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Article

Un/desired impact of capital buffers: Evidence from Indonesian bank profitability and risk-taking

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FINANCIAL ECONOMICS | RESEARCH ARTICLE

Un/desired impact of capital buffers: Evidence from Indonesian bank profitability and risk-taking

Muhammad Herru Hendrawan^{1*}, Felisitas Defung¹ and Wirasmi Wardhani¹

Abstract: The study employs a two-step system GMM technique within a panel data framework to investigate the effects of capital buffers on the profitability and risk behavior of Indonesian commercial banks from 2010 to 2020. The findings reveal that capital buffers serve a dual role, acting as a safety net against potential losses while also promoting increased financial stability and stronger shareholder engagement. This ultimately benefits the bank and its stakeholders in the long run. However, the positive effects of capital buffers come at a cost, as they are associated with reduced returns on assets and return on equity. The study emphasizes the importance of managing risk effectively, striking a delicate balance between risk-taking and prudent risk management to achieve optimal profitability. It underscores the need for banks to prioritize robust risk management practices and proper capitalization to avoid pursuing profitability at the expense of these critical factors. The study further highlights the significance of policymakers finding the right equilibrium between promoting financial stability through capital requirements and fostering a competitive banking industry that can generate profits and support economic growth.

Subjects: Banking; Economics; Finance; Risk Management

Keywords: capital buffers; profitability; risk; banking regulation and supervision

JEL Classification: G21; G28; G32

1. Introduction

The recent episodes of financial instability and global banking crises have underscored the significance of maintaining sufficient capital, prompting the Basel Committee to revise the former Basel standards and introduce Basel III, which mandates banks to establish additional capital buffers (BCBS, 2010). Enhanced capital standards have also been associated with improved performance and a more resilient banking system, as Basel III requires banks to hold higher amounts of better-quality capital compared to Basel II (Monetary Fund & IMF, 2017). However, the focus on capital buffers in bank supervision raises an important question: What potential impact does maintaining such capital buffers have on banks' financial performance, and by extension, their profits and risk?

To address this question, it is important to recognize that a capital buffer, or excess capital above the minimum requirement, serves as a cushion to absorb losses while ensuring the provision of key financial services to the real economy. It acts as a stable source of funds during potential periods of panic or bank runs, thereby reducing the likelihood and scale of contagious bank runs (Berger, 1995; Bitar et al., 2018). Moreover, capital buffers are expected to mitigate moral hazard, enhance monitoring, and control risk by shareholders. By necessitating banks to absorb losses in the event of default, rather than relying on deposit insurance or implicit government guarantees (Agoraki et al., 2011; Bitar et al., 2018; Tan & Floros, 2013). Additionally, if banks face higher deposit costs due to their riskiness, the presence of capital buffers can help alleviate such risk and reduce funding expenses (Abbas et al., 2019).¹ Banks may also hold excess capital as a signal of financial soundness and to meet the expectations of rating agencies,² aligning with the signaling hypothesis (Jokipii & Milne, 2008; Milne & Whalley, 2001). These indicate that highly capitalized banks experience lower bankruptcy and funding costs, along with enhanced risk monitoring by shareholders, ultimately drives banks to a greater ability to enhance performance (Berger, 1995; Flannery & Rangan, 2008).

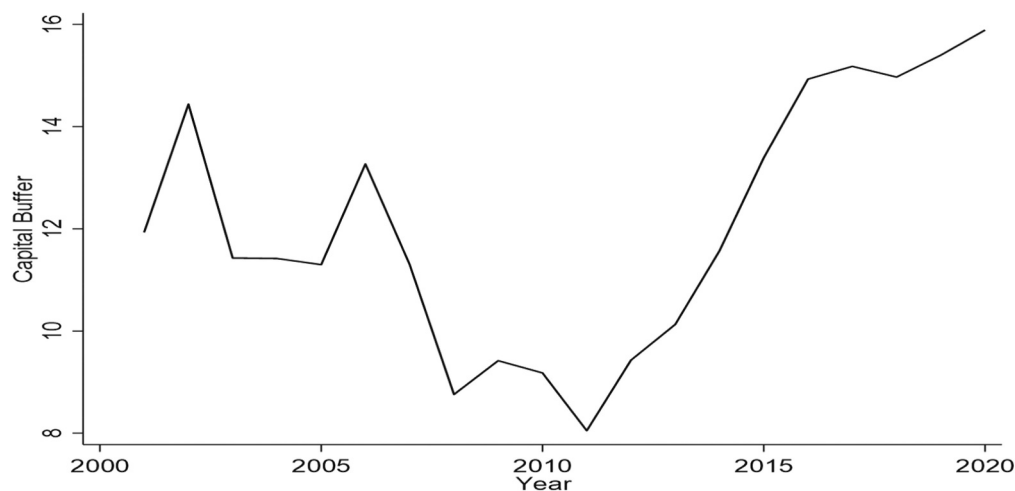
While there is evidence for the benefits of financial stability through adequate capital, some argue that holding capital above the minimum requirement can be costly for both banking institutions and the economy as a whole. This is because an increase in capital implies a decrease in the supply of loanable funds, potentially hindering economic activity by making financing and investment harder and more expensive (García-Suaza et al., 2012; Naceur & Kandil, 2009; Tabak et al., 2013). In addition, holding buffer capital is expected to come at a cost, as the funds could have been invested in profitable ventures to generate income (Goddard et al., 2010). Moreover, binding banks to hold capital above their private optimal level may reduce their leverage behavior (tax privileges of debt) and consequently lower their expected returns (Bitar et al., 2016; Mujtaba et al., 2022).³ As a result, banks may attempt to offset the adverse effect of additional capital holdings by engaging in riskier activities or finding ways to circumvent regulation.

Therefore, one could argue that holding a higher capital buffer can place constraints on bank activities, potentially weaken economic growth, increase bank risk, and decrease efficiency and profitability. Thus, it may not be obvious how bank profitability has been affected, and it is equally challenging to assess the impact on bank risk-taking.

Given the divergence in economic theory over these questions, numerous authors have made empirical attempts to assess the impact of the capital buffer. However, the existing literature provides conflicting results regarding the optimal design of the capital buffer and its effect on bank profitability. For instance, several studies have supported positive associations, suggesting that institutions with higher buffers have higher profits compared to those without. This evidence includes Tabak et al. (2013) for Brazilian banks, Bitar et al. (2016) for MENA countries, Bagntasarian and Mamatzakis (2019) for European Union, Abbas et al. (2019), and Abbas and Ali (2022) for U.S. banks. On the other hand, Lotte (2016) found a negative relationship between the capital buffer and profitability, attributing it to the tax deductibility of interest payments, as higher equity capital lowers banks' after-tax income. Tabak et al. (2017) found that an excess capital buffer led to inefficiency and a decrease in profit. Afrifa et al. (2019) showed that binding micro-finance institutions to hold more capital than their private optimal level (value-maximizing capital) distorts optimality and ultimately reduces their performance. In addition, studies have identified both the exacerbation of financial risks (e.g., Bitar et al., 2016; Jiang et al., 2020; Jokipii & Milne, 2011; Noreen et al., 2016) and the potential for the capital buffer to alleviate such risks (e.g., Abbas et al., 2019; Bagntasarian & Mamatzakis, 2019; Ding & Sickles, 2019; Shim, 2013; Vallascas & Hagendorff, 2013). Given the inconclusive findings in this field, further exploration is warranted.

Our purpose in this paper is to fill in the significant gaps identified in the previous discussion. Specifically, we focus on Indonesia, a large, bank-based emerging economy, which provides a unique context for studying the effects of capital buffers. Figure 1 highlights an interesting

Figure 1. Average capital buffer in Indonesia, source: OJK, Indonesia Financial Services Authority.



observation that Indonesian banks, on average, maintain a capital buffer of 15.89%, which is more than twice the minimum requirement of 8% set by regulators. The sector's resilience during the 2008 financial crisis, characterized by substantial capital buffers, and the attention it has received from international financial authorities make it an intriguing case study. Gaining a better understanding of these phenomena can provide more insightful inferences about the impact of capital regulation, which is crucial for regulators when determining capital levels and other explicit requirements under Basel III. Additionally, finance-stability issues are of particular interest in the context of emerging economies like Indonesia, where the banking sector plays a crucial role in providing essential financial services. This suggests that excessive bank risk-taking in such countries may have more detrimental effects compared to countries with less reliance on banks. Therefore, comprehending whether capital buffers foster stability is of immense significance, not only for designing optimal policies but also for ensuring long-term financial stability and economic growth in Indonesia.

This paper makes a twofold contribution to the literature. Firstly, it is among the first studies to investigate the impact of capital buffers on both the profitability and risk behavior of Indonesian banks. While previous research, such as Danarsari et al. (2018) and Yuwonoputro and Syaichu (2019), has explored this relationship, they have either focused solely on profitability or risk or have examined a limited time frame and a restricted set of risks and profitability measures. In contrast, our study aims to extend this literature by considering a comprehensive set of risk and profitability measures, including return on equity, net interest margin, credit risk, and portfolio risk, over a longer time period. We believe that this approach will provide a better understanding of the policy implications of capital buffers in achieving stability in the banking system. Secondly, we employ the two-step system generalized method of moments (system GMM) as our estimation technique. The system GMM effectively addresses issues such as persistence in the behavior of dependent variables over time, unobserved heterogeneity, and endogeneity. By leveraging the strengths of this established method, we can enhance the validity and robustness of our findings.

The analysis in this paper is based on a sample of 81 commercial banks in Indonesia, utilizing recent datasets that cover various risk and profitability factors. While no compelling evidence exists to support the influence of capital buffers on bank interest margin and portfolio risk, there is consistent alignment with previous research indicating that increasing the capital buffer helps mitigate bank credit and bankruptcy risk. This suggests that bank capital buffers can enhance financial stability by improving borrower monitoring and strengthening the bank's ability to absorb losses. However, the study also reveals that capital buffers have an adverse effect on bank return on assets and return on equity, supporting the notion of the expected cost associated with holding

capital buffers at levels considered suboptimal. These findings emphasize the importance of policymakers striking a balance between promoting financial stability through capital requirements and supporting a competitive banking industry capable of generating profits and fostering economic growth. Ultimately, this study contributes to the ongoing discourse on banking regulations, highlighting the need for compliance with capital guidelines.

The remainder of the paper is organized as follows. Section 2 provides a review of the empirical literature and establishes hypotheses. Section 3 outlines the research methodology, followed by Section 4 where the empirical results, along with the robustness tests, are discussed and interpreted. Lastly, Section 5 presents the conclusions drawn from the findings.

2. Literature review

2.1. Relationship between capital buffer and profitability

The relationship between excess capital and profitability has been extensively studied, with Berger's (1995) work highlighting two potential benefits of this strategy. One of them is based on signaling theory, suggesting that a high level of capital can convey that a bank is better prepared to weather adverse environments. It serves as an instrument to demonstrate the bank's commitment to preserving capital and ensuring the safety of their deposits and money market funding. This signal of stability and creditworthiness may attract depositors and subsequently reduce costs associated with capital attraction (García-Herrero et al., 2009; Lindquist, 2004; Tabak et al., 2013, 2017).

Alternatively, increasing capital based on the "bankruptcy cost" perspective can also lead to higher profitability. It reduces the expected cost of financial distress and bankruptcy, as well as the cost of insurance against these events (Dietrich & Wanzenried, 2010; Goddard et al., 2004; Lotte, 2016; Naceur & Kandil, 2009). Holding capital buffers can also provide banks with the flexibility to seize future growth opportunities and quickly acquire funds for profitable investments. This allows banks to increase the share of risky assets, such as loans, leading to higher profitability under favorable market conditions (García-Herrero et al., 2009). Several studies provide evidence supporting these hypotheses, indicating that higher levels of buffers provide self-insurance to banks and enhance depositors' confidence in the stability of the institution (e.g., Abbas & Ali, 2022; Bagntasarian & Mamatzakis, 2019; Tabak et al., 2013). Additionally, Abbas et al. (2019) found that capital buffers can decrease bank risk and funding costs, resulting in improved profitability. Building on these findings, we propose the following hypothesis:

H1: The capital buffer is positively associated with bank profitability.

2.2. Relationship between capital buffer and risk-taking

Two significant issues related to maintaining a capital buffer have been identified in studies by Jiang et al. (2020) and Abbas et al. (2022). The first issue revolves around moral hazard, where a bank exhibits increased risk-taking as the capital buffer falls below a certain threshold. This behavior arises due to the high cost associated with raising new equity, prompting banks to pursue riskier strategies to generate higher returns (Awdeh et al., 2011; Jokipii & Milne, 2009, 2011; Lee & Hsieh, 2013; Milne & Whalley, 2002; Rime, 2001). However, when the buffer is sufficient to maintain compliance with regulatory requirements, the pursuit of higher returns becomes more prominent. In such cases, excess capital can act as a cushion, allowing banks to increase their exposure to risky assets and potentially encourage further risk-taking, based on the assumption of adequate insurance against unforeseen shocks (García-Herrero et al., 2009).

