Volume LIX No. 2

ISSN 1655-1516
December 2022

The Philippine Review of Economics

SPECIAL ISSUE ON MONETARY POLICY AND CENTRAL BANKING

Issue Editor **Faith Christian Q. Cacnio**

ARTICLES IN THIS ISSUE

A joint publication of the
University of the Philippines School of Economics
and the **Philippine Economic Society**

The Philippine Review of Economics

A joint publication of the UP School of Economics (UPSE)
and the Philippine Economic Society (PES)

Aims and Scope: The *Philippine Review of Economics* (PRE) invites theoretical and empirical articles on economics and economic development. Papers on the Philippines, Asian and other developing economies are especially welcome. Book reviews will also be considered.

The PRE is published jointly by the UP School of Economics and the Philippine Economic Society. Its contents are indexed in the *Journal of Economic Literature*, EconLit, and RePec. PRE's readership includes economists and other social scientists in academe, business, government, and development research institutions.

Publication Information: The PRE (ISSN 1655-1516) is a peer-reviewed journal published every June and December of each year. A searchable database of published articles and their abstracts is available at the PRE website (http://pre.econ.upd.edu.ph).

Subscription Information:
Subscription correspondence may be sent to the following addresses:

- css@pssc.org.ph
- PSSC Central Subscription Service,
  PSSCenter, Commonwealth Avenue, 1101, Diliman,
  Quezon City, Philippines.
  P.O. Box 205, UP Post Office, Diliman, Quezon City,
  Philippines 1101
  PHONE: 922-9627, FAX: 924-4178/926-5179

Submissions: Authors may submit their manuscripts to the addresses below:

- pre.upd@up.edu.ph
- The Editor, The Philippine Review of Economics, Rm 237, School of Economics, University of the Philippines, Diliman, Quezon City, 1101.

Manuscripts must be written in English and in MS Word format. All graphs and tables must be in Excel format. Submission of a manuscript shall be understood by the PRE as indicating that the manuscript is not under consideration for publication in other journals. All submissions must include the title of the paper, author information, an abstract of no more than 150 words, and a list of 3–4 keywords. Complete guidelines can be viewed in the PRE's website.

Acknowledgements: The PRE gratefully acknowledges the financial support towards its publication provided by the Philippine Center for Economic Development (PCED). The Review nonetheless follows an independent editorial policy. The articles published reflect solely the editorial judgement of the editors and the views of their respective authors.

The Philippine Economic Society

Founded 1961

The Philippine Economic Society (PES) was established in August 1962 as a nonstock, nonprofit professional organization of economists.

Over the years, the PES has served as one of the strongest networks of economists in the academe, government, and business sector.

Recognized in the international community of professional economic associations and a founding member of the Federation of ASEAN Economic Associations (FAEA), the PES continuously provides a venue for open and free discussions of a wide range of policy issues through its conferences and symposia.

Through its journal, the *Philippine Review of Economics* (PRE), which is jointly published with the UP School of Economics, the Society performs a major role in improving the standard of economic research in the country and in disseminating new research findings.

At present the society enjoys the membership of some 800 economists and professionals from the academe, government, and private sector.

- Lifetime Membership – Any regular member who pays the lifetime membership dues shall be granted lifetime membership and shall have the rights, privileges, and responsibilities of a regular member, except for the payment of the annual dues.
- Regular Membership – Limited to individuals 21 years of age or older who have obtained at least a bachelor's degree in economics, or who, in the opinion of the Board of Directors, have shown sufficient familiarity and understanding of the science of economics to warrant admission to the Society. Candidates who have been accepted shall become members of the Society only upon payment of annual dues for the current year.
- Junior Membership – This is reserved for full-time college or graduate students majoring in economics. Affiliation for junior membership is coursed through the Junior Philippine Economic Society (JPES).

For more information, visit: www.phileconsociety.org.

The Philippine Review of Economics

Vol. LIX No. 2
December 2022

ISSN 1655-1516
DOI: 10.37907/ERP2202D

The Philippine Review of Economics
59(2):41-80. DOI:10.37907/2ERP2202D

Does bank competition affect bank risk-taking differently?

Veronica B. Bayangos*
Bangko Sentral ng Pilipinas

This paper examines the presence of two competing views—"competition-fragility" and "competition-stability"—in analyzing the impact of competition on bank stability. The approach is to first construct measures of bank competition from a unique dataset of balance sheet and income statements for 542 banks operating in the Philippines from March 2010 to December 2020. The paper then estimates the impact of these competition measures on solvency risk or the risk of being unable to absorb losses with the available capital across universal/commercial banks (U/KBs), thrift banks (TBs) and rural/cooperative banks (R/CBs) industries.

Using panel quantile regression, the results reveal that, at the industry level, bank competition reduces solvency risk and that it enhances bank stability. Looking at the risk distribution, the study shows the presence of the competition-fragility and competition-stability hypotheses holding simultaneously for U/KBs suggesting that the effect of competition depends crucially on the underlying individual bank risk. Importantly, the results highlight that the relationship between competition and bank risk is sensitive to other bank-specific characteristics and macro-financial factors related to extent of diversification strategy, cost-to-income ratio, deposit growth, capitalization, changes in the physical banking networks, and growth of real Gross Domestic Product.

JEL classification: D4, G21, L1
Keywords: Bank competition, cost efficiency, bank solvency risk, COVID-19 pandemic

1. Introduction

Since the 2000s, important reforms have greatly reshaped the structure of the global financial system. Some banks have become big and interconnected while some have become generally risk takers. Studies suggest that financial sector reforms promote bank competition in most advanced and emerging market economies. As such, discussions on bank competition have intensified in recent past years particularly in constructing different measures of bank competition and in explaining factors driving the monetary authorities' policy mandates. However, some studies also find that bank competition in many emerging countries have

* Address all correspondence to VBayangos@bsp.gov.ph.
** Director, Bangko Sentral ng Pilipinas (BSP) Research Academy (BRAC). The views expressed in this study are those of the author and do not represent the official position of the BRAC or the BSP.

declined despite the implementation of financial sector reforms. The impact of the COVID-19 pandemic on bank operations has contributed to the decline in bank competition. These findings are particularly evident in diverse banking industries where smaller banks also offer great services.

Crucially, the array of empirical studies has highlighted the influence of bank competition on financial stability, credit growth, and the regulatory drivers of competition in banking markets [De-Ramon and Straughan 2020]. Many of these recent empirical studies use a measure of bank competition that is based on either market concentration in asset markets or market power and its impact on indicators of bank stability such as strength of bank capital, quality of loans, profitability such as net income, return on assets, or return on equity. Recent discussions on bank competition have focused on the implications of the entry of digital banks and the proliferation of big technologies which have been increasingly encroaching in the financial services industry. For instance, in the Philippines, the Bangko Sentral ng Pilipinas or BSP (the Philippine central bank) has already approved six digital bank license applications. The entry of digital banks is expected to enhance bank competition and reap its benefits in terms of lower interest rates for loan products, improved banking services, and greater innovation in banking products.

This study follows more closely the role of bank competition on banking stability. There is currently a debate in the banking literature regarding the effect of competition on the stability of banks. In the traditional "competition-fragility" view, Jimenez et al. [2013] explain that increased competition among banks could threaten the solvency of individual banks and endanger the stability of the banking system. This could erode the franchise value of a bank, that is the ongoing concern or market value of a bank beyond its book value. This in turn could encourage a bank to pursue riskier policies to maintain its profits. These riskier policies are expected to increase the probability of higher nonperforming loan ratios and lead to bank failures.

By contrast, the "competition-stability" view posits that a less intensive competition could result in higher interest rates on loans, which may in turn raise the credit risk of borrowers due to moral hazard issues. The increased default risk could potentially lead to more problem loans and greater bank instability. However, such a situation allows a bank to protect its franchise value by pursuing safer policies that contribute to the stability of individual banks and the entire banking system [Boyd and De Nicolo 2005].

Empirical studies observe that competition in the banking industry can improve allocative, productive, and dynamic efficiencies through innovation, with the ultimate benefit being stronger economic growth. These benefits compel central banks to provide a level playing field for banks by ensuring that policies are fair to both big and small banks. However, it is also the responsibility of central banks to ensure that individual banks and the banking system are stable.

This paper examines the relationship between bank competition and bank risk-taking following the global financial crisis using a single country setting. In this paper, I add to the literature on bank competition and stability by first constructing measures of market power to determine the extent of bank competition across the three banking groups in the Philippines using quarterly bank-level balance sheets and income statements of 542 Philippine banks from March 2010 to December 2020. To the best of my knowledge, this is the first time that an analysis on bank competition has used the source bank reports in the Philippines. The BSP requires banks to report their quarterly balance sheets and income statements to provide the BSP with a comprehensive view of the financial strength and soundness as well as potential financial risks and transmission channels emanating from counterparties of individual Philippine banks. The Philippine banking system is dominated by three banking groups—the universal and commercial bank (U/KB) industry is composed of 41 banks, the thrift bank (TB) industry of 55 banks and the rural and cooperative bank (R/CB) industry of 441 banks.

Four unique databases are constructed from March 2010 to December 2020 to help address the main objective of the study:

First, a quarterly database of Income Statements to determine details of profit and loss, including return on assets, return on equity of individual banks, cost-to-income ratio and extent of bank diversification.

Second, a quarterly database of bank-specific characteristics from the Financial Reporting Package such as asset size, loan portfolio, loan loss reserves, nonperforming loan (NPL) ratio, NPL coverage ratio, deposits, and investments.

Third, a quarterly database containing information on the BSP's overnight policy rate, peso-dollar rate, real Gross Domestic Product (GDP) growth, and inflation based on Consumer Price Index.

Finally, a quarterly database on changes in the physical banking networks such as the number of mergers, consolidations, acquisitions, new banks, closure of banks and number of banks with payment channels such as InstaPay and PESONet.

Then I estimate the impact of the different measures of bank competition on bank risk-taking activities focusing on the differences in responses among U/KBs, TBs and R/CBs using panel quantile regression. Following De-Ramon et al. [2020], I compile the Z-score to represent stand-alone bank risk for all the banking groups. Measures of bank competition are then regressed on the Z-scores to estimate the impact of these measures of competition on bank risk. The regression equation also underscores the importance of specific bank features such as the extent of diversification measures, asset quality, capital and liquidity ratios of individual banks, macro-financial indicators such as consumer price inflation, real GDP growth, policy interest rates as well changes in physical banking network brought about by merger, consolidation, entry of new banks, closure of banks and the rising digitalization in payment channels.

The results may be summarized as follows:

First, competition reduces bank risk taking activities at the industry level.

Second, looking at the risk distribution, the competition-fragility and competition-stability hypotheses are holding simultaneously for U/KB and R/CB industries. This finding implies that the impact of competition on bank risk depends crucially on the underlying individual bank risk.

Third, the relationship between competition and bank risk is sensitive to other bank-specific characteristics and macro-financial factors related to extent of diversification strategy, changes in the physical banking networks, funding source, capitalization, and growth of real GDP.

The rest of this paper is organized as follows. Section 2 briefly presents the empirical findings of the studies on bank competition and stability. Section 3 identifies the main factors driving the major changes in the Philippine financial system during the past decade. Section 4 discusses databases used and empirical methodology, while Section 5 highlights the main findings of the paper. Section 6 concludes.

2. Survey of empirical findings

Research on bank competition has received considerable attention in the literature in recent years. Studies focus on evaluating the influence of bank competition on bank risk and stability (e.g., Schaeck and Cihák [2014]; Dutta and Saha [2021]) and credit growth (e.g., Cetorelli and Strahan [2006]). Some studies delve on developing a better understanding of the underlying regulatory drivers of competition in banking markets (e.g., Casu and Girardone [2006]). This area includes research on how regulatory, structural and technological changes in banking markets affect competition and economic outcomes [De-Ramon and Straughan 2020]. This study follows more closely the strand of research on bank competition and its impact on bank risk and stability.

There is currently a debate in the banking literature regarding the effect of competition on the stability of banks. As mentioned earlier, Jimenez et al. [2013] explain that the traditional "competition-fragility" view sees increased competition among banks as threat to the solvency of individual banks and a hindrance to the stability of the banking system at a broader level. Such a competition could erode the franchise value of a bank—the ongoing concern or market value of a bank beyond its book value. This in turn encourages a bank to pursue riskier policies to maintain its profits. Examples of riskier policies are taking on more credit risk and lower quality in the loan portfolio, reducing capital levels, or both. These riskier policies are expected to increase the probability of higher nonperforming loan ratios and possibly more bank failures that could eventually lead to greater fragility and financial instability. Therefore, less concentrated banking systems are more prone to experience crises [Berger et al. 2009].

Boyd and De Nicolo [2005] initiate a contrary "competition-stability" view. Basically, the competition-stability hypothesis argues that more competitive banking systems result in financial stability. This view is mainly built on the "risk shifting paradigm" which states that increase in market power and the resulting higher loan rates have the potential to negatively affect the stability of banks due to moral hazard and adverse selection problems on the part of borrowers. This could potentially lead to more problem loans and greater bank instability. Under such a scenario, Boyd and De Nicolo [2005] argue that banks would take immediate actions to protect their franchise value by pursuing safer policies that contribute to the stability of the entire banking system.

