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Bank Market Power, Economic Growth and Financial Stability: Evidence from Asian Banks

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Abstract

This paper examines whether Asian banks are still prone to moral hazard in the aftermath of the 1997 Asian crisis. Using a sample of commercial banks from 12 Asian countries during the 2001-2007 period, our empirical findings highlight that higher market power in the banking market results in higher instability. Although banks are better capitalized in less competitive markets their default risk remains higher. A deeper investigation however shows that such a behaviour is dependent on the economic environment. Higher economic growth contributes to neutralize higher risk taking and higher instability in less competitive markets.

JEL: G21, G28, L11

Keywords: Market Power, Financial Fragility, Economic Growth, Asian Banks

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1 Introduction

The 1997 Asian financial crisis has raised concerns regarding the stability of financial systems in Asian countries. Unlike the previous crises characterized by a failure of government macroeconomic policies, the 1997 crisis has cast doubts on the process of uncontrolled financial liberalization and its implications for the economy as a whole. In the Asian context, financial liberalization has indeed resulted in unfettered bank competition on the credit market creating bubbles notably in real estate markets (Sachs and Woo, 2000).

Moreover, the 1997 Asian crisis has also changed the structure of the banking industry and the nature of firms' corporate governance in Asia. In the banking industry, Asian countries have experienced a rapid growth of bank consolidations or mergers and acquisitions (M&As) that peaked to 25 percent per year as of 2003. Foreign Direct Investment (FDI), notably cross-border M&As involving banks in emerging countries, also showed an upward trend from US$ 2.5 billion during 1991-1995 to US$ 67.5 billion during 2001-2005 (Domanski, 2005; Moshirian, 2008). Asia therefore accounts for 36 percent of total bank M&As values, the second highest recipient of cross-border bank M&As after Latin America. Meanwhile, corporate governance reforms have also been implemented to eliminate incentives for imprudent strategies, including excessive short-term borrowing and speculative investments[1].

With regards to the implications of bank consolidations to rescue distressed banks, Berger and Mester (2003) argue that market power gained by banks after consolidation increases banks' capacity to expand their activity into various products and across national borders. This process has lead to the emergence of large "too big to fail" banks and potentially to higher moral hazard incentives to exploit government bailout. Meanwhile, regarding corporate governance reforms in Asia, firms still face major challenges, such as poor accounting systems, non-transparent management, and weak protection for minority shareholders (Park, 2006). Because firms significantly depend on banks for their external funding (Adams, 2008), bank stability is a major concern for policy makers. Corporate sector vulnerability is indeed more likely to affect bank soundness through risk-shifting mechanisms in bank-based financial systems (Stiglitz and Weiss, 1981).

In spite of the importance of such contemporary trends, few studies focus on the financial stability implications of bank consolidation in the Asian context. This paper contributes to fulfil this gap using a sample of commercial banks from 12 Asian countries that

[1] See Cook (2009) for deeper insights on the corporate governance reforms in various Asian countries.

have been affected by the 1997/1998 Asian crisis (China, Hong-Kong, India, Indonesia, Pakistan, Philippines, South Korea, Sri Lanka, Thailand, Taiwan, Thailand, and Vietnam). Specifically, we assess the link between market power in the banking industry and financial stability, as bank consolidations in the aftermath of the 1997 Asian crisis can influence the degree of competition or market power in the banking industry. We work on a sample covering the 2001-2007 period and focus on the role of the economic environment, where we investigate the link between bank instability and market power using various risk measures and by taking economic growth into consideration.

The rest of this paper is structured as follows. Section 2 provides a brief literature review on the nexus between bank market power and financial stability and discusses our research focus. Section 3 presents our data, variables and descriptive statistics. Section 4 highlights our econometric specification and methodology. Section 5 discusses our empirical findings, while Section 6 provides some sensitivity analyses. Section 7 concludes the paper.

2. Bank market power and financial stability

Research on the link between bank competition and financial stability remains inconclusive. In the U.S. banking industry, Keeley (1990) is the first to document that greater bank competition following financial deregulation in the late eighties has encouraged banks to take on more risk, as bank charter value declined. Demsetz et al. (1996) support such findings in the U.S banking industry, where banks with higher market power exhibit higher solvency ratios and lower asset risk. Bofondi and Ghobi (2004) examine such a relationship for Italian banks and find that the loan default rate is positively associated to the number of banks operating in the industry. Jimenez et al. (2008) also find a negative impact of the Lerner index on risk-taking in Spanish banks. In a cross-country setting, Levy-Yeyati and Micco (2007) document that competition in banking erodes bank stability in Latin America. Yet, Beck et al. (2006) examine the effect of bank concentration on the probability of banking crises instead of considering bank risk taking issues. Working on 69 countries during the 1980-1997 period, their empirical results highlight that countries with less competitive banking systems are less prone to banking crisis than the ones with greater bank competition. To sum up, the positive link between bank market power and financial stability is known as the “charter value” hypothesis in the literature.

Conversely, Boyd and De Nicolo (2005) develop an alternative view on the link between bank market power and financial stability, which is often referred to as the “competition-stability” hypothesis. By considering competition in both deposit and loan

markets, higher market power in the deposit market will drive banks to increase their loan interest rate. Such bank behaviour raises entrepreneurial moral hazard which in turn increases banks' default risk through risk-shifting mechanisms following Stiglitz and Weiss (1981). Boyd et al. (2006) further provide empirical evidence for the "competition-stability hypothesis" based on US data. Uhde and Heimeshoff (2009) also support the competition-stability hypothesis using European data. Moreover, they also show that the concentration-fragility nexus is more likely to occur in the less developed countries of Eastern Europe.