Conversely, studies suggest that when banks maintain an adequate capital buffer, they internalize the negative consequences associated with risky behavior, leading to more prudent

investment decisions (Naceur & Kandil, 2009; Tan, 2016). Furthermore, shareholders have a greater incentive to monitor bank managers and enforce better risk control when significant capital is at stake (Gale, 2010; García-Herrero et al., 2009; Hughes & Mester, 1998). This enhanced monitoring can result in higher levels of borrower oversight, reducing the probability of default.⁴

Empirical evidence from various studies supports the notion that a higher capital buffer in the banking sector is associated with reduced risk exposures. 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 level. 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. These findings support the regulatory recommendation of maintaining a conservative capital buffer to foster a more stable banking system and reduce overall riskiness. Building upon these observations, we formulate the following hypothesis:

H2: There is a negative relationship between capital buffer and bank risk-taking.

3. Methodology

3.1. Model specification

Following previous studies and the models on which they are based (Ayuso et al., 2004; Jokipii & Milne, 2011; Saadaoui, 2014; Shim, 2013), we assume that a bank's profitability, risk, and capital buffers are determined simultaneously. This is important because bank capital buffers are endogenous to both profitability and risk-taking. More profitable banks may be able to accumulate larger capital buffers, while on the other hand, more profitable banks may choose to operate with a lower capital buffer.⁵ Hence, the endogeneity of these variables can lead to a bidirectional relationship, and similar arguments can be applied to risk-taking. To address these challenges, we employ the system GMM estimator proposed by Blundell and Bond (1998).

The system GMM estimator is a valuable tool that considers the dynamic nature of the model and helps address issues such as autocorrelation and potential endogeneity through appropriate instruments. In our analysis, we use lagged and differenced dependent variables as instruments, following the approach of Blundell and Bond (1998). Additionally, we include other relevant control variables such as bank size, loan loss provision, Herfindahl-Hirschman Index, GDP, and the ratio of financial market development. To ensure the exogeneity of instrumental variables, we use their one-year lagged observations. Following Roodman's (2009) advice, we collapse the instrument matrix to avoid an excessive number of instruments and ensure that the number of instruments employed remains smaller than the number of groups to prevent overfitting of endogenous variables.

To assess the statistical validity of the instruments, we conduct Hansen's J-test of overidentifying restrictions, which tests the null hypothesis that the instruments are valid and uncorrelated with the error term. We also perform an AR(2) test to verify if the data meet the assumption of no second-order autocorrelation.

In summary, our analysis builds upon the studies of Bagntasarian and Mamatzakis (2019) and Jiang et al. (2020) to examine the relationship between capital buffer and bank profitability (risk). We make necessary modifications to the model and estimate the following equations:

$$Profit_{it} = \alpha_0 + \alpha_1 Risk_{it} + \alpha_2 Buffer_{it} + \alpha_3 Profit_{i,t-1} + \alpha \sum Y_i + \varepsilon_{it} \quad (1)$$

$$Risk_{it} = \beta_0 + \beta_1 Profit_{it} + \beta_2 Buffer_{it} + \beta_3 Risk_{i,t-1} + \beta \sum X_i + \mu_{it} \quad (2)$$

Here, t and i denote the period and banks, respectively. $Profit_{i,t-1}$ and $Risk_{i,t-1}$ represent the lagged dependent variable capturing the persistence of profitability and risk levels. $Buffer_{it}$ represents the capital buffer, while $\sum Y$ and $\sum X$ are two vectors of control variables explaining profitability and risk, respectively. ε and μ represent the idiosyncratic error terms.

3.2. Profitability and risk measures

In this study, we assess individual bank profitability by utilizing return on assets (hereafter, ROA). ROA is a widely accepted metric for comparing the efficiency and operational performance of banks as it looks at the returns generated from the assets financed by the bank. Additionally, ROA provides a means to compare our results with those reported in prior research. To ensure the robustness of our findings, we also consider two alternative measures of bank profitability: Return on equity (ROE), which indicates the return on shareholders' investment, and net interest margin (NIM), which focuses on the profit earned from lending activities. ROE reflects the bank's ability to utilize its equity to generate profits, while NIM provides a measure of profitability specifically related to lending activities.

The study employs three measures to evaluate the level of risk-taking in individual banks. The first risk proxy we use is the ratio of risk-weighted assets to total assets (RWATA), which is frequently used to represent banks' asset risk profiles. This is because the allocation of assets across different risk categories determines the overall risk of banks' portfolios (Aggarwal & Jacques, 2001; Rime, 2001; Shrieves & Dahl, 1992). To provide alternative measures of banks' risk positions, we also use non-performing loans (NPL) and Z-score. NPL is a good indicator of asset quality and bank risk because the NPL ratio deteriorates rapidly before the actual bank failure occurs (Daher et al., 2015; Fiordelisi et al., 2011; Ghosh, 2009; Jokipii & Milne, 2011; Zhang et al., 2012).⁶ Z-score, on the other hand, is a comprehensive measure that takes into account both the risks related to the banking business and the degree of coverage of these risks by capital. According to Beck et al. (2010), "if profits are assumed to follow a normal distribution, it can be shown that the Z-score is the inverse of the probability of insolvency", because "Z indicates the number of standard deviations that a bank's return on assets has to drop below its expected value before equity is depleted, and the bank is insolvent". We calculate the Z-score as the ratio between a bank's ROA plus equity capital to total assets and the standard deviation of the ROA. A higher Z-score indicates a lower probability of bankruptcy, while a lower Z-score indicates a higher probability of bankruptcy (Barry et al., 2011; Chortareas et al., 2012; Laeven & Levine, 2009; Shim, 2013; Stiroh & Rumble, 2006; Tan & Floros, 2013; Vazquez & Federico, 2015).

3.3. Capital buffer

Banks are incentivized by market forces to maintain a positive level of capital. This not only helps banks attract funds and maintain long-term customer relationships but also enables them to carry out essential lending risks (Allen et al., 2011; Holmstrom & Tirole, 1997; Perotti et al., 2011). However, relying solely on market forces is not enough to ensure that the equilibrium bank capital levels are optimal for the welfare of society. This is because there are frictions that lead to the private return on capital being lower than the social return, prompting banks to hold less capital than what is socially optimal. To address this issue, regulations are implemented to increase bank capital beyond the laissez-faire equilibrium. This is typically done through the imposition of risk-weighted minimum capital requirements.

New capital enhancements seek to improve both the quality and availability of capital. At the individual firm level, Basel III aims to improve the quality of banks' capital and provide clear definitions for different types of capital. Notably, it has increased regulatory capital requirements, particularly in the trading book, where securitized and OTC (Over-the-Counter) derivative products will require higher capital allocations. Moreover, counterparty risk must be considered. These

enhancements are intended to improve forward-looking provisioning for credit losses by better-assessing counterparty risk exposures. In addition, banks are also mandated to maintain an additional conservation buffer and a countercyclical buffer. These buffers, along with the minimum requirements, collectively determine the overall regulatory capital requirement. Depending on the size of the countercyclical buffer, the regulatory capital requirement can range from a minimum of 8% to 10.5%.

Basel III introduces significant changes to the capital requirements compared to Basel II. Notably, it sets higher minimum shares of common equity and Tier 1 capital. As part of these adjustments, the Tier 1 ratio has been raised from 4% to 6%, with a corresponding increase in the Common Equity Tier 1 (CET1) ratio from 2% to 4.5%. These changes signify a reinforced emphasis on the quality standards within the Tier 1 ratio.

Within the framework of Basel III, regulatory capital is classified into different categories based on its characteristics and loss absorption capabilities. CET1 represents the highest quality regulatory capital, providing immediate loss absorption. Additional Tier 1 (AT1) capital, constituting 1.5%, provides loss absorption on a going-concern basis but falls short of meeting all the criteria for CET1.⁷ This category includes certain debt instruments like perpetual contingent convertible capital instruments, which are included in AT1 but not in CET1. Tier 2 capital, considered as gone-concern capital, comes into play when a bank fails. In such a scenario, Tier 2 instruments must absorb losses before depositors and general creditors. Basel III harmonizes and simplifies Tier 2 capital at a rate of 2%, while Tier 3 capital has been abolished altogether.

As in previous studies (Jokipii & Milne, 2008, 2011; Shim, 2013), we measured the bank's capital buffer in absolute terms. Specifically, we looked at the difference between the bank's total risk-weighted capital ratio (combining Tier 1 and Tier 2 capital) in year t and the minimum regulatory requirement of 8%.⁸ We made this calculation without taking into account the additional conservation and countercyclical buffers, introduced by Basel III. This approach allowed us to capture the impact of Basel III's requirements on banks' capital buffers.

3.4. Control variables

We use the following control variables:

- $Size_{it}$: It refers to the logarithm of the bank's total assets and is utilized to account for the size effect (Guidara et al., 2013; Jacques & Nigro, 1997; Rime, 2001). The size of a bank can influence its risk and profitability through economies of scale (Altunbas et al., 2007; García-Herrero et al., 2009). Research has demonstrated that larger banks may benefit from lower funding costs, portfolio diversification, and economies of scale, which can enhance their efficiency and reduce their risk exposure (Chortareas et al., 2012; Pasiouras et al., 2008; Tan & Floros, 2013). Therefore, we expect a positive coefficient for this variable in the profitability model and an opposite effect in the risk model.
- $Loans_{it}$: It is used to represent the ratio of loans to total earning assets.⁹ Assuming that more deposits are converted into loans, higher interest margins and profits would be anticipated. However, loans typically exhibit lower liquidity and higher risk compared to other assets in a bank's portfolio. The risk of default and the additional costs associated with managing credit risk requires banks to apply a risk premium to the interest rate charged for the loan, compensating for the higher credit risk (Bennaceur & Goaid, 2008; Iannotta et al., 2007; Maudos & Fernández de Guevara, 2004). Hence, we expect a positive relationship for this variable in both the profitability and risk models.
- $Liquidity_{it}$: It represents the level of liquid assets held by banks, which can serve as a means to mitigate the bank's liquidity risk.¹⁰ However, maintaining a higher level of liquid assets may result in lower returns and potential agency problems (Iannotta et al., 2007). Therefore, we anticipate a negative coefficient for this variable in the profitability model and a positive coefficient in the risk model.
- $Listed_{it}$: It is a dummy variable with a value of 1 indicating that the bank is listed on the stock market, and 0 otherwise. We use it as a proxy for ownership dispersion, and there is no clear expectation for its coefficient sign. On the one hand, when ownership is more dispersed, the incentive problems arising from the separation of ownership and control become more severe. On

the other hand, banks whose shares are publicly traded may benefit from market discipline mechanisms, which can constrain their risk-taking behavior (Iannotta et al., 2007).

- *GDP_t*: It represents the growth rate of the national gross domestic product. This variable is included in the model to capture the influence of the economic cycle on bank performance and risk. An increase in GDP typically indicates a booming economy, which leads to higher demand for credit and a potential increase in profitability. This is because banks can exploit more investment opportunities during this period. The literature supports this claim, as observed in the work of Naceur and Kandil (2009). Therefore, we expect a positive coefficient for the GDP variable in both the profitability and risk models.
- *Inflation_t*: It represents the inflation rate, which can indirectly impact the cost of intermediation. When inflation increases, people tend to save more and borrow less, which can lead to reduced profits for banks. To stimulate demand for credit, banks may choose to lower the cost of intermediation (Naceur & Kandil, 2009). On the other hand, higher inflation can also increase uncertainty, which may reduce banks' willingness to take risks (Drakos et al., 2016).

3.5. Data description

As of December 2020, the banking industry in Indonesia comprised 109 commercial banks, including 20 with Islamic business units, 14 Islamic commercial banks, 1,506 rural banks, and 163 sharia rural banks. These institutions collectively offered a wide range of financial services, managing assets worth approximately Rp11.1 quadrillion (OJK, 2020). To construct our sample, we collected data from multiple sources. Bank-specific variables were obtained from the *Indonesia Financial Services Authority* (OJK) database, which provides detailed information on over 1,792 commercial, Islamic, and rural financing banks in Indonesia. In addition, GDP and inflation data were acquired from the *World Bank's* WDI database. The observation period of this study spans from 2010 to 2020, with all data collected on an annual basis.

To reduce sample heterogeneity, we applied specific selection criteria. Firstly, we focused exclusively on active commercial banks on the reported date, as they constitute the dominant market share in the Indonesian banking industry. Secondly, we excluded Islamic and rural banks. Islamic banks adhere to Sharia principles in their operations, fund management, risk assessment, profit sharing, and objectives, while rural banks have slightly different capital requirements compared to commercial banks. Therefore, our focus is on commercial banks that share homogeneous objectives and regulatory requirements. Lastly, we retained commercial banks for which data was available throughout the observation period and excluded banks with unobservable data for two consecutive years or more. As a result, our final sample consists of 81 commercial banks, yielding a total of 891 bank-year observations, representing approximately 83% of the total assets in the Indonesian banking sector. Table 1 provides details on the measurement employed for each variable, along with summary statistics of the data.

