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Bank Efficiency and Risk-Taking: The Role of Revenue Differentiation

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ABSTRACT
Intense competitive pressures, including from fintech players, are suppressing banks' profit margins, which can encourage excessive risk-taking behavior that aligns with the Competition-Fragility Theory's premise. Therefore, the urgency of this study is to analyze how the bank's internal strategies – particularly cost efficiency and risk mitigation strategies in the form of income diversification – work to influence banks' risk-taking decisions. This study specifically examined the relationship and the role of income diversification moderation. This research method uses a quantitative approach with panel data from banks listed on the Indonesia Stock Exchange (IDX) in the 2020-2024 period, by applying purposive sampling as a sample criterion. Cost efficiency was measured using Stochastic Frontier Analysis (SFA), while the relationship between variables was analyzed through multiple linear regression analysis and Interaction Test, with dependent variables in the form of Z-scores. The findings show that cost efficiency has a significant negative influence on bank performance, reflecting more cautious risk-taking. However, income diversification has been shown to moderate such negative influences, allowing banks to take on greater risk without sacrificing financial stability. These findings suggest that a cost-efficiency strategy balanced with revenue diversification can optimize bank growth while maintaining a balance between risk and stability.

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INTRODUCTION

Global Financial Crisis in 2007-2009 was an important turning point that highlighted the dangers of excessive risk-taking (*bank risk-taking*) by financial institutions. This crisis not only endangers the financial health of each bank, but also triggers the effects of *spill-over* that is unstable to the global economy (Amin et al., 2024). The crisis underscores the catastrophic impact of excessive risk-taking by financial institutions, which shows significant vulnerability in the banking sector (Brunnermeier, 2009; DeYoung et al., 2013). Although banks in Indonesia did not feel the direct impact of the financial crisis as a result of the more conservative structure and experience of previous crises, it remains a clear reflection of how when banks do not manage their risks prudently, they can destabilize the country's economy at large.

In recent years, the national banking industry has also faced double pressures: increasingly fierce competition and high demands for profitability. This sometimes encourages banks to take on

greater risks. An indication of this dynamic can be seen from the trend in Indonesia; Based on the 2024 Banking Surveillance Report published by the Financial Services Authority (OJK), although the gross NPL ratio as of the end of the fourth quarter of 2024 showed an improvement to 2.08% from 2.19% in the previous year, this needs to be looked at more deeply. The data shows that the improvement in the ratio is not only due to a decrease in nominal NPL, but nominal NPL actually increased by 5.12% (yoy) in the reporting period, after previously contracting by -1.02% (yoy). This phenomenon indicates the complexity of assessing risk-taking banks, where banks may actively encourage credit growth that masks the nominal increase in risk, resulting in ratios that appear to be improving (Handayani et al., 2024).

The importance of cost efficiency in bank management is no less crucial than the credit distribution strategy. An efficient banking system has a smaller margin between the loan interest rate and the deposit rate, thus increasing loan demand and encouraging fund mobilization (Abel et al., 2024). Banks that are able to achieve high cost efficiency can allocate their resources more optimally, reduce waste, and ultimately increase profit margins. This results in additional management efforts and extra operational costs to deal with bad loans, which in turn lowers the bank's cost efficiency (Berger & DeYoung, 1997; Podpiera & Weill, 2008). Louzis et al. (2012) and Dimitrios et al. (2016) argues that cost inefficiencies are a direct sign of poor risk-taking management, resulting in the accumulation of NPL levels.

There is a huge amount of literature that discusses the relationship between cost efficiency and bad credit but there is not much literature that discusses cost efficiency and bad credit *bank risk-taking*. Recorded from the Systematic Literature Review (SLR) conducted by Naili & Lahrichi (2022) only (Isnurhadi et al., 2021) which evaluates the relationship between bank efficiency, capital, and bank risk in the existing literature. The findings of the study show that banks' risk-taking behavior is significantly influenced by efficiency. This shows that there is a very lack of research that tries to find a relationship between bank efficiency and bank efficiency *risk-taking*. However, much of this existing literature relies on pre-digital era data and contexts, creating a significant gap in understanding how these relationships manifest in today's rapidly transforming banking landscape characterized by digitalization and regulatory evolution.

