Competition and risk-taking behavior of commercial banks: evidence from Bangladesh

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Abstract

This study evaluates the role of competition on the propensity to take risks in the case of Bangladeshi commercial banks. We have used yearly data from 2009 to 2022 for a sample of 29 publicly traded banks. The Lerner Index was used to measure market power or competition, whilst Risk-Weighted Assets (RWA) and Loan Loss Provision (LLP) were used as indicators to evaluate the risk-taking propensities of the banks. We have used fixed effects, random effects, and feasible generalized least square regressions to examine the correlation between competitiveness and risk-taking behavior. A robust and statistically significant association is observed between the Lerner Index and Risk-Weighted Assets irrespective of the consideration of macroeconomic variables. A similar trend between Lerner index and Loan Loss Provisions is also evident. The results indicate that an increase in market dominance or a decrease in market competition leads to a higher allocation of high-risk investments and reserves for probable loan defaults.

1. Introduction

The banking industry is crucial to the economic growth of Bangladesh. Over the past decade, the country has experienced significant economic growth, with a threefold increase in GDP between 2011 and 2021. This growth has been propelled by infrastructural expenditures, a robust export-oriented garment industry, and substantial transformations in the banking sector. The sector's stability is bolstered by significant remittance inflows and a strong focus on delivering inclusive financial services. Nonetheless, the banking system has obstacles such as liquidity constraints, capital deficiencies, and non-performing loans. Notwithstanding these obstacles, the sector continues to be a crucial catalyst for economic advancement, with financial development serving as one of the principal contributors to economic growth. Ongoing legislative modifications and resource distribution are crucial to maintain this upward trajectory and guarantee the banking sector's contribution to the wider economy.

Despite the significant contributions and importance of the banking sector, a critical issue persists. Given the scale of Bangladesh's economy, many banking

professionals and experts contend that the country has an excessive number of banks (Kallol, 2017). This oversaturation is believed to potentially disrupt economic equilibrium and render traditional business models obsolete (Dombret, 2016). Because, in order to achieve rapid expansion in the early years of banking, new entrants often adopt excessive risk and leverage (Sahay et al., 2015). In the medium to long-term, this sort of banking practice may increase the non-performing loans that is already a severe problem in the banking sector of Bangladesh (Barua and Barua, 2021). This situation usually exacerbates in absence of strong institutions and regulations.

In spite of numerous strong opinions against the increasing number of banks, several new banking institutions have been approved in the past decade. During the same time period, a number of banks that were previously considered industry leaders exhibited a marked decline in performance. In this backdrop, a fundamental issue arises about whether the banking sector's consistently subpar performance–at least in terms of excessive rise in NPLs (Uddin, 2023)–over the last decades is connected to the saturation of banks and heightened competition.

The objective of this study is to investigate the link between bank competition and the risk-taking behavior of commercial banks in Bangladesh. This research examines how competition influences the risk-taking tendencies of these banks. Using the Lerner Index to measure market power (competition) and Risk-Weighted Assets and Loan Loss Provision as proxies for risk-taking behavior, we aim to understand the dynamic relationship between market dominance and risk levels. We used data from 2009 to 2022 for 29 publicly listed

banks, and employed fixed effect panel regression, along with random effects and feasible generalized least square models, to evaluate the robustness of our findings.

The banking business in Bangladesh has experienced substantial alterations in market structure and competitiveness. Indicators like the Herfindahl-Hirschman Index (HHI) show a consistent decline in market concentration over time. An HHI score of 346.2 indicates a banking industry that is characterized by intense competition (Repon and Islam, 2021). By utilizing the Panzar-Rosse Model, it becomes clear that banks in Bangladesh function under a framework of monopolistic competition. This suggests that although there are several participants, each bank possesses a certain level of market influence (Repon and Islam, 2021). More importantly, banks see greater competition in the loan market than to the deposit sector (Uddin and Suzuki, 2015).

Generally, bank competition's impact on risk-taking behavior can be influenced by several variables, including the existence of foreign banks, banking sector legislation, supervision, macroeconomic conditions, and banks' income diversification. Some studies indicate that the influence of foreign bank entrance on the risk-taking behavior of local banks can be good or bad, contingent on factors such as competition level, business model, and foreign banks' financing source (Chen et al., 2019). Some research shows that stronger regulation and monitoring can reduce the negative impact of competition on risk-taking, while other studies indicate that they can worsen it (Chen et al., 2019; Kick and Prieto, 2015). Furthermore, certain research indicates that income diversification can either strengthen or lessen the correlation between competitiveness and risk-taking,

contingent on the kind and origin of non-interest income (Allen and Gale, 2004; Amidu and Wolfe, 2013).

Theoretically, two competing theories dominate the existing empirical evidence that exist regarding the relationship between bank competition and risk-taking aptitude. Some contend that increased competition encourages banks to engage in riskier activities in order to increase their market share and profits. This is referred to as the competition-fragility hypothesis (Allen and Gale, 2004; Boamah et al., 2021; Chen et al., 2019). As banks are incentivized to monitor and diversify their loans and confront narrower interest margins, others contend that increased competition reduces risk-taking. This is referred to as the competition-stability hypothesis (Boamah et al., 2021; Kick and Prieto, 2015).

