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The Effect of Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on Operating Expense to Operating Income at Regional Development Banks in Indonesia with Economic Growth as Mediation and Inflation as Moderation

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Bank Operational Efficiency;

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Abstract

This paper aims to analyze the direct effect of Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on BOPO, the role of economic growth as a mediator, and the role of inflation in moderating the relationship between Leverage Risk, Credit Risk, Liquidity Risk, Interest Rate and BOPO at regional development banks in Indonesia. This research is a quantitative study with an explanatory approach. The population and sample in this study are all regional development banks (BPD) totaling 27 banks. The data used is secondary data and using the Partial Least Square Structural Equation Modeling (PLS-SEM). Research results show 1) CAR and interest rates have a significant influence on bank operational efficiency (BOPO) in Indonesia, with CAR showing a negative influence and interest rates showing a positive influence. 2) Economic growth does not significantly mediate the relationship between CAR and NPL on BOPO, but mediates the effect of LDR and interest rates on BOPO. 3) Inflation moderates the effect of NPL and LDR on BOPO significantly with a negative effect, but does not moderate the effect of CAR and interest rate on BOPO.

1. Introduction

Macroeconomics is a branch of economics that studies overall economic phenomena, including interest rates, inflation, unemployment rates, fiscal policy, monetary policy, exchange rates and economic growth. Monetary and fiscal policies play an important role in controlling these variables

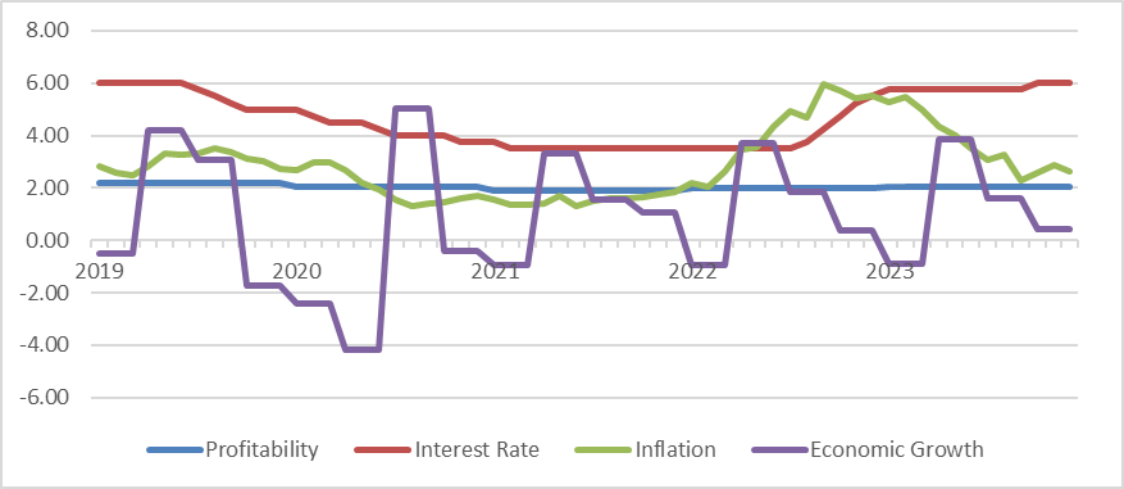
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to achieve economic stability. Interest rates, inflation and economic growth are some of the key indicators used to assess a country's economic health. Changes in interest rate policy by central banks, for example, can have a wide-ranging impact on the economy, affecting everything from consumption and investment to currency exchange rates.

The link between macroeconomics and bank profitability is very close. Banks are financial institutions that operate within a broader economic framework, so their performance is affected by macroeconomic conditions. Interest rates set by the central bank affect banks' cost of funds and interest income. For example, higher interest rates may increase the income from loan interest but also increase the cost of funds, which affects banks' profit margins (Saunders & Cornett, 2017). In addition, inflation can affect people's purchasing power and economic stability, which in turn impacts credit demand and the credit risk faced by banks (Agénor et al, 2013).

