Bank Competition and Credit Risk: Does Bank Stability moderate the Competition-Credit Risk nexus?

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Abstract

This paper intends to understand the impact of bank competition on credit risk and further determine if the association between competition and credit risk depends on bank stability, specifically focusing on commercial banks of Nepal. The study spans from 2011 to 2022 and incorporates various control variables, including macroeconomic, bank-specific, Covid-19 pandemic and regulatory factors. We incorporate a dynamic panel data model and find that while increased competition leads to an increase in credit risks, this effect is reversed in a stable banking environment with strong capitalization, profitability, and steady earnings. Our findings assist policymakers in achieving a more optimal equilibrium between promoting competition and safeguarding financial stability, while also limiting excessive risk-taking. Additionally, it can provide guidance to the bank management in improving their risk management practices.

Keywords: Bank Competition, Lerner Index, Bank Stability, Non-Performing Loan (NPL), Credit Risk, Loan Loss Provision (LLP)

JEL Classification: D53, F65, G20, G21

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I. INTRODUCTION

Banks, as pivotal financial intermediaries, serve a vital function in driving economic growth by directing savings towards investment opportunities. Their extensive involvement in every market underscores their importance for the real economy. This view aligns with Beck et al. (2000) who argue that development in financial sector is connected to higher levels of economic growth. Likewise, endogenous growth model also provides a theoretical framework for understanding the role of banks in economic growth. This model argues that banks can help to promote growth by facilitating the accumulation of physical and human capital (Bencivenga & Smith, 1991; Pagano, 1993; Levine, 1997). These findings support the idea that banking sector development is linked to economic growth, indicating that banks are competent in efficient resource allocation.

Although there is increasing consensus in research on the positive contribution of the banking sector to economic growth, there also lies an increasing concern that the banking sector, when facing competition, can potentially impact financial stability. In this regard, there are two dominant views on the association between bank competition and financial stability. The competition-fragility view posits that increased bank competition can lead to financial instability while the competition-stability view posits that increased bank competition can lead to financial stability (Berger, Klapper & Turk-Ariss, 2017). Similarly, the U-shaped view posits that there is a U-shaped association between the risk of bank failure and bank competition (Martiniz- Miera and Repullo, 2010).

The existence of aforementioned dominant perspectives on the association among competition and bank stability highlights its need to further investigate their impact on credit risk. Analyzing the risk arising from credit holds immense significance as it has the potential to trigger the downfall of the whole financial system of a nation, leading to financial instability (Jayakumar et. al.,2018). In this context, existing literature presents varying perspectives on competition and credit risk association with inconclusive findings, suggesting both positive and negative associations (Alam et al., 2018; Ali et al., 2023) as well as nonlinear relationship (Brei et al, 2020). This leads to a novel question: Could these inconclusive view on competition-credit risk nexus be attributed to the joint effect of competition and bank stability on credit risk? One of the explanations on the competition-credit risk puzzle might be to consider the role of banking stability because banking stability plays a crucial role in reducing credit risk (Ghenimi et al, 2017). In such scenarios, it is plausible to suggest that banking stability can act as a moderating factor in examining inconclusive findings on competition and credit risk association.

In this paper, we examine joint effects of bank competition and bank stability on credit risk in Nepalese commercial banks. We are motivated by several key considerations to explore the nexus between bank competition and credit risk. Firstly, Nepal's private sector credit to GDP ratio, a key indicator of financial depth, has risen from 22 percent in 2002 to 88 percent in 2020 (NRB, 2022), surpassing the South Asian average and other regional countries (World Bank, 2021). Given these developments, Nepal's banking sector merits careful attention from researchers, policymakers, and investors alike. Secondly, the influence of competition and bank stability on credit risk has yet to be explored in the context of Nepal, highlighting a substantial gap in research concerning the nexus between bank competition and credit risk.[1] Thirdly, association between competition and risk in banking has generated mixed results in the literature[2] (Claessens, 2009). The varying and inconclusive results may be dependent on

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[1] In the context of Nepal, existing literature has measured only the competitiveness of commercial banks and some show how competition affects stability (see, Gajurel & Pradhan, 2012; Neupane, 2016; Kunwar, 2018;Gautam, 2021; G.C & S.B., 2016; NRB, 2022). Additionally, the literature pertaining to credit risk has primarily focused on evaluating credit risk and performance within the commercial banking sector (Poudel, 2012; Bhattarai, 2016; Bhatt et al., 2023).

[2] See De Nicolo and Lokoinova (2007); Boyd et al. (2006); Jimenex et al. (2013); Ariss (2010); Berger et al. (2009); Kasman & Kasman (2015); Gonzalez et al. (2017); Yusiantoro et al. (2019).

the choice of country, variable selection, and time period studied. Different countries have different economic policies, indicating that a focused in-country analysis is necessary (Khatri Chettri, 2022) because the association between bank competition and credit risk cannot be generalized across countries. Fourthly, this paper only incorporates nonstructural measure of competition[3], specifically the Lerner Index, which assesses pricing power and directly gauges competition at the bank level.

We attempt to make two significant contributions to the existing literature on bank competition and credit risk. Firstly, this research is first of its kind in Nepal by comprehensively exploring the combined influence of bank competition and bank stability on credit risk, distinguishing it from prior studies that primarily focused on assessing the competitiveness of commercial banks in Nepal (Gajurel & Pradhan, 2012; Neupane, 2016; Kunwar, 2018; and Gautam, 2021). Moreover, this study adopts a holistic approach by considering Lerner index as nonstructural indicator of competition. This enables more comprehensive evaluation of the role of loan market power in contributing to overall credit risk, with the capability to assess this of each bank on an annual basis[4]. By using this metric, this paper assume that bank competitive behavior and market structure have one-to-one relationship which demonstrates that higher Lerner index and greater market power are linked to less competitive banking markets. Secondly, this study contributes, at least partially, to resolving the inconclusive association between competition and credit risk, which is conditional upon banking stability.

3 Non-structural measures of competition are preferred over structural measures due to challenges in the structural measures, such as weak theoretical foundation, uncertainty about the link between structure and behavior, and difficulties in defining market boundaries (Ergungor, 2004; Shaffer, 2004). Non-structural approaches assesses competitive pressure by directly observing firms' market conduct, using formal competition measures that reflect how output responds to input prices (Leon, 2015).

4 Lerner Index directly measures competition by examining the pricing power of a firm, which is determined by the difference between price and marginal cost, and it uniquely calculates this measure at the individual bank level (Repková, 2012). It allows assessment at the individual bank level, allowing for distinctions among banks based on factors such as size and type.