Bank competitiveness and risk-taking behavior are complex and interrelated notions that require in-depth examination and regulatory intervention. Achieving the optimal balance between competitiveness and stability in the banking sector is not universally standardized. The level of competitiveness and risk tolerance can vary throughout countries and evolve depending on the distinct characteristics and circumstances of each banking system. Therefore, periodic review is necessary to inform the policymakers and regulators for better decisions.

This research examines the influence of competition on the risk-taking tendencies of commercial banks in Bangladesh. We used the Lerner Index to measure the market power i.e., competition and Risk-Weighted Assets (RWA) and Loan Loss Provision (LLP) as the proxies to the risk-taking behavior of the banks. The Lerner

index quantifies bank market power by assessing the extent to which banks may set prices higher than their marginal costs (Elzinga and Mills, 2011). A higher Lerner index signifies greater market dominance and reduced competition. Several factors can influence the Lerner index, including interest rates, banking sector regulation, foreign bank participation, and revenue diversification of banks.

Risk-Weighted Assets, is a metric used in risk management to determine the minimum amount of capital that financial institutions need to hold. This calculation takes into account the degree of risk connected with their lending activities and other assets. This implies that if a bank has a larger RWA, it indicates a significant proportion of hazardous assets in their portfolio. RWA calculations are conducted to minimize the likelihood of insolvency and protect depositors. RWA is computed in accordance with the Basel Accord and regulations from the Bangladesh Bank.

Loan Loss Provision, is a portion of income statement expenses that is reserved to cover loans and loan payments that are unlikely to be recovered. Financial institutions are obligated to include future loan defaults and costs into their accounting practices in order to provide an accurate evaluation of their overall financial well-being. The computation of LLP is carried out in compliance with the directions issued by the Bangladesh Bank. A bank with a higher LLP signifies that a substantial fraction of its loans is in imminent danger of default.

Our study demonstrates a robust link between the Lerner Index and RWA, irrespective of the incorporation of macroeconomic variables. The results stayed the same when we used LLP

instead of RWA as the proxy for risk taking behavior. The findings suggest that there is a negative correlation between market power and both RWA and LLP. This implies that the amount of high-risk assets and reserves for potential loan losses increases when there is a rise in market power or a decrease in market competition. This behavior has the potential to result in a lack of stability within the financial industry.

The subsequent sections of the paper are organized in the following manner: Section 2 offers a summary of the pertinent literature. Section 3 describes the sample structure and methodology used in this study. Section 4 presents the main findings obtained through the methodology employed in this study. Section 5 provides additional statistical analysis to confirm the reliability of the main findings. Ultimately, this study concludes in Section 6.

2. Literature review

This segment examines the existing studies on the interplay between bank competition and risk-taking in Bangladesh, particularly emphasizing the Lerner index as a gauge of competitive intensity. The scholarly work on the subject largely revolves around two conflicting theories: competition fragility and competition stability, highlighting the mixed nature of the findings. While certain research points to beneficial effects of competition, other analyses suggest detrimental impacts.

In their 2021 study, Rahman and colleagues investigated how banking competition and operational efficiency affect the financial solidity of banks in Bangladesh (Rahman et al., 2021). The research involved analyzing data from 28 commercial banks, employing the Lerner index and Boone indicator to measure competition intensity

within the sector. Additionally, the study utilized non-performing loans and Z-score as metrics of financial robustness. Through the application of a dynamic panel GMM model, the researchers found a reverse correlation between the Lerner index and Z-score, suggesting that increased banking competition enhances financial stability. Furthermore, the Boone indicator revealed that a decrease in competitive pressures is associated with a rise in non-performing loans.

Similarly, Dutta and Saha (2021) studied how competition and efficiency affect the financial stability of Bangladeshi banks during the period of 2009 to 2017. They have examined how efficiency influences financial stability across various levels of competition by estimating Boone indicator and Z-score. Their results from the two-step GMM system indicate that stability and competition are not linearly related. While efficiency does contribute to stability, the degree of influence it has is contingent upon the existence of competition.

The interplay between market dynamics and regulatory frameworks can lead to enhanced cost-effectiveness. In 2022, Mia conducted an extensive analysis using a balanced panel dataset with 340 data points from commercial banks in Bangladesh (Mia, 2022). The main focus of the study was to assess how market competition and capital regulation affect the costs associated with financial intermediation in the banking sector. The findings of the research indicate that increased levels of competition in the market are associated with lower costs of financial intermediation for banks.

Besides cost efficiency, pricing behavior is also important for the banking industry that

is possibly impacted by the competition. Islam (2020) conducted a panel analysis using data from 42 commercial banks from the years 2011 to 2017. Their findings from the fixed effect regression analysis showed that the Lerner Index, bank size, marginal cost of operation, and industry structure all have a major role in determining the commercial banks' loan pricing strategies. Among all, the Lerner Index (i.e., market power or competition) was discovered to have a substantial impact on the loan pricing of commercial banks.