In Indonesia, the Financial Services Authority (OJK) plays an important role in setting regulations, by supervising and regulating the financial industry, especially banking in Indonesia to ensure the stability and integrity of the financial system. OJK encourages the implementation of good governance practices to improve transparency and accountability. Through it GRC (Governance, Risk Management, and Compliance) can help banks understand how monetary policy, fiscal, and global economic conditions affect risks and opportunities. Governance plays a role in determining the bank's strategic policies to deal with changes in interest rates, inflation, and economic growth. Risk management helps banks identify, measure, and manage risks related to macroeconomic fluctuations, while compliance ensures that banks meet all relevant regulations, including those on interest rates and inflation.

Figure 1. Profitability, Interest Rates, Inflation, and Economic Growth in Indonesia



Noted. Ratio in Percent

The graph above is data on profitability, interest rates, inflation, and economic growth in Indonesia from 2019 to 2023. From the graph, it can be seen that the interest rate tends to decrease gradually since 2019. Inflation shows significant fluctuations, especially during the 2021-2022 period, indicating price instability. Economic growth experienced a drastic decline in 2020, reflecting the impact of the COVID-19 pandemic, but showed a recovery with large fluctuations in the following years. Meanwhile, Probability was relatively stable but increased slightly by the end of the period, reflecting the stability of bank profitability despite significant economic fluctuations. This combination of data shows how changing macroeconomic factors affect the overall profitability of banks. Provides a contextual backdrop for the study on the effect of leverage risk, credit risk, liquidity

risk, and interest rate on operating expense to operating income at regional development banks in Indonesia, highlighting how fluctuations in macroeconomic factors impact the banks' operational efficiency, with economic growth as a mediator and inflation as a moderator.

BOPO, which measures the efficiency of a bank's operations by comparing operating expenses to operating income, is a crucial indicator of how well a bank manages its operational costs relative to its income. Borio et al. (2017) found that higher interest rates tend to increase banks' net interest margins, but this effect can differ depending on market conditions and bank management strategies. This relationship is relevant as BOPO is directly influenced by how well banks manage these risks and interest rates, impacting their operational efficiency and overall profitability.

Economic growth as a mediator refers to an increase in the capacity of the economy to produce goods and services from one period to another. Cashmere (2014) states that high economic growth is usually accompanied by an increase in demand for credit, which can increase bank income from loan interest. Tariq (2021) also asserts that stable and strong economic growth can increase bank profitability through increased loan volume and revenue diversification.

Interest rates, as an instrument of monetary policy, affect the cost of borrowing and investment, which in turn impacts the financial performance of banks (Mishkin, 2016). According to Saunders and Cornett (2017), high interest rates can increase banks' interest income but also increase the cost of funds, so the net impact on profitability can vary. Inflation as a moderating variable can affect the relationship between interest rates and bank profitability. Fischer (1993) explains that high inflation can reduce purchasing power and hamper economic growth, which in turn affects the financial performance of banks. However, inflation can also increase nominal income from loan interest if banks are able to adjust loan interest rates in accordance with the inflation rate. Kobia (2018) mentioned that moderate inflation can increase bank profitability, while very high or low inflation can have a negative impact.

Indonesia in the last five years has shown significant economic instability, with falling interest rates, fluctuating inflation, and unstable economic growth due to the COVID-19 pandemic. Although bank operational efficiency, as measured by BOPO, is relatively stable, it raises the question of how banks can maintain their efficiency amidst changing macroeconomic conditions. This study aims to analyze the direct effect of Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on BOPO, the role of economic growth as a mediator, and the role of inflation in moderating the relationship between Leverage Risk, Credit Risk, Liquidity Risk, Interest Rate and BOPO at regional development banks in Indonesia.

2. Literature Review

Macroeconomics

Macroeconomics is the field of economics that studies the economy as a whole, including issues such as inflation, economic growth, and monetary policy. Fiscal and monetary policies are the main tools used to control these macroeconomic variables and achieve economic stability. According to Mankiw (2019), monetary policy by the central bank is important in regulating the money supply and interest rates to maintain price stability and promote economic growth (Blanchard, 2020).

