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Article

Natural Disasters and Business Performance of Commercial Banks: The Moderating Role of Capitalization and Provisions for Loan Losses

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Abstract

This study investigates the impact of natural disasters on the performance of commercial banks, with a focus on the moderating roles of capitalization and loan loss provisions. Utilizing panel data from 29 Vietnamese commercial banks over the period 2009-2024, sourced from FiinPro, Open Development Mekong, and the General Statistics Office of Vietnam, the analysis employs the Cross-Sectionally Augmented Autoregressive Distributed Lag (CS-ARDL) model. The findings reveal that loan loss provisions positively moderate the procyclical relationship between disaster-induced damages and bank profitability, measured by return on assets (ROA) and return on equity (ROE). In contrast, capitalization only exhibits a statistically significant moderating effect on the relationship between natural disasters and ROE, also in a positive direction. These results suggest that banks should prioritize credit risk management and maintain adequate capital buffers to enhance profitability, even under adverse environmental conditions. Furthermore, green finance and green credit should be emphasized as integral components of risk mitigation strategies.

Keywords: banking performance; capitalization; natural disasters; provisions

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1. Introduction

Climate change has increasingly intensified natural disasters worldwide (Newman & Noy, 2023). These disasters are not only growing in severity but also spreading across larger geographic areas. They result in substantial economic and human losses, posing significant challenges to socio-economic stability. In 2024, the total damages from natural disasters, including impacts on human lives, housing, education, healthcare, culture, agriculture, forestry, fisheries, infrastructure, and the environment, exceeded USD 3.2 million (Vietnam Disaster and Dyke Management Authority, 2025). Following such events, most relief and donation efforts from both citizens and the government are conducted through bank accounts, facilitated by the growth of digital banking. In this context of escalating economic and social losses, managing relief funds and maintaining

liquidity become critical, highlighting the essential role of financial institutions, particularly intermediary banks.

The intermediary function of banks has long been emphasized in financial intermediation theory. Foundational works by Leland and Pyle (1977), Diamond (1984), and Allen and Santomero (1997) suggest that banks exist primarily to address transaction costs and information asymmetry. In the absence of complete information between depositors and borrowers, direct allocation of funds is inefficient. Banks, as financial intermediaries, collect, screen, monitor, and distribute information to mitigate adverse selection and moral hazard. Natural disasters can significantly disrupt these functions. They may exacerbate information asymmetry when credit data is lost or clients are unable to provide accurate financial information, exposing banks to mispricing of borrowers' repayment capacity and prompting tighter credit or higher interest rates to compensate for risk (Cortés & Strahan, 2017).

Moreover, disasters increase monitoring and information-gathering costs (for example, due to infrastructure disruptions or loss of communication) reducing the efficiency of financial intermediation and affecting banks' profitability and asset quality (Nie et al., 2023). Beyond individual lending risks, banks also face systemic risks from natural disasters. While geographically localized, the consequences of disasters can ripple throughout the financial system. In times of panic and asymmetric information, liquidity providers may withdraw, causing interbank market contraction. Concurrently, asset fire sales can sharply depress market prices, eroding the equity of other institutions holding similar assets and generating negative feedback loops across the system (Allen & Gale, 2000).

Banks often concentrate lending in high-yield sectors such as real estate, tourism, and agriculture, which are particularly vulnerable to natural disasters (Javan et al., 2023). When a severe disaster strikes, losses in banks within the affected region may coincide with losses in other banks holding similar portfolios. High portfolio correlations limit risk diversification, transforming a local shock into a systemic one (Acharya, 2009). In modern financial systems, derivatives, securitized products, and reinsurance contracts can further complicate institutional interconnections. Losses in a major institution may trigger a domino effect through cross-payment obligations and declining asset values, increasing the risk of cascading defaults and systemic collapse (Battiston, et al., 2012).

Given the critical role of banks in Vietnam's economy, examining their stability and growth potential under the influence of natural disasters is essential. This study investigates the relationship between natural disasters and banks' operational performance. The ratio of human losses to the previous year's total population and asset losses to GDP are used to measure the impact of disasters on the banking system. Return on assets (ROA) and return on equity (ROE) serve as indicators of banks' profitability and operational efficiency.

