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Do Competition, Size, and Macro Variables Impact Bank Risk?

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ABSTRACT

The paper investigates the correlation between bank competition, performance, and risk-taking behavior in MENA economies. Furthermore, it explores the risk level associated with dual banking as well as the bidirectional connectedness of competition and jeopardy in terms of size, GDP, and inflation rate. This work employs Generalised Method Moments (GMM) for regression findings and Two-Stage Least Squares (2SLS) for robustness tests. It uses an unbalanced panel dataset from 256 banks and 14 MENA countries from the year 2011 to 2022. According to the study's findings, financial stability improves, and bank risk-taking decreases with less bank competition. The findings of this investigation corroborate the competition fragility theory. The competition square concept suggests that in a market with competition, risk will eventually rise. In terms of economic progression, risk-taking behavior is exactly the reverse of bank competition. Again, the finding shows that good performance reduces the bank's risk, finally turning to greater financial stability. Furthermore, there is a substantial association between inflation rates and the extent of banks' risk-taking activity. In a competitive market scenario, MENA countries inflation rate risk-taking behavior initially increases and then declines over time, while bank size exhibits a similar trend in the near term. When the inflation rate rises, banks' risk-taking behavior initially decreases and then rises over time. This research will provide policymakers in MENA nations with a better grasp of how to establish strategies that benefit the banking environment.

1. Introduction

Geopolitical dynamics now allow regional nations in the Middle East and North Africa to actively pursue policies consistent with their nationwide interests. Political and humanitarian issues have arisen as a result in the area Atarodi (2019). Since 1945, the Middle East and North Africa regarded as among the world's most volatile regions (Lowe, 2013). It consists of seventeen countries, except Lebanon, with mostly Muslim populations (Lowe, 2013). Several MENA economies (including Egypt, Morocco, Tunisia, and Jordan) have implemented structural reforms and seen their monetary institutions liberalized over the last 35 years (Kamal *et al.* 2023; Naceur & Omran, 2011; Turk-Ariss, 2009). The evolution of the banking business in MENA nations differs significantly. The Gulf Cooperation Council (GCC) oil-rich countries aim to transition from oil-based to market-based economies through trade liberalization and deregulation (Outlook, 2007). The economic downturn of 2008 and its aftermath, the Arab uprising of 2010, had a detrimental impact on these countries, with real GDP declining since then. In contrast, despite Egypt's economic prominence, the country's financial sector is underdeveloped when compared to GCC economies (Omran, 2007). While families operate many Egyptian financial institutions, the government oversees the majority of the country's specialized banks (Naceur & Omran, 2011). The banking business makes a significant contribution to a nation's economic well-being, security, and progress (Claessens, 2009). The financial crisis arose in 2008. To avoid a recurrence of global financial crisis, the policymakers implemented numerous measures to fortify liquidity and bank capital. To protect the overall banking system, these novel reforms are taken (Ghiri & Sharma, 2024; Hamdi & Hakimi, 2019).

The banking business helps to improve a nation's economy. Various countries took varied measures to upgrade their banking systems, which resulted in a more competitive banking environment and improved bank performance. However, there is no need to create a more competitive environment for banks in order to enhance profits (Tan, 2016). Banking competition is at its lowest in a highly concentrated banking sector, with banks competing for higher profits (Tan, 2016).

According to a competition-fragility hypothesis, bank competition may reduce banks' interest income. Thus, the bank's profits will be depleted, increasing the likelihood of insolvency. For this reason, the overall financial systems will be disrupted by banks (Allen & Gale, 2004). From the competition–stability supporter's view, the banks charge

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an interest rate that inspires borrowers to engage in risky activities. So, financial stability growth by the competition market (Boyd *et al.*, 2006). Credit risk is generally proxied by the extent of non-performing loans (NPLs), which is regarded as the key indicator of bank failures that lead to the banking meltdown (Reinhart & Rogoff, 2011). A rising percentage of non-performing loans could threaten the banking sector, which frequently suffers from both credit and liquidity risk. The fundamental part of banking operations is considered liquidity risk (Cornett *et al.*, 2011). Liquidity risk is considered an important issue for both policymakers & academics (Hamdi & Hakimi, 2019).

Banking competition is a burning issue in MENA countries. There is scant evidence that reverse causation of competition and risk influences bank performance regarding size, GDP, and inflation rate. We have little evidence on the effect of bank rivalry on financial stability, and there is little literature about the relationship between various risks (credit risk, liquidity risk) and bank productivity in MENA countries (Abdelaziz *et al.*, 2020). We found little evidence about competition, meditation, and risk in the MENA region (González *et al.*, 2017). From the evidence, we try to identify a gap that will be a vital segment of the MENA region. In this area, the Chinese banks focused more emphasis on competition and risk (Hu & Xie, 2016; Tan, 2019; Tan & Floros, 2014; Tan *et al.*, 2020). Lately, we have given a lot of attention and emphasis to investigating sophisticated issues. Do Competition, Size, and Macro Variables Affect Bank Risk?

The study's primary objective is to explore the correlation between bank competition, performance, and risk-taking behavior in MENA economies. Additionally, this research delves into the assessment of risk (financial stability) linked with dual banking and the mutual causation of competition and risk, considering factors such as size, GDP, and inflation rate. We use GMM and 2SLS methods to ensure the robust persistence of our regression results. This study found that the less bank competition there was, the lesser bank risk-taking was, and the financial stability improved. The findings of this investigation corroborate the competition fragility theory. In the long term, it shows just the opposite pattern. The term competition square emphasizes that the risk increases with time in a competitive market. In terms of economic progression, risk-taking behavior is exactly the reverse of bank competition. In terms of performance, the findings show that good performance reduces the bank's risk, finally turning to greater financial stability.

The remaining parts of this study are designed as follows: section 2 describes the literature review; Section 3 propounds the data and methodology; Section 4 analysis and results in discussion; Section 5 displays the robustness test; and finally, section 6 presents the perfecting the paper and policy implication and future direction.

2. Literature review

This segment consists of two portions: the 1st one is theoretical literature; the second one is a review of empirical literature, focusing on the affiliation between competition and risk-taking behavior and profitability and risk-taking behavior.

2.1. Theoretical literature

Competition in the banking sector is a controversial issue. Two theories about banking competition and stability exist. The first theory, competition fragility, suggests a negative relationship between banking competition and financial stability. Excessive bank rivalry can have negative effects on market power and profit margins, forcing banks to make risky decisions (Koetter *et al.*, 2012). On the contrary, competition stability theory says that when there is more competition among banks, this will improve their financial stability (Koetter *et al.*, 2012).

