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Bank Market Power and Risk Behavior under Composite Uncertainty: Threshold Panel Evidence from an Emerging Economy

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ABSTRACT. This study examines the nonlinear link between bank market power and financial risk under varying levels of macroeconomic uncertainty in an emerging market. Using data from 27 Vietnamese banks (2010–2023) and a composite uncertainty index spanning five systemic dimensions, a Panel Threshold Regression model uncovers a critical uncertainty threshold where the risk effect of market power reverses—amplifying risk in stable conditions but reducing it when uncertainty is high. This asymmetric effect is most evident in joint-stock and small banks, and weakens post-COVID-19. Robustness checks with non-performing loans validate the threshold dynamics. The study advances the literature by providing empirical evidence of a nonlinear market power–risk nexus, introducing a multidimensional uncertainty measure, and highlighting heterogeneity in bank responses by ownership and size. These findings challenge linear assumptions in competition–stability models and offer important implications for macroprudential policy in emerging financial systems.

1. Introduction

Over the past two decades, the global banking system has increasingly operated within an environment of deepening and overlapping macroeconomic uncertainties, ranging from policy ambiguity (EPU), geopolitical instability (GPR), and institutional inconsistency (WUI, WSI), to the growing salience of ESG-related risks. These uncertainties are rarely isolated; rather, they co-evolve and interact, forming a complex architecture of systemic volatility often referred to as "composite uncertainty" ([6], [15]). In such contexts, the strategic conduct of banks plays a pivotal role in either reinforcing or mitigating financial fragility, particularly in emerging markets

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where regulatory infrastructures are still maturing and external shocks transmit more forcefully [14].

A core element in this dynamic is bank market power, typically proxied by the LERNER. The literature remains divided on its implications for financial risk: while some argue that higher market power fosters stability by enabling capital accumulation ([5], [10]), others contend it incentivizes risk-taking under weak competition ([4], [13]). Importantly, many of these assessments are rooted in linear modeling frameworks, which overlook potential nonlinear or regime-dependent behavioral shifts in bank risk under changing macroeconomic conditions.

Further compounding this gap is the limited scope of uncertainty measurement. Much prior research relies on single-dimensional indices, such as EPU or GPR, which, though valuable, may underrepresent the multifaceted nature of macroeconomic volatility ([2], [3], [11]). This fragmented view potentially obscures the true effects of uncertainty on bank behavior. To address this, a more integrative metric, a Composite Macroeconomic Uncertainty Index (CMUI), can provide a superior informational basis by synthesizing diverse uncertainty dimensions into a single empirical construct.

This study seeks to advance the field through two core research questions: (i) Does macroeconomic uncertainty alter the relationship between bank market power and financial risk-taking? (ii) Is there a threshold level of uncertainty at which the effect of market power changes direction? To explore these questions, we construct a novel CMUI tailored to Vietnam's macro-financial landscape and apply Hansen's (1999) Panel Threshold Regression (PTR) framework to capture potential regime shifts [9].

Using a balanced panel of 27 Vietnamese commercial banks over 2010–2023, the empirical findings reveal a critical threshold (CMUI = –66.80) beyond which the effect of market power on risk flips, from amplifying risk in low-uncertainty settings to mitigating it under high uncertainty. This nonlinear coordination mechanism is especially salient among small and privately owned banks and notably weaker in large or state-owned institutions. Furthermore, the strategic responsiveness of market power appears to diminish after the COVID-19 crisis, highlighting the pandemic's role as a structural disruptor in banking behavior.

In doing so, this paper makes three key contributions. First, it constructs a comprehensive uncertainty index, the first of its kind for Vietnam, by integrating EPU, GPR, ESGUI, WUI, and WSI via principal component analysis. Second, it introduces a threshold-based modeling framework that reveals an endogenous regime-switch in the market power–risk nexus. Third, it uncovers marked heterogeneity in risk behavior across ownership structures, institutional sizes, and pre-/post-crisis periods, underscoring the contextual and strategic complexity of banking under composite uncertainty.

2. Theoretical Framework

2.1. Theoretical foundations

The strategic risk-taking behavior of banks under macroeconomic uncertainty is shaped by three interrelated theoretical pillars:

Competition–stability and competition–fragility: According to the competition–fragility view, intense competition may erode profit margins and capital buffers, encouraging excessive risk-taking. Conversely, the competition–stability view suggests that competition promotes monitoring discipline and reduces agency problems. The net effect is context-dependent, varying across institutional and regulatory environments ([4], [13]).

Risk-shifting hypothesis: Banks with greater market power can accumulate capital surpluses, acting as buffers in downturns. However, unchecked power may also incentivize risk externalization, especially under implicit guarantees [5].

Strategic behavior under uncertainty: Real options theory and behavioral models propose that decision-making shifts nonlinearly when uncertainty crosses a critical threshold. Banks may shift toward defensive strategies such as liquidity hoarding or balance sheet restructuring in highly uncertain environments ([8], [17]).

These frameworks collectively imply that market power exerts a conditional influence on risk, switching from amplification to moderation depending on the surrounding uncertainty regime.

2.2. Conceptual framework

The relationship between bank market power and financial risk is hypothesized to be nonlinear, governed by a composite uncertainty threshold. Under low uncertainty, market power is expected to elevate risk due to profit-seeking incentives. Once uncertainty surpasses a critical level, banks may deploy market power defensively to enhance stability. Ownership structure, institutional size, and structural shifts (e.g., post-COVID) serve as moderating variables in this relationship.

Figure 1 illustrates this conceptual framework, positioning the composite uncertainty index as a threshold variable and delineating heterogeneity across bank types.

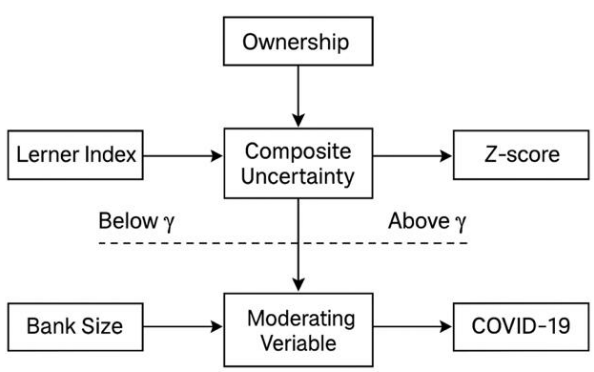

Figure 1. Conceptual framework

Source: Author' own work

3. Literature Review

Research has increasingly focused on how macroeconomic uncertainty affects financial institutions. Traditional indicators such as EPU index [3] have been supplemented by multidimensional measures, including GPR index [6], WUI index, WSI index, and ESG uncertainty indicators. These reflect the layered and interconnected nature of systemic uncertainty in global financial systems.

Empirical studies confirm that elevated uncertainty undermines bank profitability, weakens credit quality, and reduces lending activity [21]. Evidence also highlights asymmetries in how different bank types respond to shocks, with smaller and privately-owned banks displaying greater vulnerability ([18], [19]).