The paper is structured as follows. Section 2 reviews prior studies on natural disasters and bank performance. Section 3 introduces the dataset, estimation model, and methodology, followed by the analysis and discussion of results in Section 4. Finally, Section 5 concludes with key findings and policy implications.

2. Literature Review

2.1. Bank Performance

Performance in the banking sector is a key theoretical concept within the monetary and financial environment. Berger and Mester (1997) argues that a bank's operational efficiency is reflected in the relationship between output revenue and the cost of input resources; specifically, achieving the highest possible revenue with the lowest possible use of resources. Moreover, a bank can only be regarded as efficient when its return is commensurate with the level of risk it undertakes (Demirgüç-Kunt & Huizinga, 1999). A review of empirical studies on bank performance measurement shows that two broad approaches are commonly employed: the structural approach and the non-structural approach.

Under the non-structural approach, performance is assessed through profitability indicators such as ROA and ROE. These indicators have been widely used in studies by Athanasoglou et al. (2008), Flamini et al. (2009), and Chalabi-Jabado and Ziane (2024). Under the structural approach, performance is examined through the economic principles of cost minimization or profit maximization, expressed by a cost function, a profit function, or at times a production function (Hughes & Mester, 2012). Based on these approaches and prior research, the authors adopt ROA and ROE as profitability measures to evaluate bank performance.

2.2. Natural Disaster

A natural disaster is a serious disruption of the functioning of a community or society, caused by a natural hazard and resulting in widespread human, material, economic, or environmental losses that exceed the affected society's ability to cope using its own resources (UNDRR, 2017). According to Teh and Khan (2021), the degree of threat posed by natural hazards in terms of social and economic impacts is typically greater in areas where more people are affected, and total economic losses vary considerably across countries.

Researchers have developed various models to quantify disaster impacts for purposes such as recovery planning and macroeconomic analysis. Input-Output models estimate the spillover effects of a specific shock on one or more sectors of the economy and how these effects propagate to other sectors (Hallegatte, 2008). Computable General Equilibrium (CGE) models offer greater flexibility and allow for substitution at different levels, reflecting market dynamics and price adjustments (Meyer et al., 2013).

This study measures natural disasters using total asset damage as a share of GDP and the total number of people affected as a share of the population, following Noy and Vu (2010) and Fomby et al. (2013). Noy and Vu (2010) notes that disasters causing large property losses may lead to higher short-term output growth. This finding supports the reconstruction hypothesis, which posits that a surge in investment to rebuild damaged infrastructure can temporarily boost GDP. By contrast, disasters involving significant casualties tend to exert a negative influence on output.

2.3. Hypothesis Development

A substantial body of empirical research has documented that natural disasters generate adverse shocks to banks' operational performance and profitability. Using a sample of 2,891 U.S. banks during 2000–2014, Walker et al. (2022) show that natural disasters significantly reduce ROA and ROE while increasing loan losses through the combined effects of deteriorating credit quality, higher provisioning costs, and increased funding volatility. Also in the United States, Barth et al. (2024) find that bank branches located in disaster-affected areas raise deposit rates to compete for funding after natural disasters; notably, this effect spills over to neighboring non-affected areas, increasing system-wide funding costs and exerting additional downward pressure on profitability. Similarly, Shala and Schumacher (2024), examining the 2013 Elbe River flood in Germany, report a contraction in bank profitability primarily driven by heightened credit risk in corporate lending, particularly in agriculture and manufacturing, accompanied by short-term liquidity pressures. Consistent evidence is found in Do et al. (2021), who show that higher loan-deposit spreads following disasters are insufficient to compensate for credit losses, resulting in an overall decline in bank profitability. In East Asia, Nguyen et al. (2023) document a sharp post-disaster declines in deposits due to heightened cash demand, leading to severe liquidity pressures for affected banks. At the cross-country level, Alalmaee (2024) demonstrates that the negative impact of natural disasters on ROA and ROE is especially pronounced in low- and middle-income economies, where banks have more limited financial capacity.