Banking

The banking industry plays a key role in the economy by channeling funds from savers to borrowers and providing various financial services. Banks also serve as efficient intermediary institutions, which reduce transaction costs and increase liquidity in financial markets. In addition,

banks' role in managing credit and operational risks is critical to maintaining financial stability (Kasmir, 2018; Rose & Hudgins, 2017).

Governance, Risk Management, and Compliance

Governance, Risk Management, and Compliance (GRC) is a framework that helps organizations effectively achieve objectives, manage risks, and comply with regulations. Governance involves setting and controlling the organization's operations, risk management focuses on identifying and mitigating risks, and compliance ensures compliance with laws and regulations. In banking, the implementation of GRC is important to maintain financial stability, mitigate risk, and meet stringent regulations, helping banks cope with macroeconomic challenges such as interest rates and inflation (Financial Services Authority, 2016).

Interest Rate

The interest rate is a key tool of monetary policy that affects the cost of borrowing and investment. High interest rates can increase banks' interest income but also increase the cost of funds, which affects banks' profit margins. Interest rate policy also impacts public consumption and savings, as well as business investment (Mishkin, 2016; Hubbard & O'Brien, 2020).

Inflation

Inflation represents the rate of increase in the prices of goods and services in the economy. Moderate inflation can support bank profitability by increasing nominal income from loan interest, but high inflation can reduce purchasing power and economic stability. Banks need to adjust their risk management strategies to address the impact of inflation on their loan portfolio and earnings (Kobia, 2018; Samuelson & Nordhaus, 2021).

Economic Growth

Economic growth measures the increase in an economy's capacity to produce goods and services from one period to another. Strong economic growth is usually accompanied by an increase in credit demand, which increases banks' income from loan interest. Stability and sustained economic growth also encourage bank income diversification and strengthen the financial sector as a whole (Borio et al, 2017; Barro & Sala-i-Martin, 2018).

Operating Expense to Operating Income

Operating Expense to Operating Income (BOPO) is a ratio used to measure a bank's operational efficiency by comparing total operating expenses to total operating income. A lower BOPO ratio indicates higher efficiency, as a smaller proportion of income is spent on operational costs. Conversely, a higher BOPO ratio suggests that a significant portion of the bank's income is consumed by operating expenses, which can negatively impact profitability. This ratio is critical for assessing how well a bank manages its operational costs relative to its income, directly influencing its overall financial performance.

Leverage Risk

Leverage Risk refers to the potential financial instability that arises from a bank's use of debt to finance its assets. It is measured by the Capital Adequacy Ratio (CAR), which indicates the proportion of a bank's capital to its risk-weighted assets. A higher CAR suggests that the bank has a substantial buffer to absorb potential losses, thereby lowering leverage risk (Saunders & Cornett, 2017). Conversely, a lower CAR indicates higher leverage risk, as the bank may struggle to cover losses with its available capital. Managing leverage risk is crucial for maintaining financial stability and ensuring that the bank can withstand economic downturns.

