Capital Buffer and Bank Risk-Taking: Evidence of Non-Linearity from Commercial Bank in Indonesia

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ABSTRACT: Banks function as financial intermediaries and are inherently exposed to risk. Capital, particularly capital buffer, is one of the tools used to absorb such risks. Therefore, this study aims to examine the relationship between capital buffer and bank risk-taking levels, specifically focusing on the non-linear relationship among commercial banks in Indonesia. The data consists of annual data from Indonesian commercial banks from 2013–2023, excluding foreign bank branches and digital banks, with a sample size of 81 banks representing a total market share of 94%. The method employed is quantile regression. The result of the study shows that there is a non-linear and U-Shaped relationship between capital buffer and bank risk-taking among commercial banks in Indonesia.

KEYWORDS: Bank Risk-Taking, Capital Buffer, Commercial Bank, Quantile Regression, Risk Management.

1. INTRODUCTION

Banks play a crucial role in the economy through their function as financial intermediaries, managing and distributing customer funds (Nguyen, 2020). To effectively fulfill this intermediation role, banks must maintain sufficient capital to absorb potential losses, particularly during economic uncertainty (Ezike & Oke, 2013). This necessity was highlighted by the 2008 Global Financial Crisis, which led the Basel Committee on Banking Supervision (BCBS) to tighten regulations on capital, liquidity, and leverage requirements under Basel III. These regulatory enhancements were introduced to strengthen risk management, improve banking supervision, and enhance the overall stability of the financial system. Under Basel III, the capital structure and capital buffer requirements mandate banks to hold capital above the minimum regulatory threshold while improving the quality of capital compared to the capital requirements under Basel II (Lee & Hsieh, 2013). Capital buffers are essential for banks as they serve as a cushion to absorb losses. Additionally, they act as a stable source of funding during periods of financial distress or large-scale deposit withdrawals, thereby reducing the likelihood of contagion effects (Berger, 1995; Bitar et al., 2018).

Banks are exposed to various risks in their operations, so these risks must be carefully mitigated and managed. Failure to manage risks prudently can negatively affect banks, shareholders, depositors, the overall economy, and public confidence in the financial system. Research on the relationship between capital buffer and bank risk-taking has been widely conducted, but the results vary across studies. Hellman, Murdock, and Stiglitz (2000) found a positive relationship between capital buffer and bank risk-taking. According to their findings, banks with high capital buffer have a stronger ability to withstand temporary losses, greater flexibility in selecting investment projects, and a greater tendency to take on more risk because they have sufficient protection even during shocks. On the other hand, banks with low capital buffer tend to be more cautious in selecting investment assets, as their capital is close to the minimum capital requirement. A decrease in capital could bring the bank's capital level close to, or even below, the regulatory minimum. Additionally, studies by Shrieves and Dahl (1992), Shim (2010), Tan and Floros (2013), Ding and Sickles (2018), and Mahdi and Abbes (2018) also found a positive relationship between buffer capital and bank risk-taking. Meanwhile, Jokipii and Milne (2011) found a bidirectional positive relationship in the short term. Conversely, studies by Naceur and Kandil (2009), Coffinet et al. (2012), Lee and Hseih (2013), Hogan (2015), Laeven et al. (2016), Tan (2016), and Bitar et al. (2018) found a negative relationship between capital buffer and bank risk-taking. On the other hand, Guidara et al. (2013) found no relationship between capital buffer and bank risk-taking in Canada. The above studies are generally linear, showing either a positive, negative or no relationship between capital buffer and bank risk-taking. However, studies that explore non-linear relationships are still very limited. Jiang et al. (2020) and Abbas et al. (2022) investigated this relationship and found evidence of a non-linear relationship between capital buffer and bank risk-taking. According to their findings, when a bank's capital buffer falls below a certain threshold, it tends to take on more risk to cover the costs of raising new equity.