According to the competition-stability hypothesis Boyd & De NicolÓ (2005), competition in the banking sector promotes financial stability. A non-competitive banking system can lead to higher interest rates, encouraging borrowers to take on more risky investments. High interest rates raise the risk of borrower failure, leading to a rise in non-performing loans (NPLs) and potential banks fragility. More competitive financial systems are thought to be more stable. Boyd & De NicolÓ (2005) also refer to this as the risk-shifting hypothesis. Banks in concentrated systems receive subsidies to prevent failures. These policies create instability in the banking sector by encouraging banks to take on more risk.

According to the competition-fragility hypothesis, banks may take excessive risks due to competitiveness, resulting in instability. The competition-fragility hypothesis claims that increased competition causes banking sector instability. Beck (2008) dubbed this competition-fragility concept the 'Charter Value' hypothesis. According to Beck (2008), a more competitive banking sector might lead to increased risk-taking and financial fragility due to profit pressures. Banks have limited informational rents from borrowers, which reduces their incentive to screen them. According to Carletti (2008), the competition fragility theory suggests that higher deposit rates and lower margins enhance the likelihood of bank runs, exacerbating the issue of excessive risk-taking. Liberalization leads to increased competition in the banking sector, resulting in financial fragility.

Under the competition stability theory, market strength permits banks to impose higher interest rates, exaggerating negative impacts and putting banking financial stability in danger (Schaeck *et al.*, 2009). However, the competition and stability perspective is reinforced by (Goetz, 2018). Pleasantly, the competition-fragility and competition-stability perspectives are both supported by (Berger *et al.*, 2009). We focus on our basic conceptual model in Figure 1, which conducts this research smoothly.

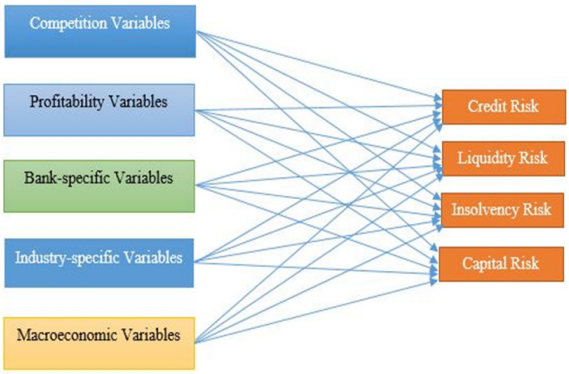

Figure 1. Basic Research Model

2.2. Empirical literature

2..2.1. Competition and risk-taking behaviour

The liberalization boosts competitiveness and tolerance for risk among banks, resulting in swelling credit risk (Li *et al.*, 2024). Bad loans can significantly and debilitatingly influence the banking sector (Jiang & Zheng, 2024). Liu (2017) studied the Chinese banking industry from 2005 to 2016, focusing on the impact of competition on risk. Higher competition was found to increase insolvency risk and the proportion of risk assets to total assets while decreasing overall stability. They emphasize the concentration ratio to examine the market competition. Tan & Anchor (2017) examined the Chinese banking system from 2003 to 2013. They discovered that increased bank rivalry raises credit, liquidity, and capital risk while decreasing bankruptcy risk. They employed the adjusted Lerner index to assess market rivalry. Albaity, Mallek, & Noman (2019) found a significant negative correlation between the z-score and the Lerner index, as well as a significant positive correlation between NPL and the Lerner index. Additionally, they found an insignificant positive relationship between ROE and the Lerner index and an insignificantly negative relationship between ROA and the Lerner index. Djebali & Zaghdoudi (2020) discovered a strong and positive correlation between liquidity risk, credit risk, and bank stability. In addition, there is a negligible positive association between Lerner and bank stability, as well as an insignificant negative relationship between the Lerner index and bank stability. Tan (2013) did not find a strong relationship between competition and risk. Hu & Xie (2016) used a structured regression model to find significant negative effects of risk competition. Several research studies have examined banking stability and market power using competition stability and fragility theories. Kasman & Kasman (2015) discovered a significant negative association between banking competition and risk using the Boone indicator. They observed that a lower Boone indicator value suggests more bank rivalry, and that competition raises the NPL ratio, implying that banking stability declines owing to competition in the banking industry. These results line with (Agoraki *et al.*, 2011; Fu *et al.*, (2014). Yeyati & Micco (2007) found a contrast to the results of (Kasman & Kasman, 2015). Soedarmono *et al.*, (2013) found a positive correlation between concentration and risk. It indicates that rivalry is less disposed to risk. Leroy & Lucotte (2017) discovered that competition stimulates banks to take risks, hence increasing their fragility. Furthermore, they conclude that competition promotes financial stability by lowering regulatory risk.

H_1: Higher competition is expected to result in a higher risk in the MENA region.

2.2.2. Profitability and risk-taking behaviour

A surge in a substitute credit line might threaten conventional banking and potentially lead to lower bank profitability (Hodula, 2024). Moudud-Ul-Huq *et al.*, (2020) found a significant impact on competition, profitability, and risk in the MENA banking industry from 2011 to 2017. They discovered a significant negative effect of competition on bank profitability using two competition indicators and three profitability indicators. Abdelaziz *et al.*, (2020) Investigated the MENA banking industry between 2004 and 2015, focusing on the influence of various risks on bank profitability. They discovered a strong negative effect of risk on bank profitability, using the Seeing Unconnected Regression estimator to ensure robust results. Tan & Floros (2014) analyzed the Chinese banking industry from 2003 to 2009, examining the relationship between risk, competition, and profitability in Chinese banks. They discovered no influence of competition on risk, but a substantial effect of profitability on risk. They suggested that credit risk is linked to liquidity risk via defaults and fund withdrawals (Diamond & Dybvig, 1983). Several empirical research investigations found a negative association between credit risk and the success of banks (Athanasoglou *et al.*, 2008; Berríos, 2013; Cucinelli, 2015; Laryea, Ntow-Gyamfi, & Alu, 2016). Some studies revealed a favorable correlation between credit, both risk and return (Flamini *et al.*, 2009; Hakimi *et al.*, 2010). Liquidity risk affects bank profitability (Bourke, 1989; Kosmidou *et al.*, 2005; Olagunju *et al.*, 2012) on the other hand few studies showed a negative association between them(Mamatzakis & Bermpei, 2014). Moudud-Ul-Huq *et al.* (2020) found a positive relationship between insolvency risk and bank profitability in the MENA region when using return on assets as a performance indicator. Tan *et al.* (2017) showed inverse results compared to (Moudud-Ul-Huq *et al.*, 2020). While Moudud-Ul-Huq *et al.*, (2020) found a negative relationship using return on equity (ROE) as a performance indicator, while Tan *et al.*, (2017) showed contrasting results.

