Master Thesis

Measuring Competition And Bank Risk Connection: An Empirical Study Of Japanese Banking System In The Period 1991-2005

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Declaration of originality

I, NGUYEN Khanh Diep declare that this thesis is my work, with originality, except for what I have quoted in my thesis. The reference and definition quotation are clearly stated in footnote and bibliography parts.

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Abstract

The thesis analyzes the correlation between competition and banking system fragility/ risk of bank failure using quantitate methodology to figure out the competition control strategy for banks and government policymakers. The dependent variables is Z-score, independent variables are Lerner Index and three bank control variables including: Bank size, Loans to Assets, and Deposit to Assets. Database of 20 banks from 1991 to 2005 is collected via Standard and Poor Capital IQ, banks' financial statements. The regression analysis is conducted in Excel and Stata. Our findings suggest that banking system competition and risk of bank failure follow a nonlinear U-shaped correlation. Too high or too low bank competition can lead to the fragility of banks. Therefore, the competition control strategy suggested is keeping $\frac{P}{MC}$ ratio in between [1.02, 2.4]

Chapter 1: Introduction

Japan has been suffering from two lost decades and experiences longest financial slump in the history. The lingering financial crisis was considered as a result of Japanese government's macroeconomic mismanagement and banking system's structural weaknesses. It was not until 1991, when the Japanese bankers warned their government of an escalating financial depression. The non-performing loans ratio of many banks were the immediate problem hitting Japanese financial system. In 1991, the government estimate of the non-performing loan was 77 trillion yen. However, in fact, this estimation did not reflect the real number from domestic banks. After the warning, MOF audit revealed that bad debts amount was reportedly increasing in months later. The causes were emerged from Japanese financial bubble time, when banks and other financial institutions competed in lending loans to commercial real estate speculators and house buyers. However, the bubble could not be kept longer than the early of 90s decade, when economic bubble busted. Japanese banks were also hit by the drop of stock market price. Even though Japanese banks cannot hold more than five percent of equity in other companies, an investigation of Japanese government shown that through subsidiaries and affiliates, some big banks hold more than thirty percent of shares in many industrial companies. When Japanese stock market declined by 60% on average, the capital and lending capacity of Japanese banks dramatically decreased.

Another problem caused by the South-East Asian lending. Foreign lending at this period in Japanese banks was 22% in total assets. This can be explained by the rise in new trend of Japanese industrial companies – operating in South- East Asian countries for smaller expenses. However, because of this lending, the bank faced to new problem: most of the contracts were signed in US dollars, and record in Japanese yen in accounting book. An appreciation in US dollars at that period led to a dramatic increase in outstanding loans overseas. The total amount of foreign loans was raised to nearly US$300 billion, six time higher than American banks' lending to South – East Asia. Moreover, South – East Asian countries are the main importers of Japanese goods. Therefore, when Asian financial crisis came in 1998, Japan were hit badly and could hardly recover.

In addition, Japanese banking system had structural problems. Even though there were many banks and banks competed hard in order to gain loans from big customers,

Japanese banks were not competitive in comparison to American banks or German banks. Disregarding of non-performing loans problem, the ROA (return-on assets ratio) of Japanese banks were only around 0.4, which were the worst among developed countries' banking system. Therefore, even if Japanese banks could solve the bad debts problem, the banks were still not profitable enough because of the structural issues. This structural issue came from the relationship between Japanese bank and its industrial companies. Because of Japanese characteristics, most of the money needed to fuel the business of an industrial companies comes from banks. The stock market was not preferred. In addition, in Japan, there were many keireitsu, which were the big corporations, having their own banks, industrial companies, insurance companies, trading companies, finance companies, etc. The existence of keireitsu in Japan made Japanese financial system an unprofitable ones, which decreased the competition because banks under keireitsu lend money to keireitsu subsidiaries with lower interest, better terms. If there is any problem with the loans to keireitsu subsidiaries, the banks faced non-performing loans and usually hide the actual condition of this loan from Bank of Japan.

The cause of economy crisis in Japan showed a link between competition in Japanese banking industry, and the risk of bank failure. This relationship between competition and bank risk is investigated in this research paper. In order to study this connection, we aim to answer three main question: Is competition good for bad to the economy and to the bank itself? What is the link between competition and risk of bank failure? And final question, to what extent should competition level behold in order to maintain a healthy banking environment?

In the academic literature, it is argued that banking system systemic risk, or risk of bank failure might be a consequence of competition among banks and financial institutions. (Keeley, 1990) stated that the competition among banks in free banking system could induce banks to take riskier portfolios, for example, hazarding bank investment into unsafe investments, taking riskier actions. Opposing to this view, from borrowers' points of moral hazard and adverse selection, (Boyd & Nicoló, 2005) argued that more competition promote banking system stability because with higher interest rate, borrowers are promoted to take higher returns investments, which usually correlated with higher risk. The likelihood of borrowers' insolvency threaten banks by increasing

non-performing loans and bankrupted customers.

In Japanese banking industry, during and after the financial deregulation and financial crisis in 80s decade, Japanese banks have been suffering from two decade of slump in economy. Many researcher have been studied about this depression in financial industry and try to figure out the link of competition to financial stability in Japanese market, from both qualitative and quantitative method. However, there were some lacks as following: First, those researches considered the connection between bank risk and competition a linear relationship, whereas it could be a nonlinear one. The competition can have in between good and bad influence on the banking industry. According to (Cetorelli, 2001), (Padoa-Schioppa, 2000) , and (Stucke, 2013), the link between competition and bank risk is more complicated than a simple one-way relationship. Too much competition is as bad as too little. Therefore, in this paper, we will examine competition in a two-way relationship, described by a U-shaped one. Secondly, the previous researches have not studied about the competition strategy. In detail, the previous studied suggested a positive or negative link between these two variables. However, a competition strategy such as to what extent competition level should be kept in order to hold a healthy financial condition in banking system, how we can decide the price and expenses level. In this research, by using quantitative approach, we will figure out the answer to this question. A sample of twenty banks during fifteen years, from 1991 to 2005 is examined.

The thesis is organized in four chapters. First chapter is Introduction in which an overall view of the situation and background information are provided. In this chapter, the thesis also states general literature review that will be further discussed in next chapter, mentions research topic, scope of study, methodology, and research questions briefly. In next chapter, academic literature review will be mentioned as concrete concepts for the argument and analyzing in later chapters. Chapter three is Methodology in which interpretation of thesis conduction method, data selection, model modification is constructed. Following chapter three, as a flow, next chapter presented the outcomes and analysis of those results are discussed. Fifth chapter is the summary of thesis, and recommendation of the thesis author to the government and the banks.

Chapter 2: Literature Review

This chapter demonstrates the background academic literature to our thesis, from theoretical and empirical academic literature. In this chapter, we aim to provide a wide range of academic journals review in order to support to our thesis. The theoretical and empirical literature are about risk of bank failure, competition, stability in the market, and fragility in the market

Section 1: Theoretical Literature

In academic literature, there have been many researches about the impact of competitiveness and the stability of financial market. Among those studies in academic literature, the competition-fragility and competition-stability strands are the two opposite but interesting discussion, which are followed by many scholars (Berger, Klapper, & Turk-Ariss, 2008). Because of the popularity of both views, many researchers have chosen this topic to study and make the discussion of whether competition-fragility or competition-stability is better view became

Competition- fragility strand suggests that competition has negative impacts on bank's performance. By reducing the profit margin and market power of a bank, bank competition is considered to increase the risk of bank failure. (Keeley, 1990) , while examining the impact of financial deregulation in US financial market, found out that the financial deregulation induced market competition and thus, led banking market to a tougher competition, which lowers the bank rent for the bank and encourages banks and other financial institutions to take riskier activities. . In line with this study of (Keeley, 1990) there are numerous different research examining the positive correlation between competition and bank risks ((Allen & Gale, 2004); (Allen & Carletti, 2008)). For example, (Jiménez, Lopez, & Saurina, 2007) discovered the link between competition which is measured by Lerner Index and non-performing credit ratio, to come to a conclusion that the competition in banking system actually enhance the level of non-performing risk ratio, thus, increase risks. (Vives, 2001) applied a limitation for liability and a social expense of bank failures and found out that the correlation between bank risk and competition is a positive sign. The study is done based on deposit market's level.

On the other hand, competition-stability strand sees from a different view. Focusing on

the effect of adverse selection and moral hazard, the researchers who follow this theory argue that when the market is more concentrated, the risk of bank failure is increased too. Focusing on the impact of moral hazard and adverse selection, (Boyd & Nicoló, 2005) argues that from the assets side of the balance sheet, when competition is reduced, bank in reality can gain more profits by increasing interest rate and earn much bank rents. From that point of view, risk of bank failure is declined. However, from the borrower point of view, this high-interest rate can cause moral hazard, because they have to cope with high-interest cost, and lead to high-risk actions. The failure of repayment of borrowers makes risk of bank failure higher. (Stern & Feldman, 2004) also supports this competition-stability view. In their book, "Too Big To Fail: The Hazards of Bank Bailouts", they point out that some banks are likely difficult to be fail because they have many customers, or they are main player in the financial market. Because of the domino effects, the failure of those banks can threaten to all economy's stability, government cannot let those banks go bankrupt. This protection of government leads to the confidence of bank that they are too big to collapse. Thus, the bankers who expect that government will save their bank can have less motivation to monitor their bank portfolio carefully, and involve in riskier activities. This is moral hazard and adverse shocks which results in higher risk of bank failure. There are many other research share this idea, for example (Brown & Dinç, 2011) or (Carmassi & Herring, 2016). This "Too Big To Fail" has been examined from both quantitative and qualitative approaches and was supported by not only theoretical but also reality facts. This theory was further discussed by (Boyd, Nicolò, & Loukoianova, 2009) in their IMF paper named: "Banking Crises and Crisis Dating: Theory and Evidence". Similarly, (Jiménez, Lopez, & Saurina, 2007) also find out that bank risk will be increased when bank has higher monopoly power. (Berger, Klapper, & Turk-Ariss, 2008) test the connection between competition and risk of bank failure using big data set of more than eight thousands banks vary in twenty-three industrialized countries and the results support competition-stability view.

