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Research Article

DETERMINANTS OF OPERATIONAL EFFICIENCY IN INDONESIAN CONVENTIONAL BANKS: THE ROLE OF INTERNAL BANK FACTORS

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ABSTRACT

Background: This study examines the development of operational efficiency in Indonesian commercial banks and investigates the effects of bank size (SIZE), capital adequacy ratio (CAR), non-performing loans (NPL), and loan-to-deposit ratio (LDR) on the cost-to-income ratio (CIR) among conventional commercial banks.
Design/methodology/approach: This study uses panel data from 43 conventional commercial banks in Indonesia over the 2021–2025 period. The relationships between the explanatory variables and CIR are examined using panel regression with a random effects model (REM).
Findings: The results show that SIZE, CAR, NPL, and LDR are jointly significant in explaining variations in CIR. Individually, SIZE and CAR have significant negative effects on the CIR, whereas NPL has a significant positive effect. LDR has a negative but statistically insignificant effect on the CIR.
Conclusion: The findings suggest that larger banks and banks with stronger capital positions tend to operate more efficiently, whereas higher credit risk is associated with greater operating costs relative to operating income. Although lending intensity may be relevant to operational efficiency, its effect was not statistically significant in this study. These results highlight the importance of scale, capital adequacy, and credit risk management in improving banks' operational efficiency.
Originality/value: This study provides recent empirical evidence of the bank-specific determinants of operational efficiency in Indonesia's conventional banking sector. By examining the 2021–2025 period, this study captures changes in bank efficiency during post-pandemic recovery and ongoing digital expansion.

ARTICLE INFO

Keywords:
cost-to-income ratio, conventional commercial banks, Indonesia, and operational efficiency

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INTRODUCTION

Banks play a key role in economic development by mobilizing public funds and allocating them to borrowers through lending and other financial services. This intermediation function supports economic growth and financial stability (Wahyuni and Susanto, 2024). To perform this role effectively, banks must maintain operational efficiency. One commonly used measure is the cost-to-income ratio (CIR), which indicates how efficiently a bank generates operating income relative to its operating expenses. A higher CIR ratio indicates lower efficiency, while a lower ratio reflects higher efficiency. The Financial Services Authority (OJK) established an operational efficiency threshold of below 85% for BUKU 1 and BUKU 2 banks, and below 75% for BUKU 3 and BUKU 4 banks, as part of its incentive framework for commercial bank branch network expansion (OJK, 2016).

Figure 1 shows that the cost-to-income ratio (CIR) of Indonesian conventional commercial banks reached 87.45%, exceeding the 85% benchmark commonly used in banking efficiency analysis. This level raises concerns about operational efficiency, as a higher CIR indicates that operating costs account for a larger share of operating income. The CIR declined from 83.7% in 2021 to 78.6% in 2022 and increased steadily through 2025. If sustained, this deterioration in efficiency may weaken banks' financial resilience and threaten

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their long-term viability (Anis et al. 2023). These developments highlight the importance of identifying the factors that influence banks' operational efficiency. Several internal bank characteristics may influence operational efficiency, particularly bank size (SIZE), capital adequacy ratio (CAR), non-performing loans (NPL), and loan-to-deposit ratio (LDR). Larger banks may benefit from economies of scale, allowing them to reduce operating costs relative to income (Deanna, 2018; Siagian, 2023). A higher CAR may strengthen banks' capacity to absorb losses and manage financial risks, while a higher NPL may increase loan-loss provisions and reduce effective income, potentially raising the CIR (Deanna, 2018; Haryanto, 2018; Liviawati et al. 2019; Siagian, 2023; Indrianni & Nurhayati, 2025). Similarly, an excessively high LDR may increase liquidity risk and funding costs, placing further pressure on operational efficiency (Deanna, 2018). These relationships suggest that both banks' financial characteristics and risk management practices may help explain differences in operational efficiency.