From Table 1, we observe that the sampled banks have an average ROA of 1.9%, indicating relatively low profitability. However, the average ROE and NIM are 12.1% and 5.9%, respectively, indicating better returns on shareholders' investment and profitability from lending activities. When comparing the different risk proxies, the Z-score has the highest value at 900%, indicating a lower probability of bankruptcy. On the other hand, the NPL has the lowest value at 1.3%, reflecting better asset quality. The average risk-weighted assets to total assets (RWATA) ratio is 67.7%, representing the banks' asset risk profiles. Additionally, the capital buffer positions of the banks vary widely between different years, ranging from the lowest value of 1.6% to the highest of 173%. The mean capital buffer for the sample is 16%, indicating that, on average, the banks operate with a capital ratio well above the minimum requirement proposed by BCBS for capital adequacy.

Table 2 presents the correlation matrix between the variables, revealing weak correlations among the explanatory variables, indicating the absence of multicollinearity and enabling their simultaneous use in the models. Specifically, we observe a negative correlation between the capital buffer and the two measures of the bank's profitability, with correlation coefficients of less than 30% for ROE and 14% for ROA. Conversely, NIM shows a positive correlation with the capital buffer at 2.2%. Additionally, the capital buffer exhibits a negative correlation with RWATA

Table 1. Descriptive statistics of the variables

Variable	Measurements	Mean	Std.Dev.	Min	Max
ROA	Net income/total assets	0.019	0.018	−0.159	0.074
ROE	Net income/total equity	0.121	0.122	−0.890	0.484
NIM	(Interest income – interest expense)/avg. interest-earning assets	0.059	0.025	−0.063	0.194
RWATA	Risk-weighted assets/total assets	0.677	0.142	0.009	1.457
NPL	Impaired loans/total loans	0.013	0.012	0.001	0.099
Z-score	(ROA + equity/assets)/standard dev. ROA	9.004	5.243	0.046	52.771
Buffer	(Tier 1 + Tier 2 over RWA) – a minimum capital requirement of 8%	0.160	0.157	0.016	1.734
Size	The logarithm of total assets	16.529	1.731	11.981	21.075
Loans	Total loans/total earning assets	0.663	0.107	0.207	0.884
Liquidity	Total liquid assets/total assets	0.254	0.040	0.185	0.364
Listed	A dummy that equals 1 if the bank is listed in a stock market, and 0 otherwise	0.380	0.486	0.000	1.000
GDP	Annual GDP growth rate	4.727	2.112	−2.069	6.224
Inflation	Annual inflation growth rate	4.484	1.410	1.921	6.413

Note: The table shows the list of variables and brief descriptions with summary statistics of them.

(−1%) and NPL (−6.5%), but it is positively correlated with Z-score (65.3%). However, it is important to note that these correlation studies have limitations as they fail to consider the influence of other variables on the observed correlations and potential interactions between the numerator and denominator components of buffer capital. Therefore, these studies provide only a limited understanding of the relationships between the variables. In the next section, we employ the system GMM approach to account for various other factors that may impact banks' levels of profitability and risk. This approach will provide a deeper and more nuanced understanding of the relationships between the variables.

4. Results and discussion

4.1. How does the capital buffer affect a bank's profitability?

In this section, we empirically analyze the impact of the capital buffer on bank profitability. The results of the two-step system GMM are summarized in Table 3, presenting the findings for ROA, ROE, and NIM in columns (2)–(4). Our analysis reveals a negative relationship between the capital buffer and the return on assets and return on equity, indicating that maintaining a larger capital base leads to higher costs of capital for banks.¹¹ These findings are consistent with previous studies conducted by Lotte (2016), Tabak et al. (2017), and Afrifa et al. (2019), which highlight

Table 2. Partial correlation matrix

Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
ROA	1												
ROE	0.857***	1											
NIM	0.432***	0.510***	1										
RWATA	-0.031**	-0.217***	-0.250***	1									
NPL	-0.383***	-0.403***	-0.196***	0.080**	1								
Z-score	0.190***	-0.043*	0.041**	0.084***	-0.104***	1							
Buffer	-0.140***	-0.298***	0.022*	-0.010*	-0.063**	0.653***	1						
Size	0.131***	0.174***	-0.164***	0.130***	-0.054**	-0.203***	-0.295***	1					
Loans	0.073**	0.061*	0.137***	0.370***	0.063**	-0.284***	-0.297***	-0.022**	1				
Liquidity	0.083***	0.031*	-0.174**	0.135***	-0.049**	-0.033**	-0.125***	0.225***	-0.031**	1			
Listed	-0.229***	-0.176***	-0.207***	0.085***	0.193***	-0.166***	-0.131***	0.386***	-0.016	-0.097***	1		
GDP	-0.198***	-0.225***	-0.177***	-0.035**	0.052**	0.042**	0.036**	0.241***	0.043**	0.008	0.070**	1	
Inflation	0.203***	0.246***	0.124***	0.068**	-0.122***	-0.047**	-0.093***	-0.143***	0.103***	0.051**	-0.055**	-0.382***	1

Note: ***, **, * represent statistical significance at 1%, 5%, and 10%, respectively.

Table 3. Results for the overall sample of the profitability and risk model

	Profitability			Risk		
	ROA	ROE	NIM	RWATA	NPL	Z-score
Risk	−0.0322** (.0149)	−0.2366* (.1312)	−0.0343** (.0157)			
Profit				−0.911** (.376)	−0.183** (0.075)	24.731 (27.319)
Buffer	−0.0498*** (.0159)	−0.4404*** (.1484)	−0.0143 (.0137)	−0.161*** (.059)	−0.024*** (.009)	13.529*** (3.608)
Size	−0.0036** (.0017)	−0.0228* (.0128)	−0.0017 (.0021)	−0.009 (.015)	0.002 (.001)	−1.395*** (.528)
Loans	0.0119 (.0101)	0.0485 (.0883)	0.0867*** (.0324)	0.516*** (.078)	0.007 (.009)	2.284 (3.175)
Liquidity	−0.0499* (.0270)	−0.3114* (.1646)	−0.0618 (.0637)	0.136 (.258)	−0.006 (.015)	−1.591 (7.406)
Listed	−0.0112 (.0129)	−0.0143 (.0793)	−0.0010 (.0082)	−0.040 (.062)	0.009** (.004)	1.103 (1.157)
GDP	−0.0009 (.0078)	−0.0924* (.0559)	−0.0253*** (.0086)	0.032 (.046)	−0.006 (.004)	1.759** (.891)
Inflation	0.0004 (.0004)	−0.0016 (.0030)	−0.0013** (.0005)	0.003 (.002)	0.0001 (.0002)	−0.093 (.079)
L1. Profit	0.2849*** (.0993)	0.4287*** (.0967)	0.7258*** (.1365)			
L1. Risk				−0.0701 (.087)	0.319*** (.075)	0.078 (.117)
Cons	0.1703 (.1967)	3.5039** (1.4776)	0.7735*** (.2338)	−0.463 (1.110)	0.154 (.114)	−19.688 (18.960)
Obs.	891			891		
AR 2 p-value	0.617	0.327	0.374	0.573	0.411	0.163
Hansen J-test	0.243	0.058	0.060	0.066	0.469	0.092

Note: Table 3 used a two-step system-GMM method to measure the impact of capital buffers on banks' profitability and risk. Banks' capital buffer is a ratio of risk-based capital to risk-weighted assets minus 8%, and all other variables are defined in Table 1. Three varying measures are considered for each model specified in Eq. (1) and (2). AR (2) is the p-value for the test of second-order autocorrelation, the null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. Hansen's J-test stands for the p-value of Hansen's J diagnostic test for instrument validity. The null hypothesis of the Hansen test is that the instruments used are not correlated with residuals (over-identifying restrictions). Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10% levels, respectively.

the potential inefficiencies and suboptimal capital levels associated with excessive buffer reserves, resulting in diminished returns for affected banks.

Additionally, the effectiveness of the capital buffer in enhancing NIM and supporting bank profitability is subject to further examination. The capital buffer is intended to signal a bank's financial strength and ability to absorb losses, thereby reducing the costs of funding and insurance against bankruptcy risk. However, in this study, the observed insignificant effect of the capital buffer on NIM suggests that these signaling and cost reduction mechanisms may not be adequately supported or realized.

These findings raise questions about the effectiveness of the capital buffer in enhancing NIM and supporting bank profitability. As a result, our findings provide evidence rejecting the hypothesis of a positive association between the capital buffer and bank profitability, as the data suggests the opposite conclusion. **Hence, the first hypothesis (H1) is rejected.**

In general, variations in profitability demonstrate a negative relationship with bank $Risk_{it}$. This indicates that as banks take on higher credit risk, their returns on assets (ROA), interest margin (NIM), and shareholders return (ROE) tend to decrease. This finding can be attributed to the allocation of resources towards risk management practices, including the maintenance of loan losses reserves, increased costs associated with monitoring and hedging, and the necessity to offer higher interest rates. These factors exert downward pressure on the overall earnings of banks (Athanasoglou et al., 2008; Dietrich & Wanzenried, 2014; Ekinici & Poyraz, 2019; Gadzo et al., 2019; Masdjojo et al., 2023; Saleh et al., 2020; Yanikkaya et al., 2018).

Larger banks tend to exhibit lower profitability, as evident from their ROA and ROE metrics. One key factor is the potential occurrence of diseconomies of scale. These institutions may experience higher administrative costs and possess more complex management structures, impeding their ability to adapt swiftly to market dynamics. The scale of their operations and the complexities involved also contribute to elevated operating costs. In addition, their size often subjects larger banks to heightened regulatory scrutiny and stricter capital requirements. Compliance with these regulations can incur additional costs that further impact profitability. Although the impact on NIM is not statistically significant, this finding aligns with previous studies highlighting that larger banks tend to exhibit lower profitability compared to smaller banks (Amare & McMillan, 2021; Saleh et al., 2020).

Therefore, it is crucial for banks to prudently manage their growth and prioritize operational efficiency to sustain or enhance profitability, particularly as they expand in size. They should also be mindful of the associated risks and costs inherent in their scale and strive to strike a balance between growth and risk management to attain optimal profitability.

$Loans_{it}$ has a notable and significant positive impact on NIM, which measures the difference between interest income earned on loans and interest paid on deposits. This relationship is intuitive, as banks generate interest income from their loan portfolios, and loan growth is a key driver of NIM (Bennaceur & Goaied, 2008; López-Espinosa et al., 2011). However, the lack of significant impact of loans on ROA and ROE, which provide a broader assessment of profitability, suggests that the sampled banks have diverse income sources and revenue streams beyond loans. As a result, the overall profitability of the banks is influenced by a combination of factors, including fee-based income, investment activities, and other business lines. This diversification helps to stabilize ROA and ROE levels, even if the direct impact of loans on these measures is not significant.

There is a notable negative relationship between $Liquidity_{it}$ and profitability, as evidenced by ROA and ROE. This can be attributed to the higher funding costs incurred when a bank maintains high levels of liquidity, resulting in lower yields on liquid assets (Munyambonera, 2013). However, liquidity levels do not noticeably interfere with the spread between interest income and expenses measured by NIM. Despite this, banks should still exercise careful management of their liquidity levels and make strategic investments in assets that offer an adequate return on investment. A recommended approach is the adoption of a holistic liquidity management strategy that balances the need for liquidity with the objective of generating sufficient returns for investors.

The lack of significant impact of being a $Listed_{it}$ company on profitability, as measured by ROA, ROE, and NIM, can be attributed to the presence of other influential factors. While being listed can offer advantages such as access to capital and increased visibility, it also entails additional costs and constraints. These include increased administrative expenses, compliance-related penalties

and fines, and opportunity costs arising from the allocation of resources and capital toward regulatory compliance rather than income-generating activities. Furthermore, regulatory requirements impose operational constraints, limiting certain activities and risk-taking, which can hinder the pursuit of profitable opportunities. In addition, increased reporting and disclosure obligations, involving rigorous processes, can be time-consuming and costly, diverting resources from revenue generation. Consequently, the potential benefits of being listed might be counterbalanced by the elevated regulatory costs that impact a company's profitability.

We observe a negative relationship between our measures of profitability and the business cycle represented by GDP_t . Contrary to the findings of Căpraru and Ihnatov (2014), our analysis reveals a stronger impact of changes in GDP on a bank's ROE and NIM. The negative coefficient for GDP can be attributed to factors such as increased interest rates that squeeze banks' profit margins and intensified competition in the banking sector, leading to lower prices and higher risk-taking.

Although the negative impact of GDP on ROE and NIM suggests that banks may face headwinds in high GDP growth environments, the effect of GDP on ROA was found to be insignificant. This could be because GDP has a stronger influence on components of ROE and NIM that are not captured by ROA. Furthermore, banks with larger asset bases may have a lower sensitivity of ROA to changes in GDP, as the impact of GDP fluctuations is spread out over a larger asset base.

