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The Linkage between Bank Competition and Stability: New International Evidence

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Abstract

It has been known among researchers that the relationship between bank competition and financial system stability is very complex. This paper, therefore, attempts to fill in the literature gap of the competition-stability nexus by using a sample of 81 countries including both developed and developing countries during the year 2000 to 2013. The results from fixed effect panel regression technique reveal that proxies for bank competition, specifically market concentration and market pricing power, have opposite effects on financial system stability. Therefore, in order to enhance the stability of the financial system, the policy makers need to consider the policy that (1) makes the market to be less monopolized by a few key players and (2) ensures that all players have enough margins to withstand economic fluctuation. In addition, these two competition measures together with three bank-specific variables, namely efficiency, revenue diversification and portfolio risk, can well explain the variation of financial system stability in the sampling countries and periods. The results are robust to an array of alternative variable specifications.

Keywords: Bank Competition, Financial System Stability, Concentration, Efficiency
JEL Classification: E00, G21, G28

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Introduction

Over the past two decades, the impact of bank competition to financial system stability has been the center of interest for both academicians and practitioners. The recent financial crises throughout the globe further exhibit the crucial need to conclude the relationship between them. At present, there is still a controversial debate on the two opposing views of the relationship. Under the traditional view called competition-fragility, the hypothesis suggests that more competitive banking systems are less stable. On the contrary, under the recent view called competition-stability, the hypothesis suggests that more competitive banking systems are more stable. To date, there are several empirical studies investigating the relationship between competition and financial system stability. However, there is no empirical evidence documenting for the effect of bank competition under structural and non-structural approaches separately. This paper will, therefore, contribute to the existing literature gap by exploring the linkage between bank competition, using both structural and non-structural measures, and financial system stability. The proposed model can well explain the variation of financial system stability in 81 countries throughout the globe during the period 2000 to 2013 with proper robustness checks.

This paper is structured as follows. Section 2 summarizes the existing literature on competition-stability nexus. Section 3 and 4 illustrate data and methodology. Then, section 5 presents and discusses the empirical results. Finally, section 6 concludes the paper with notes.

Literature Review

Based on the evolution of research on financial system stability and bank competition, the literature review can be divided into three main subsections, starting from the very early stage on how to determine the level of bank competition in section 2.1. Then, the studies on the relationship between bank competition and stability are reviewed in section 2.2. Finally, section 2.3 reviews the empirical studies on the competition-stability nexus with other factors.

Degree of Bank Competition Measurement

As competition cannot be measured directly, academicians need to find an appropriate proxy to quantify it. The research on the degree of bank competition has been developed in two main approaches called the structural and non-structural approaches. The structural approach focuses mainly on the Structure Conduct Performance (SCP) framework and the efficiency hypothesis. The SCP framework explores whether a highly concentrated market will result in a superior industry performance through the collusive behavior among larger banks or not. The non-structural approach, on the other hand, focuses mainly on the factors other than market structure and concentration that can affect the competitive behavior of the banks, such as general contestability of the market, barrier to entry and exit, competitive environment restrictions and so on.

There are two distinctive traditional models for non-structural approach that have been constructed, which are the model of Bresnahan (1989) and Panzar and Rosse (1987). There are several empirical studies

that apply either the Bresnahan's or the Panzar and Rosse's model to investigate the issue of bank competition. The study from Shaffer (1989) is one of the early applications of the Bresnahan's model. By using the data in the U.S. banking industry during the period 1965 to 1987, he finds the result that strongly rejects collusive behavior even though it is still consistent with perfect competition. By applying the same methodology to the Canadian banking industry during the year 1965 to 1989, Shaffer (1993) later concludes that such market is competitive even though the concentration level is very high. By adopting Panzar and Rosse's model, Nathan and Neave (1989) investigate Canadian banking industry and find the consistent result with that of Shaffer (1989), which employs Bresnahan's model.

In addition, the degree of bank competition and concentration are studied by Bikker and Haff (2002). They carry out the investigation on the European banking markets and make a comparison with that in the U.S. and other countries and find a strong evidence showing that the banking markets in the industrial countries are characterized by monopolistic competition. More recently, Bikker and Spierdijk (2008) study the level of competition using the sample of 101 countries during the period 1986 to 2004. They find that the level of competition is declining for developed countries and increasing for developing countries.