H_2: Higher profitability is expected to reduce the bank's risk in the MENA region.

3. Methods

Because MENA countries are frequently seen as rising economies, the MENA dataset was developed to

undertake the empirical study. The nations covered are Algeria, Bahrain, Egypt, Iraq, Jordan, Kuwait, Lebanon, Morocco, Oman, Qatar, Saudi Arabia, Tunisia, the United Arab Emirates, and Yemen. This section consists of four segments: Segment 3.1. represents the data and outline border; Section 3.2 describes the competition of measurement; 3.3. describes the determination of insolvency risk; and finally, 3.4. Research framework.

3.1. Data and Outline Border

The study is based on bank data from MENA countries from 2011 to 2022, covering 14 countries, 256 banks, and 969 observations. It uses macro variables from the bank scope database and macroeconomic variables from the World Bank indicators. The study uses an unbalanced panel dataset and includes the Lerner index as a competition indicator and three profitability indicators: return on assets (ROA), return on equity (ROE), and net interest margin (NIM). Regression and robustness results are presented in various tables, using the Generalized Method of Moments (GMM) for regression and 2 Stage Least Square for robustness checks.

3.2. Competition of measurement

Lerner index (LI): The Lerner index is the price minus the marginal cost divided by the price. The Lerner index, a measure of market strength and concentration, is frequently used to evaluate bank competitiveness. A higher Lerner index value corresponds to stronger pricing power and fewer competitive market circumstances (Moudud-Ul-Huq, 2020). It expands market power to a set price higher than the marginal cost. The index is widely used in banking research ;(Tan, 2016). The Lerner index outperforms the Herfindahl-Hirschman index, H-statistic, and Boone indicator (Boone, 2008). The Lerner index is a popular metric for measuring bank rivalry. Previous research explains why Lerner utilizes it properly to assess bank competition (Anginer *et al.*, 2014). The Lerner index (Equation-1) is shown below:

$$LI_{i,t} = \frac{(P_{i,t} - MC_{i,t})}{P_{i,t}} \dots\dots\dots (1)$$

Where 'i' denotes the number of banks, t denotes the number of years, P denotes the bank price (output), and MC represents the marginal cost. Price represents operating revenues. It computes interest income plus non-interest revenue divided by the total assets of banks. So, marginal cost (MC) is measured by the translog function (Equation-2), which is as follows:

$$Lncost_{i,t} = \beta_0 + \beta_1 lnQ_{i,t} + \frac{\beta_2}{2} lnQ_{it}^2 + \sum_{j=1}^{3} Y_{i,t}\, lnw_{j,it} + \sum_{j=i}^{3} \partial_j\, lnQ_{i,t}\; lnw_{j,it} + \sum_{j=1}^{3}\sum_{k=1}^{3} lnw_{j,it}\; lnw_{k,it} + \varepsilon_{i,t} \quad \dots\dots\dots (2)$$

Here, Ln represents the natural logarithm, cost represents the overall cost, 'i' indicates the number of banks, and t represents the number of years. Q represents the bank's output, which is proxy for total assets. W_1, W_2, and W_3 represent the input prices used in the production process. W_1 defines the price of labour (i.e., personal expenses to total assets); W_2 defines the fund's input price (i.e., interest expenses over total deposits); and W_3 specifies the price of fixed capital.

Finally, determine as marginal cost (Equation-3):

$$MC_{i,t} = \frac{cost_{i,t}}{Q_{i,t}} [\, \beta_1 + \beta_2 lnQ_{i,t} + \textstyle\sum_{j=1}^{3} \theta_j\, lnw_{j,it}] \dots\dots\dots (3)$$

3.3. Determination of insolvency risk

Return on assets plus CAP (CAP = equity/total assets) divided by the standard deviation of return on assets is known as insolvency risk, financial stability, or Z-scores. It also refers to z-scores. A greater score indicates higher stability, which translates into lesser risk (Moudud-Ul-Huq *et al.*, 2021; Zheng & Moudud-Ul-Huq, 2017).

3.4. Research Econometrics Model

A literature review shows that various methods are used to investigate the influence of bank competition profitability. on risk. i.e. ordinary least square(OLS) –fixed effects used by (Goetz, 2018). Two-stage least square (2SLS) used by (Soedarmono *et al.*, 2013).Generalized Method of Moment (GMM) used by (Moudud-Ul-Huq, 2020; Moudud-Ul-Huq *et al.*, 2021; Tan & Anchor, 2017). A fixed effect estimator was utilized to explore the impact of competition and profitability on risk (Tan *et al.*, 2020). We utilize the Generalised Method of Moments (GMM) to assess the impact of competition and profitability on bank risk. The 2SLS is utilized for robustness checks, allowing us to acquire reliable results.

Finally, we set the primary regression model as follows:

$$Risk_{i,t} = \alpha_0 + \beta_1 Risk_{(t-1)} + \beta_2\, Com_{i,t} + \beta_3 \sum_{k=3}^{5} Perf_{i,t} + \beta_4 \sum_{l=6}^{7} BLV_{i,t} + \beta_5 \sum_{w=8}^{9} ILV_{i,t} + \beta_6 \sum_{y=10}^{11} MEV_{i,t} + \varepsilon_{i,t} \quad \dots\dots\dots (4)$$

$$Risk_{i,t} = \alpha_0 + \beta_1 Risk_{i,t-1} + \beta_2 COM_{i,t} + \beta_3 \sum_{k=3}^{5} Perf_{i,t} + \beta_4 \sum_{l=6}^{7} BLV_{i,t} + \beta_5 \sum_{w=8}^{9} ILV_{i,t} + \beta_6 \sum_{y=10}^{11} MEV_{i,t} + \beta_7 \sum_{j=12}^{13} Size * COM_{i,t} + \beta_8 \sum_{h=14}^{15} Size * COM^2_{i,t} + \beta_9 \sum_{m=16}^{17} GGDP * COM_{i,t} + \beta_{10} \sum_{n=18}^{19} GGDP * COM^2_{i,t} + \beta_{11} \sum_{p=18}^{19} GGDP * Size_{i,t} + \beta_{12} \sum_{q=20}^{21} GGDP * Size^2_{i,t} + \beta_{13} \sum_{r=22}^{23} Inflation * COM_{i,t} + \beta_{14} \sum_{s=24}^{25} Inflation * COM^2_{i,t} + \beta_{15} \sum_{u=26}^{27} Inflation * Size_{i,t} + \beta_{16} \sum_{v=28}^{29} Inflation * Size^2_{i,t} + \varepsilon_{i,t} \dots\dots\dots (5)$$