We observe a negative association between $Inflation_t$ and the NIM of banks, which aligns with the findings of Huynh et al. (2021). This negative relationship can be attributed to several factors. Firstly, inflation tends to increase the cost of funds for banks, while the interest rates on loans may not increase at the same pace. Secondly, high inflation rates often lead to an overall increase in interest rates, making borrowing more expensive for consumers and reducing demand for loans.

However, banks may have diversified revenue streams and investment portfolios that are less sensitive to inflation, allowing them to generate income from sources that are not significantly affected by inflation. This diversification helps banks maintain stable ROE and ROA levels despite inflationary pressures, as evident from their profitability metrics.

Our findings align with prior research conducted by Isayas (2022), and Chi et al. (2022), emphasizing the dynamic nature of profitability models. Notably, we observe highly persistent coefficients on the lagged dependent variable $Profit_{i,t-1}$, indicating that the previous year's profitability significantly influences the current profitability of Indonesian banks. Several factors contribute to this observed persistence in profitability. Firstly, banks with higher profitability tend to have established a strong reputation within the industry, reflecting effective risk management, operational efficiency, and exceptional customer service. As a result, these banks often enjoy increased business opportunities and greater pricing power, allowing them to secure more favorable terms in their transactions. Secondly, profitable banks attract more investment capital from shareholders and lenders. Shareholders are willing to pay a premium for the bank's stock if they anticipate sustained high returns, while lenders are inclined to offer favorable loan terms to banks perceived as low-risk investments. This enhanced access to funding empowers profitable banks to allocate resources toward lucrative investments in the current year, generating higher revenues and long-term profitability.

By acknowledging the significance of past profitability in shaping current profitability, our findings highlight the importance of maintaining a strong track record and fostering a positive reputation within the banking industry. Building trust and attracting investment capital can facilitate future growth opportunities and solidify a bank's competitive position.

Having examined the behavior of Indonesian banks' profitability, we now shift our focus to the impact of capital buffers on measures of risk.

4.2. How capital buffer affects a banks risk-taking?

Our study conducted a comprehensive analysis using a two-step system GMM to examine the influence of capital buffers on banks' risk-taking behavior. The results, presented in Table 3 (columns 5–7), provide valuable insights into this relationship. Specifically, the capital buffer has a significant impact on risk-related metrics, including the non-performing loan (NPL) ratio, risk-weighted asset to total assets (RWATA), and the Z-score.

To begin with, the capital buffer serves as a protective measure that increases shareholders' stake in the game. This discourages banks from engaging in risky investments and aligns the interests of shareholders with the overall risk profile of the bank. Consequently, banks with higher capital buffers adopt more cautious lending practices, mitigating the risk of default and credit losses, as indicated by their lower NPL ratio. In addition, by considering the level of risk associated with their assets, banks with higher capital buffers allocate their assets in a more balanced and risk-sensitive manner, promoting a healthier risk profile, which is reflected in the observed RWATA. Furthermore, stronger capital positions provide banks with the ability to withstand adverse shocks and financial distress, reducing the likelihood of bankruptcy. Consequently, banks with higher capital buffers exhibit greater financial stability and resilience, ensuring their long-term viability.

In summary, our findings highlight the crucial role of capital buffers as a regulatory mechanism to discourage excessive risk-taking and promote a conservative risk profile among banks. These results align with previous research by Vallascas and Hagendorff (2013), Abbas et al. (2019), Abbas et al. (2020), and Bagntasarian and Mamatzakis (2019), supporting the Basel Committee's recommendation to maintain a conservative ratio of capital buffers for enhanced stability. **Accordingly, our analysis provides further supports for and acceptances of the second hypothesis (H2).**

Table 3 provides insights into the relationship between $Profit_{it}$, measured by ROA, and various risk-related metrics. It reveals a negative effect of profitability on both the RWATA ratio and the NPL ratio. This indicates that banks with higher profits tend to have lower levels of risk-weighted assets and fewer non-performing loans. These findings are consistent with previous studies on MENA banks and Swiss commercial banks (Abdelaziz et al., 2022; Alnabulsi et al., 2022; Dietrich & Wanzenried, 2011).

The negative relationship can be explained by the fact that profitable banks have the capacity to hold more assets. This implies that the risk is spread out over a larger base, resulting in a lower RWATA ratio. Similarly, higher profitability enables banks to allocate more resources toward credit risk management, lowering the likelihood of non-performing loans. This indicates that higher profitability enables banks to take proactive measures to manage and reduce credit risk.

However, profitability does not significantly impact the Z-score, a measure of a bank's stability. The Z-score primarily assesses the risk of bankruptcy, while the RWATA and NPL ratios focus on risk-taking behavior and loan quality. Therefore, the absence of a significant relationship between $Profit_{it}$ and the Z-score suggests that profitability may not directly influence the risk of bankruptcy. Nevertheless, the lack of significance does not undermine the importance of profitability for a bank's financial well-being.

The impact of bank $Size_{it}$ on risk measures differs across various indicators. Notably, larger banks tend to exhibit a significant negative relationship with the Z-scores, which reflects their overall financial health. This suggests that larger banks may face greater regulatory scrutiny and operational complexities, leading to higher expenses and lower profitability, ultimately impacting their financial standing (Chiaromonte et al., 2015). However, NPL and RWATA ratios do not show significant dependence on bank size, as they primarily reflect the quality and riskiness of a bank's loan portfolio or assets, and do not necessarily indicative of a bank's overall financial health.

It is important to note that the relationship between bank size and risk is multifaceted and can be influenced by various factors, including management quality, operational efficiency, and market conditions. Moreover, it is crucial to acknowledge the limitations of the study, such as the sample size and bank composition, which may impact the generalizability of the findings. Future research with larger sample sizes and more comprehensive control variables could provide further insights into the specific mechanisms through which bank size influences different risk indicators.

The positive coefficient estimates for $Loans_{it}$ in the RWATA regression suggest that an increase in loans is associated with higher risk-weighted assets, indicating potential increased risk-taking. However, this relationship is tempered by the fact that loans often correspond to larger asset bases,¹² diluting the impact on the risk-weighted ratio. Surprisingly, the positive coefficient for loans in the study suggests that the increase in risk-weighted assets due to loans is substantial enough to offset the dilution effect caused by the larger overall asset base. As a result, RWATA ratio becomes positive and higher, indicating a relatively higher level of risk-weighted assets compared to the total assets. These findings align with previous research highlighting the high regulatory risk weights assigned to lending activities under Basel rules (Abbas et al., 2019; Vallascas & Hagendorff, 2013).

However, the non-significant impact of loans on the NPL ratio and the Z-score indicates that loans are not the sole determinant of these metrics. The NPL ratio reflects the quality of a bank's loan portfolio and is influenced by various factors beyond loans, including effective risk management practices, economic conditions, industry dynamics, and external shocks. Therefore, even if banks maintain well-managed and diversified loan portfolios, these additional factors can have a significant impact on the NPL ratio.

Similarly, the Z-score, is calculated based on various financial indicators, including return on assets (ROA), equity, and the standard deviation of ROA. While loans can contribute to a bank's ROA, other factors such as operating expenses, investment activities, fee-based income, and capital structure also play a role in determining the Z-score. In spite of the complexity and multifaceted nature of this relationship, it remains crucial for banks to prudently manage their lending activities to maintain a healthy balance sheet and avoid excessive risk-taking.

We observed that the $Liquidity_{it}$ of a bank does not exhibit statistical significance in relation to RWATA, NPL, and the Z-score. Several factors could contribute to this lack of significance. Firstly, the impact of liquidity on bank risk may be indirect, operating through intermediate factors or channels. One such factor is the capital buffer maintained by banks. When banks have sufficient liquidity, they are better equipped to absorb unexpected losses and maintain a higher level of capital reserves. This increased capital buffer promotes risk aversion and cautious lending practices, leading to lower levels of risk-weighted assets, non-performing loans, and potentially higher Z-scores. In this scenario, the influence of liquidity on risk indicators is not immediate or direct but operates indirectly through its impact on the capital buffer.

Additionally, the impact of liquidity on risk-taking behavior may be contingent on other factors, such as the quality of risk management practices. Effective risk management systems enable banks to assess and mitigate risks associated with their liquidity positions, ensuring they make informed decisions that align with their risk appetite. Moreover, the presence of alternative funding sources allows banks to maintain a stable risk profile by tapping into these alternative funding sources when needed, potentially masking or moderating the direct impact of the specific liquidity measure examined in the study.

The lack of statistical significance for liquidity aligns with prior research findings, which have yielded mixed results. Some studies have reported a negative association between liquidity and NPL ratios, while others have found no significant relationship (Boungou, 2020; Chen et al., 2017; Jokipii & Milne, 2009; Noreen et al., 2016; Shim, 2013). Although our analysis did not find statistical

significance for liquidity in relation to RWATA, NPL, and the Z-score, the indirect impact of liquidity through the capital buffer and its interaction with other factors suggest a more nuanced relationship.

Being $Listed_{it}$ on the stock exchange does not have a significant impact on RWATA ratio and the Z-score. This could be due to several reasons. Firstly, the market discipline imposed on listed banks may not directly influence their risk-weighted asset composition or overall financial health as captured by the Z-score. The effects of being listed may be more evident in specific areas such as investor pressure for profit generation, which can lead to riskier lending practices and higher non-performing loans.

The NPL ratio may be more directly influenced by market discipline in the form of listing requirements and investor expectations. The pressure to generate profits from investors can incentivize some listed banks to engage in riskier lending, resulting in higher NPL ratios compared to unlisted banks. Previous studies by Cheng and Qu (2020), Iannotta et al. (2013), and Pop et al. (2018) have also found evidence supporting this relationship. However, it is important to note that not all listed banks will necessarily have higher NPL levels.

Our analysis reveals a complex and non-straightforward relationship between GDP_t , a proxy for the Indonesian business cycle, and bank risk-taking. Specifically, we find that GDP does not have a significant effect on the RWATA and NPL ratios, suggesting that macroeconomic factors may not be the primary drivers of credit risk and loan quality in the banking industry. Instead, it appears that bank-specific factors such as profitability and capital levels play a more significant role in determining these risk measures.

However, it is important to note that GDP does have a significant impact on the Z-score of banks, indicating that economic growth positively influences the financial health and stability of banks. One plausible explanation for this positive relationship is that economic growth fosters more efficient financial intermediation, leading to improved risk management, ultimately resulting in higher Z-scores (Ben Jabra et al., 2017; Yitayaw et al., 2023).

The results suggest that $Inflation_t$ does not play a significant role in explaining the variability of banks' risk, as measured by RWATA, NPL, and the Z-score. Although the positive coefficients of inflation indicate a potential impact, the lack of statistical significance suggests that any effect is likely to be small or indirect. One possible explanation for this is that inflation, if stable and predictable, allows banks to adjust their pricing and interest rates accordingly, mitigating its impact on risk. It is worth noting that the absence of significant findings may be specific to the sample and time period used in the study. Inflation may have a significant effect on bank risk in different economic contexts or over an extended period.

The findings reveal that lagged risk, represented by L1. Risk, has a significant positive effect on loan defaults, as reflected in the NPL ratio. However, it does not have a significant impact on the overall risk profile and financial health of the bank, as measured by the RWATA and the Z-score. This suggests that these measures are more sensitive to current levels of risk exposure rather than past risk levels. It highlights the importance for banks to closely monitor their credit risk, including both current and lagged credit risk, and take proactive measures to manage it effectively. Additionally, it emphasizes the need for banks to consider other risk measures, such as RWATA and the Z-score, which provide valuable insights into the overall financial health of the bank and help identify potential risks before they become significant issues. By incorporating multiple risk measures, banks can obtain a comprehensive assessment of their risk exposure and make informed decisions to ensure long-term financial stability.

4.3. Robustness check

To assess the robustness of our main findings, we performed additional analyses using different model specifications. Given that banks with different ownership characteristics may have distinct approaches to managing capital, profitability, and risks (as highlighted by Iannotta et al., 2007, 2013), we divided our sample into subsamples based on bank ownership, distinguishing between government-owned and privately owned banks. This allowed us to investigate whether our results were primarily driven by privately owned banks, which constituted a substantial portion of our observations.¹³ The results for these subsamples are presented in Tables 4 and 5.

After analyzing the overall sample, we found a negative relationship between higher capital buffers and both ROA and ROE. However, when we divided the sample into private and government-owned banks, a more nuanced picture emerged. Table 4 illustrates that the impact of capital buffer on ROA was not significant in government-owned banks while remaining consistent with the main findings of the overall sample in private banks.