Credit Risk

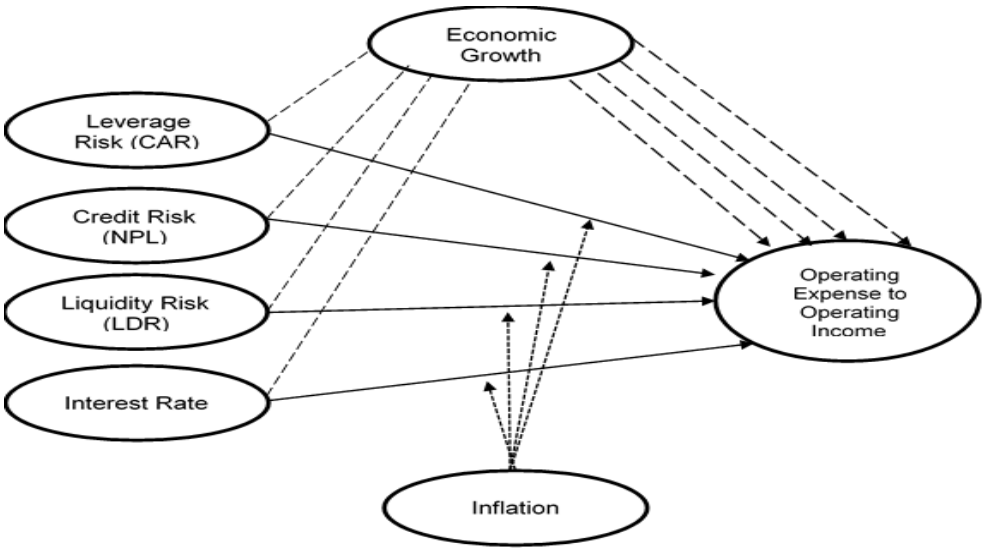
Credit Risk is the risk of loss that a bank faces when borrowers fail to repay their loans. This risk is measured by the Non-Performing Loan (NPL) ratio, which represents the proportion of loans that are in default or close to default relative to the total loans issued. A high NPL ratio indicates significant credit risk, as it shows a higher likelihood of loan defaults, which can lead to financial losses for the bank. Effective management of credit risk involves stringent credit assessment processes, ongoing monitoring of borrowers' financial health, and timely intervention to mitigate potential defaults.

Liquidity Risk

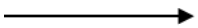
Liquidity Risk is the risk that a bank will be unable to meet its short-term financial obligations due to an imbalance between liquid assets and liabilities. This risk is measured by the Loan to Deposit Ratio (LDR), which compares the bank's total loans to its total deposits (Heffernan, 2019). A high LDR indicates that the bank has lent out a large portion of its deposits, potentially leading to liquidity issues if there is a sudden demand for withdrawals. On the other hand, a low LDR suggests that the bank has more deposits than loans, indicating better liquidity. Managing liquidity risk ensures that the bank can fulfill withdrawal requests and other short-term liabilities without compromising its financial stability.

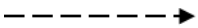
Conceptual Framework

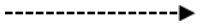
Figure 2. Conceptual Framework



Notes.

 *= Hypothesis 1*

 *= Hypothesis 2*

 *= Hypothesis 3*

Hypothesis:

H1: Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate partially have a significant influence on Operating Expense to Operating Income.
H2: Economic growth mediates the effect of Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on Operating Expense to Operating Income.
H3: Inflation moderates the effect of Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on Operating Expense to Operating Income.

3. Results and Discussion

Type of Research

This research is a quantitative study with an explanatory approach. This study aims to explain the causal relationship between Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate and Operating Expense to Operating Income by considering the role of economic growth as a mediator variable and inflation as a moderator variable.

Unit of Analysis

The unit of analysis in this research is regional development banks in Indonesia.

Population and Sample

The population and sample in this study are all regional development banks (BPD) operating in Indonesia, totaling 27 banks. This study uses the census method, where the entire population is used as a research sample.

Data Collection Method

The data used is secondary data. Interest rate and inflation data are monthly data obtained from Bank Indonesia, economic growth data are quarterly data obtained from the Central Bureau of Statistics, while Leverage Risk, Credit Risk, Liquidity Risk and Operating Expense to Operating data are quarterly data obtained from the Financial Services Authority. In quarterly data, data interpolation is carried out to estimate the value between known data points using various mathematical methods, so that modeling is more accurate. The data used is a monthly time series from 2019.