Unlike the dominant view of competition fragility, where bank competition actually alleviates credit risk (Berger et al., 2017;Beck, 2008; Jimenez et al., 2013; Carletti and Hartmann, 2003; Keeley, 1990), this study documents that bank competition can actually reduce credit risk in stable banking environment marked by strong capitalization and profitability with steady earnings. In other words, we show that increased competition is linked to increased credit risks, however the relationship is reversed in a stable banking environment marked by strong capitalization and profitability.

The rest of the sections is organized as follows: first, it gives a comprehensive review of the literature on bank competition and credit risk. Second, the methodology section outlines methods, data, and econometric models used in the paper. Finally, we show the results and conclusion of the study.

II. LITERATURE REVIEW

Keeley (1990) argued that heightened competition can lead to increased risk-taking by banks. He examined effects of deregulation in the US banking sector during the 1970s and 1980s and highlighted how increased competition exacerbated the agency problem. This shows that bank competition intensifies the agency problem, contributing to increased credit risk due to information asymmetry, adverse selection, and moral hazard problems. This problem, similar to the one described by Jensen and Meckling (1976), involved banks taking on excessive risk, knowing that deposit insurance would cover potential losses. As a result, bank owners and managers had a strong incentive to take on more risk, contributing to a surge in bank failures during that period and causing financial instability. This illustrates how heightened competition motivates bank managers to increase risk-taking to pursue higher profitability and charter value, consequently raising the likelihood of loan defaults and an escalation in credit risk.

On the contrary, in a less competitive banking industry that prioritizes relationship lending, a strong connection between banks and borrowers can develop over time (Coccorese, 2017). This can improve screening, monitoring, and loan performance, ultimately facilitating efficient credit allocation and reducing credit risk. However, in less competitive or concentrated markets, moral hazard problems arise. "Too big to fail" regulations in concentrated markets can induce moral hazard, as banks anticipate bailouts and consequently engage in greater risk-taking. Similarly, concentrated markets with high-interest rates can lead borrowers to embark on risky projects to meet increased interest payments, resulting in a higher number of loan defaults and an increase in credit risk (Clark et al., 2018).

The existing literature suggests two dominant views on the association between bank competition and financial stability. These views include Competition-Fragility View and Competition-Stability View.

Competition-Fragility View vs Competition-Stability View

Competition-fragility view suggests that excessive bank competition can increase the likelihood of bank failures. This is because banks, under competitive pressure, may take on more risk to boost profits. This viewpoint is supported by the interest rate effect, charter value hypothesis, and moral hazard issues (Carletti and Hartmann, 2003; Keeley, 1990; Beck, 2008; Berger et al., 2017; Jimenez et al., 2013). The interest rate effect suggests that with fewer banks in a market, each bank has increased market power, allowing them to charge higher interest rates and build a cushion against losses during crises. In contrast, in a competitive market, banks must aggressively compete for customers, which can push them to take on more risk. The charter value reflects a bank's franchise value, which is its ability to earn future profits. In a less competitive market, each bank's franchise is more valuable because there's less competition, making it easier for them to earn profits. Conversely, in a competitive market, each bank's franchise is less valuable due to increased competition, making it harder to earn profits. The moral hazard problem arises when banks know they'll be bailed out by the government in case of failure, encouraging them to take on more risk as they won't bear the full consequences of their actions.

Competition-stability hypothesis posits that heightened competition within the banking industry can contribute to enhanced stability, which is attributed to the fact that banks operating within a competitive environment tend to embrace prudent risk management practices while avoiding the undue assumption of excessive risks. When there are fewer banks in a market, each bank gains greater market power. Consequently, they can exert influence over interest rates on loans, which tend to be higher. Elevated interest rates can amplify the likelihood of adverse selection, thereby facilitating the funding of ventures by risk-prone borrowers. Moreover, this scenario may incentivize borrowers to embark on ventures characterized by higher risk profiles in their pursuit of loan repayment. As a result, this propensity can give rise to heightened default rates, rendering the banking system more susceptible to instability. This phenomenon, often referred to as the "risk-shifting effect," emerges due to moral hazard concerns, where the risk associated with borrowers is transferred to the bank (Schaeck et al., 2009; Boyd et al., 2006; Boyd and De Nicolo, 2005). Ultimately, the escalation in interest rates attributed to less competition in the loan market induces borrowers to undertake riskier projects offering greater returns, thus leading to the financial instability.

Likewise, Martinez-Miera and Repullo (2010) introduced the MMR hypothesis, which argues that the association between bank competition and the likelihood of bank failure follows a U-shaped pattern. This concept is founded on two key factors: the risk-shifting effect (Boyd and De Nicolo,2005), where heightened competition leads to lower loan rates, decreasing default probabilities, and the margin effect, indicating that increased competition results in lower loan rates and reduced revenue from loans, leading to riskier banks. The MMR hypothesis suggests that the margin effect is more dominant in competitive markets, while the risk-shifting effect is more pronounced in monopolistic markets, which results in the U-shaped relationship between the likelihood of bank failure and bank competition.

III. RESEARCH METHODOLOGY

Data

We focus solely on commercial banks because they constitute the majority of the financial system, accounting for 54.5 percent of assets (NRB, 2022), and play a pivotal role in banking development. Hence, this paper examines an unbalanced panel dataset covering the fiscal years from 2011 to 2022 collected from Quarterly Economic Bulletin published by Nepal Rastra Bank, Economic Survey published by Ministry of Finance, and respective sample banks' annual reports. We initially organized data in Microsoft Excel and then imported it in STATA software for deriving results.

Variables

Bank Stability Variable:

As a proxy of bank stability we incorporate the Z-score ratio which offers insights on how rapidly a bank's profits would decline before a bank's capital is exhausted (Boyd et al., 2006; Berger et al., 2009). Higher Z-score values signify greater bank stability and reduced overall risk. This measure is calculated at the bank level and provides an accounting-based assessment of risk[5]. It is calculated as:

$$Z - score = \frac{\text{ROA+E/TA}}{\text{SD(ROA)}} \tag{1}$$

5 The Z-score is computed using the methodology described by Moreno et al. (2022). They have highlighted that the most effective formula for computing Z-score integrates the current ROA, capitalization values, and the standard deviation of returns computed throughout the entire sample duration.