Table 4. Estimation results for subsamples based on bank ownership—a robustness check

	<i>Private's bank</i>			<i>Government's bank</i>		
	ROA	ROE	NIM	ROA	ROE	NIM
Risk	−0.0487***	−0.2853***	−0.0159	−0.0005	−0.1237	−0.0249
	(.0151)	(.1104)	(.0202)	(.0126)	(.1453)	(.0202)
Buffer	−0.0459***	−0.4056**	−0.0112	−0.1116	−0.6305***	0.0408
	(.0159)	(.1827)	(.0137)	(.0882)	(.1446)	(.0454)
Size	−0.0048***	−0.0211	−0.0009	0.0001	0.0046	−0.0223***
	(.0016)	(.0128)	(.0024)	(.0040)	(.0213)	(.0060)
Loans	0.0191	0.0090	0.0591**	0.0049	0.0337	0.0913*
	(.0117)	(.1387)	(.0252)	(.0144)	(.1481)	(.0913)
Liquidity	−0.0318*	−0.2687	−0.0097	−0.2638***	−0.7610	−0.0624
	(.0184)	(.1671)	(.0809)	(.0926)	(.7501)	(.1578)
Listed	−0.0117	−0.0681	−0.0065	0.0012	−0.1005	−0.0120***
	(.0166)	(.0993)	(.0108)	(.0108)	(.1971)	(.0046)
GDP	0.0146*	0.0400*	−0.0128	−0.0246**	−0.2670***	−0.0111
	(.0079)	(.0656)	(.0101)	(.0119)	(.0571)	(.0197)
Inflation	0.0010**	0.0056*	−0.0009**	−0.0005	−0.0037	−0.0015
	(.0004)	(.0033)	(.0004)	(.0004)	(.0031)	(.0010)
L1. Profit	0.2419*	0.3512***	0.6015**	0.1562	0.3453***	0.2240
	(.1332)	(.1154)	(.2601)	(.2456)	(.0902)	(.1444)
Cons	−0.2470	−0.1569	0.3781	0.9637***	8.461***	0.7625*
	(.1999)	(1.6574)	(.2930)	(.3478)	(1.505)	(.4504)
Obs.	561			330		
AR 2 p-value	0.418	0.151	0.410	0.674	0.608	0.586
Hansen J-test	0.627	0.268	0.216	0.703	0.735	0.563

Note: Table 4 used a two-step system GMM method to measure the impact of capital buffers on banks' profitability. Banks' capital buffer is a ratio of risk-based capital to risk-weighted assets minus 8%, and all other variables are defined in Table 1. Three varying measures are considered for the model specified in Eq. (1). AR (2) is the p-value for the test of second-order autocorrelation, and the null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. Hansen's J-test stands for the p-value of Hansen's J diagnostic test for instrument validity. The null hypothesis of the Hansen test is that the instruments used are not correlated with residuals (over-identifying restrictions). Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10% levels, respectively.

Table 5. Estimation results for subsamples based on bank ownership—a robustness check

	<i>Private's bank</i>			<i>Government's bank</i>		
	RWATA	NPL	Z-score	RWATA	NPL	Z-score
Profit	−1.1064***	−0.2062*	40.282	−0.2080	−0.2096	15.713
	(.3498)	(.1176)	(33.969)	(1.235)	(.1390)	(15.237)
Buffer	−0.1144**	−0.0215*	12.217***	−0.2660	−0.0496*	26.110***
	(.0581)	(.0111)	(4.379)	(.2298)	(.0286)	(2.075)
Size	−0.0193	0.0022	−1.827**	−0.0398	0.0038	−1.576***
	(.0212)	(.0024)	(.8424)	(.0311)	(.0025)	(.198)
Loans	0.5697***	−0.0002	−1.888	0.5554***	−0.0024	8.469***
	(.1131)	(.0119)	(4.984)	(.0764)	(.0126)	(1.042)
Liquidity	0.1050	−0.0101	2.084	0.8259	−0.0695	0.621
	(.3004)	(.0234)	(9.944)	(.5980)	(.0565)	(8.266)
Listed	−0.0242	0.0097	1.562	0.0078	0.0160***	0.515
	(.0973)	(.0062)	(1.625)	(.0374)	(.0030)	(0.625)
GDP	0.0952	−0.0100	2.686	0.0562	−0.0105	2.144***
	(.0670)	(.0078)	(1.747)	(.1093)	(.0116)	(.568)
Inflation	0.0036	−0.0001	−0.108	0.0025	0.0002	−0.025
	(.0031)	(.0005)	(.108)	(.0040)	(.0002)	(.039)
L1. Risk	−0.0388	0.2777***	0.128	−0.0060	0.3981***	0.093
	(.1043)	(.1001)	(.187)	(.1608)	(.1259)	(.0795)
Cons	0.1703	0.2612	−39.451	−1.431	0.3081	−35.136
	(.1967)	(.1910)	(33.917)	(2.993)	(.2936)	(19.736)
Obs.	561			330		
AR 2 p-value	0.188	0.640	0.194	0.128	0.366	0.305
Hansen J-test	0.190	0.157	0.583	0.438	0.870	0.807

Note: Table 5 used a two-step system GMM method to measure the impact of capital buffers on banks' risk. Banks' capital buffer is a ratio of risk-based capital to risk-weighted assets minus 8%, and all other variables are defined in Table 1. Three varying measures are considered for the model specified in Eq. (2). AR (2) is the p-value for the test of second-order autocorrelation, and the null hypothesis of the serial correlation test is that the errors exhibit no second-order serial correlation. Hansen's J-test stands for the p-value of Hansen's J diagnostic test for instrument validity. The null hypothesis of the Hansen test is that the instruments used are not correlated with residuals (over-identifying restrictions). Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10% levels, respectively.

In the case of government-owned banks, they may have access to cheaper sources of capital. Government banks may receive injections of capital directly from the government, which can be considered a form of internal equity. By obtaining capital from the government, government-owned banks can potentially access equity at more favorable terms compared to private banks, which typically need to raise equity from external sources such as private investors or the stock market. This preferential treatment in acquiring equity from the government could result in lower costs associated with capital for government banks. Consequently, the financial burden of maintaining larger capital buffers is reduced for government-owned banks, as they can access equity without incurring the same expenses as private banks.

While cheaper capital can reduce the financial burden and enhance the cost efficiency of government banks, there may be other challenges or constraints that hinder their ability to generate higher returns on equity. These challenges could include factors such as inefficient operations, limited autonomy in decision-making, political interference, or a focus on non-profit-oriented goals. These factors may outweigh the potential advantages of cheaper capital and contribute to the observed negative impact of capital buffers on ROE in government-owned banks.

In analyzing the control variables, we observe that certain variables exhibit varying signs and levels of significance across different subsamples. For instance, the impact of risk on profitability differs between private banks' NIM and government banks' profitability, with private banks showing a lack of statistical significance. This suggests that private banks may have effective risk management practices in place, which could contribute to a reduced impact of credit risk specifically on their NIM. However, it does not necessarily imply that the impact of credit risk on ROA and ROE is completely eliminated. Effective risk management practices can help private banks mitigate the adverse effects of credit risk, but other factors and considerations may still affect their overall profitability.

Similarly, for government banks, stricter regulations and oversight may play a role in mitigating the impact of credit risks on their profitability measures. This could explain the observed differences in the relationship between credit risk and profitability measures across private and government banks.

Upon examining the relationship between size, liquidity, and profitability in private and government banks, several notable findings emerge. Firstly, the significance of size on profitability diminishes in private banks' ROE and government banks' ROA and ROE. This suggests that the size of government banks may not play a significant role in reducing ROA and ROE, indicating that other factors may have a stronger influence on their profitability. However, as government banks expand and grow larger, they may encounter challenges in generating NIM due to intensified competition and regulatory constraints.

Additionally, the higher funding costs associated with maintaining higher liquidity levels may not hold true for the subsamples of private and government banks. The impact of liquidity on ROE may be mitigated in government-owned banks due to factors such as access to cheaper funding sources or government support. These factors can help offset the higher funding costs associated with liquidity, resulting in reduced pressure on ROE.

Even though the reduced pressure on ROE may alleviate some of the negative effects of liquidity, other aspects related to the bank's operations, income generation, and risk exposure may still be influenced by liquidity levels. As a result, the negative impact of liquidity on ROA may persist, while the impact on ROE is mitigated.

In the case of private banks, they may have tailored strategies in place to optimize the allocation of their liquid assets, aiming to generate higher yields despite the higher funding costs associated with liquidity. These strategies could include investing in higher-yielding assets or engaging in effective asset-liability management practices. While these strategies may be successful in mitigating the negative impact of liquidity on ROE, they may not fully offset the negative impact on ROA.

After analyzing the data, several notable findings emerge regarding the impact of listed status, GDP, and inflation on the profitability of private and government banks. Firstly, listed government banks experience a significant impact on their NIM. This could be attributed to the market pressure they face, which indirectly affects their funding costs by influencing their ability to attract deposits or secure funding at favorable rates.

While government banks may benefit from cheaper funding sources overall, the listed status introduces different dynamics and market expectations that can outweigh the potential benefits. This leads to a significant negative impact on NIM for listed government banks, as they face increased scrutiny and potentially higher funding costs.

Furthermore, GDP exhibits a significant positive impact on both private and government banks' ROA. This suggests that economic growth positively influences the profitability of banks in general. Additionally, when examining private banks' ROE, GDP demonstrates a different sign of coefficient

(positive) and retains its significance, while losing its significance in relation to government banks' NIM. This divergence could be attributed to the responsiveness of private banks to macroeconomic conditions, as they may be more flexible and able to capitalize on favorable economic environments compared to government banks, which may face policy constraints and political pressures due to their broader economic mandates.

In contrast, inflation shows a significant negative impact solely on NIM in the overall sample. However, it exhibits a significant positive impact on private banks' ROA and ROE. This implies that private banks may be more attuned to and responsive to inflationary conditions, allowing them to adjust their operations to capitalize on inflation-related opportunities. Conversely, government banks, with their mandate to provide affordable credit across all economic sectors, may be subject to different constraints and may not experience the same inflation-driven benefits.

We found that the significance of L1. Profit (lagged profitability) on profitability diminishes in government banks' ROA and NIM. This may be attributed to the presence of more stringent restrictions on how government banks can utilize their profits, potentially limiting the impact of past profitability on future profitability.

In conclusion, our findings demonstrate that capital buffers have a significant impact on profitability in private banks, while this effect is not observed in government-owned banks. These results are partly consistent across various subsamples, highlighting the robustness of our findings. However, it is important to acknowledge that the influence of other control variables can vary depending on the specific institutional and market conditions of the banking sector. Therefore, policymakers should take into account the unique characteristics of their respective banking systems when formulating and implementing regulatory policies.

After conducting a closer examination of the risk model through various sub-samples, Table 5 reveals intriguing findings. While higher capital buffers are generally associated with a reduced appetite for risk-taking and a more balanced asset allocation, the significance of this relationship may vary across different types of banks. Government banks, operating under distinct regulatory frameworks and resource constraints, may have different risk management practices and asset allocation strategies that mitigate the need for higher capital buffers to serve as a deterrent against risky investments. As a result, the impact of the capital buffer on risk-weighted assets may not be as significant or relevant for government banks.

Furthermore, the significance of profit on government banks' RWATA and NPL diminishes. This suggests that other factors or objectives may influence their risk management practices. It is possible that government banks prioritize different goals, such as supporting economic growth, providing affordable credit, or fulfilling social mandates, which may impact their risk allocation decisions and the relationship between profitability and risk.

Interestingly, our analysis uncovers a significant positive impact of loans on government banks' Z-score, which is not observed in the overall sample. One possible explanation could be that government banks have a greater focus on providing loans to sectors that are considered less risky or have lower default probabilities. This could be due to their mandate to support specific industries or sectors of the economy. As a result, the loan portfolios of government banks may have a lower overall risk, as reflected by a higher Z-score. However, it is important to note that the impact on NPL, which directly measures the level of non-performing loans, is not statistically significant.

Additionally, the significant positive effect of listed status on private banks' NPL is no longer observed. While the pressure to generate profits from investors can incentivize some listed banks to engage in riskier lending, resulting in higher NPL ratios compared to unlisted banks, it is crucial

to consider other factors such as regulatory requirements, market conditions, and risk management practices that can also influence the NPL ratios of private banks.

While the overall sample shows a positive relationship between GDP and bank stability, our subsample analysis suggests that this relationship may not hold for private banks in this particular context. One possible explanation is that the impact of GDP on bank stability may be influenced by other intervening factors or conditions specific to the subsample of private banks. While private banks may have the ability to adjust their operations and portfolios to capitalize on favorable economic environments, there could be additional factors at play that counteract or attenuate the positive impact of GDP on their Z-score. These factors could include changes in market conditions, shifts in regulatory requirements, or specific challenges faced by private banks within the studied context. This highlights the nuanced nature of the relationship between economic factors and bank stability, which can vary based on the specific characteristics and dynamics of different sub-samples.

After conducting a comprehensive analysis, our results demonstrate the importance of higher capital buffers in reducing risk and enhancing the stability of banks. Banks with higher capital buffers exhibit a lower likelihood of taking risks, lower non-performing loan ratios, and greater financial stability. These findings hold true not only in the overall sample but also in the subsample analysis. However, it is worth noting that the effect of capital buffers on government banks' RWATA ratios shows a distinctive pattern in the subsample analysis. This suggests that the effectiveness of capital buffers as a risk-mitigating tool may vary depending on the bank type and specific context. Additionally, factors such as GDP and listed status may interact with capital buffers, shaping the relationship between capital and risk.