However, most prior research adopts linear models and treats uncertainty unidimensionally. This limits the capacity to detect nonlinear or threshold-based behavioral shifts. Only a few studies attempt to integrate multidimensional uncertainty into models of banking behavior [4].

Limited evidence exists for emerging markets like Vietnam, where financial openness and institutional volatility are high. Most Vietnamese studies apply linear models and omit composite uncertainty dynamics [14]. There remains a research gap in understanding how market power operates as a conditional mechanism under composite uncertainty, especially through nonlinear modeling frameworks such as Panel Threshold Regression [9].

This study addresses that gap by integrating a composite uncertainty index and applying a threshold framework to assess how market power conditions bank risk behavior across uncertainty regimes, with attention to ownership and size heterogeneity.

Drawing on the theoretical foundations of competition–stability, risk-shifting behavior, and real options under uncertainty, this study formulates four interrelated hypotheses to investigate the contingent role of bank market power in shaping risk behavior under composite macroeconomic uncertainty.

Hypothesis H1: It is hypothesized that the effect of market power on financial risk is inherently nonlinear and varies with the degree of uncertainty: while power may encourage risk-taking in tranquil environments due to profit-maximizing incentives and regulatory slack [5], it can serve as a stabilizing force beyond a critical uncertainty threshold, consistent with defensive behavioral adjustment theories ([4], [8], [17]).

Hypothesis H2: This threshold effect is formally tested using Hansen's (1999) Panel Threshold Regression framework, which allows the endogenous identification of an optimal uncertainty breakpoint where bank behavior shifts from risk-seeking to risk-averse ([2], [6], [9]).

Hypothesis H3: The moderating influence of institutional characteristics is explored, positing that smaller and privately held banks, due to limited buffers and agility, exhibit more pronounced behavioral shifts under high uncertainty ([18], [19]).

*Hypothesis H4:*The analysis considers whether the COVID-19 pandemic represents a structural shock that alters the post-crisis dynamics of this relationship, potentially disrupting the stabilizing role of market power ([2], [3], [16], [20]).

4. Data and Methodology

4.1. Data Description

The empirical analysis is based on a balanced panel dataset comprising 27 Vietnamese commercial banks over the period 2010–2023, corresponding to 378 bank-year observations. Bank-specific financial data were obtained from audited financial statements and the FiinPro platform, while macroeconomic indicators were sourced from the World Bank and the International Monetary Fund (IMF). All variables were carefully cleaned and normalized to ensure comparability across institutions and years.

The dependent variable is the Z-score, a widely accepted proxy for bank stability, calculated following the methodology of Laeven and Levine (2009) [12]. A higher Z-score indicates a lower probability of insolvency and a greater ability to withstand shocks. To assess the robustness of the findings, the Non-Performing Loan ratio (NPL) is employed as an alternative dependent variable, representing credit risk.

The key explanatory variable is bank market power, proxied by the LERNER, which measures the markup between output prices and marginal costs. To capture macroeconomic uncertainty, a novel Composite Macroeconomic Uncertainty Index (CMUI) is constructed through PCA method, synthesizing five major dimensions: EPU, GPR, WUI, WSI, and ESGUI. The first principal component (PC1), which explains approximately 57.4 % of total variance, is retained as the CMUI. Tests for sampling adequacy (KMO = 0.7775) and Bartlett's test of sphericity ($p < 0.0001$) confirm the appropriateness of PCA for index construction.

Control variables include bank size (SIZE), equity-to-asset ratio (ETA), return on equity (ROE), foreign bank presence (FS1, FS2), GDP growth, inflation rate (INF), a binary COVID-19 indicator, and ownership type. All variables are winsorized to mitigate the influence of outliers.

4.2. Methodological Framework

To test for nonlinear relationships between market power and bank risk, the analysis employs the Panel Threshold Regression (PTR) methodology developed by [9]. This approach is particularly suitable for capturing threshold effects where the marginal impact of an explanatory variable changes across regimes defined by an endogenous threshold variable.

The model is specified as follows:

$$\text{Z-score}_{it} = \mu_i + \beta_1 * \text{LERNER}_{it} * I(\text{CMUI}_{it} \leq \gamma) + \beta_2 * \text{LERNER}_{it} * I(\text{CMUI}_{it} > \gamma) + \delta' * \text{Controls}_{it} + \varepsilon_{it} \quad (1)$$

Where:

- Z-score is the dependent variable representing financial stability.
- Lerner is the measure of bank market power.
- CMUI is the threshold variable representing composite macroeconomic uncertainty.
- γ is the endogenously determined optimal threshold.
- $I(\cdot)$ is an indicator function defining the two uncertainty regimes.
- Controls is the vector of control variables.
- μ_i accounts for bank-specific fixed effects.

The estimation involves three stages. First, the individual effects are removed using the within transformation. Second, a grid search algorithm is used to identify the threshold γ, which minimizes the sum of squared residuals (SSR). Bootstrap procedures with 1,000 replications are applied to construct confidence intervals for γ. Third, the slope coefficients β_1 and β_2 are estimated for the low- and high-uncertainty regimes respectively.

To ensure robustness, two additional checks are performed. First, the dependent variable is replaced by the NPL ratio to verify consistency across alternative risk measures. Second, coefficient estimates are compared across different subsamples (e.g., pre- vs. post-COVID-19; state-owned vs. private banks; small vs. large banks) to explore heterogeneity in strategic responses.

By employing a threshold-based approach with a composite uncertainty index, this methodology enables a comprehensive test of the nonlinearity hypothesis and captures the conditional nature of market power in shaping bank risk-taking behavior, an increasingly relevant dynamic in the context of systemic uncertainty ([2], [6]).

5. Empirical Results And Discussion

5.1. Descriptive Statistics and Correlation Analysis

Descriptive statistics for the sample of 27 Vietnamese commercial banks (2010–2023) are reported in Table 1.

Table 1. Descriptive Statistics

Variable	Mean	Std. Dev	Min	Max
Z-score	2.651	0.556	-0.707	4.122
FS1	0.214	0.026	0.184	0.239
FS2	0.102	0.006	0.093	0.113
SIZE	18.733	1.268	15.923	21.557
ETA	0.092	0.04	0.041	0.255

LERNER	0.168	0.083	0.001	0.460
ROE	0.110	0.085	-0.563	0.303
GDP	0.060	0.015	0.026	0.081
INF	0.072	0.111	-0.017	0.423
COVID	0.357	0.480	0.000	1.000
ORIGINAL	0.185	0.389	0.000	1.000
CMUI	~0.000	67.745	-84.485	134.077

Source: Summary of the author.

The Z-score, which measures financial stability, has a mean of 2.651 with a standard deviation of 0.556, ranging from –0.707 to 4.122. This wide dispersion reflects substantial heterogeneity in risk absorption capacity across banks, a typical feature of emerging markets where institutional buffers remain limited [14].

The average LERNER is 0.168, ranging from nearly zero to 0.460, indicating that while Vietnamese banks generally exhibit low market power, some institutions maintain significant pricing advantages. This distribution provides empirical grounding for testing nonlinear effects and potential threshold behavior (H1 and H2).

