The Indonesian Capital Market Review

Volume 9
Number 2 *July*

Article 3

7-30-2017

The Effect of Competition Levels and Banking Concentration on Systemic Risks: Indonesia's Case

I. G. B. Erri Wibowo
Faculty of Economics and Business, Universitas Indonesia

Buddi Wibowo
Faculty of Economics and Business, Universitas Indonesia, buddi.wibowo@ui.ac.id

Recommended Citation

Wibowo, I. G. B. Erri and Wibowo, Buddi (2017) "The Effect of Competition Levels and Banking Concentration on Systemic Risks: Indonesia's Case," *The Indonesian Capital Market Review*: Vol. 9 : No. 2 , Article 3.
DOI: 10.21002/icmr.v9i2.7138
Available at: https://scholarhub.ui.ac.id/icmr/vol9/iss2/3

Indonesian Capital Market Review 9 (2017) 85-100

INDONESIAN
CAPITAL MARKET REVIEW

The Effect of Competition Levels and Banking Concentration on Systemic Risks: Indonesia's Case

I G. B. Erri Wibowo and Buddi Wibowo*
Graduate School of Management, Faculty of Economics and Business, Universitas Indonesia, Depok, Indonesia

(Received: January 2017/ Revised: November 2017 / Accepted: November 2017 / Available Online: Desember 2017)

This article analyzes the relationship between Indonesian banking competition, concentration, and systemic risk, using the characteristics of individual banks and state variables as control variables. This article uses the Panzar–Rosse Model and Concentration Ratio to measure banking competition and concentration, while measuring systemic risk by applying CoVaR. The empirical result shows that concentration and competition increase systemic risk. This means increasing competition leads banks to take higher risks, and also shows that banks with high market power tend to charge higher interest rates, thus increasing systemic risk. The Net Interest Margin as a control variable is statistically significant in competition-systemic risk models as well as in concentration-systemic risks. These findings support the competition-fragility view that banking system stability is seriously affected by banking competition level, especially in decreasing net interest margin periods. On an individual bank level, the competition-systemic risk relationship depends on the bank size and the interbank deposit ratio, but the capital structure and demand-deposit to total funding ratio are not significant.

Keywords: *Banking competition; Concentration; Fragility; Systemic Risk*

JEL classification: G21; L11; L25

Introduction

The US financial crisis in 2007 to 2009, and the subsequent global crisis, has motivated scholars to review and scrutinize research on systemic risk. One debate among academics relates to the effect of banking competition levels on banking stability, in which systemic risk has been a particular concern. There are conflicting views on this matter. The traditional view of competition-fragility argues that banks in a competitive market are not obtaining sufficient monopoly rents and thus generate low profits and lower capital ratios. Alternatively, some academics hold a view of competition-stability that posits that in a less competitive banking industry, banks become more aggressive in taking risks. Where specifically big and important banks are concerned, such scholars assume that the bank is deemed 'too big to fail' and will be bailed out by the government in the event of financial difficulties (Acharya, 2009; Acharya et al, 2017; Beck, De Jonghe, & Schepens, 2013).

The competition-stability view suggests that competition leads to greater stability (Beck, De Jonghe, & Schepens, 2013). In a non-competitive industry, banks whose stronger market

* Corresponding author's email: buddi.wibowo@ui.ac.id

power tend to set higher loan interest rates – which may induce adverse selection – are likely to be less stable; riskier borrowers obtain more loan allocations than low risk borrowers, who generally have more diversified sources of financing besides bank loans. Because the majority of loans are allocated to high risk borrowers, banks are exposed to a greater default of risk and to lower performance stability. In competitive banking markets, loan interest rates are lower, and bank size and market power are similar. This drives banks to be more operationally efficient and more prudent in allocating loans, resulting in a positive link between bank competition and stability (Boyd & De Nicoló, 2005). Conversely, competition fragility suggests that excessive competition drives bank to take more aggressive actions to maintain its market share and its profitability. Banks reduce their requirements and prudential measures taken in allocating loans to borrowers. They may also jump into new and opaque market segments, increasing the bank's average default rates. A more competitive banking industry also creates short-term bank-customer relationships, since customers may easily switch to competing banks. This short-term relationship generates riskier and more expensive bank loan evaluation and monitoring. Such conflicting viewpoints have a very serious impact on banking regulations, as to whether they should shift towards encouraging a more competitive banking environment, or let just a few big banks dominate the market.

It is widely believed that regulations may induce competition through some measures that affect industry concentration (Anginer, Demirguc-Kunt, & Zhu, 2014; Martinez-Miera & Repullo, 2010). Through the Indonesian Banking Architecture policy, the Indonesia Financial Services Authority states that banks in Indonesia need to be consolidated. In this regard, small banks are encouraged to merge so as to increase bank stability expectedly. It has been widely agreed that regulators want to see fewer banks, but a greater amount of bank assets. However, some researchers show that concentration is not always a good indicator of competition levels (Bikker & Haaf, 2002; Shaffer, 2004). A more concentrated industry is not always a more competitive one, and vice versa. Berger, Klapper, and Turk-Ariss (2009) show that competition and concentration may coexist and can simultaneously induce stability or fragility within the banking industry.

Industry structure is not the most important determinant of industry competition level. Schmalensee (1982), a proponent of the New Industrial Organization (NIO), argues that the behavior of individual firms is an important factor that should be considered simultaneously with concentration, in order to explain the industry's competitive environment. Baumol (1982) and Baumol et al. (1983) propose a theory of contestability that introduces a variety of non-structural competition indicators for measuring firms' competitive behavior.

In Indonesia, the discussion of the relationship between the level of competition and banking stability – specifically systemic risk – has always been a hot topic. The number of banks in Indonesia today is considered excessive and fragile, such that they may threat banking stability across the industry. On the other hand, Indonesia's banking industry is dominated by just a few big banks. Such circumstances illustrate the pertinence of the following empirical study, which examines the two conflicting views of the competition-stability relationship and the competition-concentration measurement controversy, using Indonesian banking data. Individual banks' systemic risk impact estimations and time series analyses give a deeper and clearer understanding of this strand of research, an area that previous studies have not addressed.

This study analyzes the relationship between competition, levels of banking concentration in Indonesia, and systemic risk. In addition, the study also considers the characteristics that affect the contributions of each bank to systemic risk as a control variable in the relationship model. Moreover, macroeconomic variables are also included as control variables. It is noted that current academic discourse has not yet determined the best model to measure systemic risk.

This study uses a robust measurement methodology for systemic risk (CoVaR), concentra-

tion, and competition levels. The study also observes the effects of individual banking characteristics that have a significant influence on the relations hypothesized. Previous research on banks' systemic risk in Indonesia use simple methods to measure systemic risk and competition. Lestari (2014), for example, observes the effects of several specific banking factors and macro variables on Indonesia's systemic risks, and Lenisastri (2009) focuses on the impact of foreign banks on the Indonesian banking system's competition level and stability. Both use the concentration ratio to measure competition and Z-score as systemic risk measurement.