Therefore, identifying the relationship between capital buffer and bank risk-taking behavior is crucial for further research. In this context, the capital in the Indonesian banking sector have shown an increasing trend over the years, as reflected in the following data:

Figure 1. Capital Adequacy Ratio for Commercial Banks in Indonesia
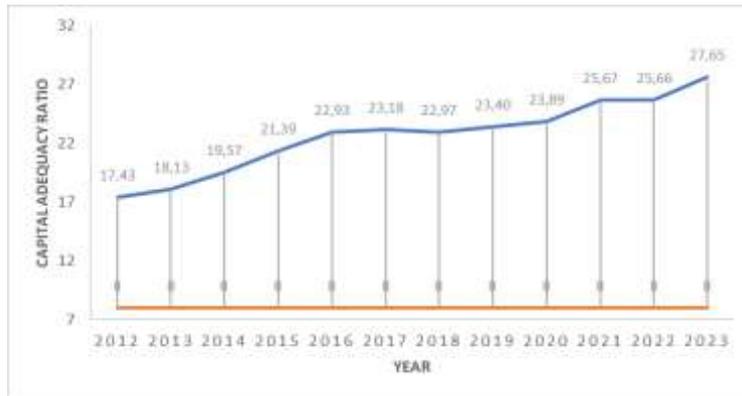
Source: Indonesia Financial Services Authority (2024)

Additionally, a bank risk-taking behavior can be assessed through its Non-Performing Loan (NPL) ratio. In Indonesia, NPL levels have also shown an increasing trend over the years, following the same data period as the capital trends, as presented below:

Figure 2. Capital Adequacy Ratio for Commercial Banks in Indonesia
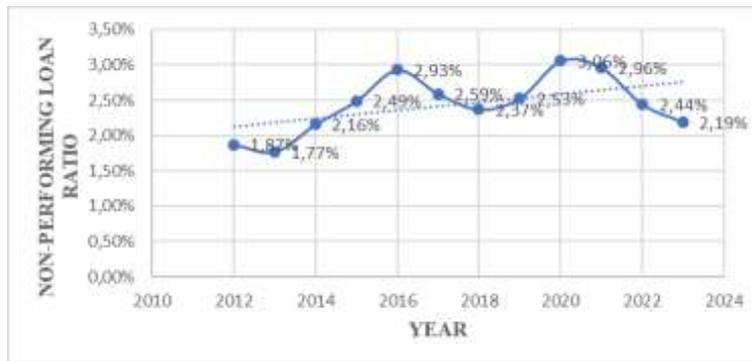
Source: Indonesia Financial Services Authority (2024)

Given the varying research results across different countries and the trend of capital and NPL ratio among commercial bank in Indonesia, it is compelling to investigate the relationship between capital buffer and bank risk-taking of commercial banks in Indonesia. To the best of the authors' knowledge, research on the relationship between capital buffer and bank risk-taking of commercial banks in Indonesia is still limited, particularly studies exploring the non-linear relationship. Research on capital buffer among commercial banks in Indonesia has been conducted by Danarsari et al. (2018), focusing on the relationship between capital buffers and bank stability. Their findings suggest that higher capital buffers contribute to greater bank stability. Additionally, Catalán et al. (2020) conducted a study on the relationship between capital buffers and credit growth in commercial banks in Indonesia, with results indicating a non-linear relationship between the two factors. In this paper, we investigate the relationship between capital buffer and bank risk-taking using quantile regression approach. Studies before mostly share a common assumption that the marginal impact of capital buffer and bank risk-taking is identical, regardless of bank risk-taking distribution. Using quantile-regression we would like to investigate the distribution in each quantile, following study by Jiang et al (2020). Furthermore, we also explore the non-linearity between them adopting quadratic estimation. We find that bank risk-taking measured by non-performing loans to total gross loans (NPL) has a U-Shaped relationship with bank capital buffer.

2. LITERATURE REVIEW

2.1 Bank Capital

The adequacy of bank capital was first introduced by the Basel Committee on Banking Supervision (BCBS) through Basel I, published in 1988, which focused on credit risk and required banks to hold capital in accordance with the risk of their portfolio assets. Basel I was amended in 1996, expanding the capital requirements to cover not only credit risk but also market risk. In 2004, Basel II was published by the BCBS to refine the framework established under Basel I. This new regulation required banks to maintain minimum capital not only for credit and market risks but also for operational risk. Additionally, capital buffers were introduced, tailored to a bank's risk profile and market discipline. Subsequently, in 2010, the BCBS introduced Basel III, which strengthened both the quality and quantity of bank capital.