We employed the three-stage least squares (3SLS) as an alternative estimation approach, addressing the limitations of the two-step system GMM allowing for simultaneous modeling of endogenous variables and correlations between error components (Greene, 2018; Wooldridge, 2010; Zellner & Theil, 1962). This approach enables us to estimate all the coefficients of the model and examine the combined effect of capital buffers on bank profitability and risk. While some variables may exhibit a slight loss of significance, our key findings are partly consistent with the overall and sub-samples specifications.

Table 6 presents the results obtained using the 3SLS method, which indicates that capital buffers have a significant negative impact on both ROA and ROE while displaying a significant positive effect on NIM. In other words, while the reduced funding costs associated with higher capital buffers can enhance NIM, the negative impact on profitability indicators like ROA and ROE suggests that the benefits of lower funding costs may not fully compensate for the constraints on income generation imposed by higher capital buffers.

We observed notable changes in the significance and direction of certain variables compared to the system GMM estimation. Specifically, variables such as size and loans exhibit different signs of influence on bank's ROA and ROE, with loans now gaining significance. Surprisingly, the previously significant impact of liquidity on profitability measures has become non-significant. In contrast, the previously insignificant variable of listed status now shows significance across the profitability model. Moreover, the effect of GDP has shifted, with a significant negative impact on ROA in the 3SLS estimate, whereas it was previously significant on ROE and NIM.

The impact of the capital buffer on the overall sample, analyzed using the two-step system GMM and 3SLS method, reveals some variation in the results. Specifically, the sign of NIM changes from negative to positive and becomes significant when estimated using the 3SLS method. However, both estimation methods indicate that the capital buffer has a significant impact on ROA and ROE. Therefore, while there may be some divergence in the magnitude and direction of the effect, the overall conclusion that higher capital buffers can lead to lower profitability is supported by both methods.

Table 6. Estimation results for the overall sample using different estimation methods—a robustness check

	Profitability			Risk		
	ROA	ROE	NIM	RWATA	NPL	Z-score
Risk	-0.0192*** (.0042)	-0.2602*** (.0281)	-0.0137*** (.0048)			
Profit				-1.226*** (.1826)	-0.0836*** (.0204)	7.371 (5.320)
Buffer	-0.0014*** (.0005)	-0.0106*** (.0011)	0.0032*** (.0003)	0.0785*** (.0051)	-0.0035*** (.0002)	5.173*** (.207)
Size	0.0016*** (.0002)	0.0138*** (.0018)	0.0003 (.0002)	0.0093*** (.0021)	-0.0004** (.0002)	-0.121** (.059)
Loans	0.0156*** (.0045)	0.1449*** (.0287)	0.0197*** (.0047)	0.2864*** (.0297)	0.0071** (.0029)	-2.616*** (.830)
Liquidity	-0.0127 (.0111)	-0.0452 (.0693)	-0.0226** (.0115)	0.1718** (.0761)	0.0044 (.0080)	5.461** (2.164)
Listed	-0.0042*** (.0009)	-0.0301*** (.0060)	-0.0029*** (.0009)	-0.0097 (.0070)	-0.0024*** (.0007)	0.242 (.195)
GDP	-0.0178*** (.0057)	-0.2147*** (.0362)	-0.0227*** (.0058)	0.0643 (.0415)	0.0079* (.0043)	0.099 (1.114)
Inflation	0.0003 (.0004)	0.0003 (.0026)	-0.0002 (.0004)	0.0145*** (.0029)	0.0002 (.0003)	-0.015 (.080)
L1. Profit	0.6756*** (.0203)	0.5696*** (.0203)	0.7716*** (.0192)			
L1. Risk				0.6019*** (.0207)	0.4921*** (.0278)	0.765*** (.018)
Cons	0.4854*** (.1600)	5.8690*** (1.0037)	0.6509*** (.1636)	-2.0689* (1.1497)	-0.2154* (.1201)	-2.9846 (31.61)

(Continued)

Table 6. (Continued)						
	Profitability			Risk		
	ROA	ROE	NIM	RWATA	NPL	Z-score
Obs.		891			891	
R-Square	0.548	0.583	0.730	0.573	0.415	0.784
Chi2	1559.86	1765.81	2496.01	1553.30	858.14	3790.60
Chi2 P-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Harvey LM Test	0.582	0.526	0.804	0.384	0.295	0.694
Ovr. System autocorrelation- Harvey LM test= 7.278 P-value= 0.4004		Contemporaneous correlation - Breusch-Pagan LM test= 1049.08 Degrees of freedom= 21.0 P-value= 0.000		Order & rank condition - System is identified		

Note: The estimation is performed using three-stage least squares (3SLS) for the models specified in Eq. (1) and (2) with three varying measures considered for each model. Harvey LM is the P-value of the test for serial autocorrelation, with the null hypothesis that the errors are uncorrelated over time or across observations. The Breusch-Pagan LM test is used to check for the presence of contemporaneous correlation (cross-sectional dependency), with the null hypothesis being that evidence of cross-sectional dependence exists within the panel data. The order and rank condition help to determine whether the system of equations is identified and whether the estimated parameters are reliable. Robust standard errors are reported in parentheses. ***, **, and * denote statistical significance at 1%, 5% and 10% levels, respectively.

After analyzing the impact of capital buffer on risk using two different estimation methods, some contrasting results emerge from Table 6. While the two-step system GMM and 3SLS models show opposite signs for RWATA, both methods support the notion that higher capital buffers lead to lower credit and bankruptcy risk, aligning with the theoretical argument of prudent lending.

The study also reveals that commercial banks in Indonesia tend to increase their holdings of risk assets when the buffer increases, which is consistent with the findings of Noreen et al. (2016). This suggests that when banks have excess capital, they are inclined to invest in riskier assets.

However, to effectively manage the risks associated with these assets, banks must intensify borrower monitoring. By doing so, they can reduce the likelihood of loan defaults and enhance their financial health. In essence, the excess capital acts as a buffer that enables banks to take on more risk while maintaining adequate stability through enhanced monitoring practices. Thus, higher capital buffers incentivize banks to allocate additional resources for risk management, safeguard larger equity stakes, and improve their overall financial health, thereby mitigating the moral hazard problem.

Although the specific impact of capital buffer on various risk measures may differ depending on the estimation method employed, the overall conclusion remains consistent, maintaining higher levels of capital buffer is beneficial for banks. It is associated with lower credit risk and improved financial stability, emphasizing the significance of maintaining sufficient capital levels to effectively manage risks. These findings align with the recommendations of Vallascas and Hagendorff (2013), Abbas et al. (2019), and Bagntasarian and Mamatzakis (2019), who support the Basel Committee's suggestion to maintain a conservative ratio of the capital buffer as a means to promote financial stability.

It is also worth noting that some control variables exhibit inconsistent or non-significant effects across different estimation methods. For instance, while size demonstrates a positive significant impact on RWATA, it has a negative significant impact on NPL and Z-score. This implies that larger banks may face specific challenges that affect their overall financial health despite having lower credit risk.

Furthermore, the magnitude and significance of the effect of loans on different risk measures vary between the two estimations. In the 3SLS estimation, loans play a crucial role in determining a bank's risk profile, credit risk, and financial health. Additionally, liquidity has a positive impact on RWATA and Z-score in the 3SLS, whereas it is not significant in the two-step system GMM. This indicates a potential trade-off between liquidity and risk, which has implications for a bank's financial stability.

The listed status displays different signs in the 3SLS, suggesting that the impact of being listed on a bank's profile may differ depending on the estimation method employed. Moreover, the study reveals that a bank's credit risk is influenced by economic growth, while inflation may lead to higher portfolio risk for banks.

Interestingly, the lagged risk variable (L1. Risk) demonstrates a positive significant impact on NPL in both the system GMM and 3SLS estimations, indicating that past credit risk serves as a reliable predictor of current credit risk. However, there are disparities in the results for RWATA and Z-score. In the system GMM estimation, L1. Risk does not exhibit a significant impact on either variable, whereas, in the 3SLS estimation, it has a positive significant impact on both RWATA and Z-score. This suggests that past credit risk may have a lasting effect on a bank's portfolio risk and overall financial health.

5. Conclusion

Our study investigates the relationship between capital buffers, bank profitability, and risk behavior in Indonesian commercial banks using a balanced panel of banks and the two-step system GMM estimation technique. By controlling for various determinants of profitability and risk levels, our study conducts additional analyses with different model specifications, and the key findings appear to hold up to a range of robustness checks.

The results demonstrate that capital buffers enhance financial stability by increasing shareholders' stake in the game, leading to improved borrower monitoring and increased buffers against losses. However, holding buffer capital comes at a cost, as it reduces return on total assets and equities. This could be due to increased costs or reduced ability to pursue riskier yet potentially more profitable investments. Moreover, higher capital buffers may limit banks' leverage, impacting their ability to generate profits from borrowed funds.

Although the effect on net interest margin is inconclusive, higher capital buffers act as a safety net against potential losses, benefiting the bank and its stakeholders in the long run. Therefore, the negative effect on return on assets and return on equity must be balanced against the positive effect of increased safety and stability in the financial system.

Our estimations further reveal that a higher risk of default on loans indicates a greater likelihood of losses, non-performing assets, and increased operating expenses related to risk management, all of which can lower bank profitability. Therefore, banks should exercise caution when taking on risky investments. It is also crucial to strike a balance between risk-taking and risk management to achieve optimal profitability in the long term.

Moreover, while profitability is important for a bank's reputation, value, and overall financial health, it should not come at the expense of adequate risk management and capitalization. Banks that prioritize profitability without sufficient regard for risk management and capitalization may engage in risky behavior or face financial difficulties during economic downturns. Thus, banks need to balance their profitability goals with prudent risk management practices.

This study focuses on the effects of capital buffers on profitability and risk-taking, and future analysis should consider additional factors such as corporate governance and ownership structure to further understand the role of managers in promoting banking stability and profitability. Additionally, emerging challenges from digital currencies, Fintech, and blockchain should be explored to gain insights into the 21st-century banking sector's profitability and risk-taking dynamics.

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Data availability statement

The data that support the findings of this study are available from the corresponding author, Hendrawan, upon reasonable request.

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Notes

1. When banks rely on uninsured funding, they face higher interest expenses, which include higher premiums due to the expected bankruptcy costs. By increasing the equity base, banks can reduce the probability of bankruptcy, leading to lower expected bankruptcy costs (Berger, 1995).
2. It is implicit in this view that the violation of the minimum capital requirement is expensive for the bank and that the bank experiences limitations and/or costs while readjusting its portfolio and increasing capital. Subject to these circumstances, the role of buffer capital as a hedging mechanism against minimum capital violation is well founded.

3. As noted in the trade-off theory, optimal capital trades off costs with benefits and should enhance performance (Berger et al., 1995). However, if capital requirements become binding, a bank may need to hold more capital than the level that maximizes its value, resulting in a negative relationship between bank capital and profitability in the short and long run (Osborne et al., 2012).
4. For example, studies by Holmstrom and Tirole (1997), Allen et al. (2011), and Mehran and Thakor (2011) have demonstrated that higher levels of bank capital result in higher levels of borrower monitoring, which, in turn, reduces the probability of default.
5. The statement suggests that banks with higher profits have the option to retain a larger portion of those profits as additional capital reserves, thereby strengthening their financial position. However, it also indicates that despite being profitable, some banks may choose to maintain a relatively smaller capital as a buffer. This decision could be driven by factors such as a higher risk appetite or a strategic focus on profit-generating activities rather than capital reserves.
6. According to Reinhart and Rogoff (2011), banking issues are the result of a prolonged decline in asset quality, and the start of a banking crisis can be marked by a significant increase in non-performing loans.
7. The term “going concern capital” refers to the capital that a bank has available to absorb losses without resulting in the bank going bankrupt. From a regulatory standpoint, “gone concern capital” is the capital that will only be used to absorb losses in the event of the bank’s liquidation.
8. The minimum capital adequacy requirement for the entire sample period was set at 8.0%.
9. To account for the varying business models of banks, we need to consider their areas of specialization. For instance, some banks may focus on lending, while others may prioritize non-proprietary trading activities, etc. This specialization can impact the relationship between capital buffers, risk-taking, and profitability. To address this issue, we used the ratio of loans to total earning assets as a control variable.
10. Ideally, we would have preferred to use liquidity proxies defined in Basel III, such as the Liquidity Coverage Ratio or the Net Stable Funding Ratio. However, these data are only available from 2017 onwards. Instead, we used the liquid assets to total assets ratio as a proxy for liquidity. This ratio indicates the level of liquidity that banks hold, rather than liquidity risk, which is associated with liabilities payments. To calculate the total liquid assets, we included both primary and secondary liquid assets as defined and utilized by the Indonesian Financial Services Authority. For further details, please refer to SEOJK available at: <https://ojk.go.id/id/regulasi/Documents/Pages/SEOJK-tentang-Rencana-Bisnis-Bank-Umum-/SAL%20-%20Lamp%205.pdf>.
11. This is of the essence when a bank maintains a higher level of capital buffer, it needs to hold more expensive forms of capital, such as equity, as compared to cheaper forms like debt.
12. When loans are extended by banks, they increase the total asset base of the bank. This is because the bank has a claim on the repayments from the borrowers, which are expected to provide future economic benefits to the bank.
13. Both government and private banks are subject to the same capital requirements mandated by regulatory authorities.

