BANK COMPETITION AND THE LINKAGE TO STABILITY AND GROWTH: INTERNATIONAL EVIDENCE AND IMPLICATION TO THAILAND

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ABSTRACT

Title of Dissertation	BANK COMPETITION AND THE LINKAGE TO STABILITY AND GROWTH: INTERNATIONAL EVIDENCE AND IMPLICATION TO THAILAND
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Over the past two decades, the impact of bank competition to financial stability as well as to economic growth has been the center of interest for both academicians and practitioners. The recent financial crises throughout the globe further exhibit the urgent need to conclude the relationship between (1) bank competition and financial stability and (2) bank competition and economic growth. This dissertation, therefore, attempts to fill in the literature gap of both competition-stability and competition-growth nexuses by using a sample of 81 countries including both developed and developing countries during the year 2000 to 2013.

For the relationship between bank competition and financial system stability, the empirical results from fixed effect panel regression technique reveal that proxies for bank competition, specifically market concentration (structural competition approach) and market pricing power (non-structural competition approach), have opposite effects on financial system stability. Also, these two measures together with three-bank specific variables, namely bank efficiency, revenue diversification and portfolio risk, can explain the variation of financial system stability in the sampling countries and periods. The results are robust to an array of alternative methodologies and variable specifications.

For the relationship between bank competition and economic growth, the empirical results from fixed effect panel regression technique confirm that proxies for bank competition, specifically market concentration (structural competition approach) and market pricing power (non-structural competition approach), have opposite effects on economic growth. Also, the impact of competition on economic growth is stronger in countries with lower level of accessibility to bank funding, lower credit to private sector and more efficient banking system.

After obtaining the above conclusions at global level, this dissertation further explores the policy implication to Thailand under competition-stability nexus. A sample of 15 commercial banks during the year 2000 to 2013 is used. The empirical results from fixed effect panel regression show that (1) there exists no relationship between market concentration (structural competition approach) and financial system stability, (2) there exists a negative relationship between market pricing power (non-structural competition approach) and financial system stability and (3) there exists a positive relationship between bank efficiency and financial system stability. Therefore, the policy that encourages the competition and efficiency in Thai banking industry is recommended.

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Sanhapas Laowattanabhongse

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CHAPTER 1

INTRODUCTION

1.1 Statement of the Problem

> *"The relationships between competition and banking system performance, access to financing, stability and growth are more complex ... The view that competition is unambiguously good in banking is more naive than in other industries."*
> *(Claessens and Laeven, 2004)*

Over the past two decades, the impact of bank competition to financial stability as well as to economic growth has been the center of interest for both academicians and practitioners. The recent financial crises throughout the globe, as summarized in Figure 1.1, further exhibit the urgent need to conclude the relationship between (1) bank competition and financial stability and (2) bank competition and economic growth.

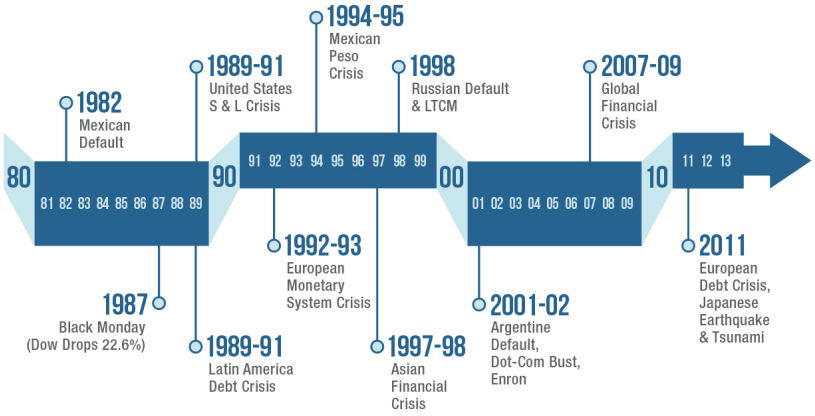

Figure 1.1: Global Financial Crises Timeline
Source: Miguel Otero-Iglesias, 2015

For the issue of bank competition and financial system stability, there is still a controversial debate on the two opposing views of the relationship. Under the traditional view called competition-fragility, the hypothesis suggests that more competitive banking systems are less stable. In other words, less competitive banking systems will be more stable because banks will have more lending opportunities and as a result can increase profits. As such, they will be able to withstand more economic fluctuation and are less likely to take excessive risky projects. Hence, the whole financial systems will become more stable. On the contrary, under the recent view called competition-stability, the hypothesis suggests that more competitive banking systems are more stable. In other words, less competitive banking systems will be less stable. One of the arguments under this hypothesis is that under more concentrated markets, banks will be able to charge higher interest rate to firms. As a result, this will induce firms to take riskier projects, and the probability that the firms will be default will be higher. As the default risk is eventually transferred from firms to banks in this circumstance, it will lead to higher chance of bank failure. Due to the inconclusive theoretical frameworks pertaining to bank competition and financial system stability, the first essay of this paper will, therefore, contribute to the existing literature by proposing the models that can explain the variation of financial system stability. Also, the segmentation analysis will also be performed in order to ensure the robustness of the findings in different market characteristics.

For the issue of bank competition and economic growth, existing theoretical frameworks still provide an inconclusive relationship between them. On one side, the view of more-competition-less-growth suggests that more competitive banking systems will provide less amount of loan to firms because they have less incentive to invest in close relationships with them. As a result, firms that heavily rely on external financing should grow slowly. On the contrary, the view of more-competition-more-growth suggests that more competitive banking systems will provide more loan to firms because they need to compete more with each other. As a result, firms that heavily rely on external financing should grow faster. Due to the inconclusive theoretical frameworks pertaining to bank competition and economic growth, the second essay of this paper will, therefore, investigate whether there exists any empirical evidence to support such theoretical relationship.

Lastly, there is still a lack of research on the topic of bank competition and financial stability in Thai banking industry. Therefore, the third and final essay of this paper will deeply investigate such issue in Thai banking industry so that the policy implication can be recommended.

1.2 Research Questions

The linkage between bank competition and (1) financial system stability and (2) economic growth is very complex, and higher competition in financial industry does not necessarily always good. Also, the existing literature pertaining to this issue has not yet been conclusive. Therefore, this paper aims to answer the following research questions.

1.2.1 What is the linkage between bank competition and financial system stability?

1.2.2 What is the linkage between bank competition and economic growth?

1.2.3 What is the policy implication to Thailand?

1.3 Research Objectives

As shown in Figure 1.1, there are always the financial crises around the globe at least once or twice every one decade. This statistic indeed exhibits the urgent need to both academicians and practitioners to conclude the relationship between bank competition and financial system stability so that the policy that can minimize such crises can be launched. However, at the moment, there are still a controversial issue pertaining to both (1) competition and stability and (2) competition and growth nexuses. Therefore, the main objective of this paper is to investigate the level of bank competition and the linkage to financial system stability and economic growth as well as to provide a policy implication to the banking industry. Even though the existing literature has indicated the theoretical framework between those variables, the empirical evidence has not yet been conclusive. This paper, therefore, attempts to fill in this literature gap by proposing the models that can explain the variation of both financial system stability and economic growth.

1.4 Research Structure

This paper is divided into five main chapters with three self-centric essays. Chapter 1 clarifies statement of the problem, research questions, research objectives as well as research structure.

Chapter 2 presents the first essay, naming "The Linkage between Bank Competition and Financial Stability: New International Evidence". This essay will initially evaluate the current degree of competition in the banking industry using both structural and non-structural approaches. The traditional competition measure calculated by structural approach includes the index, such as k-bank concentration index. The recent competition measure calculated by non-structural approach includes the index, such as Lerner index and H-statistic index. Then, panel regressions with fixed effect will be employed to investigate whether the competition measures together with other bank-specific and country-specific control variables, such as revenue diversification, efficiency and risk taking on bank balance sheet, can capture the variation of financial system stability or not. Several robustness checks will also be performed as well as segmentation analysis.

Chapter 3 presents the second essay, naming "Bank Competition and Economic Growth: A Cross-Country Investigation". This essay will explore the linkage between bank competition and economic growth by applying panel regression analysis. Dummy variables reflecting different market characteristics are also added before concluding the essay.

Chapter 4 presents the third essay, naming "The Linkage between Bank Competition and Financial Stability: The Case of Thailand". This essay will illustrate the time-series analysis together with peer comparison on the perspective of bank competition and financial system stability. Then, panel regression analysis with fixed effect will be employed to investigate the relationship between bank competition and financial system stability for the case of Thailand. Finally, the policy implications will be recommended.

Chapter 5 concludes all of the studies in this paper together with the recommended policy implications.

CHAPTER 2

THE FIRST ESSAY

"The Linkage between Bank Competition and Financial Stability: New International Evidence"

> *"Surprisingly, the relationship between stability and competition has not been studied as extensively as one might expect. On the one hand, there are many models of competition in the literature … On the other hand, there is a well-developed literature on bank crisis … But there is little on the impact of competition on stability."*
> *(Allen and Gale, 2000)*

The relationship between bank competition and financial system stability has been the center of interest for both academicians and practitioners. At present, there is still a controversial debate on the two opposing views of the relationship. Under the traditional view called competition-fragility, the hypothesis suggests that more competitive banking systems are less stable. In other words, less competitive banking systems will be more stable because banks will have more lending opportunities and as a result can increase profits. As such, they will be able to withstand more economic fluctuation and are less likely to take excessive risky projects. Hence, the whole financial systems will become more stable.

On the contrary, under the recent view called competition-stability, the hypothesis suggests that more competitive banking systems are more stable. In other words, less competitive banking systems will be less stable. One of the arguments under this hypothesis is that under more concentrated markets, banks will be able to charge higher interest rate to firms. As a result, this will induce firms to take riskier projects, and the probability that the firms will be default will be higher. As the default risk is

eventually transferred from firms to banks in this circumstance, it will lead to higher chance of bank failure.

To date, there are several empirical studies investigating the relationship between this competition and financial system stability. However, as the competition cannot be measured directly, researchers need to identify the proxy for this factor first. The development of the competition measures has been expanded in two main lines. The structural approach uses market concentration as a proxy for competition, while the non-structural approach employs market pricing power as a proxy. Even though there are substantial research papers in this area, there is no empirical evidence documenting for the impact of competition under structural and non-structural approaches separately to financial system stability. This essay will, therefore, contribute to the existing literature gap by exploring the linkage between bank competition, using both structural and non-structural measures, and financial system stability. The proposed model can explain the variation of financial system stability in 81 countries throughout the globe during the period 2000 to 2013 with proper robustness checks.

The remaining of this essay is structured as follows. Section 2.1 summarizes the existing literature on competition-stability nexus. Section 2.2 describes variables being constructed, data and methodology. Then, section 2.3 presents and discusses the empirical results. Finally, section 2.4 concludes the findings from this essay with notes.

2.1 Literature Review

Based on the evolution of research on financial system stability and bank competition, the literature review can be divided into four main subsections, starting from the very early stage on how to determine the level of bank competition in section 2.1.1. Then, theoretical frameworks on the traditional competition-fragility hypothesis and the recent competition-stability premise are reviewed in section 2.1.2. Empirical evidence supporting both views are discussed in section 2.1.3. The last section 2.1.4 reviews the recent studies on the relationship between competition, stability and other factors.

2.1.1 Degree of Competition Measurement

As competition cannot be measured directly, academicians need to find an appropriate proxy to quantify it. The research on the degree of bank competition has been developed in two main approaches called the structural and non-structural approaches.

The structural approach focuses mainly on the Structure Conduct Performance (SCP) framework and the efficiency hypothesis. The SCP framework explores whether a highly concentrated market will result in a superior industry performance through the collusive behavior among larger banks or not. Bain (1951) states that when the market concentration increases, the prices usually increase, and firms have positive normal profits. However, Smirlock (1985) and Evanoff and Fortier (1988) argues that higher profits in concentrated markets can be the result of greater productivity. The market structure can be measured by several concentration indexes, such as k-bank concentration index or Hirschman Herfindahl index.

The non-structural approach, on the other hand, focuses mainly on the factors other than market structure and concentration that can affect the competitive behavior of the banks, such as general contestability of the market, barrier to entry and exit, competitive environment restrictions and so on. While the structural approach focuses on the structure of the market (i.e. concentration index) and relates this to the conduct (i.e. pricing policy) and performance of the banks (i.e. return of asset, return of equity), the non-structural approach does not attempt to do so. Therefore, as documented by Goddard et al. (2001), the most important advantage of non-structural approach is probably that it does not presume that the concentrated markets are, in general, not competitive. That is because contestability may depend on the competitive environment and not solely on the market structure.

There are two distinctive traditional models for non-structural approach that have been constructed, which are the model of Bresnahan (1989) and Panzar and Rosse (1987). The model of Bresnahan (1989), which is the extended version of Bresnahan (1982) and Lau (1982), uses the condition of general market equilibrium. The basic concept is that profit-maximizing firm in equilibrium will choose prices and quantities such that marginal cost equal to their marginal revenue. This coincides with the demand

price under perfect competition or the industry's marginal revenue under perfect collusion. The test statistic estimated from this model is quite simple to interpret as it provides a direct relationship to a natural measure of excess capacity. In short, the estimated outcome can provide a measure of the degree of market competition, which varies between monopoly and perfect competition.

The alternative empirical model is developed by Panzar and Rosse (1987), which is the extended version of Rosse and Panzar (1977) and Panzar and Rosse (1982). This model uses bank-level data to investigate a change in factor input prices in response to a change in equilibrium revenue earned. Under the perfect competition, an increase in input prices will increase marginal costs, increase equilibrium output and eventually increase total revenue proportionately. On the contrary, under the monopoly, an increase in input prices will increase marginal costs, decrease equilibrium output and eventually reduce total revenue proportionately. This empirical model provides a measure for the degree of competition, called H-statistic index. This index has a range between zero (indicating monopoly market structure) and one (indicating perfect competition market structure).

The advantage of Panzar and Rosse (1987) model is that the bank-level data is used to compute the degree of competition, which means that it allows for the differences in production function of each bank. Therefore, this model actually allows for the possibility to study the differences between different types of banks, such as large and small banks, foreign and domestic banks, commercial and saving banks and so on. However, one disadvantage of this model is that it requires the assumption that the industry has to be in the long-run equilibrium. Therefore, a separate empirical test is also required to evaluate whether this condition is satisfied.

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

Mexican banking system is also investigated by Gruben and McComb (2003). As its marginal price is set below marginal cost, they conclude that such market before the year 1995 is very competitive. By applying Bresnahan's model to 15 countries in North America, Europe and Asia, Shaffer (2001) finds significant market power in five markets and excess capacity in one market during the year 1979 to 1991.