From the above studies, it can be concluded that there are two different angles to view competition. The first one is from the structural approach, namely market concentration. The second one is from the non-structural approach, namely market pricing power. Even though both approaches can represent the competition, the first approach has one major drawback as it presumes that the market contestability depends solely on the market structure. For example, it assumes that in a highly concentrated market, the contestability is generally low. On the other hand, the second approach does not have such presumption. Instead, it assumes that contestability may depend on other factors (i.e. competitive environment in the market), rather than market structure itself.

Bank Competition and Stability

The existing economic theories still provide an unclear conclusion on the relationship between bank competition and financial system stability. There are two main hypotheses regarding to the relationship, which are competition-fragility and competition-stability hypotheses. Under the traditional competition-fragility view, it concludes that more competitive banking systems are more fragile. In other words, in less competitive banking systems, banks usually have more lending opportunities and can increase profits. Therefore, such ample profits will help these banks be able to withstand more economic fluctuation and less likely to take excessive risky project. Hence, the systems will become more stable.

Contrary to the traditional view, the recent competition-stability view suggests that more competitive banking systems are more stable. Boyd and De Nicolo (2005) develop the theoretical framework concluding that less competition in the banking industry will eventually lead to financial instability. They begin their analysis by assuming that the borrowing firms usually choose the risk of their projects that is corresponding to the loan rates set by banks entirely. Therefore, when there is less competition in the market, banks tend to

impose higher interest rates on their loan, and that causes the borrowing firms to take riskier projects inevitably. At the higher degree of risk taken by the borrowers, the amount of Non-Performing Loan to banks will increase. So, the authors conclude that as the risk is eventually transferred from borrowers to banks in this circumstance, it will lead to a higher probability of financial system instability.

Not only the existing theories provide an ambiguous conclusion, but existing empirical studies on the effect of bank competition to financial system stability also show inconclusive results. For example, Boyd, De Nicolo and Jalal (2006) and De Nicolo and Loukoianova (2007) find that the risk of bank failure increases in less competitive markets. However, Jimenez, Lopez and Saurina (2007) finds that risks decrease when market power of incumbent banks increases. By investigating the markets in eight Latin American countries during the period 1993 to 2002, Yeyati and Micco (2007) find a positive relationship between bank risk and competition. Schaeck and Cihak (2008) examine the relationship between bank competition and stability using a sample of more than 3,600 banks from 10 European countries and more than 8,900 banks from the U.S. during the year 1995 to 2005. They conclude that competition increases stability by increasing efficiency. More recently, Anginer, Demirguc-Kunt and Zhu (2012) study a sample of 1,872 banks in 63 countries during the year 1997 to 2009 and find a positive relationship between bank competition and stability.

According to the above empirical investigations, it can be concluded that the relationship between bank competition and financial system stability are very complex. The results can vary according to the proxy specifications and sampling groups.

Bank Competition, Stability and Other Factors

The study in competition-stability nexus is not limited only between these two variables. For example, Claessens and Laeven (2004) construct a major study of competition and concentration that includes the banking systems of 50 developed and developing countries. They find the markets with greater foreign bank entry and fewer entry and activity restrictions to be more competitive. They also find no empirical evidence that the competitiveness measure relates negatively to the banking system concentration.

By using Lerner index to investigate the implication of market power on bank efficiency, Maudos and De Guevara (2007) find a positive relationship between market power and cost efficiency during the period 1993 to 2002. Delis and Tsionas (2009) investigate an empirical framework for the joint estimation of efficiency and market power for a sample of European and U.S. banks during the year 1996 to 2006. They report a negative relationship between market power and efficiency. More recently, Turk-Ariss (2010) employs a sample of 60 banks in developing countries during the year 1999 to 2005 and investigates on bank efficiency as a possible conduit through which competition influences financial stability and find a significant relationship among them. The results show that an increase in the degree of market power leads to greater bank stability and enhanced profit efficiency.

