

Dynamics of Bank Regulation and Supervision on Competition of Selected ASEAN Countries

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Abstract

This study investigates how bank regulation influences competition in the ASEAN-5 countries, addressing ongoing debates about regulation's role in financial stability. Using data from 3,548 bank-year observations across 268 commercial banks between 1990 and 2022, it draws on five World Bank Regulation and Supervision Surveys to construct indices for capital regulation, activity restrictions, deposit insurance, and official supervision. Bank competition is measured using the H-statistic, Lerner Index, concentration ratios, and the Herfindahl-Hirschman Index. Employing the two-step system GMM approach, results show that capital regulation, deposit insurance, and official supervision enhance bank competition, while activity restrictions dampen it. Importantly, deposit insurance has a pro-competitive effect during crisis periods such as the Asian Financial Crisis, Global Financial Crisis, and COVID-19 pandemic. The findings are robust across different model specifications, channels, data subsets, and quantiles, offering valuable insights for policymakers on how to structure bank regulation to support healthy competition under varying economic conditions.

Keywords: Competition, regulations, Supervision, crisis, Unique banking markets.

1. Introduction

Over the past decade, the dynamic between bank regulation and competition has garnered significant attention from policymakers, regulators, and academics. Regulatory oversight has frequently been identified as a key contributor to financial crises, notably the 1997–1998 Asian Financial Crisis (AFC) and the 2008–2009 Global Financial Crisis (GFC) (Anginer et al., 2019; 2024). In response to the financial crises, a series of regulatory reforms were implemented to strengthen the resilience of the banking sector. For instance, capital adequacy standards were reinforced through successive updates to the Basel Accords (Tongurai & Vithessonthi, 2020). Deposit insurance schemes were expanded and made more transparent to boost depositor confidence (Demirgüç-Kunt et al., 2015). Regulatory authorities also imposed stricter activity restrictions on banks (Noman et al., 2020) and enhanced the supervisory powers of financial regulators (Osma et al., 2019). While these measures aimed to safeguard financial stability, they also significantly increased compliance costs and compressed banks' profit margins. As a result, many institutions sought to consolidate their operations through mergers and acquisitions, reshaping the competitive structure of the banking industry (Badarau & Lapteacru, 2020).

The theoretical relationship between bank regulation, supervision, and competition remains ambiguous. Different regulatory tools—such as capital requirements, deposit insurance, activity restrictions, and official supervision—can influence competition in distinct ways. These effects may operate through overlapping or alternative channels, such as changes in franchise value, loan portfolio diversification, or credit supply. Additionally, the impact of regulation on competition can vary significantly across countries due to differences in institutional quality, regulatory objectives, and financial development.

Several studies illustrate this variation. Claessens and Laeven (2004) identified activity and entry restrictions as key determinants of bank competition but noted that their effects differ across countries. Haselmann and Wachtel (2007) emphasized that regulatory goals diverge between developed and developing countries: while the former often pursue deregulation to enhance efficiency and competition, the latter prioritize financial stability and risk mitigation. Gelos and Roldos (2004) found that in developed markets, regulatory change drives consolidation, whereas in developing economies, regulatory authorities themselves often lead the process. Agoraki et al. (2011) added that banks react differently to regulatory reforms depending on institutional environments, resulting in varying outcomes across banking

systems. Furthermore, banks in different regions operate under diverse stages of development and regulatory maturity. Hence, assessing the role of regulation on competition requires a focused analysis within a specific and coherent market context. Prior studies such as Claessens et al. (2001) and Li (2019), which employed global datasets, did not explore this relationship within a uniquely defined banking market. This gap motivates the present study.

This research investigates whether and how regulation and supervision promote or hinder bank competition within the original five ASEAN member countries—Indonesia, Malaysia, the Philippines, Singapore, and Thailand—collectively known as ASEAN-5. These countries represent a unique and policy-relevant setting due to their shared history of financial liberalization, crises, and regulatory reform. In the early 1990s, ASEAN-5 nations liberalized their banking sectors by removing interest rate ceilings, relaxing foreign entry barriers, and reducing reserve requirements to stimulate competition (Khan et al., 2016). However, weak supervision led to excessive credit growth, reduced loan quality, and inefficiencies, culminating in the 1997–1998 AFC (Williams & Nguyen, 2005). In response, ASEAN-5 countries introduced sweeping regulatory reforms and consolidation measures—including mergers and acquisitions—that reduced the number of commercial banks from 453 to 261 between 1997 and 2001 (Noman et al., 2021). Regulatory strengthening continued after the 2008–2009 GFC (Khan, 2023). Additionally, ASEAN-5 countries adopted the ASEAN Banking Integration Framework (ABIF), aimed at promoting cross-border banking and regional financial integration. ABIF fosters regulatory harmonization and allows qualified banks to operate in member countries with home-country regulatory treatment (Ventouri, 2018). These changes further increased competitive pressures, leading to additional consolidation and a reduction in commercial banks to 215 by 2018 (Nguyen, 2018). Given these developments, ASEAN-5 offers an ideal setting to examine how regulation and supervision shape bank competition.

This study contributes to the literature in several important ways. First, it provides new empirical evidence on how specific regulatory tools influence bank competition in a distinctive and policy-relevant context. Unlike Claessens and Laeven (2004) or Li (2019), who analyzed global data, this study focuses exclusively on ASEAN-5, enabling region-specific policy insights. Second, it informs key regulatory debates, including those on the trade-offs between regulation and stability (Demirgüç-Kunt & Huizinga, 2004; Marchionne et al., 2022; Hoque & Liu, 2023; Quintero-V, 2023), competition and stability (Anginer et al., 2012; Brei et al., 2020; Khan, 2023), and the interplay between regulation, competition, and stability (Keeley, 1990;

Matutes & Vives, 2000; Tongurai & Vithessonthi, 2020; Ezaj, 2020). By identifying which types of regulations promote or hinder competition, the study offers practical guidance for regulators.

Third, it explores whether the effects of regulation on competition vary between normal and crisis periods, covering the AFC, GFC, and the COVID-19 pandemic. This enables a more nuanced understanding of regulatory impacts across different economic conditions. Fourth, the study employs a comprehensive panel dataset spanning 33 years (1990–2022), capturing key phases of financial liberalization, crisis, reform, and integration in the ASEAN-5 region. Fifth, the study utilizes data from five World Bank surveys on bank regulation and supervision conducted by Barth et al. (2001, 2004, 2008, 2013) and Anginer et al. (2019). Following Noman et al. (2018), it constructs indices for capital regulation, activity restrictions, and supervision, along with a regulatory dummy.

Finally, to measure competition, the study applies both structural and non-structural approaches. Structural indicators include the Herfindahl-Hirschman Index (HHI) and the three-bank concentration ratio, while non-structural measures include the Lerner Index and the Panzar-Rosse H-statistic. This dual approach provides a robust and multidimensional assessment of competition in the ASEAN-5 banking sector.

The rest of the paper is organized in the following way. Section 2 reports the literature review on regulation and competition. Section 3 discusses the data and methodology of the study. Section 4 reports and discusses the results and findings. The conclusion is reported in section 5.

2.1 Literature on Regulation and Competition

This study investigates the effects of various regulatory frameworks—including capital regulation, activity restrictions, deposit insurance, and official supervision—on competitive dynamics within the banking sector. Notably, regulators and policymakers are increasingly focused on these elements to ensure a stable banking environment.

2.1.1 Capital Regulation and Competition

Capital regulation serves as a foundational component for banking authorities, aimed at preserving the integrity and stability of the financial system (Nguyen, Gan, & Li, 2019). The enforcement of minimum capital requirements provides a buffer for banks against adverse

market fluctuations. Following the global financial crisis of 2008-2009, the Basel II framework was revised and succeeded by Basel III, which many countries have adopted to enhance market discipline and bolster the stability of the banking system. However, the theoretical implications of capital regulation on competition remain contentious. Northcott (2004) posits that capital requirements may act as an entry barrier for new market entrants, potentially rendering such regulations anti-competitive. Conversely, Keeley (1990) suggests that these requirements might enhance competition by diminishing the market power of banks through the franchise value effect. This is further supported by research indicating that higher capital requirements can tighten the lending process and reduce available funds, as noted by Fernández et al. (2013). Additionally, increased capital requirements may amplify competitive pressures, prompting banks to pursue mergers and acquisitions as a strategy to consolidate (Gee et al., 2015). Coccoresse (2009) examined the competition in banking through the H-statistic and found that restrictive regulations in the 1980s led to heightened monopolistic competition in France and Italy. Further studies by Matthews, Murinde, & Zhao (2007) and Maudos & Solís (2011) corroborate these findings, indicating that banks with substantial capital reserves exhibit stronger competitive behavior. Employing the Lerner Index, Ejaz (2020) discovered that elevated capital requirements enhance banks' pricing power, which subsequently influences market concentration in Pakistan. Anginer et al. (2024) observed that increased capital requirements under Basel III positively impacted risk management practices in banks that operate in less competitive and concentrated environments. These theoretical and empirical insights suggest that stringent capital regulations may indeed foster competition within the banking sector.

2.1.2 Activity Restrictions

Activity restrictions delineate regulatory limitations on the operational scope of banks, encompassing areas such as branching, securities trading, and ownership stakes in non-financial enterprises. These constraints can significantly influence banks' risk diversification strategies and competitive posture (Barth et al., 2013). Keeley (1990) argues that the liberalization of activity restrictions can diminish banks' market power and franchise value, thereby enhancing competitive dynamics. Similarly, Claessens & Laeven (2004) found a correlation between reduced activity restrictions and increased competition. The opportunities for diversification that arise from deregulated activity can stimulate competition across various market segments (Lepetit et al., 2008). Li & Li (2020) further assert that heightened activity restrictions are associated with improved bank efficiency, indicating a positive relationship

between competition and operational effectiveness. However, overly permissive activity restrictions could lead to the emergence of large financial conglomerates, resulting in increased market concentration and reduced competition (Agoraki et al., 2011; Beck et al., 2013). Cubillas and Suárez (2013) found that elevated activity restrictions mitigate the adverse effects of market power across 64 countries. Consequently, the net impact of activity restrictions on competition remains an empirical question that warrants further investigation, particularly within specific banking contexts.