Despite the theoretical relationships between bank characteristics and operational efficiency, empirical findings remain inconsistent and context-dependent. Deanna (2018) and Siagian (2023) reported a significant negative relationship between bank size (SIZE) and the cost-to-income ratio (CIR), whereas Haryanto (2018) and Liviawati et al. (2019) found a significant positive relationship. Similarly, the findings on the capital adequacy ratio (CAR) are mixed: Siagian (2023) identified a significant negative effect, while Haryanto (2018) reported a positive relationship. Evidence concerning non-performing loans (NPL) and the loan-to-deposit ratio (LDR) is also inconclusive, with some studies reporting statistically insignificant effects. These inconsistencies suggest that the relationships between bank characteristics and operational efficiency may vary across institutional settings and economic conditions, warranting further empirical investigation.

Beyond these inconsistent findings, previous studies may not have fully captured the structural changes affecting Indonesian banking in the post-pandemic period. The years 2021–2025 represent a particularly relevant setting because banks were navigating economic recovery while accelerating digitalization and adapting their operational processes. These developments may have altered banks' cost structures, resource allocation, credit risk management, and capacity to generate income, potentially changing the effects of bank-specific characteristics on operational efficiency (Hartono et al. 2025). Consequently, findings derived from earlier periods may not adequately reflect the operating environment of Indonesian commercial banks during this period.

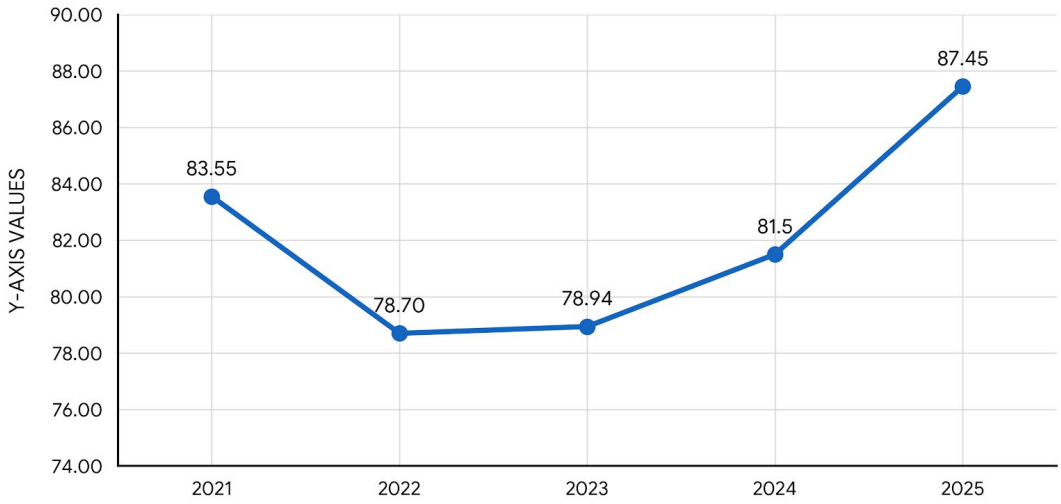


Figure 1. Trends in the Cost-to-income ratio of conventional commercial banks in Indonesia, 2021-2025

Accordingly, this study examines the effects of SIZE, CAR, NPL, and LDR on the CIR of Indonesian conventional commercial banks from 2021 to 2025. This study makes three contributions. First, it provides updated empirical evidence on the determinants of banking operational efficiency during Indonesia's post-pandemic recovery and digitalization period. Second, it contributes to the existing literature by reassessing previously inconsistent findings within a more recent and specific institutional context, helping to clarify whether bank characteristics are associated with operational efficiency in the expected direction. Third, it offers practical implications for bank management and policymakers by identifying which bank characteristics are significantly associated with operational efficiency, thereby informing decisions concerning resource allocation, capital management, credit risk control and liquidity management. By integrating these determinants within a panel data framework, this study seeks to strengthen the empirical understanding of operational efficiency in Indonesian conventional commercial banking and support efforts to improve banks' cost management and financial resilience.

METHODS

This study employs secondary data in the form of panel data, which combines cross-sectional and time-series data. The cross-sectional data comprise 43 conventional commercial banks. The time-series data are annual observations covering the period of 2021–2025. The quantitative data used for the research variables were obtained from audited annual reports published on the official websites of the banks included in the study sample.