Based on the stringent capital regulations established by the Basel Committee on Banking Supervision (BCBS), capital has become a crucial factor for banks. Capital requirements are one of the primary instruments that provide protection during adverse economic conditions and serve as a mechanism to prevent excessive risk-taking (Rochet, 1992; Dewatripont and Tirole, 1994). Understanding how a bank manages its capital ratio and, more broadly, its capital structure is important, as this is not only related to the bank's stability but also to its function as a financial intermediary (Diamond and Rajan, 2000). For a bank to effectively carry out its role as a financial intermediary, it needs to maintain an adequate capital ratio to absorb potential losses during economic downturns and financial uncertainty (Ezike and Oke, 2013). Capital also plays a vital and fundamental role in supporting the bank's long-term viability and the stability of the financial system (Rahman et al., 2018).

In the Basel documents, BCBS has set the following minimum capital requirements for banks:

1) Common Equity Tier 1 must be at least 4.5% of Risk-Weighted Assets (RWA);
2) Tier 1 capital must be at least 6% of RWA; and
3) Total capital must be at least 8% of RWA.

RWA is used in the calculation of the minimum capital for credit risk, market risk, and operational risk (BCBS, 2004). In calculating RWA for credit risk and market risk, Basel provides two alternatives: the standardized approach and the internal models approach approved by regulators. For calculating RWA for operational risk, the standardized approach is applied.

Market mechanisms incentivize banks to maintain positive capital levels. Positive capital not only attracts customers to deposit their funds and maintain long-term relationships but also helps safeguard the bank from credit risk associated with its business activities (Allen et al., 2011; Holmstrom and Tirole, 1997; Perotti et al., 2011). However, banks cannot fully rely on market mechanisms to maintain their capital levels. This is because banks tend to focus more on their own profits, often holding less capital than necessary to ensure the overall stability of the financial system. To address this, Basel introduced regulations requiring banks to maintain minimum capital based on the level of risk they undertake, as outlined in Basel II Pillar 2. This regulation aims to ensure that banks have sufficient capital to absorb losses arising from the risks taken in their business activities. With the introduction of Basel III, additional capital buffers were introduced, including the capital conservation buffer and the countercyclical buffer.

As in previous studies (Huang and Xiong, 2015; Jokipii and Milne, 2011; Shim, 2013), this paper calculates the capital buffer in absolute terms, defined as the difference between the bank's capital at time t and the minimum required capital of 8%. In this calculation, the additional capital buffers introduced in Basel III, such as the capital conservation buffer and the countercyclical buffer, are not considered. This approach is taken to capture the impact of the additional capital buffer requirements introduced by Basel III.

2.2 Bank Risk-Taking

According to Rajan (2006), risk-taking by banks is observed to increase the value of the bank, appear to provide substantial profits, and demonstrate good performance as long as the associated risks do not materialize. Research on the level of bank risk-taking typically uses risk indicators such as the share of Non-Performing Loans (NPL), Return on Equity (ROE), Z-Score, capital ratios, or credit ratings (Klomp & Haan, 2015). According to Agoraki et al. (2011) and Gaganis et al. (2006), asset quality, capitalization, and market structure are more informative indicators of the level of bank risk-taking compared to profitability, efficiency, and management quality. Almost all of these indicators are derived from on-balance sheet data, which may lead to potential miscalculations (Zhao et al., 2009). Klomp and Haan (2014) used capital adequacy, asset quality, management, earnings

and profitability, and liquidity (CAMEL) as indicators of bank risk-taking. Shim (2013) in his study used the NPL ratio and Z-Score as indicators of the level of bank risk-taking.

The research in this paper uses NPL ratio as an indicator of bank risk-taking. This is because the banking literature suggests that NPL ratio is generally considered as a good indicator for describing the level of bank risk-taking. The NPL ratio indicates a tendency for deterioration before a bank fails (Daher et al., 2015; Ghosh, 2009; Jokipii & Milne, 2011; Shim, 2013; Zhang et al., 2012). According to L. Pancoto et al. (2024), several academic literatures identify two main factors that explain the dynamics of NPL over time. The first factor includes variables that reflect the macroeconomic environment influencing the borrowers' ability to meet their financial obligations. The second factor pertains to the characteristics of the bank. Furthermore, previous studies conducted by Berger and DeYoung (1997), Klein (2013), Louzis et al. (2012), Ghosh (2015), and Anastasiou et al. (2019) consistently provide evidence supporting these two factors that influence the dynamics of NPL over time.