Competition not only serves the interests of the banking sector but also appears to be advantageous for the broader economy. Rakshit and Bardhan (2019) conducted a study across various South Asian countries, including Bangladesh, to assess the effects of bank competition and financial stability on economic development from 1997 to 2016. They measured the level of bank competition using a revised Lerner index. Their analysis, which included panel regression and the system GMM model, indicates that the banking sector in these nations is indeed competitive, as reflected by both the standard and modified Lerner indices. Moreover, the research suggests that the synergistic effect of banking sector competitiveness combined with financial stability positively and significantly contributes to economic growth. The findings highlight the importance of both stability and competitiveness in the banking sector as key drivers of sustained economic prosperity in South Asian countries.

In contrast, certain research has identified an inverse relationship between bank performance and competitive intensity. Alvi and colleagues' 2021 research scrutinized how efficiency influences the dynamics between competition and stability in 88 commercial banks across Bangladesh, India, Pakistan, and Sri Lanka over the period from 2012 to 2018 (Alvi et al., 2021). The study's outcomes reveal that when adjusted for efficiency, the Lerner index significantly inversely impacts the stability of banks. Additionally, the primary findings clearly demonstrate that efficiency serves as an intermediary factor in the association between the competitiveness of banks and their stability.

Similarly, Phan et al. (2016) found that high market concentration enhances X-efficiency, while competition diminishes X-efficiency. Additionally, the size of a bank and the increase of gross domestic product positively impact X-efficiency. Their study covers six developing Asian nations (Bangladesh, India, Malaysia, Indonesia, Vietnam and the Philippines) over a period from 2005 to 2012.

Kabir and Worthington's (2017) research analyzed the banking sectors of sixteen emerging economies, focusing on both conventional and Islamic financial institutions. The study spanned data from 2000 to 2012 and employed the Lerner index to assess competitive levels. Stability was measured using accounting-based metrics like the ratio of nonperforming loans and the Z-score, along with market-based indicators such as Merton's model for distance to default. The findings support the competition-fragility hypothesis for both bank types. Additionally, the study found that traditional banks' stability is more sensitive to market power than that of Islamic banks. It was also noted that banks with median stability levels are better equipped to manage credit risk through market control than those at the extremes. This suggests that credit risk is a significant mediator in the relationship

between market competition and bank stability.

A possible link between competition and subpar performance and stability could be the heightened risk encountered by banks due to the entry of new banks into the sector. The study by Kabir et al. (2022) explores the connection between increased competition and the potential decline in performance and stability in the banking sector. This is attributed to the risks that banks face when new competitors enter the market. Focusing on both Islamic and conventional banks in Bangladesh, the researchers analyzed data from 30 private commercial banks covering the period from 2001 to 2018 using the GMM estimation method. Their findings suggest that greater competition intensifies the risk for banks, supporting the competition-fragility hypothesis. The study also found that the size and independence of a bank's board impact its credit risk. To mitigate the risk of subprime lending, the authors recommend a 'speed limit' approach and suggest that regulatory measures should be applied to manage competition in the banking sector.

Literature about competition-fragility and competition-stability is not conclusive. However, competition has a number of advantages such as stability, cost-efficiency, pricing, etc. Therefore, positive competition ought to be encouraged while negative competition ought to be ended. Khatun and Saadat (2019) examined the correlation between governance and competitiveness within the banking industry of Bangladesh. Through the application of three-stage least squares methods over the period 1996 to 2016, it was discovered that improved governance positively influences competitiveness in the banking industry, as measured by

the Lerner index. These findings suggest that effective governance promotes the enhancement of the banking sector's competitiveness. Sector policies should prioritize governance to achieve positive results.

While the lack of market discipline resulting from limited competition is a major factor contributing to the issues in the banking sector (Nguyen et al., 2011), granting unrestricted entry for banks into the business is not the solution. The proliferation of banks and the subsequent increase in competitiveness have adverse repercussions as well. Hence, a thorough evaluation of the influence of competition on the banking industry and the practices of bankers is important. This study aims to examine the influence of competition on the propensity of banks to engage in risk-taking behavior. The correlation between competitiveness and stability/fragility is a widely debated subject in banking literature. In Bangladesh, there has been no prior study that has investigated the relationship between competitiveness and stability/fragility in the context of risk-taking behavior, despite the availability of ample data from many nations and regions. This study aims to address the existing scholarly void.

3. Data and Methodology

3.1 Sample, descriptive statics and variable definition

This research employs annual data from 2009 to 2022 of 29 commercial banks in Bangladesh that are publicly listed. Data has been collected from the annual reports of the banks considered. ICB Islamic Bank PLC. was excluded from our research since it had negative equity and net income over the whole period. We have created several

variables from the financial data to for measuring the influence of competition on the propensity of banks to engage in risk-taking behavior. Following Table 1 depicts the name and definition of these variables.