Variable and Operational Definition

1. Interest Rate (Independent Variable) is the percentage charged by the central bank (Bank Indonesia) to commercial banks for loans. Interest rate data will be taken from the Bank Indonesia benchmark interest rate (BI Rate). Indicator: BI Rate.
2. Inflation (Moderator Variable) is the rate of increase in the general price of goods and services in an economy during a certain period of time. Inflation data will be taken from the Central Statistics Agency (BPS). Indicator: Consumer Price Index (CPI).
3. Economic Growth (Mediator Variable) is an increase in the capacity of an economy to produce goods and services, compared from one period to another. Economic growth data will be taken from the Central Statistics Agency (BPS). Indicators: Annual Gross Domestic Product (GDP) growth.
4. Leverage Risk is the risk arising from the use of debt by banks to fund their assets measured in Capital Adequacy Ratio (CAR).
5. Credit Risk is the risk of loss arising from the failure of debtors to fulfill loan payment obligations measured in the Non-Performing Loan (NPL) ratio.
6. Liquidity Risk is the risk arising from the bank's inability to meet its short-term obligations measured in Loan to Deposit Ratio (LDR).
7. Operating Expense to Operating Income is a ratio that measures the bank's operating efficiency by comparing total operating expenses with total operating income measured in ratio.

Data Analysis Method

In this study using the Partial Least Square Structural Equation Modeling (PLS-SEM) method will be used to test the proposed hypothesis. The analysis carried out includes descriptive statistics, outer model analysis consisting of convergent validity, discriminant validity and reliability. As well as inner model analysis consisting of R square, path coefficient estimation and hypothesis testing.

4. Result

Outer Model

Outer Model in PLS-SEM (Partial Least Squares Structural Equation Modeling) is a measurement model that determines the relationship between latent variables (constructs) and observed indicators.

Table 1. Output Outer Model

Convergent Validity			***Discriminant Validity***		
Variable	Loading Factor	Description	Variable	AVE	Description
CAR	1,000	Valid	CAR	1,000	Valid
NPL	1,000	Valid	NPL	1,000	Valid
LDR	1,000	Valid	LDR	1,000	Valid
BOPO	1,000	Valid	BOPO	1,000	Valid
Interest Rate	1,000	Valid	Interest Rate	1,000	Valid
Economic Growth	1,000	Valid	Economic Growth	1,000	Valid
Inflation	1,000	Valid	Inflation	1,000	Valid
Reliabilitas					

Variable	Cronbach's Alpha	rho_a	rho_c	Description
CAR	1,000	1,000	1,000	Reliable
NPL	1,000	1,000	1,000	Reliable
LDR	1,000	1,000	1,000	Reliable
BOPO	1,000	1,000	1,000	Reliable
Interest Rate	1,000	1,000	1,000	Reliable
Economic Growth	1,000	1,000	1,000	Reliable
Inflation	1,000	1,000	1,000	Reliable

Convergent Validity based on the analysis shows that all instruments have a loading factor> 0.700, indicating that all variable data are valid and can be used for further analysis.

Discriminant Validity based on the analysis shows that it is seen from the AVE (Average Variance Extracted) value with the criteria that the AVE value of all variables is above the specified threshold of 0.5. Therefore, the research instrument can be said to be discriminantly valid, meaning that the instrument is able to distinguish between different latent variables.

Reliability based on analysis shows the evaluation of composite reliability and Cronbach's alpha, all constructs in this study are above 0.600, which indicates a good level of internal consistency. In addition, the composite reliability (rho_a) and composite reliability (rho_c) values for all variables are also above 0.700, which indicates a high level of construct reliability. Thus, based on the composite reliability evaluation, all constructs in this study can be considered reliable and can be used for further analysis.

Inner Model

The Inner Model in PLS-SEM is the part that evaluates the causal relationship between latent variables in the research model. This model assesses how well the independent variables affect the dependent variable through path coefficients and the R-squared (R^2) value which shows the predictive power. The Inner Model also tests the statistical significance of the relationship and may include moderation and mediation effect analysis to understand additional influences between constructs.