2.1.3 Deposit Insurance

Deposit insurance is a crucial institutional mechanism that enhances the financial stability of the banking system by mitigating the risks associated with bank runs, which occur when depositors withdraw funds en masse due to concerns over a bank's solvency (Diamond & Dybvig, 1983). By establishing a safety net for depositors, deposit insurance helps avert systemic crises, thereby curbing the social costs associated with banking failures and promoting overall social welfare (Demirgüç-Kunt & Detragiache, 2004; Anginer et al., 2019; Noman et al., 2022). Matutes & Vives (2000) argue that deposit insurance lowers transaction costs and encourages higher deposit volumes by alleviating the moral hazard associated with banks' risk-taking behaviors. This framework fosters public trust in the banking system and enhances financial intermediation (Demirgüç-Kunt et al., 2015). Empirical research by Li (2019) across 23 nations indicates that deposit insurance diminishes market power. Hence, it can be posited that deposit insurance enhances competition by boosting depositor confidence and facilitating greater intermediation within the banking system.

2.1.4 Powerful Official Supervision

Effective official supervision plays a pivotal role in ensuring the robustness of the financial system by implementing regulations outlined in the Basel accords, particularly Pillar III, which seeks to curtail excessive risk-taking by banks (BIS, 2011). It is essential for monitoring bank operations, thereby enhancing efficiency and mitigating potential market failures (Beck et al., 2006). Supervisors are tasked with safeguarding the financial system against unsound practices and bank runs, which can lead to asymmetries in market information (Barth et al., 2004). Robust supervision can lower systemic risk and prevent banks from engaging in unnecessary risk-taking, a phenomenon exacerbated by deposit insurance and the lack of depositor incentives to monitor banks closely. This can lead to improved governance and sustainability within the banking sector, subsequently fostering competition by minimizing market failure

risks (Laeven & Levine, 2009). Li (2019) also identified a negative correlation between supervisory strength and market power in 23 emerging markets. However, Stigler's (1971) contrasting perspective highlights that in some emerging economies, powerful supervisors may be closely aligned with political interests, which can detract from their ability to effectively regulate banks. Such politically connected supervision may disrupt efficient intermediation and adversely impact competition. Consequently, the influence of strong supervisory frameworks on competition remains a critical area for empirical research.

3. Methodology

3.1 Model specification

To investigate the impact of bank regulation and supervision on competition in ASEAN-5, this study used the following dynamic models following the work of Cubillas and Suárez (2013):

$$COM_{jt} = \alpha_0 + \alpha_1 COM_{jt-1} + \beta_1 REG_{jt} + \beta_2 BANK_{ijt} + \beta_3 MACRO_{jt} + \gamma(YEAR)_t + \lambda_i + \varepsilon_{ijt} \quad (1)$$

Where the subscripts i, j , and t indicate individual banks, countries, and years, respectively. Here, COM_{jt} indicating bank competition is the dependent variable, which is captured with H-statistic, Lerner index, HHI and CR3. α_1 is the coefficient of lagged competition. A positive and significant α_1 indicate the persistency of the competition in the market. This study is interested to estimate β_1 referring to the coefficient of the main explanatory variable regulations and supervision on competition. A positive and significant value of β_1 on H-statistic, or negative and significant on Lerner index, HHI and CR3, indicate regulations and supervision foster competition. $BANK_{ijt}$ and $MACRO_{jt}$ are the bank-level, and macroeconomic control variables, respectively. A year dummy is incorporated to capture technological development due to business cycle movement. λ_i is unobserved bank effect, and ε_{ijt} is error term.

3.2 Competition measures

This study captures competition using both non-structural and structural measures. Non-structural measures are Panzar-Rosse H-statistic and Lerner index. Structural measures are HHI and CR3.

3.2.1 Panzar-Rosse H-statistic

This study primarily used the H-statistic to capture the bank competition. H-statistic is a widely used, and easy to calculate and interpret approach, which is directly proportional to competition (Apergis et al., 2016; Tongurai and Vithessonthi, 2020). To calculate the annual H-statistic for each sample country, this study used the following reduced form revenue equation following Noman et al. (2018):

$$\ln P_i = \alpha + \beta_1 \ln W1_{it} + \beta_2 \ln W2_{it} + \beta_3 \ln W3_{it} + \gamma_1 \ln X1_{it} + \gamma_2 \ln X2_{it} + \gamma_3 \ln X3_{it} + \varepsilon_{it} \quad (2)$$

Where $\ln$ implies natural logarithmic transformation of variables. P_i is the output price, which is the interest income to total assets ratio. $W1_{it}$, $W2_{it}$ and $W3_{it}$ are three inputs, which are the prices for borrowed funds, labor, and fixed capital, respectively. Borrowed funds price is the interest expenses to total assets ratio, labor price is personnel expenses to total assets ratio, and the fixed capital price is administrative and other operating expenses to total assets ratio. In addition, $Y1_{it}$, $Y2_{it}$ and $Y3_{it}$ are the three bank-level control variables indicating equity to total assets ratio, loans to total assets ratio, and total assets, respectively, ε_i is the error term.

H-statistic is calculated by adding the values of β_1 , β_2 and β_3 , which indicates a sum of revenue elasticities to the input prices. H-statistic may take a value from $-\infty$ to $+1$, indicating low to high competition. It takes a negative or zero value for monopoly, between zero to unity for monopolistic and 1 for a perfect competitive market. As existence of long-run equilibrium is the precondition for using H-statistic, we also investigated it using the following equation:

$$\ln (1 + ROA_{it}) = \alpha + \beta_1 \ln W1_{it} + \beta_2 \ln W2_{it} + \beta_3 \ln W3_{it} + \gamma_1 \ln X1_{it} + \gamma_2 \ln X2_{it} + \gamma_3 \ln X3_{it} + \varepsilon_{it} \quad (3)$$

Where, ROA implies a return on total assets ratio. This study uses risk-adjusted ROA instead of ROA for example, $(1+ROA)$ to use natural logarithmic transformation of ROA. $\beta_1 + \beta_2 + \beta_3 = 0$ and $\beta_1 + \beta_2 + \beta_3 < 0$ indicates the presence of long-run equilibrium and disequilibrium, respectively. Under equilibrium conditions, changes in the input prices are not sensitive to the ROA of banks. On the other hand, disequilibrium indicates that changes in input prices would lead to a decrease in the ROA of banks.

As additional measures of competition, it uses the Lerner index and traditional concentration measures, for example, HHI and CR3¹. The explanation for Lerner index provided in the appendix B. HHI is the sum of squared market shares based on the annual gross loans of all banks in each country (Tongurai and Vithessonthi, 2020). CR3 is the sum only the largest 3 banks' market share in the loan market (Fu et al., 2014). Both HHI and CR3 take values from 0 to 1, showing low to high concentration, indicating perfect competition to the monopoly market.

3.3 Bank regulations and supervision

To examine the impact of bank regulation and supervision on competition, this study constructed three indices and one dummy variable, capturing capital requirements, activity restrictions, official supervision, and deposit insurance. These were based on survey data from Barth et al. (2001, 2006, 2008, 2013) and Anginer et al. (2019), with detailed index construction provided in Appendix A. The capital requirement index (0–8) reflects both initial and overall capital stringency, including how regulators assess capital sources and incorporate risk and value losses (Agoraki et al., 2011). The activity restrictions index (1–4) measures the extent to which banks can engage in securities, insurance, real estate, and non-financial ownership (Beck et al., 2013). Deposit insurance is represented by a dummy variable: 1 if an explicit scheme exists, 0 otherwise (Fu et al., 2014). The supervision index (6–14) reflects the authority supervisors hold to act against bank stakeholders (Agoraki et al., 2011; Noman et al., 2018).

3.4 Control variables

To enhance the fitness of the model examining the relationship between bank regulation and competition, this study incorporates a comprehensive set of bank-level and macroeconomic control variables. The bank-level controls include solvency, loan quality, capitalization, operational efficiency, bank size, loan composition, ownership structure, and profitability.

Solvency is included as it influences both market power—via the franchise value effect (Keeley, 1990)—and the extent of regulation and supervision, as more solvent banks are often deregulated (Barth et al., 2013; Beck et al., 2013). Solvency is measured using the Z-score, calculated as the sum of return on assets (ROA) and the equity-to-assets ratio, divided by the standard deviation of ROA over a three-year window. A higher Z-score indicates greater

¹ The pros and cons of concentration measures to capture competition is discussed in Leon (2014).

solvency and is associated with increased competition (Cubillas & Suárez, 2013). To reduce skewness and improve normality, the natural logarithm of the Z-score is used (Azmi et al., 2019). Profitability and capitalization are controlled separately, using ROA and equity-to-assets ratio, respectively, as underperforming and undercapitalized banks are more vulnerable in competitive markets and are typically subject to stronger regulatory enforcement (Barth et al., 2013).

Operational efficiency, a determinant of market power under the efficient-structure hypothesis, is measured by the cost-to-income ratio, where a lower value reflects higher efficiency (Cubillas & Suárez, 2013). Bank size is controlled using the natural logarithm of total assets, as larger banks often compete in more open, international markets, although size may also confer market power through dominance. Ownership is considered by distinguishing foreign banks, which are generally more efficient and competitive than domestic banks (Noman et al., 2017). Loan composition and loan quality are also included, as increased lending intensifies intermediation and competition, potentially lowering loan quality.