Table 1: Variable Description

Variable	Formula	Definition
RWA	$\dfrac{Risk\ Weighted\ Assets_{i,t}}{Total\ Assets_{i,t}}$	Risk-Weighted Assets is a measure used in banking to determine the minimum amount of capital that must be held by financial institutions. It considers the riskiness of assets, with higher-risk assets requiring more capital to mitigate potential losses.
LLP	$\dfrac{Loan\ Loss\ Provisions_{i,t}}{Total\ Loans_{i,t}}$	Loan Loss Provision is an expense set aside by financial institutions to cover potential losses from defaulted loans.
Lerner Index	$\dfrac{Price_{i,t} - Marginal\ Cost_{it}}{Price_{i,t}}$	Lerner Index is a measure of a firm's market power, defined as the difference between the price of a product and its marginal cost, divided by the price. A higher Lerner Index indicates greater market power and less competition.
Asset		Total assets
Deposit-to-Loan	$\dfrac{Total\ Deposit_{i,t}}{Total\ Loan_{i,t}}$	This ratio compares a bank's total deposits to its total loans. It is a measure of liquidity and risk. A lower ratio indicates that a bank has more deposits relative to its loans, suggesting a lower risk of liquidity issues.
ROA	$\dfrac{Net\ Income_{i,t}}{Total\ Asset_{i,t}}$	Return on Assets measures how efficiently a company can manage its assets to generate earnings. ROA is calculated as Net Income divided by Total Assets.
GDP	Collected from World Bank	Gross Domestic Product
Inflation	Collected From World Bank	Consumer Price Index

In Table 2, the summary of date is presented. The average value of RWAs to total assets is 0.7566, and the average value of LLPs to total loans is 0.0056. The average Lerner Index value of the banks in our study sample banks is 0.3232. The average value of the logarithm of total assets is 26.0749. The mean ratio of aggregate deposits to aggregate loans is 1.3349, whilst the mean return on assets is 1.02%. The average figures of the growth rate of GDP and inflation are 6.33% and 6.65% respectively. All variables used in this study, except for macroeconomic variables, have been trimmed at the 1% and 99% levels by winsorizing to limit extreme values.

Table 2: Descriptive Statistics

Variable	Mean	Std. Dev.	Minimum	Maximum	Observations
RWA	0.7566	0.1704	0.0668	1.1905	406
LLP	0.0056	0.0049	-0.0096	0.0259	405
Lerner Index	0.3232	0.0923	0.0575	0.5489	402
Asset	26.0749	0.6549	24.5940	27.6285	406
Deposit-to-Loan	1.3349	1.0487	0.8947	8.1088	406
ROA	0.0102	0.0061	0.0001	0.0320	406
GDP	0.0633	0.0107	0.0345	0.0788	406
Inflation	0.0665	0.0159	0.0542	0.1140	406

Source: Authors' estimation based on the annual data reported by the banks.

The correlation of the variables utilized in this study are documented in Table 3. The correlation between the Lerner Index and RWA is 0.40, whereas the correlation coefficient between the Lerner Index and LLPs is 0.09. The variables utilized in this investigation demonstrate a minimal level of association. Thus, multicollinearity is not a matter of concern.

The data used in this analysis is sourced only from secondary public sources, including publicly accessible yearly reports published by banks and economic statistics released by the government of Bangladesh.

Table 3: Correlation Matrix

	(1) RWA	(2) LLP	(3) Lerner Index	(4) Asset	(5) Depos-it-to-Loan	(6) ROA	(7) GDP	(8) In-flation
(1) RWA	1.00							
(2) LLP	0.05	1.00						
(3) Lerner Index	0.40	0.09	1.00					
(4) Asset	-0.46	0.13	-0.25	1.00				
(5) Depos-it-to-Loan	-0.05	0.01	-0.02	-0.10	1.00			
(6) ROA	0.52	-0.22	0.55	-0.58	-0.01	1.00		
(7) GDP	0.07	0.13	0.06	0.25	-0.05	-0.19	1.00	
(8) Inflation	0.36	-0.16	0.17	-0.33	0.03	0.34	-0.02	1.00

Source: Authors' estimation based on the annual data reported by the banks.

3.2 Empirical Model

To evaluate the influence of banking rivalry on the propensity of banks to take risks, we employ ordinary least squares panel regression. This approach incorporates robust standard errors that are clustered at the bank level, so accounting

for heteroskedasticity and autocorrelation in the error terms. Bank fixed effects are employed to control for unobservable bank-specific factors. The model employed to analyze the influence of bank competition on risk-taking behavior is –

(1) $Risk_{i,t}=\beta_0+\beta_1 Lerner\ Index_{i,t}+\beta_3 lnAsset_{i,t}+\beta_4\ DL_{it}+\beta_5\ ROA_{i,t}+B_i+\varepsilon_{i,t}$ where, $Risk_{i,t}$ is the risk parameters (RWA or LLPs) of -th bank at -th period; $Index_{i,t}$ is the proxy of bank competition, $lnAsset_{i,t}$ is the natural logarithm of total assets; DL_{it} is the deposit to loan ratio; $ROA_{i,t}$ is the return on asset; B_i is the bank fixed effect; and $\varepsilon_{i,t}$ is the noise. We also estimate another version of this Equation 1, where we include the macroeconomic factors as banks' performance largely dependent on the overall economic condition. The model used to evaluate the effect of bank competition on risk-taking behavior, while controlling the macroeconomic variables, is -

(2) $Risk_{i,t}=\beta_0+\beta_1\ Lerner\ Index_{i,t}+\beta_3 lnAsset_{i,t}+\beta_4\ DL_{it}+\beta_5\ ROA_{i,t}+\beta_6\ GDP_t+\beta_7 Inf_t+B_i+\varepsilon_{i,t}$

The variables GDP_t and Inf_t represent the growth rate of GDP and inflation rate of the -th year, respectively. All other parameters remain unchanged. The error component $\varepsilon_{i,t}$ is clustered at the level of individual banks and is allowed to exhibit heteroskedasticity and autocorrelation. This study uses Stata for analyzing the data.