Here, the subscript variables i and t represent the number of bank observations and years (2011-2022). Risk is defined as various risks: (i) Credit risk, (ii) Liquidity risk, (iii) Insolvency risk, and (iv) Capital risk. Com Here, the subscript variables i and t represent the number of bank observations and years (2011-2022). Risk is defined as various risks: (i) Credit risk, (ii) Liquidity risk, (iii) Insolvency risk, and (iv) Capital risk. Com defines the competition that is proxy by the Lerner index; Perf defines the profitability indicators which proxy by either

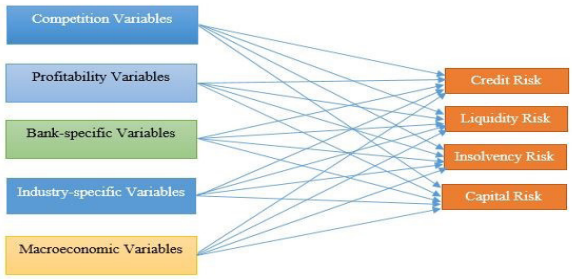

Figure 1. Basic Research Model

(i) Return on assets (ROA); (ii) Return on Equity (ROE); (iii) Net–interest margin (NIM). BLV defines the bank-level variables, which are proxies by (i) bank size (Size) and (ii) bank diversification (BD). ILV defines the industry-level variables that are proxies by (i) banking sector development (BSD) and (ii) stock market development (SMD). MEV defines the macroeconomic variables that proxy by (i) growth of gross domestic product (GGDP); and (ii) inflation rate (INF). α_1 Indicate the constraint term. β_1, β_2, β_3, β_4, β_5……β_{16} represent the co-efficient estimator for Equation 4 and Equation 5. Subscript k, l, w and y indicate the bank performance (ROA, NIM, & ROE), bank-level variables (Size, BD), industry-level variables(BSD & SMD), and macroeconomic variables (GGDP & INF), respectively, for Equation-4 and Equation-5. Subscript j, m, p, r,and u indicates the (Size × Com), (GGDP × Com), (GGDP ×

Table 1. Summary of Research Variables

Variables	types	Formula	Sources
Dependent variables			
Credit risk	**Risk**	(non-performing loans)/(total loans)	(Moudud-Ul-Huq *et al.*, 2021; Moudud-Ul-Huq *et al.*, 2020)
Liquidity risk		(liquid assets)/(total loans)	(Tan *et al.*, 2020)
Insolvency risk or Financial Stability or Z-score		(ROA /CAP)/σROA	(Moudud-Ul-Huq *et al.*, 2021; Zheng & Moudud-Ul-Huq, 2017)
Capital risk		Total regulatory capital ratio	(Moudud-Ul-Huq *et al.*, 2020)
Competition indicators			
Lerner index	**Competition**	(P-MC)/P	(Moudud-Ul-Huq *et al.*, 2021; Moudud-Ul-Huq *et al.*, 2020); (Moudud-Ul-Huq, 2020)
Profitability indicators			
Return on assets	**profitability**	(net income)/(total loans)	(Tan, 2019)
Return on equity		(net income)/(shareholder equity)	(Tan *et al.*, 2020)
Net interest margin		(net-interest income)/(earning assets)	(Tan *et al.*, 2020)
Bank-level variables			
Bank size	**Bank-level**	Natural logarithm of total assets	(Tan, 2017)
Bank diversification		(net-interest income)/(gross equity)	(Tan *et al.*, 2020)
Industry-level variables			
Banking-sector development	**Industry-level**	(banking sector assets)/(value of gross domestic product)	(Tan, 2017, 2019; Tan *et al.*, 2020)
Stock-market development		(banking sector assets)/(value of gross domestic product)	(Tan, 2019)

Continue Table 1			
Macroeconomic variables			
Growth of gross domestic product	economic	Growth of gross domestic product	World Bank indicators[1]
Inflation rates		Inflation rates	World Bank indicators[2]

Source: data.worldbank.org

× Com), (Inflation × Size) and Subscript h, n, q, s, and v quadratic effect variable of (Size × Com^2), (GGDP × Com^2), (GGDP × $Size^2$), (Inflation × Com^2), (Inflation × $Size^2$) for Equation-5 and ε represents the error term for Equation-4 and Equation-5. Table 1 displays a summary of Variables.

4. Results and Discussion

Multicollinearity issues don't exist if the value of the independent variables is not higher than 0.80. The higher value of independent variables is 0.48, the variable is 0.48, and a net-interest margin and inflation perform it, while the other remaining variables are smaller than 0.48. The Pearson correlation results suggest that this paper does not suffer from multicollinearity issues (Table 2).

The Lagrange Multiplier Test rejects the null hypothesis. Errors can be found in variables specific to a bank. The white test (White, 1980) was used to analyze the study's cross-sectional heteroskedasticity. The null hypothesis of the homoscedasticity test was rejected (at a 5% level of significance). As a result, this study's conclusions are not supported by the ordinary least squares (OLS) approach. As a result, we utilize a generalized method of moments (GMM) estimator to handle this scenario.

The primary regression findings are achieved using the GMM approach. Tables 3, 4, and 5 (following Equation-4) display the upshot of bank competition and profitability on various risks of MENA economies when performance indicators ROA, NIM, and ROE, respectively. Model-1, Model-2, Model-3, and Model-4 represent the credit risk, liquidity risk, insolvency risk, and capital risk, respectively. Model-1, Model-2, Model-3, and Model-4 are used as dependent variables for each case. The lagged dependent component of efficiency has a big coefficient, indicating that the model is dynamic and long-lasting year after year. In Table 3, the coefficient of Model-1 is negative for credit risk (Moudud-Ul-Huq, 2020); (Moudud-Ul-Huq *et al.*, 2021) and positive for Model-3 (Moudud-Ul-Huq *et al.*, 2021), showing that banks' market dominance reduces credit risk. As a result, bank financial stability improves. To put it another way, the less bank rivalry, the lesser bank risk-taking, and the greater the financial stability. Tables 4 and 5 preserve the results of Table 3, with performance metrics using NIM (Table 4) and ROE (Table 5), respectively, while Table 3 uses ROA. Our findings are consistent with those of empirical studies (Berger *et al.*, 2009; Leroy & Lucotte, 2017; Moudud-Ul-Huq, 2020). The competition fragility model supports this study's findings.