Meanwhile, Bahadur and Sharma [2016] highlight that another evidence of the competition-stability view is related to the impact of "too-big-to-fail" policies in concentrated banking systems on risk taking incentives of banks. They explain that the presence of bigger banks constitutes a potential threat to the safety and soundness of the financial system because a failure of a large bank could potentially expose the financial system to systemic risk. Governments signal that they are willing to guarantee the survival of these banks to avoid a system-wide crisis. Such an implicit guarantee of government bailout provides an incentive for big banks to pursue excessive risk taking (Mishkin [1999]; Beck et al. [2006]). However, concerns about contagion and financial crisis resulting from the failure of these large banks make regulators even more vigilant in monitoring their performance and risk management practices so as not to let them fail in the event of solvency problems. Under such a scenario, banks maintain safe and sound policies for stability.

Martinez-Miera and Repullo [2010] show that a nonlinear relationship theoretically exists between bank competition and risk-taking in the loan market. They extend the Boyd and De Nicolo's [2005] model by allowing for imperfect correlation across individual firms' default probabilities. Their model also identifies a risk-shifting effect that accounts for fewer firm defaults when loan rates decrease in a more competitive banking environment. However, since imperfect correlation between firms is assumed, there is also a "margin" effect that reduces the interest payments from performing loans and bank revenues. These two effects work in opposite directions, so that the net effect on bank risk-taking and financial stability becomes unclear. In their model, the risk-shifting effect is shown to be dominated by the margin effect in competitive banking environments, such that increased competition amplifies risk of bank failure. In a more concentrated banking market, the model suggests that the risk-shifting effect dominates and thus bank failure risk declines with more intense competition.

The empirical studies point to mixed findings. Using a cross-country panel of banks, Beck et al. [2013] show that competition has a strong positive relationship with bank fragility for distressed banks. Schaeck and Cihák [2014] find evidence consistent with the competition-stability hypothesis, but this relationship is less (more) pronounced for European banks closer to (farther from) insolvency.

Using data on nonperforming loans for Euro area banks, Karadima and Louri [2019] observe that profit margins exert a positive impact on the change in nonperforming loans for firms in the medium and upper quantiles of their distribution, supporting the competition-stability view. Liu and Wilson [2013] reveal that Japanese banks farther from insolvency take on more risk in response to more intense competition, consistent with the competition-fragility hypothesis, while those closer to insolvency reduce risk, consistent with the competition-stability hypothesis. Jimenez et al. [2013] test the competing theories of bank competition and bank risk using data from the Spanish banking system. After controlling for macroeconomic conditions and bank characteristics, they find support for this nonlinear relationship using standard measures of market concentration in both the loan and deposit markets. When direct measures of market power are used, the empirical results are more supportive of the franchise value hypothesis, but only in the loan market. Drawn from 16 developing economies over the period 2000–2012, Kabir and Worthington [2017] find the competition–fragility hypothesis supported in both Islamic and conventional banks. They measure the lack of competition using the Lerner Index, and stability using Z-score, nonperforming loan ratio, and market-based measures, including Merton's distance to default. The findings also show the magnitude of the market power effect on stability to be greater for conventional banks than Islamic banks. Meanwhile, Bahadur and Sharma [2016] show a positive relationship between greater banking competition and financial stability in Nepal, supporting the "competition-stability" view. Competition in banking sector is found to result in decrease in credit risk and contribute to financial stability. In their study, the Herfindahl-Hirschman Index (HHI) and n-bank concentration ratios are used as measure of competition while Z-index and nonperforming loans ratio are used as proxies of financial stability. Using data from the UK and multiple measures of bank competition and risk, De-Ramon et al. [2020] document relationships similar to those reported in Liu and Wilson [2013], further supporting the idea that the link between bank competition and risk may vary depending on the underlying solvency risk of the firm.

Recently, Jaume et al. [2022] examined the relationship between bank competition and bank risk-taking not through the asset market but through the retail deposit market. Using Mexican banks and constructing Lerner Index in deposits, they show that banks that compete effectively in the deposit market through various nonprice strategies such as differences in services and advertising achieve more market power that ultimately leads to less risk-taking. In the paper, Jaume et al. [2022] pushed for such an approach called "vertical differentiation." It occurs when customers rank products from the best to the worst using an objective measurement such as quality.[1]

[1] By contrast, Jaume et al. [2022] explain that horizontal differentiation occurs when depositors choose between products based on personal preferences. In the paper, they apply the concepts of differentiation to depositors and differentiation among banks.

While empirical findings on the relationship between bank competition, bank efficiency, and bank risk-taking remain inconclusive, studies on how to measure bank competition using market concentration and market power continue to evolve. There are several approaches to measuring bank competition. These include decomposition of interest spreads, measures of bank concentration under the so-called "structure-conduct-performance" paradigm, regulatory indicators that measure the contestability of the banking sector, and direct measures of bank pricing behavior or market power based on the "new empirical industrial organization" literature.

An approach used by some studies to analyze bank competition is based on interest spread decomposition. But spreads are outcome measures of efficiency, and in addition to the competition environment, cross-country differences in spreads can reflect macroeconomic performance, the extent of taxation of financial intermediation, the quality of the contractual and judicial environment, and bank-specific factors such as scale and risk preferences. So, these effects need to be controlled for in the analysis of competition.

The "structure-conduct-performance" paradigm assumes that there is a stable, causal relationship between the structure of the banking industry, firm conduct, and performance. It suggests that fewer and larger firms are more likely to engage in anti-competitive behavior. In this framework, competition is negatively related to measures of concentration, such as the share of assets held by the top three or five largest banks.

According to this approach, banking concentration can be approximated by the concentration ratio—the share of assets held by the largest banks (typically three or five) in a given economy—or the HHI, the sum of the squared market share of each bank in the system. The HHI accounts for the market shares of all banks in the system and assigns a larger weight to the biggest banks. Instead, concentration ratios completely ignore the smaller banks in the system.

However, in many empirical studies, findings suggest that concentration measures are generally not good predictors of competition. The predictive accuracy of concentration measures on banking competition is challenged by the concept of market contestability. The behavior of banks in contestable markets is determined by threat of entry and exit. Banks are pressured to behave competitively in an industry with low entry restrictions on new banks and easy exit conditions for unprofitable institutions—even if the market is concentrated.

Majority of recent research on the subject has focused on direct measures of bank pricing behavior or market power based on the "new empirical industrial organization" (NEIO) literature. The aim of the NEIO measures is to assess the level of competition directly from the firms' conduct. These include the Panzar-Rosse-H-statistic, the Lerner Index, and the Boone Indicator. The H-statistic captures the elasticity of bank interest revenues to input prices. Another frequently used measure is based on markups in banking. The Lerner Index is defined as the

difference between output prices and marginal costs (relative to prices). Higher values of the Lerner Index signal less bank competition. Finally, the Boone Indicator is a recent addition to this group of indices. It measures the effect of efficiency on bank performance in terms of profits. It is calculated as the elasticity of profits to marginal costs. The main assumption behind the Boone Indicator is that more efficient banks achieve higher profits. The more negative the Boone Indicator is, the higher the level of competition is in the market because the effect of reallocation is stronger.

Studies use an array of measures to indicate bank competition. This study follows De-Ramon and Straughan [2020] who both use four indicators that provide different perspectives on bank competition. The intention is to help understand the nature and extent of competition in a single country setting. De-Ramon and Straughan [2020] compare the measures of market power such as the Panzar-Rosse-H-statistic, the Lerner Index, and the Boone Indicator and market concentration at the industry level (the HHI) for the UK from 1989 to 2013. These comparisons allow them to identify periods when the signals from each indicator are yielding similar or contradictory inferences.

This paper is related to research on measures of bank competition and their impact on individual bank risk-taking using a single country setting. Bank competition in this study is defined as industry-wide competition. This research intends to shed light on the relationship between bank competition and bank solvency risk from the perspective of an emerging market economy, the Philippines. The focus on a single country in examining the relationship between various measures of competition and bank risk is expected to help ensure consistency in measures of the dependent and independent variables and to avoid having to control for potentially confounding factors that can influence the link [Beck et al. 2013]. The study also attempts to understand how bank efficiency [Dutta and Saha 2021] and central bank reforms and policies affecting competition are transmitted across banks [De-Ramon et al. 2020]. Indeed, the empirical evidence on this topic remains due.

There are broad similarities with De-Ramon and Straughan [2020], Dutta and Saha [2021], and Liu and Wilson [2013]. The study looks at the universe of 542 banks as of December 2020 located in the Philippines to examine measures of bank competition and how these influence bank risk using the Financial Reporting Package from March 2010 to December 2020. The study adds another dimension by providing initial insights on the impact of bank efficiency, changes in the physical banking network, and the COVID-19 pandemic on bank solvency risk.

The study shares the estimation approach used in De-Ramon and Straughan [2020]. The disaggregated data from the Financial Reporting Package (FRP) allows the study to employ a panel quantile regression. Moreover, due to the diverse nature of bank structures, the estimation approach is applied across the three banking groups—U/KB, TB, and R/CB groups.

3. "Forces of change" in the Philippine banking system during the past decade

The BSP continues to leverage on the structural changes, including the financial sector reforms it had started even before the global financial crisis, to promote a sound, stable and globally competitive financial system anchored on prudent risk management [Bayangos and Moreno 2021]. Major components of these reforms include a set of reforms in the foreign exchange regulatory framework starting in 2007, the formal shift in the monetary operations of the BSP to an interest rate corridor (IRC) system in June 2016, and the adoption of strategic financial sector reforms.[2] Eleven waves of foreign exchange liberalization reforms have been introduced since 2007. In November 2014, Republic Act (RA) No. 10641 was approved, providing the legal basis for BSP to regulate and supervise the entry and operation of foreign banks (FBs) in the country.

Moreover, RA No. 10574 was implemented to allow infusion of foreign equity in rural banks' capital. As of end-December 2021, there were 29 foreign banks that were authorized by the BSP to operate in the Philippines. Since the implementation of RA No. 10641 dated May 1994, the BSP has approved 12 FB applications (ten branches and 2 subsidiaries).[3] There are also four FBs which entered in the Philippines in the form of representative office. Most of the FBs and subsidiaries originated from the Asia-Pacific region (Taiwan and South Korea) or 73.3 percent of the total number of FBs.

In April 2020, the BSP eased the asset cover requirement on banks with expanded/foreign currency deposit units (E/FCDU) to provide these units with greater flexibility to manage their foreign currency exposures by allowing E/FCDU to offset any deficiency in the asset cover incurred on one or more days of the week with the excess cover that they may hold on other days of the same week and the immediately succeeding week.[4]

In 2020, the BSP approved the Digital Banking License Framework under the BSP Circular No. 1105, series of 2020 to support the expansion and use of digital financial services in the country. The framework forms part of the BSP's three-year digital payments transformation roadmap which aims to achieve a shift of at least 50 percent retail payment transactions to digital and 70 percent of adult Filipinos having and using a transaction account by 2023. A digital bank is a bank offering financial products and services that are processed end-to-end through a

[2] The IRC is a system for guiding short-term market rates towards the BSP policy interest rate which is the overnight reverse repurchase (RRP) rate. The primary aim of the adoption of the IRC is to improve the transmission of monetary policy.

[3] In December 2019, the BSP approved an application to establish a rural bank with a purely digital platform and majority owned by a foreign non-bank financial institution (NBFI).

[4] The previous regulation required banks to maintain a 100 percent asset cover for their foreign currency liabilities in the E/FCDUs at all times to ensure they have sufficient foreign currency-denominated assets to service withdrawals of deposits and meet payments denominated in foreign currency. The BSP also approved the alignment of the licensing process for applications for E/FCDU authority with the risk-based licensing framework being implemented by the BSP.

digital platform and/or electronic channels with no physical branch/sub-branch or branch-lite unit offering financial products and services. The end-to-end processing of products and services distinguishes the operating model of digital banks vis-à-vis traditional banks that are in the process of digitally transforming their operations to improve efficiency and maintain competitiveness. As of December 2021, the BSP had granted six digital banking licenses to Overseas Filipino Bank, Tonik Digital Bank, UNObank, Union Digital Bank, GOtyme, and Maya Bank. The entry of digital banks is expected to enhance the competitive landscape in the Philippine financial sector by offering consumers with improved electronic banking services and customized financial solutions.[5]

The BSP also pushed for a broad set of strategic reforms in the financial system to better promote financial stability, preserve the institutional safety and soundness of individual banks, and protect the public. More capital-based measures and disclosure standards have been implemented since 2008 due in part to the implementation of the Basel III requirements. The BSP adopted the Basel III capital rules for U/KBs and their subsidiary banks on January 1, 2014. U/KBs are required to comply with the 10 percent total capital adequacy ratio (CAR),[6] the leverage ratio of 5 percent in July 2018 and the framework on the countercyclical capital buffer in December 2018. However, simpler standards are applied to TBs and R/CBs that are not subsidiaries of commercial banks. Finally, the BSP adopted the international framework for dealing with domestic systemically important banks (D-SIBs),[7] requiring staggered implementation of higher capital buffers starting in January 2017, and enhanced the framework in 2019. A D-SIB is required to maintain higher capital buffers to meet regulatory capital requirements that include a Higher Loss Absorbency (HLA) requirement.[8] The BSP classifies banks depending on the extent of their systemic importance using pre-defined indicators for market size, interconnectedness, substitutability and market reliance as a financial market infrastructure as well as complexity. Market size is based on a bank's total resources relative to the banking system.[9] As of December 2021, bank capital ratios were stable despite a pick-up in risk-weight assets and were well above the minimum thresholds set by BSP (10 percent) and the Bank for International Settlements (8 percent).