By adopting Panzar and Rosse's model, Shaffer (1982) finds that banking industry in New York is under monopolistic competition during the year 1979. Nathan and Neave (1989) investigate Canadian banking industry using Panzar and Rosse's model. They find the consistent result with that of Shaffer (1989), which employs Bresnahan's model. There are also several research papers, including Molyneux, Lloyd-Williams and Thornton (1994), Bikker and Groenevald (2000) and De Bandt and Davis (2000), that apply the Panzar and Rosse's model to the European banking industry. In general, the results reject both perfect competition as well as monopoly. However, they mostly find the supporting evidence of monopolistic competition.

Recently, there is another competition measurement constructed under non-structural approach, which is called the Lerner index. This index directly measures market pricing power, and it is calculated by taking the difference between the price of the output and the marginal cost then dividing by the price. The interpretation of this index is that when there is no mark-up, it means the market is very competitive. On the contrary, when the mark-up is higher, it means the market is less competitive.

In addition, the degree of bank competition and concentration are studied by Bikker and Haff (2002). They carry out the investigation on the European banking markets and make a comparison with that in the U.S. and other countries. They adopt two non-structural models of competition, namely Bresnahan's and Panzar and Rosse's, to 23 industrialized countries inside and outside Europe during 1990s. They find an empirical evidence showing that the banking industry in the developed countries are characterized by monopolistic competition. For many countries, the estimated H-statistic index from Panzar and Rosse's model indicates a significant increase in the degree of competition over time. Additionally, the degree of competitive environment in Europe becomes stronger than that of in the U.S., Canada and Japan. Weill (2004) also evaluates the degree of bank competition using a sample of 12 European countries

over the period 1994 to 1999. The empirical result indicates monopolistic competition for all countries, which is in line with prior studies.

More recently, Bikker and Spierdijk (2008) study the level of competition using the sample of 101 countries during the period 1986 to 2004. By using the model of Panzar and Rosse (1987), they find that the level of competition is declining for developed countries and increasing for developing countries. By using the same methodology, Turk-Ariss (2009) investigates the level of competition in 12 Middle East and North African countries. He concludes that the level of competition is under monopoly for North African countries and under monopolistic competition for the countries in other regions. The list of previous empirical studies on the degree of bank competition is summarized in Table 2.1.

In summary, it can be concluded that there are two different angles to view competition. The first one is from the structural approach, namely market concentration. The second one is from the non-structural approach, namely market pricing power. Also, the empirical results on the degree of competition actually depend on the proxy used as well as the model specification.

2.1.2 Competition and Stability: Theoretical Framework

The existing economic theories still provide an unclear conclusion on the relationship between bank competition and financial system stability. There are two main hypotheses regarding to the relationship, which are competition-fragility and competition-stability hypotheses.

Under the traditional competition-fragility view, it concludes that more competitive banking systems (or less concentrated markets) are more fragile. In other words, in less competitive banking systems (or more concentrated markets), banks will have more lending opportunities and eventually can increase profits. Therefore, such ample profits will help these banks be able to withstand more economic fluctuation and less likely to take excessive risky project. Hence, the systems will become more stable.

Table 2.1: Summary of Empirical Studies on the Degree of Bank Competition

Authors	Study Period	Countries	Methodology	Results
Shaffer (1989)	1941-1983	USA	Bresnahan (1982)	Perfect competition.
Shaffer (1993)	1965-1989	Canada	Bresnahan (1982)	Perfect competition with high concentration.
Shaffer (2002)	1979-1991	Switzerland	Bresnahan (1982)	Foreign-owned banks have more market power than the state-owned banks.
Toolsema (2002)	1993-1999	Netherlands	Bresnahan (1982)	Consumer credit market was under perfect competition.
Canhoto (2004)	1990-1995	Portugal	Bresnahan (1982)	Imperfect competition in the deposit market.
Uchida and Tsutsui (2005)	1974-2000	Japan	Bresnahan (1982)	Competition is increasing on average.
Coccorese (2008)	1995-2004	Italy	Bresnahan (1982)	Imperfect competition.
Nathan and Neave (1989)	1982-1984	Canada	Panzar-Rosse (1987)	Perfect competition for 1982 and monopolistic competition for 1983 and 1984.
Shaffer and DiSalvo (1994)	1970-86	Pennsylvania (USA)	Panzar-Rosse (1987)	Duopoly. High competition.
Molyneux et al. (1994)	1986-1989	France, UK, Spain, Germany and Italy	Panzar-Rosse (1987)	Monopoly for Italy and monopolistic competition for the rest.
Molyneux et al. (1996)	1986;1988	Japan	Panzar-Rosse (1987)	Monopoly for 1986. Monopolistic competition for 1988.
Bikker and Groeneveld (1998)	1989-1996	EU-15 countries	Panzar-Rosse (1987)	Monopolistic competition. Concentration impairs competition.
Hondroyiannis et al. (1999)	1993-95	Greece	Panzar-Rosse (1987)	Monopolistic competition.
Bandt and Davis (2000)	1992-1996	Germany, USA, France and Italy	Panzar-Rosse (1987)	Competition is lower in small banks and higher in US banks.
Smith and Tripe (2001)	1996-1999	New Zealand	Panzar-Rosse (1987)	Monopolistic competition. In 1997, monopoly.
Bikker and Haaf (2002)	1988-1998	23 countries	Panzar-Rosse (1987)	Monopolistic competition for almost all countries. Perfect competition cannot be rejected in some cases.
Duncan (2003)	1989-2002	Jamaica	Panzar-Rosse (1987)	Monopolistic competition.
Belaisch (2003)	1997-2000	Brazil	Panzar-Rosse (1987)	Monopolistic competition.
Coccorese (2004)	1997-1999	Italy	Panzar-Rosse (1987)	Monopolistic competition.
Bikker et al. (2006)	1986-2005	120 countries	Panzar-Rosse (1987)	Monopolistic competition is predominant.
Trivieri (2007)	1996-2000	Italy	Panzar-Rosse (1987)	Monopolistic competition. Banks involved in cross-ownership are less competitive.
Deltuvaite et al. (2007)	2000-2006	Lithuania	Panzar-Rosse (1987)	Monopolistic competition.
Maudos and Solis (2007)	1993-2005	Mexico	Panzar-Rosse (1987)	Monopolistic competition.
Rozas (2007)	1986-2005	Spain	Panzar-Rosse (1987)	Monopolistic competition. Larger banks are more competitive.
Chan et al. (2007)	1996-2005	Australia and New Zealand	Panzar-Rosse (1987)	Conjectural variation oligopoly or monopoly for both markets.
Yuan (2006)	1996-2000	China	Panzar-Rosse (1987)	Perfect competition.
Yildirim and Philippatos (2007)	1993-2000	11 Latin American countries	Panzar-Rosse (1987)	Monopolistic competition.
Yeyati and Micco (2007)	1993-2002	8 Latin American countries	Panzar-Rosse (1987)	Monopolistic competition.
Bikker and Spierdijk (2008)	1986-2004	101 countries	Panzar-Rosse (1987)	Declining competition for developed countries. Increasing for emerging economies.
Park (2009)	1992-2004	Korea	Panzar-Rosse (1987)	Monopolistic competition and perfect competition during the crisis.
Turk-Ariss (2009)	2000-2006	12 Middle East & North African countries	Panzar-Rosse (1987)	Monopoly for North African countries and monopolistic competition for the others.

The research interest on this topic has been triggered by the article written by Keeley (1990), which concludes that one of the main reasons of bank failures in the U.S. during 1980s is resulted from various deregulation policies and market factors that lower monopoly rents (known as franchise value or charter value) of the banks. The franchise (charter) value model suggests that competition drives banks to take risky project due to the contraction of their franchise value. The model also shows that a higher franchise (charter) value resulted from an increase in market power from concentrated market may decrease the excessive risk-taking behavior by the banks, which may improve the stability of the banks themselves.

After an empirical investigation, Edwards and Mishkin (1995) conclude that the excessive risk-raking as observed during 1980s in the U.S. is from the banks' response to the decline of profits due to fiercer competition in financial industry. Also, Nagarajan and Sealey (1995) document that the effects of bank competition on excessive risk-taking behavior actually depend on how charter value is determined. They carry out the research by focusing on how regulatory policies affect charter value and conclude that high charter value stimulate excessive risk-taking behavior when they are generated by non-optimal policies.

Recently, Allen and Gale (2000) state that concentrated banking systems that compose of a few large banks are more stable because they are easily to be monitored. Boot and Thakor (2000) also suggest that larger banks tend to engage in credit rating activity because making fewer credit investment but higher quality can increase the return of investment. As a result, these will also eventually improve the stability of the systems. Furthermore, Allen and Gale (2004) carry out an empirical study on the past financial crises and conclude that the crises are more likely to occur in less concentrated banking systems. That is because in less concentrated systems, there is almost no large market player who has substantial profits that can be used as a buffer against economic fluctuation as well as the deterioration of asset quality. Likewise, Boyd et al. (2004) conduct the empirical investigation and reach the same conclusion that larger banks in concentrated banking systems usually earn substantial profits. As a result, the chance of financial crisis is reduced because higher capital can be used as a buffer to protect the systems against external shocks.

Contrary to the traditional view, the recent competition-stability view suggests that more competitive banking systems (or less concentrated markets) are more stable. It is documented by Mishkin (1990) that when the market is very concentrated, the policymakers are usually more concerned about bank failures. That is because these few large banks in such market are more likely to receive supports or subsidies from the government. As a result, this may generate a moral hazard problem by encouraging risk-taking behavior and may lead to financial instability. This concept is also known as "too big to fail". Caminal and Matutes (2002) conclude that less competition in the banking industry may result in less credit rationing. Thus, this will result in higher probability of bank failure.

In addition, Boyd and De Nicolo (2005) develop the theoretical framework concluding that less competition in the banking industry will eventually lead to financial instability. They begin their analysis by assuming that the borrowing firms usually choose the risk of their projects that is corresponding to the loan rates set by banks entirely. Therefore, when there is less competition in the market, banks tend to impose higher interest rates on their loan, and that causes the borrowing firms to take riskier projects inevitably. At the higher degree of risk taken by the borrowers, the amount of Non-Performing Loan (NPL) to banks will increase. So, the authors conclude that as the risk is eventually transferred from borrowers to banks in this circumstance, it will lead to a higher probability of financial system instability.

However, Berger et al. (2009) conclude that the two views of the hypothesis do not necessarily suggest the opposite predictions pertaining to the relationship between bank competition and financial system stability. They document that even if the borrowers need to take riskier projects to cover higher interest rate imposed by banks, such incremental risk exposure may not be fully transferred to banks. That is because banks may still be able to protect their franchise (charter) values by using risk management frameworks to mitigate risk exposures. Such frameworks are, for example, to increase equity capital, to reduce interest rate risk or to engage in some credit derivatives. As a result, the overall risk exposed by banks can be maintained. Furthermore, Martinez-Miera and Repullo (2010) recently extend the work of Boyd and De Nicolo (2005)'s risk shifting effect. They suggest that when banks impose higher interest rates to the borrowing firms, such interest also produce higher interest

revenue for banks. Therefore, this revenue becomes a buffer against larger NPL, which is known as the margin effect. As a result, the interaction between risk-shifting effect and margin effect will dynamically generate a non-linear U-shaped relationship between bank competition and financial system stability.

In summary, the existing theoretical frameworks still provide an unclear conclusion on the relationship between competition and stability. Both of the main hypotheses, namely competition-fragility and competition-stability, are theoretically valid. Therefore, researchers need to further conduct empirical investigations to support such hypotheses. The discussion of such empirical investigation is presented in section 2.1.3.

2.1.3 Competition and Stability: Empirical Evidence

Existing literature on the effect of bank competition to financial system stability still shows mixed empirical results and not yet conclusive. For example, Boyd et al. (2006) and De Nicolo and Loukoianova (2007) find that the risk of bank failure increases in less competitive markets. However, Jimenez et al. (2007) finds that risks decrease when market power of incumbent banks increases.

By investigating the markets in eight Latin American countries during the period 1993 to 2002, Yeyati and Micco (2007) find a positive relationship between bank risk (as measured by Z-score index) and competition (as measured by H-statistic index). However, they find no relationship between bank risk and concentration measure. Schaeck and Cihak (2008) examine the linkage between bank competition and financial system stability. A sample of more than 3,600 banks from 10 European countries and more than 8,900 banks from the U.S. during the year 1995 to 2005 are used in their study. They conclude that competition increases stability by increasing efficiency. In addition, Schaeck et al. (2009) use the data from 31 systemic banking crises in 45 countries during the year 1980 to 2005 and find that competition (as measured by H-statistic index) decreases the likelihood of a crisis and increases the time to a crisis, which supports competition-fragility view. Also, they conclude that competition and concentration capture different characteristics of banking systems, meaning that concentration is an inappropriate proxy for competition.

Uhde and Heimeshoff (2009) use aggregated data of 25 European countries during the year 1997 to 2005 and show that national banking market concentration has a negative impact on the stability of European banking systems. Berger et al. (2009) analyze 8,235 banks in 23 developed countries during the year 1999 to 2005 and conclude a neutral view that competition and concentration can coexist and affect financial system stability. They show that banks with more market power (as measured by Lerner index) have less overall risk exposure (as measured by Z-score index). This result support traditional competition-fragility view. On the other hand, they find that banks with higher market power results in riskier loan portfolio (as measured by NPL ratio). This result supports competition-stability view.

Liu and Wilson (2010) explore whether the effect of bank competition on financial system stability varies depending on the characteristics of banks in the Japanese market during the year 2000 to 2009 or not. They find that bank competition enhances the stability of banks with a lower stability level but reduces the stability of banks with a higher stability level. Furthermore, Liu et al. (2012) investigate four South East Asian countries (Indonesia, Malaysia, Philippines and Vietnam) during the year 1998 to 2008 and find that competition (as measured by H-statistic index) is inversely related to most risk indicators (as measured by NPL ratio, Loan Loss Reserve ratio, volatility of bank after-tax return on asset), except natural logarithm of Z-score index. Additionally, they find that bank concentration has a negative effect on bank stability, whereas regulatory restrictions positively influence bank fragility. Therefore, they conclude that bank concentration and competition can coexist, and they may affect financial stability through different channels.

Anginer et al. (2012) study a sample of 1,872 listed banks in 63 countries during the year 1997 to 2009 and find a positive relationship between bank competition (as measured by Lerner index) and systemic stability (as measured by the probability of bankruptcy). The robustness check is also conducted using concentration index as an alternative proxy for bank competition. The result remains the same. Recently, Beck et al. (2013) study cross-country variation in the relationship between bank competition and financial system stability. They use bank-level data from 79 countries during the year 1994 to 2009 to investigate how heterogeneous regulatory and institutional features affect such relationship across countries. They find that an increase in

competition will have a larger impact on bank fragility in countries with stricter activity restrictions, lower systemic fragility and better developed stock exchanges.