3.2.1   Dependent Variables

Equations 1 and 2 are estimated using two distinct dependent variables. Those are – the ratio of RWAs to total assets and LLPs

to total loans. These variables are taken as the proxies to the banks' risk-taking behavior.

Risk-Weighted Assets: RWAs are calculated according to Basel rules. It helps to calculate the minimum capital requirements for banks according to the risk profile of their assets. RWAs will be high if a bank invests in more risky assets and vice versa. In the literature, RWA is widely used as a proxy of bank risk taking behavior (Jokipii and Milne, 2011; Khan et al., 2017; Stolz and Wedow, 2011; Delis et al., 2014; Rime, 2001). We use the ratio of RWAs to the total assets as the risk measure to incorporate the bank's size into the model and it is calculated as follows:

(3) $RWA_{i,t} = \dfrac{Risk\ Weighted\ Assets_{i,t}}{Total\ Assets_{i,t}}$

Loan Loss Provisions: LLP indicates the amount of provision a bank is making for the potential losses. Banks allocate funds in the income statement for LLPs, designed to cover various types of loan losses, including non-performing loans, consumer bankruptcies, or renegotiated loans. This provision serves as a safeguard against future losses resulting from loan defaults. The guideline for LLP is provided by the central bank and banks report this amount in their publicly available income statement. LLP is also widely used as a proxy of bank risk taking behavior in the literature (Delis et al., 2014; Lee and Hsieh, 2013; Shrieves and Dahl, 1992). Once again, we utilize the ratio of LLPs to total loans in order to account for the size of the bank. This ratio is derived in the following manner:

(4) $LLP_{i,t} = \dfrac{Loan\ Loss\ Provisions_{i,t}}{Total\ Loans_{i,t}}$

3.2.2 Independent Variables

Equations 1 and 2 are measured in two forms: one with RWA and the other with LLP. Both versions use two kinds of independent variables. The primary focus is on the Lerner Index, which serves as the variable of interest. Furthermore, there is a set of control variables that can integrate different bank- and economy-specific attributes. The next paragraphs will address the structure of the independent variables.

Lerner Index: The Lerner Index serves as a measure of bank competition. The Lerner Index is a commonly employed metric in banking literature for assessing the level of rivalry among banks (Beck et al., 2013; Khan and Nayema, 2020.; Moudud-Ul-Huq et al., 2020; Nguyen, 2019). The Lerner Index is calculated by finding the difference between price and marginal cost and dividing by the price. High values of the Lerner Index indicate that banks are facing low competition i.e., banks have the ability to charge a higher rate premium over their cost of service. We calculate the Lerner Index by following the method proposed by Beck et al. (2013), Khan and Nayema, 2020, and Horvath et al. (2016). Lerner Index is calculated as follows:

$$(5) \quad Lerner\ Index_{i,t} = \frac{Price_{i,t} - Marginal\ Cost_{it}}{Price_{i,t}}$$

Price is the ratio of total operating income to total assets (Beck, De Jonghe, and Schepens, 2013; Horvath, Seidler, and Weill, 2016). Marginal cost is valued using a translog cost function with one output (total assets) and three input prices (price of labor, price of physical capital and price of borrowed funds) followed by Horvath et al. (2016). The cost function is specified as follows Beck et al. (2013; Horvath et al. (2016):

$$(6) \quad \ln TC = \alpha_0 + \alpha_1 \ln y + \frac{1}{2}\alpha_2 (\ln y)^2 + \sum_{j=1}^{3} \beta_j \ln w_j + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln w_j \ln w_k + \sum_{j=1}^{3} \gamma_j \ln y \ln w_j + \varepsilon$$

The estimated coefficients of the cost function are then used to compute the marginal cost (MC):

$$(7) \quad MC = \frac{TC}{y}\left(\widehat{\alpha_1} + \widehat{\alpha_2} \ln y + \sum_{j=1}^{3} \widehat{\gamma_j} \ln w_j \right)$$

Control Variables: The study incorporates many control variables, such as the natural logarithm of total assets (Asset), the ratio of deposits-to-loans, and return on assets (ROA). These variables are considered possible factors that may influence banks' risk-taking behavior. In addition, we use the GDP growth rate and inflation rate as control variables to regulate the overall economic conditions.

4. Analysis of the Results

Table 4 presents the findings of a fixed effects panel regression analysis that examines the influence of bank rivalry, measured by the Lerner Index, on the risk-taking tendencies of banks. There is a direct relationship between the Lerner Index and RWAs and LLPs, regardless of whether macroeconomic factors are included. These data exhibit statistical significance at a significance level of 1%. In order to account for unaccounted bank-specific characteristics, we incorporated bank fixed effects into all of our regression analyses. The findings suggest that the degree of competition has a detrimental impact on the RWAs and LLP. It is important to understand that a higher Lerner Index score signifies a reduced degree of competition or an increased level of market dominance. From a policy standpoint, this outcome indicates that the presence of high-risk assets and

loan loss provisions increases when market dominance increases or market competition decreases. Such behavior has the potential to cause instability inside the financial industry.