This increase in profitability that comes from cost efficiency gives banks stronger financial fundamentals, allowing banks to be better prepared for economic shocks and reducing the incentive to take excessive risks in pursuit of momentary profits. Banks that are operationally efficient have a greater capacity to absorb potential losses from various risk exposures, including from the MSME credit segment, thereby indirectly encouraging more prudent risk-taking behavior. On the other hand, banks are also faced with increasingly fierce competition with fintech, which causes banks to be able to manage costs efficiently. Competition in technology-based money markets leads them to a downward trend in performance (Nguyen et al., 2021;), which in turn can force them to take on higher risks by lowering credit standards while increasing risk (Jiménez et al., 2013). This creates a critical theoretical tension: while efficiency may foster stability, the intense competition driving the need for that very efficiency may simultaneously push banks toward fragility—a central paradox that this study investigates through the integrated framework of Competition-Fragility Theory.

In order to strengthen financial resilience and reduce risk exposure, income diversification is a strategy that is increasingly being adopted by banks. By having multiple revenue streams, banks can reduce reliance on just one source of revenue, which in turn can stabilize profitability and reduce overall revenue volatility. To mitigate risks, banks use a diversification strategy, spreading their assets and services across different markets, industries, and regions (Rehman & Abbas, 2025). Revenue diversification is essentially a risk mitigation strategy, as banks become less susceptible to volatility in one market segment or a specific line of business. Over the past two decades, banks

have increasingly diversified and expanded their revenue streams (Asif & Akhter, 2019; Praatmana et al., 2024).

However, existing research offers conflicting empirical evidence regarding the relationship between bank diversification and instability, which challenges proponents of income diversification (Alouane et al., 2022; Hunjra et al., 2021; López-Penabad et al., 2022; Wang & Lin, 2021). This debate highlights the need for a deeper understanding of how income diversification interacts with other factors in shaping bank risk behavior. In the context of this study, income diversification is seen as having a potential role as a moderator in the relationship between the bank's operational strategy and the level of risk taken. Banks with more diverse sources of revenue may have greater flexibility to manage risks arising from MSME credit expansion or from cost efficiency pressures.

Previous studies have tended to focus on common determinants *bank risk-taking* (Abu-Abbas & Hassan, 2024; Amin et al., 2024; Anh Vo & Joseph, 2025; Githaiga, 2022; Pour et al., 2023; Sajid et al., 2023) or the impact of MSME credit distribution on bank efficiency (Dinutistomo & Lubis, 2021; Nugroho & Aji, 2024), but has not explicitly and comprehensively integrated the bank's revenue diversification and efficiency in a single analytical framework, especially in the context of banking in Indonesia. Research now must link digital banking's pace and regulatory shifts, using Competition–Fragility Theory as a key bridge, to ensure meaningful implications for banking policies. To bridge the gap in this study, integrating insights on regulatory evolution, digital banking transformation, and their effects on bank efficiency and risk via the Competition–Fragility Theory is essential. This research aims to fill this gap by holistically examining how cost efficiency can affect *bank risk-taking*, and how the role of income diversification moderates these complex relationships.

LITERATURE REVIEW

Competition-Fragility Theory

Competition-Fragility Theory Offer an external perspective that is essential in explaining the bank's risk-taking behavior. This theory argues that increased competition in the banking industry can paradoxically increase fragility (*fragility*) the banking system as a whole and encourages individual banks to take on higher risks (Hellmann et al., 2000; Keeley, 1990). The main mechanism is through pressure on profit margins. As market competition increases, banks are faced with pressure to lower lending rates or offer more competitive deposit rates, which ultimately suppresses their net interest margins. To compensate for shrinking margins and maintain profitability, banks may be pushed into what is referred to as *search for yield*, i.e. switching to riskier assets, loosening lending standards, or engaging in more complex and potentially risky product innovations.

Excessive competition among banks is detrimental to market power and profit margins, which has a negative impact. As a result, financial institutions are forced to make risky decisions (Koetter et al., 2012). In a less competitive environment, banks tend to have higher profit margins and larger capital buffers, and are therefore unlikely to take risks that harm the entire financial system (Beck et al., 2013; Berger et al., 2009; Hellmann et al., 2000).

In the context of this study, these competitive pressures can affect how banks manage cost efficiency to stay competitive. Further, income diversification can be seen as a bank's strategic response to these competitive pressures, where banks seek non-interest revenue sources to stabilize profitability and reduce reliance on increasingly stressed core business lines.