According to the above empirical investigations, it can be concluded that the relationship between bank competition and financial system stability are very complex. The results can be varied according to the proxy selections and sampling groups. Also, there can be some other factors that are relevant to the relationship between competition and stability. Those studies are discussed in section 2.1.4.

2.1.4 Competition, Stability and Other Factors

The study in competition-stability nexus is not limited only between these two variables. For example, the linkage between competition and efficiency is firstly explored by Hicks (1935). He states that monopoly power allows the individual firm to be free from competition, and therefore, the increase in concentration should bring the decrease in efficiency. This is known as the Quiet Life Hypothesis (QLH). However, Liebenstein (1966) argues that inefficiencies are reduced by the increase in competition as the firms encounter more challenges. On the contrary, Demsetz (1973) posits a reverse causality between competition and efficiency. He states that more efficient firms have lower costs, which in turn lead to higher profits. As a result, the most efficient firms are able to increase their market share. So, the concentration will be high. This is known as the Efficient Structure Hypothesis (ESH).

Though there are several existing literatures about the measurement of the degree of competition in early 2000s, there are still a few papers investigating on the perspective of the relationship between competition, concentration and efficiency. Demirguc-Kunt and Levine (2000) state that the existing empirical evidence on this link does not suggest a conclusive positive or negative relationship. In addition, there are conflicting results on the impact of increased bank concentration through mergers and acquisitions on efficiency, bank deposit rates and profitability as documented by Berger and Humphrey (1992) and Pilloff (1996).

Claessens and Laeven (2004) construct a major study of competition and concentration that includes the banking systems of 50 developed and developing countries. They find the markets with greater foreign bank entry and fewer entry and

activity restrictions to be more competitive. They also find no empirical evidence that the competitiveness measure relates negatively to the banking system concentration.

By using the Lerner index to investigate the implication of market power on bank efficiency, Maudos and De Guevara (2007) find a positive relationship between market power and cost efficiency during the period 1993 to 2002. Their empirical result from 15 sampling European banks rejects the QLH. By using U.S. and European samples of over 10,000 banks during the period 1995 to 2005, Schaeck and Cihak (2008) report that competition can improve profit efficiency. Koetter et al. (2008) acknowledge that competition and efficiency are correlated. They use a structural model to find empirical support for the prediction of the ESH, rather than QLH during the year 1986 to 2006 in the U.S. banking industry.

Delis and Tsionas (2009) investigate an empirical framework for the joint estimation of efficiency and market power for a sample of European and U.S. banks during the year 1996 to 2006. They report a negative relationship between market power and efficiency, which supports the predictions of the QLH. More recently, Turk-Ariss (2010) employs a sample of 60 banks in developing countries during the year 1999 to 2005 and investigates on bank efficiency as a possible conduit through which competition influences financial stability and find a significant relationship among them. The results show that an increase in the degree of market power leads to greater bank stability and profit efficiency. These findings support the traditional view of competition-fragility.

Besides competition, concentration and efficiency, the impact of revenue diversification on bank stability is also under investigation even though the findings are not yet under one consensus. On one side, Stiroh (2004), Hirtle and Stiroh (2007) and Mercieca et al. (2007) find no benefits from revenue diversification. On the other side, Landskroner et al. (2005) and Baele et al. (2007) conclude that diversification indeed can decrease bank insolvency risk. Also, Sanya and Wolfe (2011) similarly conclude that revenue diversification across and within both interest and non-interest income actually decreases bank insolvency risk. In their research, they use the data set of 226 banks in 11 emerging countries during the period 2000 to 2007 and employ a new methodological approach called System Generalized Method of Moments (SGMM).

Recently, Amidu and Wolfe (2013) investigate the role of revenue diversification in the competition-stability nexus. They explore how the level of competition affects revenue diversification and financial stability by using the data of 978 banks in 55 developing countries during the year 2000 to 2007. After simulating the above panel data set using three-stage least square technique, they find that competition increases stability as revenue diversification increases. Their result is quite robust to other several alternatives, such as variable specification, regulatory environment and so on.

According to the above empirical studies, it can be concluded that the relationship between competition and stability is not a simple one to one. There are some other variables, such as efficiency and revenue diversification, which actually have effects on the relationship between bank competition and financial system stability.

2.2 Data and Methodology

2.2.1 Variable Specifications

The variables used in this essay can be categorized into five main groups. The first one is the competition measurement under the structural approach, namely market concentration, while that under non-structural approach, namely market pricing power, is described in the second group. The third group illustrates the stability measures. The bank efficiency, revenue diversification, portfolio risk and other bank-specific control variables are presented in the fourth group. The last group contains the country-specific control variables, such as GDP growth rate and Inflation rate.

2.2.1.1 Structural Competition Measure

A. Concentration Index

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

$$CI_t = \sum_{i}^{n} s_{it} w_{it} \qquad (2.1)$$

where:

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

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

n is the number of banks in the market under consideration

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

$$CI_{kt} = \sum_{i=1}^{k} s_{it} \qquad (2.2)$$

There is no specific rule to determine the optimal number of k. The index is in a range between zero and one, and it can be interpreted as following. If it is equal to one, it means that the banks included in the computation make up the entire industry. As a result, the competition is at the lowest in this case. On the other hand, if it approaches zero, it means that there exists the infinite number of very small banks in the market given that the k chosen banks for the computation is relatively small comparing to the total number of banks. As a result, the competition is at the highest in this case.

Even though there is no rule determining the optimal value of k, in order to align with other existing literature, such as Bikker and Haaf (2000), Claessens and Laeven (2004), Casu and Girarone (2006) and so on, k=3 and k=5 will be arbitrarily applied in this research (denoted as CI3 and CI5 hereafter).

2.2.1.2 Non-Structural Competition Measures

B. Lerner Index

The Lerner Index (denoted as LI hereafter) provides a direct measure of the degree of market power as it represents the mark-up of price over marginal cost. It is calculated by taking the difference between price of the output and the marginal cost that produces such output and then dividing by the price. The interpretation of this index is that when there is no mark-up (LI = zero), it means the market is very competitive. When LI is higher, it means higher market power. As a result, the competition is lower. LI can be computed as in equation 2.3.

$$LI_t = \frac{P_{it} - MC_{it}}{P_{it}} \tag{2.3}$$

where:

P_{it} is the price of each bank i at time t, which is calculated by the number of total revenue divided by total asset

MC_{it} is the marginal cost of each bank i at time t, which is derived from a translog cost function that includes three costs and several control variables. The translog cost function can be illustrated as in equation 2.4.

$$\ln TC_{i,t} = \alpha_o + \alpha_1 \ln TA_{it} + \alpha_2 (\ln TA_{it})^2 + \sum_{j=1}^{3} \beta_j \ln w_{it}^j + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln w_{it}^j \ln w_{it}^k + \sum_{j=1}^{3} \gamma_j \ln w_{it}^j \times \ln TA_{it} + \varepsilon_{it} \tag{2.4}$$

where:

TC_{it} is the total cost of each bank i at time t

w_{it} is the price of three inputs, which are deposit fund, labor and fixed asset

w_{it}^1 is the price of deposit, which is the ratio of interest expense to total deposit

w_{it}^2 is the price of labor, which is the ratio of personal expense to total asset

w_{it}^3 is the price of fixed asset, which is the ratio of operating expense to total fixed asset

TA_{it} is the total asset

ε_{it} is the error term

In order to obtain a valid cost function, the following restrictions in the translog cost function need to be imposed.

$$\sum_{j=1}^{3} \beta_j = 1 \tag{2.5}$$

$$\sum_{j=1}^{3} \gamma_j = 0 \tag{2.6}$$

$$\sum_{j=1}^{3} \beta_{jk} = 0 \text{ for } \forall k \in \{1,2,3\} \tag{2.7}$$

After imposing the above restrictions, marginal cost can be obtained as following.

$$MC_{it} = \frac{\partial TC_{it}}{\partial TA_{it}} = \frac{TC_{it}}{TA_{it}} \left(\hat{\alpha}_1 + 2\hat{\alpha}_2 \ln TA_{it} + \sum_{j=1}^{2} \gamma_j \ln \frac{w_{it}^j}{w_{it}^3} \right) \tag{2.8}$$

C. H-statistic Index

The H-statistic Index (denoted as HI hereafter) can classify the market structure into perfect competition, monopolistic competition and monopoly. It has been used as a direct measurement of the degree of competition in the well-known literature pertaining to bank competition, such as Molyneux et al. (1994), Bikker and Haaf (2002), Claessens and Laeven (2004) and so on.

This HI is firstly developed by Panzar and Rosse (1987) to measure competitive behavior of banks on the basis of reduced-form revenue equation based on cross-sectional data. They assume that the number of banks are endogenous and operate in the long-run equilibrium Also, the performance of the banks is influenced by the actions of other market participants. In order to obtain the equilibrium outputs and the equilibrium number of banks, each bank i must, therefore, maximize its profits where marginal revenue equates marginal cost as following.

$$R_i^{'}(x_i, n, z_i) - C_i^{'}(x_i, w_i, t_i) = 0 \tag{2.9}$$

where:

$R_i^{'}$ is the marginal revenue of bank i

x_i is the output of bank i

n is the number of banks

z_i is the vector of exogenous variables that affect the bank's revenue function

$C_i^{'}$ is the marginal cost of bank i

w_i is the vector of input prices of bank i

t_i is the vector of exogenous variables that affect the bank's cost function

The above profit maximization must be subjected to the following zero profit constraint so that the equilibrium condition holds at the industry level.

$$R_i^*(x^*, n^*, z) - C_i^*(x^*, w, t) = 0 \qquad (2.10)$$

The variables with an asterisk represent the equilibrium figures. Based on the equation 2.9 and 2.10, the market power is then measured by the extent to which a change in factor input prices ($\partial w_{k,i}$) is reflected in the equilibrium revenues (∂R_i^*) earned by each bank i.

Then, Panzar and Rosse (1987) define a measure of the degree of competition level, called H-statistic Index, as the sum of the elasticity of the reduced-form revenues with respect to the factor input prices1. It can be illustrated as following.

$$HI = \sum_{k=1}^{m} \frac{\partial R_i^*}{\partial w_{k,i}} \frac{w_{k,i}}{R_i^*} \qquad (2.11)$$

The index can be interpreted as following. When it is equal to zero or negative, it indicates that the market is classified as a monopoly. When it is equal to one, it indicates a perfect competition market structure, and when it is between zero and one, it indicates a monopolistic competition.

The empirical application of the Panzar and Rosse (1987) assumes a log-linear marginal cost function as following.

$$\ln MC = \alpha_0 + \alpha_1 \ln Y + \sum_{i=1}^{m} \beta_i \ln P_i + \sum_{j=1}^{n} \gamma_j \ln XC_j \qquad (2.12)$$

where:

Y is the output of the bank

P is the factor input prices (i.e. interest expense, personnel expense)

[1] See Panzar-Rosse (1987) or Vesala (1995) for the formal derivation of H-statistic Index.

XC is the other exogenous variables affecting the cost function

Similarly, the marginal revenue function is also assumed in a log-linear form as following.

$$\ln MR = \delta_0 + \delta_1 \ln Y + \sum_{k=1}^{p} \eta_k \ln XR_k \tag{2.13}$$

where:

Y is the output of the bank

XR is the other exogenous variables affecting the revenue function

For a profit-maximizing bank, marginal cost must equate marginal revenue in equilibrium, resulting in the equilibrium value for output as following.

$$\ln Y = \frac{(\alpha_0 - \delta_0 + \sum_{i=1}^{m} \beta_i \ln P_i + \sum_{j=1}^{n} \gamma_i \ln XC_j - \sum_{k=1}^{p} \eta_k \ln XR_k)}{(\delta_1 - \alpha_1)} \tag{2.14}$$

By substituting equation 2.14 into 2.13, the inverse demand equation that provides the reduced-form equation for revenues can be obtained as following.

$$\ln p = \phi + \eta \ln Y \tag{2.15}$$

For the empirical analysis, the following reduced-form revenue equation is estimated by running on a panel data set in order to obtain the index (Claessens and Laeven, 2004).

$$\begin{aligned} &\ln(P_{it}) = \alpha + \beta_1 \ln(W_{1,it}) + \beta_2 \ln(W_{2,it}) + \beta_3 \ln(W_{3,it}) \\ &+ \gamma_1 \ln(Y_{1,it}) + \gamma_2 \ln(Y_{2,it}) + \gamma_3 \ln(Y_{3,it}) + \varepsilon_{it} \end{aligned} \tag{2.16}$$

where:

P_{it} is the price of each bank i at time t, which is calculated by the number of total revenue divided by total asset

$W_{1,it}$ is the price of deposit of each bank i at time t, which is the ratio of interest expense to total deposit

$W_{2,it}$ is the price of labor of each bank i at time t, which is the ratio of personal expense to total asset

$W_{3,it}$ is the price of fixed asset of each bank i at time t, which is the ratio of operating expense to total fixed asset

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

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

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

After estimating equation 2.16 using ordinary least squares technique, HI can be calculated as in equation 2.17.

$$HI_t = \beta_1 + \beta_2 + \beta_3 \quad (2.17)$$

2.2.1.3 Stability Measures

D. Z-score Index

The Z-score Index (denoted as ZI hereafter) assesses the overall stability at the bank level, as documented by Boyd et al. (2006) and Berger et al. (2009). This measure of bank stability combines the indicators of profitability, leverage and return volatility into a single factor. Mathematically, it measures the number of standard deviation that a bank's profit must fall to drive it into insolvency. The index potentially measures the accounting distance to default for a given institution, and it is calculated as following.

$$ZI_{it} = \frac{ROA_{it} + ETA_{it}}{SD(ROA)_{it}} \quad (2.18)$$

where:

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

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

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

The interpretation of Z-score Index is that the higher ZI, the lower probability of insolvency risk.

E. Capitalization Ratio

Capitalization Ratio (denoted as CR hereafter) is used to proxy for bank stability because the Basel Accord (1998) has made banks increasingly focus on managing their capital base as a buffer against default. CR can be computed as following.

$$CR_{it} = \frac{E_{it}}{TA_{it}} \tag{2.19}$$

where:

E_{it} is the equity of each bank i at time t

TA_{it} is the total asset of each bank i at time t

The interpretation of CR is that the higher the index is, the higher the stability will become.

2.2.1.4 Bank-Specific Control Variables

F. Cost to Income Ratio

Cost to Income Ratio (denoted as CIR hereafter) is one of the most popular efficiency measurements of the bank. It is calculated as total cost over total income. So, it measures how well the expense is utilized per one unit of revenue, and the higher the ratio is, the less efficient the bank becomes.