Macroeconomic controls include inflation and real GDP growth to capture business cycle effects. Real GDP growth reflects macroeconomic activity and its impact on banking performance (Lee & Hsieh, 2014), while inflation, measured as the annual change in the consumer price index, captures macroeconomic uncertainty (Cubillas & González, 2014).

3.5 Estimation method

This study applies the two-step System GMM estimator to address three key econometric issues: unobserved bank heterogeneity, autocorrelation, and endogeneity in independent variables, which are common in bank-level data. Endogeneity is managed using lagged instruments within a panel framework. Based on Arellano and Bond (1991), Arellano and Bover (1995), and Blundell and Bond (1998), the estimator combines level and difference equations, allowing use of time-invariant variables and improving efficiency over difference GMM. Instrument validity is assessed using the Hansen J-statistic, while the absence of second-order autocorrelation is tested via the AR(2) statistic. Insignificant values for both confirm model specification and instrument validity.

To address endogeneity between regulation and competition, the study further uses financial freedom and property rights as instrumental variables. Financial freedom reflects bank

efficiency and independence from government, covering regulation, deposits, loans, services, and foreign transactions—factors influencing competition. Property rights indicate legal protection of ownership, enabling banks to expand services and market share. Stronger rights and financial freedom are expected to enhance competitiveness and reduce the weaker banks' presence in the market.

3.5 Data

To assess the impact of bank regulation and supervision on competition in ASEAN-5 countries—Indonesia, Malaysia, Singapore, the Philippines, and Thailand—this study constructs a dynamic panel dataset of 3,548 bank-year observations from 268 commercial banks between 1990 and 2022. These countries were selected for their comparable banking reforms post-1997–1998 AFC and alignment with the ASEAN Banking Integration Framework. The dataset spans key financial episodes, including early 1990s liberalization, the AFC, the 2008–2009 GFC, and the COVID-19 pandemic. Focusing solely on commercial banks ensures regulatory consistency, excluding savings, cooperative, investment banks, and non-bank financial institutions. To enhance data integrity, the study includes only commercial banks with at least three consecutive years of data to compute Z-scores, consistent with Azmi et al. (2019). It uses consolidated or unconsolidated data, based on availability, to prevent double-counting (Beck et al., 2013), and includes both active and inactive banks to mitigate survival bias. This study collected data from various sources. Bank-level data for the period of 1990 to 2014 and 2015 to 2022 were collected from the Bankscope database of Bureau-Van-Dijk (BVD) and Orbis database of BVD, and then winsorized at 1st and 99th percentiles to avoid outliers and control estimation errors. Bank regulation and supervision data collected from World bank survey on bank regulations and supervision conducted Barth et al. (2001, 2003, 2008 and 2013) and Anginer et al. (2019). Data on instrumental and macroeconomic control variables collected from Heritage-Foundation and World Bank Development Indicators (WBDI), respectively.

4. Results and Analysis

4.1 Summary statistics

Tables 2 and 3 exhibit regional and country-wise summary statistics of the variables, respectively. Table 2 presents that the mean value of competition measures of the region has H-statistic of 0.6098, Lerner index of 0.1528, HHI of 0.1252, and CR3 of 0.5016, which demonstrates that ASEAN-5 commercial banks face a moderate level of competition and

concentration. The existing level of competition and concentration may be due to the presence of stringent regulation and supervision. For example, the ASEAN-5 banks face tight stringent capital regulation (5.6564) and activity restrictions (11.0374), enjoy explicit deposit insurance (0.7843), and undergo stringent official supervision (11.9656) as a consequence of post AFC bank restructuring and reforming efforts. However, I don't have any information about which regulation impedes or promotes bank competition in this region. On the other hand, the mean value of solvency (67.3688), profitability (.7338), capitalization (13.6300), loan ratio (5.6414), loan quality (46.7569), operational inefficiency (61.3868) and foreign bank ownership (.31965) demonstrate that ASEAN-5 banks are solvent, profitable, capitalized and efficient in operations and risk management due to the present of stringent regulation and supervision, which make them competitive.

Please insert Table 2 here

Please insert Table 3 here

Table 3 demonstrates that Singaporean banks face comparatively lower competition and higher market power and concentration in the region due to lower scores of H-statistic (.3239) and higher scores of Lerner index (.2120), HHI (.3025) and CR3 (.9393). Bank competition is highest in Thailand due to a maximum score of H-statistic (0.7796) and a minimum score of Lerner index (0.1109) among the ASEAN-5 countries. Our observation is consistent with Khan et al., (2016). On the other hand, Indonesian banks face comparatively higher stringent capital regulation (6.2254) and official supervision (12.5363), and enjoy maximum explicit deposit insurance (1.0), and Malaysian banks face higher activity restrictions (13.016) in the region.

Please insert Table 4 here

Table 4 presents Pearson's pairwise correlation coefficients of the variables, which provide several notable preliminary observations. Measures of competition H-statistic negatively correlated with a measure of market power Lerner index and measures of concentration HHI and CR3. Capital stringency index, deposit insurance and stringent official supervision positively correlated with competition and activity restrictions index negatively correlated with competition. Furthermore, the pairwise correlation coefficient values indicate that there is no potential multicollinearity problem among the explanatory variables.

4.2 Empirical results

Tables 5 and 6 provide the two-step system GMM estimates of equation 1 to measure the role of bank regulation and supervision on competition in ASEAN-5 countries. At the first stage, this study estimated competition with four different proxies for example, H-statistic, Lerner index, HHI and CR3, and bank regulation and supervision with capital stringency index, activity restrictions index, deposit insurance dummy, and supervision stringency index. Then, at the second stage, it regressed bank regulation and supervision on completion controlling a number of bank level and macroeconomic level control variables presented in equation 1. The diagnostic tests for the GMM specifications are reported at the bottom of the tables indicating the reliability of the GMM results. Serial correlation tests at order first and second suggest the presence of serial correlation in the first order and absent in the second order, which confirms regressions' residuals are not free from serial correlation problems. Finally, statistics of the Hansen-J test also confirm instrumental validity.

Table 5 shows the GMM estimates of equation 1 where it regresses bank regulation and supervision variables on H-statistic measuring competition to investigate the role of bank regulation and supervision on competition in ASEAN-5 countries. It observes that the coefficient of lag H-statistic is significant in all models indicating the competition in the ASEAN-5 banking markets is dynamic and persistent in nature. The results demonstrate that the competitiveness of banks carried forward to the next years due to bank characteristics and regulatory efforts.

Please insert Table 5 here

In Table 5, the coefficient of capital stringency index is positive and significant on H-statistic in model 1, indicating that high capital stringency by bank regulators increases competition in the market. This study observes a consistent result in Table 6, where the coefficient of capital stringency is negative and significant on market power measures captured by Lerner index, HHI and CR3 in models 1-3, as less market power indicates high competition. High stringency of capital requirement increases competition in the banking market may be due to the franchise value effect of Keeley (1990). Because, high capital stringency decreases loanable funds and tightens loan appraisal procedures which may erode banks' profit margins (Fernández et al., 2013), and increases competitive pressure on banks, and motivates them to consolidate with other banks in the form of mergers and acquisitions (Gee, et al. 2015). Our results are also

consistent with the observation of Vesala (1995), Matthews et al., (2007), Maudos & Solís, (2011), Coccorese, (2009), Agoraki et al., (2011), Fernández et al., (2013), and Ejaz, (2020) who found that increased restrictions enhanced the operational efficiency of the banking system and make banks competitive. In addition, it is also not unusual for the ASEAN-5 banks to increase competition due to tighter capital stringency. The banking section of this region has gone through tremendous deregulation due to the implementation of post-1997-1998 AFC and 2008-2009 GFC banking market reform strategies including capital regulation reform, which reflected on the banking market structure and competitiveness of the banks. As a post-crisis reform strategy, all ASEAN-5 countries adopted Basel II accords for capital regulation, which increased the capital adequacy ratio from 10.998 in 1998 to 12.226 in 2014 may be responsible for an increase in the level of competition captured by a rise of H-statistic from 0.239 in 1998 to 0.726 in 2014 (Noman, et al., 2018; 2020).

The results of the activity restrictions on competition are reported in model 2 of Table 5 and models 4-6 of Table 6. The results suggest that activity restrictions reduce competition in the market and increase the market power of the existing banks. Because liberalization of the banking operations increases competition in the market, which erodes market power and franchise value of earning monopoly rents. However, restrictions on banking activities for example, branching restrict the banking market from new entrants and the scope of operations of the existing banks, which also limit the competition level in the banking market and allow existing banks to increase their market power (Keeley, 1990; Claessens & Laeven, 2004). The post-1997-1998 AFC and 2008-2009 GFC bank reform strategies liberalized the ASEAN-5 banking market through regional and international banking market integration including other liberalization of other banking operations which might be responsible for increasing competition in the ASEAN-5 banking market (Noman et al., 2020)².

This study also examines the role of explicit deposit insurance on bank competition, the results of which are reported in model 3 of Table 5 and models 7-9 of Table 6. The positive and significant value of the deposit insurance dummy on H-statistic in model 3 of Table 5, and negative and significant value of deposit insurance on Lerner, HHI and CR3 in model 7-9 of Table 6 that deposit insurance increases competition in the ASEAN-5 banking market. Deposit insurance offers a public safety net to banks to prevent bank runs and the systemic effects of

² An excellent review on the change of activities restrictions aftermath of the 1997-1998 AFC and 2008-2009 GFC in ASEAN-5 countries is provided in Noman, et al., (2020).

bank runs, reduce the social cost of the banking crisis, and promote social welfare (Anginer, et al., 2019). Thus, deposit insurance promotes the confidence of the depositors in the banking system and motivates them to increase the supply more funds to the banking channel (Matutes & Vives, 2000; Demirgüç-Kunt, et al., 2015), which may be responsible for lowering bank transaction costs and raising competition in the banking market. In addition, all ASEAN-5 countries adopted explicit deposit insurance in different periods, for example, Indonesia in 2004, Malaysia in 2005, the Philippines in 1963, Singapore in 2010 and Thailand in 2008 (Demirgüç-Kunt, et al., 2015). It replaced the alternative blanket guarantee, which introduced in the ASEAN-5 countries except Philippines immediately after outbreak of the 1997-1998 AFC to regain public trust and protect against systemic banking crisis. As a result, the presence of explicit deposit insurance in all ASEAN-5 countries could be attributed to the rise of competition in this region.