Although the detrimental impact of natural disasters on profitability is evident, the magnitude of this impact varies across banks, with capitalization emerging as a critical moderating factor. Shala and Schumacher (2024) find that banks with higher pre-disaster equity ratios maintain more stable profitability and experience smaller reductions in ROA. Alalmaee (2024) similarly shows that in countries with well-capitalized banking systems-typically high-income economies-disasters exert negligible effects on profitability, contrary to economies with thinly capitalized banks. In the context of post-disaster credit supply, Duqi et al. (2021) show that highly capitalized banks with greater market power continue to provide credit-particularly mortgage lending-thereby supporting economic recovery and indirectly mitigating profitability losses. Conversely, Zhang et al. (2024) show that small banks, particularly rural commercial banks in China, are disproportionately affected by disasters and climate-related risks due to thin capital buffers, concentrated loan portfolios, and limited diversification capacity. Such constraints make them more vulnerable to severe profitability declines when non-performing loans surge. Collectively, these findings underline the role of capitalization as a "buffer" that absorbs shocks and attenuates the adverse effects of natural disasters.

H1: Natural disasters, conditioned on the moderating role of bank capitalization, exert a significant impact on bank profitability.

Beyond capitalization, provisions for credit loss (PCL) constitute another important mechanism that mitigates the adverse effects of natural disasters on bank profitability. Maso et al. (2022) demonstrate that banks located in high disaster-risk areas tend to increase PCL proactively to internalize expected credit losses, thereby reducing profit volatility when disasters materialize. Shala and Schumacher (2024) also observe that German banks increase provisions following flood events to reflect anticipated credit deterioration, which helps limit profit declines in subsequent periods. In contrast, Do et al. (2021) show that banks with low provisioning levels or limited disaster-risk management capabilities experience more severe declines in ROA due to insufficient credit-risk buffers. Furthermore, Zhang et al. (2024) document that natural disasters and transition-related climate risks substantially increase non-performing loans, intensifying pressure on PCL; without adequate pre-existing provisions, the shock is transmitted directly to profits. Evidence from Nguyen et al. (2023) indicates that access to foreign funding helps banks maintain more stable provisioning levels after disasters, thereby shielding profitability. Together, these studies suggest that PCL not only reflect credit-risk conditions but also play a crucial moderating role in shaping banks' resilience to natural-disaster shocks.

H2: Natural disasters, moderated by loan loss provisions, exert a significant impact on bank profitability.

2.4. Conceptual Framework

In addition to natural-disaster damage, which serves as the primary explanatory variable in this study, bank liquidity, the loan-to-total-assets ratio, and credit risk are incorporated as control variables in the model. Bank liquidity reflects the institution's ability to meet short-term payment obligations without disrupting normal operations. When a bank maintains an adequate level of liquid assets or achieves a balanced structure between funding sources and liquid-asset utilization, liquidity risk is reduced (Chen et al., 2025). This stability, in turn, enhances the bank's performance and profitability. Empirical evidence from Abbas et al. (2019) indicates that higher liquidity improves profitability for banks in Asia. However, excessive holdings of low-yield liquid assets or overly aggressive lending, while potentially increasing net interest margins, may reduce ROA and ROE due to rising operating and funding costs (Saleh et al., 2020).

The ratio of loans to total assets captures the extent to which a bank concentrates its activities on lending, reflecting its lending strategy and growth orientation. Ghosh (2015) finds that this ratio positively affects bank profitability by strengthening resilience to liquidity risk. Expanding lending allows banks to generate greater interest income, thereby increasing profits and improving both ROA and ROE.

Credit risk pertains to the likelihood that borrowers fail to make timely payments or become insolvent, leading to financial losses for banks. It is one of the most critical forms of risk directly affecting bank profitability. Specifically, rising nonperforming loans (NPLs) force banks to tighten credit supply, reduce lending activities, and consequently lower interest income, which reduces overall profitability (Abdelaziz et al., 2020). Consistent with this, the majority of empirical studies show that credit risk exerts a negative impact on bank profitability (Haris et al., 2024; Gupta & Jitendra, 2020). The study variables described in Table 1 and Figure 1.

Table 1. Description of variables.