The CMUI exhibits substantial variability (mean ≈ 0; SD = 67.745; range: –84.485 to 134.077), reflecting the high volatility and multidimensionality of Vietnam's macroeconomic environment, an ideal basis for threshold-based analysis of nonlinear bank behavior.

Table 2. Correlation Matrix

	Z-score	**FS1**	**FS2**	**SIZE**	**ETA**	**LERNER**	**ROE**	**GDP**	**INF**	**COVID**	**ORIGINAL**	**CMUI**
Z-score	1											
FS1	-0.389	1										
FS2	0.183	-0.423	1									
SIZE	-0.378	0.384	-0.233	1								
ETA	0.656	-0.229	0.128	-0.560	1							
LERNER	0.001	0.100	-0.005	0.186	0.316	1						
ROE	-0.101	0.286	-0.095	0.516	-0.110	0.527	1					
GDP	0.086	-0.193	-0.228	-0.097	-0.010	-0.093	-0.078	1				
INF	-0.199	-0.370	0.307	-0.270	0.199	0.261	0.109	0.103	1			
COVID	-0.342	0.743	-0.192	0.368	-0.132	0.189	0.296	-0.405	-0.320	1		
ORIGINAL	-0.114	0.000	0.000	0.434	-0.096	0.064	0.120	-0.000	-0.000	-0.000	1	
CMUI	-0.399	0.812	-0.320	0.370	-0.175	0.133	0.276	-0.276	-0.375	0.886	-0.000	1

Source: Summary of the author.

The correlation matrix (Table 2) indicates that the Z-score exhibits an extremely weak correlation with the LERNER (r = 0.001), suggesting that the linear effect of market power on financial stability is statistically negligible. This finding reinforces the necessity of testing for nonlinear relationships, as posited in Hypothesis H1. The correlation matrix reveals that CMUI is moderately and negatively correlated with Z-score (r = –0.399), indicating that higher macroeconomic uncertainty is associated with increased financial risk. Its strong positive correlation with COVID (r = 0.886) and FS1 (r = 0.812) underscores its sensitivity to systemic shocks and foreign bank presence. These patterns confirm CMUI's capacity to capture broad, multidimensional volatility, justifying its use as a threshold variable in modeling nonlinear bank behavior under uncertainty.

Overall, the descriptive and correlation results suggest a high degree of dispersion in financial risk, capital structure, and market power across Vietnamese commercial banks. This heterogeneity, combined with the highly volatile macroeconomic environment, provides both theoretical and empirical justification for the threshold-based hypotheses (H1–H3) within the PTR modeling framework.

To ensure the statistical reliability of CMUI index, constructed from five component indicators (EPU, GPR, WUI, WSI, and ESGUI), two key diagnostic tests were performed:

- The KMO test yielded a value of 0.7775, exceeding the minimum adequacy threshold of 0.6 as recommended by Kaiser (1974). This indicates that the correlation matrix is sufficiently strong to justify PCA.
- Bartlett's Test of Sphericity returned a p-value of 0.0001 (< 0.05), allowing rejection of the null hypothesis that the correlation matrix is an identity matrix. This result confirms the presence of statistically significant linear relationships among the component variables, thereby validating their suitability for principal component extraction.

In addition, the scree plot (Figure 2) illustrates a steep drop in eigenvalues after the first component (PC1), indicating that the majority of variance is captured by a single dominant factor.

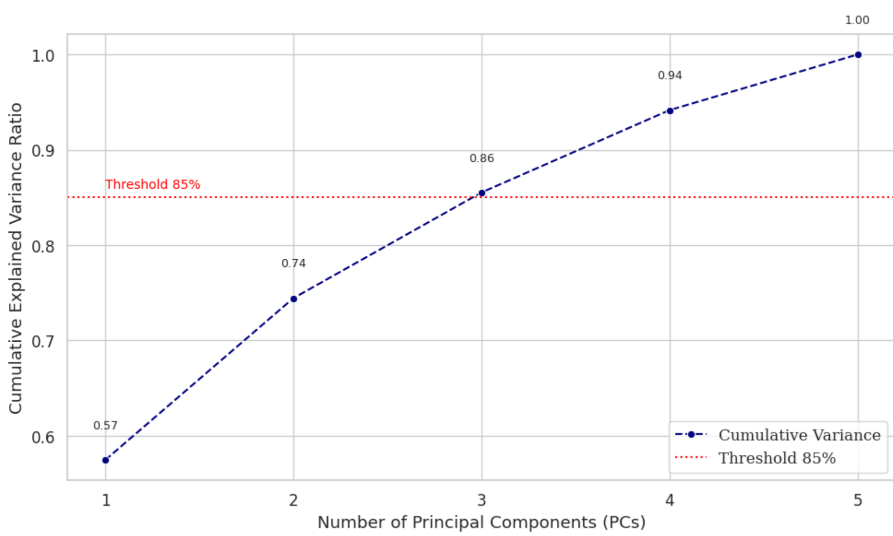

Figure 2. Scree Plot – Determining the optimal number of components in PCA

Source: Author's own work using Python

Specifically, PC1 accounts for approximately 57.4 % of total variance, substantially surpassing all subsequent components. This strongly supports the retention of PC1 as the most representative summary of systemic macroeconomic uncertainty. These findings align with recent studies employing PCA to quantify systemic risk arising from multiple uncertainty sources [2]. Accordingly, PC1 is retained as the CMUI and serves as the core threshold variable in subsequent regressions, enabling rigorous testing of banks' nonlinear strategic behavior under shifting macro-financial conditions.

5.2. PTR Model Results

This section investigates the hypothesis that the effect of bank market power (LERNER) on financial risk (Z-score) is not linear, but instead varies across different levels of macroeconomic uncertainty. Employing the PTR method, the analysis identifies an optimal threshold of macroeconomic uncertainty (denoted as γ) and estimates two separate slope coefficients, β_1 and β_2, representing the marginal effect of market power in two distinct strategic regimes: below and above the threshold γ.

5.2.1. Estimation of the Optimal Macroeconomic Uncertainty Threshold (γ)

To empirically test H2 regarding the existence of a critical level of macroeconomic uncertainty at which the impact of market power on bank risk behavior reverses, the PTR framework is applied. The focal point of this analysis is the identification of the threshold value γ, representing the level of the CMUI index at which banks' strategic posture transitions from risk-seeking to defensive behavior.

The threshold is determined through a grid search algorithm that iteratively estimates the sum of squared residuals (SSR) across a range of potential threshold values. As illustrated in Figure 3, the SSR reaches its global minimum at CMUI = –66.80. This value signifies a statistically optimal breakpoint, beyond which the behavioral shift in banking strategy becomes most pronounced.

The declining pattern of SSR across successive grid steps confirms the structural nature of this threshold, providing strong statistical justification for segmenting the CMUI into two distinct regimes: one characterized by low uncertainty (CMUI ≤ –66.80) and another by heightened uncertainty (CMUI > –66.80). The PTR model demonstrates the highest goodness-of-fit when this breakpoint is applied, validating the nonlinearity hypothesis and establishing empirical evidence of a strategic threshold in the relationship between market power and financial risk.