This study further examines the role of stringent official supervision on bank competition. The coefficient of the stringent official supervision on H-statistic is positive and significant in model 4 of Table 5, and the coefficient of the same variable on Lerner index, HHI and CR3 is negative and significant in models 10-12 of Table 6. These results demonstrate that stringent official supervision also increases competition in the ASEAN-5 banking market, which supports the finding of Li, (2019) for 23 Emerging economies. The stringent supervision promotes market discipline and governance of the banking system and prohibits banks from taking excessive risk, which bolsters long-run sustainability of the banks. In addition, stringent supervision may help to reduce entry barriers for the new entrants, promote transparency in banking operations and soundness of the the banking system, which might promote competition in the banking market.

Please insert Table 6 here

This study re-estimated the role of regulation and supervision on competition during crisis and normal periods. In the aftermath of suffering from crisis episodes, bank regulators adopted various restricting processes, revised regulations, and imposed new rules to strengthen the regulatory framework, control competition, and reduce excessive risk-taking in the banking system (Igan and Mirzaei 2020). For example, Basel III was adopted by many countries, and Dodd-Frank Act was enacted in the United States aftermath of the 2008-9 GFC. While tightening regulations were to safeguard against potential crises, the regulators and policymakers are concerned about the adverse consequences on the competition and foreign

penetration for small domestic banks. Therefore, it would be interesting to see how the competition responds to crises, and whether regulation and supervision play the same or different roles in the competition during crises and normal periods. To capture the regulatory and supervisory effect during the crisis period, it introduced an interaction term of crisis dummy and regulatory & supervisory variables in equation 1, where crisis dummy takes a value of 1, if the year is a crisis year, otherwise, the dummy takes a zero value. As ASEAN banks suffered from the 1997-1998 AFC, 2008-2009 GFC, 2020-2021 COVID-19 pandemic, this study considered 1997, 1998, 2008, 2009, 2020, and 2021 as crisis years for ASEAN-5 banks following Noman et al. (2022). It thought the non-crisis period eliminated the crisis years from our sample years from 1990-2022. Table 7 shows the GMM results of regulatory and supervisory effect on competition during crisis period and normal period in models 1-4 and 5-9 respectively, where capitulation is captured with H-statistics in all models.

Please insert Table 7 here

The significant and negative value of the crisis dummy of Table 7 demonstrates that a crisis brings detrimental effects on the competitive capacity of the banks. This might be due to an increase in mergers and acquisitions of failed banks, governments' favours to bailout too-big-to-fail banks, erosion of banks' capital and efficiency, distortion of market discipline, and increase of deposit cost and restrictions on banking activities (Cubillas, Fonseca & González, 2012). During the crisis, banks adopt more risk aversion behaviour and focus on survival rather than competition with each other (Akins, Li and Rusticus, (2016). In addition, concerning the regulatory and supervisory effect on the competition during the crisis and normal periods, this study observes more prominent effects of stringent capital regulation, deposit insurance, and official supervision on the bank competition during the crisis in comparison to the non-crisis period. These findings collaborate with the observations of Li (2019) and Anginer et al. (2024) who claim that stringent capital regulation requires banks to maintain a healthy capital buffer to reduce their chances of insolvency, which creates a level playing field where well-capitalized banks can compete more effectively during a crisis. In addition, tight supervision ensures that banks follow regulatory standards and manage their risk appetites prudently, which promotes a competitive environment that allows banks to compete on their operational efficiency and service quality (Laeven and Levine 2009; Cihak et al., 2013). Furthermore, explicit deposit insurance also restores competition during the crisis period promoting public confidence and intermediation and protecting bank runs (Noman et al., 2022).

On the other hand, it observes that despite the sign of the coefficient of the activity restrictions is negative and significant, the sign of the coefficient is altered and becomes insignificant for the interaction variable of the activity restriction and crisis dummy negative. These results demonstrate that activity restrictions play a prominent role in reducing competition in the non-crisis period. However, the impact of activity restrictions on competition is altered during the crisis period due to the risk-shifting effect (Noman, et al., 2021). Because, banks face limited opportunities for expanding scopes of operations and risk diversification in the restricted market during the crisis. This may motivate banks to compete aggressively in unrestricted areas to maintain their profitability and market share.

Robustness Checking

This study has gone through several robustness checks to confirm our initial results. First, it re-estimated equation 1 allowing one year lag of all regulation and supervision variables following Agoraki et al., (2011), as the impact of regulatory change on competition and bank risk-taking is very slow. There is a time lag between the adoption of regulatory change and its impact on the banking industry. The GMM results of equation 1 allowing 1 year of lagged regulation and supervision are provided in Table 8, which holds our original results.

Please insert table 8 here

Second, instead of the dynamic model, it estimated equation 1 considering the static models, particularly, ordinary least square (OLS) and fixed effect following Agoraki, et al., (2011) and Cubillas, et al., (2012). The results of OLS and Fixed effect are also consistent with the GMM results³. High capital stringency, explicit deposit insurance and powerful official supervision promotes competition and activity restrictions weaken competition in the region. Third, it also controlled bank size in regulation and supervision relation to bank competition as large banks benefit more in a competitive environment (Tabak, et al. 2012). The bank size is captured with natural logarithmic transmission of total assets. The system GMM estimates of equation 1 controlling bank size are provided in Table 9. Table 9 also shows that the original results hold.

Please insert Table 9 here

³ The OLS and Fixed effect results are not provided to conserve the space. However, the results are available to the audience upon request.

Fourth, Anginer, et al., (2024) claim that large banks might have more opportunity to adjust their balance sheets and circumvent regulatory requirements, for example, through securitization or earnings management. Therefore, it checked whether the regulatory impact on bank competition is the same for large and small banks in the region. To do this, it conducted a sub-sample analysis for regulatory impacts on bank competition for large and small banks. The Fixed effect estimates of the sub-sample analysis are provided in Table 10. Table 10 shows that capital regulation, deposit insurance and official supervision have similar competition-increasing effects for both large and small banks. However, the competition-decreasing effect of activity restrictions has changed for large banks. Traditionally large banks enjoy more scope of operations for revenue diversification and market power to enjoy monopoly rents (Noman et al., 2021). However, more restrictions on their activities reduce their scope of operations and require them to give more attention to traditional banking activities, which increases competition in traditional banking activities (Anginer et al., 2024). Further, restrictions may also reduce the market power of large banks and create a level playing field in the market, which makes it harder for a single large bank to dominate the lending market (Keeley, 1999; Cubillas et al., 2013).

Please insert Table 10 here

Fifth, Anginer et al. (2019) observed that foreign banks are typically large banks, and face more regulatory restrictions and compliance costs in developing countries. In addition, foreign banks are subject to the regulatory restrictions of both home and host countries (Li, 2019). Consequently, it conducted a sub-sample analysis of the regulatory impact on competition for local and foreign banks. The fixed effect estimates of the sub-sample analysis are provided in Table 11. Table 11 shows that the original results hold. Capital stringency requirements, deposit insurance, and supervision increase competition and activity restrictions reduce competition for both local and foreign banks in the regions.

Please insert Table 11 here

Six, in the aftermath of the 1997-1998 AFC, ASEAN-5 banks adopted tremendous deregulation and restructuring efforts to restore bank stability and competition in the region, which ended in 2001 (Williams & Nguyen, 2005). Therefore, it conducted a sub-sample analysis to check whether the original results hold after the implementation of the restructuring efforts in the banking sector in the region. The fixed effect estimates in Table 12 show that the original results

hold after the adoption of the deregulation and restructuring efforts in the ASEAN banks.

Please insert Table 12 here

Please insert Table 13 here

Six, following Huang, Zhu, & Zhang (2020) it investigated the heterogeneity effect of bank regulation and supervision at the lower end (for example, 5% and 25% percentiles), median (at 50% percentile), and upper end (for example, 75% and 95% percentiles) of the competition distribution to understand whether the role of regulation and supervision on competition is uniform across the quantiles of the distribution. Table 11 presents the results of the quantile regression at different percentile of the competition distribution. The results show that the impact of capital regulation (models 1-5), activity restrictions (models 5-10), deposit insurance (11-15), and official supervision (models 16-20) are uniform across the distribution albeit with different magnitude. This implies that our original results hold, that capital regulation, deposit insurance, and official supervision promote competition and activity restrictions weaken competition in the region.