2.3 Relationship between Capital Buffer and Bank Risk-Taking

There are two significant issues related to bank capital buffers based on the research conducted by Jiang et al. (2020) and Abbas et al. (2022). The first issue concerns moral hazard, where banks tend to increase their risk-taking when the capital buffer falls below a certain threshold. This behavior arises due to the high costs associated with raising new equity, which encourages banks to take on higher risks to generate greater returns (Jokipii and Milne, 2011; Lee and Hsieh, 2013; Milne and Whalley, 2002; Rime, 2001). However, when the capital buffer is sufficient to meet regulatory capital requirements, the bank's drive to pursue higher profits becomes more dominant.

Conversely, research indicates that when banks maintain an adequate capital buffer, they become more aware of the negative consequences of risky behavior, leading to more prudent investment decisions (Naceur and Kandil, 2009; Tan, 2016). Additionally, shareholders have a greater incentive to monitor bank management and enforce better risk controls when the capital at stake is significant (Gale, 2010; García-Herrero et al., 2009; Hughes and Mester, 1998). This enhanced oversight can improve borrower monitoring, thereby reducing the likelihood of default.

Empirical evidence from other studies indicates that a higher capital buffer tends to reduce the risk-taking behavior of banks. Vallascas and Hagendorff (2013) found this relationship in a cross-country sample, while Shim (2013) observed similar results for U.S. bank holding companies using the Z-score as a proxy for bank risk levels. Bagntasarian and Mamatzakis (2019) reported consistent evidence for EU-27 countries, showing that a higher capital buffer increases Altman's Z-score, thereby reducing the risk of bankruptcy. Additionally, Abbas et al. (2019) and Ding and Sickles (2019) noted that low-risk banks in the U.S. tend to maintain higher capital buffers.

3. EMPIRICAL METHODOLOGY
3.1 Quantile Regression Framework

The quantile regression methodology was first introduced by Koenker and Bassett (1978). This method is widely used when the observed variables are likely to have different effects on the conditional distribution of the dependent variable (Mello and Perrelli, 2003). Several studies have employed the quantile regression method, including Klomp and Haan (2012), who investigated the relationship between banking regulation and bank risk-taking at different quantiles. Pires (2015) examined the empirical determinants of Credit Default Swaps (CDS) spreads using quantile regressions. Lee and Li (2012) studied the effect of diversification on firm performance across various performance levels.

According to Koenker and Bassett (1978), the τ-th quantile of the conditional distribution of Y_i given X_i is,

$$Q_\tau(Y_i|X_i) = X_i'\beta_\tau \qquad (1)$$

The parameter at the τ-th quantile of the conditional distribution is estimated by:

$$\hat{\beta} = argmin \sum_{i=1}^{N} \rho_\tau (Y_i - X_i'\beta) \qquad (2)$$

Where the quantile function of $\rho\_\tau (.)$ is defined as:

$$\rho_\tau(u) = \begin{cases} (\tau - 1)\mu \; untuk \; u < 0 \\ \tau u \; untuk \; u \geq 0 \end{cases} \qquad (3)$$

Based on equation (2), the quantile regression approach allows for heterogeneity, meaning different values for each quantile τ in the interval (0,1), which provides a comprehensive view of the relationship between independent and dependent variables.

Quantile regression is not constrained by the standard error assumption in OLS estimation. This method enables the study of risk-taking behavior, particularly when the distribution is heavy-tailed.

3.2 Empirical Model

In this study, the general model used is as follows:

$$Q_\tau(RISK_{it}|X_{it}) = \alpha_i + \beta_{1\tau}BUF_{it} + \beta_{2\tau}BUF_{it}^2 + \gamma_\tau B_{it} + \varepsilon_{\tau it} \tag{4}$$

Where:

$Q_\tau(RISK_{it}|X_{it})$	$= \tau - th$ quantile regression function
$RISK_{it}$	= bank risk taking of bank i in period t
BUF_{it}	= capital buffer of bank i in period t
BUF_{it}^2	= quadratic value BUF_{it}
B_{it}	= control variables from internal and external factor of bank i in period t. These include Bank Size, Loan to Deposit Ratio (LDR), Cost to Income Ratio (CIR), Interest Rate, Herfindahl-Hirchman Index (HHI), and Inflation.

4. DATA AND VARIABLES

This study employs annual data collected from the period of December 2013 to December 2023. The data coverage used in this study includes commercial banks in Indonesia, excluding foreign bank branches and digital banks, with a sample size of 81 banks representing a total market share of 94%. This exclusion is due to the fact that foreign bank branches have a different capital structure compared to commercial banks in Indonesia, and digital banks generally had a significant capital increases over a short period of time, in line with new capital injections from shareholders.