In academic literature, competition can be measured by The Structure Conduct Performance Paradigm (SCP). SCP framework was originally from the neoclassical economics theories. In this paradigm, there are two opposite view to approach competition. The traditional SCP hypothesis suggests that competition and market

concentration are opposed to each other. To be more specific, there is a direct connection between the degree of competition among firms in same industry, and the degree of market concentration. This is explained that market competition allows firms to fraud and to conspire. This hypothesis is proved only when correlation between concentration ratio and profit ratio is positive. In other words, in concentration market, companies are likely to earn more than in competitive one, and vice versa. (Berger & Hannan, 1989) tests the relationship between price and market concentration instead of price- market concentration as usual, and found out a strong and positive link between firm price and the degree of market concentration as a supportive evidence for traditional SCP hypothesis. Similarly, (Bain, 1951) examined this relationship in American Manufacturing Industry from 1936 to 1940 using the marginal profit and market concentration as main variables and came to same conclusion.

However, later research suggest that market concentration cannot enhance profits. More specifically, firms cannot get use of their monopoly power to impose high price and gain profits. (Berger & Hannan, 1989), (Brown & Dinç, 2011), and other scholars have proved this argument in their research. In 2008, (Casu & Girardone, 2008) argue that previous research use concentration ratio method as an approach to competition. However, it is not a solid one. They found out that concentration ratio is a measurement of market power. However, it does not imply that the higher the market power, the less competition in that market.

Another hypothesis in SCP paradigm is efficiency hypothesis. In the efficiency hypothesis, not only profits and market concentration ratio are considered, but also a wider range of variables is added, including: economy of scope, economy of scale, corporation risks, government and corporation policies. (Forsund, Lovell, & Schmidt, 1980) conduct a survey to provide an overall view of efficiency approach and measurement, as well as frontier analysis methodology.

The main difference between traditional Structure Conduct Performance Hypothesis emphasizes on concentration ratio and profits of firms (without concerning about how much firm’s proficiency is), and efficiency structure hypothesis argues that there is a positive link between the efficiency and the firm’s performance. However, the debate between two views has not been solved yet. For example, (Smirlock, 1985) used OLS regression to test the two hypotheses: traditional and efficiency one. In this research,

profitability is the dependent variables, and firm's growth rates, concentration, firm's market share, and industry's entry barrier are considered as independent variables. Efficiency hypothesis was found out to be supported in this case, after generating the regression results. On the other hand, in a research written by (Berger & Hannan, 1989), based on the Federal Research System's price information, the research highly supported traditional Structure Conduct Performance hypothesis after testing the profit-market concentration correlation, and eliminates the efficiency structure hypothesis. Another example is the Europe banking system, where traditional Structure conduct performance hypothesis can explain why bank can reduce their costs and strengthen their profits (Goddard, Liu, Molyneux, & Wilson, 2011). However, (Berger, Dick, Goldberg, & White, 2005) figure out that the efficiency hypothesis works well and explain the American banking system but the Structure conduct performance hypothesis did not hold even the banks could use their own monopoly power (Claessens & Laeven, 2003). Similarly, while (Alley, 1997) supports the structure conduct performance hypothesis after analyzing Japanese banking system; (Maudos, 1998) proved contrast results after analyzing Spanish banking industry to argue that efficiency structure hypothesis explains the relationship between market concentration and firm's performance.

Even though the Structure conduct performance hypothesis measured the concentration/competition of firms based on structure, recent studies proved that structure is not the only vital element of competition (NIO). Viewing firms as active entities and taking consider strategy of the firm as an important element, NEIO literature argue that not only structure measurement works, but competition can also be measured by a variety non-structural measurements. For example, based on the characteristics of monopoly/monopolistic firms, banking competition can be assessed. Those non-structure measurements are widely used in later research, for example, (Panzar & Rosse, 1987), The Panzar and Rose Model viewed competition from wider range of variables, such as contestable market, firm's entry barriers/ firm's exit barriers, and cost structure, etc. (Claessens & Laeven, 2003) figured out that non-structure market measurement is a more-solid measurement of competition, then structure ones. Similarly, (Berger, Dick, Goldberg, & White, 2005) examined the effects of various variables on competition and the result support non-structure approach. As the author

argued, one variable – profits / efficiency cannot explain well the competition/concentration in the market. Several non-structural measurements have been widely used, namely, (Lerner, 1934); (Iwata, 1974), (Bresnahan, 1982) , (Panzar & Rosse, 1987)

Lerner Index is the most commonly used calculation among non-structural approaches. Determining competition based on the exceed proportion of firm's price over marginal cost, Lerner Index assumes that firm is a seeking for profits entity, and they operate under positive profits. The competition is assessed by taking into consideration the price-cost characteristics of firm. Lerner Index assumes that the closer the price approach to marginal cost, the more competitive the market is. In contrast, the further price value to marginal cost, the more "monopoly" the market is, because in this case, firms is the "price-maker". (Casu & Girardone, 2008) claims that because Lerner Index shows to what extent the market allow companies to fix the price in proportion of marginal cost, it is a well-established approach to competition measurement in same industry.

The Iwata (1974) is another measure of competition, approaching competition through price elasticity of demand. However, (Bikker J. A., 2005) claims that because of the complexity and limitation, Iwata Model is not popular in banking industry-academic literature. Until now, there was only once Iwata Model being applied in banking research, which is by (Shaffer & Salvo, 1994). Among the non-structural measurement of market competition, (Bresnahan, 1982), (Panzar & Rosse, 1987) model are more commonly used. For example, (Toolsema-Veldman, 2003) , and (Lau, 1982) applied (Bresnahan, 1982)'s technique into their research to find some evidence proving that the relationship between competition and efficiency is sometimes blurred, and does not necessarily be positive or negative.

(Panzar & Rosse, 1987) Model is preferred by antitrust agencies because it is more data intensive (Hirschman, 1964). By tracking the use and utilization of bank's inputs in order to generate revenue, Panzar and Rosse Model (H-Index) can accurately analyze the bank's price-making power and market competition. (Bikker & Shaffer, 2010) stated that in a free entry market, H-statistics always get to one. . Vesala (1995) argues that H-statistics measure values range from [0; 1] if the firm is monopolistic. However, H-statistics cannot accurately assess the effect of competition in long term. (Bikker,

Spierdijk, & Finnie, 2006) and (Shaffer & Spierdijk, 2013) pointed out that for a seeking for profit firm, in long term, the H-index is equal or smaller than 0, which means that no conclusion can be made. At the same time, if examined period is long, long run competitive firms experienced H-statistics equal to 1, which is not precise. Therefore, for simplicity and long-run use, most popular measurement of competition is Lerner Index. According to (Ariss, 2010), Lerner Index is simple to use, and straightforwardly measure the market competition. In order to use Lerner Index, relevant market information and based on the focus of the research, researchers can choose to include or not to include financial cost in total cost, or exclude financial cost from deposit prices. Therefore, it is considered to so-far be the most flexible indicator ((Stiglitz, 1989); (Bulow & Klemperer, 2002); etc.) Interestingly, Lerner Index can even be applied when number of observations (including years, number of firms) is limited. The advantage of Lerner Index over Panzar and Rosse Model is not only its flexibility, simplicity, and application in data limit, but also because Panzar and Rosse Model is found out to be accurate in short period of time, but for long period of time, the fluctuation of market competition cannot be analyze clearly.

In academic literature, the topic of relationship between rivalry and risk of bank failure has always been researcher contentions and long-time argued. While there are many measurements to approach competition and market concentration, the risk of bank failure is simplest measured by Z-score. Z-score was developed by Professor Edward Altman in 1968 based on his study on sixty-six manufacturing companies' sample from 1946 to 1965 (Altman, 1968). The aims of this study are to find the most distinguish way to separate bankrupted and non-bankrupted firms. In order to do so, he selected twenty-two most commonly known financial ratios and combined them to create a formula, which is later be popular because of the simple and wide-range use. Even though it is not totally accurate, as when Altman tested Z-score, ninety percent of the bankrupted companies show precise results, and more than seventy percent of non-bankrupt companies' result are accurate (Altman, 2000) because of the relevance and flexibility in the academic literature.

Despite the wide range applicability of Altman Z-score 1968, researchers found out that it cannot be applied for banking and financial institution as for the specific characteristics of those financial firms. When applying traditional Altman Z-score to the

financial and banking system, the accuracy of prediction went down to very low level. However, because of the superior idea of creating a tool to measure risks of firms based on their own financial ratios, other researchers tried to find out another ways to measures the Z-score in banking industry. Later on, Confidence-based- Z-score was developed by (Boyd & Graham, 2006). This Confidence-based Z-score is calculated based on Returns on Assets, Deviations of Returns on Assets, and Capital Adequacy Ratio, which is measured by Total Equity divided by Total Assets.

After the born of Confidence-based- Z-score, later research tried to improved (Boyd & Graham, 2006)'s formula by adding more or changing some ratios, such as (Hesse & Čihák, 2007); (Yeyati & Micco, 2007); or (Lepetit & Strobel, 2013). However, the later Confidence-based- Z-scores were both found to be inconsistent or having academic limitation. Therefore, (Boyd & Graham, 2006)'s Concentration-based ratio is most preferred in academic banking research

Section 2: Empirical Literature

In academic literature, there are a wide range of research focusing on competition and risk of bank failures. Those research can be separated into two groups: Macroeconomics approach, and microeconomics approach.