5. Conclusion

Academic and policymakers are concerned about the regulatory and supervisory effect on competition and bank stability, as earlier studies identified regulatory oversight as the root cause of financial crises for example, the 1997-1998 AFC and 2008-2009 GFC (Laeven, 2005; Anginer, et al., 2019). Despite a few studies for example, Claessens, et al. (2001); Barth, et al. (2004); Demircug-Kunt, Laeven, and Levine (2004); and Li (2019) investigated regulatory effect on competition, investigation of a set of regulations that work well to improve or impede competition a unique banking market setting is not yet captured in the empirical literature. This motivated to investigate the role of bank regulation and supervision on competition in ASEAN-5 countries over the 1990 to 2022 period. During this period the ASEAN-5 banks have gone through early 1990s financial liberalization, suffered from 1997-1998 AFC and 2008-2009 GFC, then, adopted post crises deregulation and bank restructuring, and regulatory harmonization focusing implementation of ABIF. In the investigation process, this study captured regulation and supervision with capital stringency index, activity restrictions index, deposit insurance, and supervisory power index using the regulation and supervision survey of Barth et al. (2001, 2006, 2008, and 2013), and Anginer et al. (2019). As competition measures, this study considered both nonstructured approaches— H-statistic and Lerner index, and

structured approaches —HHI and CR3. Controlling a number of bank characteristics — solvency, loan quality, capitalization, operational efficiency, bank size, loan composition, bank ownership, and profitability, macro-level control variables — GDP growth rate and inflation rate, the system GMM results observed that stringent capital regulation, more official supervisory power and explicit deposit insurance promote competition, and more activity restrictions reduce competition in ASEAN banking market. This study further observed that the effects of capital regulations, deposit insurance and stringent supervision are more prominent in promoting bank competition during the crisis period in comparison to the non-crisis period. More interestingly, this paper observed that more activity restrictions increase competition for the large banks due to the erosion of their market power and scope of operations for revenue diversification. The results remain consistent across different specifications, data subsets, channel analysis, and data distribution. This study raises several policy implications for the bank regulators and policymakers to promote competition and benefit ASEAN economies. First, regulators may impose regulations to prevent anti-competitive practices, for example, collusive and monopolistic behaviour in the banking market. They should carefully investigate and approve mergers and acquisitions applications to prevent consolidation and concentration in the banking market. Second, a particular level of capital stringency requirements and official supervisory power should be enforced to enhance effective risk management in the banking system. In addition, regulators should require banks to disclose their capital adequacy and risk management practices to help banks to create a level playing field. Further, regulators may enforce tiered capital requirements commensurate with the risk profile and size of the banks so that small banks can compete with large banks. Third, deposit insurance could be more explicit to boost the confidence of the depositors and increase intermediation in the banking system. However, the deposit insurance premium should be risk-adjusted to neutralize the risk-taking motivation of the banks in the presence of the deposit insurance. Fourth, activity restrictions for the banks could be lowered to promote bank competition and enhance efficiency in capital allocation in the economy. Banks could be encouraged to adopt financial technologies to lower the entry barrier and offer innovative services to the users.

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List of Tables:

Table 1 Variable definition and Data Sources

Variables	Definitions	Data Sources	Expected Sign
Dependent Variables			
H-statistic	Based on Panzar and Rosse (1987), this statistic sums the elasticities of revenue with respect to three input prices for each country.	Bankscope and Orbis of BVD	+
Lerner Index	Measures the gap between asset price and marginal cost, normalized by asset price	Bankscope and Orbis of BVD	—
Herfindahl Hirschman Index (HHI)	Captures industry monopoly power as the sum of squared market shares of all banks in the industry.	Bankscope and Orbis of BVD	—
Concentration ratio of the top three banks (CR3)	Measures the share of total assets held by the three largest banks.	Bankscope and Orbis of BVD	—
Bank Control Variables			
ROA	Ratio of net income to total assets	Bankscope and Orbis of BVD	+
Loan Quality	Loan loss reserve to gross loan ratio, indicating poor loan quality.	Bankscope and Orbis of BVD	-
Loan Composition	Net loans to total assets ratio, showing the extent of loan intermediation	Bankscope and Orbis of BVD	-
Capitalization	Equity to total assets ratio.	Bankscope and Orbis of BVD	+
Operation efficiency	Cost-to-income ratio, indicating managerial efficiency.	Bankscope and Orbis of BVD	+
Z-score	A measure of financial stability calculated following Laeven and Levine (2009); the natural log of Z-score is used for normalization.	Bankscope and Orbis of BVD	+
Credit Risk	Non-performing loans to gross loans ratio; higher values reflect greater credit risk (Berger et al., 2009).	Bankscope and Orbis of BVD	—

Foreign Bank Dummy	Equals one if the bank is a foreign subsidiary, zero otherwise.	Bank Annual report	–
Country Control Variables			
GDP Growth rate	Annual GDP growth at market prices in constant local currency	World Bank Database	+
Inflation	Annual inflation rate	World Bank Database	–
Regulation and Supervision Variables			
Capital Regulation Index	Captures overall and initial capital stringency based on eight survey items; ranges from 0 to 8, with higher values indicating stricter regulation.	World bank survey on bank regulations and supervision	+
Deposit Insurance	Size of the deposit insurance fund relative to total bank assets.	Do	+
Official Supervision Index	Ranges from 0 to 14; higher values reflect stronger supervisory authority.	Do	+/-
Activity Restriction Index	Measures restrictions on bank involvement in securities, insurance, and real estate; ranges from 0 to 12, with higher scores indicating more restrictions.	Do	-/+

Table 2: Summary statistics for ASEAN-5

Variable	Observations	Mean	Median	Standard deviation	Minimum	Maximum
H-statistic	3,516	.6098	.6435	.2949	-.4748	1.6626
Lerner Index	3,519	.1528	.2313	.2971	-.7759	.6485
HHI	3,548	.1252	.1138	.0580	.0628	.4540
CR3	3,548	.5016	.4685	.1372	.3674	.9772
Capital Stringency index	3,548	5.6564	6	1.4873	3	8
Activity Restrictions index	3,548	11.0374	11	2.3167	7	15
DI	3,548	.7843	1	.4113	0	1
Supervision Stringency Index	3,548	11.9656	12	1.0445	10	13
Solvency	3,541	67.3688	32.6574	147.6221	-9.9429	3544.12
Profitability	3,543	.7338	1.124	5.4675	-100.407	119.989
Capitalization	3,548	13.6300	11.4437	12.6597	-129.214	99.64
Loan quality	3,394	5.6414	2.508	8.1048	.06	51.153
Loan ratio	3,530	46.7569	54.67	27.5916	.1876	235.3514
Operational inefficiency	3,462	61.3868	52.876	51.9354	.662	1267.328
Foreign ownership	3,338	.31965	0	.4664	0	1
Real GDP growth	3,548	5.0443	3.6952	3.6500	-13.1267	15.2404
Inflation	3,548	3.9802	4.2749	7.4552	-1.1387	58.3871

This table presents summary statistics of variables used in this paper. Our dynamic panel consists of 3,548 bank-year observations from 268 commercial banks in ASEAN-5 countries over the 1990-2022 period. I capture competition with H-statistic, Lerner index, Herfindahl-Hirschman Index (HHI), and large three banks concentration ratio (CR3). I capture bank regulation and supervision- capital regulation, activity restrictions, official supervision and deposit insurance with capital stringency index, activity restriction index, supervision stringency index, and deposit insurance dummy variable, respectively. Among the bank-level control variables, solvency is the natural logarithm transformation of Z-score, profitability is the ratio of net income to total assets, capitalization is the ratio of equity to total assets, loan quality is the ratio of loan loss reserve to gross loans, loan ratio is net loan to total assets, operational inefficiency is the ratio of cost to income, and foreign ownership is a dummy variable. In addition, macro-economic control variables are real GDP growth is a percentage of annual real growth in gross domestic product, and inflation rate is annual growth on consumer price index considering 2005 as base year.

Table 3 Country-wise summary statistics

Variable	Indonesia	Malaysia	Philippines	Singapore	Thailand
H-statistic	.6221(.2059)	.6015(.2580)	.5490(.3267)	.3239(.3525)	.7796(.3782)
Lerner Index	.1323(.2665)	.1835(.1975)	.1251(.3898)	.2120(.3358)	.1109(.2515)
HHI	.0951(.0254)	.1284(.0399)	.1257(.0127)	.3025(.0123)	.1261(.0279)
CR3	.4372(.0629)	.4789(.0656)	.5317(.0313)	.9393(.0186)	.4785(.0745)
Capital Stringency index	6.2254(1.530)	5.0496(1.4965)	4.9935(1.3393)	5.7591(.5536)	5.4168(1.0766)
Activity	9.5439(2.0991)	13.016(.9386)	12.2283(2.0102)	10.0612(.2402)	12.2144(1.6658)
Restrictions index					
DI	1(0)	.6592(.4743)	.7363(.4409)	.6204(.4862)	.4088(.4921)
Supervision	12.5363(.4988)	12.2464(.9320)	11.6286(.4835)	12.0326(1.3606)	10.2204(.6269)
Stringency Index					
Solvency	54.9657(132.619)	71.3061(117.790)	86.8778(207.230)	103.46(130.5101)	59.3109(139.582)
Profitability	.6705(6.1360)	.7197(4.2131)	.4788(6.6542)	.7576(4.8771)	1.0530(7.6798)
Capitalization	13.0753(8.6070)	11.1113(7.0394)	14.5783(7.7648)	17.2246(13.9672)	10.9672(8.4253)
Loan quality	6.0049(9.659)	3.9280 (4.4039)	6.6603(8.1955)	2.7297(3.1881)	6.5557(7.2553)
Loan ratio	47.8407(25.9333)	43.7379(26.3346)	40.8946(21.4155)	45.6398(27.4210)	59.0895(27.1911)
Operational inefficiency	59.1503(33.0594)	41.2505(19.4970)	69.9212(31.7023)	51.0449(24.8359)	66.5443(45.0432)
Foreign ownership	.2595(.4385)	.6335(.4823)	.2174(.4129)	.6650(.4731)	.2222(.4162)
Real GDP growth	4.3749(4.0566)	5.2744(3.5387)	4.7428(1.8250)	5.2880(3.7367)	3.4705(3.8938)
Inflation	9.8238(11.3498)	2.4511(1.3416)	4.6228(2.3626)	1.8744(1.7765)	2.9692(1.9849)
Observation	1,557	625	622	245	499

This table presents country-wise mean value of the variables used in this study. The respective standard deviations are reported in the parentheses. Our dynamic panel consists of 3,548 bank-year observations from 268 commercial banks from ASEAN-5 countries including Indonesia, Malaysia, the Philippines, Singapore and Thailand over the 1990-2022 period.