Besides competition, concentration and efficiency, the impact of revenue diversification on bank stability is also under investigation even though the findings are not yet under one consensus. On one side,

Stiroh (2004) and Hirtle and Stiroh (2007) find no benefits from revenue diversification. On the other side, Landskroner, Rutenberg and Zaken (2005) conclude that diversification indeed can decrease bank insolvency risk. Also, Sanya and Wolfe (2011) similarly conclude that revenue diversification across and within both interest and non-interest income actually decreases bank insolvency risk. More recently, Amidu and Wolfe (2013) investigate the role of revenue diversification in the competition-stability nexus. They explore how the level of competition affects revenue diversification and financial stability by using the data of 978 banks in 55 developing countries during the year 2000 to 2007. After simulating the above panel data set using three-stage least square technique, they find that competition increases stability as revenue diversification increases. Their result is quite robust to other several alternatives, such as variable specification, regulatory environment and so on.

According to the above empirical studies, it can be concluded that the relationship between competition and stability is quite complex. There are some other variables, such as efficiency and revenue diversification, which actually have significant effects on the relationship between competition and stability.

Data and Variable Specifications

This paper uses both micro bank-level and macro country-level data during the period 2000 to 2013. The bank-level data is taken from Bankscope database. The sample is limited to the commercial banks, and the countries that have banks less than ten banks in the industry are also excluded. Also, in order to align the analysis at country level, bank-level data are aggregated into country-level. For other country-level data, they are obtained from the latest update of the World Development Indicators Database (WDID) and Global Financial Development Database (GFDD) from the World Bank.

The variables used in this paper can be categorized into five main groups. The first one is the competition measurement under the structural approach, while that under non-structural approach is described in the second group. The third group illustrates the stability measures. The fourth and fifth groups contain bank-specific and country-specific variables. Table 1 presents the summary of variable used.

Structural Competition Measure

The component of the structural competition measure is based mainly on the number of banks and the distribution of banks in a certain market. The general form of the Concentration Index (CI) can be illustrated as following.

$$CI_t = \sum_{i}^{n} s_{it} w_{it} \qquad (1)$$

where: s_{it} is the market share of bank i at time t

w_{it} is the weight that the index attaches to the corresponding market share

n is the number of banks in the market under consideration

The weights attached to the individual market shares determine the sensitivity of the indices towards changes in the shape of the bank distribution. By summing the market shares of the k largest banks in the market, the k-bank concentration index can be constructed as following.

$$CI_{kt} = \sum_{i=1}^{k} s_{it} \quad (2)$$

The index is in a range between zero and one, and it can be interpreted as following. If it is equal to one, it means that the banks included in the computation make up the entire industry. As a result, the competition is at the lowest in this case. On the other hand, if it approaches zero, it means that there exists the infinite number of very small banks in the market given that the k chosen banks for the computation is relatively small comparing to the total number of banks. As a result, the competition is at the highest in this case. Even though there is no rule determining the optimal value of k, in order to align with other existing literature, k=3 and k=5 are arbitrarily applied in this research (CI3 and CI5).

Table 1: Variable Summary

Variable	Description	Sample Period	Data Source
Group A: Structural Competition Measures			
CI3	Concentration index of 3 largest banks	2000-2013	Bankscope Database, Bureau Van Dijk
CI5	Concentration index of 5 largest banks	2000-2013	Bankscope Database, Bureau Van Dijk
Group B: Non-Structural Competition Measures			
LI	Lerner index	2000-2013	Global Financial Development Database, World Bank
HI	H-statistic index	2000-2013	Global Financial Development Database, World Bank
Group C: Stability Measures			
LNZI	Logarithmic form of Z-score index	2000-2013	Global Financial Development Database, World Bank
CR	Capitalization ratio	2000-2013	Global Financial Development Database, World Bank
Group D: Bank-Specific Control Variables			
CIR	Cost to income ratio	2000-2013	Global Financial Development Database, World Bank
ROA	Return on asset	2000-2013	Global Financial Development Database, World Bank
RDI	Revenue diversification index	2000-2013	Bankscope Database, Bureau Van Dijk
NPL	Non-performing loan to total loan ratio	2000-2013	Global Financial Development Database, World Bank
LNTA	Logarithmic form of total asset	2000-2013	Bankscope Database, Bureau Van Dijk
LTA	Loan to asset ratio	2000-2013	Bankscope Database, Bureau Van Dijk
Group E: Country-Specific Control Variables			
GDPG	GDP Growth Rate	2000-2013	World Development Indicators Database, World Bank
CPI	Inflation Rate	2000-2013	World Development Indicators Database, World Bank