Table 2. Output Inner Model

Variable		R Square		R Square Adjusted	
BOPO		0,948		0,937	
Economic Growth		0,409		0,365	
Hypothesis		**Original Sample (O)**	**T Statistics (|O/STDEV|)**	**P Values**	**Description**
H1	CAR -> BOPO	-0,647	5,537	0,000	Accepted
	NPL -> BOPO	0,162	1,606	0,108	Rejected
	LDR -> BOPO	0,397	4,475	0,000	Accepted
	Interest Rate -> BOPO	0,397	4,475	0,000	Accepted
H2	CAR -> Economic Growth -> BOPO	-0,083	1,772	0,076	Rejected
	NPL -> Economic Growth -> BOPO	-0,064	1,319	0,187	Rejected
	LDR -> Economic Growth -> BOPO	-0,157	3,359	0,001	Accepted
	Interest Rate -> Economic Growth -> BOPO	0,108	2,477	0,013	Accepted
H3	Inflation* CAR -> BOPO	0,146	1,402	0,161	Rejected
	Inflation* NPL -> BOPO	-0,140	2,198	0,028	Accepted
	Inflation* LDR -> BOPO	-0,275	3,597	0,000	Accepted
	Inflation* Interest Rate -> BOPO	-0,012	0,124	0,901	Rejected

The effect of Operating Expense to Operating Income (BOPO) is significant with an R-square adjusted value of 93.7%, while Economic Growth has an R-square adjusted value of 36.5%. Hypothesis testing results show the following results:

Direct Effect on BOPO

1. CAR -> BOPO: Significant negative effect (coefficient: -0.647, t-value: 5.537, p-value: 0.000), hypothesis accepted.
2. NPL -> BOPO: Insignificant effect (coefficient: 0.162, t-value: 1.606, p-value: 0.108), hypothesis rejected.
3. LDR -> BOPO: Significant positive effect (coefficient: 0.397, t-value: 4.475, p-value: 0.000), hypothesis accepted.
4. Interest Rate -> BOPO: Significant positive effect (coefficient: 0.397, t-value: 4.475, p-value: 0.000), hypothesis accepted.

Mediating Effect of Economic Growth on BOPO

1. CAR -> Economic Growth -> BOPO: Insignificant effect (coefficient: -0.083, t-value: 1.772, p-value: 0.076), hypothesis rejected.
2. NPL -> Economic Growth -> BOPO: Insignificant effect (coefficient: -0.064, t-value: 1.319, p-value: 0.187), hypothesis rejected.
3. LDR -> Economic Growth -> BOPO: Significant negative effect (coefficient: -0.157, t-value: 3.359, p-value: 0.001), hypothesis accepted.
4. Interest Rate -> Economic Growth -> BOPO: Significant positive effect (coefficient: 0.108, t-value: 2.477, p-value: 0.013), hypothesis accepted.

Moderating Effect of Inflation on BOPO

1. Inflation* CAR -> BOPO: Insignificant effect (coefficient: 0.146, t-value: 1.402, p-value: 0.161), hypothesis rejected.
2. Inflation* NPL -> BOPO: Significant negative effect (coefficient: -0.140, t-value: 2.198, p-value: 0.028), hypothesis accepted.
3. Inflation* LDR -> BOPO: Significant negative effect (coefficient: -0.275, t-value: 3.597, p-value: 0.000), hypothesis accepted.
4. Inflation* Interest Rate -> BOPO: Insignificant effect (coefficient: -0.012, t-value: 0.124, p-value: 0.901), hypothesis rejected.

5. Discussion

The Direct Effect of Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on Operating Expense to Operating Income at Regional Development Banks in Indonesia.

Based on the results of the path coefficient analysis, it is concluded that CAR has a significant negative effect on BOPO with a coefficient value of -0.647 (t-value: 5.537, p-value: 0.000), while LDR and interest rates have a significant positive effect on BOPO with a coefficient value of 0.397 each (t-value: 4.475, p-value: 0.000). In contrast, NPL has no significant effect on BOPO (coefficient: 0.162, t-value: 1.606, p-value: 0.108). These results suggest that an increase in CAR reduces banks' operational efficiency, while an increase in LDR and interest rate improves operational efficiency.

This finding confirms that changes in interest rates by monetary authorities directly affect banks' operational performance. An increase in interest rates increases income from loan interest, a major component of banks' income, thereby strengthening their financial performance. Moreover, the statistical significance of these results suggests that the relationship between interest rates and BOPO

does not occur by chance, so bank management needs to pay attention to interest rate policies in their strategic planning.