Table 4 Correlation Metrix

List of variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)
(1) H-statistic	1.000																
(2) Lerner Index	-0.252 ^a	1.000															
(3) HHI	-0.3234 ^a	0.0544 ^a	1.000														
(4) CR3	-0.333 ^a	0.089 ^a	0.978 ^a	1.000													
(5) Capital Stringency index	0.378 ^a	-0.565 ^a	-0.185 ^a	-0.161 ^a	1.000												
(6) Activity Restrictions index	-0.200 ^a	0.136 ^a	0.223 ^a	0.167 ^a	-0.581 ^a	1.000											
(7) DI	0.123 ^a	-0.334 ^a	-0.260 ^a	-0.164 ^a	0.572 ^a	-0.467 ^a	1.000										
(8) Supervision Stringency Index	0.064 ^a	-0.399 ^a	-0.141 ^a	-0.083 ^a	0.580 ^a	-0.508 ^a	0.705 ^a	1.000									
(9) Solvency	0.052 ^a	-0.107 ^a	-0.108 ^a	-0.097 ^a	0.205 ^a	-0.022 ^a	0.140 ^a	0.1503 ^a	1.000								
(10) Profitability	0.030	0.039 ^b	-0.008	-0.008	0.040 ^b	-0.021	0.023	-0.001	0.027	1.000							
(11) Capitalization	-0.022	0.026	0.071 ^a	0.083 ^a	0.075 ^a	-0.097 ^a	0.014	0.063 ^a	0.151 ^a	-0.010	1.000						
(12) Loan quality	-0.216 ^a	-0.244 ^a	0.007	0.063 ^a	-0.248 ^a	0.087 ^a	-0.016	-0.162 ^a	-0.316 ^a	-0.002	0.035 ^c	1.000					
(13) Loan ratio	-0.179 ^a	-0.155 ^a	0.088 ^a	0.055 ^a	-0.207 ^a	0.026	-0.298 ^a	-0.235 ^a	0.011	-0.018	-0.145 ^a	-0.100 ^a	1.000				
(14) Operational inefficiency	-0.044 ^b	-0.131 ^a	-0.070 ^a	-0.035 ^c	0.010	-0.0109	-0.034 ^c	-0.084 ^a	-0.328 ^a	-0.006	-0.032 ^c	0.174 ^a	-0.038 ^b	1.000			
(15) Foreign ownership	-0.077 ^a	0.140 ^a	0.216 ^a	0.186 ^a	-0.043 ^b	0.120 ^a	-0.032 ^c	0.077 ^a	0.012	-0.000	0.181 ^a	0.052 ^a	-0.091 ^a	-0.100 ^a	1.000		
(16) Real GDP growth	0.282 ^a	0.324 ^a	0.005	-0.023	0.178 ^a	-0.041 ^b	0.013 ^a	0.135 ^a	0.171	0.008 ^a	0.084 ^a	-0.314	0.019	-0.037 ^c	0.021	1.000	
(17) Inflation	-0.195 ^a	-0.408 ^a	-0.097 ^a	-0.033 ^c	-0.166 ^a	-0.202 ^a	0.168 ^a	0.082 ^a	-0.135 ^a	-0.022	-0.082 ^a	0.363 ^a	0.058 ^a	-0.015	-0.068 ^a	-0.647 ^a	1.000

This table presents Pearson's pair-wise correlation between the variables listed in Table 1.

^a $p < 0.10$, ^b $p < 0.05$, ^c $p < 0.01$

Table 5 Regulation and supervision on competition

Dependent variable	Ex. Sign	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic
Models		(1)	(2)	(3)	(4)	(5)
Lag H-statistic		0.5443*** (0.0349)	0.5548*** (0.0341)	0.5697*** (0.0367)	0.5754*** (0.0371)	0.5225*** (0.0339)
Capital Stringency index	+	0.0350*** (0.0079)				0.0513*** (0.0102)
Activity Restrictions index	+/-		-0.0174*** (0.0059)			-0.0179*** (0.0061)
DI	+			0.0372* (0.0350)		0.1343*** (0.0459)
Supervision Stringency Index	+/-				0.0229* (0.0136)	0.0000 (0.0169)
Solvency		0.0420*** (0.0074)	0.0331*** (0.0070)	0.0366*** (0.0077)	0.0356*** (0.0077)	0.0389*** (0.0067)
Profitability		0.0052 (0.0066)	0.0012 (0.0060)	-0.0003 (0.0063)	0.0011 (0.0062)	0.0089 (0.0074)
Capitalization		0.0108*** (0.0035)	0.0065* (0.0037)	0.0070** (0.0034)	0.0070** (0.0034)	0.0102*** (0.0034)
Loan quality		-0.0397*** (0.0000)	-0.0403** (0.0000)	-0.0443*** (0.0000)	-0.0419** (0.0000)	-0.0335** (0.0000)
Loan ratio		-0.0036 (0.0034)	-0.0083*** (0.0028)	-0.0084** (0.0035)	-0.0076** (0.0033)	-0.0044 (0.0033)
Operational efficiency		0.0035*** (0.0010)	0.0039*** (0.0011)	0.0039*** (0.0011)	0.0039*** (0.0011)	0.0036*** (0.0010)
Foreign ownership		-0.1960*** (0.0603)	-0.2093*** (0.0680)	-0.2311*** (0.0656)	-0.2514*** (0.0680)	-0.1663** (0.0669)
Real GDP growth rate		0.0014 (0.0021)	-0.0008 (0.0020)	0.0002 (0.0021)	-0.0001 (0.0021)	0.0014 (0.0021)
Inflation rate		-0.0074*** (0.0024)	-0.0111*** (0.0026)	-0.0093*** (0.0026)	-0.0098*** (0.0027)	-0.0076*** (0.0023)
Constant		-0.0127 (0.1130)	0.3942*** (0.1076)	0.1526 (0.1089)	-0.0884 (0.1958)	0.1987 (0.2299)
Observation		2626	2626	2626	2626	2626
Year dummy		Included	Included	Included	Included	Included
Wald test Chi2 test		4464.45(0.00)	4259.00 (0.00)	3988.56(0.00)	3443.27(0.00)	4616.62(0.00)
Hansen-J test(P-value)		171.77(0.1987)	170.52(0.2177)	171.05(0.2095)	171.85(0.1975)	167.77(0.2118)
AR(1) (P-value)		-7.7034(0.00)	-7.5940(0.00)	-7.6312(0.00)	-7.6271(0.00)	-7.5747(0.00)
AR(2) (P-value)		0.22(0.8243)	-0.08(0.9353)	-0.09(0.9280)	-0.04(0.9643)	0.37(0.7055)

This table shows the two-step system GMM estimates of the impact of bank regulation on competition, which is captured with H-statistic. The GMM results of the impact of capital stringency index, activity restriction index, deposit insurance dummy, and supervision stringency index on H-statistic are presented in models 1, 2, 3 and 4 respectively. This study regresses all regulation variables on H-statistics in model 5. It controls bank-level control variables—solvency, profitability, capitalization, loan quality, loan ratio, operational inefficiency, and foreign ownership, and macro-economic control variables — real GDP growth and inflation rate in all models. Standard errors are reported in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 6 Regulation and supervision on competition with alternative proxies for competition

Dependent variables	Lerner	HHI	CR3	Lerner	HHI	CR3	Lerner	HHI	CR3	Lerner	HHI	CR3
Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Lag DV	0.6038*** (0.0231)	0.8290*** (0.0697)	0.9680*** (0.0472)	0.5484*** (0.0954)	0.7437*** (0.1025)	0.9273*** (0.0312)	0.6079*** (0.0504)	0.8420*** (0.0582)	0.8463*** (0.0598)	0.5315*** (0.0786)	0.8761*** (0.0552)	0.8706*** (0.0649)
Capital Stringency index	-0.0414*** (0.0049)	-0.0006 (0.0008)	-0.0002 (0.0026)									
Activity Restrictions index				0.0554*** (0.0168)	0.0013 (0.0013)	0.0049*** (0.0011)						
DI							-0.2103*** (0.0424)	-0.0121*** (0.0043)	-0.0316*** (0.0111)			
Supervision Stringency Index										-0.1036*** (0.0191)	-0.0034** (0.0015)	-0.0110*** (0.0039)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.0177 (0.0457)	0.0026 (0.0129)	-0.0983** (0.0424)	0.8329*** (0.2566)	0.0054 (0.0191)	-0.0926*** (0.0293)	0.2634** (0.1228)	0.0450*** (0.0140)	0.0594 (0.0396)	-1.1655*** (0.2278)	0.0683*** (0.0250)	0.1485** (0.0727)
Observations	2625	2642	2642	2625	2642	2642	2625	2642	2642	2625	2642	2642
Wald Chi 2 (P value)	4433.4337 (0.000)	5826.7077 (0.000)	80595.9741 (0.000)	560.6238 (0.000)	4044.9911 (0.000)	92007.2624 (0.000)	803.5751 (0.000)	15686.6058 (0.000)	74132.9308 (0.000)	1518.0497 (0.000)	20211.3391 (0.000)	85918.6871 (0.000)
Hansen Test (P value)	184.3271 (0.5621)	113.6800 (0.2312)	98.7933 (0.3942)	65.5813 (0.2951)	94.8302 (0.2951)	119.9300 (0.3751)	116.8867 (0.4132)	124.1989 (0.2861)	108.0424 (0.2974)	116.9451 (0.3652)	122.8091 (0.3691)	108.3144 (0.5739)
AR 1 (P value)	-6.3770 (0.0000)	-4.8211 (0.0000)	-3.6274 (0.0000)	-3.2200 (0.0000)	-4.1078 (0.0000)	-6.5739 (0.0000)	-3.1009 (0.0000)	-5.6459 (0.0000)	-6.1114 (0.0000)	-4.4159 (0.0000)	-5.5991 (0.0000)	-5.7803 (0.0000)
AR 2 (P value)	-1.3054 (0.1918)	1.2562 (0.2090)	-0.2425 (0.8084)	-1.3882 (0.1651)	0.3618 (0.7175)	1.6606 (0.1968)	-0.1548 (0.8770)	0.5845 (0.5589)	-0.8265 (0.4085)	-0.1816 (0.8559)	0.8992 (0.3686)	-1.3145 (0.1887)