Non-Structural Competition Measures

There are two main measures under this group. The first one is called Lerner Index (LI). It provides a direct measure of competition and represents the mark-up of price over marginal cost. It is calculated by taking the difference between price of the output and the marginal cost that produces such output and then dividing by the price. The empirical studies that use this measure include, for example, Berger, Klapper and Turk-Ariss (2009), Liu, Molyneux and Nguyen (2012), Anginer, Demirguc-Kunt and Zhu (2012), Beck, Jonghe and Schepens (2013), Amidu and Wolfe (2013) and so on. The interpretation of this index is that when there is

no mark-up, it means the market is very competitive. When LI is higher, it means higher market power. As a result, the competition is lower. LI can be computed as following.

$$LI_t = \frac{P_{it} - MC_{it}}{P_{it}} \quad (3)$$

where: P_{it} is the price of each bank i at time t (derived from total revenue over total asset)

MC_{it} is the marginal cost of each bank i at time t (derived from total expense over total asset)

The second measure under this category is called H-statistic Index (HI). This proxy can classify the market structure into perfect competition, monopolistic competition and monopoly. The empirical studies that use this measure include Boyd, De Nicolo and Jalal (2006), De Nicolo and Loukoianova (2007), Yeyati and Micco (2007), Schaeck and Cihak (2008) and so on. This measure can be obtained by estimating the following equation.

$$\ln(P_{it}) = \beta + \beta_1 \ln(W_{1,it}) + \beta_2 \ln(W_{2,it}) + \beta_3 \ln(W_{3,it}) + \gamma_1 \ln(Y_{1,it}) + \gamma_2 \ln(Y_{2,it}) + \gamma_3 \ln(Y_{3,it}) + \varepsilon_{it} \quad (4)$$

where: P_{it} is the price of each bank i at time t (derived from total revenue over total asset)

$W_{1,it}$ is the price of deposit of each bank i at time t (derived from interest expense over total deposit)

$W_{2,it}$ is the price of labor of each bank i at time t (derived from staff cost over total asset)

$W_{3,it}$ is the price of fixed asset of each bank i at time t (derived from operating cost over fixed asset)

$Y_{1,it}$ is a control variable for the ratio of total equity to total asset

$Y_{2,it}$ is a control variable for the ratio of total loan to total asset

$Y_{3,it}$ is the log of total asset to capture size effect

ε_{it} is the error term

After estimating the above equation, HI can be calculated as following.

$$HI_t = \beta_1 + \beta_2 + \beta_3 \quad (5)$$

Stability Measures

There are two main measures under this group. The first one is called Z-score Index (ZI). This measure of bank stability combines the indicators of profitability, leverage and return volatility into a single factor. The empirical studies that use this measure include, for example, Beck, Demirguc-Kunt and Levine (2007), Schaeck and Cihak (2008), Laeven and Levine (2009), Cihak and Hesse (2010) and so on. Mathematically, it measures the number of standard deviation that a bank's profit must fall to drive it into insolvency. So, the higher ZI, the lower probability of insolvency risk. It is computed as following.

$$ZI_{it} = \frac{ROA_{it} + ETA_{it}}{SD(ROA)_{it}} \quad (6)$$

where: ROA_{it} is the 1-year average return on asset of each bank i at time t

ETA_{it} is the 1-year average of equity over total asset of each bank i at time t

$SD(ROA)_{it}$ is the standard deviation of ROA from 3-year rolling period

The second measure under this category is called Capitalization Ratio (CR), which is simply a ratio between total equity and total asset. According to Amidu and Wolfe (2013), "Capitalization ratio is used as a proxy for bank stability because the 1998 Basel Accord has made banks increasingly focus on managing their capital base as a buffer against default." In addition, Allen, Carletti and Marquez (2005) document that bank equity capital is associated with the competitive environment in credit market. Therefore, this measure can be used as an alternative proxy to represent bank stability, and the higher the index is, the higher the stability becomes.