In the next section, we give a theoretical overview of previous studies. The research methodology is described in the following section, subsequently accompanied by a discussion relating to the level of competition, the degree of concentration, systemic risk, and the relationship between these factors. Finally, we present conclusions of the study.

Literature Review

In a perfect competitive market, all banks behave as price-takers and have no incentive to help troubled banks in need of liquidity. Troubled banks eventually declare bankruptcy, something that has no significant impact on the entire industry (Allen & Gale, 2004). In imperfect competitive markets, banks tend to cooperate and help each other to cope with temporary liquidity shortages. This is generally because their businesses correlate to some extent, and defaulted banks can have serious repercussions for all other banks. Systemic risk tends to be higher in an imperfect competitive banking industry (Berger, Klapper, & Turk-Ariss, 2009).

On the other hand, Allen and Gale (2004) show that a concentrated banking system may tend towards lower systemic risk because having a few large dominant financial institutions create more stability than many small weak banks across the industry. Fewer large banks are easier to monitor, and have enough resources to develop a more reliable, sophisticated, and supportive internal banking information system, and to sustain customer loyalty through more a more complete product and service. They are also therefore more resilient to economic and demand shocks. Larger banks are assumed to enjoy economies of scales and scope so that they have comparative advantages in creating new products and services, but can still maintain a favorable level of efficiency and profitability.

At the same time, bank defaults are more likely to occur in less concentrated banking systems because there is no powerful bank to act as a buffer or stabilizer when a smaller bank suffers asset deterioration as a result of external macroeconomic and liquidity shocks (Berger, et al. 2009). However, the alternative competition-stability hypothesis states a contrasting position: namely, more competitive and/or less concentrated banking systems are more stable (Barth et al., 2012). Large banks in a concentrated banking system are more exposed to greater moral hazards, as they tend to be overconfident regarding receipt of government guarantees that encourage risk-taking behavior and fragility. On the other hand, Barth et al (2012) show that regulators are usually more concerned with big bank failures ('Too Big To Fail') and thus neglect to establish prudent regulatory settings for the whole industry.

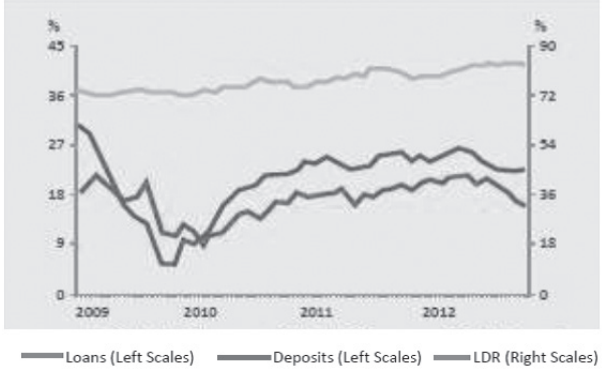
Some empirical researches have tested concentration, competition, and banking stability relationships across countries. Yeyati and Micco (2007) show that in Latin America, commercial banks have a positive link between bank risk (as measured by the Z-score) and competition (as gauged by Panzar and Rosse 1987, H-statistic), whereas the coefficient for bank concentration is not significant. The results of research conducted by Yeyati and Micco (2007) support the competition-fragility paradigm. Schaeck and Cihak (2008) show that banks in ten European countries and in the US have a positive link between competition level (as measured by the Boone indicator) and efficiency. They also find that more concentrated banking markets are more stable. Schaeck et al. (2009) show that competition (as measured by the Panzar Rosse H-statistic) reduces systemic risk, even after controlling for banking system concentration.

Table 1. Indonesia Commercial Banks Core Capital

Core Capital	2010		2011		2012	
	Number of Bank	%	Number of Bank	%	Number of Bank	%
more than Rp 10 Trillion	8	6.56	9	7.5	10	8.34
Rp 1 Trilion -Rp 10 Trillion	40	32.79	44	36.67	49	40.8
Rp 100 Billion - Rp 1 Trillion	74	60.66	67	55.83	61	50.8
Lower than Rp 100 Billion	0	0	0	0	0	0
Total	122	100	120	100	120	100

Source: Bank Indonesia (2012)

Figure 1. Indonesia Commercial Bank Loan, Deposits, and LDR



The Measurement for Banking Competition

Market competition can be classified into four types: perfect competition, monopoly, oligopoly, and monopolistic competition. The measurement method for industry competition levels can be divided into two major approaches:

Structural Approach. This approach states that the structure of the market (market concentration) is associated with competition. Bikker and Haaf (2002) describe the Concentration Index (Concentration Ratio or CRN) and the Herfindahl Hirschman Index as two competition structural approach measurements that are frequently used.

Non-Structural Approach. This approach is rooted in Industrial Organization Theory. Models using this approach examine competition and analyze the behavior of the company without using explicit information about the structure of the market. Models included in this approach include:

Markup Test Approach/Conjectural Variations (CV). This approach constructs a structural model consisting of the supply and demand equation, considering a markup price over marginal cost as a measurement of company market power. The Markup Test approach has two advantages that explicitly model the demand conditions, costs, and profit maximization confronted by market participants.

Panzar-Rosse Approach. Panzar and Rosse (1987) formulate a simple model that measures the relationship of bank revenue to various input variables. Panzar and Rosse assume that banks operate on a long-term balance and that their performance is influenced by the actions of other banks. The Panzar-Rosse approach measures competition as a bank marginal cost sensitivity to bank revenue changes.

Schaffer (2004) summarizes the advantages and disadvantages of each measurement method. According to Schaffer, owing to its simplicity, the Panzar-Rosse model is more applicable and thus widely used in empirical studies. The weakness of this approach, which is relevant for research on the industry's competition level, is that it cannot identify extreme competition levels such as monopsony or a very segmented market.

Structure and growth in Indonesian commercial banks can be observed in Table 1 and

Graphic 1. Based on the 2012 Bank Indonesia Report of Banking Supervision, there are 120 conventional commercial banks, 9 Islamic banks, and 1.653 rural banks. Of 120 commercial banks, only 10 banks hold core capital of more than 10 trillion rupiahs.

Systemic Risks

The systemic risk measurement methodology consists of two main approaches that can be described as macroprudential and microprudential. The macroprudential approach sees a banking system as a portfolio of assets that may collapse simultaneously owing to high asset correlation. In the realm of macro-prudential measures, academics propose various methods to determine whether a bank may be included as a Systematically Important Bank (SIB). On the other hand, microprudential approach stresses that individual bank's defaults may impact an entire banking system.

CoVaR and MES comprise systemic risk models that are used and espoused by many academics and practitioners. Both methods convey different views on how failures of financial institutions contribute to systemic risk. Acharya et al. (2010) explain that the MES defines the systemic risk contribution of a financial institution as the average stock return of each institution when the whole financial system is in trouble (i.e. when the market experiences 5% worst days). Instead of stock return, Adrian and Brunnermeier (2011) define CoVaR as the value at risk (VaR) of the financial system, conditional on an institution's VaR. Systemically important financial institutions are financial institutions that have a significant effect on financial systemic risk when institutions experience financial distress, entailing banks to run and disrupt financial systems as a whole.