In the meantime, some studies also consider bank capital ratios in the relationship between bank competition and financial stability. Schaeck and Cihák (2007) document that a competitive banking market drives banks to hold higher capital ratios to preserve their competitive advantages on their peers. On the contrary, Berger et al. (2009) show that higher bank market power enhances bank capitalization. Furthermore, their empirical results suggest that although higher bank market power increases non-performing loans, such trends are associated with a decrease in bank default risk. This is because the levels of capitalization in banks with higher market power are sufficient to cover an increase in banks' non-performing loans and hence, bank stability is not affected.

Our paper builds on the work of Berger et al. (2009), Uhde and Heimeshoff (2009), Schaeck and Cihák (2007), and Soedarmono et al. (2011), and extends it in other directions. First, Berger et al. (2009) estimate the degree of bank-level market power, while our paper estimates the degree of market power for the whole banking system in order to account for bank consolidation trends that may change the degree of competition in the banking market. In this aspect, our conception of bank consolidation is close to Uhde and Heimeshoff (2009). However, we do not consider the implication of bank consolidations through the bank concentration channel as in Uhde and Heimeshoff (2009), but through the degree of market power in the banking market[2]. Second, we focus on the impact of bank competition on bank capitalization, insolvency risk and risk taking measured by the volatility of returns rather than the extent of non-performing loans. Risk taking refers to an *ex-ante* action while a risk measure based on non-performing loans indicates an *ex-post* condition. To prevent the excessive accumulation of non-performing loans that may contribute to the occurrence of a financial crisis, raising concerns on bank moral hazard that leads to excessive risk taking is an important dimension. Third, we also consider the influence of macroeconomic performance

[2] DeYoung et al (2009) provide a comprehensive discussion on the link between consolidation and market power in banking.

on the nexus between bank competition and financial stability following Schaeck and Cihák (2007).

Schaeck and Cihák (2007) analyze the impact of country-level per capita income on the link between bank competition and the capital ratio, while we focus on the role of economic growth in the competition-stability nexus in banking. In this sense our work is also related to the literature on the procyclicality of bank capital buffer, showing that banks hold lower capital as economic growth increases (Ayuso et al, 2004; Jokipii and Milne, 2008). Hence, higher economic expansion could therefore affect the impact of bank competition on capital ratios that in turn could influence bank income volatility and insolvency risk[3]. Our paper follows and adds to Soedarmono et al. (2011) who investigate the competition-stability nexus for Asian banks showing that higher market power is associated with higher instability except during the 1997 financial crisis period. In their setting they do not consider the role played by economic growth in the risk taking implications of the degree of bank competition.

3. Data sources, variables and descriptive statistics

3.1 Data sources

Our data come from several sources and consist of bank-specific and country-specific data. For bank-specific data, we start by taking from BankScope Fitch-IBCA a set of annual series for the 1999-2007 period. We consider commercial banks in 12 Asian countries. These include China (137) [4], Hong Kong (53), India (74), Indonesia (80), Malaysia (51), Pakistan (30), Philippines (41), South Korea (21), Sri Lanka (14), Taiwan (49), Thailand (23), and Vietnam (34). Our bank sample consists of 607 commercial banks. For country-specific data, we use several datasets such as the International Financial Statistics from the International Monetary Fund, the Financial Structure database from Beck and Demirgüç-Kunt (2009), the Governance Indicator index from Kaufmann et al (2008), and the Economic Freedom index from Heritage Foundation.

3.2 Bank Market Power

Claessens and Laeven (2004) argue that bank performance measures do not appropriately indicate the degree of bank market power because such measures can be

[3] The issue of procyclicality of bank capital is beyond the scope of this paper but taking into account the role of economic growth in the link between market power and bank stability is an important dimension. As higher economic growth improves borrowers' financial health, it might also enable banks to increase their profitability without undertaking excessive risk.

[4] The values in parentheses represent the number of banks obtained.

affected by various bank-level and country-level characteristics. Therefore, the degree of bank competition should be determined endogenously. In a similar vein, Beck (2008) highlights that using measures of bank market structure and concentration ratios to assess the degree of bank market power is inappropriate, since such measures do not account for differences in bank strategies. Consequently, such indicators merely indicate the actual market share of each bank. They do not necessarily measure bank competition captured by the degree of bank market power.

Meanwhile, the use of the H-statistic developed by Panzar and Rosse (1987) can be an alternative method to infer the degree of market power in the banking industry (Claessens and Laeven, 2004; Molyneux and Nguyen-Linh, 2008). Nevertheless, a critical feature of the H statistic is that the Panzar-Rosse approach must be applied on the basis of observations that are in long-run equilibrium (Bikker and Bos, 2008). An equilibrium test needs to be conducted by equalizing adjusted rates of return across banks. At equilibrium, the rates of return will not be correlated with input prices. When the equilibrium test is rejected, then the *H* estimates should be interpreted with great caution, as they may be based on observations from a disequilibrium situation.