In this study, we investigated the determinants of bank operational efficiency in Indonesian conventional commercial banks using panel data analysis. Panel data combine cross-sectional and time-series information, offering more informative observations, reducing multicollinearity, and improving estimation efficiency (Firdaus, 2020). This study employed three standard panel data approaches: Pooled Least Squares (PLS), Fixed Effects Model (FEM), and Random Effects Model (REM). Model selection was conducted using the Chow, Hausman, and Lagrange Multiplier (LM) tests. The results indicate that the Random Effects Model (REM) is the most appropriate specification (Table 1). The diagnostic tests also indicate that the panel regression model is free from multicollinearity and heteroscedasticity, satisfying these key assumptions for reliable estimation (Table 2 and Table 3).

This study adopts the empirical model proposed by Anwar (2019), Azhar and Yeniwati (2020), and Deanna (2018). The panel regression model is specified as follows:

$$CIR_{it} = \beta_0 + \beta_1 SIZE_{it} + \beta_2 CAR_{it} + \beta_3 NPL_{it} + \beta_4 LDR_{it} + \varepsilon_{it} \quad (1)$$

where CIR_{it} represents the cost-to-income ratio of bank at time which serves as a proxy for operational efficiency, with a higher ratio indicating lower efficiency. $SIZE_{it}$ denotes bank size, measured by the natural logarithm of total assets, while CAR_{it} represents the capital adequacy ratio, measuring a bank's capital relative to its risk-weighted assets. NPL_{it} denotes the non-performing loan ratio, reflecting the quality of a bank's loan portfolio, whereas LDR_{it} represents the loan-to-deposit ratio, indicating the proportion of third-party funds allocated to lending. The coefficients β_0 and β_1 to β_3 represent the constant and the estimated coefficients of the explanatory variables, respectively, while ε_{it} denotes the error term. The subscripts and refer to the individual bank and the observation period, respectively.

Table 1. Results of model selection tests

Test	Probability	Decision
Chow Test	[0.0000]***	Reject H_0 (Fixed Effects Model)
Hausman Test	[0.0786]	Do not reject H_0 (Random Effects Model)

Notes: [**] Denotes significance at 5% level. [***] Denotes significance at 1%

Table 2. Correlation coefficients among variables

	SIZE	CAR	NPL	LDR
SIZE	1			
CAR	-0.22367	1		
NPL	-0.12907	0.096097	1	
LDR	-0.07373	0.064235	0.153836	1

Table 3. Heteroscedasticity Test (Glejser Method)

Variable	Probability
SIZE	0.4397
CAR	0.2928
NPL	0.1881
LDR	0.2893

Literature Review and Hypothesis Development

Efficiency Theory

Efficiency refers to a firm's ability to maximize output from a given set of inputs or minimize the inputs required to produce a given level of output (Farrell, 1957). It comprises technical efficiency, which reflects the ability to maximize output from available inputs, and allocative efficiency, which concerns the optimal combination of inputs given their prices; together, these components determine economic efficiency (Farrell, 1957). In banking, cost efficiency reflects a bank's ability to produce a given level of output at the lowest possible cost, relative to best-practice institutions (Berger & Mester, 1997). However, differences in banking efficiency may also arise from managerial decisions, organizational characteristics, and operating conditions (Berger & Mester, 1997; Leibenstein, 1966). Banking efficiency is commonly measured using frontier approaches, such as data envelopment analysis (DEA) and stochastic frontier analysis (SFA), or accounting-based financial ratios, with each approach capturing different dimensions of efficiency (Berger & Humphrey, 1997). This study focuses on the Operating Expenses to Operating Income Ratio or known as *cost-to-income ratio* as a proxy for operational efficiency. Unlike DEA and SFA, which assess relative efficiency against an estimated best-practice frontier, CIR measures the relationship between a bank's operating expenses and operating income using accounting data (Berger & Humphrey, 1997; Hardianto & Wulandari, 2016). A lower CIR indicates greater operational efficiency because the bank incurs fewer operating expenses relative to the income generated, whereas a higher CIR indicates greater cost pressure and potentially weaker cost management (Hardianto & Wulandari, 2016; Sukmadewi, 2020).

Theoritical background on the Determinnats of Bank Operational Efficiency

The literature on financial institution efficiency emphasizes that observed differences in bank performance can arise from managerial practices, organizational characteristics, market conditions, and regulatory environments (Berger & Humphrey, 1997; Berger & Mester, 1997). Accordingly, bank-specific characteristics, including size, capital adequacy, credit risk, and liquidity management, may influence the CIR through their effects on operating costs, resource allocation and income generation.