This study uses the CoVaR approach to measure systemic risk and to test the relationship between the level of banking competition and systemic risk at bank level. In addition, CoVaR uses banks' financial statements and stock returns, both of which are available and relatively easy to work with, compared with methods that use credit default spreads that are difficult to estimate and require cumbersome procedures and model owing to unavailable data.

Competition and Systemic Risks

There are conflicting views about the influence of banking competition on banking stability. In the traditional view, which bases its argument on the competition-fragility proposition, Keeley (1990) argues the banks in a competitive market are not able to get sufficient monopoly rents. As such, they generate low profits and low capital ratios. Consequently, banks became more aggressive in taking risks and are more vulnerable to economic shock. In line with this argument, Hellman et al. (2000) find that more concentrated banking sectors are more stable because the banks reduce their risks and enjoy monopoly profits (concentration stability). Studies conducted recently by Llewellyn (2007), Brunnermeier (2009), and Milne (2009) show that excessive deregulation and competition were both significant factors in causing the financial crisis in the US and UK.

Contrastingly, instead of competition-fragility, some academics view the competition-stability argument as aligning more to the reality of the industry. A less competitive banking industry make banks become more aggressive in taking risks, because banks assume they will be bailed out by the government in the event of financial difficulties. Boyd and De Nicolo (2005) state that banks with substantial market power tend to charge higher interest rates so that the debtors' risk of defaulting is higher. In the more competitive banking industry, the interest rate will be lower so that banks are more stable. Anginer et al. (2014) have produced research based on data from 63 from 1997 to 2009 that align with this argument. The authors conclude that competition encourages banks to diversify risk so that they become more stable. In addition, regulatory and institutional frameworks also play an important role in stabilizing the banking system.

Fu, Lin, and Molyneux (2014) examine the effects of banking competition on financial stability in 14 Asia Pacific countries from 2003 to 2010. They observe the effect of competition,

concentration, regulation, and national banking institutions on the fragility of the banking system. Their findings also align with the competition-stability hypothesis. Fu et al. (2014) conclude that competition and lower market powers drive more prudent risk-taking behavior among banks, after controlling for macro variables, bank-specific characteristics, and the regulatory and institutional framework. In terms of regulations and institutions, higher entry restrictions are generally beneficial to banking stability. The wider deposit insurance scheme also increases banking fragility.

Martinez-Miera and Repullo (2010), in explaining this contradiction, argue that the relationship of competition and financial stability is U-shaped (non-linear). Competition encourages lower interest rates so that the risks of debtors are smaller and banks are more stable. However, lower interest rates also reduce bank income from current loans (performing loans) so the given bank is more vulnerable to shock. This causes the results of statistical tests on the relationship between competition and stability of the banking system to be conflicting. The results of empirical tests by Jimenez, Lopez, and Saurina (2013) within Spanish bank data reinforce this U-shaped relationship.

Bretschger et al. (2012) examine the effects of profitability on the relationship between banking competition and stability. The authors examine data from 160 countries from 1970 to 2009. Their results support the competition-stability view. Bretschger et al. (2012) also conclude that market concentration does not affect systemic risk directly, but instead opens opportunities for banks which have strong market power to reach higher profitability levels, subsequently affecting bank risk-taking and stability.

Research Methods

The Relationship Between the Level of Banking Competition, Banking Industry Concentration, and Systemic Risks

The Relationship Between the Level of Banking Competition, Banking Industry Concentration and Systemic Risks is modeled with the panel data regression equation below:

$$Risk_{ijt} = \beta_0 + \beta_1 Competition_{ijt} + \phi Bank_{ijt} + \gamma Market_{ijt} + \alpha_i + \lambda_t + \varepsilon_{ijt} \quad (1)$$

where Risk is systematic risk, Bank is specific bank characteristics as control variables, and Market are market condition as state variables. The Specific Bank variables are Size, Net Interest Margin, capital structure (capital to total assets ratio), profitability (ROA), and bank capital structure that is Demand Deposit to Capital ratio (DDC) and inter-bank loans (BDEP). The economy state variable is monthly BI Rate.

Banking Competition and Concentration

Banking concentration is measured using a structural approach comprising CR5 concentration index (concentration of 5 largest banks). This method is chosen owing to its simplicity and intuition. The concentration ratio is calculated using the following equation model:

$$CR = \sum_{i=1}^{k} s_i \quad (2)$$

CR is the ratio of Concentration Index, s_i is the market share, k is the number of banks in the calculation.

To measure banking competition we use the Panzar-Rosse model. The model follows Bikker & Haaf (2002):

$$\ln INTR = \alpha + (\beta \ln AFR + \gamma \ln PPE + \delta \ln PCE) + \xi \ln B + \eta \ln OI + e \quad (3)$$

where INTR is the ratio of interest income to total asset in the quarter t, AFR (Average Funding Rate) is the ratio of interest expense to total funds, PPE (Price Personnel Expense) is the ratio personnel expense to total balance sheet. PCE (Price Capital Expenditure) is the ratio of physical CAPEX and other expense to fixed assets, BSF is a bank exogenous factor, which describes the risks, costs, size, and structure of the bank, which affects the function of marginal revenue and costs. As a proxy of risk components, this study uses the ratio of capital to to-

tal assets (EQ), the ratio of loans to total assets (LO), the ratio of loan to deposit ratio (LDR), and the ratio of loss provisions to loans (LLP). As a proxy of deposit structure, the ratio of demand deposits to total bank funding (DDC) is used to capture the differences in the structure of deposits. For bank size measures, the log of total assets (SIZE) is used. OI as Other Income is the ratio of other income to the total balance sheet at quarter t, and e is the error term.

The level of competition is measured by calculating the H statistic per month through a rolling sample of 12 months, with H = β + γ + δ. Bank competition level is classified based on the results of the H statistic where H ≤ 0 means a market is monopoly, oligopoly with perfect collusion or short term conjectural variation oligopoly, 0 < H ≤ 1 means a monopolistic competition, and H = 1 is for perfect competition.

We also conducted a test over the long run equilibrium, as a prerequisite of the Panzar–Rosse model that Matthews, Murinde, and Zhao (2007) assert. There is a long-term equilibrium if the profits of a bank are not related to the input factor (the sum of the input factor coefficients equal to zero), which is estimated by the following models:

$$\ln ROA = \alpha + (\beta \ln AFR + \gamma \ln PPE + \delta \ln PCE) + \xi \ln BSF + \eta \ln OI + e \quad (4)$$

If E=β+γ+δ=0, then there is strong indication of long run equilibrium, while if E<0 , a disequilibrium is indicated.

Systemic Risks

The measurement of individual bank contributions to systemic risk using ΔCoVaR and CoVAR is estimated using Quantile Regression, following Adrian and Brunnermeier (2011). The method is chosen because it does not require assumptions around the distribution of existing errors, and is more appropriate for the limited amount of Indonesian banking data available. The time series model such as MGARCH/ GARCH requires some assumptions about error distribution and data frequency. The use of Quantile Regression follows Koenker (2005).