Where,

ROA = Return on Assets

E/TA = Equity to total assets

SD (ROA) = Standard Deviation of Return on Assets

Bank Competition Measure:

We incorporate the Lerner Index introduced by Lerner (1934) as a proxy for the bank competition measure. This method evaluates a firm's pricing power by calculating the ratio of the difference between price and marginal cost to the price itself. The degree of competition is represented by a value ranging from 0 to 1, with 0 indicating perfect competition and 1 indicating a complete monopoly. A Lerner Index below 0 suggests that prices are set below marginal cost, potentially indicating non-optimal bank behavior. Lerner index is calculated by using the following functions.

$$\text{Lerner Index} = \frac{P_{it} - \text{MC}}{P_{it}} \quad (2)$$

Where, *P* represents the price of total assets, indicated by the ratio of total revenues to total assets for bank *i* at time *t*. The marginal cost *MC* cannot be directly observed; instead, it is determined empirically using the parameters obtained from estimating a trans-log cost function or a total cost function as outlined below.

$$\log(C_{it}) = \alpha + \beta_1.\log(Q_{it}) + \beta_2.(\log Q_{it})^2 + \beta_3.\log(W1_{it}) + \beta_4.\log(W2_{it}) + \beta_5.\log(W3_{it}) + \beta_6.\log(Q_{it}).\log(W1_{it}) + \beta_7.\log(Q_{it}).\log(W2_{it}) + \beta_8.\log(Q_{it}).\log(W3_{it}) + \beta_9.(\log W1_{it})^2 + \beta_{10}.(\log W2_{it})^2 + \beta_{11}.(\log W3_{it})^2 + \beta_{12}.\log(W1_{it}).\log(W2_{it}) + \beta_{13}.\log(W1_{it}).\log(W3_{it}) + \beta_{14}.\log(W2_{it}).\log(W3_{it}) + \varepsilon_{it} \quad (3)$$

where, *C* represents the total cost, which encompasses interest expenses, commission and fee expenses, trading expenses, personnel expenses, other administrative expenses, and operating expenses, all measured in rupees. *Q* represents output quantity, measured in billions of rupees of total assets. *W1* stands for ratio of interest expenses to total assets, *W2* denotes ratio of personnel expenses to total assets, and *W3* signifies ratio of administrative and other operating expenses to total assets. We incorporate bank fixed effects to account for time-varying unobserved heterogeneity at the bank level and year fixed effects to control for time variation to estimate cost function following Fungacova et al. (2013). The marginal cost (*MC*) can be measured by using the following relation.

$$MC = \delta C/\delta Q = {C_{it}}/{Q_{it}}\,[\beta_1 + 2.\beta_2.\log(Q_{it}) + \beta_6.\log(W1) + \beta_7.\log(W2) + \beta_8.\log(W3)] \quad (4)$$

The regression result is reflected in Appendix 2. After estimation of the translog cost function, marginal cost is then derived to finally compute the Lerner Index.[6]

Other Variables

We employ non-performing loans (NPLs) as a proxy for credit risk. As an alternative proxy to credit risk, loan loss provision (LLP) is also employed for robustness checks. The macroeconomic control variables are inflation, interbank interest rate, and GDP growth rate. Bank control variables include income diversification, loan ratio, and bank total assets. Regulatory control variables include capital adequacy ratio. Details on variables are outlined in Appendix 1 for a comprehensive overview (refer to Appendix 1).

Model Specifications

We include dynamic panel data model using the two-step Generalized Method of Moments (GMM) approach, following the framework proposed by Blundell and Bond (1998) and Arellano and Bond (1991). The dynamic panel model is chosen due to the dynamic nature of data and dependence of current behavior on past behavior. Building on the works of Brei et al. (2020), Dang (2021), Farooq

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6 The Lerner Index, the main variable of interest for bank competition, is estimated and entered into the main equation, which may cause a "generated regressor" problem and inaccurate standard error estimates (Pagan, 1984). Therefore, to minimize the biasness in standard errors, we employ bootstrapping procedure with 500 repetitions following the work of Tan et al. (2020).

and Mumtaz (2020), and Ali et al. (2023), we account for the dynamic nature of credit risk, wherein past levels of NPL significantly influence current NPL levels. To capture this persistence, the lagged dependent variable is included as an explanatory variable in the regression framework. Therefore, selecting this dynamic model specification is appropriate, particularly when the lagged dependent variable shows significance and a positive relationship with the dependent variable[7]. Further, the decision to employ the dynamic GMM is also supported by the fact that the number of sampled banks exceeds the number of years. The two-step GMM estimation incorporates robust standard errors with Windmejer correction and offers advantages over traditional instrumental variable estimators[8]. Further, it effectively handles concerns related to unobserved heterogeneity, endogeneity, reverse causality, and crisis control, in contrast to the differenced GMM, which removes time-invariant variables (Azmi Al., 2019; Ijaz et al., 2020). Additionally, the system GMM method addresses stationarity issues by determining the model at both levels and employing first differences (Albaity et al., 2019). Further, two-step system GMM is effective even when distribution and normality assumptions are not considered (Rustamov, 2019; Oseni, 2016).

7 It is important to note that using a lagged dependent variable as an independent variable introduces endogeneity issues in the dynamic model and in such instances, parameters derived from OLS estimations or traditional panel methods like Fixed/Random effects may be biased, especially when the sample comprises fewer than 15 time periods (Abedifar et al., 2018). However, for robustness check purposes, we also employed a static model employing OLS, Random and Fixed Effects models to verify if the results differed from those obtained through the two-step System GMM approach. The results are consistent and are reported in Appendix (5 and 6) and further discussed in upcoming sections.

8 As suggested by Khattak et al. (2021), data at bank level identifies the presence of heteroscedasticity; and the adoption of the two-step system GMM not only enhances result quality but also addresses issues related to autocorrelation, measurement errors, unobserved heterogeneity, dynamic endogeneity, omitted variable bias, reverse causality, and crisis control (Azmi Al., 2019; Ijaz et al., 2020; Yitayaw et al.,2023). Further, Hall (2005) also stated that GMM methodology exhibits greater efficiency compared to 2SLS methodology.