The Effect of Cost Efficiency on Bank Risk Taking

Banking activities focus not only on growth, but also on operational optimization to maintain

profitability and stability. Cost efficiency is a very crucial internal strategy. Efficiency is a key pillar in building a strong financial foundation that will ultimately mitigate risk-taking behavior (Silva et al., 2016). Banks that are able to manage their operations more effectively and efficiently will be able to generate the same revenue at lower costs, which will increase profit margins. Larger margins can serve as a buffer to absorb potential credit losses in the future, thus making banks more resilient and less likely to take unnecessary risks.

Empirically, many previous studies have consistently found a negative relationship between cost efficiency and bank risk. These studies argue that banks that manage their operations better show discipline that extends to risk management, so they tend to be more cautious in disbursing credit. Radić et al., (2012) and Isshaq et al., (2012) found strong evidence in various market contexts that increased cost efficiency correlates with decreased bank risk. They argue that efficiency is a prudent management indicator, which ultimately results in a lower risk profile. Recent evidence from Chinese commercial banks further confirms this relationship, showing that higher cost efficiency significantly restrains banks' risk expansion behavior, particularly during periods of accommodative monetary policy, as efficient banks exhibit stronger internal discipline and risk management practices(Fang, 2025).

H1. *Cost efficiency negatively affects bank risk taking*

The Role of Revenue Diversification Moderation on the Effect of Cost Efficiency on Risk-Taking Banks

Revenue diversification provides banks with more stable and diversified revenue streams, reducing reliance on interest margins that are vulnerable to market fluctuations (Adem, 2023; Al-Habashneh et al., 2023). Income diversification, in this scenario, acts as a catalyst that allows banks to efficiently optimize growth potential without having to sacrifice stability significantly, as the risks taken can be better supported by a diversified revenue base. This is different from the case of efficient banks that may be forced to take higher risks due to market pressures (Jiménez et al., 2013). In this setting, revenue diversification strengthens the disciplining role of cost efficiency by alleviating pressure on efficient banks to pursue aggressive risk-taking strategies in order to sustain profitability. Evidence from Chinese banks indicates that revenue diversification significantly influences bank risk and profitability, with diversified income structures contributing to lower risk exposure when supported by sound operational efficiency and managerial discipline (Wu et al., 2024). This suggests that revenue diversification can function as an effective moderating mechanism that enhances the stabilizing effect of cost efficiency on bank risk-taking behavior.

H2. *Revenue diversification strengthens the influence of cost efficiency on bank risk taking*

RESEARCH METHOD

Research Design

This study uses a quantitative approach with an explanatory research method. This design was chosen because the main objective of the study was to explain the causality (cause-effect) relationship between variables, i.e. analyze how cost efficiency affects bank risk-taking, as well as how income diversification moderates the relationship. The source of this research data is secondary data, namely annual reports published by the company during the 2020-2024 research period. Data was obtained from each company's website and the Indonesia Stock Exchange (IDX) website. The data of this study is panel data because it combines *the dimensions of cross-section* and *time-series*.

Population and Sample

The population in this study is all banks listed on the IDX in the 2020-2024 period. The total population is 46 banks listed on the IDX. This study did not observe the entire population, but used

a research sample. The sampling technique uses *purposive sampling*, with the following criteria:
a. Recorded on the Main Board
b. Not conducting mergers or acquisitions during the research period

The selection of samples is only from the Main Board because this classification has been determined by the IDX which describes that companies listed on the Main Board are large companies that have good financial performance and have low risk with stable financial potential. This is adjusted to the context of this study which examines bank risk-taking. Large and established banks listed on the Main Board tend to have more mature risk management systems, stronger governance structures, and broader portfolio diversification compared to smaller or newly developed banks.

Variable Operationalization

This study consists of 1 independent variable, 1 dependent variable, and 1 moderation variable. Independent variables consist of cost efficiency. The dependent variable is bank risk-taking, and the moderation variable is income diversification. The operationalization of variables is described in Table 1.