For such reasons, we use the new industrial organisation approach following Uchida and Tsutsui (2005), Brissimis et al (2008), and Soedarmono et al. (2011) to quantify the degree of market power in Asian banking. We thereby obtain a more tractable measure of bank competition. The merit of this non-structural measure of bank competition is to provide the estimates of the degree of banking industry market power in each period. Furthermore, this measure does not require any information on the market structure of each bank. Eventually, this method allows us to endogeneously determine the degree of market power in the banking industry. More specifically, we estimate a system of three equations that correspond to a translog cost function, to a revenue function obtained from bank profit maximization, and to an inverse loan demand function. This system is shown in System (1).

$$
\begin{aligned}
\ln C_{it} &= b_0 + b_1 \overline{\ln q_{it}} + \frac{1}{2} b_2 \left(\overline{\ln q_{it}}\right)^2 + b_3 \overline{\ln d_{it}} + \frac{1}{2} b_4 \left(\overline{\ln d_{it}}\right)^2 + b_5 \overline{\ln w_{it}} + \frac{1}{2} b_6 \left(\overline{\ln w_{it}}\right)^2 \\
&\quad + b_7 \left(\overline{\ln q_{it}}\right)\left(\overline{\ln w_{it}}\right) + b_8 \left(\overline{\ln q_{it}}\right)\left(\overline{\ln d_{it}}\right) + b_9 \left(\overline{\ln d_{it}}\right)\left(\overline{\ln w_{it}}\right) + e_{it}^{C} \\
R_{it} &= \frac{\theta_t}{\eta_t} R_{it} + r_{it} q_{it} + c_{it} \left(b_1 + b_2 \left(\overline{\ln q_{it}}\right) + b_7 \left(\overline{\ln w_{it}}\right) + b_8 \left(\overline{\ln d_{it}}\right)\right) \\
&\quad + C_{it} \frac{q_{it}}{d_{it}} \left(b_3 + b_4 \left(\overline{\ln d_{it}}\right) + b_8 \left(\overline{\ln q_{it}}\right) + b_9 \left(\overline{\ln w_{it}}\right)\right) + e_{it}^{S} \\
\ln p_{it} &= g_0 - (1/\eta) \ln q_{it} + g_1 \ln GDPG_t + g_2 \ln OPL_{it} + e_{it}^{D}
\end{aligned}
\tag{1}
$$

In defining revenue, we follow Brissimis et al (2008) using total revenue from both interest and non-interest revenue. This construction allows us to implicitly capture the different strategies followed by banks in shifting part of their activities to non-interest income activities. Considering total revenue also allows us to account for earnings generated by assets other than loans[5]. Variables with bars represent deviations from their cross-sectional means in each time period, where this procedure is to cope with multicollinearity. The degree of market power in the banking industry in each year is given by $\theta_t \in [0,1]$ representing the well-known conjectural variations elasticity of total industry outputs with respect to the output of the i-*th* bank. In the case of perfect competition, $\theta_t = 0$; under pure monopoly, $\theta_t = 1$; and finally, $\theta_t < 0$ implies pricing below marginal cost and could result, for example from a non-optimizing behavior of banks. In the special case of Cournot competition, θ_{it} is simply referred to as the market share of the i-*th* bank.

Moreover, C_{it} is defined as total expenses from both interest and non-interest income activities, q_{it} as total earning assets, d_{it} as total deposits and short-term funding, w_{it} as the ratio of operating expenses to total assets, R_{it} as total revenue, r_{it} as the ratio of interest expenses to total deposits, and p_{it} as the ratio of total revenue to total earning assets. Meanwhile, $GDPG_t$ and OPL_{it} are factors that affect demand, defined as the real gross domestic product growth rate, and the ratio of operating expenses to total loans, respectively. Following Brissimis et al (2008) and Soedarmono et al. (2011), System (1) is estimated country by country. To estimate θ_t we use dummy variables for each year, while to estimate η we use time dummy variables every two years due to the fact that η values are linearly dependent on the time-specific control variable (*GDPG*).

[5] Uchida and Tsutsui (2005) only consider revenue generated by bank loans.

3.3. Financial stability

In this paper, financial stability is captured by bank income volatility, insolvency risk and capitalization. In order to measure bank income volatility that reflects bank risk-taking strategies, we use the standard deviation of banks' return on average assets (*SDROA*) and that of banks' return on average equity (*SDROE*). *SDROA* is calculated from the return on average assets (*ROAA*) values taken from period t to $t - 2$ (a three-period rolling window). Analogically, *SDORE* is calculated from the return on average equity (*ROAE*) using a three-period rolling window. This approach is consistent with Agoraki et al. (2011)[6].

To account for bank insolvency risk, we use the Z-score method based on *ROAA*. The Z-score (*ZROA*) indicates the number of standard deviations that the bank's *ROAA* has to fall below its expected value before equity is completely exhausted. Thus, higher Z-score is interpreted as a decrease in bank insolvency risk. *ZROA* is formulated as follows.

$$ZROA_{i,t} = \frac{ROAA_{i,t} + EQTA_{i,t}}{SDROA_{i,t}} \tag{2}$$

EQTA is the ratio of total equity to total assets. For robustness, we also consider the Z-score measure based on *ROAE* (*ZROE*) which is formulated as follows.

$$ZROE_{i,t} = \frac{ROAE_{i,t} + 1}{SDROE_{i,t}} \tag{3}$$

In order to capture the levels of bank capitalization, we use the total risk-based capital ratio (*CAR*) and the equity to total assets ratio (*EQTA*). *EQTA* is essentially a measure of leverage. The use of such a variable is consistent with Blum (2008) who highlights that the leverage ratio can be a tool to discipline bank moral hazard. Meanwhile, *CAR* is the sum of equity capital and other hybrid capital divided by risk-weighted assets. Repullo (2004) argues that risk-based capital requirements can overcome bank moral hazard in a competitive market.

3.4. Control variables

First, we incorporate country-specific control variables. We follow Schaeck and Cihák (2007) by considering the inflation rate (*INF*) and the real gross domestic product growth rate (*GDPG*), since macroeconomic developments are likely to affect the quality of banks' assets, as well as the level of bank capitalization.