The specific specifications of our model is as follows.

$$Credit\ risk_{it} = \beta_0 + \beta_1 Credit\ risk_{it-1} + \beta_2 Competition_{it} + \beta_3 Stability_{it} + \beta_4 Competition_{it} * Stability_{it} + \beta_5 Macrocontrols_t + \beta_6 Bankcontrols_i + \beta_7 Regulatorycontrols_t + \beta_8 . Covidcrisis_{2020} + \varepsilon_{it} \quad (5)$$

Where, *i* indicates the bank and *t* indicates the year. Also, ε is the random error term. The model examines the association between the credit risk at the bank level and a designated measure of market competition for banks, controlling for macroeconomic, bank level, regulatory measure, and the covid crisis with a dummy variable. To account for the COVID-19 pandemic, a dummy proxy with a value of 1 in 2020 (COVID-19 pandemic period) and 0 in all other years is used (Elnahass et al., 2021). This paper has treated merged banks as though they were two separate entities before the merger and as a single entity afterward in regards to mergers (Jimenez et al.,2013).

Consistent with previous literature concerning dynamic panel data (Roodman, 2009; Blundell and Bond, 1998), and the existing body of work on bank competition and credit risk (Schaeck and Cihak, 2014; Almarzoqi et al., 2015; Farooq & Mumtaz, 2020), we instrumented original regressors into the dynamic panel model to address concerns related to endogeneity[9] (Yitayaw et al., 2023). Further, Wintoki et al. (2012) argue that using older lags as instruments is advantageous because they are exogenous to the current residuals. Therefore, to mitigate endogeneity issues, we employ the third lag of the regressor in levels as

9 As explained by Hill et al. (2021) endogeneity in regression occurs when explanatory variables and the error term are related or correlated. This can happen if there is omission of explanatory variables from the regression, making explanatory variables correlated with the error term. It might also result from using proxies for hard-to-measure variables, causing measurement errors. Additionally, endogeneity can stem from the dependent variable being affected by certain explanatory variables, and these variables, in turn, are influenced by dependent variable known as simultaneous bias. This endogeneity can also be dynamic, where past values of the dependent variable impact current values of the explanatory variables.

instruments[10]. Additionally, bank branches are used as external instruments. We transform the number of bank branches into logarithmic form to mitigate skewness and capture proportional effects. As illustrated by Carlson and Mitchener (2006), bank branches promote competition and ultimately facilitates the diversification of bank portfolios. This diversification of bank portfolios might help to reduce bank credit risk. Nevertheless, the suitability of the instruments employed relies on the validity of instruments, which is assessed through the statistical value of the Sargan/Hansen Test within two-step system GMM framework.

Although system GMM is designed to address econometric challenges such as autocorrelation, unobserved heterogeneity, endogeneity, reverse causality, measurement errors, and omitted variable bias (Yitayaw et al., 2023), we still conduct diagnostic tests to ensure the validity of the model and the instruments used. We use the F-test of joint significance to assess whether the independent variables collectively and significantly explain the model. Additionally, Blundell and Bond (1998) emphasize the importance of conducting serial correlation tests, specifically the AR(1) and AR(2) tests, on the random error term in system GMM estimation. Rejecting the null hypothesis of the AR(1) test and accepting the null of the AR(2) test is crucial for obtaining reliable results. The reliability of the system GMM estimator depends on the validity of the instruments. To assess the overall validity of the instrumental variables, we employ the Sargan and Hansen J tests for over-identifying restrictions. Both tests evaluate whether all instruments, as a group, are exogenous and valid. A failure to reject the null hypothesis in these tests indicates that the instruments are valid, whereas a rejection suggests that the instruments are inappropriate. Moreover, to strengthen the reliability of the Sargan and Hansen tests, we ensure that the

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10 To ensure robustness of lag selection in instrument construction, we compared models using 1st, 2nd, and 3rd lags of endogenous regressors as instruments. Following Creel et al., (2015) and Adjei-Frimpong et al. (2016), the final model uses third lags, as it provided the most consistent diagnostic results(robust AR(1) and AR(2), and Sargan/Hansen results)

number of instruments remains below the number of groups to reduce the risk of instrument proliferation[11]. Finally, to mitigate the influence of outliers and prevent inference problems, we apply winsorization at the 5% level (Dharmapala & Khanna, 2018).

IV. EMPIRICAL RESULTS AND DISCUSSION

Descriptive Statistics

Table 1 provides a snapshot of key statistics for the period from 2011 to 2022. Further, we also analyze Variance Inflation Factor (VIF) and the tolerance values associated with the explanatory variables. The analysis of these metrics indicates that there is no risk of multicollinearity as each explanatory variable shows a VIF below the critical threshold of 10 (see Appendix 4).

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
NPL	383	1.979	0.673	1.179	3.333
LLP	383	2.589	0.616	1.636	3.673
Lerner Index	383	0.132	0.159	-0.381	0.245
Z-score	383	27.843	3.224	21.887	32.11
Inflation	383	6.942	2.293	3.6	9.934
GDP	383	4.456	2.951	-2.37	8.977
Interbank Interest	383	2.231	2.027	0.16	6.992
Asset Size	383	11.191	0.752	9.931	12.295
Loan Ratio	383	0.662	0.026	0.627	0.699
Diversification	383	0.119	0.019	0.092	0.155
CAR	383	13.65	1.075	11.921	15.039

Source: Author's Calculation

11 In our system GMM estimation, we use instruments that include the lagged dependent variable as a GMM-style instrument, explanatory variables and bank-level and macroeconomic variables lagged by three periods as level instruments. The model limits the instrument count to 22, which is fewer than the 30 cross-sectional units, to prevent instrument proliferation (Roodman, 2009)

Impact of Bank competition on Credit Risk

Table 2 shows that NPL persist over time, with a positive and significant coefficient for the lag of NPL at the 1% significance level. Approximately 74.7% of current credit risk outcomes are explained by past credit risks. This highlights the lasting impact of past credit risks on current outcomes and underscores the need to address historical issues to ensure long-term financial stability.

The results reveal a negative relationship between the Lerner Index and credit risk (NPL), indicating that a 1% increase in market power reduces credit risk by 2.12%. This implies that higher market power or lower competition among banks reduces credit risk. Banks with greater market power tend to adopt cautious lending practices, improve screening and monitoring, enhance loan performance, and implement robust risk management. As a result, they are less likely to issue non-performing loans. This finding supports the competition fragility view, which suggests that increased competition raises financial instability by increasing credit risk. The correlation analysis shows the same results (see Appendix 3).

The results demonstrate the joint significance of the variables, as indicated by a notable F-statistic, while the Sargan test confirms the absence of over-identified restrictions. The analysis confirms the presence of first-order autocorrelation in all cases and rules out second-order autocorrelation, ensuring the consistency of the results. The significant and positive coefficient of the lagged dependent variable (NPL) supports the model's dynamic specification, suggesting that the current NPL of Nepalese commercial banks is strongly influenced by the previous year’s NPL.