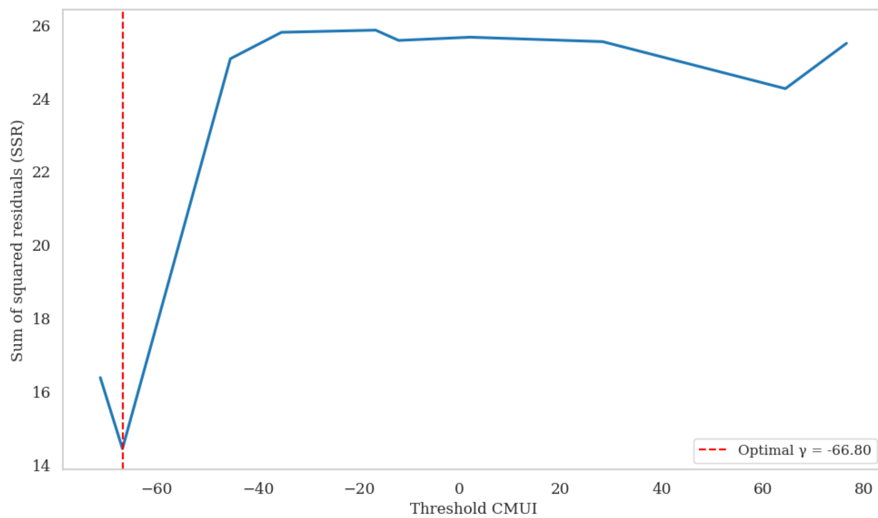

Figure 3. The sum of squared residuals SSR at CMUI threshold

Source: Author's own work using Python

The bootstrap results (Figure 4) confirm the statistical stability of the threshold γ, as evidenced by a symmetric distribution and the absence of irregular outliers, thereby reinforcing the robustness and reliability of the estimated breakpoint.

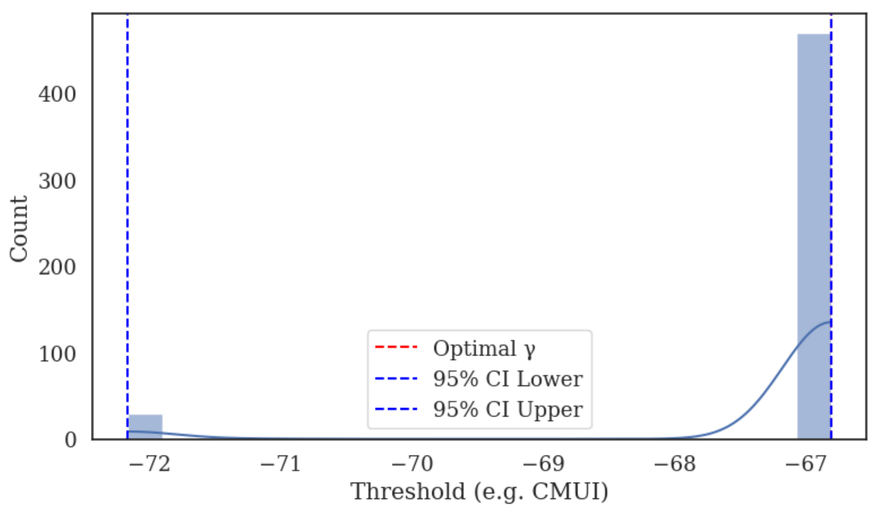

Figure 4. Bootstrap distribution of threshold gamma

Source: Author's own work using Python

This finding provides strong empirical support for H2, affirming the existence of an optimal threshold of macroeconomic uncertainty at which the role of bank market power in moderating financial risk shifts from destabilizing to stabilizing. When CMUI falls below this threshold, reflecting a relatively "predictable" macroeconomic environment, market power tends to encourage greater risk-taking, likely due to the absence of external defensive pressures. However, once uncertainty surpasses the critical level of –66.80, market power evolves into a "strategic shield," enabling banks to restructure their balance sheets and recalibrate their risk appetite. This behavioral shift is consistent with nonlinear strategic choice theory under uncertainty ([4], [17]).

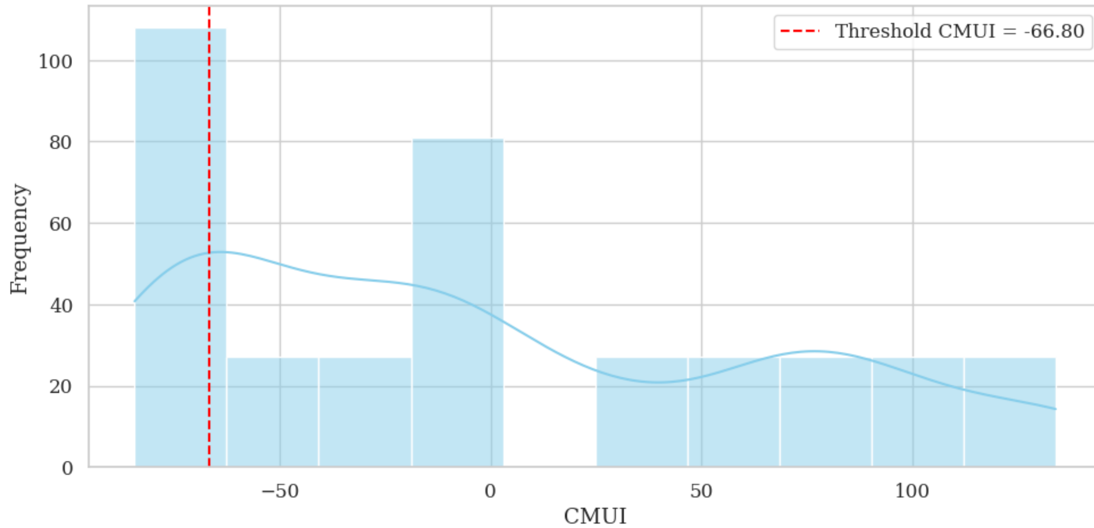

Figure 5. The frequency distribution of the CMUI

Source: Author's own work using Python

Figure 5 presents the frequency distribution of the CMUI index across the entire research sample, while also marking the optimal threshold value identified at γ = –66.80. The distribution reveals a clear and substantial representation in both the low and high CMUI regions, indicating that the threshold is not driven by noise or extreme outliers. This observation reinforces the empirical validity of the PTR model and lends strong support to H2 concerning nonlinear strategic behavior.

The successful identification of threshold γ not only highlights the presence of nonlinearities in bank behavior but also demonstrates the methodological superiority of the PTR framework over conventional linear specifications. This is particularly relevant in contexts characterized by systemic and cumulative uncertainty shocks, as underscored by recent literature ([2], [6]).