Bank-Specific Control Variables

There are six variables under this group. The first and the second ones are the efficiency measures, which are Cost to Income Ratio (CIR) and Return on Asset (ROA). CIR is calculated as total cost over total income. So, it measures how well the expense is utilized per one unit of revenue. The higher the ratio is, the less efficient the bank becomes. ROA is computed as net income over average total asset. Therefore, the higher the ratio is, the more efficient the bank becomes.

The third variable under this category is the Revenue Diversification Index (RDI). It is calculated by using Hirschman Herfindahl approach for each bank. It accounts for the diversification between interest and non-interest income. The higher RDI means higher revenue concentration and hence lower revenue diversification.

$$RDI_{it} = \left(\frac{NII_{it}}{TR_{it}}\right)^2 + \left(\frac{FI_{it}}{TR_{it}}\right)^2 + \left(\frac{TI_{it}}{TR_{it}}\right)^2 \qquad (7)$$

where: TR_{it} is the total revenue (or the sum of NII, FI and TI) of each bank i at time t

NII_{it} is the net interest income of each bank i at time t

FI_{it} is the fee income of each bank i at time t

TI_{it} is the trading income of each bank i at time t

The fourth variable is Non-Performing Loan ratio (NPL). It is used to proxy for loan portfolio risk. It can be computed as NPL over total loan, and the higher ratio means higher portfolio risk. The fifth variable under this category is Bank Size. It is the total asset held by each bank. The variable is presented in logarithmic form (LNTA). Lastly, the sixth one is Loan to Asset ratio (LTA). It is the total loan over total asset of each bank.

Country-Specific Control Variables

There are two variables under this group. The first one is GDP Growth Rate (GDPG). The second one is Inflation Rate (CPI), which is computed based on Consumer Price Index. They are used to control for the general economic development, macroeconomic stability and institutional framework as these are likely to affect banking system performance in a country.

Methodology

The following baseline equation is used to investigate the relationship between bank competition and financial system stability. In essence, financial system stability is a function of bank competition and a series of bank-specific and country-specific control variables.

$$\text{Stability} = f\left(\text{Competition}, \text{Bank Controls}, \text{Country Controls}\right) \quad (8)$$

In order to align the model set up with previous studies, the fixed effect panel regression is adopted. The empirical model can be illustrated as following.

$$Z_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + \varepsilon_{it} \quad (9)$$

where: Z_{it} is a measure for bank stability of each country i at time t

C_{it} is a measure for bank competition of each country i at time t

X_{ij} is a set of bank-specific and country-specific variables

ε_{it} is the error term

5. Empirical Results

Main Results

Table 2 presents the summary of fixed effect panel regression results from various traditional models. The main models are T11 to T14, which use LNZI as the proxy for stability and use LI, HI, CI3 and CI5 as the proxy for competition. In model T11, the coefficient of LI is positive and statistically different from zero, it can be interpreted that as the market pricing power is higher, it increases the stability. In other words, when the market is less competitive, the stability increases. Therefore, this result supports the traditional competition-fragility view. In addition, the coefficient of CIR, RDI and NPL are negative and statistically different from zero. It means that (1) when banks become more efficient, the stability increases, (2) when banks diversify more sources of revenue, the stability is enhanced and (3) when banks have higher portfolio risk, the stability decreases. Similarly to that of model T11, the coefficient of HI in model T12 is negative and statistically different from zero, it can be interpreted that when the market pricing power moves toward monopoly, the stability decreases. This result also supports competition-fragility view. Also, similarly to the result from model T11, the coefficient of CIR, RDI and NPL are also negative.

The most striking finding from this table is that when the proxy of competition is changed from market pricing power, namely LI and HI, to market concentration, namely CI3 and CI5, the result turns to be the opposite. For instance, the coefficient of CI3 is negative and statistically different from zero. The implication is that when the market become more concentrated (less competitive), the stability is lower. Therefore, this result supports competition-stability view. The results are also consistent when using either CI3 or CI5.