G. Return on Asset

Return on Asset (denoted as ROA hereafter) is an alternative measure of efficiency of the bank. It is computed as net income over average total asset. Therefore, the higher the ratio is, the more efficient the bank is.

H. Revenue Diversification Index

Following Mercieca et al. (2007), Revenue Diversification Index (denoted as RDI hereafter) is calculated by using Hirschman Herfindahl approach for each bank. It accounts for the diversification between interest and non-interest income. The higher RDI ratio means higher revenue concentration and hence lower revenue diversification.

$$RDI_{it} = \left(\frac{NII_{it}}{TR_{it}}\right)^2 + \left(\frac{FI_{it}}{TR_{it}}\right)^2 + \left(\frac{TI_{it}}{TR_{it}}\right)^2 \tag{2.20}$$

where:

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

NII_{it} is the net interest income of each bank i at time t, which is computed by interest income minus interest expense

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

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

I. Non-Performing Loan Ratio

Non-Performing Loan ratio (denoted as NPL hereafter) is used to proxy for loan portfolio risk. This proxy indeed takes into account that (1) the risk should not imply a higher risk of bank failure if the asset allocation tilts towards a larger holding of risk-free assets and (2) the measures at best should capture the default risk related to the loan portfolio. This measure can be computed as NPL over total loan, and the higher ratio means higher portfolio risk.

J. Bank Size

It is the total asset held by each bank. The variable is presented in logarithmic form (denoted as LNTA hereafter).

K. Loan to Asset Ratio

It is the total loan divided by total asset by each bank (denoted as LTA hereafter).

2.2.1.5 Country-Specific Control Variables

L. GDP Growth Rate

It is used to control for the general economic development, macroeconomic stability, and institutional framework as these are likely to affect banking system performance in a country. The rate of real GDP growth rate (denoted as GDPG hereafter) is used as a proxy.

M. Inflation Rate

It is used to control for the general economic development, macroeconomic stability, and institutional framework as these are likely to affect banking system performance in a country. The inflation rate is computed based on Consumer Price Index (denoted as CPI hereafter).

2.2.2 Data

This essay uses both micro bank-level and macro country-level data during the period 2000 to 2013. The micro bank-level data is taken from Bankscope Database. All data are reported in USD currency and are expressed in constant prices where appropriate. The sample is limited to the commercial banks, and the countries that have banks less than ten banks in the industry will also be excluded. Also, in order to align the analysis at country level, bank-level data are aggregated into country level. The macro country-level data is mainly obtained from the latest update of the World Development Indicators Database (WDID) and Global Financial Development Database (GFDD) from the World Bank. The details of variables used and their source are summarized in Table 2.2.

Table 2.2: Variables used and their Source

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

Table 2.3 presents the list of countries in the sample and the numbers of banks as of 2013. The numbers of banks are in the range of the lowest 10 banks in Angola, Bahrain, Jordan, El Salvador and Uzbekistan to the highest 6,073 banks in the U.S. Most of the sampling countries contain banks no more than 100, except China, Japan, Russia and the U.S. Total numbers of banks in the sampling year 2013 are at 8,968.

Table 2.3: Numbers of Banks by Country as of 2013

Country Name	Country Code	Numbers of Bank	Country Name	Country Code	Numbers of Bank	Country Name	Country Code	Numbers of Bank
UAE	AE	15	Guatemala	GT	17	Paraguay	PY	11
Angola	AO	10	Hong Kong	HK	26	Romania	RO	16
Argentina	AR	31	Honduras	HN	14	Serbia	RS	23
Austria	AT	52	Croatia	HR	25	Russia	RU	784
Australia	AU	12	Hungary	HU	14	Sweden	SE	21
Azerbaijan	AZ	19	Indonesia	ID	55	Slovenia	SI	12
Bosna	BA	17	India	IN	50	El Salvador	SV	10
Bangladesh	BD	15	Italy	IT	65	Thailand	TH	17
Belgium	BE	19	Jordan	JO	10	Turkey	TR	24
Bulgaria	BG	13	Japan	JP	107	Tanzania	TZ	19
Bahrain	BH	10	Kenya	KE	26	Ukraine	UA	12
Brasil	BR	64	South Korea	KR	15	United States	US	6,073
Belarus	BY	17	Kazakhstan	KZ	23	Uruguay	UY	13
Canada	CA	35	Lebanon	LB	18	Uzbekistan	UZ	10
Switzerland	CH	80	Sri Lanka	LK	16	Venezuela	VE	21
Chile	CL	22	Luxembourg	LU	32	Vietnam	VN	29
China	CN	119	Latvia	LV	16	South Africa	ZA	12
Colombia	CO	20	Mauritius	MU	13	Armenia	AM	15
CostaRica	CR	13	Mexico	MX	37	Moldavia	MD	11
Czech	CZ	14	Malaysia	MY	21	Uganda	UG	13
German	DE	82	Nigeria	NG	17	Zambia	ZM	12
Denmark	DK	29	Netherlands	NL	23			
Dominican	DO	31	Norway	NO	13			
Ecuador	EC	16	Nepal	NP	27			
Egypt	EG	20	New Zealand	NZ	12			
Spain	ES	25	Panama	PA	29			
France	FR	91	Peru	PE	13			
England	GB	87	Philippines	PH	34			
Georgia	GE	12	Poland	PL	25			
Ghana	GH	13	Portugal	PT	14	**Total**		**8,968**

2.2.3 Methodology

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

$$Stability = f(Competition, BankControls, CountryControls) \qquad (2.21)$$

The empirical model can be illustrated as following**.**

$$Z_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + \varepsilon_{it} \quad (2.22)$$

Also, in order to account for period fixed effect, time dummy variable is added into equation 2.22. The final baseline model is illustrated as following in which *T* is the time dummy variable.

$$Z_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + T + \varepsilon_{it} \quad (2.23)$$

where:

Z_{it} is a measure for bank stability of each country i at time t, which is represented by variable LNZI or CR

C_{it} is a measure for bank competition of each country i at time t, which is represented by variable CI3, CI5, LI or HI

X_{ij} is a set of bank-specific and country-specific control variables, which is represented by variables as described in section 2.2.1.4 and 2.2.1.5

ε_{it} is the error term

2.3 Empirical Results

2.3.1 Descriptive Statistics

Table 2.4 illustrates the average measures by countries during the period 2000 to 2013. For the structural competition measure or the market concentration, the top three countries with the highest CI3 are Norway, Switzerland and Portugal, while those with the highest CI5 are South Africa, Norway and Uzbekistan in which the value is more than 90%. It can be interpreted that the market structure of these countries are almost monopoly. The top three countries with the lowest CI3 and CI5 are the U.S., India and Russia in which the value is around 40% to 50%. So, the markets in these countries are characterized as monopolistic competition.

Table 2.4: Average Measures by Country during the Period 2000 to 2013

		Average Measures by Country during the Period 2000 to 2013									
Country Name	Country Code	Structural Competition		Non-Structural Competition		Stability Measures		Efficiency Measures		Diversification Measure	Portfolio Risk Measure
		CI3	CI5	LI	HI	LNZI	CR	CIR	ROA	RDI	NPL
UAE	AE	0.6269	0.8187	0.4517	0.1584	3.26	0.1366	0.3102	0.0265	0.5285	0.0878
Angola	AO	0.8858	0.9620	0.4386	0.1680	2.45	0.0076	0.4448	-0.0049	0.5165	0.0000
Argentina	AR	0.4959	0.6772	0.1489	0.1766	1.44	0.0955	0.6429	0.0079	0.5580	0.0717
Austria	AT	0.8191	0.8774	0.2011	0.2085	3.21	0.0608	0.6235	0.0050	0.6377	0.0243
Australia	AU	0.7441	0.9499	0.1171	0.0761	1.95	0.0579	0.4960	0.0092	0.6256	0.0104
Azerbaijan	AZ	0.7736	0.8504	0.3295	0.0821	1.44	0.0481	0.5840	0.0219	0.5588	0.0174
Bosna	BA	0.6109	0.7625	0.1580	0.1347	1.80	0.1278	0.6484	0.0041	0.5574	0.0903
Bangladesh	BD	0.5543	0.7140	0.3287	0.1004	1.08	0.0264	0.4732	0.0174	0.4752	0.1130
Belgium	BE	0.7638	0.9236	0.1411	0.2134	2.11	0.0389	0.6437	0.0052	0.6935	0.0269
Bulgaria	BG	0.7054	0.8714	0.2409	0.1714	1.62	0.1084	0.5372	0.0130	0.5419	0.0744
Bahrain	BH	0.8418	0.9720	0.3805	0.0050	2.64	0.0370	0.3576	0.0206	0.5422	0.0197
Brasil	BR	0.6408	0.7743	0.2235	0.2026	2.45	0.1029	0.6104	0.0217	0.7829	0.0397
Belarus	BY	0.8554	0.9392	0.2849	0.2061	1.36	0.1413	0.6558	0.0124	0.4855	0.0518
Canada	CA	0.8328	0.9541	0.2277	0.2124	2.75	0.0459	0.5847	0.0244	0.7473	0.0093
Switzerland	CH	0.9512	0.9659	0.1184	0.1799	2.26	0.0537	0.7671	0.0079	0.6342	0.0120
Chile	CL	0.4665	0.7202	0.2813	0.2281	2.04	0.0733	0.5174	0.0117	0.5867	0.0168
China	CN	0.6456	0.8094	0.3338	0.1628	2.86	0.0431	0.4434	0.0083	0.7336	0.1013
Colombia	CO	0.7239	0.8595	0.2970	0.1542	1.89	0.1208	0.6121	0.0128	0.5291	0.0479
CostaRica	CR	0.7174	0.8595	0.1987	0.2388	2.91	0.1133	0.6920	0.0122	0.6547	0.0196
Czech	CZ	0.7790	0.8829	0.2327	0.1924	1.37	0.0589	0.5277	0.0105	0.5733	0.0702
German	DE	0.8295	0.9008	0.0664	0.2295	2.63	0.0441	0.7780	0.0045	0.6498	0.0376
Denmark	DK	0.7616	0.8644	0.2503	0.1200	2.24	0.0528	0.6086	0.0064	0.5824	0.0197
Dominican	DO	0.8278	0.9219	0.2181	0.1450	3.04	0.0957	0.7243	0.0182	0.6958	0.0422
Ecuador	EC	0.7211	0.8453	0.1989	0.2118	0.81	0.0958	0.7223	0.0105	0.5755	0.0728
Egypt	EG	0.6528	0.7788	0.0927	0.1047	2.63	0.0489	0.4703	0.0080	0.5657	0.1674
Spain	ES	0.8589	0.9438	0.2869	0.1278	2.65	0.0679	0.5346	0.0094	0.6177	0.0301
France	FR	0.5013	0.6423	0.1386	0.1978	2.46	0.0516	0.6705	0.0082	0.5810	0.0400
England	GB	0.5967	0.7604	0.2030	0.1671	2.23	0.0639	0.5901	-0.0948	0.5996	0.0248
Georgia	GE	0.7074	0.8859	0.3023	0.0697	1.91	0.1929	0.5431	0.0165	0.5499	0.0406
Ghana	GH	0.7658	0.8536	0.3244	0.0601	1.75	0.1033	0.5223	0.0381	0.4642	0.1406
Guatemala	GT	0.7305	0.8492	0.0000	0.0000	2.62	0.0750	0.6966	0.0168	0.8061	0.0336
Hong Kong	HK	0.7001	0.8145	0.4861	0.0220	2.81	0.1081	0.5045	0.0198	0.5718	0.0241
Honduras	HN	0.6371	0.8275	0.1949	0.2666	3.36	0.0659	0.6080	0.0122	0.6819	0.0286
Croatia	HR	0.6883	0.8552	0.2724	0.0838	1.51	0.1167	0.5578	0.0075	0.5256	0.0891
Hungary	HU	0.6201	0.8143	0.1797	0.1788	1.59	0.0660	0.6214	0.0058	0.4964	0.0634
Indonesia	ID	0.5118	0.6642	0.2601	0.1574	1.00	0.0974	0.5099	0.0128	0.6924	0.0956
India	IN	0.4073	0.5060	0.2440	0.1715	2.13	0.0639	0.4969	0.0108	0.5358	0.0565
Italy	IT	0.8237	0.8712	0.0843	0.2202	2.59	0.0616	0.6489	0.0061	0.5667	0.0854
Jordan	JO	0.8858	0.9481	0.3221	0.0688	3.31	0.1014	0.4811	0.0142	0.5292	0.0985
Japan	JP	0.4897	0.5930	0.3617	0.1434	2.40	0.0465	0.5764	0.0008	0.7501	0.0346
Kenya	KE	0.5690	0.7190	0.3319	0.1129	2.48	0.0904	0.5639	0.0190	0.5632	0.1131
South Korea	KR	0.5155	0.7536	0.3188	0.1527	1.96	0.0619	0.4575	0.0057	0.6641	0.0181
Kazakhstan	KZ	0.6405	0.7921	0.2788	0.1543	0.04	0.1195	0.5035	0.0180	0.5461	0.0761
Lebanon	LB	0.5294	0.7396	0.1600	0.1181	3.29	0.0634	0.5507	0.0092	0.5848	0.0838
Sri Lanka	LK	0.6806	0.8151	0.2080	0.0390	2.33	0.0181	0.6375	0.0142	0.5686	0.0093
Luxembourg	LU	0.5503	0.7010	0.1831	0.1956	3.18	0.0514	0.4256	0.0074	0.6165	0.0036
Latvia	LV	0.6673	0.8364	0.2434	0.1234	0.89	0.0873	0.5464	0.0067	0.4840	0.0539
Mauritius	MU	0.6800	0.8563	0.2941	0.1374	2.90	0.0378	0.4478	0.0144	0.6094	0.0173
Mexico	MX	0.6155	0.8095	0.0000	0.2441	2.98	0.1002	0.6292	0.0015	0.6038	0.0296
Malaysia	MY	0.6975	0.8039	0.2967	0.1856	2.64	0.0852	0.3784	0.0080	0.5639	0.0839
Nigeria	NG	0.7337	0.8303	0.1826	0.1778	1.08	0.0971	0.5751	0.0221	0.4793	0.1437
Netherlands	NL	0.9240	0.9716	0.1765	0.2163	2.29	0.0420	0.6421	0.0047	0.5822	0.0191
Norway	NO	0.9756	0.9889	0.2769	0.1954	1.90	0.0567	0.5308	0.0035	0.7612	0.0121
Nepal	NP	0.4613	0.6323	0.2935	0.2097	1.86	0.0000	0.4537	0.0134	0.5612	0.0000
New Zealand	NZ	0.6803	0.9375	0.1652	-0.0494	2.82	0.0315	0.6147	0.0098	0.5956	0.0065
Panama	PA	0.6061	0.7344	0.3654	0.2031	3.18	0.1146	0.5368	0.0165	0.6479	0.0226
Peru	PE	0.7968	0.9197	0.3758	0.2218	2.69	0.0966	0.5501	0.0142	0.6536	0.0511
Philippines	PH	0.5129	0.6791	0.2005	0.0669	2.88	0.1161	0.6036	0.0254	0.4819	0.0991
Poland	PL	0.6323	0.7640	0.2333	0.1777	1.90	0.0809	0.6181	0.0117	0.5260	0.0880
Portugal	PT	0.9346	0.9724	0.1907	0.2167	2.29	0.0614	0.5608	0.0036	0.5850	0.0406
Paraguay	PY	0.6299	0.8381	0.1190	0.1906	2.59	0.1006	0.7254	0.0186	0.6325	0.0632
Romania	RO	0.7735	0.8916	0.1823	0.2449	1.47	0.0993	0.5752	0.0055	0.5131	0.0708
Serbia	RS	0.5476	0.6933	0.1727	0.2161	2.42	0.1724	0.6756	-0.0017	0.6062	0.1287
Russia	RU	0.4384	0.5271	0.1692	0.2081	2.00	0.1172	0.7074	0.0196	0.6059	0.0539
Sweden	SE	0.8976	0.9397	0.2863	0.1294	1.87	0.0450	0.6282	0.0132	0.5751	0.0095
Slovenia	SI	0.6435	0.7802	0.2187	0.1961	1.27	0.0607	0.5705	0.0018	0.5394	0.0558
El Salvador	SV	0.8227	0.9707	0.3107	0.1689	3.14	0.1144	0.5319	0.0119	0.7592	0.0271
Thailand	TH	0.5507	0.7852	0.3142	0.1244	0.97	0.0814	0.5381	0.0089	0.5735	0.0847
Turkey	TR	0.6256	0.7931	0.4041	0.2046	2.02	0.1171	0.4499	0.0145	0.6376	0.0723
Tanzania	TZ	0.6462	0.7947	0.2694	0.1180	2.25	0.0293	0.5479	0.0063	0.5032	0.0176
Ukraine	UA	0.7934	0.9327	0.1670	0.1849	1.72	0.1396	0.5903	0.0034	0.5078	0.1604
United States	US	0.3922	0.4852	0.2762	0.1317	3.18	0.1055	0.5868	0.8711	0.0154	0.0219
Uruguay	UY	0.6345	0.8411	0.1471	0.2092	1.06	0.0796	0.7198	-0.0078	0.5973	0.0621
Uzbekistan	UZ	0.9194	0.9758	0.2736	0.1886	2.26	0.0741	0.6498	0.0195	0.5066	0.0090
Venezuela	VE	0.4670	0.6760	0.2831	0.2136	2.25	0.1140	0.5941	0.0354	0.6392	0.0343
Vietnam	VN	0.6812	0.7691	0.2181	0.1856	1.61	0.0326	0.4377	0.0129	0.7025	0.0088
South Africa	ZA	0.8446	0.9946	0.1826	0.2307	2.68	0.0781	0.5711	0.0155	0.5396	0.0303
Armenia	AM	0.6382	0.7998	0.3205	0.1888	2.27	0.1835	0.5527	0.0098	0.5404	0.0467
Moldavia	MD	0.7594	0.8974	0.3077	0.1302	2.23	0.1695	0.5259	0.0404	0.4435	0.0907
Uganda	UG	0.6962	0.8646	0.1624	0.0614	0.54	0.1270	0.5391	0.0223	0.6317	0.0418
Zambia	ZM	0.6310	0.8649	0.1975	0.1176	0.75	0.0303	0.6479	-0.0041	0.5508	0.0288