From macro economics academic literature, researchers used their analysis on competition and risk of bank failure to analyze the relationship of competitiveness and financial stability. (Schaeck, Čihák, & Wolfe, 2006) examined 45 banking systems in 45 different countries from 1980 to 2005. The research uses quantitative approach and measures competition by non-structural methodology. In particular, they use H-statistics as representation of competition, and observe the competition and market behavior before and after the period of banking system crisis. Several financial crises has been analyzed in this study. Similarly (Thorsten, 2008) examined the impact of concentration ratio to financial crisis. Taking market share of three major banks from 69 nations in the period of 1980 to 1997, compared to 47 financial crises happened within this duration of time. This research figures out that the more concentrated the market is, the less financial crisis occurs. Thus, market concentration and risk of bank failure is negatively correlated.

Approaching from microeconomics literature, the competition in banking system and the risk to each individual bank is considered. For example, Jimenez, (Jiménez, Lopez, & Saurina, 2007) examine Spanish banking system by taking into account 107 banks to conduct quantitative research. The research analyze the link between competition and portfolio performance, in which competition is measured by both concentration ratio and Lerner Index, and portfolio performance is estimated as the proportion of non-performing loan out of total bank's loans. Even though there was no clear conclusion about the correlation between those two variables, because as they explained, the correlation is not strong enough, that result does not mean competition and risk of bank failure has no or less correlation because the risk of bank failure measured by non-=performing loan ratio is not rationale. In the same year, (Berger, Klapper, & Turk-Ariss, 2008) conducted a survey on 23 nations with a sample of more than 8000 banks. The methodology they use was Generalized Methods of Moments. Using both concentration, H-Index and Lerner Index to measure competition, Z-score, Non-Performing Loan Ratio for risk and financial stability, they argue that the higher the monopoly, the riskier the bank operates.

Chapter 3: Methodology

Section 1: Competitiveness Measurement

These research reviewed over representable a few selective measures from assessing bank competition to explore the relationship, and impact of bank competition toward bank risk. Those measures could be from the structural or non-structural approach and each measure has its own points of interest and shortcomings. Originally, from the structural approach, the degree of bank competition could be measured by the "Structure–conduct–performance" paradigm. This theory utilized bank concentration rate to assess the bank's completion level. Bank concentration rate is measured by the market shares of biggest banks in the market. The higher the concentration rate, the higher the "monopoly level", which reduces competition among banks and improve bank's profit. This calculation is also known as HH Index (Herfindahl-Hirschman index) [1]

On the other hand, non-structural approach measures bank competition in indirect ways, for example, market structure or bank's price. We can take some examples like Lerner Index, Iwata Model, Panzar and Rosse Model, Bresnahan Model, and so forth throughout this measurement, and commonly used by several types of research. In those non-structural proxies, the competition is indirectly approached through directly infer bank's behaviors and characteristics. In this research, we choose to use Lerner Index (1934) to analyze those level of bank competition in the Japanese market for these reasons. First, in order to use another model, we have to define the financial market, which is not easy. On the other hand, Lerner Index is a straightforward and reliable tool, which we can use data from historical bank's financial statements and central bank's data. It can measure the bank competition of each banking system independently. Secondly, monopoly and monopsony are distinguished smoothly by deducting financial expenses out of bank's deposits price and total expenses (Turk-Ariss (2010). Thirdly, Lerner Index is perfect to calculate the bank's competition level when we only have

[1] Herfindahl-Hirschman index is proposed by Hirschman in 1945 and Orris C. Herfindahl in 1950, calculating the market concentration level based on the square root (or without squared root in Orris C. Herfindahl's work) of the sum of of the market share of all players in the market square

limited number of observations. Fourth, by considering both bank name, bank type, and time at Lerner Index, the effect of different time, different banks, and different markets are separating well (Berger, Klapper, & Turk-Ariss, 2008). Therefore, it is more superior to concentration ratio or Herfindahl-Hirschman index.

Another Index which is also preferable to calculate bank competition level is Panzar and Rosse Model. However, in this research, we don't use this model because of two reasons. First, Panzar and Rosse Model (or H-statistic) is not accurate to calculate the bank competition over long period of time (Demirguc-Kunt, Peria, & Martinez, 2010). In this research, we use data of 20 Japanese banks over 15 years, therefore, this model is not fit to our database. Second, H-statistics does not consider the effect of time, it cannot separate years to years, banks to banks. Therefore, we choose to use Lerner Index.

(Casu & Girardone, 2008) indicates that Lerner Index (1934) is a well-established measure of banks market power. It shows the difference between price of a bank and its marginal cost, thus, analyzing its competitiveness in the market. This index can receive value ranging from 0 to 1, as the assumption to apply Lerner Index is Marginal Cost (MC) is smaller than Price (P). The closer the Lerner Index to 0, the higher the competition in the market. If Lerner Index is closer to 1, the higher the Lerner Index, the lower the competition in the market because, it indicates that bank has more market power, and is a price maker, not a price taker.

Going from the characteristics of a bank, in which we make an assumption that banks operate for profits, therefore, the Price always has to be greater than its Marginal Cost. We have:

$$P_{it} > MC_{it} \quad (1)$$

In a perfect competition market, P and MC are equal. So the idea of Lerner index is to compute how far the distance between P and MC. The greater the distance, the further that bank is from perfect competition, and also, the higher the market power that bank possesses. Lerner Index is computed as the following equation:

$$LI_{it} = \frac{P_{it} - MC_{it}}{P_{it}} \quad (2)$$

In which:

LI_{it} indicates Lerner Index of bank t at time t

P_{it} indicates the price of assets (Berger, Dick, Goldberg, & White, 2005) of bank t at time i, proxied by the ratio of total revenues (TR) divided by total assets (TA)

MC_{it} indicates the marginal cost of bank t at time i, which is calculated by a trans-log cost function.

Following to (Coccorese, 2014) in his study "Estimating the Lerner index for the banking industry: a stochastic frontier approach", because MC is the cost added to produce one more unit of product, so $MC = \frac{\partial TC}{\partial Q}$ in which TC is the total cost, and Q is denoted by Total Assets.

From (1), if we multiply all sides to $\frac{Q_{it}}{TC_{it}}$,we will have:

$$\frac{P_{it}Q_{it}}{P_{it}} > \frac{\partial TC}{\partial Q}\frac{Q_{it}}{TC_{it}}$$

Because PQ=TR (in which TR denotes Total Revenue):

$$\frac{TR_{it}}{P_{it}} > \frac{\partial TC}{\partial Q}\frac{Q_{it}}{TC_{it}} \quad (3)$$

Right-hand side is $\frac{\partial TC}{\partial Q}\frac{Q_{it}}{TC_{it}}$, which is the elasticity of Total Cost, with respect to Total Assets.

Using stochastic frontier approach (Aigner, Lovell, & Schmidt, 1977), we can a make a scholastic model as following:

$$Y_{it} = f(y_{it}, w_{nit,} T_t, \beta)\exp(v_{it})\exp(-u_{it}) \quad (4)$$

Where:

Y_{it}: observed scalar output of the bank I at time t

y_{it}: output of bank I at time t

w_{it}: input n-th of bank i at time t

T_t: time trend

β: unknown coefficients between output and input variables that need to be estimated.

$EXP(v_{it})$: Schocastic component. Schocastic component represents the some kinds of shock which can influence to the production of firm. These shocks are randomly measured

$\exp(-u_{it})$: ratio of observed output to maximum attainable output.

Following to Řepková Iveta (2010), observed scalar output of the bank could be

measured by total profit and/or total cost of that bank. In this research, we use the Total Cost of bank. Input of bank is the resources that the banks use in order to gain their profit. Thus, we take three input, labor, funds, and capital, because they are the most important resources which banks need to utilize.

w_1 denotes labor, and it is calculated by ratio of Personnel Expense divided to Total Assets

w_2 denotes funds, and is calculated by Interest Expense divided to Total Funds

w_3 denotes capital, and is calculated by ratio of Other Non-Interest Expense (excluding Personnel Expense) to Total Assets

Time trend is added because technology change over time, so time is the easiest variable to represent technology trend (Brissimis et al., 2010).

Take the natural logarithm of both sides in equation (4), and set $v_{it} - u_{it} = \mathcal{E}_{it}$ we have:

$$\ln TC_{it} = \beta_1 \ln TA_{it} + \frac{1}{2}\beta_2 \ln TA_{it}^{\,2} + \sum_{n=1}^{3} \beta_{wn} \ln TA_{it} w_{nit} + \sum_{h=1}^{3}\sum_{k=1}^{3} \beta_{hk} w_{hit} w_{kit} + + \sum_{j=1}^{3} \beta_{Tj} T_t w_{jit} + \beta_3 \ln TA_{it} T_t + \beta_4 T_t + \frac{1}{2}\beta_5 T_t^{\,2} + \mathcal{E}_{it} \quad (5)$$

Because:

$$MC = \frac{\partial TC}{\partial TA} = \frac{\partial TC}{\partial \ln TC}\frac{\partial \ln TA}{\partial TA}\frac{\partial \ln TC}{\partial \ln TA} \quad (6)$$

Because $\frac{\partial TC}{\partial \ln TC} = TC$; $\frac{\partial \ln TA}{\partial TA} = \frac{1}{TA}$; From (5), after taking first derivative of lnTC with respect to lnTA, and substitute to (6)

$$MC_{it} = \frac{\partial TC_{it}}{\partial TA_{it}} = TC_{it}\frac{1}{TA_{it}}(\beta_1 + \beta_2 \ln TA + \beta_3 T_t \textstyle\sum_{n=1}^{3} \beta_{wn} w_{nit}) \quad (7)$$

After calculating Marginal Cost and Price, we can obtain Lerner Index for later regression

Section 2: Risk of bank failure measurement

Measuring bank risk is an important topic which is focused by many academic journals. In academic literature, the most traditional way to calculate the bank risk is by using VAR or ES. However, both VAR and ES have their shortcomings. For example, VAR has a tail risk which leads to a question that what if the loss is beyond intolerance level. In that case, VAR cannot capture the risk because it is incoherent. Therefore, although it is commonly used and recommended by Basel II, academic researcher doubt about its accuracy. Then, ER was introduced as a measurement to reduce the shortcoming of VAR and became the official standard risk measurement in Basel III. Even though ER has been improved from VAR, both ER and VAR only capture the risk of individual institution. Therefore, those techniques ignore an important risk – systemic one.