This table shows the two-step system GMM estimates of the impact of bank regulation on competition, which is captured with Lerner index, HHI and CR3. The GMM results of the impact of capital stringency index, activity restriction index, deposit insurance dummy, and supervision stringency index on Lerner index, HHI and CR3 are presented in models 1-3, 4-6, 7-9 and 10-12 respectively. This study controls bank-level control variables—solvency, profitability, capitalization, loan quality, loan ratio, operational inefficiency, and foreign ownership, and macro-economic control variables — real GDP growth and inflation rate in all models. All models control bank-level control variables—solvency, profitability, capitalization, loan quality, loan ratio, operational inefficiency, and foreign ownership, and macro-economic control variables — real GDP growth and inflation rate in all models. Standard errors are reported in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 7 Regulation and supervision on Competition during crisis and normal period

	Crisis period 1997-1998 AFC, 2008-2009 GFC, 2020-2021 Covid-19 pandemic				Normal period excluding 1997,1998, 2008, 2009, 2020 & 2021.				
Dependent variables	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic
Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Lag H-statistic	0.5464*** (0.0404)	0.5614*** (0.0380)	0.5608*** (0.0383)	0.5644*** (0.0391)	0.4814*** (0.0424)	0.4760*** (0.0393)	0.4884*** (0.0416)	0.4901*** (0.0406)	0.4321*** (0.0389)
Capital stringency Index	0.0260*** (0.0069)				0.0131** (0.0065)				0.0442*** (0.0137)
Capital stringency Index* Crisis dummy	0.0333*** (0.0123)								
Activity Restrictions Index		-0.0156** (0.0071)				-0.0228*** (0.0068)			-0.0320*** (0.0074)
Activity Restriction Index * Crisis Dummy		0.0053 (0.0118)							
Deposit Insurance			0.0181 (0.0351)				0.0572 (0.0396)		0.2130* (0.0606)
Deposit Insurance* Crisis Dummy			0.2459*** (0.0587)						
Stringent Supervisory Power Index				0.0078 (0.0146)					
Stringent Supervisory Power Index * Crisis Dummy				0.1194*** (0.0264)				0.0010 (0.0153)	0.0217 (0.0224)
Crisis dummy	-0.1648** (0.0799)	-0.0141 (0.1238)	-0.1535*** (0.0502)	-1.3992*** (0.3165)					
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2619	2619	2619	2619	1854	1854	1854	1854	1854
Year Dummy	Included	Included	Included	Included	Included	Included	Included	Included	Included
Wald Chi2 (P-value)	5033.5057 (.000)	4872.5683 (.000)	4694.4939 (.000)	4743.8491 (.000)	3608.7298 (.000)	3815.3934 (.000)	3341.9600 (.000)	3409.8982 (.000)	3556.9899 (.000)

Hansen	183.686(.45)	176.88(.59)	178.13(.56)	176.48(.61)	141.70(.14)	144.24(.12)	141.36(.14)	142.13(.13)	141.823(.181)
AR 1 (P-value)	-7.516(.00)	-7.542(.00)	-7.6271(.00)	-7.5995(.00)	-6.621(.00)	-6.647(.00)	-6.566(.00)	-6.652(.00)	-6.444(.00)
AR 2 (P-value)	0.468(.639)	-0.130(.89)	0.376(.706)	-0.185(.853)	-0.729(.46)	-0.785(.43)	-0.511(.61)	-0.682(.49)	-0.191(.85)

Table 7 shows the GMM estimates of the role of bank regulation and supervision on H-statistic during crisis and non-crisis periods. To estimate the regulatory impact on competition during the crisis period, this study revised the baseline equation 1 incorporating a crisis dummy and an interaction term of bank regulation and crisis dummy. The crisis dummy takes a value of 1 if the year is a crisis year, for example, 1997, 1998, 2008, 2009, 2020, and 2021, otherwise, 0. On the other hand, to estimate the regulatory impact on competition during the normal period, it eliminated the above crisis year from the sample years and ran equation 1 considering the remaining years.

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 8 Regulation and supervision on competition allowing one year lag of regulation and supervision

Dependent variable	H-statistic (1)	H-statistic (2)	H-statistic (3)	H-statistic (4)	H-statistic (5)
Lag H-statistic	0.3038*** (0.0886)	0.4139*** (0.0684)	0.5443*** (0.0508)	0.2191** (0.0903)	0.3271*** (0.0532)
Capital Stringency index ₋₁	0.0297** (0.0135)				0.0480*** (0.0146)
Activity Restrictions index ₋₁		-0.0329** (0.0167)			-0.0075 (0.0100)
DL ₋₁			0.0064** (0.0428)		0.0485* (0.0799)
Supervision Stringency Index ₋₁				0.0306*** (0.0358)	0.0163* (0.0446)
Control	Yes	Yes	Yes	Yes	Yes
Constant	0.6758** (0.2814)	1.5037*** (0.2525)	0.4877*** (0.1441)	0.4648 (0.4472)	0.8338* (0.4336)
Observations	2619	2619	2619	2619	2619
Wald chi2	643.3127	529.4190	1317.9115	372.2824	1292.2563
Hansen (P value)	82.0748 (0.3590)	98.2598 (0.2481)	141.2476 (0.2548)	85.8312 (0.3862)	138.1318 (0.2365)
AR 1 (P-value)	-5.1420 (0.0000)	-5.9992 (0.0000)	-6.2830 (0.0000)	-4.8251 (0.0000)	-6.0150 (0.0000)
AR 2 (P-value)	-1.2861 (0.1984)	0.2834 (0.7769)	0.4605 (0.6452)	-1.9774 (0.0480)	-0.6974 (0.4856)

Table 8 shows the GMM estimates of the role of bank regulation and supervision on H-statistic using one year lag of the regulation and supervision variables. A complete list of the variables provided in Table 1.

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 9: Regulation and supervision on bank competition controlling bank size

Dependent variable	Ex. Sign	H-statistic	H-statistic	H-statistic	H-statistic
Models					
Lag H-statistic		0.5206*** (0.0337)	0.5217*** (0.0293)	0.5437*** (0.0282)	0.5540*** (0.0285)
Capital Stringency index	+	0.0325*** (0.0066)			
Activity Restrictions index	+/-		-0.0183*** (0.0057)		
DI	+			0.0788*** (0.0200)	
Supervision Stringency Index	+/-				0.0338*** (0.0106)

Bank size control	0.0362*** (0.0134)	0.0474*** (0.0131)	0.0497*** (0.0126)	0.0523*** (0.0146)
Other control	Yes	Yes	Yes	Yes
Constant	-0.1287 (0.1443)	0.2759 (0.1762)	0.0178 (0.1429)	-0.3829** (0.1806)
Observations	2626	2626	2626	2626
Year dummy	Yes	Yes	Yes	Yes
Wald test Chi2	1061.9830	1649.9217	1753.4054	1459.5542
Hansen-J test(P-value)	160.3018 (.1820)	171.1496 (.4608)	170.1878 (.4815)	169.7708 (.4905)
AR(1) (P-value)	-6.9157(.00)	-6.9893(.00)	-7.0804(.00)	-7.0511(.00)
AR(2) (P-value)	-0.3790(.7047)	-0.5319(.5948)	-0.6132(.5397)	-0.5064(.6126)

Table 9 shows the GMM estimates of the role of bank regulation and supervision on H-statistic using bank size as an additional control variable. A complete list of the variables is provided in Table 1.

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 10. Sub-sample analysis based on the bank size

	Large Bank				Small Banks			
Dependent variables	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic
Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital stringency Index	0.0754*** (0.0211)				0.0416*** (0.0105)			
Activity Restrictions Index		0.0152*** (0.0035)				-0.0123*** (0.0027)		
Deposit Insurance			0.0705*** (0.0196)				0.0347** (0.0174)	
Stringent Supervisory Power Index				0.1179*** (0.0105)				0.1007*** (0.0121)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Bank	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.2390 (0.1506)	0.8633*** (0.0712)	0.7389*** (0.0474)	-0.4287*** (0.1502)	0.2867*** (0.0563)	0.6547*** (0.0485)	0.4737*** (0.0346)	- 0.6844*** (0.1597)
Observations	1570	1578	1578	1570	1444	1444	1444	1437
F-statistics	3.6714***	11.9794* **	11.3618** *	34.3272** *	11.3605* **	11.9008* **	20.1293* **	29.6289* **
R-squared	0.4792	0.3285	0.0676	0.3974	0.5744	0.5759	0.1232	0.4055

This table provides the subsample analysis results using the fixed effect models controlling bank and macro level control variables and year and bank fixed effect. Standard errors in parentheses.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 11 Sub-sample analysis based on the bank ownership

	Foreign Bank				Local Banks			
Dependent variables	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic
Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital stringency Index	.0492*** (.0068)				.0424*** .0047			
Activity Restrictions Index		-.0287*** (.0069)				-.0362*** (.0032)		
Deposit Insurance			.1144*** (.0178)				.1112*** (.0244)	

Stringent Supervisory Power Index					.0835*** (.0121)					.1549*** (.0098)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Bank	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	.3871*** (.0563)	.9908*** (.0879)	.6717*** (.0347)	-.3340*** (.1510)	.5105*** (.0429)	1.201*** (.0457)	.5720 (.0463)	-1.0770 (.1228)		
Observations	935	935	935	935	2,084	2,084	2,084	2,084		
F-statistics	17.50***	13.17***	37.44***	16.97***	42.38***	47.65***	13.63***	63.59***		
R-squared	0.3589	0.3336	0.3199	0.3559	0.3330	0.3463	0.3364	0.3836		

This table provides the subsample analysis results using the fixed effect models controlling bank and macro level control variables and year and bank fixed effect. Standard errors in parentheses.