Theoretically, the positive relationship between interest rates and bank operating efficiency can be explained through the net interest margin theory. When interest rates rise, interest income from loans granted by banks also increases, thereby increasing the net interest margin. This directly contributes to the improvement of the bank's operational efficiency, which is reflected in a better BOPO. Although rising interest rates may also increase the cost of funds, the positive effect on earnings is usually more dominant, especially in conditions where banks can adjust lending rates faster than deposit rates (Mishkin, 2016).

In addition, financial market structure theory states that higher interest rates can increase the attractiveness of investing in bank financial products, such as time deposits, which offer higher interest rates to customers. This not only increases interest income, but also helps banks in strengthening their funding base. Thus, banks can allocate more funds to profitable loans, which in turn improves operational efficiency as measured by BOPO (Saunders & Cornett, 2017). The implementation of GRC (Governance, Risk Management, and Compliance) shows that banks with good governance, effective risk management, and regulatory compliance can manage the influence of interest rates more optimally. Governance ensures that the bank's strategic policies can respond appropriately to changes in interest rates. Risk management helps identify and manage risks arising from interest rate fluctuations, while compliance ensures that all practices and policies implemented are in accordance with applicable regulations, so that banks can continuously improve operational efficiency and maintain financial stability.

The Role of Economic Growth as a Mediator in the Relationship between Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on Operating Expense to Operating Income at Regional Development Banks in Indonesia

The analysis shows that economic growth does not significantly mediate the relationship between CAR and BOPO or between NPL and BOPO, as both hypotheses are rejected due to insignificant effects. However, economic growth significantly mediates the relationship between LDR and BOPO with a negative effect, and between interest rates and BOPO with a positive effect. This indicates that while economic growth influences the impact of LDR and interest rates on BOPO, it does not play a significant role in mediating the effects of CAR or NPL on BOPO.

Theoretically, economic growth should affect the operational efficiency of banks because an increase in economic growth usually increases the demand for credit and strengthens the banking sector. However, the results show that the economic growth variable is not strong enough to explain the effect of interest rates on BOPO. This may be due to Indonesia's highly diversified economic structure with high dependence on certain sectors such as commodities and manufacturing. Uneven economic growth across all sectors makes its impact on bank operational efficiency insignificant. In addition, banks' operational efficiency is more influenced by interest rate policy which directly affects net interest margin, as banks tend to adjust lending rates faster than deposit rates.

On the other hand, credit market conditions in Indonesia may also affect this result. Access to and demand for credit does not always keep pace with economic growth due to various factors such as tight credit policies, political instability, and consumer confidence levels. In addition, banks' operational efficiency and sound risk management play an important role in maintaining operational efficiency. External factors such as global economic conditions and other countries' economic policies also affect the banking sector in Indonesia. These results show that while economic growth affects the impact of LDR and interest rates on BOPO, economic growth does not play a significant role in mediating the effects of CAR and NPL on BOPO.

The results of this study are in line with several other studies that show that economic growth does not always significantly affect the operational efficiency of banks. In accordance with the research of Altavilla et al. (2018), it was found that the effect of economic growth on bank operational efficiency may vary depending on credit market conditions and monetary policy. The researchers pointed out that in some cases, economic growth does not have a direct impact on the operational efficiency of banks due to various external and internal factors that affect the financial market as a whole.

In addition, research by Petkovski et al. (2023) which examined the relationship between bank operational efficiency and economic growth in Central and Eastern European countries also showed that improvements in bank operational efficiency are not always sustainable and can be affected by various factors other than economic growth. This finding corroborates the results of this study that in Indonesia, other factors such as interest rate policy, operational efficiency, and risk management are more dominant in determining the operational efficiency of banks compared to economic growth. This result shows that economic growth does not significantly mediate the relationship between CAR and BOPO or between NPL and BOPO, but has a significant influence in mediating the relationship between LDR and BOPO and between interest rates and BOPO.