Adrian and Brunnermeier (2011) work with the stock return of financial institutions i (Rit) model with the following equation:

$$R_t^i = \frac{ME_t^i.LEV_t^i - ME_{t-1}^i.LEV_{t-1}^i}{ME_{t-1}^i.LEV_{t-1}^i} = \frac{A_t^i.A_{t-1}^i}{A_{t-1}^i} \quad (5)$$

where ME_t^i is the total equity market value of financial institutions i and LEV_t^i is bank leverage based on the ratio of total assets to equity book value.

To capture the time varying on VAR_t^i and $CoVaR_{q,t}^{system|i}$, Adrian and Brunnermeier run two quantile regressions, of which the first equation is the individual bank return, R_t^i as dependent variable and economy state variable M as an independent variable, and the second equation is the banking system return, R_t^{system} as dependent variable and R_t^i and economy state variable as the independent variable. R_t^{system} is the average stock return of all existing financial institutions in a system.

The two equations are:

$$R_t^i = \alpha^i + \gamma^i M_{t-1} + \varepsilon_t^i \quad (6)$$

$$R_t^{system} = \alpha^{system|i} + \beta^{system|i} R_t^i + \gamma^{system|i} M_{t-1} + \varepsilon_t^{system|i} \quad (7)$$

After obtaining quantile regression parameters from the two above equations, the predicted value of VaR and CoVaR are calculated by:

$$VAR_t^i = \alpha^i + \gamma^i M_{t-1} \quad (8)$$

$$R_t^{system} = \alpha^{system|i} + \beta^{system|i} R_t^i + \gamma^{system|i} M_{t-1} + \varepsilon_t^{system|i} \quad (9)$$

An individual bank's contribution to systemic risk, $\Delta CoVar^i_t$ for each institution can be calculated using this equation:

$$\Delta CoVaR_t^i(q) = CoVaR_t^i(q) + CoVaR_t^i(50\%) \quad (10)$$

$$= \beta^{system|i} \left(VaR_q^i(q) - VaR_q^i(50\%) \right) \quad (11)$$

As a state variable, referring to Adrian and Brunnermeier (2011), lagged one period in-

Figure 2. Graph of The Level of Banking Concentration Trends

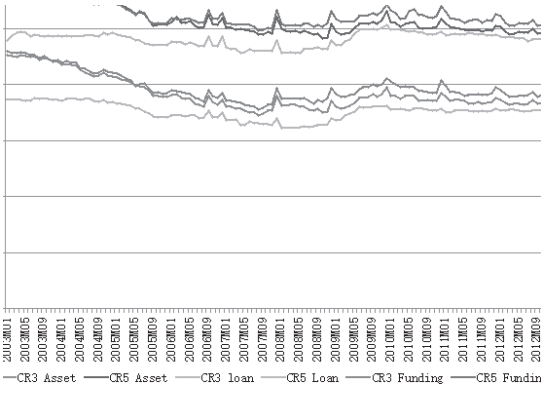


Table 2. Commercial Banks Competition with Dynamic Application Model

Variable	Coefficient	Standard Error	P-Stat
A	0.788236	(0.044005)	0.0000
LOG(AFR)	0.403122	(0.003627)	0.0000
LOG(PCE)	0.127756	(0.002694)	0.0000
LOG(PPE)	0.314881	(0.003570)	0.0000
LOG(LO)	0.529961	(0.008617)	0.0000
LOG(OI_)	-0.138324	(0.018562)	0.0000
LOG(LDR)	-0.484569	(0.008489)	0.0000
LOG(LLP)	0.027159	(0.002586)	0.0000
LOG(EQ_)	0.689035	(0.023723)	0.0000
SIZE	0.014123	(0.001436)	0.0000
LOG(BIRATE)	0.258739	(0.017107)	0.0000
LOG(INF)	-0.071242	(0.008000)	0.0000
LOG(INTR(-1))	0.102885	(0.003123)	0.0000
	Adjusted R-squared	0.900857	
	Prob(F-statistic)	0.000000	
	Akaike info criterion	0.066579	
	Durbin-Watson stat	0.490321	

dexed stock Return, BI Rate return, and JIBOR return are included as control variables. We also include Average Monthly USD-IDR Exchange rate and Exchange Rate Volatility to control for the influence of foreign capital on the stock market.

Data

We use monthly financial reports of commercial banks from Bank Indonesia, and market value of bank shares from Reuters. We measure the level of banking competition of all commercial banks from 2003 to 2013. Total assets of all listed commercial banks used in this study cover 95% of the total banking industry assets, so that the value of H statistics obtained is fairly robust.

Systemic risk is estimated for just 16 of the 33 Indonesian listed banks from 2004 to 2013. We observe just 16 banks as sample data because CoVaR method relies on the bank market value information for the long-observed sample period. Total assets of these 16 listed commercial banks comprise 70% of Indonesia's total banking assets.

Result and Discussions

Indonesian Banking Concentration

Figure 2 shows a decline in the level of banking concentration (CR5) from 0.6 to 0.5 during the period 200 to 2005. After this period, the level of banking concentration fluctuates in a range slightly above 0.5. The Merger of Bank Niaga and Bank Lippo into CIMB Niaga in December 2009 changes the composition of the five largest banks but does not alter the level of banking concentration.