Although the estimated threshold value of CMUI is negative (γ = –66.80), this is a statistical property of the PCA-based construction rather than a reflection of "negative uncertainty." Since the CMUI is derived from standardized variables with mean zero, its scale is centered and unbounded. A negative value indicates that the overall macroeconomic uncertainty is below the long-run average, whereas a positive value reflects heightened uncertainty relative to the systemic baseline. Thus, the threshold at –66.80 marks a critical shift from stable to turbulent macro-financial conditions, where bank behavior transitions from risk-seeking to risk-averse strategies. This is fully consistent with threshold-based models of strategic adjustment under uncertainty.

5.2.2. Differential analysis of β₁ and β₂

Using the estimated threshold γ, the PTR model delineates two distinct behavioral regimes through the estimation of two corresponding coefficients:

Table 3. PTR results: Market power and financial risk across macroeconomic uncertainty

Macroeconomic Uncertainty Regime	*Coefficient (β)*	*Effect of Market Power*	*p-value*
Low Uncertainty (≤ –66.80)	+1.2209	Positive	< 0.001
High Uncertainty (> –66.80)	–2.1676	Negative	< 0.001

Source: Author's own estimation using Python

The empirical results illustrated in Table 3 provide valuable insights:

- *β_1 (LERNER_low):* When macroeconomic uncertainty falls below the threshold of –66.80, market power exerts a significantly positive effect on financial risk (coefficient β_1 = +1.2209, $p < 0.001$). This indicates that in stable macroeconomic environments, banks with greater market power tend to engage in riskier behavior in pursuit of higher returns. This finding aligns with the core tenets of the risk-shifting hypothesis ([5]), as well as corroborating evidence from empirical studies such as Fu et al. (2014) ([7]).
- *β_2 (LERNER_high):* Conversely, when macroeconomic uncertainty exceeds the identified threshold, the effect of market power on financial risk turns significantly negative (coefficient β_2 = –2.1676, $p < 0.001$). This suggests that under heightened uncertainty, banks leverage their market power as a strategic stabilization mechanism, enhancing capital buffers and curbing high-risk lending activities.

These contrasting dynamics are vividly illustrated in Figure 6, which captures the regime shift in risk behavior across the two segments of the CMUI distribution. The results offer compelling evidence of banks' nonlinear strategic responses to varying degrees of macroeconomic uncertainty, with market power serving both as a risk amplifier in tranquil times and as a stabilizer under elevated systemic stress.

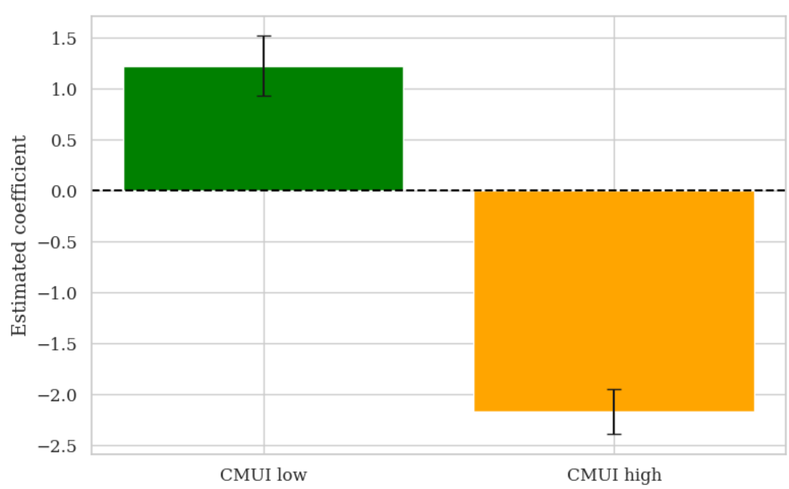

Figure 6. The impact of LERNER on Z-score under CMUI

Source: Author's own work using Python

These empirical findings provide compelling support for H2: there exists an optimal threshold of macroeconomic uncertainty at which the effect of market power on bank risk undergoes a structural shift. The significant divergence between coefficients β_1 and β_2 reflects a strategic transition in bank behavior, an inflection that has been largely overlooked in previous literature, which predominantly assumes a linear risk-power nexus.

This study contributes meaningfully to the existing discourse by extending the foundational insights by [4], and [20]. Specifically, it does so by leveraging a novel CMUI, which captures a multidimensional spectrum of uncertainty sources, including ESG factors, media sentiment, geopolitical instability, and economic policy dynamics. This comprehensive index allows for a more nuanced understanding of the external environment in which banks operate.

Moreover, by integrating contemporary behavioral theories with robust empirical techniques, this research offers a powerful analytical framework to elucidate the evolving dynamics of bank risk regulation under volatility. It transcends traditional boundaries by reconciling theoretical postulates with real-world data in a threshold modeling context, revealing a strategic recalibration of risk-taking behavior as uncertainty intensifies.

5.3. Bank-Specific Heterogeneity Analysis

To test hypothesis H3, that the impact of market power on bank financial risk varies according to ownership structure and institutional size, sub-sample estimations of the PTR model are conducted across distinct banking segments. The model is estimated separately for two dimensions: (i) State-Owned Commercial Banks (SOCBs) versus Joint Stock Commercial Banks (JSCBs), and (ii) banks categorized by size, large, medium, and small, as classified by the SIZE variable.

5.3.1. Ownership-Based Segmentation: SOCBs vs. JSCBs

Figure 7 reveals a pronounced divergence in strategic responses between the two ownership groups. This heterogeneity underscores the importance of governance structures and institutional mandates in shaping banks' reactions to macroeconomic uncertainty. State-owned banks, often guided by policy-driven objectives, exhibit markedly different risk behavior dynamics compared to their joint-stock counterparts, which tend to prioritize profitability and shareholder value maximization.

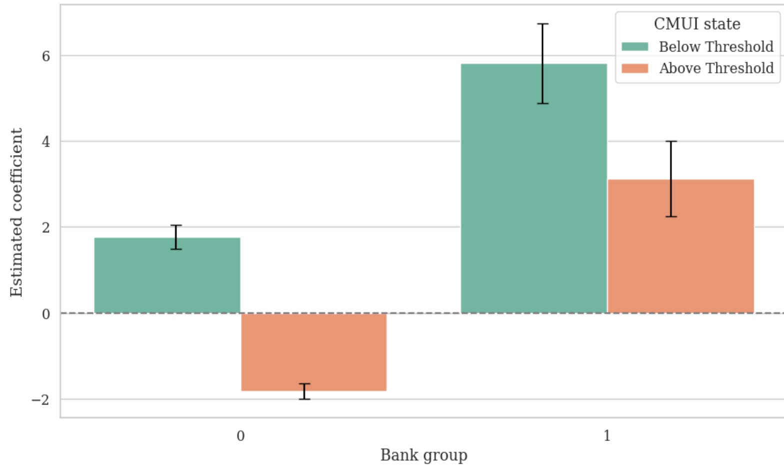

Figure 7. The Impact of LERNER on Z-score under ORIGINAL

Source: Author's own work using Python

Table 4. Separate PTR estimations by bank ownership types

Ownership	*β₁ (Low Uncertainty)*	*β₂ (High Uncertainty)*	*Significance*
SOCBs	5.8046	3.1214	Both sig. at 1%
JSCBs	1.7679	-1.8254	Both sig. at 1%