References

- Abbas, F., & Ali, S. (2022). Is economic freedom a moderator of the relationship between bank capital and profitability? *Scientific Annals of Economics and Business*, 69(2), 273–292. <https://doi.org/10.47743/saeb-2022-0016>
- Abbas, F., Ali, S., & McMillan, D. (2020). Dynamics of bank capital ratios and risk-taking: Evidence from US commercial banks. *Cogent Economics & Finance*, 8(1), 1838693. <https://doi.org/10.1080/23322039.2020.1838693>
- Abbas, F., Ali, S., Yousaf, I., & Wong, W. K. (2022). Economics of risk-taking, risk-based capital and profitability: Empirical evidence of Islamic banks. *Asian Academy of Management Journal of Accounting and Finance*, 18(1), 1–31. <https://doi.org/10.21315/aamjaf2022.18.1.1>
- Abbas, F., Butt, S., Masood, O., & Javaria, K. (2019). The effect of bank capital buffer on bank risk and net interest margin: Evidence from the US. *Global Journal of Social Sciences Studies*, 5(2), 72–87. <https://doi.org/10.20448/807.5.2.72.87>
- Abdelaziz, H., Rim, B., & Helmi, H. (2022). The interactional relationships between credit risk, liquidity risk and bank profitability in MENA Region. *Global Business Review*, 23(3), 561–583. <https://doi.org/10.1177/0972150919879304>
- Afrifa, G. A., Gyaopong, E., & Zalata, A. M. (2019). Buffer capital, loan portfolio quality and the performance of microfinance institutions: A global analysis. *Journal of Financial Stability*, 44(1), 1–16. <https://doi.org/10.1016/j.jfs.2019.100691>
- Aggarwal, R., & Jacques, K. T. (2001). The impact of FDICIA and prompt corrective action on bank capital and risk: Estimates using a simultaneous equations model. *Journal of Banking and Finance*, 25(6), 1139–1160. [https://doi.org/10.1016/S0378-4266\(00\)00125-4](https://doi.org/10.1016/S0378-4266(00)00125-4)
- Agoraki, M. E. K., Delis, M. D., & Pasiouras, F. (2011). Regulations, competition and bank risk-taking in transition countries. *Journal of Financial Stability*, 7(1), 38–48. <https://doi.org/10.1016/j.jfs.2009.08.002>
- Allen, F., Carletti, E., & Marquez, R. (2011). Credit market competition and capital regulation. *Review of Financial Studies*, 24(4), 983–1018. <https://doi.org/10.1093/rfs/hhp089>
- Alnabulsi, K., Kozarević, E., & Hakimi, A. (2022). Assessing the determinants of non-performing loans under financial crisis and health crisis: Evidence from the MENA banks. *Cogent Economics & Finance*, 10(1), 2124665. <https://doi.org/10.1080/23322039.2022.2124665>
- Altunbas, Y., Carbo, S., Gardener, E. P. M., & Molyneux, P. (2007). Examining the relationships between capital, risk and efficiency in European Banking. *European Financial Management*, 13(1), 49–70. <https://doi.org/10.1111/j.1468-036X.2006.00285.x>
- Amare, A., & McMillan, D. (2021). Capital structure and profitability: Panel data evidence of private banks in Ethiopia. *Cogent Economics & Finance*, 9(1), 1953736. <https://doi.org/10.1080/23322039.2021.1953736>
- Athanasoglou, P. P., Brissimis, S. N., & Delis, M. D. (2008). Bank-specific, industry-specific and macroeconomic determinants of bank profitability. *Journal of International Financial Markets, Institutions and Money*, 18(2), 121–136. <https://doi.org/10.1016/j.intfin.2006.07.001>
- Awdeh, A., EL-Moussawi, C., & Machrouh, F. (2011). The effect of capital requirements on banking risk. *International Research Journal of Finance & Economics*, 66(66), 133–146.

- Ayuso, J., Pérez, D., & Saurina, J. (2004). Are capital buffers pro-cyclical? evidence from Spanish panel data. *Journal of Financial Intermediation*, 13(2), 249–264. [https://doi.org/10.1016/S1042-9573\(03\)00044-5](https://doi.org/10.1016/S1042-9573(03)00044-5)
- Bagntasarian, A., & Mamatzakis, E. (2019). Testing for the underlying dynamics of bank capital buffer and performance nexus. *Review of Quantitative Finance & Accounting*, 52(2), 347–380. <https://doi.org/10.1007/s11156-018-0712-y>
- Barry, T. A., Lepetit, L., & Tarazi, A. (2011). Ownership structure and risk in publicly held and privately owned banks. *Journal of Banking and Finance*, 35(5), 1327–1340. <https://doi.org/10.1016/j.jbankfin.2010.10.004>
- BCBS. (2010). Basel III a global regulatory framework. In *Basel committee on banking supervision*, Issue December. http://www.bis.org/publ/bcbs189_dec2010.pdf
- Beck, T., Demirgü-Kunt, A., & Levine, R. (2010). Financial institutions and markets across countries and over time: The updated financial development and structure database. *World Bank Economic Review*, 24(1), 77–92. <https://doi.org/10.1093/wber/lhp016>
- Ben Jabra, W., Mighri, Z., Mansouri, F., & McMillan, D. (2017). Determinants of European bank risk during financial crisis. *Cogent Economics & Finance*, 5(1), 1298420. <https://doi.org/10.1080/23322039.2017.1298420>
- Bennaceur, S., & Goaid, M. (2008). The determinants of commercial bank interest margin and profitability: evidence from Tunisia samy bennaceur 1 mohamed goaid 2. *Frontiers in Finance and Economics* –, 5(1), 106–130.
- Berger, A. N. (1995). The profit-structure relationship in banking tests of market-power and efficient-structure hypotheses. *Journal of Money, Credit and Banking*, 27(2), 404–431. <https://doi.org/10.2307/2077876>
- Berger, A. N., Herring, R. J., & Szegö, G. P. (1995). The role of capital in financial institutions. *Journal of Banking & Finance*, 19(3–4), 393–430. [https://doi.org/10.1016/0378-4266\(95\)00002-X](https://doi.org/10.1016/0378-4266(95)00002-X)
- Bitar, M., Pukthuanthong, K., & Walker, T. (2018). The effect of capital ratios on the risk, efficiency and profitability of banks: Evidence from OECD countries. *Journal of International Financial Markets, Institutions and Money*, 53, 227–262. <https://doi.org/10.1016/j.intfin.2017.12.002>
- Bitar, M., Saad, W., & Benlemlih, M. (2016). Bank risk and performance in the MENA region: The importance of capital requirements. *Economic Systems*, 40(3), 398–421. <https://doi.org/10.1016/j.ecosys.2015.12.001>
- Blundell, R., & Bond, S. (1998). Initial conditions and moment restrictions in dynamic panel data models. *Journal of Econometrics*, 87(1), 115–143. [https://doi.org/10.1016/S0304-4076\(98\)00009-8](https://doi.org/10.1016/S0304-4076(98)00009-8)
- Boungou, W. (2020). Negative interest rates policy and banks' risk-taking: Empirical evidence. *Economics Letters*, 186, 108760. <https://doi.org/10.1016/j.econlet.2019.108760>
- Căpraru, B., & Ihnatov, I. (2014). Banks' profitability in selected central and Eastern European countries. *Procedia Economics and Finance*, 16(May), 587–591. [https://doi.org/10.1016/S2212-5671\(14\)00844-2](https://doi.org/10.1016/S2212-5671(14)00844-2)
- Cheng, M., & Qu, Y. (2020). Does bank FinTech reduce credit risk? Evidence from China. *Pacific Basin Finance Journal*, 63, 101398. <https://doi.org/10.1016/j.pacfin.2020.101398>
- Chen, M., Wu, J., Jeon, B. N., & Wang, R. (2017). Monetary policy and bank risk-taking: Evidence from emerging economies. *Emerging Markets Review*, 31, 116–140. <https://doi.org/10.1016/j.ememar.2017.04.001>
- Chiaromonte, L., Croci, E., & Poli, F. (2015). Should we trust the Z-score? Evidence from the European Banking Industry. *Global Finance Journal*, 28, 111–131. <https://doi.org/10.1016/j.gfj.2015.02.002>
- Chi, L. H. D., Hac, L. D., Nhat, N. Q., & Hang, B. T. T. (2022). Corporate environmental responsibility and financial performance: The moderating role of ownership structure and listing status of Vietnam banks. *Cogent Economics & Finance*, 10(1), 2087286. <https://doi.org/10.1080/23322039.2022.2087286>
- Chortareas, G. E., Girardone, C., & Ventouri, A. (2012). Bank supervision, regulation, and efficiency: Evidence from the European Union. *Journal of Financial Stability*, 8(4), 292–302. <https://doi.org/10.1016/j.jfs.2011.12.001>
- Daher, H., Masih, M., & Ibrahim, M. (2015). The unique risk exposures of Islamic banks' capital buffers: A dynamic panel data analysis. *Journal of International Financial Markets, Institutions and Money*, 36, 36–52. <https://doi.org/10.1016/j.intfin.2015.02.012>
- Danarsari, D.N., Viverita, & Rokhim, R. (2018). Capital buffer for stronger bank stability: Empirical evidence from Indonesia's commercial banks. *Pertanika Journal of Social Sciences & Humanities*, 26(1), 55–67.
- Dietrich, A., & Wanzenried, G. (2010). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money*, 21(3), 307–327. <https://doi.org/10.1016/j.intfin.2010.11.002>
- Dietrich, A., & Wanzenried, G. (2011). Determinants of bank profitability before and during the crisis: Evidence from Switzerland. *Journal of International Financial Markets, Institutions and Money*, 21(3), 307–327. <https://doi.org/10.1016/j.intfin.2010.11.002>
- Dietrich, A., & Wanzenried, G. (2014). The determinants of commercial banking profitability in low-, middle-, and high-income countries. *The Quarterly Review of Economics & Finance*, 54(3), 337–354. <https://doi.org/10.1016/j.qref.2014.03.001>
- Ding, D., & Sickles, R. C. (2019). Capital regulation, efficiency, and risk taking: A spatial panel analysis of US Banks. *Panel Data Econometrics*, 2. <https://doi.org/10.1016/b978-0-12-815859-3.00013-5>
- Drakos, A. A., Kouretas, G. P., & Tsoumas, C. (2016). Ownership, interest rates and bank risk-taking in Central and Eastern European countries. *International Review of Financial Analysis*, 45, 308–319. <https://doi.org/10.1016/j.irfa.2014.08.004>
- Ekinci, R., & Poyraz, G. (2019). The effect of credit risk on financial performance of deposit banks in Turkey. *Procedia Computer Science*, 158, 979–987. <https://doi.org/10.1016/j.procs.2019.09.139>
- Fiordelisi, F., Marques-Ibanez, D., & Molyneux, P. (2011). Efficiency and Risk in European Banking. *Journal of Banking and Finance*, 35(5), 1315–1326. <https://doi.org/10.1016/j.jbankfin.2010.10.005>
- Flannery, M. J., & Rangan, K. P. (2008). What caused the bank capital build-up of the 1990s? *Review of Finance*, 12(2), 391–429. <https://doi.org/10.1093/rof/rfm007>
- Gadzo, S. G., Kportorgbi, H. K., Gatsi, J. G., & Murray, L. (2019). Credit risk and operational risk on financial performance of universal banks in Ghana: A partial least squared structural equation model (PLS SEM) approach. *Cogent Economics & Finance*, 7(1), 1589406. <https://doi.org/10.1080/23322039.2019.1589406>
- Gale, D. (2010). Capital regulation and risk sharing. *International Journal of Central Banking*, 6(4), 187–204.