Figure 3. Monthly Banking Competition Dynamics in Indonesia

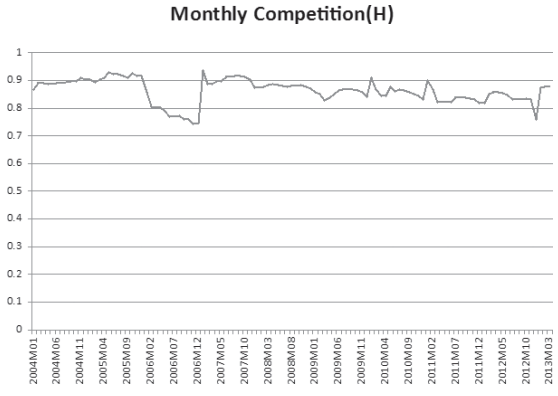


Table 3. Summary of VaR Statistic Values

	VAR_ PUNDI	VAR_ AGRAHA	VAR_ BVIC	VAR_ MNC	VAR_ BNGA	VAR_ MEGA	VAR_ NISP	VAR_ PRMT	VAR_ PNBN	VAR_ BNII	VAR_ BBNI	VAR_ BMRI	VAR_ BDMN	VAR_ BBRI	VAR_ BBCA	VAR_ QNB	VAR_ SYSTEM
Mean	-0.3245	-0.2041	-0.2028	-0.1861	-0.1469	-0.1440	-0.1363	-0.1336	-0.1191	-0.1077	-0.1032	-0.0969	-0.0851	-0.0811	-0.0627	-0.0557	-0.0586
Median	-0.2713	-0.2207	-0.1980	-0.1775	-0.1468	-0.1357	-0.1428	-0.1385	-0.1077	-0.1089	-0.0984	-0.0855	-0.0767	-0.0818	-0.0633	-0.0580	-0.0542
Max	-0.0880	0.0597	-0.0447	-0.0584	-0.0295	0.0399	0.0161	-0.0356	0.0097	-0.0220	0.0546	-0.0067	-0.0367	-0.0361	0.0367	0.0043	0.1166
Min	-1.6975	-0.3637	-0.4712	-0.6172	-0.2116	-0.2647	-0.3512	-0.1957	-0.3653	-0.2405	-0.4059	-0.5390	-0.3953	-0.1731	-0.1096	-0.0833	-0.3890
St. Dev	0.1942	0.0809	0.0661	0.0762	0.03414	0.0495	0.05573	0.0247	0.0634	0.0270	0.0570	0.06418	0.0477	0.01483	0.0163	0.01510	0.06768
Skew	-3.6782	0.7891	-1.5558	-2.4076	1.0642	0.5451	-0.5178	0.93536	-0.9589	-0.4469	-1.3576	-3.4377	-3.8625	-1.7871	1.8733	1.6091	-1.0657
Kurtosis	24.399	4.2303	7.5149	12.9557	5.4523	5.4220	6.1278	5.80355	5.17246	8.46138	9.74600	22.3125	23.1870	15.9421	14.9021	6.94589	7.34197

Indonesian Banking Industry Competition

As a prerequisite of the Panzar–Rosse model, the long-term equilibrium test is conducted by estimating model (4). Given ROA as dependent variables, we conducted a dynamic treatment model by adding a lagged variable of ROA (-1) as the independent variable (referring to Brooks (2008)). Wald test results with F-statistic tests on the data panel to value E = 0 (F (1.13909) = 10.22896) indicate that there is long-run equilibrium and that the Panzar-Rosse model is applicable.

The value of the Durbin-Watson statistic, which is quite small, indicates an autocorrelation (see Table 2). Brooks (2009) states that autocorrelation may occur in cross-sectional data such as ours owing to the regional dimension, which is not considered in the model. This problem usually occurs in analyzing US banking data that has significant differences among banks operating in different regions in the US. We continue using the Panzar-Rosse model since our sample covers all commercial banks in Indonesia, so there is no regional dimension problem in our data.

The estimated H-statistic (Panzar-Statistics) indicates the level of banking competition is 0.845759, conveying monopolistic competition. Banks have enough market power to set prices (interest rate), although pricing strategies still consider other banks' strategies operating in the same geographical area or engaging in similar products. This competition mode is characterized by free entry and exit in the long term. Because there are many competitors, collusion – as in the case of oligopoly – does not occur. The calculation of the level of bank competition within a 12-month rolling sample can be seen in Figure 3.

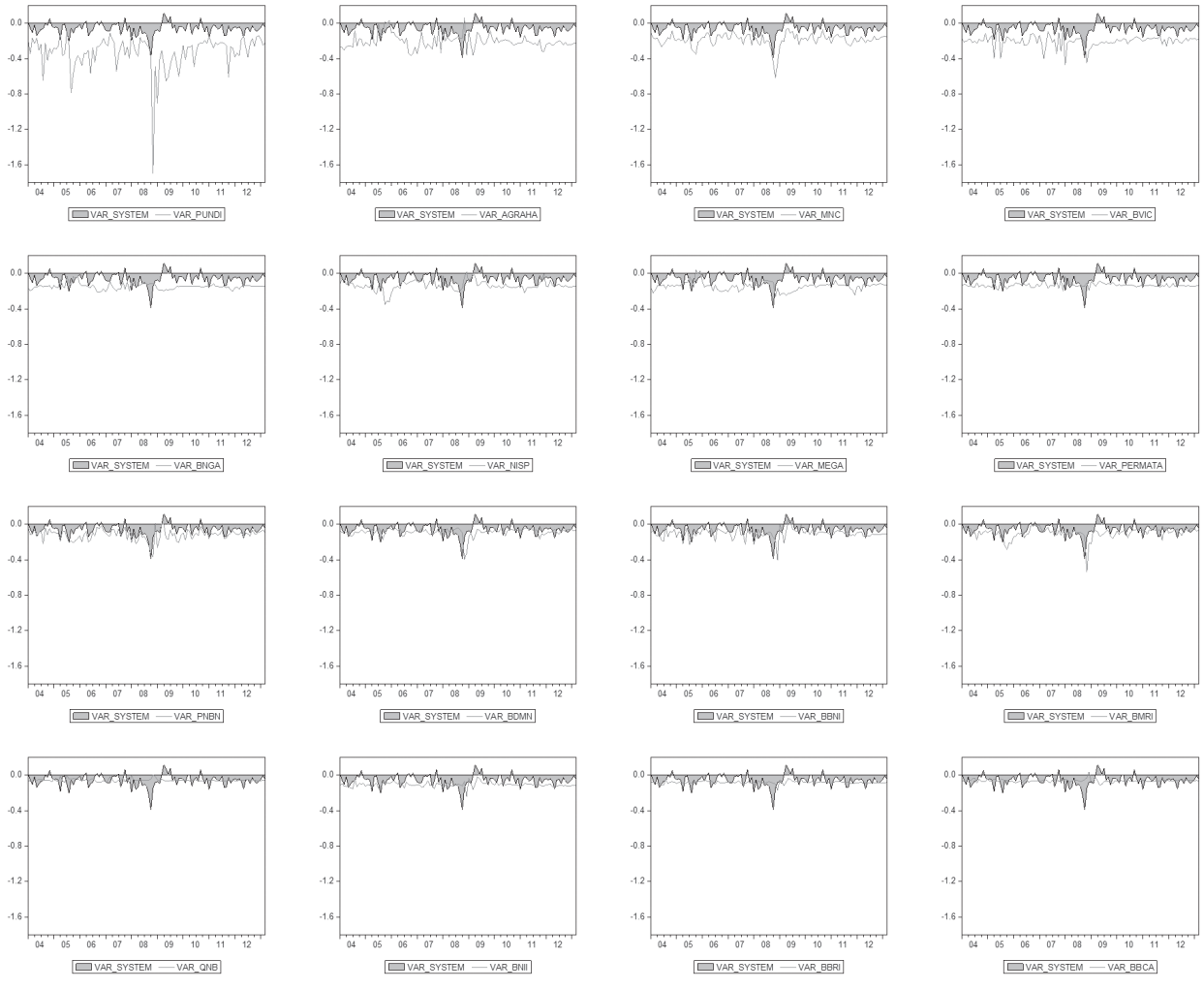
In general, the level of bank competition fluctuated in the range of 0.9 to 0.8. It decreased in 2006 following a decreased BI Rate from 8.25% in July 2005 to 12.75% in December 2005. Contrastingly, arising BI Rate in 2008 lowered banking competition.

Indonesian Banking Industry Systemic Risk

Individual banks' Value at Risk is presented in Table 3 and Figure 4.

Pundi Bank and Bank Artha Graha are banks with the highest VaR5% volatility. Pundi Bank has the lowest VaR value of -169%, while Bank Artha Graha has a VaR value of -36%. Based on the Pundi Bank VaR chart, we can categorize this bank as having a serious impact on Indonesian systemic risk, as perceived in the propaga-

Figure 4. Graph of Banking Value at Risk



tion of the VaR financial system. Other banks that have similar patterns were BVIC (Bank Victoria) and MNC banks, albeit with a smaller magnitude.