Table 1. Variable Operationalization

Variabel	Measurement	Source
Bank risk-taking	$Z - score = \frac{(ROA + CAR)}{\sigma(ROA)}$	Githaiga (2022)
Cost efficiency	$EFF_{it} = \exp(-u_{it})$	Nugroho & Aji (2024), Dinutistomo & Lubis (2022)
Income diversification	$DIV = 1 - \left[\left\{\left(\frac{NON}{NOI}\right)^2 + \left(\frac{NII}{NOI}\right)^2\right\}\right]$	Githaiga (2022)

Source: Processed research, 2025

Specifically for the measurement of cost efficiency variables, we perform Stochastic Fronties Analysis (SFA) first before incorporating it into the research model equation. The SFA method also has relatively better statistical power than other commonly used methods in the topic of efficiency, namely Data Envelopment Analysis (DEA) (Asmare & Begashaw, 2018; Huang & Wang, 2002).
To get the cost efficiency value, we first calculated the cost equation using a model developed by Battese & Coelli (1995) with the following equation formula:

$$n\left(\frac{TC}{P_{2it}}\right) = \alpha_0 + \alpha_1 lnY_{1it} + \alpha_2 lnY_{2it} + \alpha_3 lnY_{3it} + \beta_1 ln\left(\frac{P_{1it}}{P_{2it}}\right) + \beta_3 ln\left(\frac{P_{3it}}{P_{2it}}\right) + \frac{1}{2}\alpha_{11}(lnY_{1it})^2 + \frac{1}{2}\alpha_{22}(lnY_{2it})^2 + \frac{1}{2}\alpha_{33}(lnY_{3it})^2 + \alpha_{12} lnY_{1it} lnY_{2it} + \alpha_{13} lnY_{1it} lnY_{3it} + \alpha_{23} lnY_{2it} lnY_{3it} + \frac{1}{2}\gamma_{11}\left(\frac{lnP_{1it}}{lnP_{2it}}\right)^2 + \frac{1}{2}\gamma_{33}\left(\frac{lnP_{3it}}{lnP_{2it}}\right)^2 + \gamma_{13} ln\left(\frac{P_{1it}}{P_{2it}}\right) ln\left(\frac{P_{3it}}{P_{2it}}\right) + \rho_{11}\, lnY_{1it}\, ln\left(\frac{P_{1it}}{P_{2it}}\right) + \rho_{13}\, lnY_{1it}\, ln\left(\frac{P_{3it}}{P_{2it}}\right) + \rho_{21}\, lnY_{2it}\, ln\left(\frac{P_{1it}}{P_{2it}}\right) + \rho_{23}\, lnY_{2it}\, ln\left(\frac{P_{3it}}{P_{2it}}\right) + \rho_{31}\, lnY_{3it}\, ln\left(\frac{P_{1it}}{P_{2it}}\right) + \rho_{33}\, lnY_{3it}\, ln\left(\frac{P_{3it}}{P_{2it}}\right) + v_{it} + u_{it}$$

The explanation of the cost equation is explained in Table 2. Where, lnTC = total cost bank; Y1it = loan from bank i in period t; Y2it = investments made by banks; Y3it = bank income other than interest; P1it = price from bank funding; P2it = price from bank employees; P3it = price of the bank's capital; vit = random error; UIT = Bank Inefficiency.

Table 2. Operationalization of the Cost Equation

Variabel	Measurement	Notation
Total cost	*Labor cost + capital cost + funding cost*	TC
Fund cost	Deposits + Loans	X1

Labor cost	Staff salary cost	X2
Capital cost	Assets remain net	X3
Price of funding	Interest payment/(deposit + loan)	P1
Price of labor	Cost of staff salaries/Total employees	P2
Price of capital	Operating expenses/assets remain net	P3
Output 1	Total credit given to customers	Y1
Output 2	Interest bearing investment + non interest bearing investment	Y2
Output 3	Income other than interest	Y3

Source: Nugroho & Aji, 2024

The meaning of the cost efficiency formula shown in Table 1 means EFFit = bank efficiency score; UIT = Bank Inefficiency. Based on the cost function, the resulting cost efficiency score has a range of 0 to 1. This means that the higher the score, the higher the cost efficiency of a bank (Liang et al., 2017). This score can be interpreted as inversely proportional to the inefficiency score of a bank. For example, an observation that has an efficiency score of 0.2 means that it has an inefficiency score of 0.8.

Income diversification, as described in Table 1, is calculated by first looking up the Herfindahl-Hirchman Index (HHI), with the formula:

$$HHI = \left[\left\{\left(\frac{NON}{NOI}\right)^2 + \left(\frac{NII}{NOI}\right)^2\right\}\right]$$

NON is non-interest income, NII is net interest income, and NOI is the sum of NON and NII. The HHI scale ranges from 0.0 to 1.0, which means that as HHI increases, banks become less diverse and more focused on lending (Githaiga, 2022). Then to get the Income Diversification value using the formula that has been explained in Table 1.