The dependent variable in this study represents bank risk-taking. In this paper, the indicator used to describe bank risk-taking is Non-Performing Loan (NPL) ratio, as the banking literature commonly mentions that NPL is a widely used indicator to reflect credit risk and serves as a good indicator of risk-taking levels because it provides an indication of deterioration before bankruptcy occurs (Daher et al., 2015; Ghosh, 2009; Jokipii and Milne, 2011; Shim, 2013; Zhang et al., 2012). The independent variable in this study is capital buffer. The bank's capital buffer is defined as the difference between the total capital held by the bank at a given time and the minimum capital which 8%. In this study, the capital buffer as an independent variable is described as follows:

BUF_{it}	= capital buffer of bank i in period t
BUF_{it}^2	= quadratic value of BUF_{it}

This variable is used to examine the non-linear, U-shaped relationship between the capital buffer and bank risk-taking.

The control variables used in this study include Bank Size, which reflects the natural logarithm of total assets, Loan-to-Deposit Ratio (LDR), Cost-to-Income Ratio (CIR), Interest Rate, Herfindahl-Hirchman Index (HHI), and Inflation.

5. RESULTS AND DISCUSSIONS

5.1 Descriptive Statistics

This study utilizes eight variables and employs annual data collected from the period of December 2013 to December 2023. The data coverage used in this study includes commercial banks in Indonesia, excluding foreign bank branches and digital banks, with a sample size of 81 banks representing a total market share of 94%. This exclusion is due to the fact that foreign bank branches have a different capital structure compared to commercial banks in Indonesia, and digital banks generally had a significant capital increases over a short period of time, in line with new capital injections from shareholders. Banking data consist of individual bank-level data, while inflation data are based on national-level statistics, and the Herfindahl-Hirschman Index (HHI) is derived from industry-level data.

Table 1. Descriptive Statistic

	Number of Observation	Mean	Std. Dev	Min	Max
Capital Buffer	891	15,592	8,968	2,436	79,490
Capital Buffer Squared	891	323,438	508,422	5,935	6.318,660
CIR	891	84,185	18,382	43,760	252,470
LDR	891	86,292	25,154	16,660	295,760
Size	891	17,108	1,415	12,613	21,330
Interest Rate	891	4,469	1,586	0,000	5,813
HHI	891	0,070	0,003	0,064	0,074
Inflation	891	3,995	2,200	1,684	8,359

In general, there are no outliers among the variables used, which is reflected in the standard deviation values being smaller than the average. However, some data points have values significantly above the mean, particularly in the CIR and LDR ratios. CIR ratio is relatively high in some banks, mainly due to a decline in profits, poor financial conditions, high provisions for impairment losses on financial assets, and substantial charges for impairment losses on non-financial assets. As for the LDR ratio, some banks also exhibit relatively high values. This is partly due to a decline in Third-Party Funds, which results from funding restructurings aimed at lowering the cost of funds and increasing the Net Interest Margin (NIM). In addition, some banks have alternative funding sources such as Medium-Term Notes (MTNs), bonds, bilateral loans, or loans from their group entities. Other contributing factors include acquisitions by other banks and regional government-owned banks, which typically have limited sources of Third-Party Funds—mainly from local communities or regional civil servants. Despite this, these banks are still encouraged to extend credit to support regional economic development.

In this case, the correlation among independent variables is generally below 0.65, as shown in Table 2. Based on the correlation table of independent variables, multicollinearity among the independent variables is low. The squared capital buffer variable is used to identify a non-linear (U-shaped) relationship between capital buffer and the bank risk-taking.