Variable	Notion	Measurement	Expected sign
Dependent variables			
Returns on Assets	ROA	Net Income/ Average Total Assets	
Returns on Equity	ROE	Net Income/ Average Total Equity	
Independent variable			
	Damage	The mean value of total affected population divided by the previous year's population and total asset losses (USD) divided by GDP after being standardized using z-scores.	+
Moderating variables			
Capitalization	CAP	Total Equity/Total Assets (%)	+
Provisions for Loan Losses	PCL	Provisions for Loan Losses/Total Assets (%)	+
Control variables			
Liquidity	LIQ	Liquid assets/Deposits and short-term funding (%)	+/-
Loans to Assets	LOANS	Gross Loans/Total Assets (%)	+
Credit Risk	CR	Non-Performing Loans/Gross Loans (%)	-

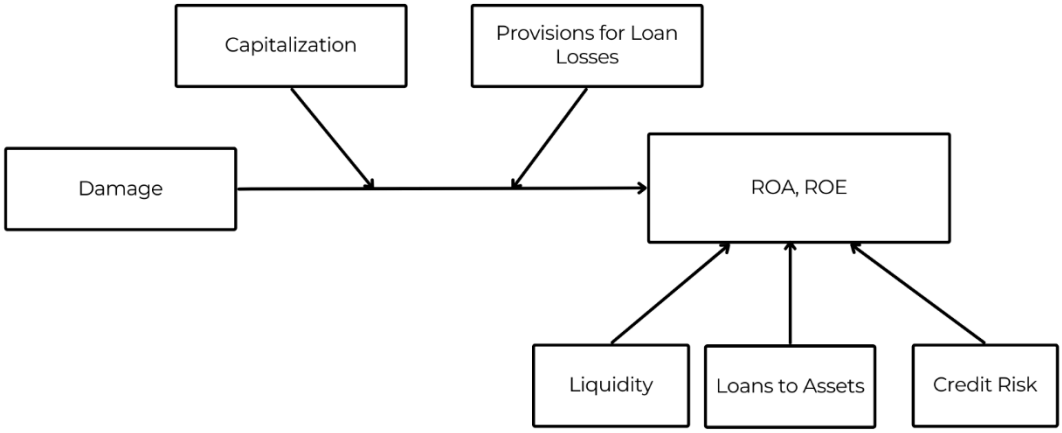

Figure 1. Conceptual framework.

3. Methods

3.1. Data

The dataset used in this study consists of 29 Vietnamese commercial banks listed on the domestic stock exchanges. The banks were selected using a non-probability sampling method, based on the availability and continuity of their financial data. The authors collected data for the period 2009–2024 to avoid distortions associated with the 2008 global financial crisis, which could bias the model estimation results. Secondary bank-level data were obtained from FiinPro, a reputable and standardized data source that compiles information from publicly disclosed financial statements of Vietnamese banks. Data on natural disasters were extracted from the One Development Mekong database, an open-data platform providing information on five countries including Cambodia, Laos, Myanmar, Vietnam, and Thailand. Population and GDP data for Vietnam were retrieved from the General Statistics Office (GSO) for the computation of disaster-damage variables.

3.2. Data Processing Methodology

After collecting data from multiple sources, the authors conducted several processing steps to ensure completeness, consistency, and suitability for quantitative analysis. First, the raw dataset was screened and cleaned by removing banks with incomplete disclosures across the observation period (missing data). Quantitative variables were then standardized to reduce scale-related distortions during model estimation. Finally, the cleaned dataset was merged by bank and by year to construct a balanced panel suitable for descriptive analysis and model estimation.

Within the panel-data framework, the variables were first examined for pairwise correlations and multicollinearity. The results indicate no multicollinearity among the independent variables included in the model. Next, the authors tested for cross-sectional dependence and found that all variables exhibit significant cross-sectional dependence. Additionally, all variables with cross-sectional dependence were found to be stationary, satisfying the necessary condition for estimating a dynamic panel model. Furthermore, Granger causality tests between the independent variables and the two dependent variables (ROA and ROE) show bidirectional relationships and identify lag 1 as the optimal lag structure.