The results of Model 2 show a substantial and positive relationship between bank competition and liquidity risk, implying that lower bank competition encourages bank management to properly deploy liquidity assets in many firms to generate higher profitability. The result recommended that they reduce the volume of liquidity assets. Massive utilization increases the extent of liquidity risk. Tables 4 and 5 keep the results of Table 3 but utilize NIM (Table 4) and ROE (Table 5), respectively, for performance indicators, whereas Table 3 uses ROA.

Model 3 demonstrates a strong positive relationship between bank rivalry and insolvency risk. It suggests that reduced bank competition encourages banks to engage in several activities. For these reasons, banks are in the process of providing huge loans. It creates a potential default loan that increases the risk of insolvency. Tables 4 and 5 keep the results of Table 3 but utilize NIM (Table 4) and ROE (Table 5), respectively, for performance indicators, whereas Table 3 uses ROA.

Based on capital risk, Model-4 has a significant and positive impact on bank competition and capital risk. It suggests that lower banks' competition increases the non-performing loans. Even though bank competition has a significant negative impact on credit risk, it's in line with Tan *et al.* (2020) In MENA banking systems, non-performing loans are written off as expenses, decreasing the volume of capital and increasing capital risk. Tables 4 and 5 keep the results of Table 3 but utilize NIM (Table 4) and ROE (Table 5), respectively, for performance indicators, whereas Table 3 uses ROA. This result follows up with Tan *et al.* (2020) the difference (Tan & Floros, 2014). The first hypothesis of this study is that higher competition is expected to result in higher risk in the MENA region. So, the findings of this study support hypothesis 1.

Tables 3, 4, and 5 reveal a significant and negative (positive) association between risk models Model-1, Model-2, Model-4 (Model-3), and profitability indicators ROA, NIM, and ROE. The outcome followed by Tan *et al.* (2020), though Tan *et al.* (2020) showed insignificant effects on capital risk (Tan *et al.*, 2020). Tables 4 and 5

keep the results of Table 3 but utilize NIM (Table 4) and ROE (Table 5), respectively, for performance indicators, whereas Table 3 uses ROA. The banking systems of MENA countries are well-decorated, with an effective monitoring system and management mechanism. It aids in the detection of nonperforming loans and has the potential to minimize them. Finally, it minimizes credit and insolvency risk. Otherwise, big profits boost banks' total capital. It suggests that a high income can lower capital risk. The second hypothesis of this study is that increased profitability will lessen the bank's risk in the MENA region. So, the results of this investigation lend support to hypothesis 2.

In Table 3, there is a significant (insignificant) and positive relationship between bank size and risks for Model-1, Model-2, and Model-4 (Model-3). Tan *et al.* (2020) found that liquidity risk significantly impacts bank

Table 2. Correlation Analysis

	1	2	3	4	5	6	7	8	9	10	11	12	13
	Credit risk	Liquidity risk	Insolvency risk	Lerner	ROA	NIM	ROE	Size	BD	BSD	SMD	GGDP	INF
1	1												
2	0.126**	1											
3	0-.131**	-0.053	1										
4	0.059	0.087**	-0.028	1									
5	0.010	-0.050	-0.125**	0.293**	1								
6	0.105**	0.016	-0.254**	0.005	0.202**	1							
7	-0.214**	-0.296**	0.228**	-0.217**	0.129**	-0.064*	1						
8	-0.003	0.231**	-0.220**	0.150**	0.171**	-0.014	-0.123**	1					
9	-0.087**	-0.026	0.094**	-0.097**	0.035	-0.031	0.134**	-0.240**	1				
10	-0.090**	-0.103**	0.195**	-0.139**	0.006	-0.145**	0.470**	-0.075*	0.051	1			
11	-0.105**	-0.124**	0.125**	0.009	0.003	-0.127**	0.386**	-0.086**	0.078*	0.304**	1		
12	-0.008	0.162**	-0.024	0.086**	0.002	0.051	-0.054	0.166**	-0.095**	-0.035	-0.092**	1	
13	-0.017	0.097**	-0.244**	0.022	0.192**	0.480**	0.036	0.089**	-0.014	-0.151**	-0.098**	0.027	1

Note: Here, the dependent variables are (1) Credit risk, (2) Liquidity risk, and (3) Insolvency risk. The competition variable is (4) Lerner (Lerner index). Performance indicators are (5) ROA (return on assets), (6) NIM (net interest margin), and (7) ROE (return on equity). Bank-level variables are (8) Size (bank size), & (9) BD (bank diversifications). Industry-level variables are (10) BSD (Banking sector development) & (11) SMD (Stock market development). Macroeconomic variables are (12) GGDP (Growth of gross domestic product), & (13) INF: (Inflation rate).
**, * indicate 1% and 5% levels of significance respectively.

Table 3. The effect of bank competition and profitability (ROA) on risk (GMM)

Variables	**Model-1**	**Model-2**	**Model-3**	**Model-4**
	Credit risk	Liquidity Risk	Insolvency Risk	Capital risk
Model (t-1)	0.000***	0.000*	0.001**	0.000**
Lerner	-0.003***	0.008***	0.090***	0.005***
Profitability	-0.025*	-0.016	0.006***	-0.043***
Size	0.001***	0.028***	0.029	0.001***
Bank-diversification	0.001***	0.128**	1.108***	0.032***
Banking-sector development	1.010**	1.075***	2.001***	-0.023*
Stock-market development	0.053	-0.077***	0.010	-0.003***
GGDP	-0.001***	-0.005	-0.002	-0.030*
Inflation	-0.003*	-0.002**	1.010*	-0.020**
C	2.709***	6.096***	-1.009***	4.043***
R-squared	0.591	0.463	0.621	0.482
Adjusted R-squared	0.512	0.454	0.627	0.475
WALD Test (P-value)	0.000	0.000	0.000	0.000
AR (1) (P-value)	-0.010	0.000	0.000	-0.001
AR (2) (P-value)	0.270	0.502	0.372	0.318
Hansen Test (P-value)	0.891	0.927	0.828	0.512