---

[5] In August 2021, the Monetary Board of the BSP approved the closure of application window for new digital banks, including converting banks, starting August 31, 2021 to allow the BSP to monitor the performance and impact of digital banks on the banking system and their contribution to the financial inclusion agenda.

[6] The BSP also adopted the 6.0 percent common equity Tier 1 (CET1), 7.5 percent Tier 1 and the capital conservation buffer (CCB) of 2.5 percent.

[7] D-SIBs are characterized as banks whose distress or disorderly failure would cause significant disruptions to the wider financial system and economy.

[8] This serves to strengthen a D-SIB's capacity to absorb losses thereby reducing its probability of distress or failure during periods of stress. D-SIBs must also meet higher supervisory expectations. In the annual submission of their internal capital adequacy assessment process (ICAAP) document, D-SIBs must have in place acceptable recovery plans to be carried out in the event of breaches in capital requirements. These requirements, in turn, will contribute to a safer and more resilient financial system.

[9] The D-SIBs framework is in line with the initiatives pursued under the Basel III reform agenda.

The BSP also introduced liquidity standards. The Liquidity Coverage Ratio (LCR) requires banks to maintain highly liquidity assets to ensure their ongoing ability to meet short-term obligations. As of end-December 2020, the banking system's LCR was way above the BSP's regulatory threshold of 100 percent [Bayangos and Moreno 2021]. Another liquidity standard is the Net Stable Funding Ratio (NSFR) that aims to promote resilience over a longer time horizon by creating incentives for banks to fund their activities with more stable sources of funding on an ongoing basis. The general objective is to support financial stability by ensuring that funding shocks do not significantly increase the probability of distress for individual banks, a potential source of systemic risk. In January 2019, stand-alone TBs, R/CBs and non-banks with quasi-banking functions (NBQBs) were required to adopt the minimum liquidity ratio (MLR). As a result, banks opted to increase their issuances of fixed-income securities, including bonds and long-term negotiable certificates of time deposits (LTNCTDs) to better manage their funding costs. The BSP also laid down the proactive financial surveillance and reporting towards a dynamic banking system such as in supervision of conglomerates, cross-border risks and vulnerabilities tools as well as enhanced reports.

Financial technology (fintech) has also developed rapidly in the Philippines in recent years. Technologies such as Artificial intelligence (AI), big data, cloud storage and blockchain have been driving the digital transformation of financial institutions. Majority of fintech players in the Philippines are in the business of payments and lending, while the rest are into e-wallets, remittance services, blockchain/cryptocurrencies, e-commerce, insurance, and even regulatory technology services, based on the Philippines Fintech Report 2020. The same report highlights that fintech companies are heavily engaged in lending and payments, electronic wallets and remittance services.

In many studies, there are claims that fintech has improved lending services to businesses as well as the self-employed. Empowered by digital technologies, financial institutions can digitalize the whole procedures of credit approval and risk control, which enables them to provide services more quickly, better target risks, and serve more people. There are also observations that fintech has fundamentally changed banking sector competition while significantly improving the services and efficiency of operations. More and more financial transactions are intertwined with customers' consumption, work, and life. With massive data on customers' behavior, platform companies can extrapolate the financial needs and financial situations of their customers. The rapid development of innovative online financial products has also accelerated diversion of bank deposits. In response to rapid changes, many big banks are investing heavily in fintech and its application. Mobile Internet, biometric identification, big data, artificial intelligence, and many other technologies can help banks expand service channels, reduce human labor, strengthen whole-process risk control, and lower compliance cost.

Fintech has also supported the Philippines' response to the COVID-19 pandemic. Following the demand for contactless financial services after the outbreak of the pandemic, fintech has enabled the shift from physical meeting to virtual communication, which has softened the negative impact of COVID-19 on businesses, as financial consumers are still able to enjoy undisrupted financial services. Banks have been more open to exploring the potentials of innovative solutions following the onset of the pandemic.[10] Some banks have embraced digital transformation as a strategic move to give them the edge over their competitors. In the case of U/KBs, many of them have already adopted programs on digitalization even prior to the pandemic. Some have carefully planned their digital transformation while other institutions simply put the idea on hold.

As shown in Table 1 below, U/KBs and subsidiary banks are ahead in the digital transformation process compared to stand-alone TBs and R/CBs. With the sudden shift in priorities following the outbreak of the pandemic, many banks plan to fast-track the adoption of newer technologies and re-assess the timeline of their digital transformation journey. For some TBs and R/CBs, operational changes brought about by the "new normal" have made them realize the importance of digital transformation and are incorporating the same in their business plans moving forward. In the short-term, banks intend to collaborate with fintech companies and participate in payment platforms such as InstaPay and PESONet.

TABLE 1. Current phase in digital transformation

Particulars	U/KBs*	Stand-alone TBs	Stand-alone R/CBs
Right on schedule	53%	20%	28%
Behind schedule	28%	30%	39%
Has not started yet but are planning their approach	19%	50%	33%

*Including subsidiary banks
Source: Based on BSP-supervised financial institutions' (BSFI) survey responses in 2020. Financial Supervision Sector-TRISD.

Since 2019, the BSP has been seeing a growing interest from fintechs that are looking to provide enhancements to the domestic payments' ecosystem, with an increasing number of applicants aspiring to obtain authority to operate as electronic money issuers and virtual asset service providers. Newcomers and established financial institutions alike have started considering the acquisition of a digital banking license following the recently established framework for digital banks. For instance, GCash, the most widely used fintech application, has partnered with a Malaysian foreign bank, CIMB. Another is Union Bank of the Philippines (UBP) which is pushing for more financial inclusion initiatives and the adoption

[10] BSP Financial Supervision Sector-TRISD Briefing Notes, September 2021.

of innovative services through its platforms in e-commerce, lending, payments, and recently in open finance. At the forefront of these innovative services is UBX, the fintech venture studio and fund spun out of the UBP. The UBX's i2i platform aims to grow its network of digitized rural banks to help achieve greater financial inclusion, especially among rural Filipinos. Launched in 2019, i2i is a Distributor Ledger Technology (DLT)-based platform that links rural banks to the country's mainstream financial network. To date, the network has 106 bank members, representing TBs and R/CBs, making up a total of 2,000 branches nationwide.[11] Moreover, UBX launched its open finance platform, Xpanse. Its main goal is to enable banks, fintechs and startups to build new financial solutions through APIs and customer-controlled data sharing across member institutions in the Philippines. Given a large number of smartphone users, the Philippines remains a key strategic area for fintechs to tap. Financial innovators can potentially thrive in the expanding market for digital finance services and secure a foothold in the Philippine financial system.

However, the ease and speed with which these companies could scale up their activities and expand into financial services may create significant concentration dynamics. This could eventually affect the adequate functioning of the financial system and may endanger market contestability and eventually increase operational vulnerabilities due to the excessive reliance of market players, including banks, on the services provided by big techs [Crisanto et al. 2021].

Another "force of change" has been the increasing digitalization in payment services. In November 2017, the BSP launched the Philippine Electronic Fund Transfer (EFT) System and Operations Network Automated Clearing House (PESONet), a batch EFT service which replaced the paper-based check system. Unlike a check, the PESONet allows the receipt of funds on the same banking day the sender initiates the payment within a certain cut-off time. In January 2022, the BSP and the Philippine Payments Management, Inc. (PPMI) launched the PESONet's Multiple Batch Settlement (MBS) facility to increase the frequency of PESONet settlements from once to twice a day. Settlements are done at 10 AM and 4 PM on weekdays.

Meanwhile, InstaPay, a real-time EFT facility that allows fund transfers at near-real time 24/7, went live in April 2018. Being a fast payment system, InstaPay addresses low value and urgent payment requirements. InstaPay caps each transaction at ₱50,000 (approximately USD 1,000). Hence, InstaPay enables the performance of person-to-person payments, domestic remittances, e-commerce transactions, bills payment and other immediate low value payments.

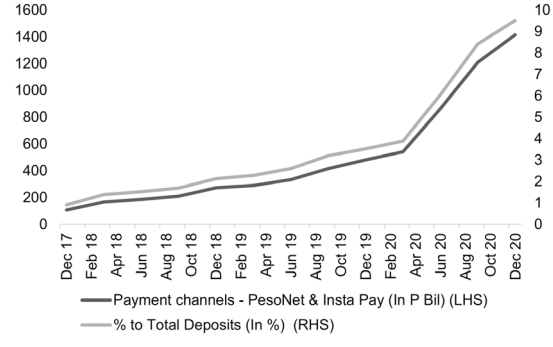
By using PESONet and InstaPay rails, the end-users can transfer funds from their own account to any transaction account of a BSP-supervised financial institution (BSFI) using any mobile device. This means that an end-user, which may be an

[11] Based on the Union Bank's Media Release, "Union Bank continues digitizing more rural banks", November 30, 2020.

individual or an institution, need only to maintain a single bank or electronic money account to be able to conveniently transact with other individuals or institutions whose accounts are maintained with other payment service providers. With such added efficiency and convenience, these interoperable digital payment solutions urge more end-users to use digital channels for making payments. This also encourages industry players to develop more innovative digital payment streams that can function through these rails, thereby promoting industry collaboration and healthy competition.

Since the launch of PESONet and Instapay, digital payments have exhibited sustained uptrend with broader adoption of digital payments following the outbreak of COVID-19 pandemic in March 2020. As of end-December 2020, the combined value of PESONet and InstaPay fund transfers reached ₱1.4 trillion. This is equivalent to 9.5 percent of the banking sector's total deposits. In terms of YoY growth, the combined value of InstaPay and PESONet grew by an annual average of 124.1 percent from December 2017 to December 2020 (Figure 1). These developments indicate the consumers' growing sentiment towards the use of digital payments due to social mobility restrictions following the outbreak of the pandemic. The number of participating institutions also rose to 82 BSFIs participating in PESONet and 54 in InstaPay as of 30 June 2021. TBs and R/CBs as well as non-bank electronic money issuers (EMIs) participate in these facilities, indicating a more diverse set of payment service providers.

FIGURE 1. Rising annualized value of combined InstaPay and PESONet transactions, December 2017 to December 2020



Source: BSP-DSA.

Banks are the more dominant players in PESONet since this digital payment rail is envisioned as the digital alternative that will eventually replace checks as a means of payment. Meanwhile, non-bank EMIs such as G-Xchange, Inc. (operator of GCash) and PayMaya exhibit stronger market position in InstaPay which facilitates smaller size immediate retail payments.

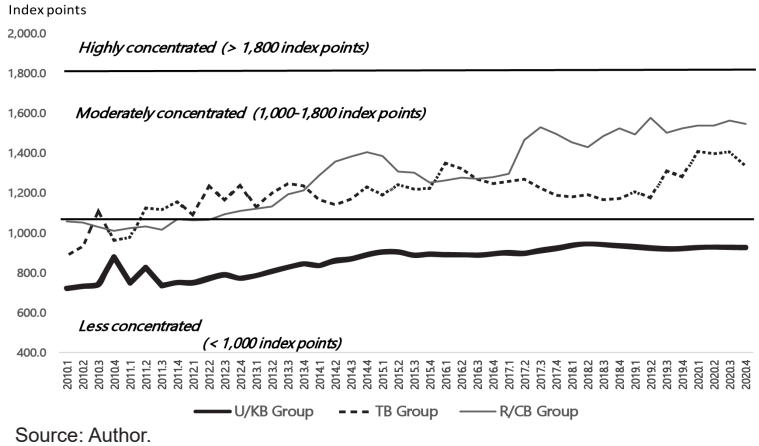
An expected strategy among BSFIs due to the adoption of financial reform initiatives are mergers and consolidation. Given the rapid pace of globalization and accelerating technological advancement, the BSP sees merger and consolidation as a means to create stronger and globally competitive banking institutions. Mergers and consolidation are expected to help merged/consolidated banks harness with greater efficiency their collective experience, expertise and technological know-how. It is implicit that parties to mergers and consolidation have a strategic vision to make their merged enterprise more competitive, since mergers and consolidation will allow them to complement each other in terms of the markets they serve and the products and services they offer, allowing them to focus on core competencies. From March 2010 to December 2020, there were 28 episodes of mergers, consolidations and conversions; majority of these involved U/KBs and thrift banks, U/KBs and R/CBs, and TBs and R/CBs.