For the non-structural competition measure or the market pricing power, the top three countries with the highest LI are Hong Kong, UAE and Angola, while those with the lowest HI are New Zealand, Bahrain and Hong Kong. This means that these countries have high market pricing power, which can be implied that the market that they operate in is less competitive. On the other hand, the top three countries with the lowest LI are Mexico, German and Italy, while those with the highest HI are Belarus, Honduras and Romania. This means that these countries have low market pricing power, which can be implied that the market that they operate in is more competitive.

The logarithmic form of ZI is lowest at 0.04 in Kazakhstan indicating the highest probability of insolvency risk, while it is highest at 3.36 in Honduras indicating the lowest probability of insolvency risk. Unlike the logarithmic form of ZI, CR is lowest in Nepal and highest in Georgia. For efficiency measures, CIR is at the lowest in UAE indicating the highest efficiency level, while it is at the highest in German indicating the lowest efficiency level. ROA is, on the other hand, at highest in the U.S., while it is at the lowest in England. For revenue diversification measure, RDI is at the highest in Guatemala indicating the lowest level of revenue diversification, while it is at the lowest in the U.S. indicating the highest level of revenue diversification. For portfolio risk measure, NPL ratio is at the highest level in Egypt, while it is at the lowest in Luxembourg.

Table 2.5 presents the overall descriptive statistics of all variables across time and across countries. For group A, the mean of CI3 and CI5 are at 0.69 and 0.83 respectively, and they are quite close to their median. For group B, the mean of LI is at 0.24 and in the range of -0.62 to 0.84, which means that on average a banking industry can do the pricing 24% higher than their marginal cost. The mean of HI is at 0.16 and varies between -0.67 to 1.06, which can be interpreted that the market structure in this sample is very competitive as the value of HI is moving toward zero. For stability measure in group C, the sample mean of LNZI is at 2.17, and it varies between -1.33 to 3.71. For an alternative measure of stability, the sample mean of CR is at 0.08.

For bank-specific control variables in group D, the sample mean of CIR is at 0.57. This can be interpreted that on average, banks spend 57% of their revenue to the expense. Also, the sample mean of ROA is at 0.01, which can be interpreted that on average the bank’s asset in the sample can generate profits by 1%. For revenue

diversification measure, the mean of RDI is at 0.59 and in the range between 0.38 (much diversified revenue) to 1.00 (perfect concentrated revenue). For portfolio risk, the mean of NPL is at 0.05, which can be implied that on average banks have 5% of NPL in their portfolio. Lastly, for macroeconomic variables in group E, the mean of GDP growth rate is at 0.04, while the mean of inflation rate is as high as 0.07.

Table 2.5: Descriptive Statistics

Variable	Observation	Mean	Median	Max	Min	Stdev	Skewness	Kurtosis
Group A: Structural Competition Measures								
CI3	1,044	0.6921	0.6827	1.0000	0.2475	0.1751	0.0540	2.2076
CI5	1,044	0.8283	0.8459	1.0000	0.3681	0.1369	-0.7566	3.1507
Group B: Non-Structural Competition Measures								
LI	1,134	0.2392	0.2427	0.8351	-0.6232	0.1326	-0.5437	6.4776
HI	1,134	0.1575	0.0000	1.0640	-0.6720	0.2806	1.3216	3.2418
Group C: Stability Measures								
LNZI	1,114	2.1755	2.2558	3.7075	-1.3310	0.7645	-0.5715	3.2057
CR	1,134	0.0815	0.0820	0.3060	0.0262	0.0501	0.3818	3.7147
Group D: Bank-Specific Control Variables								
CIR	1,134	0.5707	0.5682	2.1809	0.0325	0.1328	1.5815	22.4192
ROA	1,134	0.0124	0.0114	0.0809	-0.0670	0.0134	-0.0816	8.9891
RDI	1,042	0.5922	0.5808	1.0000	0.3830	0.0986	0.5827	3.3989
NPL	1,134	0.0521	0.0300	0.3730	0.0041	0.0623	2.0874	7.7924
LNTA	1,134	1,112	178	74,021	0	7,537	9	80
LTA	1,044	0.5441	0.5587	0.9326	0.1724	0.1288	-0.3292	3.4102
Group E: Country-Specific Control Variables								
GDPG	1,134	0.0415	0.0403	0.3450	-0.1480	0.0406	0.6950	11.0044
CPI	1,134	0.0683	0.0386	3.2500	-0.0369	0.1465	12.4035	225.1541

2.3.2 Preliminary Investigation

2.3.2.1 Correlation Matrix

Table 2.6 presents the correlation matrix between each individual series. As expected the correlation between both market concentration measures, CI3 and CI5, is extremely high at 93%. This is simply due to the fact that CI3 is the concentration index of the three-largest banks in a country, while CI5 is that of the five-largest banks. The second highest correlation is between LI and efficiency measures, CIR and ROA. The correlation between LI and CIR is at 50%, while that between LI and ROA is at 40%. This can be preliminary evidence showing that the efficiency can affect the stability of the banks even though the full regression tests need to be performed in the subsequent section. One of the interesting results from this matrix is that the correlation between

ROA and GDP growth rate is as high as 39%. Also, the correlation between structural competition measures or market concentration and non-structural competition measures or market pricing power shows inconsistent results. The correlation between market concentration and HI is around 30%, but that between market concentration and LI is less than 10%. For the rest of the variables, the correlation is less than 30%.

Table 2.6: Correlation Matrix

	CI3	CI5	LI	HI	LNZI	CR	CIR	ROA	RDI	NPL	LNTA	LTA	GDPG	CPI
CI3	1.00	0.93	-0.06	-0.30	0.05	-0.20	0.09	-0.01	0.02	-0.05	0.00	-0.03	0.01	0.06
CI5		1.00	-0.05	-0.31	0.03	-0.16	0.04	0.03	-0.02	-0.05	0.03	-0.04	0.01	0.04
LI			1.00	0.08	0.08	0.10	-0.50	0.40	-0.21	-0.17	0.03	0.11	0.22	0.10
HI				1.00	0.01	0.08	0.04	-0.10	0.03	0.01	0.00	0.13	-0.09	-0.07
LNZI					1.00	-0.05	-0.11	0.06	0.19	-0.15	0.16	-0.10	-0.08	-0.12
CR						1.00	0.06	0.24	-0.18	0.26	0.05	0.16	0.07	0.00
CIR							1.00	-0.26	0.12	0.10	0.02	0.00	-0.15	-0.01
ROA								1.00	-0.23	-0.16	-0.04	-0.08	0.39	0.19
RDI									1.00	-0.12	-0.09	0.07	-0.16	-0.07
NPL										1.00	-0.06	0.05	-0.08	0.04
LNTA											1.00	-0.01	-0.07	-0.05
LTA												1.00	-0.13	-0.24
GDPG													1.00	0.09
CPI														1.00

Table presents correlation matrix between individual data series. CI3 and CI5 are the concentration index of the three- and five-largest banks in a country. LI is the Lerner Index. HI is the H-Statistic Index. LNZI is the logarithmic form of Z-Score Index. CR is the Capitalization Ratio. CIR is the Cost to Income Ratio. ROA is the Return on Assets. RDI is the Revenue Diversification Index. NPL is the Non-Performing Loan Ratio. LNTA is the logarithmic form of Total Asset. LTA is the Loan to Asset Ratio. GDPG is the GDP Growth Rate. CPI is the Consumer Price Index.

2.3.2.2 Graphical Analysis

Figure 2.1 illustrates the graphical data of average competition and stability measures during the year 2000 to 2013. For structural competition measure, CI3, it is in an obvious downward trend. For non-structural competition and stability measures, LI and LNZI, they are slightly in an upward trend.

Figure 2.2 illustrates the graphical data of average other bank-specific control variables during the year 2000 to 2013. For efficiency measure, CIR, it is quite stable and is in the range of 0.55 to 0.60. Also, revenue diversification measure, RDI, is also quite stable even though a moderate variation is observed. For portfolio risk measure, NPL, it is slightly lower from 0.046 in the year 2000 to 0.034 in the year 2013.