Table 4. The effect of bank competition and profitability (NIM) on risk

Variables	**Model-1**	**Model-2**	**Model-3**	**Model-4**
	Credit risk	Liquidity Risk	Insolvency Risk	Capital risk
Model (t-1)	0.000**	0.003*	0.000***	0.000*
Lerner	-0.003***	0.015***	1.042***	0.012***
Profitability	-0.018***	-0.033***	0.084***	-0.032***
Size	0.001***	0.102***	2.077	0.002***
Bank-diversification	0.101***	0.126***	0.063***	0.201***
Banking-sector development	0.045***	0.087***	1.031***	-0.129***
Stock-market development	0.048	-0.028***	0.000	-0.079***
GGDP	-0.001***	-0.010	-0.017	-0.030**
Inflation	-0.000**	-0.005**	0.067**	-0.103***
C	2.025***	5.087***	1.090	4.056***
R-squared	0.671	0.635	0.618	0.405
Adjusted R-squared	0.675	0.632	0.644	0.397
WALD Test (P-value)	0.000	0.000	0.000	0.000
AR (1) (P-value)	-0.000	0.000	0.004	-0.001
AR (2) (P-value)	0.270	0.502	0.372	0.318
Hansen Test (P-value)	0.721	0.707	0.828	0.912

Note: The profitability indicator is NIM (Net Interest margin).WALD Test = A method for determining whether or not explanatory variables in a model are significant. Hansen Test for = Testing over-identifying restrictions. AR (1) and AR (2) are first and second-order auto-correlation. These results run by the GMM approach. *, **, *** represent 10%, 5%, 1% level of significant respectively.

Table 5. The effect of bank competition and profitability (ROE) on risk (GMM)

Variables	**Model-1**	**Model-2**	**Model-3**	**Model-4**
	Credit risk	Liquidity Risk	Insolvency Risk	Capital risk
Model (t-1)	0.0012***	0.001**	0.043***	0.010*
Lerner	-0.013***	0.016***	0.032***	0.016***
ROE	-0.101	-0.106***	1.018***	-0.108***
Size	0.015***	0.032***	0.073***	0.021***
Bank-diversification	0.016***	0.137***	0.043***	0.031***
Banking-sector development	0.071***	0.091***	5.069**	-1.082***
Stock-market development	0.035***	-0.058***	0.077	-0.203***
GGDP	-0.002***	-0.001	-0.009	-0.010***
Inflation	-0.010**	-0.003***	0.008***	-0.001***
C	7.017***	4.304***	-8.064***	8.120***
R-squared	0.526	0.456	0.724	0.640
Adjusted R-squared	0.524	0.495	0.774	0.639
WALD Test (P-value)	0.000	0.000	0.000	0.000
AR (1) (P-value)	-0.000	0.000	0.002	-0.002
AR (2) (P-value)	0.290	0.421	0.473	0.410
Hansen Test (P-value)	0.781	0.807	0.828	0.813

Note: The profitability indicator is ROE (Return on equity). WALD Test = A method for determining whether or not explanatory variables in a model are significant. Hansen Test for = Testing over-identifying restrictions. AR (1) and AR (2) are first and second-order auto-correlation. These results are run by the GMM approach. *, **, *** represent 10%, 5%, 1% level of significant respectively.

size, suggesting that larger banks face increased risk. This is due to their provision of long-term loans or short-term long-term loans that yield higher income, which can result in non-performing loans. Finally, credit risk, capital risk, and insolvency risk should be increased. However, engaging more loan term loan businesses creates crisis bank liquidity that increases liquidity risk. Tan *et al.* (2020) found that credit risk also has a significant and positive relationship between them, whereas our result suggests that most cases are positively significant between bank size and risk. This indicates that the higher diversification of bank loans increases the risk of the bank. The more diversified bank needs to assign assets to a wider range of activities. In this case, the bank needs proper monitoring and efficient management mechanisms to control these resources. Sometimes, banks fail to manage these assets and lack political supervision as well as these activities due to lack of proper supervision, efficient management, proper investigation, and unethical employment. Tables 4 and 5 keep the results of Table 3 results.

Table 3 demonstrates a substantial and positive relationship between bank diversification and risk for Models 1, 2, 3, and 4. Tables 4 and 5 keep the results from Table 3. These findings line with (Stern & Feldman, 2004; Zheng *et al.*, 2017). Bank diversification focuses on banks needing huge employees to monitor the systems. Assets are allocated broadly. It increases the expense of banks and reduces liquidity assets to operate immediately which increases liquidity risk. More diversified organizations need to assign assets to a broader range of activities. For this reason, management can give less emphasis to monitoring their loan activities, which increases the probability of the volume of non-performing loans and increases the credit risk.

From the view of industry-specific variables in Table 3, banking sector development has a significantly positive (negative) impact on risk for Model-1, Model-2, Model-3, and (Model-4). Tables 4 and 5 keep the results of Table 3 results. These outcomes are supported by (Tan *et al.*, 2020). However, they showed an insignificant impact on insolvency risk. Nowadays, economic sectors heavily depend on banking sectors to acquire credit and to handle most international financial transactions handled by banks. Engaging various financial institutions increases the various types of risk. The majority of financial institutions make loans run smoothly with a lower credit rating, which increases the credit expansion of these institutions and increases credit risk as well as insolvency risk. Credit extends to a portfolio that is capable of minimizing capital risk (Tan *et al.*, 2020). The liquidity risk approach suggests that the higher banking sector needs to meet the huge service demand, which leads to short-term growth. As a result, the number of liquid assets is reduced, which increases liquidity risk (Tan *et al.*, 2020).

From the view of the stock market in Table 3, Market development has an insignificant positive and significant

(negative) impact on risk for Model-1, (Model-2) Model-3, and (Model-4). When Tan *et al.* (2020) found an insignificant impact on various risks (Tan *et al.*, 2020). The sign of the significant and negative effect of the stock market on liquidity risk and capital risk is that the approach is to improve the non-interest business rather than the interest income business. Increasing non-interest business activities leads to higher profitability (Tan *et al.*, 2020). As a result, it reduces liquidity risk and capital risk (Tan *et al.*, 2020). On the other hand, a higher stock development market increases costs, leading to lower profitability. As a result, it increases the credit risk (Tan *et al.*, 2020). Tables 4 and 5 retain the results of Table 3.

Macroeconomic variables in Table 3, GGDP has a significant (insignificant) and negative impact on risk for Model-1, (Model-2) (Model-3) and Model-4). Whereas Tan *et al.* (2020) Found an insignificant effect on various risks. High GDP traditionally affects business activities that contribute to non-interest income. Finally, reduce credit risk, insolvency risk as well as capital risk (Tan *et al.*, 2020). Tables 4 and 5 retain the results of Table 3.