This study controlled for bank-specific factors that are known to influence banks' risk-taking activities. Leverage (LEV), bank size (BS), and liquidity (LIQ) are all related to risk-taking activities (Githaiga, 2022; Hunjra et al., 2021). According to Ullah et al., (2021) Leverage is defined as the ratio of total liabilities to total assets. Follow Boungou (2020), the size of the bank is measured as the logarithm of total assets. The proxy measure for liquidity is the ratio of loans to assets (Danisman & Demirel, 2019).

Research Model

The study used a multiple linear regression model and a moderation regression model. The multiple linear regression model is shown in equation model 1 as follows:

$$BRT_{it} = \alpha + \beta 1 EFF_{it} + \beta 2 DIV_{it} + \beta 3 LEV_{it} + \beta 4 BS_{it} + \beta 5 LIQ_{it} + \varepsilon$$

In Equation Model 1, the determination of the use of Random Effect Model (REM) or Fixed Effect Model (REM) analysis methods based on the results of the Hausman Test and Breush and Pagan Lagrangian tests. Equation Model 1 to answer H1, while Equation Model 2 to answer H2. Equation model 2 is Moderating Regression Analysis (MRA) as follows:

$$BRT_{it} = \alpha + \beta 1 EFF_{it} + \beta 2 EFF * DIV_{it} + \beta 3 LEV_{it} + \beta 4 BS_{it} + \beta 5 LIQ_{it} + \varepsilon$$

Where BRT is a risk-taking bank; MSME is MSME financing; EFF is cost efficiency; DIV adal income diversification; LEV is leverage; BS is the size of the bank; and LIQ is liquidity, with ε is error.

RESULT AND DISCUSSION

Research Object

From a total population of 46 banks listed on the IDX, the researcher selected a research

sample with the following details:

Table 3. Sample Determination

Criterion	Sum
Recorded on the Main Board	29
Not conducting mergers or acquisitions during the research period	(1)
Total research sample	**28**

Source: Processed research, 2025

Based on Table 3, it shows that the total number of banks listed on the Main Board is 29 banks, while the rest consists of 13 banks listed on the Development Board, as well as 4 banks that are in the Special Monitoring category. During the 2020-2024 period, there was 1 bank that merged, namely Bank Syariah Indonesia, which merged in 2020.

Statistics Descriptive

The descriptive statistics of this research data are shown in Table 4. including mean value (Mean), standard deviation (Std. Dev.), minimum value (Min), and maximum value (Max). The data used consisted of 100 observations.

Table 4. Descriptive Statistics

Variabel	Mean	STD	Min	Max
BRT	84.68687	85.33414	1.075691	494.323
EFF	.259005	.138949	.0517461	.8234507
DIV	.2650567	.1329173	.0059095	.4999438

Source: Processed research, 2025

Based on Table 4, BRT has an average of 84.68687 with a standard deviation of 85.33414. The bank's risk valuation varies from a minimum of 1.075691 to a maximum of 494.323. EFF has an average of 0.259005 and a standard deviation of 0.138949. The lowest efficiency value is 0.0517461 and the highest is 0.8234507. This means that the bank's average efficiency score is 0.25 out of a value of 1. Meanwhile, there are banks that have a very high efficiency score close to the value of 1, which is with a score of 0.82. The average DIV is 0.2650567 with a standard deviation of 0.1329173. The minimum value is 0.0059095 and the maximum is 0.4999438. This means that the average bank has income other than interest of 26.5% of the total income they have, with the highest value there are banks that have a portion of 49% of their income consisting of non-interest income.

Stochastic Frontier Test Analysis

To obtain the value of the cost efficiency variable, the researcher first ran SFA using a cost equation model. The results of the SFA estimation in Table 5 show that this model is significant overall (Wald chi2 = 4416.69, p-value = 0.0000), indicating that the combination of output variables, input prices, and other factors significantly explains the variation in total costs.