To determine the effect of mergers and consolidations on market concentration, I construct an HHI[12] each for the three Philippine banking groups—U/KB, TB and R/CB industries—from March 2010 to December 2020. There are perceived shortcomings of the HHI as a measure of market concentration. However, I treat this measure as a first approximation of market concentration. Following Meyer [2018], the HHI has three key ranges and market classifications: less than 1,000 index points (less concentrated); 1,000-1,800 index points (moderately concentrated) and above 1,800 index points (highly concentrated). If the HHI value for a specific banking group exceeds 1,800, that group can be considered highly concentrated—that is, merger activity is severely limited. Figure 2 shows that the U/KB industry and R/CB industry are relatively far from being oligopolistic in terms of asset distribution. This means that there are numerous competitors with significant market shares. Figure 2 reveals that among the three groups, TB and R/CB industries, which both account for about 7.2 percent of the banking sector's total assets as of end-December 2020, are moderately concentrated, while the U/KB industry, which accounts for 92.8 percent of the sector's assets, is less concentrated.

The decline in the HHIs of TB and R/CB industries from 2015 to 2017 can be attributed to the larger banks being able to establish branches in markets that were previously only served by UKBs, while the gradual rise in HHI after 2008 may be the result of post-Global Financial Crisis consolidation. This implies that there may be limitations in mergers among TBs and R/CBs. This may also mean that an out-of-group bank merger is a reasonable strategy.

[12] The HHI is calculated by summing the square of the share of assets for each bank with the group total assets. For example, if there are five banks operating, each holding a 20 percent market share, the HHI will be 2,000. If the market has only one bank (a monopoly), the HHI will be 10,000.

FIGURE 2. Competitive structure of Philippine banking groups based on Herfindahl-Hirschman Index (HHI), March 2010 to December 2020



Source: Author.

I then compare the computed bank-level HHI with return on assets (ROA) over the same period. Figure 3 shows that the ROA has been generally increasing with the HHI, although there are R/CBs with negative ROAs. This may also be attributed to the higher degree of diversification among U/KBs. Table 2 shows that the range of diversification between interest and non-interest activities among U/KBs is higher than those of the TBs and R/CBs. Overall, the results show that banks are generally stable and that while recent big mergers and consolidation have increased market concentration, these are not enough to pose a threat to the overall competition levels since market shares remain relatively well dispersed among the remaining players. The results also confirm that the U/KB industry still has enough room for more mergers and consolidation without necessarily inhibiting efficient competition.

FIGURE 3. Bank-level market concentration and return on assets, March 2010 to December 2020

Source: Author.

TABLE 2. Indicator of diversification[1/] measures of Philippine banks, March 2010 to December 2020

Descriptive statistics	U/KBs	TB group	R/CB group
Mean	-2.06	-0.02	-0.62
Median	0.03	0.05	-0.57
Std. deviation	78.53	0.16	0.27
Coefficient of variation	-38.12	-10.47	-0.44
Number of banks	41	44	457

[1/]Based on Liang et al. (2020). Defined as:
Diversification Measure = 1-[(*Interest income/total operating income*)^2 + (*Non-interest Income/Total Operating Income*)^2]
Source: Author.

4. Data and empirical strategy

I compile three unique quarterly datasets on detailed balance sheets and income statements of 542 banks from the Financial Reporting Package (FRP)[13] covering March 2010 to December 2020. These supervisory datasets allow the study to pose a number of questions. Tables A1 to A4 in Annex A present the variables and variable names used in the study. The databases are briefly described here.

4.1. Bank-level balance sheet and income statements

All banks are required to prepare the FRP on solo[14] and consolidated basis.[15] In the dataset, there are 41 U/KBs (composed of 14 UKBs, four commercial banks or KBs, and 23 FBs[16]), 44 TBs and 457 R/CBs as of end-December 2020. To arrive at a balanced panel, I only include the surviving or the latest list of banks with minimum observation points of three years. To eliminate the effects of outliers, I winsorize all variables at the first and 99th percentiles.

The bank-specific data include quarter-end data on the size of a bank (relative to total bank assets), credit growth, liquid assets relative to total assets, capitalization relative to total assets, funding composition using outstanding deposits relative to total liabilities, profitability of banks using annualized

[13] The FRP is a set of financial statements for prudential reporting purposes composed of the Balance Sheet, Income Statement and Supporting Schedules. The FRP is primarily designed to align the BSP's reportorial requirements with the (a) provisions of the Philippine Financial Reporting Standards (PFRS)/Philippine Accounting Standards (PAS), and (b) Basel 2 Capital Adequacy Framework. It is also designed to meet the BSP's statistical requirements.
[14] Solo basis refers to the combined financial statements of the head office and branches/other offices.
[15] Consolidated basis refers to the combined financial statements of parent bank and subsidiaries consolidated on a line by line basis. Only banks with financial allied subsidiaries, excluding insurance subsidiaries are required to submit the report on consolidated basis.
[16] Three foreign banks which entered the industry in 2018 and two commercial banks are excluded due to data limitations.

net income or loss, net interest margin (NIM), total operating income, interest income, non-interest income, Return on Equity (ROE), ROA, and quality of bank loans using nonperforming loans ratio (NPL), nonperforming assets ratio (NPA), nonperforming loan coverage ratio, and loan loss reserves (LLR). Other quarterly bank accounts in the income statements of banks are also compiled such as cost-to-income ratio (a measure of bank efficiency), total expenses, input costs, total revenues, variable profits, and variable costs. In the study, I use financial reporting data on solo basis. I also include dummy variables for banks' business model or banking group.

4.2. Vector of controls

This dataset includes macro-financial indicators and the BSP policy actions. These indicators include real GDP growth, inflation, monetary policy rate or overnight policy rate, bank lending rate, deposit rate, outstanding bank loans, nominal peso-dollar rate, and real effective exchange rates.

4.3. Measures of bank risk and bank competition

This database contains specific measures on individual bank risk and bank competition. Competition in this study refers to banking markets or banking groups, not in a specific product. I construct individual competition measures for the three banking groups—U/KB, TB and R/CB. As discussed in the previous section, the three groups show different market concentration based on HHI.

Following De-Ramon et al. [2020], I estimate the Z-score to represent stand-alone bank risk for all the banking groups. The relationship between the individual Z-scores and measures of bank competition are then estimated to examine the impact of these measures of competition on bank risk.[17]

The Z-score is an accounting-based measure of risk calculated at the bank level as,

$$Z_{b,t} = (ROA_{b,t} + c_{b,t}) / \sigma ROA_{b,t} \,, \tag{1}$$

where $ROA_{b,t}$ refers to ROA of bank b at time t, $c_{b,t}$ is total capital to assets ratio of bank b at time t, and $\sigma ROA_{b,t}$ is the standard deviation of ROA of bank b at time t. Following episodes of mergers and consolidation, I use a four-quarter (one year) rolling window of ROA to calculate $\sigma ROA_{b,t}$.[18]

I construct three measures of market power to represent bank competition: Panzar-Rosse-H-statistic (H-statistic), the Lerner Index (LI) and Boone Indicator (BI).[19]

[17] See Boyd et al. [2006]; Schaeck and Cihák [2014].

[18] In the initial estimation, bank-level Return on Equity and NPL ratio are used. However, the results are not significant. In the future, forecasted bank-level ROA can be used. This is an area for future research.

[19] Following the other papers by De-Ramon et al. [2020], Meyer [2018], Anginer et al. [2014], and Berger et al. [2009], I also use the HHI to compute the market concentration for bank assets of U/KBs, TBs, and R/CBs. The HHI is calculated by summing the square of the share of assets for each bank with the banking

4.4. Panzar-Rosse-H-statistic (*H-statistic*)

The H-statistic infers the degree of competition among banks by capturing the elasticity of bank interest revenues to input prices, that is, how sensitive interest revenue is to changes in bank costs.[20] The H-statistic is calculated in two steps. First, running a panel regression with bank and time fixed effects of the logarithm of measures of banks' input prices on the logarithm of gross total revenues.[21] Second, adding the estimated coefficients for each input price. Input prices include the price of deposits (commonly measured as the ratio of interest expenses to total deposits), the price of personnel (as captured by the ratio of personnel expenses to assets), and the price of equipment and fixed capital (approximated by the ratio of other operating and administrative expenses to total assets)

Higher values of the H-statistic are associated with more competitive banking systems. Under a monopoly, an increase in input prices typically results in a rise in marginal costs, a fall in output, and a decline in revenues (assuming that the demand curve is downward sloping), leading to an H-statistic of less than or equal to 0. Under a perfect competition, an increase in input prices generally raises both marginal costs and total revenues by the same amount (assuming that the demand curve is perfectly elastic); hence, the H-statistic will be equal to one.

4.5. Lerner Index (*LI*)

The LI directly measures pricing power by calculating the price markup over marginal cost, that is, the extra cost of producing an additional unit of output. Following De-Ramon and Straughan [2020], the LI ($L_{b,t}$) is seen in Equation 2 as,

$$L_{b,t} = (A_{b,t} - MC_{b,t}) / A_{b,t} , \tag{2}$$

as the ratio of the difference in output price $A_{b,t}$ of bank b at time t and marginal cost of bank b at time t ($MC_{b,t}$) to output price ($A_{b,t}$). The output price is proxied by total assets and is calculated as the sum of interest and non-interest revenue

group's total assets. I recognize that the HHI is not a direct measure of bank competition, but I include this in this study to provide a comparison with previous studies and to help assess the robustness of results from previous studies.

[20] In the initial regression, I used the interest income to revenue ratio. However, the bank-level ratios are relatively small. There are also banks that registered losses from their interest-earning transactions. Hence, there are challenges in using the ratio in regressions. Defined as the sum of interest and non-interest income, operating income has a bigger scope and therefore higher than interest income.

[21] The results of panel regression with bank and time fixed effects from March 2010 to December 2020 are as follows:

	Log (total revenues)		
	U/KBs	TBs	R/CBs
Log(total input prices)	0.671	0.238	0.632

Source. Author.

per unit of total output.[22] The marginal cost ($MC_{b,t}$) is not directly observable. In this study, the LI is calculated in two steps. First, running a panel regression with bank and time fixed effects of the logarithm of total cost on the logarithm of total assets and banks' input prices (*ln W*) in Equation 3.[23] These input prices include bank personnel compensation, funding cost, and other operating costs. Second, adding the estimated coefficients for each input price in Equation 3. Equation 3 below approximates the ($MC_{b,t}$) as,

$$MC_{b,t} = \frac{TC_{b,t}}{A_{b,t}} \left[a_{1b,t} + a_{2b,t} lnA + \sum_{b=1}^{3} a_{3t} lnW \right]. \quad (3)$$

The LI estimated for individual bank denotes its pricing power. Based on the theory, the LI can range between 0 and 1. An LI with a value approaching one indicates increasing level of market power or wider margins on the part of the bank and lower levels of competition.

4.6. Boone Indicator (BI)

The BI measures the effect of efficiency on bank performance in terms of profits. Following De-Ramon and Straughan [2020], it is calculated as the elasticity of variable profits to average variable costs. The BI in Equation 4 below is,

$$LogP_{b,t} = a + \beta_1 LogC_{b,t} + \beta_2 O_{b,t} + \mu_{b,t}, \quad (4)$$

where $LogP_{b,t}$ is the logarithm of variable profits for bank *b* at time *t*, $LogC_{b,t}$ is the logarithm of average variable costs, $O_{b,t}$ are other control variables which include macro-financial indicators and other specific characteristics of bank *b*, and $\mu_{b,t}$ is the error term. For consistency with the specifications of H-statistic and LI, the baseline BI calculation excludes the $O_{b,t}$. The BI is seen in β_1 which is estimated for bank *b* at time *t*. To estimate Equation 4, I calculate variable profits as the ratio of total revenue less variable costs (i.e., interest paid, personnel expenditure, other variable costs including occupancy of building) to total assets.[24]

[22] The impact of competition based on differentiated products on risk can be explored. Also, by type of portfolio such as households, corporates. I take this as an area of future research.

[23] The results of panel regression with bank and time fixed effects from March 2010 to December 2020 are as follows:

	Log (total cost/total assets)		
	U/KBs	TBs	R/CBs
Log(total input prices)	0.030	0.109	0.211

Source. Author.

[24] Equation 4 is estimated by panel regression with bank and time fixed effects from March 2010 to December 2020. The results are as follows:

	Log (variable profit/total assets)		
	U/KBs	TBs	R/CBs
Log(total input prices)	0.010	0.098	0.110

Source. Author.

Average variable costs are measured as variable costs scaled by variable revenue derived directly from current activity (i.e., interest received, foreign exchange receipts, investment income, fees and other charges).