First, bank size (SIZE) can influence operational efficiency through the theory of production and cost, particularly the concept of economies of scale. Under this theoretical framework, a firm's cost efficiency depends partly on how its scale of production affects the average cost of providing goods or services (Panzar & Willig, 1977; Baumol et al. 1982). Applied to banking, economies of scale occur when an increase in the volume of banking operations reduces average costs because fixed expenditures on technology, administrative infrastructure, regulatory compliance, and distribution networks can be spread across a larger base of activities (Berger & Humphrey, 1997; Berger & Mester, 1997). Larger banks may therefore achieve operational advantages through resource specialization, broader service networks, and the more extensive use of technology, potentially reducing operating expenses relative to operating income (Berger & Mester, 1997). However, production and cost theory also recognizes that expansion does not necessarily generate continuous cost reductions, as organizations may eventually encounter diseconomies of scale when increasing operational complexity and

coordination requirements raise average costs (Baumol et al. 1982; Berger & Humphrey, 1997). Accordingly, the relationship between SIZE and the cost-to-income ratio (CIR) is theoretically ambiguous: if economies of scale dominate, larger banks are expected to exhibit a lower CIR, indicating greater operational efficiency; conversely, if diseconomies of scale and organizational complexity prevail, larger banks may experience a higher CIR. Therefore, the effect of bank size on operational efficiency depends on whether the cost savings associated with expansion outweigh the additional costs of managing a larger organization.

Second, capital adequacy (CAR) can be examined through capital structure theory, which explains how the composition of financing influences firms' risk, incentives, and performance, alongside the financial resilience perspective, which emphasizes the role of capital buffers in absorbing unexpected losses (Modigliani & Miller, 1958; Berger & Bonaccorsi di Patti, 2006). In banking, adequate capital strengthens the capacity to absorb losses and may reduce the likelihood and costs of financial distress, thereby supporting more stable operations (Diamond & Rajan, 2000; Berger & Bouwman, 2013). Empirical evidence further indicates that bank capital and asset quality are interconnected, as changes in capitalization may precede changes in problem loans (Berger & DeYoung, 1997). Applied to the CIR, a higher CAR may be associated with a lower ratio when stronger capitalization supports resilience, effective risk management, and stable income generation relative to operating costs (Berger & Mester, 1997).

Third, credit risk, measured by the non-performing loan ratio (NPL), can be explained through information asymmetry theory, which holds that borrowers and lenders possess unequal information about borrowers' financial conditions and repayment prospects (Akerlof, 1970; Stiglitz & Weiss, 1981). In credit markets, this information imbalance may generate adverse selection before lending and moral hazard after financing is provided, increasing the likelihood of lending to riskier borrowers and weakening repayment discipline (Stiglitz & Weiss, 1981). When problem loans accumulate, banks may face higher monitoring, collection, restructuring, and recovery costs, alongside reduced interest-income generation and potential credit-loss expenses (Berger & DeYoung, 1997; Bessis, 2015). In relation to CIR, a higher NPL is therefore expected to increase the ratio when the additional operating costs and reduced income associated with impaired loans outweigh banks' recovery efforts and cost adjustments (Berger & DeYoung, 1997).

Lastly, the relationship between the loan-to-deposit ratio (LDR) and operational efficiency can be explained by financial intermediation theory, which describes how banks transform deposits into loans while providing liquidity to depositors (Diamond & Dybvig, 1983; Bryant, 1980). This process requires banks to balance income-generating lending against the need to maintain sufficient liquidity to meet withdrawal and funding obligations (Diamond & Dybvig, 1983). A higher LDR may reduce the cost-to-income ratio (CIR) when additional lending generates sufficient income to outweigh associated operating costs; however, excessive lending may increase funding costs and liquidity-management burdens (Berger & Bouwman, 2009; Basel Committee on Banking Supervision, 2008).

Evidences on the Determinants of Bank Operational Efficiency

Empirical studies on the determinants of banking operational efficiency in Indonesia have produced mixed findings, particularly regarding the effects of bank size, capital adequacy, credit risk, and liquidity on efficiency. Empirical studies on the determinants of banking operational efficiency in Indonesia have reported mixed findings, particularly regarding bank size (SIZE), capital adequacy (CAR), credit risk (NPL), and liquidity (LDR).