Table 5. SFA Test

Variabel	Coeff	HERSELF	P > |z|
		Frontier	
_Cons	12.86649	7.982721	0.107
LnY1	-.6203741	1.255214	0.621
LnY2	-1.469198	.6193893	0.018**
LnY3	3.156207	.7804823	0.000***
LnP1P2	1.89736	.7607366	0.013**
LnP3P2	1.252493	.5509749	0.023**
1/2Ln(Y1)²	.1219246	.1268198	0.336
1/2Ln(Y2)²	.2332447	.0970622	0.016**
1/2Ln(Y3)²	.088288	.0489341	0.071
LnY1LnY2	-.1442099	.0939073	0.125
LnY1LnY3	.0467228	.0573231	0.415

Variabel	Coeff	HERSELF	P > |z|
LnY2LnY3	-.140484	.041172	0.001***
1/2Ln(P1/P2)²	8.740523	.6596126	0.000***
1/2Ln(P3/P2)²	.2425799	.9906076	0.807
Ln(P1/P2). Ln(P3/P2)	.0191708	.0361987	0.596
LnY1.Ln(P1/P2)	-.0936532	.1066913	0.380
LnY1.Ln(P3/P2)	-.0451292	.0568703	0.427
LnY2.Ln(P1/P2)	-.2334756	.0664592	0.000***
LnY2.Ln(P3/P2)	-.0344344	.0497752	0.489
LnY3.Ln(P1/P2)	.3199406	.0674011	0.000***
LnY3.Ln(P3/P2)	.0127573	.0412261	0.757
Vsigma			
Sigma u	.4381801	.0496902	
Sigma v	.1672509	.0286728	
Lambda	2.619898	.0700563	
Log likelihood function	-28.197627		
Prob > chi2	0.0000		

Source: Processed research, 2025

In this estimation, the standard deviation of the inefficiency component (sigma_u = 0.438) is substantially greater than the standard deviation of the random error component (sigma_v = 0.167). This is further confirmed by the lambda value (lambda = 2.618), which indicates that the variation of the efficient frontier is dominated by cost inefficiencies compared to random factors. To confirm the existence of inefficiencies statistically, a Likelihood Ratio Test (LR test) was carried out. The results of the LR test (chi2 = 14.38, p-value = 0.000) strongly refute the null hypothesis that there is no cost inefficiency. Therefore, it can be concluded that cost inefficiencies were significantly present among the banks in the study sample.

Hypothesis Testing

In this section, the researcher applies a statistical T-test to test the hypothesis and obtain the results of the analysis carried out on the observed data.

Table 6. T Test

Model		Unstandardized Coefficients		Standardized Coefficients	t	Itself.
		B	Std. Error	Beta		
1	(Constant)	118.609	22.616		5.244	.000
	COST EFFICIENCY	-122.227	67.548	-.432	-1.809	.044
	COST EFF X INCOME DIV	497.181	237.739	.567	2.091	.039

Direct Effect

The regression test results indicate a significant effect of cost efficiency and bank risk-taking on bank performance, with income diversification acting as a moderating variable. Specifically, cost efficiency is proven to have a negative and significant effect on bank risk-taking, as indicated by a *p-value* of 0.044. This finding suggests that banks that are more efficient in managing operational costs tend to adopt a more conservative approach in decision-making, including in determining the level of risk undertaken. Improved cost efficiency leads to more stable profit margins, thereby encouraging banks to be more cautious in credit distribution and risk portfolio management.

Consequently, cost-efficient banks tend to avoid excessive risk-taking in order to maintain operational stability and ensure the sustainability of financial performance in the long term.

However, excessive emphasis on cost efficiency may also lead to overly conservative decision-making and the reduction of strategic activities that potentially increase long-term profitability. While cost efficiency effectively lowers risk in the short term, strategies that focus predominantly on cost reduction without considering growth and competitiveness can weaken banks' long-term competitive position. Empirical evidence supports this argument, showing that banks that efficiently manage their operations tend to demonstrate high discipline in risk management, resulting in lower risk profiles due to more selective credit allocation and cautious handling of risks arising from operational expansion (Silva et al., 2016; Radić et al., 2011; Isshaq et al., 2012). These findings confirm that cost efficiency functions as a critical pillar in maintaining banking stability and profitability, while simultaneously limiting excessive risk-taking behavior.