Table 2: Impact of bank competition on credit risk using Two Step System GMM

Dependent Variable= Non Performing Loan(NPL)		
Variables	Coef	t-value
NPL(-1)	0.747***	16.11
Lerner Index (Market Power)	-2.124**	-2.44
GDP growth	0.038	1.45
Inflation	-0.053	-1.36
Interbank Interest Rate	-0.020	-0.90
Asset Size(log of total assets)	-0.157***	-2.90
Loan Ratio	-1.449	-1.51
Income Diversification	0.502	0.22
CAR	-0.087**	-2.13
Covid Dummy	0.902***	4.57
Constant	4.718***	2.82
AR (1)/p-value	0.000	
AR(2)/p-value	0.075	
Sargan Test P-value	0.670	
Hansen Test P-value	0.202	
F-statistic	2879.59***	
Number of Observations	249	
Number of Groups	30	
Number of Instrument	22	

****, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.*
Source: Author's Calculation

Effects of Bank Competition and Bank Stability on Credit Risk

The results presented in Table 3 show F-test statistic (Prob> F = 0.000) for both models, indicating a strong fit. The Hansen J-test is employed to assess the validity of instruments, testing the hypothesis that instruments are valid. Hansen's J-statistic, with Prob> chi2 = 0.303, affirm the validity of included instruments. Sargan test assumes that residuals or error terms are uncorrelated with instrument variables. Sargan test results, with Prob> chi2 = 0.569 demonstrate that overidentifying restrictions in the GMM estimation are valid across all specifications. Furthermore, test for AR (2) with Pr> z = 0.170 rejects the presence of second-order autocorrelation, confirming its absence.

The positive relationship between credit risk (NPL) and its lagged values indicates that past credit risk has an influence on current credit risk, suggesting persistence in credit risk patterns over time. This justifies our choice of selecting a dynamic model and aligns with the findings of Brei et al. (2020), Dang (2021), Farooq and Mumtaz (2020), and Ali and Alam (2023). Bank competition, gauged by the Lerner Index, shows a negative relationship with credit risk, suggesting that when banks hold greater market power (i.e., less competition), credit risk declines. This supports the "competition fragility" view, which posits that reduced competition lowers financial instability by decreasing credit risk. This result shows that bank market power decreases credit risk and aligns with the findings of Almarzoqi et al. (2015) and Farooq and Mumtaz (2020).

Bank stability, represented by the Z-score, shows a negative association with credit risk, indicating that profitable and well-capitalized banks are more stable and less likely to face credit risk issues. This result aligns with the findings of Ghenimi et al. (2017) and Imbierowicz and Rauch (2014).

The interaction between the bank competition (Lerner Index) and bank stability (Z-score) has significant positive impact on credit risk. This result indicates that only a combination of increased competition among banks (low market power), along with bank stability, can effectively reduce credit risk. In other words, the result suggests that a reduction of credit risk through bank competition is dependent on the stability of the bank[12]. This emphasizes the importance of a stable banking environment as a critical factor in ensuring that bank competition within the loan market is effective in reducing credit risk. This result shows that joint presence of bank competition and bank stability can reduce credit risk.

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12 In Appendix 8 and 9, we present the marginal effects of competition on credit risk across Z-score values. The results confirm that the impact of bank competition on credit risk varies with bank stability. These findings highlight the need for stability-sensitive regulatory approaches rather than one-size-fits-all competition policies.

Among macroeconomic controls, GDP growth rate, inflation rate, and interbank interest rate show no significant association with credit risk. This suggests that although macro variables are important predictors of credit risk, their marginal contribution becomes insignificant when all control variables are included in the model.

Among bank-specific controls, bank size shows a negative association with credit risk, indicating that larger banks typically face lower credit risk due to their ability to assess loan quality more effectively, supported by greater resources and more efficient information processing. This finding aligns with Salas and Saurina (2002) and Moudud-Ul-Huq (2021), who highlight that larger banks benefit from advanced risk management systems. In contrast, Brei et al. (2020) and Clark et al. (2018) report no significant relationship between bank size and credit risk, while Haq and Heaney (2012) find a positive association, suggesting that the "too big to fail" belief may encourage moral hazard and riskier behavior in larger banks.

Further, loan ratio, diversification, and capital adequacy ratio (CAR) show an inconsequential association with credit risk. The insignificant relationship between loan ratio, diversification, and credit risk may result from effective risk mitigation measures that offset their potential impact. These measures could include rigorous credit assessments, collateral requirements, or sound risk management practices. Similarly, Nepalese commercial banks must comply with regulatory requirements mandating a minimum level of capital adequacy. As banks consistently meet these requirements, the limited variation in CAR across the sample may explain its insignificant relationship with credit risk.

In terms of the COVID crisis, results indicate that the crisis heightened credit risk in the banking sector. This finding aligns with Azmi et al. (2019), who reported that the global financial crisis increased credit risk.

Table 3: Impact of Bank Competition and Interaction with Bank Stability on Credit Risk using Two Step System GMM

Dependent Variable= Non Performing Loan(NPL)		
Variables	Coef	t-value
NPL(-1)	0.821***	12.75
Lerner (Market Power)	-14.847***	-3.07
Z score	-0.091**	-2.30
Lerner* Z- score	0.490***	2.93
GDP growth	0.039	1.08
Inflation	0.011	0.17
Interbank Interest Rate	-0.006	-0.17
Asset Size(log of total assets)	-0.200***	-2.93
Loan Ratio	1.508	0.54
Diversification	-0.191	-0.05
CAR	0.040	0.59
Covid Dummy	0.957**	2.69
Constant	3.386	1.55
AR (1)/p-value	0.000	
AR(2)/p-value	0.170	
Sargan Test p-value	0.569	
Hansen Test p-value	0.303	
F-statistic	1199.40***	
Number of Observations	249	
Number of Groups	30	
Number of Instrument	22	

****, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.*
Source: Author's Calculation

Robustness Checks

To ensure the reliability of findings from the two-step system GMM (dynamic model), we also employed static panel models (OLS, Random, and Fixed Effects) using two measures of credit risk (NPL and LLP) while maintaining the same controls, including bank-specific variables, macroeconomic factors, regulatory factors, and a COVID-19 dummy variable. This helps to ensure if the results are consistent across different approaches. Appendix 5 and 6 reports regression results obtained from both static and dynamic models. We show that results from both static (OLS, Random, Fixed Effect) and dynamic (two-step system GMM) models consistently support the study's objective. The findings reveal that increased competition among banks (low market power) combined with bank stability effectively lowers credit risk, underlining the significance of a stable banking environment in reducing credit risk. Hence, these consistent results across different proxies for credit risk and methods make this study's conclusion more reliable and strong.