In the actual estimation, the computed BI is then regressed on the four-quarter rolling window of ROA and $O_{b,t}$. I use bank-level variables found in the literature in addition to variable profit and average variable cost as controls for macro-financial indicators and other bank-specific characteristics such as capitalization/ total assets, outstanding deposits/total liabilities, and loan-to-asset ratio. As mentioned in the previous section, the main assumption behind the BI is that more efficient banks achieve higher profits. In practice, the BI is negative. The more negative the BI is, the higher the level of competition is in the market, because the effect of reallocation is stronger.

4.7. Measure of changes in the physical banking network

This database compiles the number of closed banks, entry of new banks (including entry of foreign and digital banks), mergers, consolidation, acquisition, and banks which applied for digital payment channels for banking services such as InstaPay and PESONet from March 2010 to December 2020. A dummy variable is assigned a value of 1 when a bank enters, merges, consolidates, and applies for digital payment services and 0 if otherwise. The measures are computed as the quarterly sum of banks to match the frequency of the dependent variables in the models. In the final regression results, only the measures on changes in physical banking network are significant.

Table 3 shows the descriptive statistics of the major variables used in the final estimation. The main variables of interest are the Z-scores and measures of market power—the H-statistics, BIs, and LIs—of U/KBs, TBs and R/CBs. The Z-score of U/KBs is the most volatile among these measures following the entry of new foreign banks and abrupt movements in their ROAs from March 2010 to December 2020. Among the bank-specific characteristics, the cost-to-income ratios (CI), a traditional measure of bank efficiency, of U/KBs and R/CBs are the more volatile indicators. I see large variations in the operating incomes of U/KBs and R/CBs particularly following the outbreak of the pandemic in March 2020.

TABLE 3. Summary of descriptive statistics of selected variables, March 2010 to December 2020

Variable name	Description	Mean	Median	Max.	Min.	Std. Dev.	10th per-centile	90th per-centile
Zscore_UKB	4-quarter moving average Z-score of universal and commercial Banks (U/KBs)	8.27	5.24	214.35	-9.12	10.98	0.49	17.74
Zscore_TB	4-quarter moving average Z-score of thrift banks (TBs)	10.92	8.94	29.17	3.78	8.12	4.22	26.29
Zscore_RCB	4-quarter moving average Z-score of rural and cooperative banks (R/CBs)	5.74	3.96	19.65	-2.10	5.72	0.06	13.59

TABLE 3. Summary of descriptive statistics of selected variables, March 2010 to December 2020 (continued)

Variable name	Description	Mean	Median	Max.	Min.	Std. Dev.	10th per-centile	90th per-centile
HSTAT_UKB	H-Statistic of UKBs	0.06	0.05	0.20	0.01	0.02	0.03	0.09
HSTAT_TB	H-Statistic of TBs	0.12	0.13	0.15	0.03	0.02	0.09	0.15
HSTAT_RB	H-Statistic of R/CBs	0.21	0.22	0.28	0.07	0.04	0.16	0.26
BI_UKB	Boone Indicator (BI) of U/KBs	0.11	0.06	4.32	-0.02	0.26	0.02	0.17
BI_TB	BI of TBs	0.48	0.45	0.79	0.33	0.13	0.31	0.79
BI_RCB	BI of R/CBs	0.86	0.79	1.41	0.44	0.21	0.62	1.25
LI_UKB	Lerner Index (LI) of U/KBs	-1.46	-0.37	1.40	-86.16	5.38	-3.15	0.37
LI_TB	LI of TBs	-2.98	-2.93	-1.71	-5.22	0.99	-6.20	-1.71
LI_RCB	LI of R/CBs	-6.39	-6.17	-4.12	-15.05	2.06	-8.97	-4.20
TLP_UKB	Total outstanding loans/total assets of U/KBs	0.46	0.50	0.98	0.00	0.23	0.05	0.70
TLP_TB	Total outstanding loans/total assets of TBs	0.79	0.79	0.81	0.74	0.02	0.77	0.81
TLP_RCB	Total outstanding loans/total assets of R/CBs	0.84	0.87	0.94	0.67	0.08	0.72	0.93
CAP_UKB	Total capitalization/total assets of U/KBs	0.20	0.14	0.99	0.04	0.17	0.09	0.50
CAP_TB	Total capitalization/total assets of TBs	2.68	2.78	3.37	1.58	0.56	1.88	3.58
CAP_RCB	Total Capitalization/total assets of R/CBs	0.15	0.14	0.24	0.11	0.04	0.12	0.23
CI_UKB	Cost-to-income ratio (CI) of UKBs	0.73	0.72	1.08	0.48	0.14	0.56	0.93
CI_TB	CI of TBs	0.61	0.60	0.67	0.50	0.04	0.57	0.66
CI_RCB	CI of R/CBs	0.91	0.77	1.86	0.56	0.33	0.60	1.43
DV_UKB	Diversification index (1-[(Interest Income/Total Operating Income)^2 + (Non-Interest Income/Total Operating Income)^2]	-0.09	0.02	0.47	-4.16	0.52	-0.76	0.57
DV_TB	DV of TBs	-0.01	0.05	0.17	-0.38	0.16	-0.22	0.19
DV_RCB	DV of R/CBs	-0.64	-0.60	-0.18	-1.24	0.27	-0.99	-0.28
RGDP	Real gross domestic product (GDP)	0.05	0.06	0.08	-0.17	0.05	0.03	0.08
INF	Inflation	0.95	0.94	1.07	0.85	0.06	0.86	1.01
POL	BSP policy rate	0.04	0.04	0.05	0.02	0.01	0.03	0.05
PES	Peso-dollar rate (average)	47.55	47.17	54.25	40.94	3.86	43.00	52.21

Source: Author.

4.8. Estimation method

To date, there is no generally accepted framework for analyzing the relationship between bank risk and competition. Moreover, the results are sensitive to the details of model specification, notably the choice of control or instrument variables. In this study, the parameters in the main model are estimated

using balanced panel quantile regression. This is a more appropriate empirical methodology to estimate the influence of various measures of bank competition and other factors affecting bank risk at bank level. Specifically, the panel quantile regression encourages a finer view of the potential heterogeneous effects across the conditional risk distribution.

The study recognizes that competition may be endogenous if weaker, less-efficient institutions increase leverage and balance sheet size (potentially raising return on assets) to avoid insolvency in periods of instability. These actions can be misinterpreted as a sign of increased competition. I address this problem by using lags (*t-j*) in the competition measures and bank-specific characteristics [Liu and Wilson 2013]. The choice of lag length is supported by results of exogeneity tests that formally evaluate the null hypothesis that the specified endogenous regressor, i.e., competition in this case, can be treated as exogenous.

4.9. Robustness checks

Diagnostics tests are used to check the stability of indicators in the study, including measures of competition, bank risk, and bank-specific characteristics. I use alternative specifications of the parameters of the model. For bank risk, I use one-year (four quarters) and two-year (eight quarters) rolling average ROA. Bank-specific characteristics such as the NPL ratio, NPL coverage ratio, loan loss reserves, liquid assets to total assets ratio, outstanding deposits to outstanding total liabilities ratio are used as factors driving ROA.[25] I employ 1 percent, 5 percent, and 10 percent levels of significance.

4.10. Empirical analysis

Equation 5 denotes the baseline model of the impact of bank competition on bank risk. On the left-hand side, $R_{b,t}$ represents a measure of risk of bank *b* during quarter-end *t-j*. I use the Z-score based on four-quarter (one year) moving average of ROA (see Annex A, Tables A1 to A4). Following De-Ramon and Straughan [2020], I interpret the Z-score as a measure of how many standard deviations a bank is away from exhausting its capital base. A higher value indicates lower probability of insolvency and therefore lower bank risk. This also indicates higher overall bank stability.

On the right-hand side, $K_{b,t-j}$ refers to a measure of competition of bank *b* during quarter-end *t-j*. $V_{b,t-j}$ represents a vector of macro-financial indicators and other bank-specific characteristics. $\varepsilon_{b,t}$ is a random error that has a normal distribution. The main coefficient of interest in Equation 5 is that associated with competition, β_1.

$$R_{b,t} = a_b (\pm) \beta_1 K_{b,t-j} + \beta_2 V_{b,t-j} + \varepsilon_{b,t} . \quad (5)$$

[25] However, the estimations yielded insignificant coefficients and were dropped in the final regression.

I analyze the relationship between bank competition and bank-level risk using separate regressions for each measure of bank competition and for each banking group—U/KBs, TBs and R/CB.

Following De-Ramon et al. [2020], Equation 6 specifies the panel quantile regression.

$$Q_{\phi}(R_{b,t} \setminus K_{b,t-j}, V_{b,t-j}) = a_b (\pm) \beta_{1\phi} K_{b,t-j} + \beta_{2\phi} V_{b,t-j} + \varepsilon_{b,t}, \quad (6)$$

where the term $Q_{\phi}(R_{b,t} \setminus K_{b,t-j}, V_{b,t-j})$ on the left hand side of Equation 6 refers to the ϕ^{th} conditional quantile of bank risk given competition ($K_{b,t-j}$), bank-specific characteristics and macro-financial controls ($V_{b,t-j}$); $\beta_{1\phi}$ and $\beta_{2\phi}$ are vectors of parameters on competition and other bank-specific characteristics and macro-financial controls, respectively; and $\varepsilon_{b,t}$ is the residual. The term Q_{ϕ} denotes the difference with the standard least squares' estimator expressed in Equation 5, which provides information only about the effect of competition at the conditional mean of bank risk. The quantile regression produces multiple coefficient estimates for competition that are unique to each quantile of the conditional distribution of bank risk. This approach allows the study to examine whether the relationship between competition and bank-level risk differs across banks depending on each bank's underlying risk profile.

Testing for equality of the coefficient estimates at various quantiles requires estimation of the variance-covariance matrix.[26] The test statistic is computed by using the variance-covariance matrix of the coefficients of the system of quantile regressions. The null hypothesis is that the coefficient on competition at the $\phi_{1^{st}}$ quantile is statistically the same as the one in the $\phi_{2^{nd}}$ or that the quantiles are symmetric using the Wald test. The alternative hypothesis is where the coefficients are not equal. The intention of this test is to determine if the relationship between risk and competition varies across the conditional risk distribution. I also check if the model has no omitted variables and is correctly specified using the Ramsey RESET test. Finally, I ensure that the data used are normally distributed using the Jarque-Bera test.

The study implemented a number of tests to highlight the dynamics between bank competition and bank risk. The focus of the discussions is the dynamics between bank competition and measures of bank risk such as the H-statistic (Table A1), Lerner Index (Table A2) and Boone Indicator (Table A4). These are posed as questions listed below.

First, does competition reduce bank risk? I find that the H-statistic, Lerner Index and Boone Indicator covary and correlate with bank risk (Z-score) across the three banking groups at 1 percent, 5 percent and 10 percent levels of significance from March 2010 to December 2020. I also observe that these measures Granger cause the Z-score at 1 percent and 5 percent levels of significance during the

[26] The covariance matrix is derived by using Huber sandwich technique.

same period. The test is on the overall significance of β_1 in Equations 5 and 6. As implied in the previous section, β_1 in Equations 5 and 6 will have a different interpretation for the Boone Indicator and the Lerner Index. A positive coefficient of β_1 suggests that more competition is associated with higher risk (lower Z-scores), consistent with the competition-fragility hypothesis, while finding a negative coefficient implies that more competition is related with lower risk and supports the competition-stability hypothesis.

For H-statistic, a positive β_1 suggests that as competition increases, profitability and capitalization rise, bank risk declines and bank stability improves. This supports the risk-shifting paradigm and competition-stability hypothesis. A negative β_1 indicates that as competition intensifies, profitability and capitalization decrease, bank risk increases, and bank stability weakens. This supports the competition-fragility hypothesis.

I assume that the overall significance of β_1 depends on bank-specific characteristics and macroeconomic variables. I include other key attributes of banking performance following the specifications in Liu and Wilson [2013]. All these bank-specific characteristics and macro-financial variables have bilateral Granger causality with bank risk from March 2010 to December 2020.

Bank efficiency in this study refers to operational cost-to-income (CI) ratio.[27] It is defined as the ratio of annualized non-interest expenses (net of impairment losses) to annualized total operating income,[28] I expect the CI ratio to be negatively related to bank risk as less efficient banks are likely to take on greater risk to generate returns and to improve their financial performance [Boyd et al. 2006]. In the dataset, the CI ratios of U/KB, TB and R/CB groups are relatively high at more than 60 percent. Among the groups, the TB industry has the lowest average CI ratio at 62.2 percent from March 2010 to December 2020, followed by the U/KB industry at 65.5 percent and the R/CB industry at 76.1 percent.

Moreover, the ratio of outstanding total bank loans to total assets (total loan portfolio or TLP) could be positively related to bank risk, since greater loan exposure may mean higher probability of a default risk. If TLP is low, however, profits (which could act as the buffer to default risk) may be reduced. I also assume that the size of a bank, measured by the logarithm of total assets, is negatively related to bank risk. The idea is that the benefits of economies of scale and market power may allow large banks to remain more stable than their smaller counterparts. However, it may be assumed that larger banks are prepared to accept more risk particularly when their capital buffers are healthy.