Deanna (2018), using data from 81 conventional commercial banks during 2011–2016, finds that banking income performance is negatively associated with the operating expenses to operating income ratio or cost-to-income ratio (CIR), whereas LFR and NPL have positive effects. Similarly, Haryanto (2018) reported positive relationships between SIZE, CAR, NPL, and CIR. In contrast, Rosita et al. (2025) find a negative and significant relationship between SIZE and CIR among seven publicly listed Indonesian banks, suggesting that larger banks may benefit from economies of scale. Azhar and Yeniwati (2020), however, find no significant effects of total assets and CAR, although NPL has a positive and significant effect. These findings indicate that the relationships between bank size, capitalization, and operational efficiency may vary across samples and observation periods.

Credit risk emerges as a relatively consistent determinant of operational efficiency. Deanna (2018), Haryanto (2018), Azhar and Yeniwati (2020), and Indrianni and Nurhayati (2025) report positive relationships between NPL and CIR, suggesting that deteriorating credit quality increases loan monitoring, collection, and problem-loan management costs. However, Siagian (2023) found no significant effect of NPL. Evidence regarding liquidity is also inconclusive. Deanna (2018) reported a positive relationship between LFR and CIR, whereas Liviawati et al. (2019) and Indrianni and Nurhayati (2025) found no significant effect of LDR. Siagian (2023) identified LDR as a significant determinant but did not specify the direction of its effect. These differences suggest that the efficiency implications of lending activities may depend on banks' risk management and ability to generate operating income.

The evidence on capitalization and profitability is similarly heterogeneous. Haryanto (2018) finds a positive relationship between CAR and CIR, while Azhar and Yeniwati (2020) and Indrianni and Nurhayati (2025) report the insignificant effects of CAR on CIR. Liviawati et al. (2019) identified CAR as significant but did not specify its direction. Regarding profitability, Deanna (2018) and Indrianni and Nurhayati (2025) find a negative relationship between income performance or ROA and the CIR. In contrast, Indrianni and Nurhayati (2025) report a positive relationship between NIM and CIR, whereas Liviawati et al. (2019) find no significant effect. Siagian (2023) also identifies NIM as significant, although its direction remains unspecified. These findings indicate that overall profitability and interest margins may have different implications for operational efficiency in the banking sector (Table 4).

Overall, NPL has the most consistent positive association with BOPO, while the findings concerning SIZE, CAR, and LDR remain mixed. Differences in sample composition, observation periods, and model specifications may explain these inconsistencies. To extend this literature, the present study examines the effects of SIZE, CAR, NPL, and LDR on BOPO among Indonesian conventional commercial banks from 2021 to 2025. Focusing on the post-pandemic period provides an opportunity to reassess these relationships under the more recent banking conditions.

Based on the empirical and theoretical arguments above, this study proposes the following hypothesis:
H1: Bank size (SIZE) has a negative effect on the cost-to-income ratio (CIR)
H2: Capitalization (CAR) has a negative effect on the cost-to-income ratio (CIR)
H3: Credit risk (NPL) has a positive effect on the cost-to-income ratio (CIR)
H4: Liquidity (LDR) has a negative effect on the cost-to-income ratio (CIR)

RESULTS

The Determinants of Bank Operational Efficiency

The empirical findings focus on the factors determining bank operational efficiency in Indonesian conventional banks, as presented in Table 5. As mentioned in the methodology section, we estimated several models, including Pooled Least Squares (PLS), Fixed Effects Model (FEM), and Random Effects Model (REM). The model selection tests indicate that the Random Effect Model (FEM) is the most appropriate specification. The Chow test rejects the null hypothesis at the 5% significance level (p-value = 0.0000), indicating that the FEM is preferred over the Pooled Least Squares (PLS). However, the Hausman test yields a p-value of 0.0786, which exceeds the 5% significance level. Therefore, the null hypothesis is not rejected, suggesting that the Random Effects Model (REM) is more appropriate than the FEM. Based on these test results, the REM is selected as the most appropriate estimation model for this study (see Appendix 1). The diagnostic tests show that the regression model is free from multicollinearity and heteroscedasticity issues. The pairwise correlation coefficients among the independent variables range from −0.224 to 0.154, remaining below the commonly used threshold of 0.80. Furthermore, the Glejser test yields probability values above the 5% significance level for all explanatory variables (SIZE = 0.4397, CAR = 0.2928, NPL = 0.1881, and LDR = 0.2893). Thus, the null hypothesis of homoscedasticity cannot be rejected, supporting the reliability of the regression estimates with respect to these diagnostic assumptions (Table 2 and Table 3).