Table 2: Regression Results from Traditional Models

Stability = C + Competition + Bank-Specific Variables + Country-Specific Variables

Model	T11	T12	T13	T14	T21	T22	T23	T24
Stability	LNZI	LNZI	LNZI	LNZI	CR	CR	CR	CR
Competition	LI	HI	CI3	CI5	LI	HI	CI3	CI5
	Co-efficient				Co-efficient			
C	2.5995*** (0.1333)	2.9256*** (0.1228)	3.1679*** (0.1424)	3.4758*** (0.1672)	0.2500*** (0.0247)	0.2963*** (0.0228)	0.3057*** (0.0265)	0.3307*** (0.0313)
LI	0.5592*** (0.1016)				0.0761*** (0.0177)			
HI		-0.2120*** (0.0678)				-0.0330*** (0.0126)		
CI3			-0.3160*** (0.0872)				-0.0154 (0.0162)	
CI5				-0.5773*** (0.1159)				-0.0383* (0.0217)
CIR	-0.4354*** (0.1058)	-0.6034*** (0.1022)	-0.6083*** (0.1020)	-0.6271*** (0.1014)	-0.0270 (0.0189)	-0.0470*** (0.0183)	-0.0479*** (0.0184)	-0.0495*** (0.0184)
RDI	-0.3941*** (0.1364)	-0.5613*** (0.1343)	-0.5469*** (0.1341)	-0.5757*** (0.1332)	0.0692*** (0.0252)	0.0468* (0.0248)	0.0473* (0.0249)	0.0460* (0.0248)
NPL	-0.9923*** (0.1891)	-1.1283*** (0.1892)	-1.1143*** (0.1890)	-1.0819*** (0.1881)	-0.0224 (0.0336)	-0.0577* (0.0327)	-0.0569* (0.0329)	-0.0537* (0.0329)
LNTA	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
LTA	-0.1171 (0.1283)	-0.0492 (0.1295)	-0.1715 (0.1324)	-0.2109 (0.1316)	-0.2712*** (0.0238)	-0.2653*** (0.0239)	-0.2728*** (0.0246)	-0.2773*** (0.0246)
GDPG	0.7324*** (0.2756)	0.8670*** (0.2782)	0.8759*** (0.2778)	0.8607*** (0.2758)	0.0218 (0.0509)	0.0365 (0.0512)	0.0330 (0.0514)	0.0327 (0.0513)
CPI	-0.0392 (0.0940)	0.0406 (0.0938)	0.0479 (0.0936)	0.0277 (0.0931)	-0.0468*** (0.0166)	-0.0391** (0.0166)	-0.0382** (0.0166)	-0.0395** (0.0166)
R-squared	0.91	0.91	0.91	0.91	0.60	0.59	0.59	0.59
Adj. R-squared	0.90	0.90	0.90	0.90	0.55	0.55	0.55	0.55
F-stat	95.55	93.29	93.66	94.95	13.81	13.53	13.39	13.44
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	0.06	0.08	0.08	0.06	-3.29	-3.28	-3.27	-3.27
SIC	0.55	0.57	0.57	0.56	-2.80	-2.79	-2.78	-2.79

Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

One possible explanation from the above findings is that the competition proxies from structural and non-structural approaches measure competition in two different angles. On one side, the structural approach or market concentration, considers solely the concentration of the market. On the other side, the non-structural approach or market pricing power, considers the pricing power of banks in the market. Therefore, it is possible that when the market becomes more concentrated, the pricing power does not necessarily increase. Therefore, it is possible that the effect from increasing market pricing power and increasing market

concentration can be in the opposite direction. Significant estimated coefficients together with the high R-squared and significant F-statistic confirm the above hypothesis. In addition, the above results are still robust even when the proxy for stability measure is changed from LNZI to CR in the model T21 to T24. Nevertheless, the impact is smaller than when LNZI is used.

In order to firmly document the finding above, the market concentration measure is added into the traditional models that initially contain market pricing power measure, specifically LI or HI. The summary of fixed effect panel regression results from four augmented models is presented in Table 3. The first group of the models, namely A11 and A12, use LNZI as a stability measure, LI as a market pricing power, and CI3 or CI5 as a market concentration measure. The results are as expected. All of the coefficients are statistically different from zero and have the same sign as expected.