In order to solve the systemic problem, and furthermore, to calculate bank's probability of insolvency, Z-score was first introduced by Alman in 1968. Since then, the Z-score model became very popular among researcher because of its wide-range applicability. Z-score is known under two ways of calculation. First formula is the traditional one, which was originally developed by Altman, which can be applied to every firm. However, because the banking industry's characteristics are more complicated and cannot be mixed with other business, Altman Z-score cannot be applied by banks and other financial institutions (Boyd and Graham, 1986) developed new way to calculate ROA, and can be used only for bank. This Z-score is called: the confidence-based Z-score. After that, Hesse and Cihák (2007) introduced second version of Z-score. At the same year, Yeyati and Micco (2007) develop their third Z-score calculation. Recently, in2013, Lepetit and Strobel (2013) improved latest one. The traditional Z-score and Confidence-Based Z-score's formulas are as below:

Traditional Z-score (Z_0)

$$Z_0 = 1.2\ A_1 + 1.4A_2 + 3.3A_3 + 0.6A_4 + 1.0A_5 \quad (8)$$

In which:

A_1 is the ratio of Working Capital divided to Total Assets

A_2 is the ratio of Retained Earnings divided to Total Assets

$A_3$is the ratio of Earnings Before Interest and Tax divided to Total Assets

A_4 is the ratio of Market Value of Equity divided to Total Liabilities

A_5 is the ratio of Sales to Total Assets

Confidence-Based Z-score

(Boyd and Graham, 1986)'s Confidence-Based Z-score (Z_1)

$$Z_1 = \frac{\mu_{ROA,k} + \mu_{CAR,k}}{\sigma_{ROA,k}} \quad (9)$$

Hesse and Cihák (2007)'s Confidence-Based Z-score Z_2

$$Z_2 = \frac{ROA_T + CAR_T}{\sigma_{ROA,k}} \quad (10)$$

Yeyati and Micco (2007)'s Confidence-Based Z-score Z_3

$$Z_3 = \frac{ROA_T + CAR_{,T}}{|ROA_T - \mu_{ROA,t}|} \quad (11)$$

Lepetit and Strobel (2013) 's Confidence-Based Z-score Z_4

$$Z_4 = \frac{\mu_{ROA,t} + CAR_T}{\sigma_{ROA,t}} \quad (12)$$

In which:

ROA is Return On Assets

CAR is Capital Adequacy Ratio

μ is average

σ is standard deviation of population

T is time and t is duration of time

However, because both (2), (3), (4) have their limitation so in this thesis, (1) will be used to measuring the risk of bank failure. In detail, Z_3 consider the ROA and CAR at one moment (current ROA, and CAR), but use standard deviation of all period. Therefore, the random variable is not clear and we cannot know which random variable it is. Similarly, Z_2 and Z_4 consider sigma, which is accurate only when we consider all population. However, because the scope of this thesis is small as we only consider 15 years, we choose not to use those formulas.

Section 3: Developing Main Model

In this thesis, we have two parts. First is calculating the elements for main model, which is in detail, calculating Z-score and Lerner Index of banks. Based on those results of the first part, we can analyze the bankruptcy likelihood of a bank and how competitive that bank is. Second is to input the Z-score and Lerner Index, plus several bank control variables as dependent and independent variables of the main model.

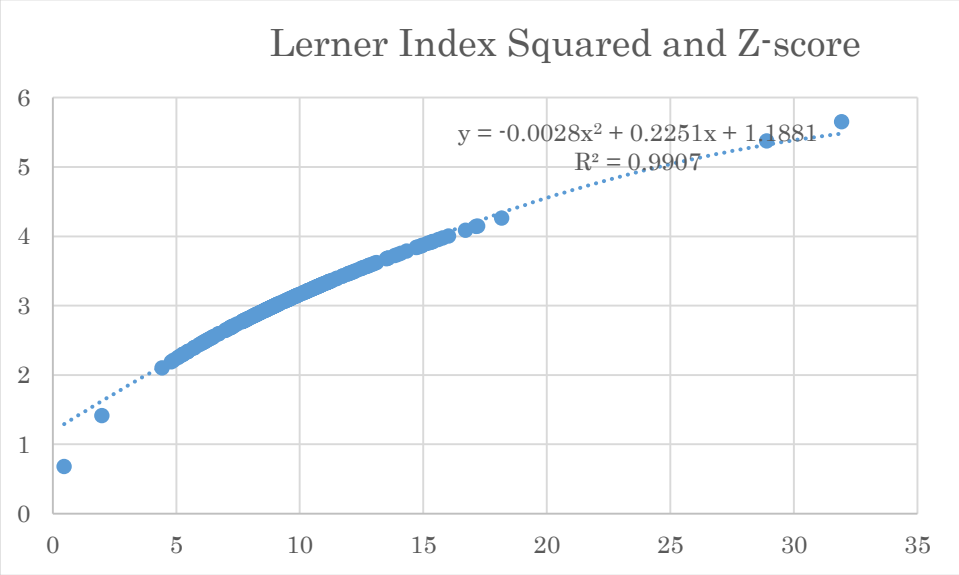
$$Z - score_{it} = \alpha + \propto_1 \text{ Lerner Index} + \propto_2 \text{ Lerner Index Squared} + \sum_{i=1}^{n} \beta_i \text{ bank control variables i} + \varepsilon_{it} \quad (13)$$

Subscript: Bank i and time t

The main model incorporates one dependent variable – bank risk, and competition, and bank control variables as independents variables

Previously, many researcher have been studied about this depression in financial industry and tried to figure out the link of competition to financial stability in Japanese market, from both qualitative and quantitative method. However, there were some lacks as following: First, those researches considered the connection between bank risk and competition a linear relationship, whereas it could be a nonlinear one. The competition can have in between good and bad influence on the banking industry. According to (Cetorelli, 2001), (Padoa-Schioppa, 2000), and (Stucke, 2013), the link between competition and bank risk is more complicated than a simple one-way relationship. Too much competition is as bad as too little. History showed failures example of over-regulation and liberated banking sector which led to recent financial crises. Therefore, in this paper, we will examine competition in a two-way relationship. Following (Cetorelli, 2001)‘s idea, we investigated the connection between bank competition and bank risk through an U-shaped one, by adding one Lerner- Index Squared variables. In order to reconfirm this idea, we see a significant positive $\propto_1$ and

negative $\propto_2$ confirms that the relationship between completion and risk of bank failure follows a U-shaped. Based on our data, we can plot a graph in which y is risk of bank failure and x is Lerner Index Squared



Graph 1: Relationship between Lerner Index Squared and Z-score

Therefore, we use nonlinear u-shaped relationship to describe the correlation between competitive index and the risk of bank failure in Japan instead of a linear one.

Those second autonomous variables (bank control variables) incorporate four components that affect to bank risk in the academic literature. In 2008, Arena had named the four components influencing the risk of bank failure, which are: Bank Size, Loan to Assets, and Deposits to Assets. In this research, those data is generated from S&P Capital IQ's database.

- Bank size is the first bank control variable and it is calculated by taking the logarithm of the Total Assets. Normally, this variable is supposed to have negative correlation with the dependent variable – Risk of bank failure because bigger bank usually have more profitability, more diversification, and efficiency. To be more specific, banks always want to grow bigger because of three reasons. First, the diversification. When the bank has more resources, it can separate and utilize those resource into different areas in order to minimize the risk. Diversification helps banks to reduce the likelihood of losing-all-in-one-area. Second reason is to get use of the "economy of scale". There are many "hidden costs" in every transactions of bank, for example, the infrastructure cost, IT cost,

compliance and legal cost, risk management costs. Those cost per transaction can be reduced for bigger banks because they have more banking transactions. Third, synergy. Synergy refers to one stop shop, which means that a bank can meet all customer's need of services. For example, if a customer opens an account in Bank A, and Bank A also offers other services such as granting loans, international payment. It is likely that the customer will use those services of Bank A because it is more convenient. Also when a customer use several services in a bank, that bank can reduce the cost of collecting customer's information and also lessen the risk. However, if bank grows too big, due to the "too big to fail" theory, it is argued that bank might take riskier action, be less efficient, and get smaller profit. Therefore, there is no clear expectation for the sign of the correlation between this bank control variable, and the risk of bank failure.

- Loan to Assets is the second bank control variable. This ratio shows the lending level of the bank and supposed to receive a negative connection with the risk of bank failure. Because bank's lending level is a measurement of profitability, and the probability of instability, the higher the bank's lending level, the lower the risk of bank failure.