The average value of VaR system (-0058) was very small compared to all individual banks' VaR. The highest VaR system was -0.38, occurring in the global financial crisis of 2008. There were high VaR system fluctuations from 2008 to 2009 because of oscillating banking stock prices. Investors sold stock owing to the panic triggered by the 2008 global crisis, but they re-entered the market when it became clear that Indonesian banks were not significantly affected.

Table 4 summarizes the calculation of the statistical value on the bank contribution to the systemic risk (ΔCoVaR).

There are differences in the banks' rating composition in terms of ΔCoVaR (banks' contribution to systemic risk) and VaR. Bank Pundi and Bank Artha Graha, both having the highest VaR, only contribute -0.2% and -0.062% to systemic risk, respectively. Other small banks like Bank QNB Kesawan hardly contribute to systemic risk, on average.

On the other hand, large banks' systemic risk contribution were quite substantial. Nonetheless, contributions to systemic risk were not perfectly correlated to bank size. For example, Bank Niaga and Bank BNI, both of which have greater assets, contribute to systemic risk at a level that is far below Bank Permata's contribution.

Based on our estimation, BCA had the highest average value of ΔCoVaR (6.7%). In this regard, BCA was the most systemically important bank. Bank Mandiri, the largest bank during the observation period, had an average value ΔCoVaR that was 5.8% below BCA's contribu-

Figure 5. Individual Banks' Contribution to Systemic Risk (ΔCoVaR)

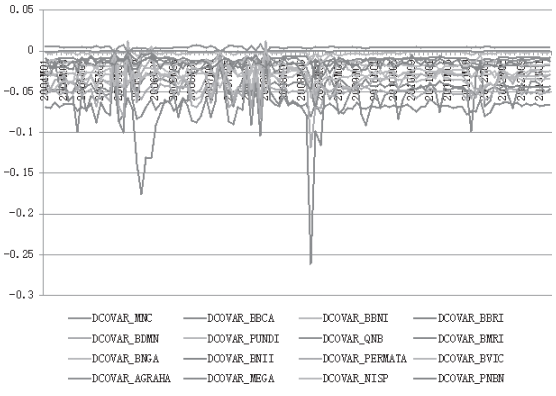


Table 4. Summary of ΔcoVaR Statistical Values

	Mean	Median	Maximum	Minimum	Std. Dev.	Skewness	Kurtosis
DCOVAR_BBCA	-0.067000	-0.067750	0.001695	-0.10434	0.015093	1.990818	10.286070
DCOVAR_BMRI	-0.058540	-0.052430	-0.012200	-0.26083	0.032389	-2.917350	16.782210
DCOVAR_PERMATA	-0.048740	-0.049960	0.011322	-0.08348	0.013253	1.748079	9.612942
DCOVAR_BBRI	-0.043270	-0.043450	-0.014580	-0.07055	0.008383	0.668572	5.975632
DCOVAR_BDMN	-0.035760	-0.033520	0.011375	-0.11838	0.015638	-1.026370	9.698079
DCOVAR_BNGA	-0.035040	-0.035020	0.008476	-0.05920	0.012189	1.070389	5.407765
DCOVAR_BBNI	-0.028750	-0.028780	-0.008780	-0.06368	0.006249	-1.061130	11.685840
DCOVAR_BVIC	-0.027300	-0.026130	-0.011800	-0.05613	0.006538	-1.388180	6.918478
DCOVAR_BNII	-0.017110	-0.017580	-0.007770	-0.03455	0.003783	-0.468870	6.446871
DCOVAR_NISP	-0.016040	-0.016600	0.002838	-0.03422	0.005497	0.242272	5.153187
DCOVAR_PNBN	-0.015990	-0.015020	-0.004510	-0.04619	0.006401	-1.540140	7.586560
DCOVAR_MNC	-0.011590	-0.011190	0.000463	-0.03384	0.004303	-1.210200	9.219121
DCOVAR_MEGA	-0.009230	-0.009010	-0.001290	-0.01574	0.002335	0.437726	4.365849
DCOVAR_PUNDI	-0.002550	-0.002180	0.000138	-0.01263	0.001506	-3.147610	20.107320
DCOVAR_AGRAHA	-0.000620	-0.000670	0.000466	-0.00125	0.000305	1.109724	5.161930
DCOVAR_QNB	0.004144	0.004223	0.008009	-0.00214	0.001531	-1.592950	8.405935

tion. However, Bank Mandiri had the highest ΔcoVaR volatility. Bank Mandiri's highest systemic risk contribution was amounted to -26% in October 2008 and -17% in October 2005. High Bank Mandiri's CoVaR volatility indicates that bank assets are an important factor in individual banks' contributions to systemic risk.

From our research, it also became clear that ΔCoVaR has a seasonal pattern. ΔCoVaR tends to fluctuate in the last quarter of the year when credit markets have a higher level of competition and high level of loan disbursement.

The Effect of Concentration and Competition on Banking Systemic Risks

Table 5 shows that Competition is statistically significant and has the opposite effect on systemic risk. This indicates that bank competition increases systemic risk (competition-fragility). The study also shows that the Net Interest Margin (NIM) significantly increases systemic risk. The significance of Net Interest Margin's effects on systemic risk in Indonesian banking is a result of types of bank competition. Since they operate in a monopolistic banking competition structure, each bank has the market power to set price. Owing to its strong position in the market, banks tend to maximize their profits while simultaneously taking higher risks by increasing the Net Interest Margin (NIM). Higher loan interest rates increase the average default risk of a bank's loan portfolio, threatening bank stability and increasing systemic risk.

The study's results also find that changes in BI Rate have a significant, positive relationship to systemic risk. Higher market interest rates drive higher systemic risk. Higher interest rates increase debtors' default probability, bringing

Table 5. The Effect of Competition on Systemic Risks

Variable	Coefficient	Standard Error	P-Stat
α	0.133284	(0.014483)	0.0000
COMPETITION(-1)	-0.050695	(0.013715)	0.0013
RBIRATE_	-0.037573	(0.019274)	0.0273
SIZE(-1)	-0.005132	(0.000376)	0.0000
NIM(-1)	-0.042488	(0.017498)	0.0153
EQ(-1)	0.003376	(0.010836)	0.7554
DDC(-1)	0.006877	(0.003684)	0.0923
COVAR(-1)	0.434432	(0.020795)	0.0000
	Adjusted R-squared	0.494779	
	Prob(F-statistic)	0.000000	
	Akaike info criterion	-4.825442	
	Durbin-Watson stat	2.153634	

Table 6. Banking Industry Concentration and Systemic Risks

Variable	Coefficient	Standard Error	P-Stat
α	0.146327	0.016705	0.0000
CR5ASSET(-1)	-0.105106	0.027673	0.0002
RBIRATE_1	-0.068563	0.017435	0.0001
SIZE(-1)	-0.005363	0.000374	0.0000
NIM(-1)	-0.029534	0.017433	0.0904
EQ(-1)	0.006611	0.010634	0.5343
DDC(-1)	0.005449	0.003631	0.1336
COVAR(-1)	0.423501	0.020409	0.0000
	Adjusted R-squared	0.513085	
	Prob(F-statistic)	0.000000	
	Akaike info criterion	-4.861762	
	Durbin-Watson stat	2.148583	

about more non-performing loans, lower bank stability, and higher systemic risk.