Source: Author's own work using Python

The empirical results presented in Table 4 provide valuable insights:

- For SOCBs, the coefficients capturing the impact of market power on the Z-score remain positive and statistically significant across both CMUI regimes. This consistent pattern reflects the reality that SOCBs often operate under greater institutional protection, with preferential access to policy support mechanisms. Consequently, they exhibit lower strategic flexibility in restructuring risk under conditions of heightened macroeconomic uncertainty. This finding is consistent with prior research suggesting that SOCBs are generally less responsive to macro-financial volatility, owing to their quasi-fiscal mandates and policy-implementing roles in emerging economies such as Vietnam [19].
- In contrast, JSCBs demonstrate a distinct strategic regime shift. Specifically, when CMUI falls below the threshold, the LERNER coefficient is positive and statistically significant ($\beta_1 > 0$, $p < 0.01$), indicating a pronounced inclination toward risk-leveraging in pursuit of higher returns during stable periods. However, once macroeconomic uncertainty exceeds the threshold, the LERNER coefficient turns significantly negative ($\beta_2 < 0$, $p < 0.01$), highlighting the role of market power as a "strategic shield" in turbulent environments.

This nonlinear response pattern aligns with Gabaix's (2019) theoretical proposition on threshold-based risk adjustment behavior under uncertainty [8].

5.3.2. Size-Based Heterogeneity in Strategic Behavior

The estimation results of the PTR model by bank size group, illustrated in Figure 8, reveal significant heterogeneity in strategic responses to macroeconomic uncertainty. These findings offer robust support for H3, which posits that *"The impact of market power on bank risk under elevated uncertainty is systematically differentiated by bank size."* For detailed slope coefficients across size-based subsamples, refer to Table 5.

Table 5. Separate PTR results for small, medium, and large banks

Bank Size	*β_1 (Low Uncertainty)*	*β_2 (High Uncertainty)*	*Significance*
Small	0.6170	-2.7426	$p < 0.01$ both
Medium	2.0678	-0.9661	$p < 0.01$ / $p < 0.05$
Large	1.9211	0.2105	β_2 not sig.

Source: Author's own work using Python

This size-based differentiation underscores the structural and operational asymmetries among banks, suggesting that larger institutions may possess greater internal buffers and risk management capabilities, whereas smaller banks may exhibit more reactive or constrained behavior under the same uncertainty regimes. The nuanced interplay between market power and institutional scale underlines the importance of tailored regulatory frameworks that account for such endogenous heterogeneity in financial systems.

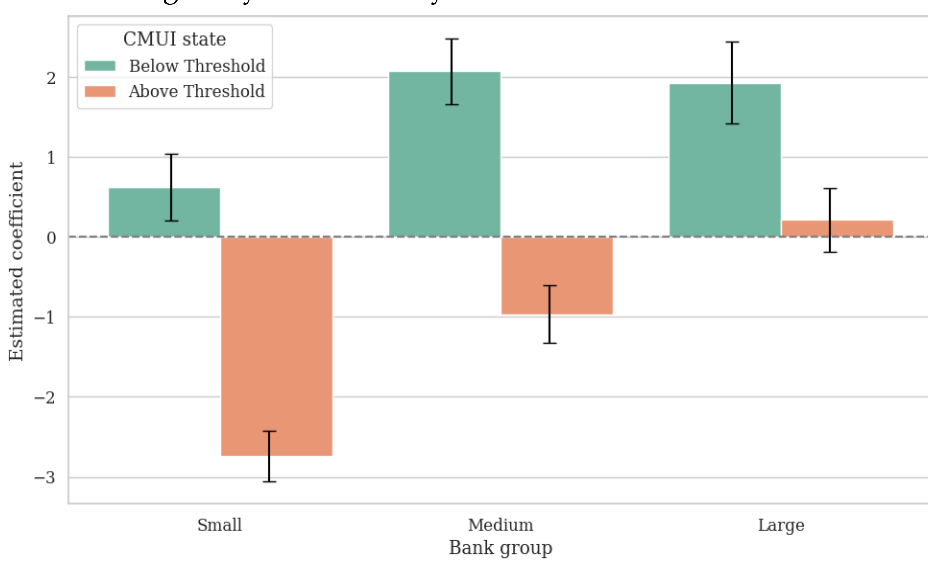

Figure 8. The Impact of LERNER on Z-score under SIZE

Source: Author's own work using Python

Banks exhibit notable heterogeneity in strategic responses to macroeconomic uncertainty, contingent on institutional size. Among small banks, market power positively influences financial risk under low uncertainty ($\beta_1 = 0.6170$, $p < 0.01$), reflecting a profit-seeking pricing strategy. However, once CMUI exceeds –66.80, the relationship sharply reverses ($\beta_2 = –2.7426$, $p < 0.01$), suggesting market power is redeployed defensively to contain risk.

This behavioral shift is consistent with real options theory, which highlights the greater strategic agility and responsiveness of smaller institutions under uncertainty ([8], [17]). It also aligns with empirical evidence from China and ASEAN, where small banks adjust more forcefully due to governance flexibility and competitive intensity ([18], [20]).

Medium-sized banks display similar, though more moderate, regime-switching. In low uncertainty, market power increases risk ($\beta_1 = 2.0678$, $p < 0.01$), while under high uncertainty, the effect becomes significantly negative ($\beta_2 = -0.9661$, $p < 0.05$). This suggests conditional adaptation constrained by capital structure and informational access.

Large banks, by contrast, show no significant behavioral change. While market power contributes to risk in tranquil regimes ($\beta_1 = 1.9211$, $p < 0.01$), it becomes insignificant under high uncertainty ($\beta_2 = 0.2105$, $p = 0.597$), indicating limited strategic adjustment, likely due to implicit regulatory backing and "too-big-to-fail" expectations ([4], [5], [19]).

Overall, the findings confirm the asymmetric role of market power as a conditional risk-management mechanism, activated primarily in small and medium banks with greater structural flexibility ([8], [13]).