Furthermore, the robustness check is also performed as presented in model A13 and A14 in which HI is applied instead of LI. As expected, the results are still the same. Therefore, it can be concluded that the conventional competition measures, the market concentration and market pricing power, indeed have the opposite effects on stability. Besides, as the information criteria statistics of these augmented models, namely AIC and SIC, are lower than those of the traditional models, it can be concluded that these augmented models are more preferable. In summary, the augmented models that contain both market pricing power and market concentration together with other bank-specific variables, CIR, RDI and NPL, and country-specific variables, are fitted well enough to explain the variation in banking system stability.

Robustness Checks

Table 4 presents the summary of redundant fixed effect tests to ensure the appropriateness of using fixed effect models. The tests are separated into three main tests as followings: (1) the pure cross-section fixed effect test, (2) the pure period fixed effect test and (3) the combined cross-section and period fixed effect test. The test results confirm that there exist both cross-section and period fixed effect. Therefore, it is appropriate to apply fixed effect models to this empirical study.

Table 3: Regression Results from Augmented Models

Stability = C + Market Power + Market Concentration + Bank-Specific Variables + Country-Specific Variables

Model	A11	A12	A13	A14
Stability	LNZI	LNZI	LNZI	LNZI
Market Power	LI	LI	HI	HI
Concentration	CI3	CI5	CI3	CI5
	Co-efficient		Co-efficient	
C	2.8661*** (0.1501)	3.1804*** (0.1723)	3.1950*** (0.1419)	3.4975*** (0.1665)
LI	0.5651*** (0.1009)	0.5731*** (0.1002)		
HI			-0.2176*** (0.0674)	-0.2124*** (0.0670)
CI3	-0.3234*** (0.0858)		-0.3222*** (0.0867)	
CI5		-0.5947*** (0.1140)		-0.5778*** (0.1153)
CIR	-0.4333*** (0.1051)	-0.4502*** (0.1044)	-0.6030*** (0.1015)	-0.6220*** (0.1009)
RDI	-0.3749*** (0.1355)	-0.4019*** (0.1345)	-0.5439*** (0.1334)	-0.5731*** (0.1326)
NPL	-0.9628*** (0.1879)	-0.9271*** (0.1869)	-1.1001*** (0.1881)	-1.0685*** (0.1872)
LNTA	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
LTA	-0.2249* (0.1306)	-0.2668** (0.1298)	-0.1557 (0.1318)	-0.1935 (0.1311)
GDPG	0.7763*** (0.2739)	0.7595*** (0.2718)	0.9127*** (0.2766)	0.8958*** (0.2747)
CPI	-0.0357 (0.0933)	-0.0577 (0.0928)	0.0449 (0.0932)	0.0247 (0.0927)
R-squared	0.91	0.92	0.91	0.91
Adj. R-squared	0.90	0.91	0.90	0.90
F-stat	96.11	97.57	93.79	95.04
F-stat (prob.)	0.00	0.00	0.00	0.00
AIC	0.05	0.03	0.07	0.06
SIC	0.54	0.53	0.56	0.55

Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 4: Redundant Fixed Effect Tests

Stability = C + Market Power + Market Concentration + Control Variables

Model	A11	A12	A13	A14
	statistic		statistic	
Cross-section F	102	104	101	103
Cross-section Chi-square	2,343	2,361	2,330	2,347
Period F	2	2	3	3
Period Chi-square	33	35	45	45
Cross-Section/Period F	89	90	87	89
Cross-Section/Period Chi-square	2,351	2,368	2,338	2,354
	prob.		prob.	
Cross-section F	0.00	0.00	0.00	0.00
Cross-section Chi-square	0.00	0.00	0.00	0.00
Period F	0.01	0.00	0.00	0.00
Period Chi-square	0.00	0.00	0.00	0.00
Cross-Section/Period F	0.00	0.00	0.00	0.00
Cross-Section/Period Chi-square	0.00	0.00	0.00	0.00

The alternative measure for stability, namely CR, is also applied to the augmented model instead of LNZI to ensure the robustness of the key findings in section 5.1. The summary of results is presented in Table 5. As the estimated coefficients are all statistically different from zero and have similar sign as expected from model A11 to A14, it can be confirmed that the findings in section 5.1 are robust.