Table 2. Correlation among Independent Variable

	Capital Buffer	CIR	LDR	Size	Interest Rate	HHI	Inflation
Capital Buffer	1						
CIR	-0,051	1					
LDR	-0,026	0,030	1				
Size	-0,238	-0,147	-0,125	1			
Interest Rate	0,054	0,057	0,048	0,088	1		
HHI	0,301	0,074	-0,253	0,236	0,384	1	
Inflation	-0,164	-0,113	0,077	-0,159	-0,431	-0,647	1

NPL, as the dependent variable in this study, is not normally distributed, as shown in the histogram in Figure 4 below:
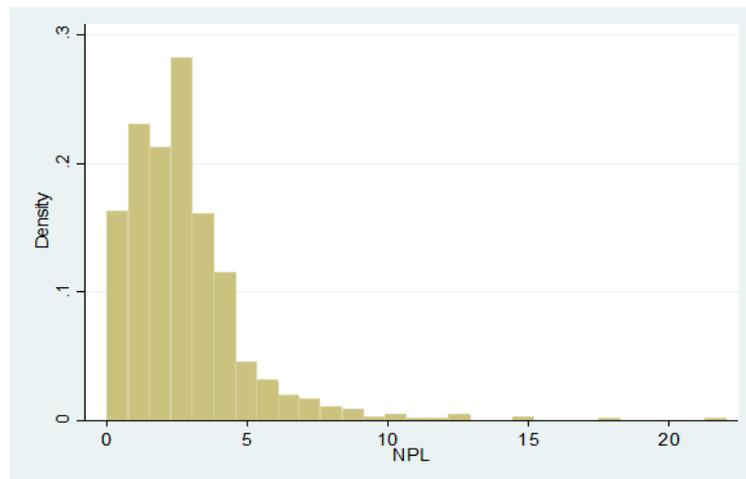
Figure 4. Histogram of NPL

The histogram shows that the distribution of NPL is heavy right-tailed. Therefore, using a conditional mean distribution would not accurately represent the data, as such an approach is more suitable for normally distributed data. This further strengthens the rationale for using a quantile regression approach.

5.2 Quantile Regression Result and Discussion

In the OLS regression and panel data regression performed based on the average of the data distribution. This approach may not adequately reflect the data distribution in this study, especially since the dependent variable is not normally distributed. As a result, mean-based regression may produce estimates that are either too low or too high. Therefore, this study employs the quantile regression method, which provides estimates at various quantiles, making the results more representative of the actual data distribution. In this paper, we use quantile regression method to the data used in this study. The quantiles used are the 10th, 25th, 50th, 75th, 80th, and 90th percentiles, following the approach used by Jiang et al. (2020), as follow:

Table 3. Quantile Regression Result

		Quantile					
		10%	**25%**	**50%**	**75%**	**80%**	**90%**
	Coefficients	-0,045	-0,055	-0,074	-0,113	-0,119	-0,099
Capital Buffer	Std. Error	0,020	0,023	0,019	0,028	0,034	0,041
	Sig.	0,025	0,017	0,000	0,000	0,001	0,015
	Coefficients	0,000	0,001	0,001	0,002	0,002	0,001
Capital Buffer Squared	Std. Error	0,000	0,000	0,000	0,000	0,001	0,001
	Sig.	0,192	0,130	0,004	0,001	0,003	0,041
	Coefficients	0,012	0,033	0,047	0,057	0,056	0,072
CIR	Std. Error	0,000	0,004	0,003	0,005	0,006	0,007
	Sig.	0,000	0,000	0,000	0,000	0,000	0,000
	Coefficients	-0,004	-0,002	-0,002	-0,002	0,000	-0,001
LDR	Std. Error	0,002	0,003	0,002	0,003	0,004	0,005
	Sig.	0,100	0,585	0,448	0,999	0,955	0,907
Size	Coefficients	0,188	0,234	0,160	0,065	0,017	0,049

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	Std. Error	0,046	0,052	0,044	0,065	0,079	0,093
	Sig.	0,000	0,000	0,000	0,321	0,829	0,597
	Coefficients	0,018	0,013	-0,002	0,055	0,085	0,093
Interest Rate	Std. Error	0,041	0,047	0,039	0,059	0,071	0,084
	Sig.	0,660	0,780	0,950	0,348	0,226	0,265
	Coefficients	41,680	42,968	71,880	49,434	38,633	-39,399
HHI	Std. Error	29,041	33,245	27,636	41,452	49,958	59,373
	Sig.	0,152	0,197	0,009	0,233	0,440	0,507
	Coefficients	-0,041	-0,076	-0,070	-0,054	-0,034	0,021
Inflation	Std. Error	0,036	0,041	0,034	0,051	0,061	0,073
	Sig.	0,251	0,062	0,038	0,286	0,576	0,778
	Coefficients	-5,199	-7,091	-7,926	-4,728	-3,132	1,041
Constanta	Std. Error	2,052	2,349	1,953	2,929	3,530	4,195
	Sig.	0,011	0,003	0,000	0,107	0,375	0,804
Number of Obs.		891	891	891	891	891	891
Pseudo R2		0,087	0,118	0,153	0,170	0,175	0,216