Based on these diagnostic results, the CS-ARDL model was selected for estimation. This approach addresses partial endogeneity by incorporating lagged dependent variables and applying the Common Correlated Effects (CCE) estimator. Consequently, the CS-ARDL framework yields reliable estimates without requiring instrumental variables, unlike DGMM or SGMM models (Chudik & Pesaran, 2015). Finally, Pesaran's CADF test for panel data with cross-sectional dependence confirms that unit-root concerns are adequately addressed. The empirical model is estimated as follows:

$$p = \beta_0 + \beta_1 * damage * CAP + \beta_2 * damage * PCL + \beta_3 * Control + \beta_6 * L.p + e$$

In this model, p represents the bank performance indicators, namely ROA and ROE. The main explanatory variable is natural disaster damage moderated by capitalization and provisions for credit loss (damage_cap,

damage_pcl). The control variables include loan loss provisions (PCL), capital adequacy (CAP), liquidity (LIQ), loan intensity (Loans), and credit risk (CR).

4. Results

Table 2 presents the descriptive statistics of the variables employed in the model. ROA and ROE exhibit mean values of 0.97% and 10.84%, respectively, accompanied by relatively low standard deviations (0.0087 and 0.0959). This indicates that the banks in the sample maintain relatively stable profitability. The variable damage, capturing natural-disaster losses, has the highest standard deviation (0.97) among all variables, suggesting substantial year-to-year variation in disaster severity. The capitalization ratio (CAP) averages 9.3%, reflecting an adequately capitalized banking system, while the liquidity ratio (LIQ) averages 0.94, implying strong short-term liquidity positions. The mean value of LOANS is 0.58, indicating that net loans account for approximately 59% of total assets. Meanwhile, the credit-risk indicator (CR) shows a relatively low mean of 2.1%, suggesting generally favorable credit quality. Overall, the variables display moderate dispersion and no extreme outliers, indicating that the dataset is well-suited for the panel regression analysis conducted in this study.

Table 2. Descriptive statistics.

Variable	Obs	Mean	Std. dev.	Min	Max
ROA	464	.0097347	.0086588	-.0599	.0557
ROE	464	.108414	.0958924	-.9169	.3033
Damage	464	-9.31e-09	.9727275	-.9183316	2.051505
CAP	464	.0931813	.0414744	.04	.3324
PCL	464	-.0063842	.0055449	-.0362871	.004846
LIQ	464	.9420466	.182886	.4851729	3.07409
LOANS	464	.5900203	.1214106	.1697195	.8297651
CR	464	.0213961	.0220101	0	.3035

Source: Author's analysis results.

The results reported in Table 3 indicate that the correlation coefficients among most independent variables are relatively weak ($|r| \leq 0.6$). The correlation between damage_cap and damage_pcl is noticeably stronger, which is expected given that both variables are constructed based on the damage measure.

Table 3. Correlation matrix.

Variable	damage_cap	damage_pcl	PCL	CAP	LIQ	LOANS	CR	ROA	ROE
damage_cap	1.0000								
damage_pcl	-0.6799	1.0000							
PCL	0.1107	-0.1560	1.0000						
CAP	0.1726	0.0095	-0.0378	1.0000					
LIQ	0.1032	-0.0344	-0.1429	0.2352	1.0000				
LOANS	-0.0791	0.0634	-0.3681	-0.1099	0.3810	1.0000			
CR	-0.0263	0.0211	-0.1071	0.0025	-0.0574	0.0101	1.0000		
ROA	0.0457	0.0330	-0.1252	0.3552	0.3169	0.1267	-0.2767	1.0000	
ROE	-0.0448	0.0389	-0.1426	-0.0674	0.2649	0.2298	-0.3864	0.8361	1.0000

Source: Author's analysis results.

According to Table 4, the VIF values for all variables are below 2, with an average VIF of 1.43, indicating that multicollinearity is not a concern among the independent variables in the model. Table 5 presents of model results.

Table 4. Variance inflation factor results.

Variable	VIF	1/VIF
damage_cap	1.99	0.502760
damage_pcl	1.94	0.515617
LOANS	1.41	0.709370
LIQ	1.31	0.765567
PCL	1.20	0.830828
CAP	1.18	0.850948
CR	1.02	0.982731
Mean VIF	1.43	

Source: Author's analysis results.

