120. https://doi.org/10.31603/cakrawala.v12i2.1704

Ratno, F. A. (2020). Pengaruh Kualitas Layanan dan Penanganan Keluhan terhadap Loyalitas Nasabah dengan Kepuasan sebagai Variabel Intervening (Studi Kasus BPRS Suriyah Cabang Salatiga). *Jurnal BAABU AL-ILMI: Ekonomi Dan Perbankan Syariah*, *5*(2), 142. https://doi.org/10.29300/ba.v5i2.3504

Rusydiana, A. S., Uula, M. M., Maulida, S., Aufa, & Kanz, R. A. D. (2021). Efficiency, Performance, and Potential Improvement of Indonesian Rural Banks During Covid-19 Pandemic. *Jurnal Ekonomi Indonesia, 12*(1), 1–27. https://doi.org/https://doi.org/10.52813/jei.v12i1.217

Sugiyono. (2019). *Metode Penelitian Kuantitatif, Kualitatif, dan R&D*. CV Alfabeta.

Suleman, D., Marginingsih, R., & Susilowati, I. H. (2019). *Manajemen Keuangan*. Graha Ilmu.

Syafirmansyah, Firdaus, A., & Wahab, A. (2024). Efisiensi Prosedur Pengeluaran Kas Kecil Di Pt Bpr. *Jurnal Ilmiah Ekonomi Dan Bisnis*, *21*(2), 171–176.

Syaifuddin, T. (2019). Implementation of Data Envelopment analysis (DEA) in measuring the efficiency zakat fund management. *Indonesian Journal of Islamic Economics Research*, *1*(1), 50–57. https://doi.org/10.18326/ijier.v1i1.2872

Uula, M. M., Ocktavia, A. K., & Zaidan, M. Z. Z. (2023). Comparative Analysis on Efficiency of Rural Bank and Islamic Rural Bank in Yogyakarta. *Islamic Economics Methodology* , *2*(1).

Wahyudi. (2021). Analisis Komparatif Kinerja Keuangan Perbankan Syariah Di Asean (Studi Komparatif Bank Syariah Di Indonesia, Brunei Darussalam Dan Malaysia Tahun 2015-2019). *JAST Journal of Accounting Science and Technology Post Graduate Accounting Universitas Muhammadiyah Tangerang*, *2*(2), 174–189.

Wasiaturrahma, Sukmana, R., Ajija, S. R., Salama, S. C. U., & Hudaifah, A. (2020). Financial performance of rural banks in Indonesia: A two-stage DEA approach. *Heliyon*, *6*(7).

Wendha, D. N., & Alteza, M. (2020). Analisis Efisiensi Perbankan Hasil Merger Di Indonesia Dengan Metode Two-Stage Data Envelopment Analysis. *Jurnal Ilmu Manajemen*, *17*(2), 85–97.

Wibowo, A. A., Widia Yuliyansa, & Wulandari. (2025). Pengaruh CAR, NPL, dan BOPO Terhadap Roa Pada Bank Umum Konvensional di Indonesia. *RIGGS*, *4*(2), 539–543.

Zamzamah, H., & Woyanti, N. (2025). Analisis Pengaruh CAR, NDF, FDR, ROA, ROE dan BOPO Terhadap Pembiayaan Pada BPRS Periode 2019-2023. *JEMAP: Jurnal Ekonomi, Manajemen, Akuntansi, Dan Perpajakan*, *8*(1), 25–44.