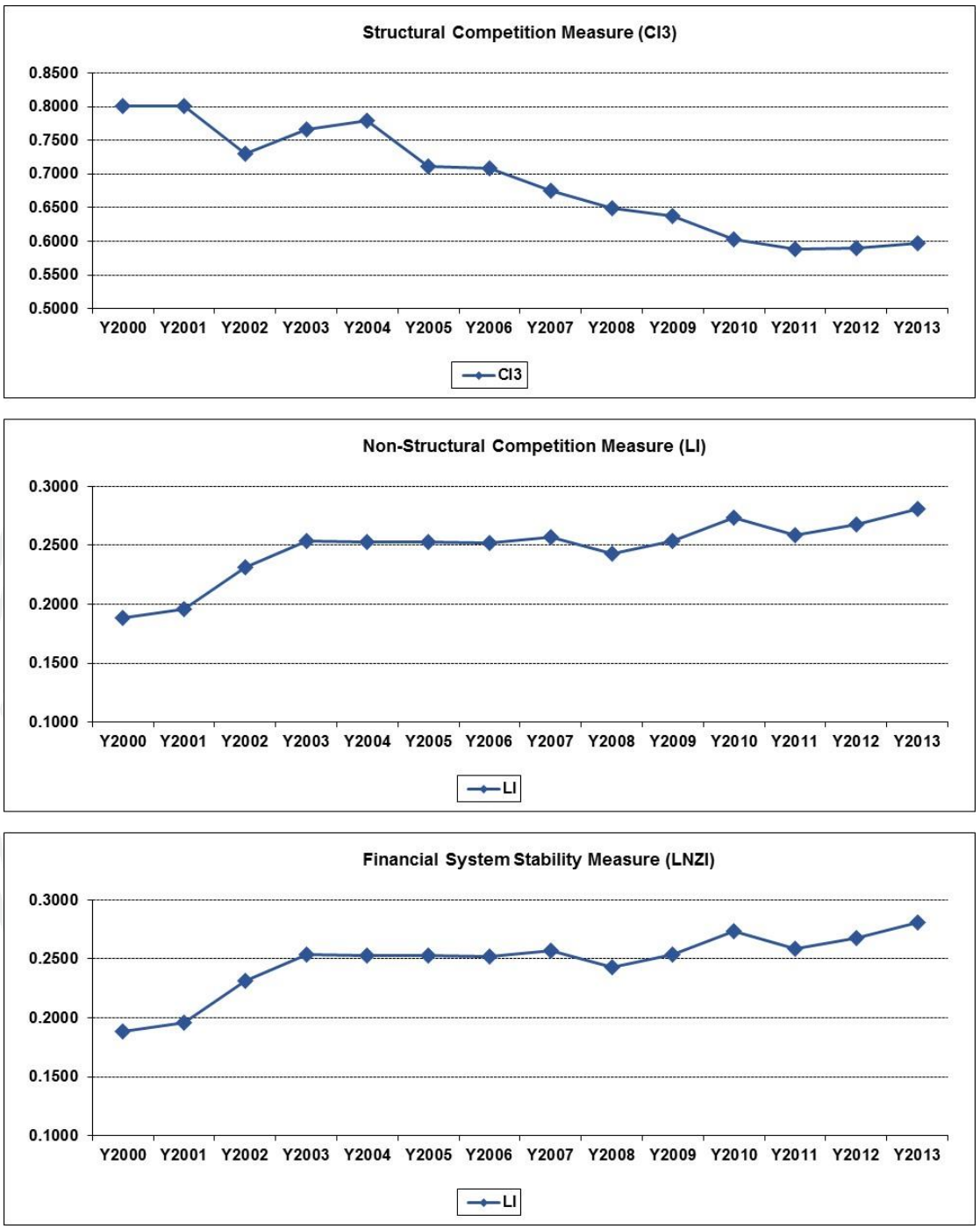

Figure 2.1: Average Competition and Stability during 2000 to 2013

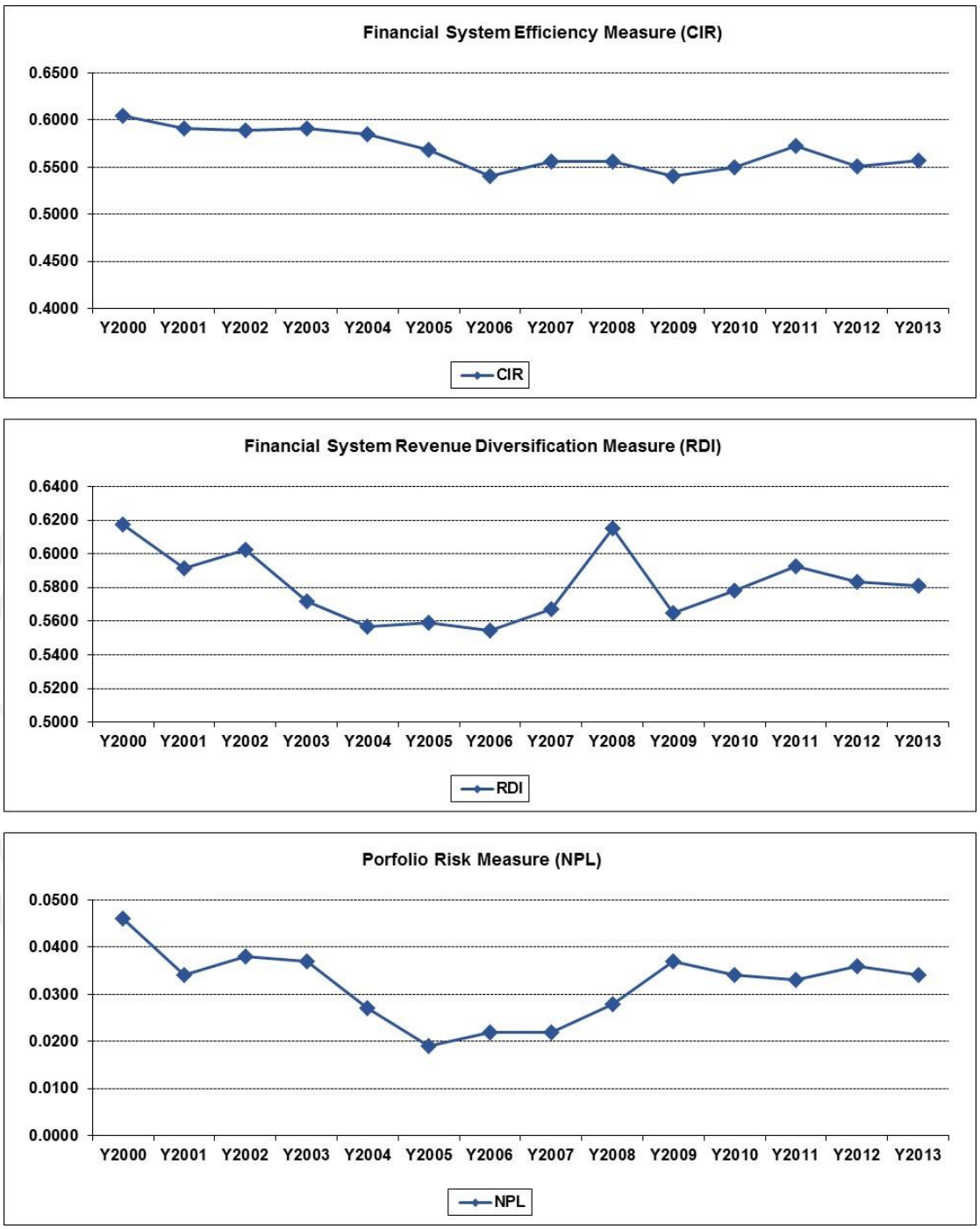

Figure 2.2: Average Bank-Specific Variables during 2000 to 2013

2.3.2.3 Panel Unit Root Tests

Stationarity is one of the important characteristics of time-series and panel data. The standard estimation methodologies and related statistical inference require the data to be stationary. Therefore, in order to ensure that the data used in the analysis is free from unit root problem, four panel unit root tests, namely Levin, Lin and Chu test, Im, Pesaran and Shin test, ADF-Fisher test and PP-Fisher test, are conducted. The results are presented in Table 2.7. From the table, it shows that by using Levin, Lin and Chu's common unit root test, all of the data series are integrated of order zero. Also, by using individual unit root tests, most of the data series, except HI and LNTA, are still free from unit root at level. For those series that have unit root at level, they all become integrated of order one (not presented in the table).

Table 2.7: Panel Unit Root Tests

Null: Unit Root at Level

	Levin, Lin and Chu t-stat	Im, Pesaran and Shin W-stat	ADF-Fisher Chi-square	PP-Fisher Chi-square	Levin, Lin and Chu t-stat (prob.)	Im, Pesaran and Shin W-stat (prob.)	ADF-Fisher Chi-square (prob.)	PP-Fisher Chi-square (prob.)
CI3	-2.91	-8.42	329.45	647.40	0.00	0.00	0.00	0.00
CI5	-6.72	-7.99	321.33	693.93	0.00	0.00	0.00	0.00
LI	-7.03	-3.69	240.85	319.73	0.00	0.00	0.00	0.00
HI	-6.42	7.61	45.79	40.55	0.00	1.00	1.00	1.00
LNZI	-6.80	-2.64	201.63	301.42	0.00	0.00	0.01	0.00
CR	-7.03	-3.69	240.85	319.73	0.00	0.00	0.00	0.00
CIR	-9.28	-5.21	274.29	332.27	0.00	0.00	0.00	0.00
ROA	-14.47	-6.39	298.40	350.98	0.00	0.00	0.00	0.00
RDI	-7.50	-4.46	236.78	322.00	0.00	0.00	0.00	0.00
NPL	-13.48	-5.44	305.08	325.80	0.00	0.00	0.00	0.00
LNTA	-6.86	4.17	90.70	127.46	0.00	1.00	1.00	0.98
LTA	-10.60	-3.29	225.39	242.86	0.00	0.00	0.00	0.00
GDPG	-12.37	-7.12	298.12	447.97	0.00	0.00	0.00	0.00
CPI	-22.27	-11.68	380.21	558.91	0.00	0.00	0.00	0.00

Table presents the panel unit root tests for each series using four methodologies: Levin, Lin and Chu t-stat test, Im, Pesaran and Shin W-stat test, ADF-Fisher Chi-square test and PP-Fisher Chi-square test. Null hypothesis indicates the series has unit root at level.

2.3.3 Main Results

2.3.3.1 Traditional Models

Table 2.8 presents the summary of fixed effect panel regression results from various traditional models. The main models are T11 to T14, which use LNZI as the proxy for stability and use LI, HI, CI3 and CI5 as the proxy for competition. In model T11, the coefficient of LI is positive and statistically different from zero, it can be interpreted that as the market pricing power is higher, it increases the stability. In other words, when the market is less competitive, the stability increases. Therefore, this result supports the traditional competition-fragility view. In addition, the coefficient of CIR, RDI and NPL are negative and statistically different from zero. It means that (1) when banks become more efficient, the stability increases, (2) when banks diversify more sources of revenue, the stability is enhanced and (3) when banks have higher portfolio risk, the stability decreases. Similarly to that of model T11, the coefficient of HI in model T12 is negative and statistically different from zero, it can be interpreted that when the market pricing power moves toward monopoly, the stability decreases. This result also supports competition-fragility view. Also, similarly to the result from model T11, the coefficient of CIR, RDI and NPL are negative and statistically different from zero.

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

Table 2.8: Regression Results from Traditional Models

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

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

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measures (LNZI and CR) using alternative measures of competition (LI, HI, CI3 and CI5). The dependent variable for model T11 to T14 is LNZI (the logarithmic form of Z-score index), while that for model T21 to T24 is CR (capitalization ratio). The independent variable for model T11 and T21 is LI (Lerner index, which measures the degree of market pricing power or non-structural competition approach). The independent variable for model T12 and T22 is HI (H-statistic index, which measures the degree of market pricing power or non-structural competition approach). The independent variable for model T13 and T23 is CI3 (concentration index of three-largest banks in a country, which measures market concentration or structural competition approach). The independent variable for model T14 and T24 is CI5 (concentration index of five-largest banks in a country, which measures market concentration or structural competition approach). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

One possible explanation from the above findings is that the competition proxies from structural and non-structural approaches measure competition in two different angles. On one side, the structural approach or market concentration, considers solely the concentration of the market. On the other side, the non-structural approach or market pricing power, considers the pricing power of banks in the market. Therefore, it is possible that when the market becomes more concentrated, the pricing power does not necessarily increase. Therefore, it is possible that the effect from increasing market pricing power and increasing market concentration can be in the opposite direction. Significant estimated coefficients together with the high R-squared and significant F-statistic confirm the above hypothesis.

In addition, the above results are still robust even when the proxy for stability measure is changed from LNZI to CR in the model T21 to T24. Nevertheless, the impact is smaller than when LNZI is used. Also, R-squared is much lower from 91% to around 60%. Still, F-statistic indicates that the model is significant.

*2.3.3.2 Augmented Model*s

In order to firmly document the finding in section 2.3.3.1, the market concentration measure is added into the traditional models that initially contain market pricing power measure, specifically LI or HI. The summary of fixed effect panel regression results from four augmented models is presented in Table 2.9.

The first group of the models, namely A11 and A12, use LNZI as a stability measure and LI as a market pricing power. Then, CI3 or CI5 measures are used as a market concentration measure. The results are as expected. All of the coefficients are statistically different from zero and have the same sign as expected in 2.3.1. Furthermore, when the robustness is checked in model A13 and A14 in which HI is applied instead of LI, the results are still the same. Therefore, it can be concluded that the conventional competition measures, the market concentration and market pricing power, indeed have the opposite effects on stability.

Table 2.9: Regression Results from Augmented Models

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

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

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using alternative measures of market pricing power (LI and HI) and market concentration (CI3 and CI5). The market pricing power for model A11 and A12 is LI (Lerner index), while that for model A13 and A14 is HI (H-statistic index). The market concentration for model A11 and A13 is CI3 (the concentration index of three-largest banks in a country), while that for model A12 and A14 is CI5 (the concentration index of five-largest banks in a country). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Besides, as the information criteria statistics of these augmented models, namely AIC and SIC, are lower than those of the traditional models, it can be concluded that these augmented models are more preferable. In summary, the augmented models that contain both market pricing power and market concentration together with other bank-specific control variables, CIR, RDI and NPL, and country-specific variables, are fitted well enough to explain the variation in banking system stability.

2.3.4 Robustness Checks

2.3.4.1 The Tests for Fixed Effect

Table 2.10 presents the summary of redundant fixed effect tests to ensure the appropriateness of using fixed effect models. The tests are separated into three main tests as followings: (1) the pure cross-section fixed effect test, (2) the pure period fixed effect test and (3) the combined cross-section and period fixed effect test. The test results confirm that there exist both cross-section and period fixed effect. Therefore, it is appropriate to apply fixed effect models to this empirical study.

Table 2.10: Redundant Fixed Effect Tests

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

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

Table presents the redundant fixed effect tests for model A11 to A14. The tests cover cross-section, period and both cross-section and period fixed effects. Null hypothesis indicates the model does not have fixed effect.

2.3.4.2 The Tests for Alternative Measure of Stability

In this section, the alternative measure for stability, specifically CR, is applied to the augmented models instead of LNZI. The objective is to test for the robustness of the key findings in section 2.3.3.2. The summary of empirical results is presented in Table 2.11.

The estimated coefficients of all key variables, such as market pricing power and market concentration, are all statistically different from zero at 1% confidence interval. In addition, those variables have the same sign as that from model A11 to A14 as presented in Table 2.9. Specifically, in model A21 and A22, the coefficients of market pricing power and market concentration have the opposite sign, while in model A23 and A24, the coefficients of market pricing power and market concentration have the same sign. Based on these findings, it can be interpreted that market pricing power has the positive relationship with financial system stability, while market concentration has the negative one with stability. These results confirm the conclusion in section 2.3.3.2.

Table 2.11: Regression Results from Augmented Models with CR as Stability

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

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

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (CR, which is the capitalization ratio) using alternative measures of market pricing power (LI and HI) and market concentration (CI3 and CI5). The market pricing power for model A11 and A12 is LI (Lerner index), while that for model A13 and A14 is HI (H-statistic index). The market concentration for model A11 and A13 is CI3 (the concentration index of three-largest banks in a country), while that for model A12 and A14 is CI5 (the concentration index of five-largest banks in a country). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

2.3.4.3 Segmentation Analysis by Accessibility and Size

The segmentation analysis in this section is performed to ensure the robustness of the key findings in section 2.3.3.2 as well as to further investigate whether the relationship between bank competition and financial system stability varies in different market characteristics or not. The test is designed by separating the total 81 sampling countries into four different groups by using two important dimensions that may reflect the different market characteristics.

The first dimension is the accessibility to the funding via banking industry. The proxy for this accessibility dimension is the percentage of firms using banks to finance their working capital (denoted as FBFW hereafter). The data is obtained from the Global Financial Development Database (GFDD), the World Bank. After obtaining the data, the total 81 samplings are separated by using the median of FBFW to classify the countries into High and Low accessibility.

The second dimension is the size of financial market relative to GDP. This dimension can be represented by the ratio of credit to private sector over GDP (denoted as CPSR hereafter). Similarly, the data is obtained from the Global Financial Development Database (GFDD), the World Bank. After obtaining the data, the total 81 samplings are separated by using the median of CPSR to classify the countries into Big and Small size of credit relative to country's GDP.

After separating the samplings into two groups in each dimension, they are combined together to get four groups by crossly intersection. Table 2.12 presents the list of countries in each segmented group.