Second, we also control for bank-specific characteristics. We consider the loan-to-deposit ratio (*LDR*) to capture bank liquidity that may affect bank default probability. We

[6] It is worth noting that our study only covers the 2001-2007 period, although our initial sample covers the 1999-2007 period. This is because our risk indicators are based on a three-year rolling window starting in 2001.

further incorporate the ratio of loan loss reserves to total loans (*LLR*) to account for credit risk, since credit risk is the major determinant of bank risk and capitalization. In the meantime, Foos et al. (2010) also document that excessive loan growth can result in higher bank risk and lower capital ratios. We thus include the loan growth rate as a control variable. We also control for the differences in technical efficiency following Agoraki et al. (2011) and Boyd et al. (2006). Technical efficiency is captured by the ratio of operating expenses to total assets (*OVERHEAD*). Bank size can also be a major factor of higher risk taking due to "too big to fail" effects in larger banks (Kane, 2000; Mishkin, 2006). To take into account size effects, we incorporate the logarithm of banks' total average assets (*SIZE*) in our estimations.

3.5. Descriptive statistics and the market power index

Table 1 presents the "clean" descriptive statistics of our variables after imposing several restrictions on our dataset to exclude outliers that may affect our empirical results. Our restrictions are as follows. We exclude the 2.5% highest values of *LDR*, *OPL*, *OVERHEAD*, *ZROA* and *ZROE* because these variables have a right-skewed distribution. For *OVERHEAD*, we further exclude all values that are lower than 0. To this end, Table 2 shows the values taken by the Lerner index for each country every year.

4. Econometric model and estimation methodology

To assess the impact of bank competition on financial stability, we construct the following equation that is consistent with the previous literature (Boyd et al, 2006; Brissimis et al, 2008; Agoraki et al, 2011; Soedarmono et al, 2011).

$$\begin{aligned} STABILITY_{i,j,t} &= \alpha_1 LERNER_{j,t} + \alpha_2 GDPG_{j,t} + \alpha_3 INF_{j,t} + \alpha_4 LDR_{i,j,t} + \alpha_5 LLR_{i,j,t} \\ &+ \alpha_6 LOANG_{i,j,t} + \alpha_7 OVERHEAD_{i,j,t} + \alpha_7 SIZE_{i,j,t} + \varepsilon_{i,t} \end{aligned} \tag{4}$$

where *i*, *j*, *t* indicates bank, country, and time index, respectively. Meanwhile, $STABILITY$ represents dependent variables consisting of *SDROA*, *SDROE*, *ZROA*, *ZROE*, *EQTA*, and *CAR*. Moreover, our paper also examines whether the macroeconomic environment influences the nexus between bank competition and financial stability. For this purpose, we specify the following equation.

$$\begin{aligned} STABILITY_{i,j,t} &= \alpha_1 LERNER_{j,t} + \alpha_2 GDPG_{j,t} + \alpha_3 LERNER * GDPG_{j,t} \\ &+ \alpha_4 INF_{j,t} + \alpha_5 LDR_{i,j,t} + \alpha_6 LLR_{i,j,t} + \alpha_7 LOANG_{i,j,t} + \alpha_8 OVERHEAD_{i,j,t} \\ &+ \alpha_9 SIZE_{i,j,t} + \varepsilon_{i,t} \end{aligned} \tag{5}$$

To estimate (4) and (5), we run Fixed Effect (FE) regressions to correct for unobservable bank-specific and time-specific characteristics. We also correct for possible heteroskedasticity and autocorrelation problems using the appropriate White coefficient covariance method.

Recent empirical literature further sheds light on endogeneity problems in the nexus between bank competition and financial stability (Berger et al, 2009; Uhde and Hemishoff, 2009; Gonzales, 2005; Schaeck and Cihák, 2007). In order to take this issue into account, we further endogenize the measure of bank competition by specifying instrumental variables. For this purpose, we also estimate (4) and (5) using the Generalized Method of Moments (GMM) with fixed-effect corrections instead of using the Two-Stages Least Squares (2SLS) method as in Uhde and Heimeshoff (2009) and Schaeck and Cihák (2007). In this regard, Hall (2005) shows that the GMM estimation is robust to the distribution of errors. The GMM estimation further accounts for heteroskedasticity and hence, the GMM estimation is more efficient than the 2SLS estimation.

With regards to instrumental variables for *LERNER*, we consider three macroeconomic variables. These include the ratio of stock market capitalization to *GDP* (*STOCK*), the rule of law index (*RLAW*), and the economic freedom index (*ECOFREE*). *STOCK* is retrieved from Beck and Demirgüç-Kunt (2009), while *RLAW* and *ECOFREE* are taken from Heritage foundation and Kaufmann et al (2008), respectively.

STOCK is expected to influence *LERNER* because higher stock market development can affect the demand for banking services (Schaeck and Cihák, 2007). As the stock market develops, banks will compete with capital markets to preserve bargaining power in the market[7]. Moshirian (2009) also points out that greater minority shareholders' protection helps boosting financial globalization that in turn, affects the degree of competition in the banking market. In order to account for the quality of law enforcement that protects minority shareholders' rights, we consider the rule of law index (*RLAW*) as one of the instrumental variables for *LERNER*. Finally, we consider the degree of economic freedom (*ECOFREE*) as an instrumental variable for *LERNER*, as greater economic freedom can lead to new investment opportunities. Higher economic freedom is also associated with weaker bank activity restrictions, leading to higher sophistication in banking products that may in turn affect the degree of bank competition.

[7] See Boot and Thakor (2000) for further discussions on the bank-capital market competition and the inter-bank competition.

Table 3 shows that such instrumental variables significantly affect the degree of market power in the banking market (*LERNER*). In the Asian context, greater bank competition is mainly due to stronger protections for minority shareholders represented by the rule of law index (*RLAW*), while with higher economic freedom and stock market development, banking markets appear to be less competitive.