- García-Herrero, A., Gavilá, S., & Santabábara, D. (2009). What explains the low profitability of Chinese Banks? *Journal of Banking and Finance*, 33(11), 2080–2092. <https://doi.org/10.1016/j.jbankfin.2009.05.005>
- García-Suaza, A. F., Gómez-González, J. E., Pabón, A. M., & Tenjo-Galarza, F. (2012). The cyclical behavior of bank capital buffers in an emerging economy: Size does matter. *Economic Modelling*, 29(5), 1612–1617. <https://doi.org/10.1016/j.econmod.2012.05.021>
- Ghosh, S. (2009). Charter value and risk-taking: Evidence from Indian banks. *Journal of the Asia Pacific Economy*, 14(3), 270–286. <https://doi.org/10.1080/13547860902975606>
- Goddard, J., Liu, H., Molyneux, P., & Wilson, J. O. S. (2010). Do Bank Profits Converge? *European Financial Management*, 19(2), 345–365. <https://doi.org/10.1111/j.1468-036X.2010.00578.x>
- Goddard, J., Molyneux, P., & Wilson, J. O. S. (2004). The profitability of European banks: A cross-sectional and dynamic panel analysis. *The Manchester School*, 72(3), 363–381. <https://doi.org/10.1111/j.1467-9957.2004.00397.x>
- Greene, W. H. (2018). *Econometric Analysis* (8th ed.). Pearson.
- Guidara, A., Lai, V. S., Soumaré, I., & Tchana, F. T. (2013). Banks' capital buffer, risk and performance in the Canadian banking system: Impact of business cycles and regulatory changes. *Journal of Banking and Finance*, 37(9), 3373–3387. <https://doi.org/10.1016/j.jbankfin.2013.05.012>
- Holmstrom, B., & Tirole, J. (1997). Financial Intermediation, Loanable Funds, and the Real Sector. *Quarterly Journal of Economics*, 112(3), 979–1014. <https://doi.org/10.1162/0033539755316>
- Hughes, J. P., & Mester, L. J. (1998). Bank capitalization and cost: Evidence of scale economies in risk management and signaling. *Review of Economics and Statistics*, 80(2), 314–325. <https://doi.org/10.1162/003465398557401>
- Huynh, J., Dang, V. D., & McMillan, D. (2021). Loan portfolio diversification and bank returns: Do business models and market power matter? *Cogent Economics & Finance*, 9(1), 1891709. <https://doi.org/10.1080/23322039.2021.1891709>
- Iannotta, G., Nocera, G., & Sironi, A. (2007). Ownership structure, risk and performance in the European Banking Industry. *Journal of Banking and Finance*, 31(7), 2127–2149. <https://doi.org/10.1016/j.jbankfin.2006.07.013>
- Iannotta, G., Nocera, G., & Sironi, A. (2013). The Impact of Government Ownership on Bank Risk. *Journal of Financial Intermediation*, 22(2), 152–176. <https://doi.org/10.1016/j.jfi.2012.11.002>
- Isayas, Y. N. (2022). Determinants of banks' profitability: Empirical evidence from banks in Ethiopia. *Cogent Economics & Finance*, 10(1), 2031433. <https://doi.org/10.1080/23322039.2022.2031433>
- Jacques, K., & Nigro, P. (1997). Risk-based capital, portfolio risk, and bank capital: A simultaneous equations approach. *Journal of Economics and Business*, 49(6), 533–547. [https://doi.org/10.1016/s0148-6195\(97\)00038-6](https://doi.org/10.1016/s0148-6195(97)00038-6)
- Jiang, H., Zhang, J., & Sun, C. (2020). How does capital buffer affect bank risk-taking? New evidence from China using quantile regression. *China Economic Review*, 60, 1–34. <https://doi.org/10.1016/j.chieco.2019.04.008>
- Jokipii, T., & Milne, A. (2008). The cyclical behaviour of European Bank Capital Buffers. *Journal of Banking and Finance*, 32(8), 1440–1451. <https://doi.org/10.1016/j.jbankfin.2007.12.001>
- Jokipii, T., & Milne, A. (2009). *Bank capital buffer and risk adjustment decisions*. Swiss National Bank.
- Jokipii, T., & Milne, A. (2011). Bank capital buffer and risk adjustment decisions. *Journal of Financial Stability*, 7(3), 165–178. <https://doi.org/10.1016/j.jfs.2010.02.002>
- Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics*, 93(2), 259–275. <https://doi.org/10.1016/j.jfineco.2008.09.003>
- Lee, C. C., & Hsieh, M. F. (2013). The impact of bank capital on profitability and Risk in Asian Banking. *Journal of International Money and Finance*, 32(1), 251–281. <https://doi.org/10.1016/j.jimonfin.2012.04.013>
- Lindquist, K. G. (2004). Banks' Buffer Capital: How Important is Risk. *Journal of International Money and Finance*, 23(3), 493–513. <https://doi.org/10.1016/j.jimonfin.2004.01.006>
- López-Espinosa, G., Moreno, A., & Pérez de Gracia, F. (2011). Banks' net interest margin in the 2000s: A macro-accounting international perspective. *Journal of International Money and Finance*, 30(6), 1214–1233. <https://doi.org/10.1016/j.jimonfin.2011.06.001>
- Lotte, P. (2016). *The Impact of Bank Capital in Profitability in the EU: An Examination of Multiple Capital Ratios*. University of Groningen.
- Masdjoko, G. N., Suwanti, T., Nuswandari, C., & Sudiyo, B. (2023). The relationship between profitability and capital buffer in the Indonesian banking sector. *Banks and Bank Systems*, 18(2), 13–23. [https://doi.org/10.21511/bbs.18\(2\).2023.02](https://doi.org/10.21511/bbs.18(2).2023.02)
- Maudos, J., & Fernández de Guevara, J. (2004). Factors explaining the interest margin in the banking sectors of the European Union. *Journal of Banking and Finance*, 28(9), 2259–2281. <https://doi.org/10.1016/j.jbankfin.2003.09.004>
- Mehran, H., & Thakor, A. (2011). Bank capital and value in the cross-section. *Review of Financial Studies*, 24(4), 1019–1067. <https://doi.org/10.1093/rfs/hhq022>
- Milne, A., & Whalley, A. E. (2001). Bank Capital and Incentives for Risk-Taking. *Cass Business School Research Paper*, WBS Finance Group Research Paper, (15). <https://doi.org/10.2139/ssrn.303176>
- Milne, A., & Whalley, A. E. (2002). Bank Capital Regulation and Incentives for Risk-Taking. *SSRN Electronic Journal*. Issue December. <https://doi.org/10.2139/ssrn.299319>
- Monetary Fund, I., & IMF. (2017). Indonesia: Financial system stability assessment—press release and statement by the executive director for Indonesia. *IMF Staff Country Reports*, 17(152), 1. <https://doi.org/10.5089/9781484303559.002>
- Mujtaba, G., Akhtar, Y., Ashfaq, S., Abbas Jadoon, I., & Hina, S. M. (2022). The nexus between Basel capital requirements, risk-taking and profitability: What about emerging economies? *Economic Research-Ekonomska Istrazivanja*, 35(1), 230–251. <https://doi.org/10.1080/1331677X.2021.1890177>
- Munyambonera, E. F. (2013). Determinants of Commercial Bank Profitability in Sub-Saharan Africa. *International Journal of Economics and Finance*, 5(9), 134–147. <https://doi.org/10.5539/ijef.v5n9p134>
- Naceur, S. B., & Kandil, M. (2009). The Impact of Capital Requirements on Banks' Cost of Intermediation and Performance: The Case of Egypt. *Journal of Economics and Business*, 61(1), 70–89. <https://doi.org/10.1016/j.jeconbus.2007.12.001>
- Noreen, U., Alamdar, F., & Tariq, T. (2016). Capital Buffers and Bank Risk: Empirical Study of Adjustment of

- Pakistani Banks. *International Journal of Economics and Financial Issues*, 6(4), 1798–1806.
- OJK, I. F. S. A. (2020). Indonesia Banking Statistics 2020. 19(1), <https://www.ojk.go.id/id/kanal/perbankan/data-dan-statistik/statistik-perbankan-indonesia/Pages/Statistik-Perbankan-Indonesia—Desember-2020.aspx>
- Osborne, M., Fuertes, A., & Milne, A. (2012). Capital and Profitability in Banking: Evidence from US Banks. In *3rd Emerging Scholars in Banking and Finance Conference*, Cass Business School. http://www.cass.city.ac.uk/_data/assets/pdf_file/0013/152122/Osborne_Matthew_Capital-and-earnings-in-banking-Emerging-Scholars.pdf
- Pasiouras, F., Liadaki, A., & Zopounidis, C. (2008). Bank Efficiency and Share Performance: Evidence from Greece. *Applied Financial Economics*, 18(14), 1121–1130. <https://doi.org/10.1080/09603100701564346>
- Perotti, E., Ratnovski, L., & Vlahu, R. (2011). Capital regulation and tail risk. *International Journal of Central Banking*, 7(4), 123–163. <https://doi.org/10.2139/ssrn.1910491>
- Pop, I. D., Cepoi, C. O., & Anghel, D. G. (2018). Liquidity-threshold effect in non-performing loans. *Finance Research Letters*, 27, 124–128. <https://doi.org/10.1016/j.frl.2018.02.012>
- Reinhart, C. M., & Rogoff, K. S. (2011). From financial crash to debt crisis. *American Economic Review*, 101(5), 1676–1706. <https://doi.org/10.1257/aer.101.5.1676>
- Rime, B. (2001). Capital Requirements and Bank Behaviour: Empirical Evidence for Switzerland. *Journal of Banking and Finance*, 25(4), 789–805. [https://doi.org/10.1016/S0378-4266\(00\)00105-9](https://doi.org/10.1016/S0378-4266(00)00105-9)
- Roodman, D. (2009). How to do xtabond2: An introduction to difference and system GMM in Stata. *Stata Journal*, 9(1), 86–136. <https://doi.org/10.1177/1536867x0900900106>
- Saadaoui, Z. (2014). Business cycle, market power and bank behaviour in emerging countries. *International Economics*, 139(February), 109–132. <https://doi.org/10.1016/j.inteco.2014.04.001>
- Saleh, I., Abu Afifa, M., & Murray, L. (2020). The effect of credit risk, liquidity risk and bank capital on bank profitability: Evidence from an emerging market. *Cogent Economics & Finance*, 8(1), 1814509. <https://doi.org/10.1080/23322039.2020.1814509>
- Shim, J. (2013). Bank capital buffer and portfolio risk: The influence of business cycle and revenue diversification. *Journal of Banking and Finance*, 37(3), 761–772. <https://doi.org/10.1016/j.jbankfin.2012.10.002>
- Shrieves, R. E., & Dahl, D. (1992). The relationship between risk and capital in commercial banks. *Journal of Banking and Finance*, 16(2), 439–457. [https://doi.org/10.1016/0378-4266\(92\)90024-T](https://doi.org/10.1016/0378-4266(92)90024-T)
- Stiroh, K. J., & Rumble, A. (2006). The dark side of diversification: The case of US financial holding companies. *Journal of Banking and Finance*, 30(8), 2131–2161. <https://doi.org/10.1016/j.jbankfin.2005.04.030>
- Tabak, B. M., Fazio, D. M., Ely, R. A., Amaral, J. M. T., & Cajueiro, D. O. (2017). The effects of capital buffers on profitability: An empirical study. *Economics Bulletin*, 37(3), 1468–1473.
- Tabak, B. M., Li, D., Vasconcelos, L., De, J. V. L., & Cajueiro, D. O. (2013). Do Capital Buffers Matter? A Study on the Profitability and Funding Costs Determinants of the Brazilian Banking System. Banco Central do Brasil.
- Tan, Y. (2016). The Impacts of Risk and Competition on Bank Profitability in China. *Journal of International Financial Markets, Institutions and Money*, 40, 85–110. <https://doi.org/10.1016/j.intfin.2015.09.003>
- Tan, Y., & Floros, C. (2013). Risk, Capital and Efficiency in Chinese Banking. *Journal of International Financial Markets, Institutions and Money*, 26(1), 378–393. <https://doi.org/10.1016/j.intfin.2013.07.009>
- Vallascas, F., & Hagendorff, J. (2013). The risk Sensitivity of Capital Requirements: Evidence from an International Sample of Large Banks. *Review of Finance*, 17(6), 1947–1988. <https://doi.org/10.1093/rof/rfs042>
- Vazquez, F., & Federico, P. (2015). Bank Funding Structures and Risk: Evidence from the Global Financial Crisis. *Journal of Banking and Finance*, 61, 1–14. <https://doi.org/10.1016/j.jbankfin.2015.08.023>
- Wooldridge, J. M. (2010). *Econometric Analysis of Cross Section and Panel Data*. MIT press. <https://doi.org/10.1515/humr.2003.021>
- Yanikkaya, H., Gümüç, N., & Pabuçcu, Y. U. (2018). How profitability differs between conventional and Islamic banks: A dynamic panel data approach. *Pacific Basin Finance Journal*, 48(January), 99–111. <https://doi.org/10.1016/j.pacfin.2018.01.006>
- Yitayaw, M. K., Mogess, Y. K., Feyisa, H. L., Mamo, W. B., & Abdulahi, S. M. (2023). Determinants of bank stability in Ethiopia: A two-step system GMM estimation. *Cogent Economics & Finance*, 11(1), 2161771. <https://doi.org/10.1080/23322039.2022.2161771>
- Yuwonoputro, D. A., & Syaichu, M. (2019). Indonesian banks risk-taking: The effect of liquidity risk, capital buffer and bopo: z-score measure asproach. *Diponegoro Journal of Management*, 8(3), 149–160.
- Zellner, A., & Theil, H. (1962). Three-stage least squares: Simultaneous estimation of simultaneous equations. *Econometrica*, 30(1), 54–78. <https://doi.org/10.2307/1911287>
- Zhang, J., Wang, P., & Qu, B. (2012). Bank risk taking, efficiency, and law enforcement: Evidence from Chinese city commercial banks. *China Economic Review*, 23(2), 284–295. <https://doi.org/10.1016/j.chieco.2011.12.001>