- Deposits to Assets is the last bank control variable. This ratio supposed to get a positive sign in the main model because it is a criteria to assess bank's operation activities. Deposit of Assets can tell us how much is bank's ability to gain profit, and bank's level of stability. Historical data showed that deposit withdrawal is the main reason for bank failure (Fungáčová & Weill, 2013)

In this thesis, as mentioned above, the analysis will be divided into three parts. First of all, we will run a regression model based on model () in order to find the correlation among variables and use those correlation number as an input to calculate the marginal cost. After calculating marginal cost and bank price, we are able to calculate the Lerner Index, which will be used in the final model. In second part, Z-score will be calculated by using the Confidence-Based Z-score (Z_1), developed by (Boyd and Graham, 1986).

In final part – running main model, we will divided the regression into two smaller steps: First, running the model with only Z-score (dependent variable), and competitiveness index (Lerner Index and Lerner Index Squared) to study about the effect of competitiveness to risk of bank failure. Second, we will add three more bank control variables, which is Bank Size, Loan to Assets, and Deposit to Assets, respectively in order to estimate the impacts of both variables to bank risk. Based on the result, we will have further analysis, discussion, and recommendations. Further details will be presented in the next chapter

Chapter 4: Data Analysis, Discussion, and Findings

This part analyzes the information set gathered from S&P Capital IQ database and discuss the outcomes from the regressions model. In this thesis, we use Excel and Stata to analyze descriptive statistic, heteroscedasticity test, and linear regression test. After that, the link between competitiveness and the risk of bank failure, as well as the connection between risk of bank failure and bank control variables will be used for further discussion

Section 1: Z-score Calculation

Table 1: Summary Statistics Of Z-score , ROA, Equity To Assets, and SDROA

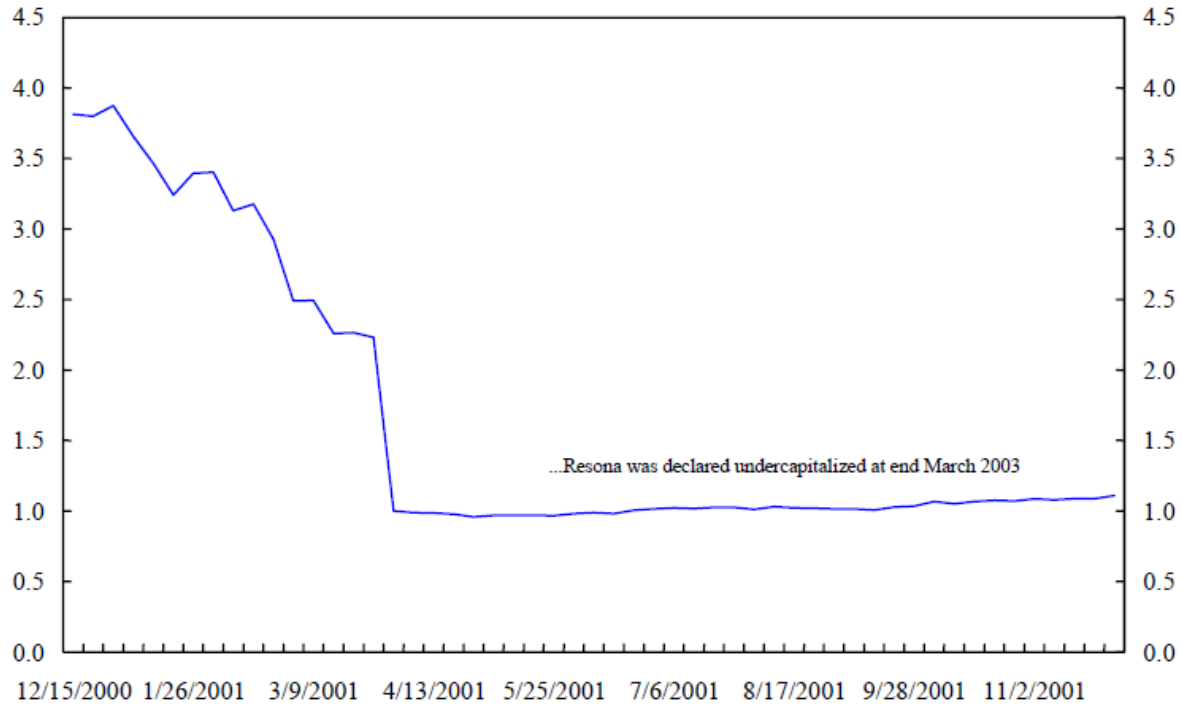
Z-score		ROA		Equity To Assets		SDROA	
Mean	9.594987	Mean	0.00024	Mean	0.039063	Mean	0.00391
Standard Error	0.220553	Standard Error	0.000333	Standard Error	0.000728	Standard Error	0.000204
Median	9.108216	Median	0.0011	Median	0.036682	Median	0.003466
Standard Deviation	3.52885	Standard Deviation	0.005335	Standard Deviation	0.011645	Mode	0.004136
Sample Variance	12.45278	Sample Variance	2.85E-05	Sample Variance	0.000136	Standard Deviation	0.003257
Kurtosis	11.38861	Kurtosis	27.26174	Kurtosis	12.13565	Sample Variance	1.06E-05
Skewness	1.138304	Skewness	-4.15043	Skewness	2.335337	Kurtosis	5.916482
Range	39.69152	Range	0.05785	Range	0.10705	Skewness	2.361081
Minimum	-7.75666	Minimum	-0.04691	Minimum	0.011536	Range	0.014438
Maximum	31.93486	Maximum	0.010942	Maximum	0.118586	Minimum	0.000782
Sum	2456.317	Sum	-0.06064	Sum	10.00002	Maximum	0.01522
Count	256	Count	256	Count	256	Sum	1.000983

The table above provide descriptive statistics for all variables in calculating Z-score. As can be seen from the table, Z-score has average value of 9.594987, and the actual values range from -7.75666 to 31.93486. This result is far higher than the study of (Luc Laeven, 2008), in which he found out that the Z-score based on a wide cross-country database is 2.88 only. This can be explained from the standard deviation of ROA in this study (0.00391) is more than three times lower than that one in the study of (Laeven & Levine, 2008) (0.01). The small standard deviation indicates more stable bank performance. Therefore, Japanese banking system is likely to have more stability than other countries.

In our data it is very significant that Resona Bank's Z-score is very low in the whole examined period, especially from 1998 to 2004. According to (Chan-Lau & Sy, 2006), in the IMF working paper named "Distance-to-Default in Banking: A Bridge Too Far?" the authors stated that since 2001, the capital adequacy of Resona Bank fell below 4%, the PCA threshold[2]. This situation indicates serious undercapitalization of Resona Bank. However, because the bank is one of five biggest bank in Japanese banking system and its collapse can cause a financial crisis, on May 17, 2003, Japanese Government decided to give capital injection to this bank in order to keep the Japanese financial systemic stability. Below figure shows the Distance-to-capital of Resona Bank, calculated based on Merton Formula (source: (Chan-Lau & Sy, 2006).

[2] PCA refers to Principal Component Analysis. PCA capital ratios and ratio thresholds are used to restrict credit unions and financial institutions of too high level of risk assets

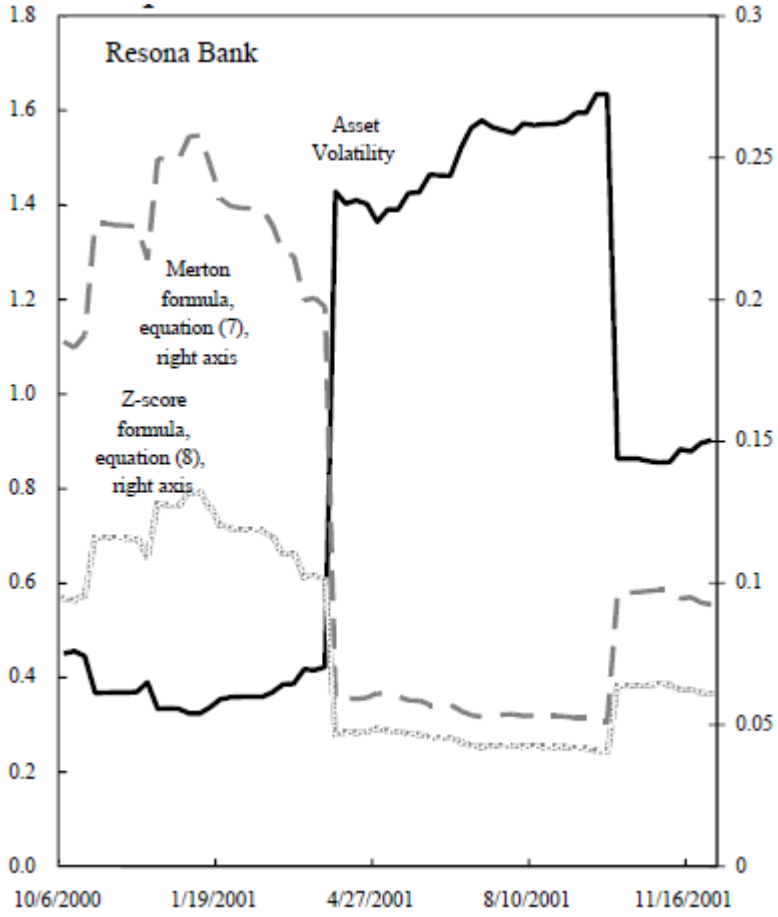
Figure 1: Distance-to-capital of Resona Bank in 2001, calculated based on Merton Formula[3]



Source: Bloomberg and Chan-Lau & Sy's calculation

[3] Merton Formula or Merton Model was developed by Robert C. Merton. This Model can be used to measure the company's risk of credit default based on company's total debts and maturity date

Figure 2: Asset Volatility , Merton Formula Equation, Z-score of Resona Bank in 2001



As can be seen from Figure 2, the Asset Volatility is very high while Z-score and Merton Index is very low, indicate a serious problem of bank's performance. The bad performance of Resona Bank is explained by two reasons: First, because of the continuous loss-making of bank. Second, because of the Japanese banking system policy. In particular, the Japanese deferred tax principle allow banks to have a tax rebate and in the future, banks can receive this tax rebate if they can make enough profit. For Resona Bank, they were permitted to have three years tax asset even though at that time, the capital amount is smaller than the permitted tax asset rebate.