Table 4. Summary of previous studies on the determinants of bank operational efficiency

Authors	Title	Method	Findings
Rosita et al. (2025)	Bank Size as a Determinant of Operational Efficiency: Empirical Evidence from Publicly Listed Banks in Indonesia	Panel regression; 7 publicly listed banks	CIR: SIZE ((−), significant), indicating that larger banks may benefit from economies of scale.
Indrianni and Nurhayati (2025)	Determinants of Banking Efficiency in Indonesia	Multiple linear regression; 24 banks	CIR: NPL ((+), significant); LDR (insignificant); CAR (insignificant); ROA ((−), significant); and NIM ((+), significant).
Siagian (2023)	Determinants of Banking Operational Efficiency and the Relationship Between These Factors and Market Prices: Evidence from Indonesia	Multiple linear regression; 28 banks	CIR: SIZE, CAR, LDR, NIM, and inflation are significant; NPL and exchange rates are insignificant. The direction of the significant effects is not specified.
Azhar and Yeniwati (2020)	Analysis of the Determinants of Banking Efficiency in Indonesia	Panel regression; Indonesian banks, 2010–2019	CIR: NPL ((+), significant); total assets, and CAR are insignificant.
Liviawati et al. (2019)	Factors Affecting Banking Efficiency: A Study of Private Banks Listed on the Indonesia Stock Exchange	Multiple regression; 9 private banks	CIR: SIZE, CAR, and NPL are significant; LDR, NIM, and market interest rates are insignificant. The directions of the significant effects were not specified.
Haryanto (2018)	Determinants of Bank Efficiency: An Analysis of Banks in Indonesia	Multiple linear regression; 23 banks	CIR: SIZE (+); CAR (+); NPL (+).
Deanna (2018)	Determinants of Operational Efficiency in Indonesian Banking: An Empirical Study of Conventional Commercial Banks	Multiple regression; 81 conventional commercial banks	CIR: Banking income performance (−), LFR (+), and NPL (+).

Table 5. Panel regression testing the determinants of bank operational efficiency in the Indonesian conventional banks

Variable	Coefficient	T-statistic	Probability
C	141.8638	5.313099	[0.0000]***
SIZE	-2.966042	-2.059414	[0.0407]***
CAR	-0.177726	-2.301321	[0.0224]***
NPL	3.054123	3.721181	[0.0003]***
LDR	-0.054978	-1.292147	[0.1977]

Notes: [*] Denotes significance at the 10% level. [**] denotes significance at 5%. [***] Denotes significance at 1%

Table 5 presents the panel regression results for the determinants of operational efficiency in Indonesian conventional commercial banks, with the cost-to-income ratio (CIR) as the dependent variable. Because a higher CIR indicates lower operational efficiency, a negative coefficient suggests an improvement in efficiency, whereas a positive coefficient indicates a decline in efficiency, ceteris paribus.

First, bank size (SIZE) has a negative and statistically significant effect on the CIR at the 5% level (coefficient = −2.966; p-value = 0.0407). This finding indicates that larger banks tend to have lower cost-to-income ratios, suggesting greater operational efficiency. This finding is consistent with the theory of production and cost, particularly the concept of economies of scale, which suggests that larger banks can reduce average operating costs by distributing fixed expenditures across a greater volume of banking activities (Berger & Humphrey, 1997; Berger & Mester, 1997). Empirically, the negative relationship between SIZE and CIR is consistent with Rosita et al. (2025), who report that larger Indonesian banks tend to achieve greater efficiency.