V. CONCLUSIONS

This paper attempts to understand impact of bank competition on credit risk and further determine if the association between competition and credit risk depends on banking stability. The initial findings indicated that bank competition contributes to an increase in credit risk. However, upon considering the moderating effect of banking stability, this study discovered an intriguing outcome suggesting that in a stable banking sector supported by strong capital and profitability, competition in banking industry can actually decrease credit risk. This occurs when banks have substantial capital and profitability where they gain the financial strength and confidence to compete without jeopardizing the quality of their loan portfolios.

In response to competition, they enhance risk management practices, implement cautious lending standards, and improve their credit assessment procedures. Consequently, this cultivates a safer lending environment, ultimately reducing the overall credit risk. These findings underscore the critical importance of maintaining a stable and well-regulated banking environment, supported by high profitability, robust capitalization, and consistent earnings. This emphasizes that bank stability, coupled with healthy competition, can encourage prudent risk management behaviors and ultimately contribute to the mitigation of credit risk. These findings can offer valuable guidance to bank management in improving risk management, assist policy makers in crafting balanced policies that promote competition while ensuring financial stability and preventing excessive risk-taking, and aid regulators in developing effective oversight measures that account for the influence of competition on credit risk and enhance the banking sector's stability.

While this study offers valuable insights, there are certain limitations that merit consideration for future research. Firstly, expanding the scope beyond commercial banks could provide more depth and accuracy of the findings. Additionally, incorporating multiple indicators of bank competition, such as the number of banks, H-statistics, and the Boone indicator, among others, would offer a more nuanced understanding. Similarly, incorporating additional measures of bank stability, such as Tobin's Q, return on equity, and return on assets would yield a more robust analysis. Furthermore, integrating industry-specific variables like the banking freedom index, banking development index, and stock market development would contribute to a more comprehensive understanding of the factors influencing the stability of the banking system. Addressing these considerations in future research would provide a more holistic view for a better understanding of the nexus between bank competition and credit risk.

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APPENDIX 1

Determinants	Proxies	Definition	Sources
Dependent Variable			
Credit Risk	NPL	The proportion of nonperforming loans in relation to total gross loans. A lower value denotes a lower credit risk, whereas a higher value denotes a higher credit risk (Brei et al., 2020;Dang, 2021; Farooq &Mumtaz, 2020; Ali et al., 2023; Zhang et al., 2016).	Nepal Rastra Bank Website
	LLP	Ratio of loan loss provisions to gross loans, a metric commonly employed to indicate a safeguard against potential credit portfolio losses. An increase suggests that credit risk has increased and loan quality has deteriorated (Bhattarai, 2016; Abedifar et al., 2018).	Nepal Rastra Bank Website
Independent Variable			
Nonstructural measure of Competition	Lerner Index	Market power in the banking sector. Increased values reduce bank competition (Brei et al., 2020; Almarzoqi et al., 2015; Leon, 2015; Farooq & Mumtaz,2020; Ali et al., 2023).	Author's Calculation: Data derived from NRB website
Interaction Variable			
Bank Stability	Z score	It shows bank profits and capital relative to return volatility risk. Higher Z-scores indicate bank stability and lower risk (Almarzoqi et al., 2015; Dang, 2021; Farooq & Mumtaz, 2020; Ali et al., 2023).	Author's Calculation: Data derived from NRB website
Macro Control			
Inflation Rate	Inflation	It shows annual inflation and increase in price levels. Inflation lowers loan values and makes them easier to service. This lowers borrowers' real income, affecting their debt service ability (Brei et al., 2020; Martín-Oliver et al., 2020; Dang, 2021; Ali et al., 2023).	Nepal Rastra Bank Website
GDP growth Rate	GDP	Annual growth rate of GDP. It shows business cycles and predicts a negative relation between the economy and NPLs (Brei et al., 2020; Martín-Oliver et al., 2020; Dang, 2021; Ali et al., 2023).	Nepal Rastra Bank Website
Interbank Interest Rate	Interest rate	An elevated market interest rate raises the loan interest rate which would subsequently boost the likelihood of loan defaults (Martín-Oliver et al., 2020).	Nepal Rastra Bank Website
Bank Level Controls			
Bank Total Asset	Asset Size	It is the natural logarithm of total assets. Larger banks can evaluate loan quality better due to their resources and information processing economies of scale (Brei et al., 2020; Dang, 2021; Ali et al., 2023).	Nepal Rastra Bank Website
Loan Ratio	Loan ratio	A bank's loan-to-assets ratio measures its credit growth history because larger loan portfolios may have grown faster (Yagli, I., 2020; Brei et al., 2020).	Nepal Rastra Bank Website
Income Diversification	Diversification	The percentage of non-interest income to revenue indicates diversification. Diversification improves loan quality and reduces risk (Brei et al., 2020; Ali et al., 2023).	Nepal Rastra Bank Website
Regulatory Controls			Nepal Rastra Bank Website
Capital Adequacy Ratio	CAR	Total capital to risk-weighted assets. Increased capitalization to risk-weighted assets lowers loan loss rates for banks (Naili & Lahrichi, 2022).	Nepal Rastra Bank Website

APPENDIX 2

Variables	(1) 500 sampled Bootstrapped Translog Cost Function
ln_Q	0.985***
	(0.011)
ln_Q_sq	-0.001***
	(0.001)
ln_W1	0.232***
	(0.034)
ln_W2	0.348***
	(0.027)
ln_W3	0.377***
	(0.054)
QW1	0.005**
	(0.002)
QW2	0.004**
	(0.002)
QW3	-0.019***
	(0.004)
ln_W1_sq	0.110***
	(0.002)
ln_W2_sq	0.092***
	(0.002)
ln_W3_sq	0.060***
	(0.008)
W1W2	-0.131***
	(0.004)
W1W3	-0.097***
	(0.008)
W2W3	-0.053***
	(0.006)
Constant	1.091***
	(0.115)
Observations	346
F-statistic	0.000
Replications	500