In overall, for twenty banks examined, Z-score are high and stable, except for the year 1998 and 1999. This situation can be explained as there was a huge financial crisis happened in that period, led to financial slump and increasing systemic and liquidity risk.

Section 2: Lerner Index Calculation

Following the Lerner Index formula constructed in Methodology chapter, in particular:

$$\ln TC_{it} = \beta_1 \ln TA_{it} + \frac{1}{2}\beta_2 \ln TA_{it}^{\,2} + \sum_{n=1}^{3}\beta_{wn}\ln TA_{it} w_{nit} + \sum_{h=1}^{3}\sum_{k=1}^{3}\beta_{hk} w_{hit} w_{kit} + \\ + \sum_{j=1}^{3}\beta_{Tj} T_t w_{jit} + \beta_3 \ln TA_{it} T_t + \beta_4 T_t + \frac{1}{2}\beta_5 T_t^{\,2} + \mathcal{E}_{it} \quad (14)$$

After running the linear regression model based on our database of 256 observations, we obtain the result displayed in the following table:

Table 2: Lerner Index Regression Result

	Coefficients	Standard Error	t Stat	P-value
Intercept	-2.72404	0.67436	-4.03945	7.19E-05
lnTA	0.972512	0.049772	19.53954	9.63E-52
ln(TA)^2/2	2.69E-05	0.001	0.026874	0.978582
ln(w2)	-0.16967	0.212495	-0.79845	0.425391
ln(w3)	0.233567	0.239802	0.974	0.331025
lnw2w3	0.00752	0.008447	0.890226	0.374225
lnTAlnW2	-0.00203	0.011642	-0.17441	0.861691
lnTAlnW3	-0.00183	0.013455	-0.13621	0.891771
T	0.130117	0.084864	1.533251	0.126515
T^2	0.002721	0.001122	2.424381	0.016065
TlnTA	-0.01405	0.005355	-2.624	0.009241
TlnW2	-0.00206	0.004806	-0.42777	0.669197
TlnW3	-8.6E-05	0.000213	-0.40597	0.685125

The coefficients of independent variables are used as inputs to calculate marginal cost (MC) following the equation (6) in Methodology chapter:

$$MC_{it} = \frac{\partial TC_{it}}{\partial TA_{it}} = \frac{TC_{it}}{TA_{it}}(\beta_1 + \beta_2 \ln TA + \beta_3 T_t \sum_{n=1}^{3}\beta_{wn} w_{nit}) \quad (15)$$

P, MC, and Lerner Index result summary is presented in the below table

Table 3: Summary Statistics of MC, P, and Lerner Index

MC		P		Lerner Index	
Mean	0.029866	Mean	0.03907	Mean	0.268978
Standard Error	0.001023	Standard Error	0.001018	Standard Error	0.010984
Median	0.025711	Median	0.035561	Median	0.27684
Standard Deviation	0.016363	Standard Deviation	0.016281	Standard Deviation	0.175738
Sample Variance	0.000268	Sample Variance	0.000265	Sample Variance	0.030884
Kurtosis	-0.95718	Kurtosis	-0.72524	Kurtosis	14.5278
Skewness	0.565087	Skewness	0.53378	Skewness	-2.47717
Range	0.060923	Range	0.077886	Range	1.579534
Minimum	0.008036	Minimum	0.00872	Minimum	-0.93077
Maximum	0.068958	Maximum	0.086607	Maximum	0.648764
Sum	7.64566	Sum	10.00186	Sum	68.85847
Count	256	Count	256	Count	256

The table above summarizes descriptive statistics for P, MC, and Lerner Index. As can be clearly seen from the table, Lerner Index has an average value of 0.268978, which indicates that Japanese market is quite competitive and bank has no significant market power. The Lerner Index ranges from -0.93077 to 0.648764. Minimum value is negative, which can be explained as because for some years, some banks was loss-making. Therefore, it does not follow the assumption of Lerner Index – firms operate for profits. Because some banks operated in loss, their Marginal Cost in those years is greater than the Price, and led to negative Lerner Index. From the summary statistics, the standard deviations of Price and Marginal Cost is high, demonstrate a fluctuation in banking system when bank cannot remain stable cost and price level. As can be clearly seen, even though the maximum price is far higher than the maximum marginal cost, minimum price is lower than minimum marginal cost also. However, in overall, most of the Lerner Index of every banks are positive, and there are no significant differences between Lerner Index

of big banks and Lerner Index of small banks. The close result of big and small banks indicates that in Japanese banking system, big bank does not have enormous market power, and the Japanese market is quite stable and competitive.

Section 3: Analyzing Main Model

$$Z - score_{it} = \alpha + \propto_1 \text{ Lerner Index} + \propto_2 \text{ Lerner Index Squared} + \sum_{i=1}^{n} \beta_i \text{ bank control variables i} + \varepsilon_{it} \quad (16)$$

Subscript: Bank i and time t

Table 4: Main Model Variables Summary Statistics

Variables	Mean	Standard deviation	Median	Minimum	Maximum
Z score	9.747150974	3.257168268	9.135771426	0.4613914	31.93485605
Lerner index	0.283056073	0.131362029	0.278156538	0.0590466	0.648763781
Lerner index squared	0.516265015	0.128811293	0.527405463	0.2429950	0.80545874
Bank Size	15.57449731	1.28593211	15.215753	13.25788	18.22157385
Loan to Assets	0.669173819	0.067542954	0.67364104	0.4344825	0.797563244
Deposit to Assets	0.79063553	0.182421583	0.865132737	0.1655552	0.935892242

The descriptive statistics of Z-score, Lerner Index, Lerner Index Squared, Bank Size, Loans To Assets, and Deposits To Assets are demonstrated in the above table. As can be inferred from this table. Z-score has average value of 9.747, which is higher than 3, indicates that most of the examined banks were in Safe condition in that period of time. The Z-score varies in the range of [0.4614; 31.3949]. Noticeably, minimum value of

Z-score is very low, much lower than the Limit for Risk condition, states that among the banks, there are some banks suffering from bad situation. The high standard deviation also proves the instability in banking system in this period. It is interesting that the minimum of Deposits to Assets is less than the minimum Loans to Assets ratio. Going back to our database, the thesis figured out that in this period, Industrial Bank of Japan lent more than receiving deposits from citizens. This bank was later merged with Dai-Ichi Bank to form Mizuho Financial Groups. The high non-performing loans out of total loans is the explanation to high Loans to Assets ratio

Table 5: Industrial Bank Of Japan's Loan To Assets ratio and Deposit to Assets Ratio (1991 to 2002)

Year	Loan to Assets	Deposit to Assets
1991	0.568688	0.271531
1992	0.57471	0.235585
1993	0.595982	0.214563
1994	0.582621	0.223281
1995	0.602121	0.22763
1996	0.620576	0.225715
1997	0.588071	0.246633
1998	0.556077	0.224629
1999	0.575395	0.194232
2000	0.57527	0.165555
2001	0.516317	0.190068
2002	0.487812	0.2438

a. First Step Regression (eliminates Bank Control variables out of model)

   In order to find out the correlation between risk of bank failure and competitiveness, this thesis runs first model with only Lerner Index and Lerner Index Squared as two independent variables, and eliminates the effects of other bank control variables by not adding them into the model. As discussed above, Lerner Index Squared is added because the relationship between dependent variable – Z-score and Lerner Index is nonlinear. We have proved in Chapter 3

that for Japanese banking system, the relationship is a U-shaped one. Below is the summary of regression analysis.

Table 6: Competition and Risk of bank failure Regression (without effect of Bank control variables) output summary

	Coefficients	Standard Error	t Stat	P-value
Intercept	13.33121033	3.077228489	4.332213	2.14239E-05
Lerner Index	37.78315431	12.42101864	3.041872	0.002602582
Lerner Index Squared	-27.65790864	12.66698108	-2.18346	0.029935473

The output proved that and Lerner Index Squared is significantly affect to Z-score, as P-value of both variables is smaller than 0.05 (5%). Therefore, U-shaped model is accepted. Lerner Index variable has positive relationship with Z-score, while Lerner-Index Squared variable negatively links with the dependent variables. We can write a function to show the connection between risk of bank failure and competitiveness of bank as below:

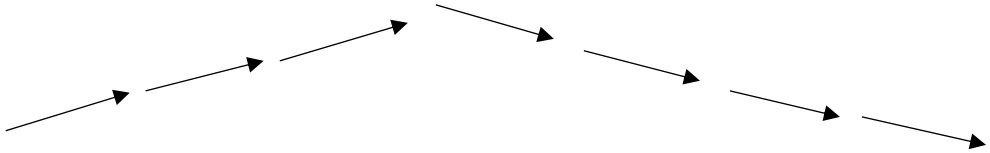
$$\mathrm{Z-score_{it}} = 37.78315431 * \text{Lerner Index} - 27.65790864 * \text{Lerner Index Squared} + \varepsilon_{it} \quad (18)$$

- Taking the first derivative of function (18), and set it equal to 0, we can calculate the maximum value of Lerner Index Squared = 0.7321. It means that when Lerner Index Squared is smaller than or equal to 0.7321, competitiveness and risk of bank failure has negative correlation. Therefore, if Lerner Index is smaller than 0.536, when bank increases its competitiveness index, risk of bank failure is decreased.
- When Lerner Index Squared is greater than 0.536, competitiveness and bank failure has positive link. Therefore, if Lerner Index is bigger than 0.536, if bank increase its competitiveness, risk of bank failure is increased.