Finally, the degree of diversification may also affect the dynamics between competition and bank risk. Using risk distribution among banks in 48 countries

[27] Dutta and Saha [2021] suggest that bank efficiency could be measured by either efficiency index of net interest margin, working capital ratio, asset turnover ratio, and operating efficiency ratio constructed by Principal Components Analysis (PCA).

[28] Based on the Report on the Philippine Financial System, Second Semester 2020, BSP.

from 1998 to 2018, Liang et al. [2020] find that higher diversification in bank portfolio reduces stand-alone bank risk but not the systemic risk as diversification tends to expose banks to a common risk in terms of activities and portfolio. Following Liang et al. [2020], I construct a bank-level diversification index (DV)[29] across the three banking groups.

To capture the effects of macro-financial shocks on bank risk, I include Inflation (INF) and real GDP growth (RGDP) in the baseline model. Inflation is calculated as the percentage change in consumer price index (CPI). Inflation has been used in previous studies of banking performance to account for macroeconomic shocks, which have been found to affect the financial system and the real economy. Specifically, higher inflation can distort decision-making, exacerbate information asymmetry and introduce price volatility. Consequently, a positive relationship between inflation and bank risk is expected. RGDP growth is included to capture movements in the business cycle. A significant strand of recent literature emphasizes the procyclical nature of the banking business, enhanced by a tendency of financial institutions to lend excessively during economic upturns, and to adopt cautious lending standards during downturns. Such lending patterns are likely to have implications for bank risk over the business cycle.

Meanwhile, I capture the initial impact of pandemic on bank risk by assigning a dummy variable for the pandemic period from March 2020 to December 2020.

I use the components of the Z-score in Equation 1 to shed light on the impact of competition on bank risk. These include the impact on profitability ($ROA_{b,t}$), bank capitalization ($c_{b,t}$) and volatility of bank profits ($\sigma ROA_{b,t}$). I also control for changes in physical banking network (DCHANGE). I expect a positive relationship between Z-score (lower bank risk) and DCHANGE.

To the best of my knowledge this is the first attempt to construct indicators of market concentration and market power using detailed bank-level balance sheet data and income statements from source reports in the Philippines.

Second, does the relationship between changes in competition and bank risk differ across banks? The main motivation behind this question is to capture the impact of changes in competition on bank risk distribution. I expect the association between measures of competition and bank risk to vary across banks given that the banks in the dataset have different ownership structures, serve different geographical areas (National Capital Region and in areas outside the National Capital Region), have different access to external finance, and are subject to proportionality in regulation.[30]

[29] Based on Liang et al. [2020], Diversification Measure = 1-[(Interest Income/Total Operating Income)^2 + (Non-Interest Income/Total Operating Income)^2].

[30] Rostoy [2018] defines proportionality in banking regulations as the application of simplified prudential requirements for small, non-complex institutions with simpler business models.

In addition, the relationship between competition and risk may differ depending on the initial risk level of banks [Liu and Wilson 2013]. High-risk banks (lower Z-score) may tend to avoid taking on more risk in order to protect their franchise values (which tend to decline) when competition increases. Low-risk banks (higher Z-score), by contrast, when faced with more intense competition, may tend to take on riskier projects in order to gain or protect market share and increase profitability. However, in empirical studies, the exact nature and impact of such interaction remains inconclusive. The test is on the overall significance of the measures of bank competition on the distribution of bank risk (Tables A2 to A4 in Annex A) based on the interpretation of β_1 in Equation 6. I use the results from the panel quantile regression.

5. Results

Table 4 below provides the summary of detailed results (Tables A1, A2 and A4 in Annex A) of the baseline model. Following the diagnostics and robustness checks, the results are consistent with the results of the previous studies (De-Ramon et al. [2020]; Liu and Mathison [2013]).

TABLE 4. Summary of the impact of measures of competition on bank risk, March 2010 to December 2020

	Bank competition measures		
	H-Stat	Boone	Lerner
Banking group	Coef.[1]	Coef.[1]	Coef.[1]
U/KB	0.118**	-0.539**	-0.028*
TB	-0.162*	-0.031*	0.019**
R/CB	0.127***	-0.045***	0.456 **

[1] The symbols *, **, and *** represent significance of regression coefficients at 10 percent, 5 percent and 1 percent levels of significance, respectively.
Source: Author.

First, competition reduces bank risk taking activities at industry level. Table 4 shows that across the three banking groups, the Boone Indicator significantly reduces bank-level solvency risk. Specifically for the U/KB industry, the impact of Boone Indicator on bank risk is higher than the Lerner Index and the H-statistic suggesting that bank efficiency in terms of profits is a significant driver of competition. This result is in line with the findings in previous studies by De-Ramon et al. [2020]. This is also consistent with the competition-stability hypothesis. However, the H-statistic (except the TB industry) and Lerner Index (except for U/KB) show a positive impact on bank risk that is consistent with competition-fragility hypothesis. This result may mean that banks are competing for quality of products and that there is a high degree of collusion among banks [Tabak et al. 2013]. I take this as an area of future research.

Looking at the coefficients of the H-statistic, Boone Indicator and Lerner Index, Table 4 shows that bank competition eases bank risk taking activities at the industry level. Among the banking groups, the U/KB group shows the highest impact on bank risk. This also implies that the banking sector continues to have adequate capitalization. Based on latest available data, total capitalization as a share of total assets stood at 12.5 percent as of end-June 2021, with the R/CB industry recording the highest ratio at 18.9 percent.[31]

Contrary to the previous findings by Liang et al. [2020], I find a negative impact of the diversification index (DV) on bank risk across banking groups (Tables A1, A2 and A4 in Annex A). This means that the banking groups are not that well-diversified and that their portfolio strategy may need to be enhanced. When looking at the DV by banking group, the R/CB is the least diversified as its portfolio is largely skewed to interest income. However, in terms of the average net interest margin (NIM)[32] from March 2010 to December 2020, the R/CB industry's average NIM was higher at 12.5 percent compared to the TB industry at 9.1 percent and to the U/KB industry at 3.1 percent.

In the initial regressions, the NPL ratio, Return on Equity (ROE), Inflation and peso-dollar rate were included. However, these were consequently excluded from the final regression as the coefficients turned out to be insignificant. I checked the robustness of the coefficients for the Boone Indicator and Lerner Index across all quantiles. All coefficient estimates are statistically distinct using the Wald F-test. This finding indicates that the relationships are heterogeneous across the quantiles. This result is also consistent with a two-year rolling average of ROA.

Second, competition affects individual bank risk-taking differently. In Tables A1, A2 and A4, I find mixed relationships between competition and Z-score when looking at the conditional risk distributions within the three banking groups using panel quantile regression from March 2010 to December 2020. In the case of the U/KB industry, the negative relationship (competition-stability hypothesis) between the Boone Indicator and Z-score is significant only for U/KBs in the 40th to the 70th percentile or for those banks in the middle of risk distribution (low-medium Z-score) (Table A3, Figure A1). Majority of U/KBs in these distributions are large domestic U/KBs and foreign banks. In the case of the Lerner Index and Z-score, the negative relationship between the two variables is more dispersed and is significant only for U/KBs in the 50th and 60th percentiles (Table A4, Figure A2). These banks are in the middle of risk distribution (medium Z-score). Large U/KBs universal and new foreign banks dominate these quantiles. These findings imply that the impact of competition on bank risk depends ultimately on the underlying individual bank risks.

[31] The corresponding ratios for the U/KB and TB industries are 12.5 percent and 13.9 percent. Data are based on the Balance Sheet of the Philippine Banking System as of August 9, 2021 in the BSP website.

[32] Defined as the ratio of net interest income to average earning assets. Based on Report on the Philippine Financial System (Second Semester of 2020) in the BSP website.

However, I estimate a mixed relationship between competition and bank risk within the risk distributions in TB and R/CB industries. Using the Boone Indicator, the negative association is consistent and significant across the quantiles in the TB and R/CB industries at 1 percent level of significance. Looking at the Lerner Index in Table A4, I estimate a positive and significant impact on Z-score in TB and R/CB industries. This relationship is consistent and significant within the TB industry. In the case of the R/CB industry, the positive impact of Lerner Index on the Z-score is seen in all risk distributions, except in the 40th percentile when the relationship between the two switches to negative. Together, these findings imply that the relationship between competition and risk can potentially be countervailing within banking groups [De-Ramon et al. 2020].

These results are consistent with Liu and Wilson [2013] who both find that the strength of the relationship between competition and risk of Japanese commercial and cooperative banks varies across initial levels of risk. They find that competition reduces risk at the weakest banks in Japan, while at the same time it increases risk at healthier banks. These contrasting results for the different quantiles are consistent with both the competition-fragility and competition-stability hypotheses holding simultaneously for individual banks in the Philippines. This also suggests that competitive opportunities remain for smaller U/KBs and to a limited extent the R/CBs.

I also show that the relationship between competition and risk is sensitive to other bank-specific characteristics related to deposit growth, capitalization (Liu and Wilson [2013]; Schaeck and Cihák [2014]), cost-to-income ratio, diversification index, and macro-financial factors that could potentially have further influences. For instance, across estimations, bank-level Z-scores increase (risk decreases) as real GDP growth rises.

Third, changes in physical banking network (DCHANGE) lead to lower bank risk for large banks but not so for smaller banks. Results in Table A3 show that *DCHANGE* when interacted with Lerner Index has a negative and significant influence on the U/KBs' Z-score. This means that *DCHANGE* leads to lower risk. To some extent, this finding is consistent with observations by Altunbas and Marques [2008] and Sharma [2020] that merger has tangible benefits in areas such as profitability driven by diversification and utilization of economies of scale, technical progress (particularly in communication technology), deregulation, globalization and the resulting competition for banks. In the database, I account for 28 mergers and consolidations across the U/KB, TB and R/CB industries from March 2010 to December 2020.[33]

By contrast, the interaction between DCHANGE and bank risk (Boone Indicator) is negative and significant for TBs and R/CBs. This means that the objectives of merger, acquisition, and consolidation may not necessarily be favorable as discussed in Rezitis [2008].[34]

[33] The main reference is Factbook: The Philippine Banking System: 2010-2020, a BSP publication.

[34] Using a Generalized Malmquist productivity index on five merged banks in Greece, Rezitis [2008] concludes that banks that participated in merging activity experienced a decline in technical efficiency and in total factor productivity.

6. Conclusion

This paper contributes to the debate regarding the impact of competition on the stability of banks by examining the "competition-fragility" and "competition-stability" views. Three measures of market concentration and market power are constructed from a unique dataset of balance sheet and income statements for 542 banks operating in the Philippines from March 2010 to December 2020. These measures include the H-Statistic, Lerner Index and the Boone Indicator. The impact of these measures on bank solvency risk is then estimated across the U/KB, TB, and R/CB industries using panel quantile regression.

Following the diagnostics and robustness checks, the paper finds that, at the industry level, bank competition significantly reduces bank-level solvency risk. Looking at the risk distribution, the results show the competition-fragility and competition-stability hypotheses holding simultaneously for U/KBs. These findings imply that the impact of competition on bank risk depends crucially on the underlying individual bank risk. The results also mean that competitive opportunities remain for smaller U/KBs.

The study argues that the relationship between competition and risk is sensitive to other bank-specific characteristics and macroeconomic factors related to extent of diversification strategy, cost-to-income ratio, deposit growth, capitalization and real GDP growth. Importantly, the findings show the significant impact of changes in the physical banking network on bank risk for U/KBs, but negative for TBs and R/CBs.

From the technical standpoint, the results of the study may be extended to examine the impact of bank competition on economic growth in the long run and on monetary policy transmission mechanism. Empirical findings on the existing theoretical frameworks on bank competition and economic growth remain inconclusive. This study shows a significant and positive influence of real GDP growth on bank solvency risk. It will be interesting to analyze the impact of bank competition and bank stability on economic growth.

The results of the paper imply that the analysis of bank competition does not only depend on market size. It is equally relevant to include measures of market power. This could be relevant in the analysis of capital charge for operational risks that is dependent on banks' gross income. It could be expanded to include variable profits consistent with the Boone Indicator or marginal cost like the Lerner Index. Operational risk is defined in the capital framework as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. Philippine banks are using the Basic Indicator Approach (BIA) in computing the operational risk capital charge for regulatory capital purposes. Under the BIA, the aggregate gross income of a bank is subject to a 15 percent operational risk capital charge.

Different measures of competition may be useful in the determination of D-SIBs. As I have mentioned in Section 2, the BSP classifies banks depending on the extent of their systemic importance using pre-defined indicators for market

size, interconnectedness, substitutability, and market reliance as a financial market infrastructure as well as complexity. Market size is based on a bank's total resources relative to the banking system. The market size of a bank may consider measures of market power such as the H-statistic, Lerner Index and the Boone Indicator.