Source: Author's Calculation

Note: The table (Appendix 2) shows regression results of translog cost function (equation 2) using bootstrapping procedure with 500 bootstrapped samples. Bootstrapping serves as a resampling method employed for assessing the uncertainty associated with regression coefficients and various model parameters. The coefficients derived through bootstrapping provide estimates of the actual regression coefficients with reduced bias compared to the original coefficients. Additionally, a model is deemed statistically significant if its p-value is below 0.05. This regression incorporates bank fixed effects to account for time-varying unobserved heterogeneity at the bank level and year fixed effects to control for time variation. Robust Standard errors (bootstrap standard errors with 500 repetitions) in parentheses. *** p<0.01, ** p<0.05, * p<0.1

APPENDIX 3

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
(1) NPL	1.000									
(2) Lerner Index	-0.223***	1.000								
(3) Z-score	-0.162***	-0.097*	1.000							
(4) Inflation	0.150***	-0.302***	-0.133**	1.000						
(5) GDP rate	-0.048	0.049	0.104*	-0.405***	1.000					
(6)Interbank interest Rate	-0.121**	0.097*	0.065	-0.715***	-0.016	1.000				
(7) Loan Ratio	-0.320***	0.101*	0.405***	-0.288***	0.087	0.223***	1.000			
(8)Income Diversification	-0.125**	0.387***	-0.211***	-0.001	-0.015	-0.028	-0.387***	1.000		
(9)Bank Size (log of total assets)	-0.024	0.371***	-0.222***	-0.649***	0.005	0.566***	-0.003	0.180***	1.000	
(10) CAR	-0.230***	-0.086	0.402***	-0.160***	0.138**	0.147***	0.049	-0.158***	-0.152***	1.000

Source: Author's Calculation

Note: The table (Appendix 3) reports the correlation coefficient between bank competition measure and credit risk along with macro level controls and bank level controls. In this table NPL is Non-Performing Loan. Competition is measured through Lerner Index. Bank Stability is gauged through the Z-score. Macro level control variables are Interest rate, Inflation, and GDP growth rate whereas bank level controls are Asset size, Loan ratio, Diversification, and capital adequacy ratio. The superscripts ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

APPENDIX 4

Variables	VIF	1/VIF
Inflation	5.27	0.189
Interbank interest	2.90	0.344
Bank Size	2.74	0.364
Loan Ratio	1.72	0.582
GDP rate	1.79	0.557
Lerner Index	1.55	0.644
Diversification	1.53	0.653
Z-score	1.56	0.642
CAR	1.38	0.727
Mean VIF	2.27	

Source: Author's Calculation

Note: The table (Appendix 4) shows VIF and tolerance of explanatory variables from fiscal year 2011 to 2022. Competition is measured by Lerner Index. Bank Stability is gauged through the Z-score. Macro level control variables are Interest rate, Inflation, and GDP growth rate whereas bank level controls are Asset size, Loan Ratio, Diversification, and capital adequacy ratio (CAR). Data are collected through NRB database and respective bank website.

APPENDIX 5

Dependent Variable = Non Performing Loan (NPL)				
Variables	(1) OLS	(2) Random Effect	(3) Fixed Effect	(4) Two step System GMM
NPL(-1)				0.821***
				(0.064)
Lerner Index (Market Power)	-3.744***	-2.701***	-2.510**	-14.847***
	(1.272)	(0.958)	(1.007)	(4.833)
Z-score (Bank Stability)	-0.004	-0.001	0.002	-0.091**
	(0.009)	(0.012)	(0.020)	(0.040)
Lerner Index* Z-score	0.101***	0.092***	0.090***	0.490***
	(0.035)	(0.026)	(0.028)	(0.167)
Interbank Interest Rate	-0.023	0.022	0.034	-0.006
	(0.050)	(0.032)	(0.027)	(0.038)
Inflation	-0.027	0.007	0.016	0.011
	(0.067)	(0.048)	(0.046)	(0.066)
GDP rate	-0.006	0.023	0.029	0.039
	(0.043)	(0.033)	(0.034)	(0.036)
Bank Size(log of total assets)	-0.009	-0.218	-0.281**	-0.200***
	(0.131)	(0.148)	(0.132)	(0.068)
Loan Ratio	-8.086***	-5.779***	-4.840***	1.508
	(1.300)	(1.676)	(1.537)	(2.801)
Income Diversification	-9.203***	-4.111**	-2.661	-0.191
	(1.902)	(2.054)	(2.144)	(3.814)
CAR	-0.123***	-0.130***	-0.135***	0.040
	(0.034)	(0.037)	(0.043)	(0.068)
Covid-19 Dummy	0.005	0.351	0.438*	0.957**
	(0.371)	(0.240)	(0.248)	(0.356)
Constant	10.395***	10.036***	9.779***	3.386
	(2.410)	(2.295)	(2.040)	(2.182)
F-statistics/Wald statistics	9.68***	65.01***	6.11***	1199.40***
Observations	345	345	345	249
R-squared	0.275	0.229	0.216	
AR(1) p-value				0.000
AR(2) p-value				0.170
Sargan Test p-value				0.569
Hansen Test p-value				0.303
No of Groups/Instruments				30/22

Source: Author's Calculation

Note: The table (Appendix 5) reports the summary regression result (Equation 5) obtained from OLS, Random, Fixed and two step system GMM. In this table NPL is Non-Performing Loan proxy for credit risk. Competition is measured through the Lerner Index. Bank Stability is measured through Z-score and Interaction shows the joint impact of competition and bank stability on credit risk. Macro level control variables are interbank interest rate, Inflation, and GDP growth rate whereas bank level controls are Asset size, Loan Ratio, Diversification, and capital adequacy ratio. Covid-19 dummy is to understand the Covid-19 impact on credit risk. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