Our findings neither support bank' competition-fragility nor competition-stability hypothesis. However, the result complies with a couple of previous studies. For example, Rahman et al. (2021) discovered that less competition leads to an increase in non-performing loans. In a study, Alvi et al. (2021) reported that the efficiency-adjusted Lerner index (or market power) significantly impairs the stability of banks. In contrast to our own findings, Kabir et al. (2022) shown that competition in banks really amplifies risk, hence corroborating the competition-fragility hypothesis. Echoing from the literature, our findings suggest that the lack of market discipline resulting from insufficient competition is a major factor contributing to the issues faced by the banking industry (Nguyen et al., 2011). Granting banks unfettered entry into the business is not the answer. As we can see many banks have entered the industry in the last decades or so, still the level of competition failed to stop banks from taking risks.

Table 4: Regression Results - Fixed Effects Panel

Dependent variables	(1) RWA	(2) LLP	(3) RWA	(4) LLP
Lerner Index	0.6071***	0.0176***	0.3726***	0.0173***
	(0.0004)	(0.0005)	(0.0032)	(0.0008)
Asset	-0.1124***	-0.0006	-0.1105***	-0.0009
	(0.0000)	(0.5865)	(0.0000)	(0.3964)
Deposit-to-Loan	-0.0176***	0.0001	-0.0140*	0.0001
	(0.0001)	(0.6974)	(0.0531)	(0.6123)
ROA	2.4062	-0.3636***	3.3348*	-0.3376***
	(0.2524)	(0.0009)	(0.0902)	(0.0023)
GDP			2.8789***	0.0264
			(0.0026)	(0.4064)
Inflation			1.6387***	-0.0343**
			(0.0000)	(0.0157)
Constant	3.4908***	0.0181	3.2114***	0.0276
	(0.0000)	(0.5100)	(0.0000)	(0.3309)
Bank Fixed Effects	Yes	Yes	Yes	Yes
Adjusted R-squared	0.4151	0.1194	0.4891	0.1329
Observations	402	402	402	402

Source: Authors' estimation.
Note: The influence of competitive forces on the propensity for risk among banks can be quantified through the Lerner Index coefficients, determined by employing panel OLS regression. This approach incorporates fixed effects specific to each bank, controls unique to the banking industry, and allows for the inclusion of additional economic factors. The standard errors are calculated to be robust and are aggregated according to each bank. The p-values are indicated within parentheses. Significance levels are denoted as follows: * for 10%, ** for 5%, and *** for 1%.

Table 4 demonstrates a negative correlation between total assets and bank risk-taking behavior. Consequently, larger banks are reducing their risk-taking activities in response to changes in the amount of competition. Phan et al. (2016) discovered that the size of a bank has a positive impact on the X-efficiency of the banks. Further research conducted by Kabir et al. (2022) found that the danger in Bangladesh decreases as the size of the bank decreases. Moreover, Table 4 demonstrates a negative correlation between the deposit-to-loan ratio and RWA. This suggests that banks experiencing challenges in distributing loans are encountering an increased issue of granting loans with a higher level of risk. The correlation between ROAs and RWAs is positive, whereas the correlation between ROAs and LLPs is negative.

When it comes to macroeconomic data, there is a direct relationship between the growth rate of GDP and RWA, meaning that as GDP increases, so does RWA. On the other hand, inflation and LLPs have an inverse relationship, meaning that as inflation decreases, LLPs increase. Overall, inflation may greatly influence banking risks, impacting several facets of banking operations and financial stability, which is also exhibited in our results. Extended and heightened inflation presents a potential threat to the credit and revenues of banks, as it can result in more stringent financing conditions, higher borrowing expenses for risky borrowers, and eventually affect the quality of bank credit and the growth of loans. Financial institutions must diligently oversee these risks by engaging in cautious lending practices, effectively managing the relationship between assets and liabilities, and keeping sufficient capital reserves to safeguard against the detrimental impact of inflation.

5. Robustness of the Results

5.1 Random Effects Panel Regression

In robustness checks, we first (re)estimate equations 1 and 2 using random effects panel regressions. In a random effects model, the parameters are considered to be random variables. Random effects pertain to unobservable heterogeneity that fluctuates across distinct groups. The model assumes that this heterogeneity is not connected with the independent variables. Table 5 displays the predicted outcomes of the random effect models without include bank fixed effects and treating banks as homogeneous. The results exhibit a similar quality to those calculated using fixed effect models. According to the data presented in Table 5, there is a statistically significant positive correlation between the Lerner Index and the risk-taking behavior of banks. This correlation is statistically significant at a significance level of 1%. Similar to fixed effects models, the results of random effects panel regression also indicate that less competition leads to increased risk-taking by banks. The estimated coefficients of both the key interest variable and the bank- and economy-specific control variables are similar to those obtained from fixed effects models (refer to Table 4).