5. Empirical findings

In order to analyze the impact of market power in the banking market on bank risk taking, insolvency risk and capitalization, we proceed in two steps. First, we investigate the link in a general framework. Second, we consider how economic growth influences the link between market power in banking and financial stability, where financial stability refers to bank risk taking, insolvency risk and capital ratios.

Table 4 shows our estimation results from the FE and the GMM regressions. Our results highlight that the degree of market power in the banking market (*LERNER*) is positively related to bank income volatility as measured by either *SDROA* or *SDROE*. Higher *LERNER* further exacerbates bank insolvency risk (*ZROA* or *ZROE*). However, higher *LERNER* is also associated with an increase in capital ratios (*EQTA* or *CAR*).

These findings indicate that although banks in less competitive markets are able to hold higher capital ratios, these levels are not sufficient to cover an increase in bank risk taking that in turn exacerbates bank insolvency risk. More precisely, Equation (2) provides a straightforward intuition on such empirical findings, where the levels of capitalization are insufficient to cover banks' risk-taking. Indeed, we observe that banks in less competitive markets are able to increase their equity to total assets ratio (*EQTA*). But according to Equation (2), the impact of market power (*LERNER*) on bank insolvency risk (*ZROA*) remains negative as long as *LERNER* is positively related to bank income volatiltiy (*SDROA*) and at the same time, a higher value of *LERNER* increases *SDROA* more strongly than *EQTA.* In other words, bank moral hazard in less competitive markets is likely to exist.

Our findings are consistent with Molyneaux and Nguyen-Linh (2008), Agusman et al. (2006), and Soedarmono et al. (2011). Molyneaux and Nguyen-Linh (2008) document that higher bank competition reduces risk taking in Southeast Asian banks, while Agusman et al (2006) point out that higher charter value in publicly-traded banks in Asia fails to alleviate banks' asset risk. Our findings are also consistent with Soedarmono et al (2011), even though they include financial crises periods in their study.

Our findings do not support the "charter value" hypothesis. More specifically, our findings differ from Ariss (2010) who finds that bank-level market power enhances the stability of banks in developing countries including some countries in Asia. Such different findings can be due to differences in econometric specifications. Ariss (2010) considers a cross-section analysis, while our paper employs panel data methodology that takes into account both time-specific and bank-specific characteristics. The composition of countries used in our study may also explain such differences, since macroeconomic and regulatory environements can influence the link between bank competition and financial stability.

Previous studies have not accounted for the influence of macroeconomic environments on the nexus between bank competition and financial stability. An exception is Schaeck and Cihák (2007) who consider the influence of country-level degree of economic development on the link between bank competition and capital ratios. Their results indicate that higher bank competition as captured by the Panzar-Roose H-statistics tends to alleviate bank capital ratios in countries with higher *GDP* per capita.

Following Schack and Cihák (2007), we further investigate whether the macroeconomic environment affects the impact of bank competition on bank risk taking, insolvency risk and capital ratios. However, in our study we consider the influence of economic growth instead of country-level economic development used by Schaeck and Cihák (2007). Our sample consists of developing countries with presumably relatively more homogeneous economic development levels. More specifically, we follow the steps of Soedarmono et al. (2011) who consider the same sample of countries to investigate the impact of financial crises on the link between bank competition and risk. In the present study, we focus on the period following the 1997/1998 Asian crisis and extend their approach by introducing the effect of economic growth on the competition-stability nexus.

Table 5 shows our estimation results when we augment our model by introducing the interaction term between *LERNER* and *GDPG* as an explanatory variable. Following Schaeck and Cihák (2007) as well, *LERNER*GDPG* is treated as an endogenous variable. Our empirical results show that higher economic growth brings banks in less competitive markets to reduce bank risk taking (*SDROA* and *SDROE*), overcome insolvency risk (*ZROA* and *ZROE*) and increase the equity to total asset ratio (*EQTA*)[8].

[8] Although *LERNER*GDPG* is negatively related to the total risk-based capital ratio (*CAR*), this result does not change the overall intuition with regard to the impact of economic growth on the link between bank competition and financial stability. As higher economic growth drives banks in less competitive market to reduce bank total risk-based capital ratio, such banks obviously tend to exhibit higher insolvency risks.

6. Sensitivity analyses

To check for robustness, we perform several sensitivity analyses in our paper[9]. First, we modify the inverse loan demand function (the third equation) as shown in System (1) by including the logarithm of total assets (*SIZE*) as a control variable that influences the pricing of banking products. Using this different specification, the empirical findings discussed in Section 5 are not altered. Second, we also control for bank income diversification, since non-interest income can affect bank stability (Lepetit et al, 2008). Considering the ratio of non-interest income to total gross revenue (*NNI*) as a control variable does not change our main findings. Third, we further control for the macroeconomic environment by incorporating the ratio of the five largest banks' total assets to the banking system's total assets (*CFIVE*) following Schaeck and Cihák (2007). Our main findings remain the same. Fourth, we exclude the year 2007 from our sample to isolate the impact of the 2007/2008 financial crisis. The link between bank competition and financial stability is not altered.

7. Conclusion

The process of bank consolidation is one of the major trends in Asian banking systems in the aftermath of the 1997 financial crisis. As bank consolidations tend to specifically affect the degree of bank competition in emerging and developing countries (Jeon et al, 2011), this paper examines the link between bank competition and financial stability in the Asian context, particularly in the post-1997 crisis period.

Using a sample of commercial banks in 12 Asian countries over the 2001-2007 period, our empirical findings indicate that higher market power in the banking industry is associated with better capital adequacy. However, the higher level of bank capitalization in less competitive markets is not sufficient to cope with bank moral hazard that induces excessive risk taking and exacerbates bank insolvency risk. Nevertheless, our findings also indicate that stronger economic growth mitigates higher risk taking behaviour and higher bank instability in less competitive markets.