The results suggest that supervisory, regulatory, and competition authorities would benefit significantly from regularly assessing the combined effect of competition and innovation on financial stability. This assessment would also probably include other considerations, such as efficiency gains derived from financial innovation or competition especially when the services include a financial technology company. This may involve coordination among several institutions. For instance, micro and macro prudential supervisors and other institutions in charge of financial stability may need to coordinate and regularly exchange data with competition authorities. A first step in this direction could be the development of measures of bank competition that can be integrated in the financial stability framework of these institutions.

Importantly, a reliable, timely, complete, and readily accessible database are crucial for efficient and effective risk identification and assessment in financial sector supervision and enforcement. Such a database is particularly important for financial supervisors who are facing fast innovation and a regulatory perimeter that is getting bigger because of the growing digital financial services and the entry of digital banks. What kind of data to collect, how frequently, in what format, through what means are important questions, along with what aspects to improve upon. It may be useful and relevant to re-assess the approach to data collection, with the goal of further strengthening supervision while fostering digital transformation.

Acknowledgements: I am grateful to Assistant Governor Lyn Javier (Policy and Specialized Supervision Sub-Sector), Senior Director Raymond O. Estioko (Payment System Oversight Department), former Director Mark Anthony Perez (Department of Supervisory Analytics), Director Noel Guinto (Department of Supervisory Analytics), Director Melchor T. Plabasan (Technology Risk and Innovation Supervision Department), officers and staff of the Supervisory Policy and Research Department (SPRD), colleagues in the BSP Research Academy (BRAC), Ms. Siti Hanifah Borhan Nordin (Bank Negara Malaysia), and participants during the 14th Asia Research Network and Bank for International Settlements Research Workshop held on March 29, 2022 for their insightful comments and suggestions.

References

Altunbas, Y. and D. Marques. [2008] "Mergers and acquisitions and bank performance in Europe: The role of strategic similarities", *Journal of Economics and Business* 60:204-222.

Anginer, Deniz, A. Demirgüç-Kunt, and M. Zhu [2012] "How does bank competition affect systemic stability?", *Policy Research Working Paper* 5981.

Bahadur, S. and G. Sharma [2016] "Effect of bank competition on financial stability: empirical evidence from Nepal", *Economic Literature* XIII:19-31

Bayangos, V. and R. Moreno [2021] "What drives cross-border bank flows", BSP *Discussion Paper* No. 04.

Bayangos, V., L. Elloso, J.M. Hallig, J.N. Yeung, and A.M. Salamatin [2016] "The impact of foreign exchange liberalization reforms on the Philippine economy: An initial assessment", *BSP Working Paper Series* No. 2016-01.

Bayangos, V., R.L. Briones, R. Suguitan, and D. Lucela [2020] "Chapter 5: How Philippine banks are holding up amid the pandemic", in *BSP Unbound: Central Banking and the COVID-19 Pandemic in the Philippines*. BSP.

Beck, T., A. Dermirguc-Kunt, R. Levine [2006] "Bank concentration, competition and crises: First results", *Journal of Banking and Finance* 30:1581-1603.

Beck, T., O. De Jonghe, and G. Schepens [2013] "Bank competition and stability: Cross-country heterogeneity", *Journal of Financial Intermediation* 22:218-244.

Berger, A., L. F. Klapper, and R. Turk-Ariss [2009] "Bank competition and financial stability", *Journal of Financial Services Research* 35:99–118.

Boyd, J.H. and G. De Nicolo [2005] "The theory of bank risk taking and competition revisited", *Journal of Finance* 60:1329–1343.

Boyd, J., G. De Nicoló, and A. Jalal [2006] "Bank risk-taking and competition revisited: New theory and new evidence", *IMF Working Paper*, WP/06/297.

Casu, B. and C. Girardone [2006] "Bank competition, concentration and efficiency in the single European market", *The Manchester School* 74(4): 441–468.

Cetorelli, N. and P. E. Strahan [2006] "Finance as a barrier to entry: Bank competition and industry structure in local US markets", *The Journal of Finance* 61(1):437–461.

Crisanto, J.C., J. Ehrentraud, A. Lawson, and F. Restoy [2021] "Big tech regulation: what is going on? FSI Insights on policy implementation", *FSI Insights on Policy Implementation* No. 36.

De-Ramon, S. and M. Straughan [2020] "The evolution of competition in the UK deposit-taking sector, 1989–2013", *The European Journal of Finance* 26(10): 958-977.

De-Ramon, S., W. Francis, and M. Straughan [2020] "The link between bank competition and risk in the United Kingdom: two views for policymaking", *Bank of England Staff Working Paper* No. 885.

Dutta, K.D. and M. Saha [2021] "Do competition and efficiency lead to bank stability? Evidence from Bangladesh", *Future Business Journal* 7(6).

Jaume, D., M. Tobal, and R. Yslas [2022] "Vertical differentiation, risk-taking and retail funding" *Journal of Financial Services Research*, https://doi.org/10.1007s10693-022-00391-2.

Jimenez, G., J. Lopez, and J. Saurina [2013] "How does competition affect bank risk-taking?", *Journal of Financial Stability* 9: 185–195.

Karadimi, M. and H. Louri [2019] "Nonperforming loans in the euro area: Does market power matter?", *Bank of Greece Working Paper* 271.

Liang, S., F. Moreira, and J. Lee [2020] "Diversification and bank stability", *Economics Letters* 193: 109312.

Liu, H. and J.O.S. Wilson [2013] "Competition and risk in Japanese banking", *The European Journal of Finance* 19 (1):1-18.

Martinez-Miera, D. and R. Repullo [2010] "Does competition reduce the risk of bank failure?", *Review of Financial Studies* 23:3638–3664.

Meyer, A. [2018] "Market concentration and its impact on community banks", *Regional Economist*.

Rezitis, A. [2008] "Efficiency and productivity effects of bank mergers: Evidence from the Greek banking industry", *Economic Modelling* 25(2):236-254.

Sharma, D. [2020] "Merger and acquisition: A literature review", *Suresh Gyan Vihar University International Journal of Economics and Management* 8(4).

Schaeck, K. and M. Cihák [2014] "Competition, efficiency, and stability in banking", *Financial Management* 43(1):215–241.

Tabak, B.M, D. Fazio, and D.O. Cajueiro [2011] "The relationship between banking market competition and risk-taking: Do size and capitalization matter?", *Banco Central do Brazil Working Paper Series* 261.

Annex

TABLE A1. Bank competition and bank risk using H-Statistic, March 2010 to December 2020

Independent variables	Dependent variable (I) UKB/KB Group Z-Score (ZSCORE)		Dependent variable (II) Thrift Bank Group Z-Score (ZSCORE)		Dependent variable (III) Rural/Coop Bank Group Z-Score (ZSCORE)	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
H-statistic	-0.118	0.259	-0.162	(0.017)***	0.127	(0.075)***
Significant percentile	Not significant in all percentiles		All percentiles		All percentiles	
Bank-specific characteristics						
DEP (-1) (Ratio of deposits/total liabilities)	0.872	(0.275)***	0.179	(0.046)***	-	-
TLP (-1)	-	-	0.226	(0.029)***	0.562	(0.830)***

TABLE A1. Bank competition and bank risk using H-Statistic, March 2010-December 2020 (continued)

Independent variables	Dependent variable (I) UKB/KB Group Z-Score (ZSCORE)		Dependent variable (II) Thrift Bank Group Z-Score (ZSCORE)		Dependent variable (III) Rural/Coop Bank Group Z-Score (ZSCORE)	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
LIQ (-1) (Ratio of liquid assets/deposits)	-	-	-	-	-	-
CI (-1) (Cost-to-income ratio)	-0.008	(0.004)**	-0.179	(0.021)***	-0157	(0.003)***
DV (-1) (Diversification index)	-0.145	(0.132)*	-	-	-0.397	(0.082)***
CAP (-1) (Ratio of total capitalization to total assets)	0.265	0.364***	-0.132	(0.095)***	-0.157	(0.682)**
Macro and other indicators						
RGDP (Real GDP growth)	0.036	(0.172)*	0.202	(0.062)***	0.956	(0.324)***
POL (BSP policy rate)	-	-	-	-	-	-
DCHANGE (Dummy for changes in banking structure)	0.049	(0.033)*	0.042	(0.201)*	-0.060	(0.002)***
DCHANGE*HSTA (Interaction term)	-0.564	0.118	0.169	(0.035)**	-0.045	(0.003)**
DCOV (Dummy for pandemic)	-0.109	0.274	0.054	0.012	0.154	(0.124)***
Diagnostics						
Adjusted R^2	*0.501*		*0.868*		*0.621*	
Sample period	*2010Q1-2020Q4*		*2010Q1-2020Q4*		*2010Q1-2020Q4*	
Banks	*41*		*44*		*457*	
No of bank observations	*1,365*		*1,044*		*14,167*	
Stability test 1	*0.000*		*0.078*		*0.023*	
Residual test 2	*0.123*		*0.167*		*0.176*	
Symmetric quantiles test 3	*0.201*		*0.111*		*0.211*	
Standard error of regression	*0.008*		*0.000*		*0.000*	

Notes: Robust standard errors are reported in brackets. The symbols *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent respectively.
[1] Reports *p*-values for the null hypothesis that the model has no omitted variables and is correctly specified using Ramsey RESET test.
[2] Reports *p*-values for the null hypothesis that the data is normally distributed using Jarque-Bera test.
[3] Reports *p*-values for the null hypothesis that the quantiles are symmetric using Wald test.
Source: Author.

TABLE A2. Bank competition and bank risk using Boone Indicator, March 2010 to December 2020

Independent variables	Dependent variable (I) UKB/KB Group Z-Score (ZSCORE)		Dependent variable (II) Thrift Bank Group Z-Score (ZSCORE)		Dependent variable (III) Rural/Coop Bank Group Z-Score (ZSCORE)	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Boone	-0.539	(0.254)**	-0.031	(0.935)**	-0.045	(0.143)**
Significant quintile	0.4, 0.5, 06, and 0.7 quintiles		All quintiles		All quintiles	
Bank-specific characteristics						
DEP (-1) (Ratio of deposits/total liabilities)	0.172	(0.103)*	-	-	-	-
TLP (-1)	-	-	-	-	-	-
LIQ (-1) (Ratio of liquid assets/ deposits)	-	-	-	-	-	-
CI (-1) (Cost-to-income ratio)	-	-	-0.517	(0.195)**	-0.193	(0.005)**
DV (-1) (Diversification index)	-0.039	(0.849)***	-0.127	(0.263)**	-0.112	(0.297)
CAP (-1) (Ratio of total capitalization to total assets)	-0.863	(0.233)***	-0.155	(0.624)***	-0.567	(0.117)**
NPLR (Nonperforming loan ratio)	-0.027	0.026	-	-	-	-
Macro and other indicators						
RGDP (Real GDP growth)	0.049	(0.098)*	0.110	(0.226)***	0.020	(0.115)**
POL (BSP policy rate)	0.027	(0.022)				
DCHANGE (Dummy for changes in banking structure)	-0.084	(0.063)*	0.179	(0.342)**	0.377	(0.009)**
DCHANGE*HSTA (Interaction term)	0.162	(0.089)***	-0.178	(0.503)**	-0.507	(0.013)
DCOV (Dummy for pandemic)	-0.100	0.121	-0.095	0.181	0.787	(0.198)**
Diagnostics						
Adjusted R^2	*0.308*		*0.6552*		*0.574*	
Sample period	*2010Q1-2020Q4*		*2010Q1-2020Q4*		*2010Q1-2020Q4*	
Banks	*41*		*44*		*457*	
No of bank observations	*1,227*		*968*		*15,081*	
Stability test[1]	*0.052*		*0.095*		*0.000*	
Residual test[2]	*0.210*		*0.201*		*0.178*	
Symmetric quantiles test[3]	*0.100*		*0.189*		*0.142*	
Standard error of regression	*0.096*		*0.043*		*0.021*	

Notes: Robust standard errors are reported in brackets. The symbols *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent respectively.
[1] Reports *p*-values for the null hypothesis that the model has no omitted variables and is correctly specified using Ramsey RESET test.
[2] Reports *p*-values for the null hypothesis that the data is normally distributed using Jarque-Bera test.
[3] Reports *p*-values for the null hypothesis that the quantiles are symmetric using Wald test.
Source: Author.