Table 5: Regression Results - Random Effects Panel

Dependent variables	(1) RWA	(2) LLP	(3) RWA	(4) LLP
Lerner Index	0.5423***	0.0172***	0.3513***	0.0167***
	(0.0000)	(0.0000)	(0.0013)	(0.0000)
Asset	-0.1055***	-0.0005	-0.1053***	-0.0008*
	(0.0000)	(0.2897)	(0.0000)	(0.0866)
Deposit-to-Loan	-0.0157*	0.0001	-0.0133*	0.0001
	(0.0546)	(0.8149)	(0.0870)	(0.7727)
ROA	3.2767**	-0.3557***	3.8617***	-0.3291***
	(0.0358)	(0.0000)	(0.0097)	(0.0000)
GDP			2.8716***	0.0259
			(0.0000)	(0.1890)
Inflation			1.6595***	-0.0335**
			(0.0000)	(0.0130)
Constant	3.3214***	0.0163	3.0760***	0.0251**
	(0.0000)	(0.1828)	(0.0000)	(0.0460)
Bank Fixed Effects	No	No	No	No
Observations	402	402	402	402

Source: Authors' estimation.

Note: The relationship between competitive activity and banks' risk-taking tendencies is reflected in the Lerner Index coefficients, which are calculated through a random effects panel OLS regression. This model takes into account controls specific to individual banks and can be adjusted to include or exclude other economic variables. The standard errors are designed to be robust, grouped according to each bank, and the p-values are detailed within parentheses. Significance levels are denoted as follows: * for 10%, ** for 5%, and *** for 1%.

5.2 Feasible Generalized Least Squares Regressions

Next, we (re)estimate equations 1 and 2 using the feasible generalized least squares (FGLS) method. In a multiple linear regression model, FGLS is used to estimate coefficients in cases when the covariance matrix of the innovations (errors) is unknown. This method estimates the error covariance matrix consistently, taking into consideration nonspherical errors such as heteroskedasticity, serial correlation, and cross-sectional correlations. Again, FGLS regression results are qualitatively similar to the fixed effects and random effects models. The data presented in Table 6 illustrates a direct association between the Lerner Index and the propensity of banks to engage in risk-taking behavior. Furthermore, the statistical analysis indicates that these findings are highly significant at a significance level of 1%. The FGLS findings indicate (reconfirm) that banks operating in less competitive environments have a higher propensity to engage in risky behavior.

Table 6: Regression Results - Feasible Generalized Least Squares

Dependent variables	(1) RWA	(2) LLP	(3) RWA	(4) LLP
Lerner Index	0.3424***	0.0162***	0.2703***	0.0156***
	(0.0002)	(0.0000)	(0.0024)	(0.0000)
Asset	-0.0711***	-0.0002	-0.0702***	-0.0004
	(0.0000)	(0.6584)	(0.0000)	(0.3639)
Deposit-to-Loan	-0.0110*	0.0000	-0.0105	0.0000
	(0.0989)	(0.9766)	(0.1012)	(0.9256)
ROA	7.2366***	-0.3279***	7.2800***	-0.3016***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
GDP			2.7527***	0.0228
			(0.0000)	(0.3144)
Inflation			1.7604***	-0.0302*
			(0.0001)	(0.0516)
Constant	2.4395***	0.0088	2.1465***	0.0149
	(0.0000)	(0.4533)	(0.0000)	(0.2178)
Bank Fixed Effects	No	No	No	No
Observations	402	402	402	402

Source: Authors' estimation.

Note: The impact of market competition on banks' inclination towards risk is indicated by the Lerner Index coefficients, derived from Feasible Generalized Least Squares Regressions. These regressions incorporate controls tailored to each bank and can be conducted with the inclusion or exclusion of supplementary economic variables. The standard errors are resilient and are bank-specifically clustered. The p-values are enclosed within parentheses for reference. Significance levels are denoted as follows: * for 10%, ** for 5%, and *** for 1%.

In summary, the robustness the robustness checks on the findings pertaining to the banking sector of Bangladesh confirm that an increased level of market concentration is correlated with heightened levels of Loan Loss Provisions and Risk-Weighted Assets. This correlation highlights the prudent approach that financial institutions take in markets with greater concentration, wherein they augment their risk reserves and allocate greater provisions in anticipation of potential credit losses. These findings are crucial for policymakers and banking regulators, as they underscore the necessity of adopting an equitable strategy towards market concentration that protects the stability of the banking system while promoting a competitive atmosphere that is favorable to economic expansion.

6. Conclusion and policy implication

Currently, there are 61 scheduled banks and 35 non-bank financial institutions (FIs) categorized into several types such as state-owned, private commercial, Islami, foreign, specialized, etc. Given the magnitude of the economy, banking professionals and analysts often contend that Bangladesh has an excessive number of banks (Kallol, 2017). The presence of an

excessive number of banks has the ability to disrupt the balance of the economy and render traditional business models outdated (Dombret, 2016). Although there have been several dissenting views over the growing number of banks, several banks have been granted licenses in the last decade or so. Simultaneously, some banks that were formerly regarded as frontrunners in the business saw a significant deterioration in their performance. Against this background, a crucial question emerges about the potential link between the banking sector's persistently underwhelming performance, particularly in relation to the significant increase in non-performing loans (Uddin, 2023), and the saturation of banks and intensified competition over the previous decade.