- When Z-score is greater than 3, the bank is in Safe condition (Altman, 1964). From equation (18), Lerner Index has to be from 0.02 to 0.584 to ensure that Z-score is greater than 3.
- Similarly, if Z-score is smaller than 1.8, the bank is in Risk condition (Altman, 1964). Combine with equation (18) above, we can infer that when Lerner Index is smaller than 0.0064 or greater than 0.6477, bank is in unfavorable condition and risk of bank failure is very high
- When Lerner Index receive value from 0.0064 to 0.02, or from 0.584 to 0.6477, bank is in "Survivor" condition (Altman, 1964).

We can demonstrate our analysis result in below table:

Table 7: Lerner Index and Z-score correlation

Lerner Index	0	0.0064	0.02	0.536	0.584	0.6477	1
Sign							
Z-score	-∞	1.8	3	0	3	1.8	-∞

When competitiveness increases, risk of bank failure is decreased. However, when competition is too tough in the financial market, banks are easy to be involve in the Price Competition. In order to get more customers, banks has to offer more attractive interest.

According to (Suzuki, 2011), the closer the nominal interest rate approach to equilibrium interest rate, the less "bank rent" the bank has. Thinner "bank rent" gives bank less incentives to cautiously monitor their portfolio. Thus, this "bank rent" effect lead to "adverse selection" and "moral hazard" issues. Below figure demonstrates the "bank rent" effect further:

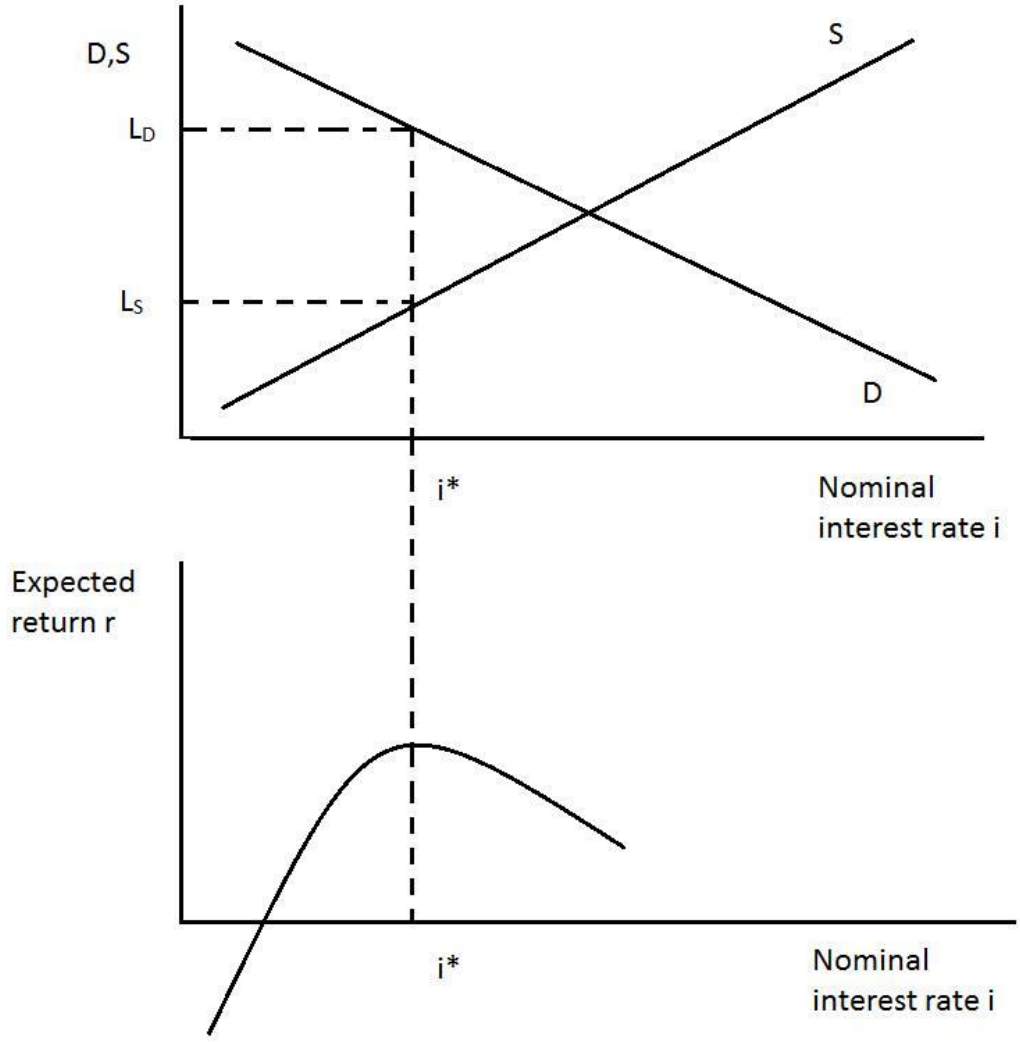


Figure 3: Market disequilibrium with effective monitoring. Source: (Suzuki & Adhikary, 2009)

If we look at the figure above, we can see that when the nominal interest rate increase, the expected return will increase to a peak when i equal to i*, then drops because of the "adverse selection" problem. When i is too high, there are too many bad risks because it will attract more bad borrowers. In addition, there is also "moral hazard" problem which will lead to a result of bankruptcy. However, at i* point, the Loan Demand is higher than the Loan Supply because the banks are only willing to lend at LS. This model show us that the efficient financial markets will not be necessarily be in equilibrium. (Khan, 2000)

This figure partly explains our analyzing result. When Lerner Index is too low, which means that the price bank offer to borrowers is low, too. In order to do so, banks have to offer an interest rate which is closer to equilibrium interest rate in capital market. However, increasing number of borrowers also mean increasing number of bad borrowers, and decreasing the rents of bank. Thus, when bank rents is thinner than before, bank has less incentive to control the portfolio management. As a consequence, the bank might not separate carefully good and bad borrowers. Therefore, the amount of non-performing loan rises. Following high amount of non-performing loans is high risk of bank failure. In a nutshell, too tough competition in banking market leads to high likelihood of banking system fragility. For more visual demonstration, the below graph represents our explanation above:

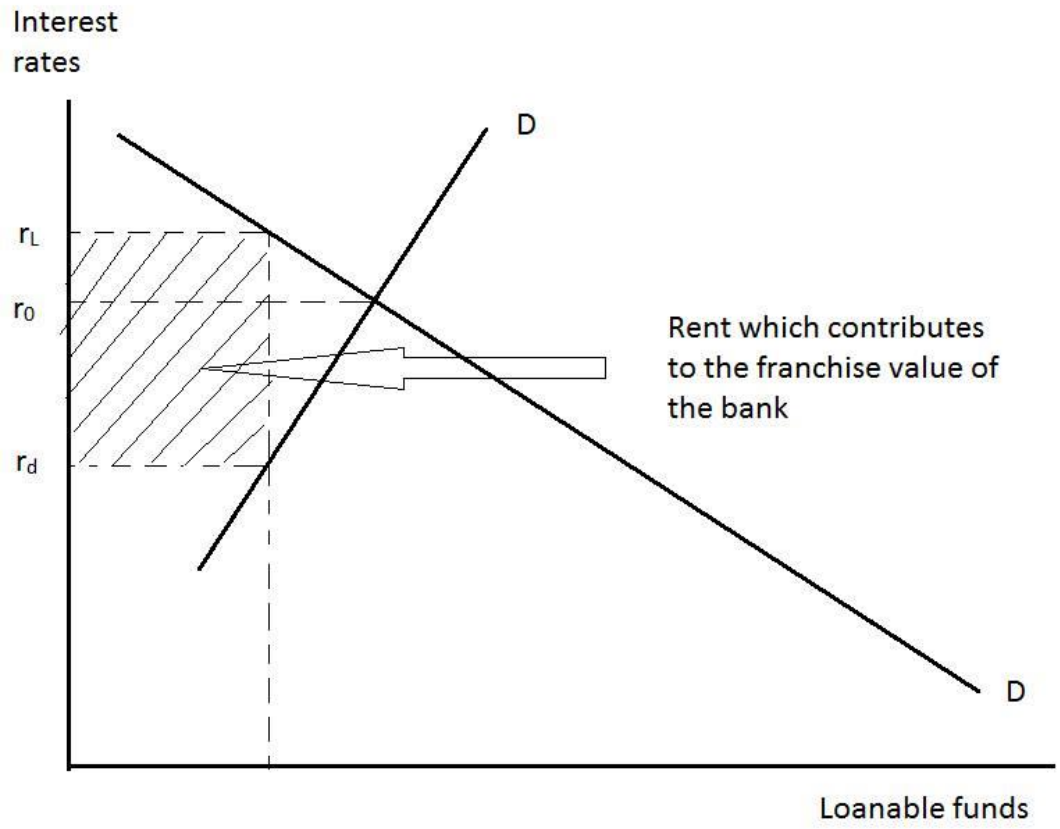


Figure 4: Financial sector rents as incentives for portfolio monitoring. Source: (Suzuki & Adhikary, 2009)

In contrast, when competition is less in banking system, Lerner Index is high refers to the high capacity of bank to set high price. Offering too high-interest rate to borrowers can cause moral hazard problem from the side of borrowers. In order to earn enough profit to cover for high-interest expense, borrowers are induced to take riskier investments. Accompanying to high returns is always high risk, which might take some borrowers into the insolvency situation. Thus, the bank has to deal with high non-performing loans because borrowers cannot repay, and the bank will suffer from risk of failure.