The Role of Inflation Moderates the Relationship between Leverage Risk, Credit Risk, Liquidity Risk and Interest Rate on Operating Expense to Operating Income at Regional Development Banks in Indonesia.

The analysis shows that inflation does not significantly moderate the relationship between CAR and BOPO and between interest rates and BOPO. However, inflation has a significant negative moderating effect on the relationship between NPL and BOPO and between LDR and BOPO, with coefficients of -0.140 and -0.275 respectively. This means that inflation reduces the positive effects of NPL and LDR on banks' operational efficiency, reinforcing the importance of effective risk management in the face of inflation fluctuations.

Theoretically, high inflation can lead to economic instability which negatively impacts bank performance. When inflation is high, banks' operating costs increase due to rising prices of goods and services, which can reduce profit margins. In addition, high inflation can also lead to an increase in nominal interest rates, but it is not always followed by an increase in real interest rates, which means interest income does not increase as expected. This may reduce the bank's ability to improve operational efficiency despite rising interest rates.

The results showed that inflation did not moderate the relationship between CAR and BOPO and between interest rates and BOPO significantly. However, inflation has a significant negative moderating effect on the relationship between NPL and BOPO and between LDR and BOPO, with coefficients of -0.140 and -0.275 respectively. This means that inflation reduces the positive effect of NPL and LDR on bank operational efficiency. High inflation can affect customers' purchasing power and ability to repay loans, which can increase the risk of bad debts for banks. Higher credit risk forces banks to set aside more funds for credit losses, which in turn reduces operational efficiency. In Indonesia, inflation is often influenced by external factors such as global commodity prices and exchange rate fluctuations, which adds uncertainty for bank management in managing inflation risk.

High inflation can reduce banks' operational efficiency through several mechanisms. First, inflation leads to an increase in operating costs, including the cost of labor, goods, and services, which directly impacts the bank's profit margin. This increase in costs is often not offset by an increase in interest income as nominal interest rates may rise, but real interest rates remain constant or even decline if inflation is uncontrolled (Mishkin, 2017). Secondly, high inflation also affects customers' purchasing power and their ability to repay loans, which increases the risk of bad debts. This forces banks to increase loan loss reserves, reduces the amount of funds available for productive investment,

and ultimately reduces operational efficiency.

In Indonesia, inflation is often influenced by external factors such as fluctuations in global commodity prices and currency exchange rates. As a developing country that relies heavily on imports, rising prices of imported goods can quickly translate into high domestic inflation (Kuncoro, 2018). In addition, government and central bank policies in responding to inflation are sometimes ineffective or untimely, which keeps inflation high or fluctuates significantly. In such a situation, banks face greater uncertainty in risk management, which exacerbates the negative impact of inflation on operational efficiency.

The results show that inflation does not moderate the relationship between CAR and BOPO and between interest rates and BOPO significantly. However, inflation has a significant negative moderating effect on the relationship between NPL and BOPO and between LDR and BOPO. This suggests that inflation reduces the positive effect of NPL and LDR on bank operating efficiency. In this case, the role of bank management in implementing GRC (Governance, Risk Management, and Compliance) becomes very important to manage the impact of inflation on operational efficiency. Good governance helps banks create strategic policies that can anticipate the negative impact of inflation, while effective risk management can help identify, measure, and manage inflation risks. Compliance ensures that banks comply with relevant regulations and maintain financial stability amidst volatile inflationary conditions.

6. Conclusion

Based on the results of the analysis, it is concluded that, first, CAR and interest rates have a significant influence on bank operational efficiency (BOPO) in Indonesia, with CAR showing a negative influence and interest rates showing a positive influence. Second, economic growth does not significantly mediate the relationship between CAR and NPL on BOPO, but mediates the effect of LDR and interest rates on BOPO, indicating that other factors such as operational efficiency and risk management are more dominant in determining BOPO. Third, inflation moderates the effect of NPL and LDR on BOPO significantly with a negative effect, but does not moderate the effect of CAR and interest rate on BOPO, which emphasizes the importance of effective risk management strategies to manage the impact of inflation and improve the operational efficiency of banks.

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