Conclusion

This paper contributes to the existing literature gap by exploring the linkage between bank competition and financial system stability. Both micro bank-level and macro country-level data from a selected sample of 81 countries including both developed and developing countries during the year 2000 to 2013 are used in this study. The data at bank-level is firstly aggregated to be at country-level. Then, the panel regression with cross-section and period fixed effects technique is conducted to analyze cross-country information. The stylized facts obtaining from the study can be summarized as followings.

Firstly, the proxies for bank competition in the market concentration and market pricing power approach indeed have the opposite effect on financial system stability. The empirical results in section 5.1 show that the traditional measure of competition, namely market concentration, has a negative relationship with financial system stability. That is, when the market becomes more concentrated, the system becomes more fragile. Alternatively, the recent measure of competition, the market pricing power, has a positive relationship with financial system stability. It is obvious that when banks have higher pricing power, the system becomes more stable.

Table 5: Regression Results from Augmented Models with CR as Stability

Stability = C + Market Power + Market Concentration + Bank-Specific Variables + Country-Specific Variables

Model	A21	A22	A23	A24
Stability	CR	CR	CR	CR
Market Power	LI	LI	HI	HI
Concentration	CI3	CI5	CI3	CI5
	Co-efficient		Co-efficient	
C	0.1447*** (0.0190)	0.1876*** (0.0219)	0.1698*** (0.0177)	0.2119*** (0.0208)
LI	0.0350*** (0.0120)	0.0362*** (0.0119)		
HI			-0.0385*** (0.0084)	-0.0375*** (0.0084)
CI3	-0.0579*** (0.0109)		-0.0596*** (0.0108)	
CI5		-0.0928*** (0.0144)		-0.0928*** (0.0144)
CIR	0.0185 (0.0128)	0.0154 (0.0127)	0.0097 (0.0123)	0.0063 (0.0122)
RDI	-0.0392** (0.0171)	-0.0435*** (0.0169)	-0.0490*** (0.0166)	-0.0538*** (0.0165)
NPL	0.1140*** (0.0228)	0.1196*** (0.0227)	0.0990*** (0.0219)	0.1037*** (0.0218)
LNTA	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)
LTA	-0.0396** (0.0165)	-0.0438*** (0.0164)	-0.0358** (0.0164)	-0.0394** (0.0163)
GDPG	0.0433 (0.0344)	0.0395 (0.0342)	0.0544 (0.0342)	0.0503 (0.0340)
CPI	-0.0380*** (0.0112)	-0.0414*** (0.0111)	-0.0350*** (0.0111)	-0.0383*** (0.0110)
R-squared	0.67	0.68	0.68	0.68
Adj. R-squared	0.64	0.64	0.64	0.65
F-stat	19.07	19.45	19.44	19.77
F-stat (prob.)	0.00	0.00	0.00	0.00
AIC	-4.07	-4.08	-4.08	-4.09
SIC	-3.58	-3.59	-3.59	-3.60

Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Secondly, these two measures of competition together with three bank-specific variables, specifically bank efficiency, revenue diversification and portfolio risk, can well explain the variation of financial system stability in the sampling countries and periods. The empirical results in section 5.1 show that bank efficiency and revenue diversification have a positive relationship with financial system stability. On the other hand, portfolio risk has a negative one, intuitively. Moreover, the results are robust to an array of alternative variable specifications.

From the above findings, it can be concluded that there are actually two angles of competition; the market concentration and the market pricing power. As the impacts of these two angles of competition are on the opposite side, they indeed have important policy implications. In order to enhance the stability of the financial system, the policy makers need to consider the policy that (1) makes the market to be less monopolized by a few key players and (2) ensures that all players have enough margins to withstand economic fluctuation. Yet, these policy implications are drawn from the cross-country investigations in selected sampling countries. The implications to individual countries are left for future research.

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