Based on the quantile regression results in Table 3, the direction of the coefficients for the main independent variables—capital buffer and squared capital buffer —is consistent across all quantiles. These findings align with the study of Jiang et al. (2020). Specifically, the coefficient of the capital buffer variable is negative, while the coefficient of the squared capital buffer variable is positive across all quantiles. The capital buffer variable shows a negative and statistically significant relationship at all quantiles at the 95% confidence level. In contrast, the squared capital buffer variable has a positive and significant relationship starting from the 50th quantile and above at the 95% confidence level.

Using quantile regression, it is indicated that a U-shaped relationship between capital buffer and bank risk-taking behaviour occurs from the 50th quantile onwards. This result follows the findings of Jiang et al. (2020), who also found that the U-shaped relationship emerges at higher quantiles. Initially, capital buffer is negatively associated with bank risk-taking—meaning that the higher the capital buffer, the lower the banks' risk-taking behaviour. However, beyond a certain threshold, further increases in capital buffer are associated with higher risk-taking behaviour. This result is aligned with the findings of Jiang et al. (2020), which serves as a key reference in this study. These results suggest that the non-linear relationship between capital buffer and bank risk-taking is more significant in high-risk banks (those with high NPLs) than in low-risk banks (those with low NPLs).

Among the control variables, CIR is statistically significant across all quantiles, and size variable (ln assets) is significant at the lower quantiles (10%, 25%, and 50%). This indicates that a higher CIR is associated with higher risk-taking behaviour, as banks may attempt to increase operational income—implying a focus on profit generation while potentially overlooking risk. For the log of total assets, the findings suggest that larger banks tend to take on more risk, especially at lower quantiles (i.e., banks with low NPLs). This result implies that banks with low NPLs may be less cautious in their lending practices, increasing NPLs as total assets grow.

The absolute values of the coefficients for capital buffer and squared capital buffer also vary across quantiles, reflecting differences in how banks respond to the level of capital buffer about risk-taking. As shown in Table 3, the absolute value of the capital buffer coefficient is larger at higher quantiles—for instance, the absolute value at the 90th quantile (0.099) is approximately 2.2 times greater than that at the 10th quantile (0.045).

The turning points for each quantile also vary: 22.5% for the 10th quantile, 27.5% for the 25th, 37% for the 50th, 28.25% for the 75th, 29.75% for the 80th, and 49.5% for the 90th quantile. These results suggest that the capital buffer turning point tends to increase with higher quantiles, though at certain levels (such as the 75th quantile), the turning point declines. For example, at the

10th quantile, if a bank's capital buffer is below 22.5%, an increase in capital buffer leads to lower risk-taking. However, once the capital buffer exceeds 22.5%, the relationship reverses—higher capital buffer leads to higher risk-taking. This interpretation holds for the respective turning points at other quantiles as well.

Furthermore, the mean-based regressions (OLS and random effects panel regressions) overestimate turning point values—58% and 48%, respectively—compared to the quantile-specific estimates. This reinforces the argument that quantile regression provides a better and more comprehensive approach than conditional mean regressions, as it offers more detailed insights across different segments of the data distribution.

6. CONSLUCIONS AND RECOMMENDATION

Based on the research findings, it is concluded that there is a non-linear relationship between capital buffer and bank risk-taking among commercial banks in Indonesia, consistent with the study by Jiang et al. (2020). The research findings indicate that a high capital buffer leads banks to take lower risks in several quantiles. However, an increase in the capital buffer encourages banks to take on greater risks beyond a certain threshold. Additionally, the varying results across different quantiles highlight the heterogeneity in the relationship between capital buffer and bank risk-taking.

Based on these findings, several recommendations can be made for regulators. These include tightening regulations, particularly in risk management, enhancing supervision—such as stricter oversight of banks' Internal Capital Adequacy Assessment Process (ICAAP) regarding assumptions and capital determinations for certain banks at specific thresholds. Recommendations for the banking industry include developing strategic planning, implementing effective risk management, enforcing strong corporate governance practices, and adopting more stringent decision-making processes, particularly for banks that engage in higher risk-taking beyond certain thresholds.

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