The effect of bank size on systemic risk is also positively significant. We can thus conclude that the risk-taking behavior of large banks is an important factor in generating systemic risk. However, banks' equity is not significant, which is an indication that banks' risk-taking behavior is not directly affected by banks' equity. Instead, banks' funding structures are more important to the risk-taking behaviors that they demonstrate. The amount of short term funding (DDC) in a bank's funding structure has a significant effect on systemic risk, although it is not excessive.

We also compare the effects of competition and concentration by estimating similar models but substituting competition with concentration. Table 6 illustrates the effect of banking concentration on systemic risk contribution.

Table 6 shows that banking concentration has a significant effect on systemic risk (concentration-fragility). Bank concentration shows a high significance, as a variable. All other variables in the model have similar significance level, except DDC (bank's funding structure)

By substituting competition with concentration as an explanatory variable, it can be seen that Net Interest Margin – which is still a significant variable – is an influential factor to systemic risk. This indicates that both competition and concentration increases systemic risk through the Net Interest Margin (NIM), though concentration has a higher magnitude of regression coefficient in the last model. The results relating to the effects of concentration on increasing systemic risk aligns with empirical studies into the effects of concentration levels on the Z-score in the banking system (Brestchger et al.2012). These findings are also consistent with Boyd and De Nicolo (2005), who state that the major banks with substantial market power tend to charge a higher interest rate to debtors, thus making them more susceptible to external shock and default threats.

The relationship between banks' funding structures (DDC) and systemic risk is not statistically significant if we include concentration, rather than competition, as an explanatory vari-

able of systemic risk. Banking industry concentration already reflects banks' funding structure strategies.

Conclusions

Our empirical test indicates that competition in Indonesia's banking market mimics a landscape of monopolistic competition, even though concentration of the five largest banks is quite high, in the range of 60-50%. Each bank has enough market power to set prices, because of their strong position in the market segment, either through product and service superiority, differentiation, location advantage, etc.

Banks with the highest level of systemic risk contribution (ΔCoVaR) are BCA, Bank Mandiri, Bank Permata, Bank BRI and Bank Danamon, subsequently. All these banks' contributions to Indonesia's systemic risk is equivalent to about 25% of systemic risk.

We also find that the level of competition and banking industry concentration significantly affects the banks' systemic risk (COVAR). These findings support the hypothesis of competition and concentration fragility. The effect of concentration on systemic risk is much higher than the effect of competition. Specific bank characteristics, including bank asset size, net interest margin, and bank funding structure, all have significant effects as control variables. However, the effects of funding structure disappear if we substitute competition with banking industry concentration. Concentration already reflects bank funding structure and dominates effects on systemic risk.

The highly significant net interest margin effect on systemic risk supports previous studies that find that increasing competition encourages banks to take higher risks. High levels of concentration and monopolistic competition also encourage banks with substantial market power to charge higher interest that increases the systemic risk of the entire financial system. The simultaneous effect of concentration, competition, and NIM indicate that concentration and competition both affect systemic risk through NIM.

Regulators should consider that increasing banking concentration – through consolidating the government bank, for example – will increase systemic risk. This policy will increase bank market power in charging higher interest rates and reach higher Net Interest Margin. Our empirical result shows that NIM play an important and effective channel of competition and concentration in boosting systemic risk.

References

Acharya, V., Pedersen, L., Philippon, T., & Richardson, M. (2017). Measuring systemic risk. *The Review of Financial Studies*, *30(1)*, 2–47. https://doi.org/10.1093/rfs/hhw088

Acharya, V. (2009). A theory of systemic risk and design of prudential bank regulation. *Journal of Financial Stability*. *5(3)*, 224-255 https://doi.org/10.1016/j.jfs.2009.02.001

Adrian, T., & Brunnermeier, M. K. (2016). CoVaR. *American Economic Review,* 106(7): 1705-41. https://doi.org/10.1257/aer.20120555

Allen, F., & Gale, D (2004). Competition and Financial Stability. *Journal of Money, Credit, and Banking*. 36(3), 453-480 https://doi.org/ 10.1353/mcb.2004.0038

Anginer, D., Demirguc-Kunt, A., & Zhu, M. (2014). How does bank competition affect systemic stability? *Journal Financial Intermediation, 23*(1), 1-26. https://doi.org/10.1016/j.jfi.2013.11.001

Bank Indonesia (2012). Laporan Pengawasan Perbankan. Departemen Penelitian dan Pengaturan Perbankan Bank Indonesia.

Barth, J. R., Prabha, A., & Swagel, P. (2012). Just how big is the too-big-to-fail problem? *Journal of Banking Regulation, 13*(4), 265–299. https://doi.org/10.1057/jbr.2012.13

Baumol, W. J. (1982). Contestable markets: An uprising in the theory of industry structure. *The American Economic Review, 72*(1), 1-15. http://www.jstor.org/stable/1808571

Baumol, W. J., Panzar, J.C., & Willig, R. D. (1983) Contestable markets: An uprising in

the theory of industry structure: Reply. *The American Economic Review, 73*(3), 491-496. http://www.jstor.org/stable/1808145

Beck, T., De Jonghe, O., & Schepens, G. (2013). Bank competition and stability: cross-country heterogeneity. *Journal of Financial Intermediation, 22*(2), 218-244. https://doi.org/10.1016/j.jfi.2012.07.001

Berger, A. N., Klapper, L. F., & Turk-Ariss, R. (2009). Bank competition and financial stability. *Journal of Financial Services Research, 35*(2), 99-118. https://link.springer.com/article/10.1007/s10693-008-0050-7

Bikker, J. A. & Haaf, K. (2002). Competition, concentration, and their relationship: an empirical analysis of the banking industry. *Journal of Banking and Finance., 26*(11), 2191-2214. https://doi.org/10.1016/S0378-4266(02)00205-4

Billio, M., Getmansky, M., Lo, A. W., & Pelizzon, L. (2010). Measuring Systemic Risk in the Finance and Insurance Sector. MIT Sloan School, Working paper # 4774-10. http://hdl.handle.net/1721.1/66679

Bisias, D., Flood, M. D., Lo, A. W., & Valavanis, S. (2012). A survey of systemic risk analytic. *Annual Review of Financial Economics, 4*(1), 255-296. https://doi.org/10.1146/annurev-financial-110311-101754.

Borio, C. (2011). Implementing a macroprudential framework: Blending boldness and realism. *Capitalism and Society, 6*(1). https://doi.org/10.2202/1932-0213.1083

Boyd, J. H., & De Nicolo, G. (2005). The theory of bank risk taking and competition revisited. *The Journal of Finance, 60*(3), 1329–1343. doi:10.1111/j.1540-6261.2005.00763.x.