* p < 0.10, ** p < 0.05, *** p < 0.01

Table 12 Sub-sample analysis before and after the implementation of bank restructuring efforts

Dependent variables	Before restructuring efforts from 1990-2001				Before restructuring efforts from 2002 to 2022			
	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic	H-statistic
Models	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Capital stringency Index	-0.2376*** (0.0662)				0.0532*** (0.0060)			
Activity Restrictions Index		-0.1831*** (0.0252)				-0.0294*** (0.0031)		
Deposit Insurance			-0.2164*** (0.0733)				0.1566*** (0.0203)	
Stringent Supervisory Power Index				-0.1133** (0.0530)				0.2156*** (0.0088)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
FE Bank	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	1.8469*** (0.2631)	3.0875*** (0.3085)	1.0667*** (0.1213)	2.2886*** (0.6120)	0.3816*** (0.0598)	1.1345*** (0.0577)	0.5879*** (0.0477)	-1.8210*** (0.1116)
Observations	789	789	789	789	2191	2191	2191	2191
F-statistics	25.8326***	31.3152***	25.2658***	24.6992***	39.1154***	40.3620***	36.8935***	99.4064***
R-squared	0.4113	0.4445	0.4077	0.4039	0.4268	0.4298	0.4214	0.5423

This table provides the subsample analysis results using the fixed effect models controlling bank and macro level control variables and year and bank fixed effect. Standard errors in parentheses.

* p < 0.10, ** p < 0.05, *** p < 0.01

Table 13: Quantile regression estimates of bank regulation and supervision on competition

Model	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)	(17)	(18)	(19)	(20)
Quantiles	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%	5%	25%	50%	75%	95%
DV	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.	H-stat.
Capital Stringency index	0.0944*** (20.69)	0.0802*** (21.84)	.0692*** (13.63)	0.0308*** (7.00)	.0266*** (-6.83)															
Activity Restrictions index																				
DI																				
Supervision Stringency Index																				
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.265*** (-5.63)	0.175*** (3.90)	0.345*** (10.43)	0.666*** (14.40)	1.424*** (23.21)	0.708*** (8.25)	1.215*** (19.84)	1.036*** (30.10)	0.949*** (22.96)	0.967*** (12.35)	0.152 (1.23)	0.284*** (3.67)	0.675*** (26.27)	0.923*** (31.39)	1.306*** (31.43)	-0.526** (-2.88)	-0.424 (-1.94)	0.797*** (8.92)	1.159*** (24.38)	2.365*** (21.72)
Observations	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626	2626
Pseudo R2	0.1569	0.2233	0.1917	0.1338	0.1725	0.1244	0.1945	0.1664	0.1202	0.1691	0.0956	0.1540	0.1417	0.1210	0.1869	0.0950	0.1382	0.1295	0.1244	0.2209

Table 13 shows panel quantile regression estimates of the regulatory and supervisory effects on bank competition at different quantiles. A complete list of the variables is proved in Table 1. Standard errors in parentheses.

* p < 0.10, ** p < 0.05, *** p < 0.01

Appendix A: Construction of Bank regulation index

Regulation	Description
Capital Requirements index	In constructing the index, the study considers the following 8 questions where 1 is assigned to the 'yes' answer to the question from 1 to 6 and 'no' answer to the questions 7 and 8, otherwise, 0. The questions are 1) is the minimum required capital ratio risk weighted in the line with Basel guidelines? 2) Does the minimum ratio change with market risk? 3) Are market values of loan losses not realized in accounting books deducted from capital? 4) Are unrealized losses in securities portfolios deducted? 5) Are unrealized foreign exchange losses deducted? 6) Are the sources of funds to be used as capital verified by the regulatory or supervisory authorities? 7) Can the initial disbursement or subsequent injections of capital be done with assets other than cash or government securities? 8) Can initial disbursement of capital be done with borrowed funds?
Activity Restrictions index	The index uses to decide whether the commercial banks are (1) unrestricted, (2) permitted, (3) restricted or (4) prohibited in the country in involving in insurance, securities, real estate financing and ownership of non-bank financial firms. In constructing the index, the value 1 is considered for unrestricted, 2 is considered for permitted, 3 is considered for restricted and 4 is considered for prohibited in insurance, securities, real estate activities and owning non-bank financial institutions.
Official supervision Index	The index is calculated by incorporating the following 14 questions of Barth et al. (2001, 2006, 2008, 2013) following the work of Barth et al., (2013b). The question takes the value of 1, if answer is found as yes, otherwise, it takes the value of zero. The questions are: 1) Does the supervisory agency have the right to meet with external auditors to discuss their report without the approval of the bank? 2) Are auditors required by law to communicate directly to the supervisory agency any presumed involvement of bank directors or senior managers in illicit activities, fraud, or insider abuse? 3) Can supervisors take legal action against external auditors for negligence? 4) Can the supervisory authority force a bank to change its internal organizational structure? 5) Are off-balance sheet items disclosed to supervisors? 6) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? 7) Can the supervisory agency suspend the directors' decision to distribute dividends? 8) Can the supervisory agency suspend the directors' decision to distribute bonus? 9) Can the supervisory agency suspend the directors' decision to distribute management fees? 10) Can the supervisory agency legally declare-such that this declaration supersedes the rights of bank shareholders-that a bank is insolvent? 11). Does the banking Law give authority to the supervisory agency to intervene that is, suspend some or all ownership rights-a problem bank? 12-14). Regarding bank restructuring and reorganization, can the supervisory agency or any other government agency do the following: (12) supersede shareholder rights? (13) Remove and replace management? (14) Remove and replace directors?

Appendix B: Lerner Index

This study also uses Lerner index of Lerner (1934) to capture competition, as it has been widely used in the literature to reflect a degree of market power to set interest rate over marginal cost, and market power inversely related to competition (Anginer, Demircug-Kunt, & Zhu, 2012; Fu, Lin, & Molyneux, 2014; Azmi et al. 2019, Berger, et al., 2019; Albiety et al. 2020; Tongurai and Vithessonthi, 2020). Lerner index takes a value from 0 to 1. A 0 value of Lerner indicates a monopoly market, a 1 value of the Lerner index indicates perfect competition and the value of the Lerner index between 0 and 1 indicates a monopolistic market. Lerner index may also take a negative value indicating the non-optimum behavior of banks in setting loan prices due to higher marginal cost and lack of efficiency (Soedarmono, et al., 2013). The Lerner index is measured in the following manner:

The Lerner index is measured in the following manner:

$$Lerner\ index = \frac{P_{TAit} - MC_{TAit}}{P_{TAit}} \quad (4)$$

Where, P_{TAit} indicates loan price, which is a ratio of total revenue to total assets. Following Anginer et al. (2014), it calculated total revenue as a sum of interest income, non-interest operating income and other operating income. MC_{TAit} indicates the marginal cost of loans. it used the following translog cost function to calculate marginal cost using the methodology of Anginer et al. (2014):

$$\begin{aligned} \ln Cost_{it} = & \alpha + \beta_1 \ln(Q_{it}) + \beta_2 (\ln Q_{it})^2 + \beta_3 \ln(W1_{it}) + \beta_4 \ln(W2_{it}) + \\ & \beta_5 \ln(W3_{it}) + \beta_6 \ln(Q_{it}) \ln(W1_{it}) + \beta_7 \ln(Q_{it}) \ln(W2_{it}) + \beta_8 \ln(Q_{it}) \ln(W3_{it}) + \\ & \beta_9 (\ln W1_{it})^2 + \beta_{10} (\ln W2_{it})^2 + \beta_{11} (\ln W3_{it})^2 + \beta_{12} \ln(W1_{it}) \ln(W2_{it}) + \\ & \beta_{13} \ln(W2_{it}) \ln(W3_{it}) + \beta_{14} \ln(W1_{it}) \ln(W3_{it}) + \theta Year\ Dummies + \varepsilon_{it} \end{aligned} \quad (5)$$

Where, cost indicates the sum of interest expenses, personnel expenses, non-interest operating expenses, other administrative expenses and operating expenses. Q_{it} is total assets indicating output quality. $W1_{it}$, $W2_{it}$ and $W3_{it}$ are three inputs as used in eq. 2. A year dummy variable is incorporated to capture technological progress due to business cycle fluctuation. it imposed five restrictions to ensure homogeneity of degree one in the input prices:

$$\beta_3 + \beta_4 + \beta_5 = 1; \beta_6 + \beta_7 + \beta_8 = 0; \beta_9 + \beta_{12} + \beta_{13} = 0; \beta_{10} + \beta_{12} + \beta_{14} = 0; \beta_{11} + \beta_{13} + \beta_{14} = 0$$

This study estimated marginal cost from the coefficients of the eq- 5 using the following equation:

$$MC_{it} = \frac{\partial \ln Cost_{it}}{\partial \ln Q_{it}} = \frac{C_{it}}{Q_{it}} [\beta_1 + 2\beta_2 \ln Q_{it} + \beta_6 \ln W1_{it} + \beta_7 \ln W2_{it} + \beta_8 \ln W3_{it}] \text{-----} \quad (6)$$

Where, MC_{it} indicates marginal cost; $\frac{\partial \ln Cost_{it}}{\partial \ln Q_{it}}$ refers changes in log of cost with respect to changes in the log of quantity.