On the whole, in the aftermath of the 1997 Asian crisis, Asian banks in general still seem to suffer from moral hazard. Higher market power in banking that is expected to enhance banks' self-discipline still fails to moderate high risk taking strategies. Nevertheless, such problems are less likely to occur in expansionary economic environments.

[9] The results from these sensitivity analyses are not shown in the paper but are available upon request.

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Appendix.

Table 1. Descriptive statistics

Variables	Definition	Mean	Median	Max	Min	Std. Dev.
Q	Total earning assets (million USD)	10580572	717092	863000000	40.874	44235815
C	Total expenses (million USD)	562126	56354	43603212	0.810	2070488
D	Total deposit and short term funding (million USD)	9576041	682700	804000000	7	39528240
R	Total revenue (million USD)	591999	63988	39037317	1.191	2102181
W	Total operating expenses to total assets	0.5706	0.0211	24.7477	0.0000	2.3346
R	Ratio of interest expenses to total deposits	0.0527	0.0295	9.3901	0.0001	0.3212
P	Ratio of total revenue to total earning assets	0.0859	0.0599	26.5119	0.0001	0.4661
OPL	Ratio of operating expenses to total loans	0.0525	0.0369	0.3262	0.0112	0.0443
ROAA	Return on average assets	0.0081	0.0087	0.7132	-0.5922	0.0378
EQTA	Ratio of equity to total asset	0.0832	0.0548	0.9988	-0.6322	0.1074
SDROA	Standard deviation of *ROA* from three-year rolling window	0.0153	0.0049	0.7311	0.0003	0.0467
ZROA	Z-score based on *ROA*	41.7830	23.4620	341.5850	-5.8090	54.9370
ROAE	Return on average equity	0.0831	0.1102	9.6712	-7.2452	0.4466
SDROE	Standard deviation of *ROE* from three-year rolling window	0.0559	0.0354	0.6950	0.0001	0.0690
ZROE	Z-score based on *ROE*	49.4890	30.9390	387.0560	-6.5160	58.7830
CAR	Ratio of total capital to risk-weighted assets	0.1756	0.1250	0.9929	0.0008	0.1569
EQTA	Ratio of total equity to total assets	0.0746	0.0487	0.9987	-0.6321	0.1041
LDR	Ratio of total loans to total deposits	0.6587	0.6771	1.3803	0.0001	0.2103
LLR	Ratio of loan loss reserves to total loans	0.0598	0.0344	1.0000	0.0010	0.0094
LOANG	Annual loan growth	0.2704	0.1156	6.9765	-0.9650	0.8969
OVERHEAD	Ratio of operating expenses to total revenue	0.4656	0.3531	45.7500	0.0003	1.2268
SIZE	Logarithm of total average assets	13.1690	13.6090	20.6610	3.8640	3.1690
INF	Annual inflation rate	0.0358	0.0305	0.2075	-0.0395	0.0414
GDPG	Annual real gross domestic product growth	0.0064	0.0063	0.1140	-0.0022	0.0027
RLAW	Rule of law index from Kaufman et al (2008)	0.0387	0.0275	0.1577	0	0.0355
ECOFREE	Economic Freedom index from Heritage Foundation	60.1197	55.2000	90	42	11.4480
STOCK	Ratio of stock market capitalisation to GDP	0.8313	0.4047	5.0050	0.0045	0.9903

Table 2. The Lerner index in the Asian banking industry.

	LERNER					
	China	Hong Kong	Indonesia	India	South Korea	Sri Lanka
2001	0.570440	0.428638	0.504237	-0.143449	0.395923	0.599729
2002	-1.560907	0.900392	0.489753	-0.118262	0.273264	0.741071
2003	-0.999889	0.935591	0.60836	-0.02357	0.410607	0.874385
2004	0.869676	0.70721	0.76211	0.000143	0.48544	0.915859
2005	0.822145	0.43478	0.730938	-0.026172	0.492796	0.859094
2006	0.797429	0.285657	0.688297	-0.075694	0.475937	0.813794
2007	0.790910	0.366164	0.75164	-0.100164	0.357278	0.704037
	LERNER					
	Malaysia	Philippines	Pakistan	Thailand	Taiwan	Vietnam
2001	0.712439	0.513135	0.571413	0.523875	0.155124	0.152861
2002	0.742263	0.635231	0.534409	0.498261	0.222008	0.018305
2003	0.75319	0.732586	0.641901	0.566692	0.271306	-0.192593
2004	0.766969	0.545519	0.709296	0.721333	0.359072	-0.051874
2005	0.775379	0.619123	0.666741	0.807386	0.318770	0.135218
2006	0.738516	0.638452	0.604942	0.761431	0.350857	0.137389
2007	0.716482	0.669991	0.600564	0.724995	0.334961	0.141521

Source: Authors' calculation
Notes: The Lerner index is calculated using the new industrial organisation approach following Uhida and Tsutsui (2005). A higher (lower) Lerner index is associated with an increase (decrease) in market power. Moreover, higher market power in the banking industry is associated with lower bank competition.

Table 3. The first-stage regression between instrumental variables and market power in the banking industry.