Table 5. Results of the models.

	ROA	ROE
damage_cap	0.0985627	1.719859**
	(0.06176)	(0.7723802)
damage_pcl	0.5673126**	5.496481*
	(0.281658)	(3.004117)
PCL	0.1661211	-0.1308001
	(0.1589595)	(1.501115)
CAP_LIQ	0.155319**	0.8946305
	(0.0712138)	(0.7297561)
LOANS_CR	-0.3502037*	-4.452583*
	(0.2096848)	(2.289246)
L.ROA/L.ROE	0.4304206***	0.5399896***
	(0.1652845)	(0.2019627)
Prob > F	0.00	0.00
R-squared (MG)	0.81	0.74
p-value (CD Statistic)	0.0834	0.1878
p-value (Pesaran's CADF test)	0.000	0.001
Total Observations	435	435

Source: Authors' estimations using STATA. Standard errors are in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

5. Discussion

From Table 5, the p-values of the F-tests are all below 0.01, indicating that both the ROA and ROE models are statistically significant overall and exhibit strong model fit. In addition, the mean-group R-squared values are relatively high, at 81% and 74%, respectively, implying that the models explain a substantial proportion of the between-group variation. The p-values of the CD Statistic exceed 0.05, suggesting that cross-sectional dependence is no longer present in the models. Furthermore, unit-root concerns are mitigated based on results from Pesaran's CADF test. Overall, all diagnostic tests confirm that the model specifications are valid.

Capitalization (CAP), serving as a moderating variable in the relationship between natural-disaster damage and bank profitability, exhibits a positive association with both ROA and ROE. However, while CAP is not statistically significant in the ROA model, it is significant at the 5% level in the ROE model. Accordingly, Hypothesis H1 is partially supported. This finding is consistent with prior literature, which shows that although natural disasters impose substantial losses, well-capitalized banks are better able to sustain returns on equity. Strong capital buffers allow banks to absorb credit and liquidity shocks and maintain investor confidence, thereby mitigating negative effects on profitability and, in some cases, enabling them to capitalize on reconstruction-related lending opportunities.

Moreover, natural-disaster damage exerts a positive effect on both ROA and ROE when moderated by credit-risk provisions (PCL), significant at the 5% and 10% levels, respectively. Thus, Hypothesis H2 is supported. This result aligns with previous empirical evidence indicating that when loan-loss provisions are adequately increased, higher disaster-related losses do not necessarily translate into declining profitability. Instead, prudent provisioning and effective risk-management practices help banks mitigate credit-risk deterioration, preserve capital, and maintain earnings performance. Consequently, shareholders' returns are better protected from unexpected losses due to strengthened provisioning mechanisms.

With respect to the effects of capitalization and liquidity, this interaction term is significant at the 5% level in the ROA model but not statistically significant in the ROE model. In other words, banks with stronger capital positions and higher liquidity ratios tend to achieve higher ROA, suggesting that maintaining robust cash flows and payment capacity enhances resilience against shocks such as natural disasters. Furthermore, ample liquidity provides banks with greater flexibility in allocating funds and supporting affected customers during stress periods.

The effects of loan intensity and credit risk on both ROA and ROE are negative and significant at the 10% level. This relationship is intuitive: as banks extend more loans and credit risk increases, financial costs and potential loan losses rise, thereby reducing profitability. Higher lending amplifies the impact of nonperforming loans on earnings, consistent with the trade-off theory: banks expand lending in pursuit of greater interest income, yet this is accompanied by heightened credit-risk exposure that ultimately suppresses profits.

Finally, the lagged values of ROA and ROE are significant at the 1% level with positive coefficients, indicating strong persistence in bank profitability over time. This implies that banks with higher profitability in the previous year tend to maintain superior performance in subsequent periods.