The objective of this research is to explore how competitive forces affect the risk-taking behaviors of commercial banks in Bangladesh. The analysis utilizes yearly data spanning from 2009 to 2022, gathered from a selection of 29 publicly traded commercial banks in the country. To gauge market competition, the study uses the Lerner Index, while Risk-Weighted Assets and Loan Loss Provisions serve as measures for assessing the banks' propensity for risk-taking. The main goal is to assess the level of competition within Bangladesh's banking sector and to understand its potential impact on the banks' willingness to take risks.

The analysis establishes a strong correlation between the Lerner Index and RWA, as well as LLPs, regardless of the inclusion of macroeconomic factors. The findings suggest that there is a negative correlation between market power and both RWAs and LLPs. Therefore, whether the market becomes stronger or less

competitive, there is a greater allocation of high-risk assets and reserves for potential loan losses.

Our findings neither support bank' competition-fragility nor competition-stability hypothesis. In the Bangladeshi banking industry, we have seen that risk tolerance increases when market competition decreases. In theory, when there is no intense competition, banks should provide loans to cautious applicants. Nevertheless, that is not the situation. A potential reason for this phenomenon might be the absence of market discipline due to inadequate competition, despite the increase in the number of banks over recent decades. When there is a lack of sufficient competitive pressure, banks are not incentivized to adhere to prudent risk management practices. This can lead to complacency, where financial institutions take on higher levels of risk without appropriate safeguards, expecting that the market will not penalize them for such behavior. Furthermore, the proliferation of banks without corresponding regulatory oversight can dilute the effectiveness of market discipline. This environment allows banks to operate with less scrutiny and accountability, thereby increasing their propensity for risky activities. As a result, the intended benefits of a competitive banking sector, such as efficiency and innovation, are not fully realized, and the financial stability of the sector may be compromised.

In summary, our result analysis of the banking sector in Bangladesh reveals a positive correlation between loan loss provisions and risk-weighted assets, which are indicators of market concentration among banks. This observation indicates that an increase in the proportion of assets with higher risk weights held by a smaller

number of institutions indicates a more prudent approach towards prospective credit losses. Simultaneously, these financial institutions allocated more substantial provisions for loan losses, which signifies an increased cognizance of the hazards linked to a concentrated market. The aforementioned financial prudence exemplifies the approaches adopted by the banks to safeguard themselves against possible defaults and preserve stability amidst a dynamic and competitive economic climate. The complex relationship between market concentration and risk management practices highlights the delicate equilibrium that banks in Bangladesh endeavor to attain in terms of market dominance, financial stability, and expansion.

The results indicate that an overabundance of banks might destabilise economic equilibrium and render conventional business models outdated. Policymakers have to contemplate enacting more stringent controls on the issue of new banking licenses to avert market saturation and preserve robust competition within the banking industry. Furthermore, the inverse relationship between market power and risk-taking behaviour suggests that heightened competition may result in more hazardous banking practices. Consequently, regulatory authorities must enhance market discipline by implementing stringent regulatory frameworks that promote responsible lending practices and mitigate excessive risk-taking.

The positive association between loan loss provisions and risk-weighted assets suggests that banks exhibit more prudence regarding possible credit losses in a concentrated market. This highlights the necessity for ongoing enhancement of risk management methods to guarantee financial stability. Banks have to be urged to implement thorough risk assessment and mitigation procedures. The substantial rise in non-performing loans (NPLs) underscores the necessity for proactive strategies to manage and mitigate these debts. Policymakers must formulate and implement policies to enhance loan recovery procedures and diminish the prevalence of non-performing loans within the banking industry.

Data Availability Statement: The data presented in this study are available on request from the corresponding author.

Conflicts of Interest: The authors declare no conflict of interest.

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Appendix A: List of commercial banks used in this study

Sl. No.	Bank Name
1	AB Bank PLC.
2	Al-Arafah Islami Bank PLC.
3	Bank Asia PLC.
4	BRAC Bank PLC.
5	Dhaka Bank PLC.
6	Dutch-Bangla Bank PLC.
7	Eastern Bank PLC.
8	Export Import (Exim) Bank of Bangladesh PLC.
9	First Security Islami Bank PLC.
10	IFIC Bank PLC.
11	Islami Bank Bangladesh PLC.
12	Jamuna Bank PLC.
13	Mercantile Bank PLC.
14	Mutual Trust Bank PLC.
15	National Bank PLC.
16	National Credit and Commerce Bank PLC.
17	One Bank PLC.
18	Premier Bank PLC.
19	Prime Bank PLC.
20	Pubali Bank PLC.
21	Rupali Bank PLC.
22	Shahjalal Islami Bank PLC.
23	Social Islami Bank PLC.
24	Southeast Bank PLC.
25	Standard Bank PLC.
26	The City Bank PLC.
27	Trust Bank PLC.
28	United Commercial Bank PLC.
29	Uttara Bank PLC.