Explanatory variables	***LERNER***
ECOFREE	0.0196***
	(13.39)
RLAW	-0.346***
	(-15.53)
STOCK	0.0503***
	(3.459)
GDPG	0.0041
	(1.202)
INF	1.433***
	(5.402)
LDR	0.1314***
	(3.699)
LLR	0.0387
	(0.3564)
LOANG	0.0886***
	(5.622)
OVERHEAD	0.1947***
	(5.35)
SIZE	0.0022
	(0.6967)
R-square	0.22
Number of observations	2302

Notes: The dependent variable is the Lerner index (*LERNER*). Instruments consist of *ECOFREE*, *RLAW*, and *STOCK*. *ECOFREE* is the Economic Freedom index obtained from Heritage Foundation. *RLAW* is the Rule of Law index obtained from Kaufmann et al (2008). *STOCK* is the ratio of stock market capitalization to GDP obtained from Beck and Demirgüç-Kunt (2009). *LERNER* is the market power index calculated from the new industrial organization approach following Uchida and Tsutsui (2005). *GDPG* is the real gross domestic product growth rate. *INF* is the inflation rate. *LDR* is the ratio of total loans to total deposits. *LLR* is the ratio of loan loss reserves to total loans. *LOANG* is the annual loan growth rate. *SIZE* is the logarithm of total average assets. *OVERHEAD* is the ratio of operating expenses to total revenue. A constant is included but not reported. The model is estimated using the Ordinary Least Squares method. The *t-statistic* values are reported in parentheses. (***) indicates significance at the 1% level, while (**) and (*) indicate significance at the 5% and 10% levels, respectively.

Table 4. The nexus between market power in banking and financial stability**.**

	SDROA		*SDROE*		*ZROA*		*ZROE*		*EQTA*		*CAR*	
Explanatory variables	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*
LERNER	0.00095**	0.0022	0.0268***	0.031*	-8.624*	-147.1***	-14.766**	-203.8***	0.0075**	-0.0428	0.0043	0.1466**
	(2.0002)	(0.5925)	(3.139)	(0.4759)	(-1.944)	(-3.317)	(-2.886)	(-4.135)	(2.311)	(-1.473)	(0.6626)	(2.309)
GDPG	0.00913	0.0906***	1.961***	1.965***	-129.21	-360.3**	-251.09**	-565.3***	0.107	0.0234	-0.1141	0.1576
	(1.319)	(6.725)	(9.775)	(8.019)	(-1.189)	(-2.271)	(-2.025)	(-3.41)	(1.333)	(0.2253)	(-0.8105)	(0.8569)
INF	0.0091	0.0093	0.0888	0.2238*	-4.601	-17.016	4.385	-14.357	0.054	0.0469	0.0479	0.0519
	(1.319)	(1.334)	(0.4956)	(1.761)	(-0.0722)	(-0.2062)	(0.0602)	(-0.1345)	(1.157)	(0.9679)	(0.5683)	(0.4477)
LDR	-0.005***	-0.005***	-0.150***	-0.141***	22.88**	3.169	36.238***	7.501	0.0859***	0.0786***	-0.033**	-0.0195
	(-3.766)	(-3.339)	(-6.866)	(-5.689)	(1.981)	(0.1955)	(2.717)	(0.3671)	(10.051)	(5.17)	(-2.022)	(-0.6507)
LLR	0.0082**	0.0071*	-0.1011	-0.1568**	-91.85***	20.987	-33.41	114.57**	-0.255***	-0.2128**	0.1746***	0.0687
	(2.551)	(1.596)	(-0.5759)	(-2.019)	(-3.258)	(0.4103)	(-1.038)	(2.247)	(-12.247)	(-2.157)	(3.182)	(0.6428)
LOANG	-0.000182	-0.00035	0.0019	-0.000392	-6.813**	11.229	-1.822	21.818**	-0.014***	-0.0071	-0.036***	-0.047***
	(-0.5533)	(-0.5913)	(0.3951)	(-0.0378)	(-2.276)	(1.623)	(-0.533)	(2.438)	(-6.116)	(-1.414)	(-8.218)	(-3.494)
OVERHEAD	0.0073***	0.0073***	0.0857***	0.1162***	-32.85***	-31.07***	-28.42***	-26.548**	-0.0011	8.33E-05	-0.038***	-0.039***
	(7.374)	(7.301)	(2.087)	(6.187)	(-3.648)	(-2.661)	(-2.779)	(-2.188)	(-0.1714)	(0.0097)	(-3.249)	(-2.906)
SIZE	-0.0008***	-0.001***	-0.019***	-0.018***	1.5901	10.965***	6.082***	18.547***	-0.0014	0.002	-0.00025	-0.0104*
	(-4.414)	(-2.809)	(-12.122)	(-3.355)	(1.013)	(3.042)	(3.402)	(4.395)	(-1.227)	(0.703)	(-0.089)	(-1.658)
R-square	0.5	0.5	0.45	0.47	0.32	0.15	0.24	0.1	0.79	0.76	0.79	0.71
Hausman test	46.121***	NA	61.699***	NA	35.071***	NA	39.231***	NA	404.52***	NA	203.42***	NA
J-statistics	NA	33.37	NA	44.31	NA	5.3	NA	6.11	NA	2.62	NA	0.69
Number of observations	1983	1983	1978	1978	1935	1935	1937	1937	1992	1992	1584	1584

Notes: SDROA (*SDROE*) is the standard deviation of return on average assets (return on average equity) calculated from a three-period rolling window. *ZROA* (*ZROE*) is the Z-score index based on return on average assets (return on average equity). *LERNER* is the Lerner index capturing the degree of bank competition. *GDPG* is the real gross domestic product growth rate. *INF* is the inflation rate. *LDR* is the ratio of total loans to total deposits. *LLR* is the ratio of loan loss reserves to total loans. *LOANG* is the annual loan growth rate. *OVERHEAD* is the ratio of operating expenses to total assets. *SIZE* is the logarithm of total average assets. Estimations are carried out using the Panel Least Squares with individual and time fixed-effects (FE), as well as using the Generalized Method of Moment (GMM) with individual and time fixed-effects. For those using the GMM, *LERNER* is instrumented with the Economic Freedom index (*ECOFREE*), the Rule of Law index (*RLAW*) and the ratio of stock market capitalization to GDP (*STOCK*). Hausman test for random effects is provided, as well as *J-statistic* for over identification condition. The *t-statistics* values are in parentheses. A constant is included but not reported.