5.4. Structural Change Test: Pre- vs. Post-COVID-19 Periods

To empirically test hypothesis H4, that the effect of market power on bank risk changed significantly between the pre- and post-COVID-19 periods, separate estimations of the PTR model are conducted for each phase, using a binary COVID indicator (COVID = 0 for the pre-2020 period, and COVID = 1 for 2020 onward). The PTR estimation results, as illustrated in Figure 9, reveal a distinct structural divergence between the two periods:

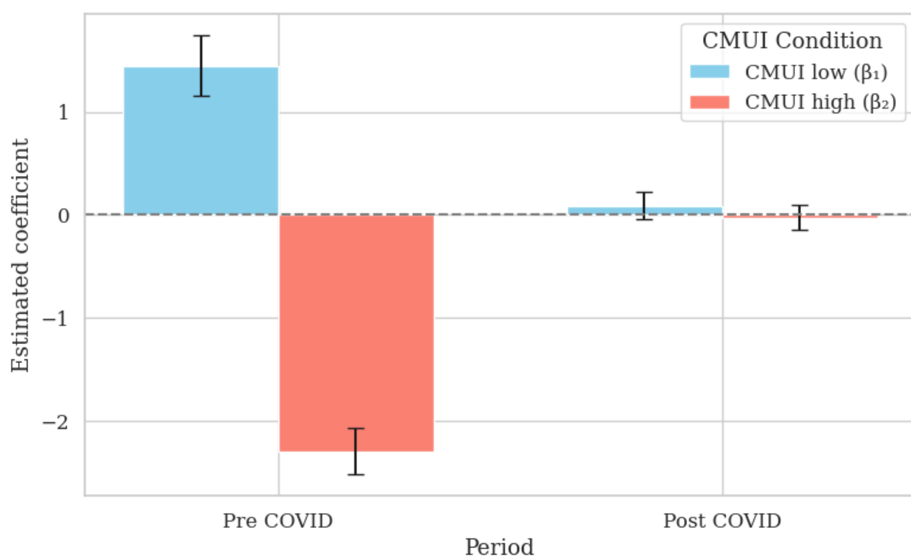

Figure 9. The Impact of LERNER on Z-score Pre- and Post- COVID-19

Source: Author's own work using Python

Table 6. Separate PTR estimations before and after COVID-19 onset (2020).

Period	*β_1 (Low Uncertainty)*	*β_2 (High Uncertainty)*	*Significance*
Pre-COVID	1.4480	-2.2973	p < 0.01 both
Post-COVID	0.0900	-0.0260	Not significant

Source: Author's own work using Python

Table 6 provides compelling evidence of nonlinear strategic behavior prior to COVID-19. When macroeconomic uncertainty was low (CMUI < γ), market power significantly increased bank risk ($\beta_1 = 1.4480$, $p < 0.01$), reflecting opportunistic risk-taking driven by pricing advantages. Conversely, under high uncertainty, market power became a stabilizing force, sharply reducing risk ($\beta_2 = -2.2973$, $p < 0.01$). These patterns validate the existence of threshold-based adjustments consistent with real options theory and behavioral models of organizational strategy ([8], [17]).

Post-COVID-19, this dynamic broke down. The relationship between market power and risk became statistically insignificant ($\beta_1 = 0.0900$; $\beta_2 = -0.0260$; $p > 0.48$), suggesting that banks no longer adapted risk-taking behavior across uncertainty regimes. The strategic role of market power effectively dissipated.

This disruption may stem from expansive pandemic-era interventions, credit guarantees, liquidity support, and fiscal stimuli, that muted endogenous strategic responses. Heightened regulatory scrutiny and post-crisis compliance shifts likely further standardized bank behavior, eroding pre-pandemic heterogeneity. These findings imply that COVID-19 was not merely a volatility shock, but a structural break that reconfigured the foundations of strategic banking behavior, echoing Altig et al. (2020)'s view of the pandemic as a systemic uncertainty accelerator [2]. Contrary to expectations of heightened post-crisis differentiation, the evidence highlights a strategic convergence, reinforcing Hypothesis H4 and underscoring the need to reassess policy and institutional designs in post-crisis banking systems.

5.5. Robustness Checks

To evaluate the stability and reliability of the core findings, the study conducts two robustness checks: (i) substituting the dependent variable from Z-score to the non-performing loan ratio (NPL), a widely accepted proxy for bank credit risk; and (ii) visually comparing regression results between the two dependent variables to assess consistency in the threshold-driven strategic adjustment mechanism.

5.5.1. Robustness Test with NPL

The results PTR using NPL instead of Z-score are illustrated in Table 7 and Figure 10.

Table 7. PTR model results when NPL replaces Z-score as the dependent variable

CMUI Regime	*LERNER Coefficient*	*p-value*	*Interpretation*
Low Uncertainty	-0.0262	0.209	Not significant
High Uncertainty	-0.0801	< 0.01	Significant reduction in NPL

Source: Author's own work using Python

In the low-uncertainty regime (CMUI < γ), the LERNER_low coefficient is –0.0262 and statistically insignificant ($p = 0.209$). In contrast, in the high-uncertainty regime (CMUI > γ), the LERNER_high coefficient is 0.0801 and statistically significant ($p < 0.01$).

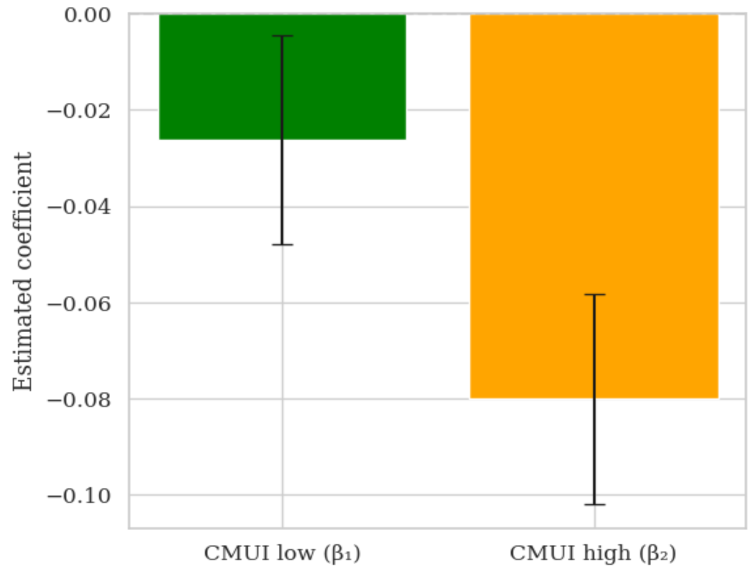

Figure 10. The impact of LERNER on NPL under CMUI

Source: Author's own work using Python

This indicates that market power does not significantly affect credit risk in stable macroeconomic conditions, but plays a meaningful role in reducing non-performing loans (NPLs) when macroeconomic uncertainty becomes elevated. These findings partially support Hypotheses H1 and H2, and emphasize that the strategic impact of market power appears more pronounced when measured through a composite risk indicator (Z-score) rather than a single-dimension credit risk proxy such as NPL.

5.5.2. Comparative Analysis of Z-score and NPL

When using Z-score, a distinct nonlinear pattern emerges, β_1 is significantly positive in low-uncertainty environments, while β_2 turns significantly negative once uncertainty surpasses the threshold. This clearly illustrates the activation of nonlinear strategic behavior across the CMUI threshold. In contrast, the pattern is less pronounced when using NPL as the dependent variable. Here, β_1 is statistically insignificant, and although β_2 is negative, it exhibits only mild magnitude, albeit still statistically significant. This divergence highlights the differing sensitivity of risk measures to market power, and suggests that Z-score captures a broader spectrum of bank risk behavior, including solvency and income volatility, whereas NPLs reflect only one dimension of bank performance, credit quality.

Figure 11 provides a visual comparison of the estimated LERNER coefficients across the two dependent variables within the PTR framework.