APPENDIX 6

Dependent Variable = Loan Loss Provision (LLP)				
Variables	(1) OLS	(2) Random Effect	(3) Fixed Effect	(4) Two step System GMM
LLP(-1)				0.906***
				(0.069)
Lerner Index(Market Power)	-2.968**	-2.363**	-2.181*	-31.136***
	(1.176)	(1.032)	(1.107)	(7.453)
Z-score(Bank Stability)	-0.008	-0.008	-0.004	-0.256***
	(0.008)	(0.013)	(0.022)	(0.063)
Lerner Index* Z-score	0.070**	0.067**	0.064**	1.025***
	(0.032)	(0.027)	(0.029)	(0.261)
GDP rate	0.027	0.047	0.051	0.043*
	(0.039)	(0.031)	(0.033)	(0.023)
Inflation	0.039	0.055	0.060	-0.071
	(0.064)	(0.051)	(0.050)	(0.062)
Interbank Interest Rate	0.017	0.051**	0.059**	-0.082**
	(0.046)	(0.024)	(0.024)	(0.039)
Bank Size(log of total assets)	0.169	-0.023	-0.074	-0.305**
	(0.130)	(0.127)	(0.107)	(0.122)
Loan Ratio	-7.473***	-5.416***	-4.691**	7.769***
	(1.286)	(2.072)	(2.028)	(2.340)
Income Diversification	-7.260***	-3.274**	-2.332	4.390
	(1.760)	(1.511)	(1.576)	(3.060)
CAR	-0.110***	-0.117***	-0.123**	0.095**
	(0.032)	(0.039)	(0.051)	(0.035)
Covid-19 Dummy	0.143	0.410**	0.466**	1.621***
	(0.353)	(0.181)	(0.200)	(0.254)
Constant	7.725***	7.760***	7.616***	4.739
	(2.476)	(2.442)	(2.188)	(3.360)
Observations	345	345	345	249
R-squared	0.300	0.207	0.209	
F-statistics/Wald statistics	9.88***	69.06***	6.12***	720.03***
Observations	345	345	345	249
R-squared	0.275	0.229	0.216	
AR(1) p-value				0.006
AR(2) p-value				0.216
Sargan Test p-value				0.383
Hansen Test p-value				0.494
No of Groups/Instruments				30/22

Source: Author's Calculation

Note: The table (Appendix 6) reports the summary regression result (Equation 5) obtained from OLS, Random, Fixed and two step system GMM. In this table, LLP is Loan loss provision, proxy for credit risk. Competition is measured through Lerner Index. Bank Stability is measured through the Z-score and interaction shows the joint impact of competition and bank stability on credit risk. Macro level control variables are interbank interest rate, Inflation, and GDP growth rate whereas bank level controls are Asset size, Loan ratio, Diversification, and capital adequacy ratio. Covid-19 dummy is to understand the Covid-19 impact on credit risk. Robust standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1.

APPENDIX 7

S.N	Bank Name	Starting Year	Ending Year
1	ADBNL	2011	2022
2	BOA	2011	2012
3	BOK	2011	2022
4	CBL	2011	2022
5	CTBNL	2011	2013
6	Century	2011	2022
7	Citizen	2011	2022
8	EBL	2011	2022
9	Global	2011	2022
10	Grand	2011	2015
11	HBL	2011	2022
12	Janata	2011	2019
13	Kumari	2011	2022
14	Laxmi	2011	2022
15	Lumbini	2011	2015
16	MBL	2011	2022
17	Mega	2011	2022
18	NABIL	2011	2022
19	NBBL	2011	2021
20	NBL	2012	2022
21	NCC	2011	2022
22	NIBL	2011	2022
23	NIC	2011	2022
24	NMB	2011	2022
25	NSBI	2011	2022
26	Prabhu	2011	2022
27	Prime	2011	2022
28	RBB	2012	2022
29	SBL	2011	2022
30	SCBNL	2011	2022
31	Sanima	2012	2022
32	Sunrise	2011	2022

Source: Author's Calculation

Note: The table (Appendix 7) provides a comprehensive list of banks included in the sample and reports the start and end years for each bank. For merged banks, each entity is treated as a separate unit prior to the merger and as a single entity afterward.

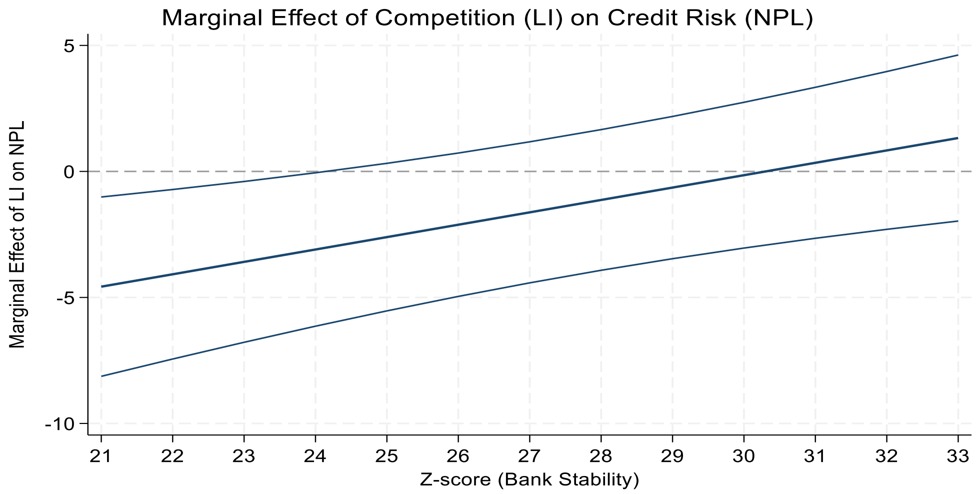
APPENDIX 8

Z-score	Marginal Effect of LI on NPL(dy/dx)	Std. Err.	p-value	95% CI
21	-4.57	1.82	0.012	[-8.13, -1.01]
22	-4.08	1.72	0.017	[-7.44, -0.72]
23	-3.59	1.63	0.027	[-6.78, -0.40]
24	-3.1	1.55	0.046	[-6.14, -0.05]
25	-2.61	1.49	0.081	[-5.53, 0.32]
26	-2.11	1.45	0.145	[-4.96, 0.73]
27	-1.62	1.43	0.256	[-4.42, 1.18]
28	-1.13	1.42	0.427	[-3.92, 1.66]
29	-0.64	1.44	0.657	[-3.46, 2.18]
30	-0.15	1.48	0.92	[-3.04, 2.74]
31	0.34	1.53	0.822	[-2.65, 3.34]
32	0.83	1.6	0.601	[-2.30, 3.97]
33	1.33	1.68	0.43	[-1.97, 4.62]

Source: Author's Calculation

Note: The table (Appendix 8) presents the marginal effects of the Lerner Index on credit risk across Z-score values ranging from 21 to 33—the observed range in our sample. The results from the table support our hypothesis that the impact of competition on credit risk is contingent upon a bank's level of stability.

APPENDIX 9



Note: The figure (Appendix 9) shows the marginal effects of the Lerner Index (LI) on credit risk (NPL) across Z-score values (21–33), which confirms that the impact of bank competition on credit risk varies with bank stability. This figure shows that competition reduces credit risk for less stable banks but has an insignificant effect for more stable ones. These findings highlight the need for stability-sensitive regulatory approaches rather than one-size-fits-all competition policies.