Bresnahan, T. F. (1982). The oligopoly solution concept is identified. *Economic Letters, 10*(1-2), 87-92. https://doi.org/10.1016/0165-1765(82)90121-5

Bretschger, L., Kappel, V., & Werner, T. (2012). Market concentration and the likelihood of financial crises. *Journal of Banking and Finance, 36(*12), 3336-3345. https://doi.org/10.1016/j.jbankfin.2012.07.016

Brooks, C. (2008). *Introductory econometrics for finance*. Cambridge University Press.

Brunnermeier, M. K. (2009). Deciphering the liquidity and credit crunch 2007–08. *Journal of Economic Perspectives, 23*(1), 77-100. http://www.jstor.org/stable/27648295

Chamberlin, E. H. (1933). *The Theory of Monopolistic Competition: A Re-orientation of the Theory of Value*. Harvard University Press.

De Bandt, O., Hartmann, P., Peydró, J. L. (2002). Systemic Risk in Banking: An Update. In Allen N. Berger, A.N., Molyneux, P. & Wilson, J.O.S. (Eds.), *The Oxford Handbook of Banking (1st ed.)*. Oxford University Press.

Fu, X., Lin, Y., & Molyneux, P. (2014). Bank competition and financial stability in Asia Pacific. *Journal of Banking & Finance, 38*, 64-77. https://doi.org/10.1016/j.jbankfin.2013.09.012

Hellmann, T. F., Murdock, K. C., & Stiglitz, J. E. (2000). Liberalization, moral hazard in banking, and prudential regulation: are capital requirements enough? *American Economic Review, 90*(1), 147-165. http://www.jstor.org/stable/117285

Huang, X., Zhou, H., & Zhu, H. (2009). A framework for assessing the systemic risk of major financial institutions. *Journal of Banking & Finance, 33*(11), 2036-2049. https://doi.org/10.1016/j.jbankfin.2009.05.017

Iwata, G. (1974). Measurement of Conjectural Variations in Oligopoly. *Econometrica, 42*(5), 947-966. http://www.jstor.org/stable/1913800

Jeon, J. Q., & Lim, K. K. (2013). Bank competition and financial stability: A comparison of commercial banks and mutual savings banks in Korea. *Pacific-Basin Finance Journal, 25*, 253-272. https://doi.org/10.1016/j.pacfin.2013.10.003

Jimenez, G., Lopez, J. A., & Saurina, J., (2013). How does competition impact bank risk-taking?. *Journal of Financial Stability, 9*(2), 185-195. https://doi.org/10.1016/j.jfs.2013.02.004

Keeley, M. C. (1990). Deposit insurance, risk, and market power in banking. *American Economic Review, 80*(5), 1183-1200. http://www.jstor.org/stable/2006769

Koenker, R. (2005). *Quantile Regression* (No.

38). Cambridge University Press.

Koenker, R., & Machado, J. A. F. (1999). Goodness of fit and related inference processes for quantile regression. *Journal of America Statistics Association, 94*, 1296-1310. doi: 10.1080/01621459.1999.10473882

Lau, L. J. (1982). On Identifying the Degree of Competitiveness from Industry Price and Output Data. *Economic Letters, 10*(1-2), 93-99. https://doi.org/10.1016/0165-1765(82)90122-7

Lenisastri. (2009). Pengaruh tingkat konsentrasi industri perbankan dan penetrasi bank asing terhadap tingkat kompetisi antar bank dan stabilitas sistem perbankan di Indonesia. Unpublished Thesis. Universitas Indonesia.

Lestari, Nike. (2014). Kontribusi risiko sistemik dan hubungannya dengan karakteristik individual bank pada perbankan Indonesia. Unpublished Thesis. Universitas Indonesia.

Llewellyn, D. T. (2007). The Northern Rock crisis: a multi-dimensional problem waiting to happen. *Journal of Financial Regulation and Compliance, 16*(1), 35-58. https://doi.org/10.1108/13581980810853208

López-Espinosa, G., Moreno, A., Rubia, A., & Valderrama, L. (2012). Short-term wholesale funding and systemic risk: A global CoVaR approach. *Journal of Banking and Finance, 36*(12), 3150-3162. https://doi.org/10.1016/j.jbankfin.2012.04.020

Matthews, K., Murinde, V., & Zhao, T. (2007). Competitive conditions amon the major British banks. *Journal of Banking & Finance, 31*(7), 2025-2042. https://doi.org/10.1016/j.jbankfin.2006.11.009

Martinez-Miera, D., & Repullo, R. (2010). Does competition reduce the risk of bank failure? *Review of Financial Studies, 23(*10), 3638-3664. https://doi.org/10.1093/rfs/hhq057

Milne, A. (2009). *The Fall of the House of Credit*. Cambridge University Press, Cambridge.

Panzar, J. C., & Rosse, J. N. (1987). Testing for "monopoly" equilibrium. *Journal of Industrial Economics, 35*(4), 443-456. http://www.jstor.org/stable/2098582

Rogers, R. P. (1989). The measurement of conjectural variations in an oligopoly industry. *Review of Industrial Organization, 4*(1), 39-65. https://doi.org/10.1007/BF02284661

Schaeck, K., Cihak, M., & Wolfe, S. (2009). Are Competitive Banking Systems More Stable? *Journal of Money, Credit, and Banking*. 41(4), 711–734 doi: 10.1111/j.1538-4616.2009.00228.x

Schaeck, K., & Cihak, M. (2008). How does competition affect efiiciency and soundness in banking: New empirical evidence. European Central Bank Working Paper Series

Schmalensee, R. L. (1982) Antitrust and the New Industrial Economics. *American Economic Review* 72(2), 24-28.

Segoviano, M. A., & Goodhart, C. (2009). Banking stability measures. IMF Working Papers

Shaffer, S. (2004). Patterns of competition in banking. *Journal of Economics and Business, 56*(4), 287-313. https://doi.org/10.1016/j.jeconbus.2003.10.003

Shaffer, S. (1983). Non-structural measures of competition: toward a synthesis of alternatives. *Economics Letters, 12*(3-4), 349-353. https://doi.org/10.1016/0165-1765(83)90061-7

Soedarmono, W., Machrouh, F., & Tarazi, A. (2013). Bank competition, crisis and risk taking: Evidence from emerging markets in Asia. Journal of International Financial Markets, Institutions & Money, 23, 196-221. https://doi.org/10.1016/j.intfin.2012.09.009

Tabak, B. M., Fazio, D. M., & Cajueiro, D.O. (2012). The relationship between banking market competition and risk-taking: do size and capitalization matter? *Journal of Banking & Finance, 36*(12), 3366-3381. https://doi.org/10.1016/j.jbankfin.2012.07.022

Tirole, J. (1988). *The Theory of Industrial Organization*. The MIT Press.

Yeyati, E. L., & Micco, A. (2007). Concentration and foreign penetration in Latin American banking sectors: Impact on competition and risk. *Journal of Banking & Finance* 31(6), 1633-1647 doi:10.1016/j.jbankfin.2006.11.003