There are several recommendations offer for banks and policy makers. First, natural disaster damage has a positive relationship with bank profitability, primarily through increased credit demand from businesses and households for production recovery. The State Bank of Vietnam (SBV) should exercise its regulatory role by reducing the refinancing rate and injecting reasonable liquidity to support controlled credit expansion and maintain financial system stability. Second, to mitigate credit risk, the SBV, in coordination with the Ministry of Agriculture and Environment (MOAE) and the Ministry of Finance (MOF), should issue guidelines on green credit and climate-adaptive credit. This would create a clear legal framework that encourages banks to finance environment-friendly projects and limit exposure to climate-sensitive sectors. Concurrently, the Government should support banks in accessing external finance for green credit. Third, capitalization, loan loss provisions, and liquidity are key factors to a bank's resilience. Regulatory agencies should strengthen the overall supervisory framework by (i) setting clear capital and liquidity requirements aligned with Basel III, (ii) monitoring banks' compliance through stress testing and climate-risk reporting, and (iii) enhancing early-intervention mechanisms for institutions vulnerable to disaster-related shocks.

Commercial banks must view credit risk management in disaster-prone regions as a strategic priority. It is important to develop early warning systems, integrate climate data into credit rating models, and build region-specific response plans. In the post-disaster period, banks should restructure loans, maintain loan classifications as guided, and support the restructuring of large loans to reduce NPLs and help clients recover their businesses. Additionally, banks can collaborate with insurance companies to develop micro-insurance products for natural disasters, featuring low costs and simple terms, to help clients protect their finances and reduce banks' exposure to credit risk. Finally, banks need to strengthen their internal financial buffers by increasing loan loss provisions, raising equity capital, and ensuring full Basel III compliance to enhance resilience and support sustainable growth amid climate risks.

Data on natural disaster damage is limited and does not fully capture indirect impacts. In reality, many economic losses, such as supply chain disruptions and labor losses, cannot be fully measured or published, leading to potential measurement bias. Therefore, the disaster variables in this study may not capture the full extent of the impact on banks. Furthermore, the study does not disaggregate results by bank size or disaster-affected region. In Vietnam, where the impact of natural disasters varies geographically, failing to group banks by region, even though commercial banks have nationwide branches, makes it difficult to avoid the model overlooking group-specific (heterogeneous) effects.

6. Conclusions

In the current context of climate change, the increasing intensity and frequency of natural disasters are causing increasingly severe economic and human losses, posing significant challenges to socio-economic stability. Within the financial system, commercial banks play a key intermediary role but are also profoundly affected. Theoretically, natural disasters not only increase information asymmetry, leading banks to tighten credit to compensate for risk, but also amplify systemic risk. These risks manifest as liquidity shocks when the interbank market contracts, asset value depreciation due to fire sales, and domino effects from high correlation in credit portfolios, especially in vulnerable sectors like agriculture or real estate. The purpose of this study is to examine the impact of natural disasters on the profitability of commercial banks in the Vietnamese banking system during the 2009-2024 period. In the estimation model, bank profitability is measured by ROA and ROE, and 'damage' is used to represent natural disaster losses. The dataset was compiled from FiinPro, Open Development Mekong, and the General Statistics Office of Vietnam. Additionally, bank-level control variables were added to the model. Through pre-estimation diagnostics, the independent variables showed weak correlation and no multicollinearity; however, cross-sectional dependence was found among all variables in the model. Therefore, the CS-ARDL model was employed for estimation. The authors found a positive relationship between damage_cap, damage_pcl, and both ROA and ROE, a result that strengthens the findings of previous studies on this topic. This relationship implies that natural disaster damage contributes to an increase in bank profitability, provided that the bank has high capitalization and substantial loan loss provisions. This result does not imply that the bank's financial performance improves amidst the harshness of natural disasters, which cause significant loss of life and property. Instead, the study identifies a relationship between natural disaster

damage and bank profitability in correlation with risk mitigation methods, such as increasing capitalization and loan loss provisions, aiming to provide recommendations that help banks overcome the difficulties brought by natural disasters.

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Project administration: Khuc The Anh.
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Validation: Le Phong Chau, Tran Hoang Anh.
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Writing –original draft: Le Phong Chau, Le Thuy Duong, Dang Vu Minh Phuong, Dinh Phuong Tuan, Tran Hoang Anh, Le Tu Thanh,
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