In Table 3, there is a significant and negative (positive) relationship between the inflation rate and risks for Model-1, Model-2, (Model-3), and Model-4. Tables 4 and 5 retain the results of Table 3. From the view of inflation is a crucial element to determine the risk of a country as well as to determine the economic condition of a nation. Our results suggest that higher inflation helps reduce risks. Our findings are consistent with those of Tan *et al.*, (2021) regarding the Chinese banking industry. Overflow of money in a capital market during a period of increased inflation in a country indicates the extraordinary circulation of cash in the economy. Higher currency values raise commodity prices. To limit the excessive circulation of cash. The government should implement effective measures to curb currency circulation (bank rate, open market operation, reserve ratio, credit rationing, and direct action) (Tan, 2020). Banks are currently working to manage the high volume of cash in the market. They make fewer credit loans and focus on the most important areas. As a result, it might be used to minimize nonperforming loans. Finally, it lowers the level of credit risk. High inflation levels considerably minimize capital risk in the MENA banking system.

We have referred earlier that banks provide fewer credit loans during periods of higher inflation as well as offer higher interest rates so that people are interested in opening deposits. As a result, banks hold a huge volume of deposits, which increases the level of liquidity assets as well as reduces the level of liquidity risk. High-level inflation increases the level of insolvency risk (Model-3) in the MENA banking industry. Earlier refers to higher inflation allure to bank deposit as well as reduce the volume of credit loans performed. It also increases interest expenses as a consequence of the increasing volume of deposit funds holding. Otherwise, it reduces the interest income as a result of less credit loan provision. The gap between expenses and income occurs in conflict, and banks are unable to fulfill their obligations in due time. As a result higher expenses than the lower-income, it increases the insolvency risk (Jabra *et al.*, 2017).

In summary, The findings of this investigation corroborate the competition fragility theory. The competition square concept suggests that in a market with competition, risk will eventually rise. In terms of economic progression, risk-taking behavior is exactly the reverse of bank competition. Again, the finding shows that good performance reduces the bank's risk, finally turning to greater financial stability.

4.1. Quadratic effect of competition size, GDP, and inflation on risk (financial stability)

This study examines the nonlinear relationship (Gupta *et al.*, 2021; Kouki and Al-Nasser (2017); Tabak *et al.*, 2012) between market competition, bank size, GDP, inflation, and financial stability using square terms. Equation 5 displays the GMM estimators with a nonlinear effect, as shown in Table 6.

The impact of size and market competition on risk is observed in this study, which finds that size and market competition have a homogenous effect on risk (Financial stability). All competition measures (Lerner index) have positive and significant interim term size × Lerner coefficients. It refers to the increase in market competition; regardless of size, the risk of MENA banks is reduced. The amount of the competition square term (a square measure of competition) at Lerner in Model-1, Model-2, Model-3, and Model-4, respectively, indicates that the risk increases in the long run. In economic progression, risk-taking behavior is exactly the reverse of bank competition.

The risk indicator reveals some intriguing facts about MENA banks (see Table 6). The scale risk-taking behavior of banks is linked to market competition and development indicators (GDP). In a competition measure, the size of a bank has a substantial relationship with risk. Furthermore, there is a considerable link between GDP and the magnitude of banks' risk-taking behavior. In a competitive market setting, bank size risk-taking behavior of MENA nations initially increases and decreases in the long run, while banks' size also shows the same tendency in the short term. With increased GDP, banks' risk-taking behavior declines at first, then increases in the long run.

Bank risk-taking behavior is linked to market competition and macroeconomic indicators on a large scale (inflation rate). The rate of inflation in MENA economies has a significant association with risk in terms of competition. Additionally, there is a substantial relationship between inflation rates and the amount of banks' risk-taking activities. In a competitive market scenario, MENA countries' inflation rate risk-taking behavior initially increases and then declines over time, while bank size exhibits a similar trend in the near term. When the inflation rate rises, banks' risk-taking behavior decreases at first and then rises over time.

Table 6. Quadratic effect of competition size, GDP, and inflation on risk

Variables	**Model-1**	**Model-2**	**Model-3**	**Model-4**
	Credit risk	Liquidity Risk	Insolvency Risk	Capital risk
Model (t-1)	0.010***	0.200*	0.001**	0.000***
Lerner	-0.021**	0.043***	0.092***	0.103*
ROA	-0.015***	-0.095	0.104***	-0.002**
NIM	-0.021	-0.012**	0.065***	-0.031**
ROE	-0.106**	-0.034***	0.024***	-0.011***
Size	0.078**	0.032***	0.102	0.137***
Size × Lerner	0.103***	0.021***	0.017***	0.027*
Size × Lerner^2	-0.021***	-0.023***	-0.008***	-0.021*
Bank-diversification	0.028**	0.106**	0.017***	0.021***
Banking-sector development	0.051***	1.082**	6.014**	-0.017**
Stock-market development	0.029	-0.038**	0.101	-0.042*
GGDP	-0.022*	-0.018	-0.029	-0.021**
GGDP × Lerner	-0.017*	-0.028	-0.017	-0.038*
GGDP × Size	-0.019**	-0.051*	-0.011*	-0.047
GGDP × Lerner^2	0.063***	0.012**	0.027***	0.039**
GGDP × Size^2	0.095***	0.006*	0.007**	0.082***
Inflation	-0.011***	-0.013**	0.017**	-0.101**
Inflation × Lerner	-0.029*	-0.001**	0.031***	0.003*
Inflation × Size	-0.071**	-0.042*	0.051**	0.008**
Inflation × Lerner^2	0.042***	0.007***	0.017**	0.019***
Inflation × Size^2	0.071***	0.028***	0.038***	0.081***
C	0.013**	0.072**	0.001	0.049***
R-squared	0.552	0.582	0.528	0.827
Adjusted R-squared	0.583	0.649	0.677	0.509
WALD Test (P-value)	0.000	0.000	0.000	0.000
AR (1) (P-value)	-0.000	-0.000	0.010	-0.000
AR (2) (P-value)	-0.331	-0.425	-0.345	-0.419
Hansen Test (P-value)	0.847	0.624	0.546	0.924

Note: Model $_{(t-1)}$ is a lag value of the dependent variables. (P-MC)/P) price minus marginal cost divided by price, which is defined as the Lerner index, is the main competition measurement proxy variable. Lerner^2 indicates the square term of the Lerner Index. Lerner × Size represents the bank competition multiple bank size; Lerner × GGDP represents the bank competition multiple commercial GGDP; Lerner × inflation represents the bank competition multiple inflation rate. GGDP × Size, GGDP × Size^2 indicate GGDP multiple bank size and square term of bank size, respectively. Inflation × Size, Inflation × Size^2 indicate inflation rate multiple bank size and square term of bank size respectively. WALD Test = A method for determining whether or not explanatory variables in a model are significant. Hansen Test for = Testing over-identifying restrictions. AR (1) and AR (2) are first and second-order auto-correlation. These results are run by the GMM approach. *, **, *** represent 10%, 5%, 1% level of significant respectively.