Table 5. The influence of economic growth on the nexus between market power in banking and financial stability.

	SDROA		*SDROE*		*ZROA*		*ZROE*		*EQTA*		*CAR*	
Explanatory variables	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*	*FE*	*GMM*
LERNER	0.0184***	0.0514	0.2762***	1.435**	-52.67***	-400.5***	-51.574**	-510.6***	-0.0366**	-0.1072	0.0737***	0.2203**
	(4.175)	(1.496)	(4.078)	(2.421)	(-2.612)	(-3.753)	(-2.396)	(-4.491)	(-2.459)	(-1.348)	(2.72)	(2.249)
*LERNER*GDPG*	-0.002***	-0.0101*	-0.024***	-0.2059**	4.445**	43.777**	3.72*	53.302***	0.0044***	0.011	-0.007***	-0.015
	(-3.939)	(-1.956)	(-3.629)	(-2.439)	(2.239)	(2.557)	(1.762)	(2.957)	(3.033)	(0.9156)	(-2.638)	(-0.8571)
GDPG	0.2714***	0.4862***	3.876***	9.319***	-289.05**	-1633***	-383.4***	-2094***	-0.0526	-0.2983	0.1062	0.4935
	(4.779)	(2.959)	(4.301)	(3.475)	(-2.226)	(-3.155)	(-2.698)	(-3.862)	(-0.5429)	(-0.8073)	(0.6501)	(1.154)
INF	0.0302	0.0392	0.3101	0.5468	-12.669	-80.312	-2.115	-85.619	0.0464	0.0344	0.0519	0.0585
	(1.184)	(1.301)	(0.5993)	(0.934)	(-0.1989)	(-1.035)	(-0.0271)	(-0.969)	(0.9946)	(0.4379)	(0.6172)	(0.6644)
LDR	-0.027***	-0.041***	-0.278***	-0.523***	26.493**	64.42**	39.511***	87.933***	0.0896***	0.0944***	-0.0399**	-0.0424
	(-3.815)	(-3.743)	(-3.227)	(-3.401)	(2.275)	(2.303)	(2.785)	(2.739)	(10.407)	(5.146)	(-2.417)	(-1.326)
LLR	-0.0245	0.0241	-0.18303	0.5327	-96.45***	-171.29*	-37.46	-116.15	-0.259***	-0.2621	0.1769***	0.1337
	(-1.374)	(0.7693)	(-0.8067)	(1.231)	(-3.417)	(-1.948)	(-1.312)	-3.145	(-12.463)	(-1.303)	(3.231)	(1.323)
LOANG	0.0019	0.0079**	0.0126	0.0863*	-6.606**	-10.218	-1.639	-0.2866	-0.013***	-0.0124*	-0.037***	-0.042***
	(1.484)	(2.169)	(0.8649)	(1.851)	(-2.208)	(-0.9816)	(-0.6023)	(-1.238)	(-6.029)	(-1.807)	(-8.326)	(-4.841)
OVERHEAD	0.0024	-0.0027	0.1521*	0.0296	-29.49***	-0.3674	-25.58***	11.975	0.0022	0.0074	-0.043***	-0.048***
	(0.6932)	(-0.5171)	(1.671)	(0.2556)	(-3.236)	(-0.0231)	(-2.771)	(0.6783)	(0.3281)	(0.4222)	(-3.598)	(-2.907)
SIZE	-0.002***	-0.00034	-0.038***	-0.0274	2.361	6.348*	6.718***	13.118***	-0.00062	0.00084	-0.0017	-0.0078
	(-4.209)	(-0.3008)	(-3.604)	(-1.513)	(1.471)	(1.723)	(2.792)	(3.186)	(-0.5404)	(0.4165)	(-0.5925)	(-1.459)
R-square	0.34	0.35	0.43	0.29	0.32	0.32	0.24	0.23	0.79	0.79	0.79	0.78
Hausman test	133.34***	NA	44.57***	NA	35.04***	NA	38.753***	NA	473.03***	NA	189.89***	NA
J-statistic	NA	6.67	NA	10.18	NA	0.14	NA	0.0102	NA	2.04	NA	0.18
Number of observations	1983	1983	1978	1978	1935	1935	1937	1937	1992	1992	1584	1584

Notes: SDROA (*SDROE*) is the standard deviation of return on average assets (return on average equity) calculated from a three-period rolling window. *ZROA* (*ZROE*) is the Z-score index based on return on average assets (return on average equity). *LERNER* is the Lerner index capturing the degree of bank competition. *GDPG* is the real gross domestic product growth rate. *INF* is the inflation rate. *LDR* is the ratio of total loans to total deposits. *LLR* is the ratio of loan loss reserves to total loans. *LOANG* is the annual loan growth rate. *OVERHEAD* is the ratio of operating expenses to total assets. *SIZE* is the logarithm of total average assets. Estimations are carried out using the Panel Least Squares with individual and time fixed-effects (FE), as well as using the Generalized Method of Moment (GMM) with individual and time fixed-effects. For those using the GMM, *LERNER* is instrumented with the Economic Freedom index (*ECOFREE*), the Rule of Law index (*RLAW*) and the ratio of stock market capitalization to GDP (*STOCK*). Hausman test for random effects is provided, as well as *J-statistic* for over identification condition. The *t-statistics* values are in parentheses. A constant is included but not reported.