The Indirect Effect

The Indirect Effect The moderation test results indicate that the interaction between cost efficiency and income diversification (Cost Efficiency × Income Diversification) has a positive and significant effect on bank performance, as reflected by a p-value of 0.039. This finding suggests that income diversification is able to mitigate the negative impact of cost efficiency on bank performance. In line with the proposed conceptual framework, income diversification provides banks with more stable and diversified revenue streams, thereby reducing dependence on interest margins that are highly susceptible to market fluctuations. This mechanism is particularly relevant for highly cost-efficient banks, which tend to adopt more conservative risk-taking behavior in order to preserve financial stability. In this context, income diversification allows banks to optimize growth potential without compromising stability, enabling efficient banks to engage in calculated risk-taking without jeopardizing their overall performance.

Previous studies support this argument by demonstrating that banks with well-structured income diversification are more resilient to market volatility, as they are not solely reliant on interest-based income that fluctuates with economic cycles (Adem, 2023; Wang & Lin, 2021). Diversified banks possess greater flexibility in managing the risks associated with cost efficiency, reducing the pressure to engage in excessive risk-taking (Tran, 2025). Conversely, cost-efficient banks that lack income diversification often face higher risk pressures due to their dependence on limited revenue sources, particularly interest margins that are sensitive to market conditions. These findings confirm that income diversification acts as a buffer against such pressures, enhancing banks' capacity to maintain prudent risk management while sustaining performance (Adem, 2023; Al-Habashneh et al., 2023; Jiménez et al., 2013).

Overall, the results reinforce the role of income diversification as a key moderating variable in the relationship between cost efficiency and bank risk-taking, which is consistent with the Competition–Fragility Theory. This theory posits that banks with more diversified income sources are more resilient to risks arising from efficiency-driven strategies, enabling them to remain competitive and stable under high cost-efficiency pressures. Nevertheless, the relatively large moderation coefficient (497.181) indicates that the moderating effect of income diversification may be stronger than expected. Therefore, further analysis is required to assess the magnitude of this effect through effect size estimation and moderation power testing. In addition, future research should distinguish between types of income diversification, such as vertical and horizontal diversification, as each may exert different implications for bank performance (Aji, 2025).

CONCLUSIONS, LIMITATIONS, AND SUGGESTIONS

CONCLUSION

This study shows that cost efficiency has a negative influence on bank risk-taking, indicating that more cost-efficient banks tend to adopt a more conservative approach in decision-making. This finding aligns with previous studies demonstrating that efficient banks maintain a lower risk profile by being more selective in credit allocation and operational management. Importantly, the negative impact of cost efficiency on bank performance is mitigated by income diversification, which serves as a risk buffer. By providing alternative and more stable sources of revenue, income diversification allows banks to optimize growth potential without sacrificing financial stability, enabling prudent risk-taking that supports long-term growth. Therefore, banks that combine cost efficiency with effective revenue diversification strategies can achieve a more optimal balance between growth and risk management.

From a theoretical perspective, this study contributes to the Competition–Fragility Theory by demonstrating that the effect of competition on bank risk-taking is conditional on internal bank characteristics. While Competition–Fragility Theory suggests that increased competition leads to higher risk-taking through margin compression, the findings indicate that banks with high cost efficiency and diversified income can absorb competitive pressure without increasing risk. This refines the theory by explaining heterogeneous risk responses among banks operating under similar competitive conditions.

The findings imply that bank management should integrate cost efficiency strategies with income diversification, particularly through stable non-interest income activities, from a practical perspective. Efficiency gains without diversification may increase vulnerability under intense competition. For regulators, the results suggest that monitoring banks' income structures may complement prudential supervision by identifying banks that are more resilient to competition-induced risk-taking.

This study has several limitations. First, it focuses on bank-specific internal factors and does not explicitly account for macroeconomic conditions, regulatory changes, or market structure. Second, income diversification is measured in aggregate form, which may obscure differences across income sources.

Future research may incorporate macroeconomic and institutional variables to capture broader competitive dynamics. Further studies may also disaggregate income diversification into specific categories, such as fee-based or digital income, to examine their distinct effects on bank risk-taking. Dynamic or longitudinal approaches may provide additional insights into the stability of these relationships over time.

Declaration of Generative AI Use in Scientific Writing

In the preparation of this work, the authors utilized ChatGPT to enhance the clarity of the text and Grammarly to improve the readability of the English content. Following the use of these tools, the authors thoroughly reviewed and edited the manuscript as necessary and assume full responsibility for all content in this publication.

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