TABLE A3. Bank competition, bank efficiency, and bank risk using Boone Indicator, March 2010 to December 2020

Independent variables	Dependent variable (I) UKB/KB Group Z-Score (ZSCORE)		Dependent variable (II) Thrift Bank Group Z-Score (ZSCORE)		Dependent variable (III) Rural/Coop Bank Group Z-Score (ZSCORE)	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Boone	-0.323	(0.032)*	-0.031	(0.935)**	-0.042	(0.002)*
Boone^2[a]	Linear	Linear	0.002	(0.001)**	-	-
Significant quintile	0.2, 0.7, 08, and 0.9 quintiles		All quintiles		All quintiles	
Bank-specific characteristics						
DEP (-1) (Ratio of deposits/total liabilities)	-	-	-	-	-	-
TLP (-1)	-	-	-	-	0.152	(0.022)**
LIQ (-1) (Ratio of liquid assets/ deposits)	-	-	-	-	-0.051	(-0.011)**
CI (-1) (Cost-to-income ratio)	-0.685	(0.351)***	-0.136	(0.023)***	-0.245	(0.024)**
Boone (-1) * CI (-1) (Interaction term)	-0.575	0.685	-0.495	(0.151)*	-0.024	(0.023)*
DV (-1) (Diversification index)	-	-	-0.043	(0.077)**	0.059	(0.032)*
CAP (-1) (Ratio of total capitalization to total assets)	-0.354	(0.036)***	-0.088	(0.009)***	-0.411	(0.037)**
NPLR (Nonperforming loan ratio)	-0.027	0.026	-0.062	0.010	-0.047	(0.002)**
Macro and other indicators						
RGDP (Real GDP growth)	0.039	(0.016)***	0.161	(0.013)***	0.064	(0.019)**
POL (BSP policy rate)	-	-	-0.199	(0.034)***	-	-
DCHANGE (Dummy for changes in banking structure)	0.014	0.033	0.018	(0.034)**	0.069	(0.001)*
DCOV (Dummy for pandemic)	-0.055	(0.023)*	-0.102	(0.056)*	-0.017	(0.007)**
Diagnostics						
Adjusted R^2	*0.502*		*0.683*		*0.723*	
Sample period	*2010Q1-2020Q4*		*2010Q1-2020Q4*		*2010Q1-2020Q4*	
Banks	*41*		*44*		*457*	
No of bank observations	*1,227*		*968*		*15,081*	
Stability test[1]	*0.011*		*0.026*		*0.001*	
Residual test[2]	*0.198*		*0.278*		*0.199*	
Symmetric quantiles test[3]	*0.101*		*0.201*		*0.156*	
Standard error of regression	*0.008*		*0.056*		*0.041*	

Notes: Robust standard errors are reported in brackets. The symbols *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent respectively.
[1] Reports *p*-values for the null hypothesis that the model has no omitted variables and is correctly specified using Ramsey RESET test.
[2] Reports *p*-values for the null hypothesis that the data is normally distributed using Jarque-Bera test.
[3] Reports *p*-values for the null hypothesis that the quantiles are symmetric using Wald test.
Source: Author.

TABLE A4. Bank competition and bank risk using Lerner Index, March 2010 to December 2020

Independent variables	Dependent variable (I) UKB/KB Group Z-Score (ZSCORE)		Dependent variable (II) Thrift Bank Group Z-Score (ZSCORE)		Dependent variable (III) Rural/Coop Bank Group Z-Score (ZSCORE)	
	Coef.	Standard error	Coef.	Standard error	Coef.	Standard error
Lerner	-0.028	(0.014)**	0.019	(0.244)*	0.456	(0.013)***
Significant quintile	0.5 and 0.6 quintiles		All quintiles		All quintiles except 0.40 quintile	
Bank-specific characteristics						
DEP (-1) (Ratio of deposits/total liabilities)	-	-	-	-	-	(0.142)***
TLP (-1)	-	-	0.127	(0.877)*	-	-
CI (-1) (Cost-to-income ratio)	-0.449	(0.292)**	-0.150	(0.387)*	-0.185	(0.083)***
DV (-1) (Diversification index)	-0.021	(0.399)*	-0.095	(0.174)**	-0.011	(0.046)***
CAP (-1) (Ratio of total capitalization to total assets)	-0.361	(0.114)***	-0.266	(0.167)**	-0.031	(0.236)**
Macro and other indicators						
RGDP (Real GDP growth)	0.761	(2.517)*	0.117	(0.133)**	0.010	(0.159)**
POL (BSP policy rate)	0.016	(1.053)	-	-	-	-
DCHANGE (Dummy for changes in banking structure)	-0.072	(0.037)*	0.125	(0.020)**	-0.177	(0.005)***
DCHANGE*Lerner (Interaction term)	-0.009	(0.004)**	0.128	(0.004)*	0.029	(0.011)**
DCOV (Dummy for pandemic)	-0.198	0.236	-0.042	(0.254)**	0.090	(0.026)***
Diagnostics						
Adjusted R^2	*0.5*		*0.797*		*0.574*	
Sample period	*2010Q1-2020Q4*		*2010Q1-2020Q4*		*2010Q1-2020Q4*	
Banks	*41*		*44*		*457*	
No of bank observations	*1,804*		*998*		*15,081*	
Stability test[1]	*0.068*		*0.000*		*0.000*	
Residual test[2]	*0.120*		*0.211*		*0.231*	
Symmetric quantiles test[3]						
Standard error of regression	*0.083*		*0.003*		*0.051*	

Notes: Robust standard errors are reported in brackets. The symbols *, **, and *** represent significance levels of 10 percent, 5 percent, and 1 percent respectively.
[1] Reports *p*-values for the null hypothesis that the model has no omitted variables and is correctly specified using Ramsey RESET test.
[2] Reports *p*-values for the null hypothesis that the data is normally distributed using Jarque-Bera test.
[3] Reports *p*-values for the null hypothesis that the quantiles are symmetric using Wald test.
Source: Author.

FIGURE 1A. Bank competition and bank risk among universal and commercial banks using Boone Indicator, March 2010 to December 2020

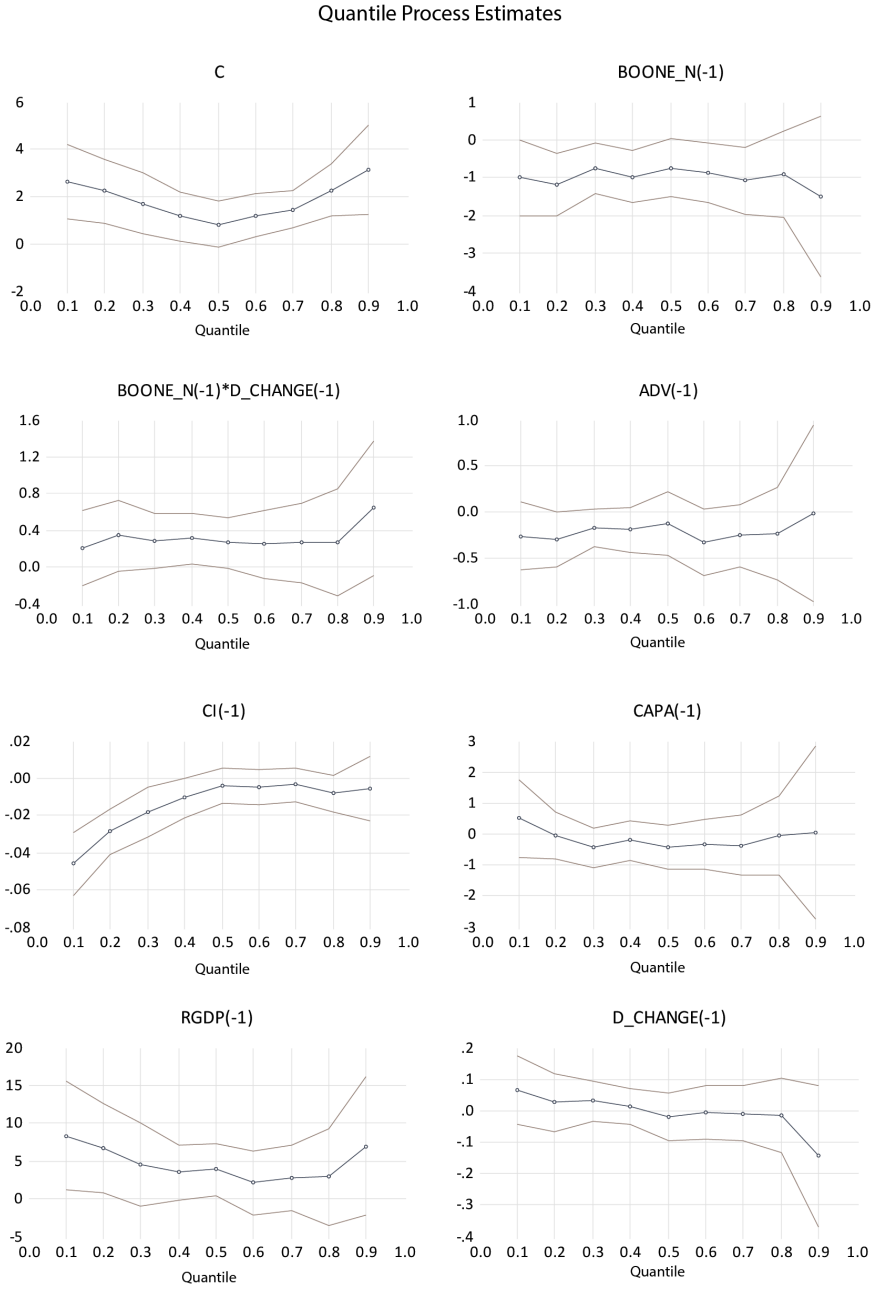


FIGURE 1A. Bank competition and bank risk among universal and commercial banks using Boone Indicator, March 2010 to December 2020 (continued)

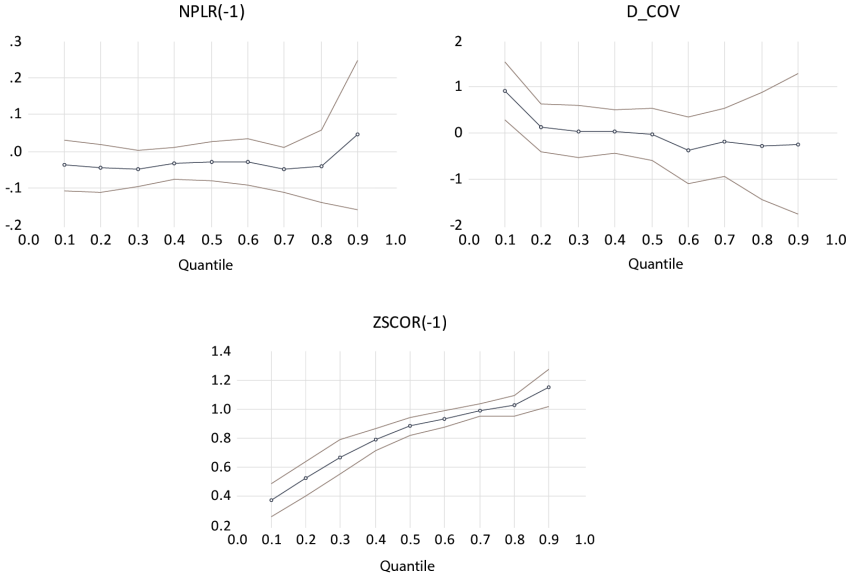


FIGURE 1B. Bank competition and bank risk among universal and commercial banks using Lerner Index, March 2010 to December 2020

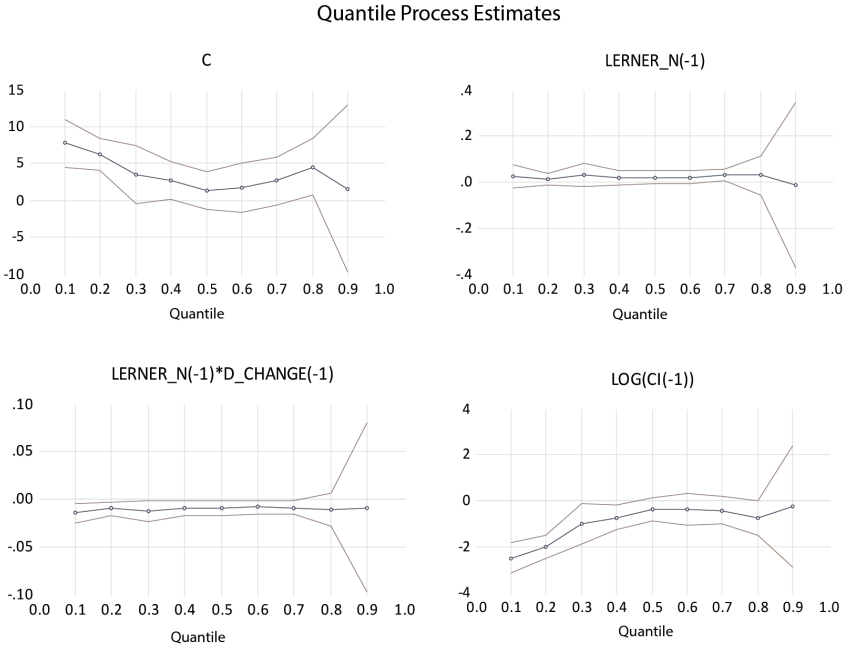


FIGURE 1B. Bank competition and bank risk among universal and commercial banks using Lerner Index, March 2010 to December 2020 (continued)