Table 2.12: Sampling Countries in each Segment (Accessibility and Size)

Accessibility	High	High	Low	Low
Size	Big	Small	Big	Small
	Bosna	Argentina	UAE	Angola
	Bulgaria	Bangladesh	Austria	Azerbaijan
	Brasil	Belarus	Australia	Canada
	Chile	Colombia	Belgium	Egypt
	German	CostaRica	Bahrain	Georgia
	Spain	Czech	Switzerland	Ghana
	Honduras	Dominican	China	Guatemala
	Croatia	Ecuador	Denmark	Indonesia
	South Korea	Hungary	France	Mexico
	Lebanon	India	England	Nigeria
	Latvia	Kenya	Hong Kong	Norway
	Mauritius	Kazakhstan	Italy	New Zealand
	Malaysia	Sri Lanka	Jordan	Philippines
	Nepal	Peru	Japan	Russia
	Panama	Poland	Luxembourg	Tanzania
	Slovenia	Paraguay	Netherlands	Uruguay
	Thailand	Romania	Portugal	Uzbekistan
	Turkey	Serbia	Sweden	Venezuela
	Vietnam	El Salvador	Ukraine	Uganda
		Armenia	United States	Zambia
		Moldavia	South Africa	
Total	**19**	**21**	**21**	**20**

Figure 2.3 illustrates the graphical time-series data of competition and stability measures for each segment (by accessibility and size). For structural competition measure, CI3, it is in gradually downward trend during the year 2000 to 2013 for all segments. The measure is lower from 0.7-0.9 in the year 2000 to 0.5-0.7 in the year 2013. In addition, the non-structural competition measure, LI, shows an obvious upward trend. The measure is in the range of 0.17-0.22 in the year 2000, but it increases to 0.26-0.29 in the year 2013. For stability measure, LNZI, it is quite stable throughout the year 2000 to 2013 with a certain degree of variation. Also, the measure in each segment is quite separate among each other. For example, in the year 2013, the measure of LB segment is as high as 2.60, but that of LS segment is as low as 1.98. This can be the preliminary evidence showing the variation of stability in different market characteristics.

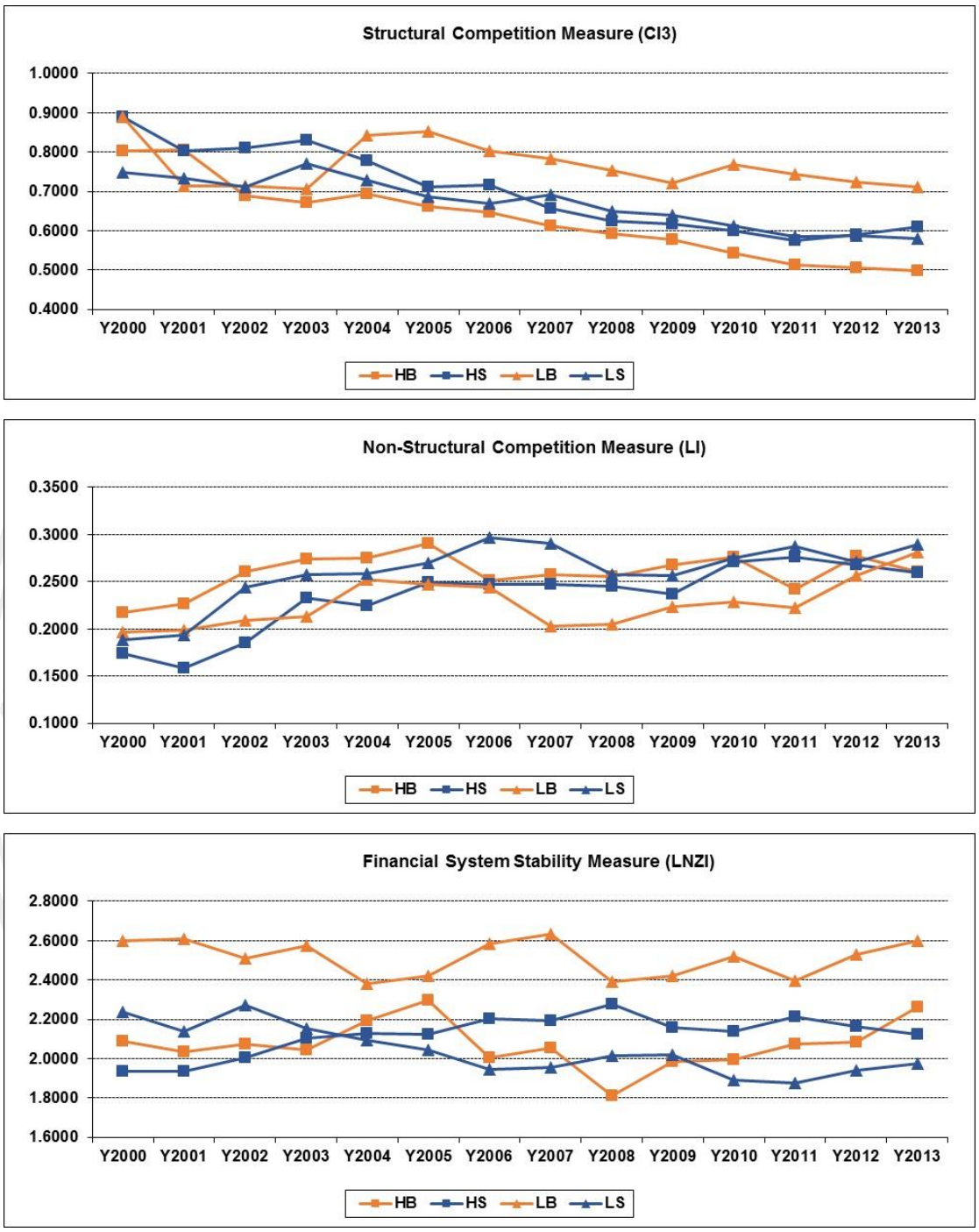

Figure 2.3: Competition and Stability by Segment (Accessibility-Size)

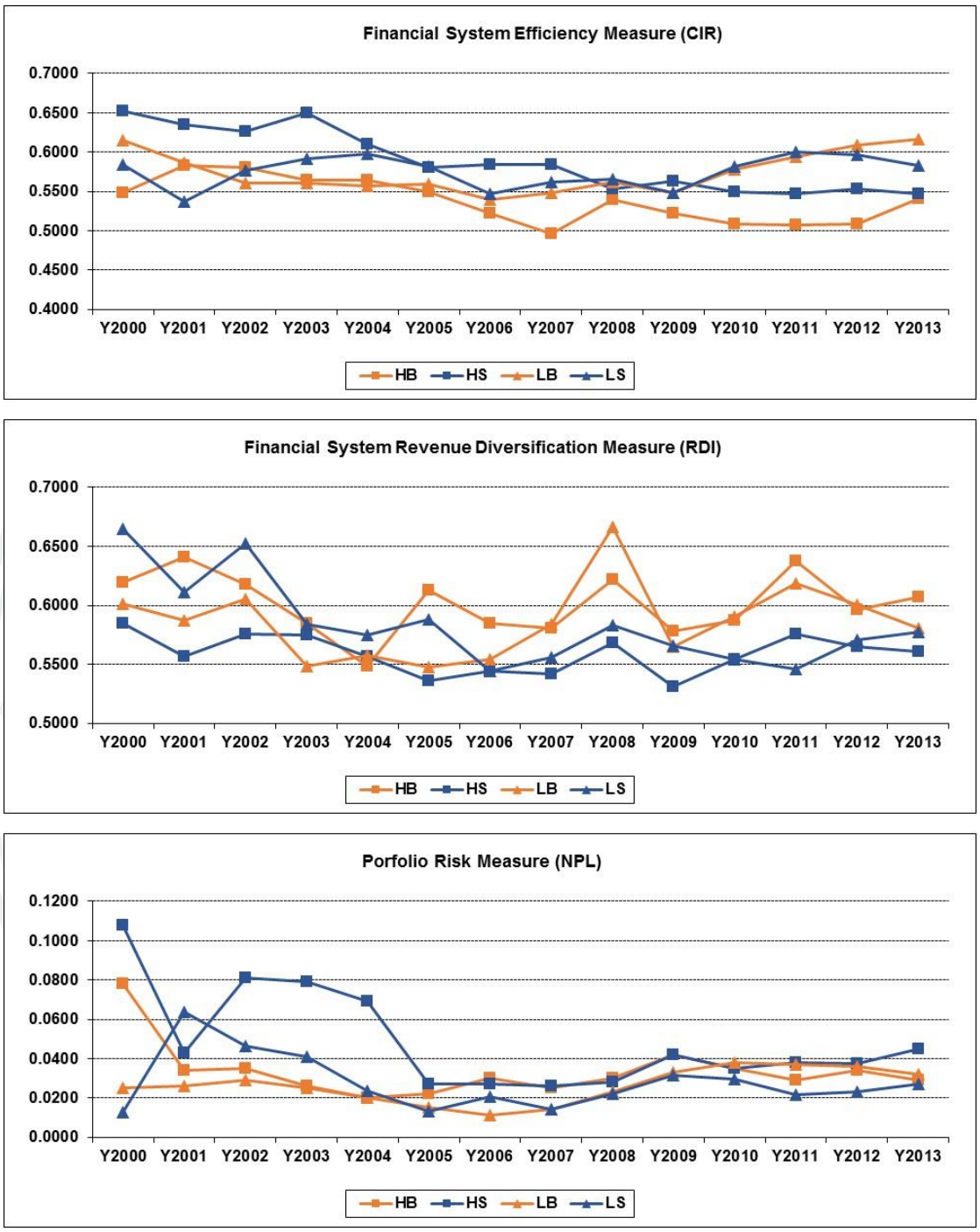

Figure 2.4: Bank-Specific Variables by Segment (Accessibility-Size)

Figure 2.4 illustrates the graphical time-series data of other bank-specific control variables for each segment (by accessibility and size). For efficiency measure, CIR, it is quite stable throughout the year 2000 to 2013 and is in the range of 0.50 to 0.65. Also, revenue diversification measure, RDI, is also quite stable throughout the year 2000 to 2013 even though its variation is more than CIR. For portfolio risk measure, NPL, it is in an obvious downward trend, especially HS segment in which the ratio is lower from 0.11 in the year 2000 to 0.05 in the year 2013.

After classifying the total samplings into four main categories, specifically (1) High accessibility and Big size, (2) High accessibility and Small size, (3) Low accessibility and Big size and (4) Low accessibility and Small size, the fixed effect panel regressions are performed similar to section 2.3.3.2. In short, model A11 and A12 in section 2.3.3.2 are replicated using the samplings as segmented.

Table 2.13 presents the regression results from segmented sampling using LI as a proxy for market pricing power and CI3 as a proxy for market concentration. There are five main segmented models. The first model, S11-ALL, is the same as model A11 in section 2.3.3.2 in which all of 81 sampling countries are used. The other four models, specifically S11-HB, S11-HS, S11-LB and S11-LH, use the sampling countries as described in Table 2.12. The results from models S11-HS, S11-LB and S11-LH are the same as those from model S11-ALL.

Therefore, it can be firmly concluded that there are two angles to view competition. The first one is market pricing power, while the second one is market concentration, and these two angles have the opposite relationship with financial system stability. In addition, the results are still the same even with the two-dimensional segmentation.

However, there is another interesting result obtained from model S11-HB. In this model, it includes 19 sampling countries that have High accessibility and Big size of credit offered to private sector relative to GDP. Even though the coefficient of market concentration, specifically CI3, is negative, which is the same as in other models, the coefficient of market pricing power, specifically LI, is also negative. This can be interpreted that the relationship between market pricing power and financial system stability is negative, which is in line with the relationship between market concentration and financial system stability. The implication to the policy makers from this striking

result is that the relationship between bank competition and financial system stability may not necessarily be the same across all countries.

Table 2.13: Results from Segmented Models (Accessibility and Size) with CI3

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

Model	**S11-ALL**	**S11-HB**	**S11-HS**	**S11-LB**	**S11-LH**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**	**LI**
Concentration	**CI3**	**CI3**	**CI3**	**CI3**	**CI3**
			Co-efficient		
C	2.8050***	3.7699***	2.0694***	2.9536***	2.9364***
	(0.1533)	(0.3671)	(0.3302)	(0.3567)	(0.2928)
LI	0.6054***	-0.5124**	1.2025***	0.4492	0.9605***
	(0.1068)	(0.2419)	(0.2004)	(0.2931)	(0.1897)
CI3	-0.3213***	-0.4226**	-0.3498	-0.1237	-0.7427***
	(0.0869)	(0.1850)	(0.2203)	(0.1879)	(0.2037)
CIR	-0.4013***	-1.1371***	0.4920**	-0.1632	-0.4449**
	(0.1089)	(0.2071)	(0.2353)	(0.2397)	(0.2155)
RDI	-0.3736***	-0.5116*	-0.8216***	-0.4086	-0.1477
	(0.1416)	(0.2954)	(0.2964)	(0.3648)	(0.2582)
NPL	-0.9933***	-1.3856***	-0.9405***	-1.2656***	-1.9446***
	(0.1923)	(0.5360)	(0.2948)	(0.4958)	(0.4264)
LNTA	0.0000	-0.0001	0.0008*	0.0000	-0.0009***
	(0.0000)	(0.0003)	(0.0004)	(0.0000)	(0.0003)
LTA	-0.2177	-0.4575	-0.1209	-0.2727	-0.3900
	(0.1372)	(0.3527)	(0.2605)	(0.2914)	(0.2656)
GDPG	0.8035***	0.5101	0.9466*	1.9024**	0.3886
	(0.2762)	(0.6433)	(0.5551)	(0.8619)	(0.4041)
CPI	-0.0227	0.2287	0.0241	0.4107	-0.3285**
	(0.0953)	(0.3680)	(0.1601)	(0.7449)	(0.1405)
R-squared	0.91	0.94	0.93	0.82	0.93
Adj. R-squared	0.90	0.93	0.91	0.79	0.91
F-stat	91.45	74.70	64.85	25.16	56.52
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	0.05	-0.05	0.09	0.19	-0.12
SIC	0.56	0.57	0.68	0.75	0.51
No. Countries	81	19	21	21	20

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI3 as the proxy for market concentration. Model S11-ALL includes all sampling countries. Model S11-HB includes 19 sampling countries that are categorized as High accessibility and Big size. Model S11-HS includes 21 sampling countries that are categorized as High accessibility and Small size. Model S11-LB includes 21 sampling countries that are categorized as Low accessibility and Big size. Model S11-LS includes 20 sampling countries that are categorized as Low accessibility and Small size. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 2.14: Results from Segmented Models (Accessibility and Size) with CI5