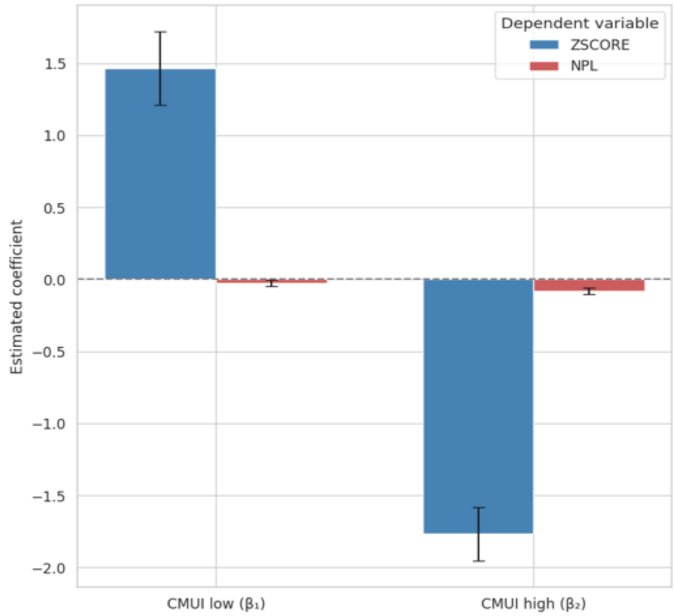

Figure 11. Comparison of the impact of LERNER on Z-score and NPL across the CMUI threshold

Source: Author's own work using Python

This comparison reveals that Z-score is a more comprehensive and sensitive indicator of banks' strategic adjustments, while NPL primarily reflects partial defensive behaviors during periods of crisis. Nonetheless, the consistently negative effect of market power in the high-uncertainty regime across both metrics reinforces the existence of a threshold-based reaction mechanism, in line with Hypothesis H2.

The robustness checks conducted affirm that the PTR model delivers consistent and economically convincing insightsinto the nonlinear relationship between bank market power and financial risk. Although the intensity of the responses varies across different types of risk, the directionality remains stable, especially under high macroeconomic uncertainty. These findings strengthen the model's quantitative credibility, support Hypotheses H1 and H2, and lay a solid foundation for extending the framework to alternative uncertainty thresholds in future research.

5.5.3. Threshold Sensitivity to Single-Dimensional Uncertainty Measures

The robustness check using each individual uncertainty measure supports the core findings, in Table 8.

Table 8. PTR model results when Z-score replaces Z-score as the dependent variable

Uncertainty Index	*β_1 (Low Uncertainty)*	*β_2 (High Uncertainty)*	*Significance*
EPU	1.4651	-1.7664	Both sig. at 1%
GPR	-2.6714	-0.3182	β_2 not sig.
WUI	-2.9404	-0.3998	Both sig. at 1%
ESGUI	-1.8565	0.1300	β_2 not sig.
WSI	-0.2453	-1.8338	β_1 not sig.

Source: Author's own work using Python

In particular, the EPU index replicates the threshold-based reversal in the effect of market power on risk, aligning closely with the CMUI-based results. WUI and GPR exhibit partially consistent one-directional effects, suggesting the presence of nonlinear but not necessarily regime-reversing dynamics. The ESGUI-based estimation yields weak and inconsistent results, underscoring the limitation of relying on single-source uncertainty proxies. Overall, these findings validate the construction of a composite uncertainty index and affirm the robustness of the threshold specification.

6. Conclusion and Policy Implications

6.1. Conclusion

This study provides the first empirical evidence from Vietnam on the nonlinear relationship between bank market power and financial risk under varying levels of macroeconomic uncertainty. By constructing a Composite Macroeconomic Uncertainty Index (CMUI) from EPU, GPR, WUI, WSI, and ESGUI sources, and applying the PTR framework, this study finds that:

Market power can increase risk when uncertainty is low, but functions as a “strategic shield” under high uncertainty, validating Hypotheses H1 and H2, consistent with real options theory and organizational behavior models ([8], [17]).

There exists clear heterogeneity in strategic responses by ownership type and bank size, with private and smaller banks responding more actively to macroeconomic volatility. This supports Hypothesis H3 and extends the insights by [19] and [20].

The pre-COVID-19 period exhibited the most evident strategic reaction mechanisms, whereas post-pandemic, the role of market power in risk moderation diminished significantly, reflecting the structural shock nature of COVID-19 and supporting Hypothesis H4, as also observed in [2].

In summary, this research shows that the risk-coordination role of market power is real, conditional, and nonlinear, a finding of particular relevance for emerging financial systems like Vietnam, which are increasingly exposed to systemic macro-financial shocks.

6.2. Policy Implications

This study offers several critical insights for macroprudential design in emerging markets like Vietnam, where financial liberalization unfolds alongside institutional fragility and systemic exposure to macroeconomic shocks.

First, incorporating uncertainty-sensitive tools, such as the CMUI proposed herein, into the State Bank of Vietnam’s surveillance framework would enable earlier detection of behavioral inflections and systemic distress. By embedding CMUI within countercyclical capital regimes under Basel II Pillar II, regulators can better align capital buffers with shifting macro-financial conditions.

Second, the finding that market power stabilizes risk under high uncertainty calls for a nuanced recalibration of antitrust enforcement. Blanket restrictions on consolidation or pricing could inadvertently weaken resilience mechanisms. A context-sensitive competition framework, differentiating stabilizing from destabilizing concentrations, would enhance systemic robustness under volatility.

Third, heightened behavioral asymmetry among smaller and joint-stock banks warrants tailored supervisory responses. The SBV should consider liquidity facilities contingent on governance standards, capital incentives triggered by CMUI thresholds, and real-time dashboards for risk monitoring. These measures would strengthen Resolution 42/2017/QH14 implementation without compromising discipline.

Fourth, integrating behavioral metrics into Basel II/III, such as uncertainty-adjusted ICAAPs and scenario-based disclosures, can shift supervision from static compliance to dynamic risk coordination. Finally, the post-COVID erosion of strategic responsiveness underscores the need for credible exit strategies from prolonged regulatory forbearance to mitigate latent moral hazard.

Collectively, these insights reinforce the case for adaptive, risk-sensitive regulation attuned to institutional heterogeneity and macro-financial complexity.

6.3. Limitations and Future Research Directions

While this study establishes robust empirical evidence on the nonlinear impact of market power under composite uncertainty, several limitations invite further exploration. First, the composite CMUI may obscure the differentiated effects of its components; future research should decompose these to isolate source-specific dynamics. Second, the analysis relies on institution-level data, limiting insights into intra-bank behavior, micro-level loan or portfolio data could enhance granularity. Third, global financial spillovers such as capital flow volatility and exchange rate shocks are omitted. Future extensions could incorporate cross-country ASEAN comparisons, adopt machine learning to classify bank responses, and examine ESG-linked uncertainties to refine the theoretical and policy relevance of uncertainty-driven risk behavior.

Conflicts of Interest: The authors declare that there are no conflicts of interest regarding the publication of this paper.

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