5. Robustness check

To check the robustness result in Table 7, we use a different method, Two-Stage Least Square (2SLS), including all profitability indicators like ROA, ROE, and NIM. It also employs other competition indicators, the HHIA-Herfindahl-Hirschman Index for Assets (HHIA) and the HHIL-Herfindahl-Hirschman Index for Gross Loans (HHIL); the results are displayed in Table 7 . Here, we also use a different formula for credit risk. Credit risk is carried out by the reduction of total loans and loss reserves to test creditworthiness (Tan *et al.*, 2020). Otherwise, impaired loans to total loans are used to measure the main regression results. In most cases, the robust results confirm our findings.

Table 7 clearly shows a substantial negative (positive) link

Table 7. The effect of bank competition and profitability on risk (2SLS)

Variables	**Model-1**	**Model-2**	**Model-3**	**Model-4**
	Credit risk	Liquidity Risk	Insolvency Risk	Capital risk
Model (t-1)	0.000***	0.000***	0.001***	0.021***
HHIA	-0.021**	0.043***	0.092***	0.010***
HHIL	-0.003***	0.028***	0.031**	0.092***
ROA	-0.051***	-0.095**	0.014***	-0.003***
NIM	-0.012**	-0.010**	-0.065***	-0.021***
ROE	-0.016**	-0.034***	-0.004***	-0.017***
Size	0.078**	0.032***	0.102***	0.017***
Bank-diversification	0.028**	0.016**	0.107***	0.021***
Banking-sector development	0.051***	0.082**	0.043**	-0.033***
Stock-market development	0.029**	-0.038**	0.012	-0.028***
GGDP	-0.002*	-0.018	-0.029	-0.021**
Inflation	-0.101***	-0.023**	0.107**	-0.011**
C	0.032**	0.073**	0.012*	0.049***
R-squared	0.583	0.439	0.377	0.419
Adjusted R-squared	0.558	0.462	0.396	0.457
WALD Test (P-value)	0.000	0.000	0.000	0.000
AR (1)	-0.00	-0.00	-0.01	-0.00
AR (2)	-0.31	-0.25	-0.35	-0.19
Hansen Test (P-value)	0.857	0.864	0.746	0.924

Note: For robustness check, this study uses alternative competition variables such as HHIA and HHIL. All performance indicators (ROA, NIM, ROE) are used for performance measurement. Where Model-1 (Credit risk), Model-2 (Liquidity Risk), Model-3 (Insolvency Risk), and Model-4 (Capital risk) are used as dependent variables. WALD Test = A method for determining whether or not explanatory variables in a model are significant. Hansen Test for = Testing over-identifying restrictions. AR (1) and AR (2) are first and second-order auto-correlation. These results run by the 2SLS approach. *, **, *** represent 10%, 5%, 1% level of significant respectively.

between the competition indicators (HHIA, HHIL) and credit risk for Models 1, 2, 3, and 4. The study's primary findings show a continuous negative (positive) association between the Lerner index and risk for Models 1, 2, 3, and 4. This shows that reduced bank competition leads to less risk-taking and greater financial stability (Djebali & Zaghdoudi, 2020).

6. Conclusion

The study aims to explore the relationship between bank competition, performance, and risk-taking behavior in MENA economies. It also examines the level of risk associated with dual banking and the bidirectional causality of competition and risk concerning size, GDP, and inflation rate. This study uses GMM and 2SLS to obtain robust results.

This study found that the less bank competition there was, the lesser bank risk-taking was, and the financial stability improved. The findings of this investigation corroborate the competition fragility theory. In the long run, it exhibits precisely the opposite pattern. The competition square term indicates that the risk increases in the long run in a competitive market. In terms of economic progression, risk-taking behavior is exactly the reverse of bank competition. In terms of performance, the findings show that good performance reduces the bank's risk, finally turning to greater financial stability.

This study examines the influence of size and market competition on risk and concludes that size and market competition have a homogeneous effect. In a competitive market system, the size and risk-taking behavior of MENA countries initially increase and fall in the long run, while the size of banks likewise exhibits the same trend in the short term. Banks' risk-taking behavior decreases initially but subsequently increases in the long run as GDP rises.

Inflationary pressures in MENA econones are strongly linked to competitive risk. Furthermore, the rate of inflation is strongly correlated with the extent of banks' risk-taking activity. In a competitive market scenario,

MENA countries' inflation rate risk-taking behavior initially increases and then declines over time, while bank size exhibits a similar trend in the near term. When the inflation rate rises, banks' risk-taking behavior initially decreases and then rises over time. Although the scope of this study is limited, it can draw extremely broad policy recommendations, and each country has its financial authority; there is no single financial authority or government for this region where action can be recommended and implemented uniformly. The study's conclusions have substantial policy implications in MENA emerging economies. First, less competition boosts bank profitability and financial stability. Second, because bank sizes are more vulnerable in a competitive market, there should be a greater reluctance to analyze and approve national acquisitions. Additionally, in times of financial crisis, banks need to reduce the overall risk for their non-performing loans and snowball financial stability. Finally, we suggest that MENA countries should pay more attention to the study of bank competition and standards for making sound financial decisions about profitability and risk-taking behavior.

Overflow of the currency in a capital market during a period of higher inflation in a nation specifies the extreme circulation of currency in the economy. Higher currency increases the prices of commodities (Tan, 2020). To control the extreme circulation of currency. The government should take some effective steps to reduce the circulation of currency (bank rate, open market operation, reserve ratio, credit rationing, and direct action) (Tan, 2020).

The Lerner index and combined banks were employed in this study, but the Lerner efficiency, ownership structure, and concentrated ownership patterns were not, which is the study's fundamental limitation. Future researchers will be able to improve the study by including these metrics, particularly intellectual capital efficiency.

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