Competition control strategy

From Methodology, because:

$$\text{Lerner Index} = \frac{P-MC}{P},$$

In order to keep Z-score greater than 1; based on the table above (Table 7), Lerner Index has to satisfy this condition:

$$0.02 \leq \text{Lerner Index} \leq 0.584.$$

Therefore:

$$0.02 \leq \frac{P-MC}{P} \leq 0.536$$

Thus:

$$1.02 \leq \frac{P}{MC} \leq 2.4$$

In conclusion, the ratio of Price divided to Marginal Cost has to be from 1.02 to 2.4 in order to keep the competition in appropriate level, enough to make sure that competition will keep banking system stability.

b. Second Step Regression –Main Model with Bank Control Variables

In order to make sure that our database does not contain cross-sectional data, we run Correlation Analysis. If the correlation between two independent variables is higher than 0.59, it indicates a high effect and strong relationship between two variables (source: BMJ Publish). As can be seen from the below table, the correlation among all independent variables is smaller than 0.59, therefore, there are no- or less likely that the variables are cross-sectional data.

Table 8: Correlation matrix of independent variables in Main Model

	Z-score	Lerner Index	Bank Size	Loan to Assets	Deposits to Assets
Z-score	1				
Lerner Index	0.436982	1			
Bank Size	-0.16598	-0.23490006	1		
Loan to Assets	-0.16628	0.123086287	-0.481658899	1	
Deposits to Assets	0.134203	0.2781483	-0.54306437	0.512710229	1

After testing the correlation among independent variables and found out that there are no cross-sectional data, we ran the main model in full, including the bank control variables: Bank Size, Loan to Assets, Deposits to Assets. The regression model is as following:

$$\mathrm{Z-score_{it}} = \alpha + \propto_1 \text{ Lerner Index} + \propto_2 \text{ Lerner Index Squared} + \sum_{i=1}^{n} \beta_i \text{ bank control variables i} + \varepsilon_{it}$$

The brief result is demonstrated in following table:

Table 9: Main Model Regression (include Bank control variables)

	Coefficients	Standard Error	t Stat	P-value
Intercept	38.2661341	5.933986017	6.448639075	5.92816E-10
Lerner Index	38.21929252	12.11534564	3.15461842	0.001807081
Lerner Index Squared	-28.86806523	12.36949172	-2.333811759	0.020411692
Bank Size	0.782549333	0.195160873	-4.009765492	8.06427E-05
Loan to Assets	-18.68546422	3.231739618	-5.781859443	2.23101E-08
Deposits to Assets	0.326347715	1.312634735	2.486203568	0.0303861893

After running the Regression Analysis in Excel, we can infer from the output that all five independent variables is significantly impact to the dependent variables. Because P-value of all variables are small, all variables in our model are statistically significant at 5%

The R-squared of this model is 0.558467957, higher than 0.5, which means that our regression model is reliable enough to be accepted.

After adding bank control variables, Lerner Index and Lerner index squared has almost no change in both sign and absolute value, with very small P-value of both variables. Hence, the analysis and discuss result in previous regression model is kept. We conclude that competition and risk of bank failure has U-shaped impact over risk of bank failure. If competition level is too low, or even to high, the banking system stability will be eroded.

Bank size and Z-score has positive correlation, indicates that bigger banks have less risk of bank failure than smaller banks. When natural logarithm of Total Assets increases 1 unit, Z-score will increase by 0.7825 unit. The higher the Z-score, the less risk of bank failure. Our finding supports the “too big to fail” theory that the bigger the bank, the more likely the failure of that bank can threaten all banking system stability. Therefore, government will protect big banks from bankruptcy to

prevent the economy. This finding is also similar with previous researches of (Stern & Feldman, 2004) and (Fungáčová & Weill, 2013) that mentioned in previous chapters.

Loans to Assets and Z-score has negative connection, which means the higher the Loans to Assets ratio, the more risk of bank failure. When natural logarithm of Loan to Assets ratio increases by 1 unit, Z-score will decline by 18.6854 unit. This result proves that Loan to Assets ratio is significantly important and should be controlled. Only few change in this ratio can leverage to high change in Z-score. Due to high non-performing loans and bad debts, the banks can suffer from high insolvency probability. This finding is consistent with (Wheelock & Wilson, 2000)'s research.

In contrast, Deposits to Assets and Z-score link together in a negative connection. The more deposits the banks have in their financial statements, the less risk of failure they have. This indicates once again the importance of attracting more deposits and keeping it in appropriate level. However, contradict to Loan to Assets ratio, a change in Deposits to Assets ratio leads to very few change in Z-score. This finding suggests that in order to increase the banks' stability, it is more vital to collect non-performing loans and the bank should monitor their portfolio more carefully.

Chapter 5: Conclusion and Recommendation

This thesis's purpose is to examining the impact of the competition in banking system on the risk of bank failure in Japanese market over fifteen years (from 1991 to 2005). In academic literature, even though there were many scholars studied about this topic before, there was no journal measure the connection between those two variables directly and quantitatively, this thesis aims to add up some quantitative output to the gap in academic studies. In our thesis, bank data from twenty banks all over Japan from 1991 to 2005 has been collected via S&P Capital IQ. The data was analyzed by regression tool in Excel and Stata. Several journals were used as theoretical academic literature and reference.

In the first chapter of this thesis, an overview and introduction to the topic was provided as a background for the thesis. In next chapter – Literature review, theoretical and empirical academic literature were demonstrated. In this chapter, the opposite views of "competition-fragility" and "competition-stability" strands were discussed. We found out that different markets led to different conclusions. Some markets are "competition-fragility" while other markets are "competition-stability" types. Among those views, this thesis aims to find out which kind of market Japanese market belongs to, whether in Japanese market, competition supports profit, or whether it enhances the risk of bank failure. Third chapter is Methodology, Hypotheses, Data Collection, and Thesis's Limitation. This thesis uses quantitative approach to analyze the connection among independent and dependent variables. Independent variables includes: competition, three bank control variables, which are Bank Size, Deposits to Assets, and Loans to Assets, respectively. Dependent variable is risk of bank failure. Competition is measured by Lerner Index, and Risk of bank failure is measured by Z-score. In next chapter, the regression, analysis, and discussion is further conducted.

Our thesis found out that the relationship between competition and risk of bank failure is not a linear relationship in Japanese market, but rather a U-shaped one. The analysis result suggests that competition and bank risk is negatively correlated when Lerner Index is smaller than 0.536, and positively connected when Lerner Index is greater than 0.536. It means that Japanese market is very special because is not really a "competition-fragility" or "competition-stability" market but rather an

"in-between" those two strands. The regression results also tell us that when Lerner Index belongs to [0.02, 0.584] range, bank is in Safe condition with Z-score's value equal or greater than 3. When Lerner Index is in [0.0064, 0.02) U (0.584, 0.6477], bank is in Survival condition, which is not favorable, but risk to failure is still kept in control. However, if Lerner Index is [0, 0.0064) U (0.6477, 1], bank faces to high likelihood of bankruptcy (Altman, 1968). Another notable finding is the relationship between Price and Marginal Cost. Based on thesis result, in order to keep Z-score equal or greater than 3, the ratio of Price and Marginal Cost should be in value of [1.02, 2.4]. Furthermore, apart from the correlation between risk of bank failure and competition, the thesis also tests the relationship between Bank Size and Bank Risk, Deposits to Assets and Bank Risk, and Loans to Assets and Bank Risk. The results were as following: Bigger banks has less risk of bank failure than smaller banks, the greater the loan/total assets ratio, the higher risk of bank failure, and finally, the smaller the deposits/assets ratio, the higher risk of bank failure.

The analysis results lead to some suggestions/recommendations for both banks and government policymakers. First, bank should remain their Price/Marginal Cost level within [1.02, 2.4]. When banks try to reduce the interest rate to compete with other banks and financial in the market, they will lessen their incentive to monitor their portfolio carefully. Thus, the adverse selection and moral hazard problem occur and bank can fall into bankruptcy situation by high level of Non-performing loans. In order to keep bank failure likelihood in control, bank should increase deposits to assets ratio or decrease loans to assets ratio in proper level. This means that bank risk will fail when bank increase their stability and profitability. For example loans to assets can be reduced if bank has small ratio of outstanding debts. This can be conducted only if bank manage and control the portfolio properly. In addition, to reduce bank risk, bank can also increase the bank size, which means increasing Total Assets. By growing total assets amount, bank can offer wider range of services and increase their profitability. However, first, because increasing bank size is hard; second, due to "too big to fail" theory, this solution is not highly recommended. For government, from the conclusion about Japanese market characteristics, which is "in between" the "competition-fragility" and "competition-stability", the suggestion for government policy makers is: First, as low competition in the market caused bank

risk, government should not prevent monopoly, or let any banks be too big. This will keep competition inappropriate level and avoid any banks being “price maker” in the market, or in other word, avoid “too big to fail” trap, which is easily lead to bank’s systemic risk. Secondly, even though government should keep competition in the banking market, they also should monitor the level of competition to make sure that competition is not too tough in the Japanese financial market and every Japanese banks cannot compete severely in the race for interest rate. Otherwise, banks rents effect will cause high bank risk and lead to bank failure. For example, if the lending interest rate in the market is too low, government can set interest rate floor in order to save the rents for banks and avoid bank rents effect.

Due to time, effort, and data limitation, the thesis only study twenty bank in short period of time (fifteen years). That is the limitation of this thesis and also a gap for further studies. For further studies, more banks, longer period, and more variables (if possible) will be studied. Also, Japanese banks can be divided into smaller categories such as: city banks, regional banks, trust banks, foreign banks, etc. and we can compare the different results for each group of banks in future studies.

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