Second, the capital adequacy ratio (CAR) has a negative and statistically significant effect on CIR at the 5% level (coefficient = −0.178; p-value = 0.0224). This finding is supported by the financial resilience perspective of capital structure theory, which suggests that adequate capital buffers strengthen banks' capacity to absorb losses and sustain operations, potentially improving operational efficiency (Berger & Bonaccorsi di Patti, 2006; Berger & Bouwman, 2013). The negative relationship between CAR and CIR indicates that better-capitalized banks tend to operate more efficiently in the Indonesian conventional banking sector. Adequate capital can strengthen financial resilience, reduce dependence on external funding, and support investment in technology and risk management. Nevertheless, the relationship should be interpreted cautiously because higher capital adequacy does not automatically translate into more efficient operations; its effect may depend on how banks allocate and utilize their capital.

Third, the non-performing loan ratio (NPL) has a positive and statistically significant effect on CIR at the 1% level (coefficient = 3.054; p-value = 0.0003). This finding is consistent with information asymmetry theory, which explains how adverse selection and moral hazard can contribute to deteriorating loan quality and increase the costs associated with credit monitoring and recovery (Akerlof, 1970; Stiglitz & Weiss, 1981). The positive relationship between NPL and CIR is also consistent with Berger and DeYoung (1997), who examined the relationship between loan quality and bank cost efficiency, and with previous empirical studies in Indonesia, including Deanna (2018), Haryanto (2018), Azhar and Yeniwati (2020), and Indrianni and Nurhayati (2025). These findings collectively suggest that deteriorating credit quality can weaken operational efficiency by increasing problem-loan management costs and reducing income-generating capacity. In detail, an increase in non-performing loans may require banks to allocate additional resources to loan monitoring, collection, and recovery activities, while also incurring higher loan-loss provisions and reducing interest income from impaired assets. These pressures can increase operating costs relative to income and weaken banks' overall efficiency.

Finally, the loan-to-deposit ratio (LDR) has a negative but statistically insignificant effect on the CIR (coefficient = −0.055; p-value = 0.1977). Therefore, there is insufficient statistical evidence to conclude that LDR significantly affects the operational efficiency of the sampled banks. The negative but statistically insignificant relationship between LDR and CIR can be interpreted through financial intermediation theory, which emphasizes the need for banks to balance income-generating lending activities with liquidity provision and funding obligations (Diamond & Dybvig, 1983; Bryant, 1980). Although greater lending may improve operational efficiency by generating additional interest income from available deposits, this benefit may be offset by the funding costs, liquidity constraints, and credit risk. Empirically, the insignificant result is consistent with Liviawati et al. (2019) and Indrianni and Nurhayati (2025), who also report no statistically significant effect of LDR on the operational efficiency.

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

This study examines the determinants of operational efficiency in Indonesian conventional commercial banks using panel regression analysis. The findings indicate that bank size (SIZE) and capital adequacy (CAR) have negative and statistically significant relationships with the cost-to-income ratio (CIR), suggesting that larger and better-capitalised banks tend to achieve higher operational efficiency. In contrast, non-performing loans (NPL) exhibit a positive and statistically significant relationship with CIR, highlighting the adverse implications of deteriorating credit quality for operational performance. Meanwhile, the effect of the loan-to-deposit ratio (LDR) is negative but statistically insignificant, indicating insufficient evidence of a systematic relationship between lending intensity and operational efficiency in the sampled banks. Overall, the findings suggest that operational efficiency depends not only on banks' scale and capital strength but also on their ability to maintain sound credit quality. These results provide empirical insights into the internal factors associated with operational efficiency in Indonesia's conventional banking sector.

Recommendations

These findings have several implications for bank management and financial regulators. First, bank management should strengthen operational cost control by leveraging economies of scale, improving resource allocation, and investing in technology that enhances

process efficiency. However, expansion strategies should be accompanied by effective organizational and cost management to avoid potential economies of scale. Second, maintaining adequate capital buffers should remain a priority, as stronger capitalization is associated with a lower CIR. Therefore, banks should balance capital adequacy requirements with productive capital allocation to support sustainable operational performance. Finally, the positive relationship between NPL and CIR underscores the importance of prudent lending standards, effective borrower screening, continuous credit monitoring, and timely loan restructuring and recovery. Regulators should reinforce risk-based supervision and encourage banks to integrate credit risk management into operational efficiency assessments.

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