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

Model	**S12-ALL**	**S12-HB**	**S12-HS**	**S12-LB**	**S12-LH**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**	**LI**
Concentration	**CI5**	**CI5**	**CI5**	**CI5**	**CI5**
			Co-efficient		
C	3.1261***	4.0775***	2.7000***	3.2594***	3.4105***
	(0.1743)	(0.4071)	(0.4090)	(0.3889)	(0.4265)
LI	0.6242***	-0.4487*	1.2032***	0.4519	0.9548***
	(0.1061)	(0.2363)	(0.1965)	(0.2914)	(0.1931)
CI5	-0.6090***	-0.6802***	-0.9089***	-0.4185*	-1.0687***
	(0.1156)	(0.2402)	(0.3017)	(0.2351)	(0.3434)
CIR	-0.4127***	-1.1367***	0.4362**	-0.1571	-0.5330***
	(0.1080)	(0.2056)	(0.2322)	(0.2382)	(0.2150)
RDI	-0.4029***	-0.5802**	-0.8101***	-0.4986	-0.2123
	(0.1403)	(0.2926)	(0.2896)	(0.3658)	(0.2645)
NPL	-0.9537***	-1.3147***	-0.8964***	-1.0841**	-1.8502***
	(0.1911)	(0.5274)	(0.2909)	(0.4911)	(0.4280)
LNTA	0.0000	-0.0001	0.0005	0.0000	-0.0008**
	(0.0000)	(0.0003)	(0.0004)	(0.0000)	(0.0003)
LTA	-0.2652**	-0.4549	-0.1985	-0.2750	-0.4742*
	(0.1364)	(0.3480)	(0.2546)	(0.2886)	(0.2720)
GDPG	0.7843***	0.4076	1.0102*	1.8597**	0.4678
	(0.2739)	(0.6335)	(0.5423)	(0.8565)	(0.4067)
CPI	-0.0464	0.1629	0.0044	0.4307	-0.4037***
	(0.0946)	(0.3663)	(0.1575)	(0.7376)	(0.1448)
R-squared	0.91	0.94	0.93	0.82	0.93
Adj. R-squared	0.90	0.93	0.91	0.79	0.91
F-stat	93.04	75.89	66.91	25.52	55.34
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	0.03	-0.07	0.06	0.17	-0.10
SIC	0.54	0.56	0.65	0.74	0.53
No. Countries	81	19	21	21	20

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI5 as the proxy for market concentration. Model S12-ALL includes all sampling countries. Model S12-HB includes 19 sampling countries that are categorized as High accessibility and Big size. Model S12-HS includes 21 sampling countries that are categorized as High accessibility and Small size. Model S12-LB includes 21 sampling countries that are categorized as Low accessibility and Big size. Model S12-LS includes 20 sampling countries that are categorized as Low accessibility and Small size. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

For example, when the countries are categorized as High accessibility and Big credit size relative to GDP, the relationship between market pricing power and financial system stability is on the opposite direction comparing to that between other categories.

In addition, Table 2.14 presents the regression results from the same segmented sampling using LI as a proxy for market pricing power and CI5 as a proxy for market concentration. The results are all the same as per Table 2.13 presented previously. Specifically, the sign of the coefficient of market pricing power from model S12-HB is statistically negative, which is different from other models. Therefore, it can be confirmed that the results from previous findings are robust.

2.3.4.4 Segmentation Analysis by Stability and Efficiency

The second segmentation analysis performed in this section is to further investigate the robustness of the key findings in section 2.3.3.2 by using another pair of two important dimensions in financial sector, which are stability and efficiency.

The first dimension is the stability of the financial industry. The proxy for this stability dimension is LNZI, the logarithmic form of the Z-score index, as described in section 2.2.1.3. After obtaining the data, the total 81 samplings are separated by using the median of LNZI to classify the countries into High and Low stability. The second dimension is the efficiency of financial industry. The proxy for this efficiency dimension is ROA, the return on asset, as described in section 2.2.1.4. After obtaining the data, the total 81 samplings are separated by using the median of ROA to categorize the countries into High and Low efficiency.

After separating the samplings into two groups for each dimension, they are combined together to get four groups by crossly intersection. Table 2.15 presents the list of countries in each segmented group.

Table 2.15: Sampling Countries in each Segment (Stability and Efficiency)

Stability	**High**	**High**	**Low**	**Low**
Efficiency	**High**	**Low**	**High**	**Low**
	UAE	Austria	Argentina	Australia
	Angola	Belgium	Azerbaijan	Bosna
	Bahrain	Brasil	Bangladesh	Bulgaria
	Dominican	Canada	Belarus	Ecuador
	Egypt	Switzerland	Chile	England
	Guatemala	China	Colombia	Croatia
	Hong Kong	CostaRica	Czech	Hungary
	Honduras	German	Georgia	India
	Jordan	Denmark	Ghana	Latvia
	Kenya	Spain	Indonesia	Netherlands
	Sri Lanka	France	Kazakhstan	Norway
	Mauritius	Italy	Nigeria	Portugal
	Malaysia	Japan	Nepal	Romania
	Peru	South Korea	Poland	Sweden
	Philippines	Lebanon	Russian Federation	Ukraine
	Paraguay	Luxembourg	Thailand	Uruguay
	El Salvador	Mexico	Turkey	Uzbekistan
	Tanzania	New Zealand	Venezuela	Vietnam
		Panama	Armenia	
		Serbia	Moldavia	
		Slovenia	Uganda	
		United States	Zambia	
Total	**18**	**22**	**22**	**18**

Figure 2.5 illustrates the graphical time-series data of competition and stability measures for each segment (by stability and efficiency). For structural competition measure, CI3, it is in an obvious downward trend during the year 2000 to 2013 for all segments. For non-structural competition measure, LI, it is slightly upward trend for all segments even though a huge variation is observed. For stability measure, LNZI, it is quite stable throughout the year 2000 to 2013.

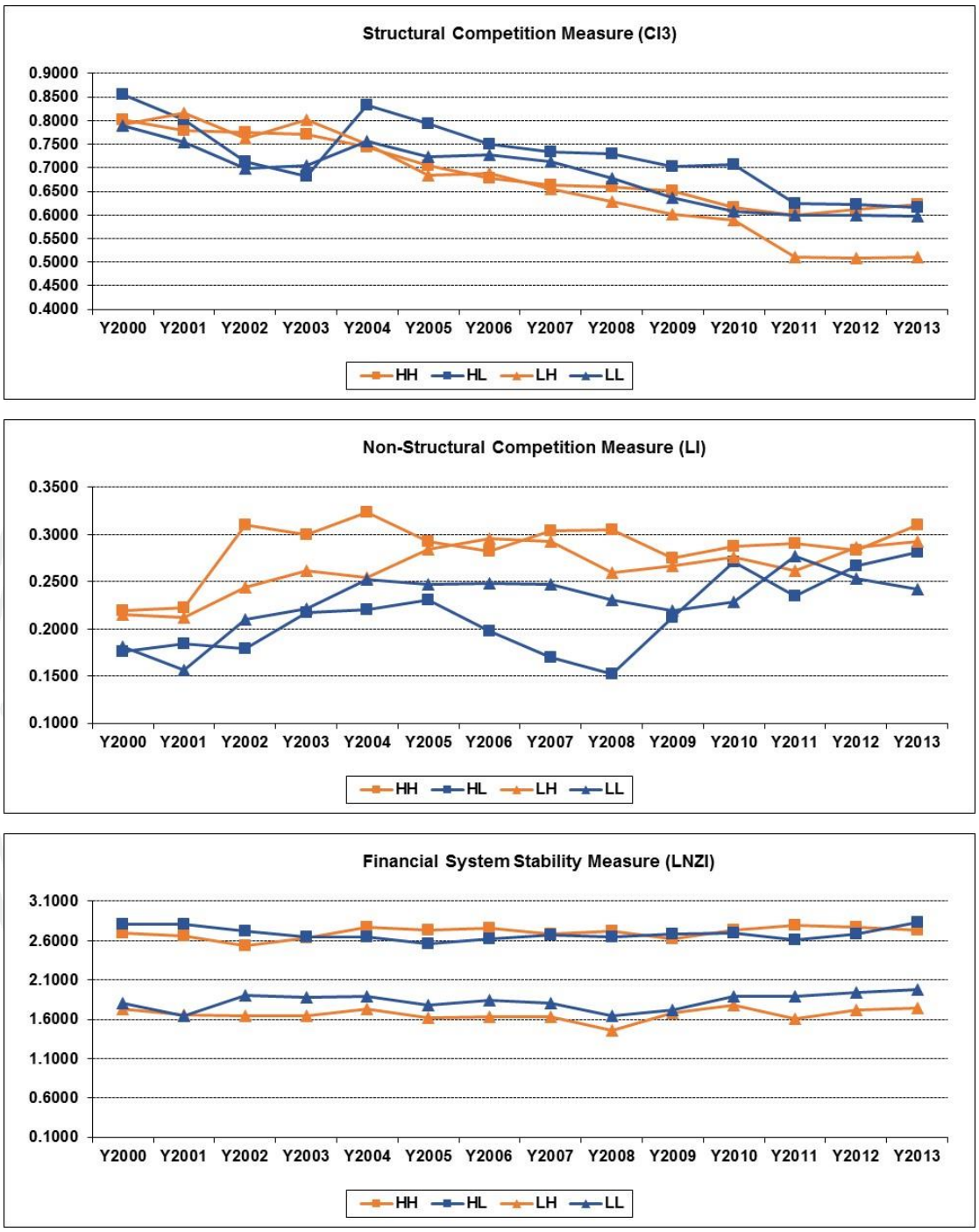

Figure 2.5: Competition and Stability by Segment (Stability-Efficiency)

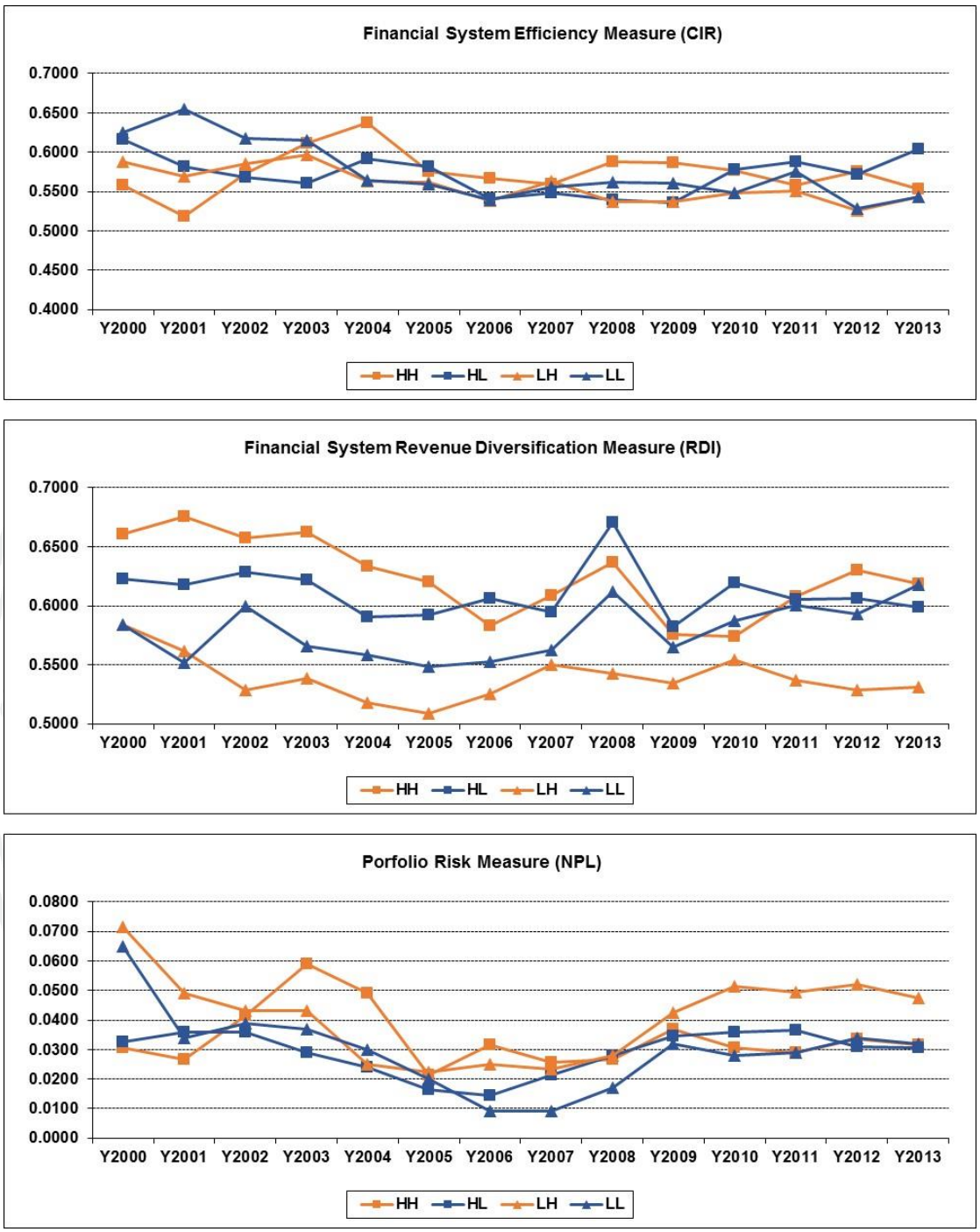

Figure 2.6: Bank-Specific Variables by Segment (Stability-Efficiency)

Figure 2.6 illustrates the graphical time-series data of other bank-specific control variables for each segment (by stability and efficiency). For efficiency measure, CIR, it is quite stable throughout the year 2000 to 2013 and is in the range of 0.50 to 0.65. Also, revenue diversification measure, RDI, is also quite stable throughout the year 2000 to 2013 even though a huge variation is observed. For portfolio risk measure, NPL, it is in an obvious downward trend for all segments.

After classifying the total samplings into four main categories, specifically (1) High stability and High efficiency, (2) High stability and Low efficiency, (3) Low stability and High efficiency and (4) Low stability and Low efficiency, the fixed effect panel regressions are performed similar to section 2.3.3.2. In short, model A11 and A12 in section 2.3.3.2 are replicated using the samplings as segmented.

Table 2.16 presents the regression results from segmented sampling using LI as a proxy for market pricing power and CI3 as a proxy for market concentration. There are five main segmented models. The first model, S13-ALL, is the same as model A11 in section 2.3.3.2 in which all of 81 sampling countries are used. The other four models, specifically S13-HH, S13-HL, S13-LH and S13-LL, use the sampling countries as described in Table 2.15. Also, Table 2.17 present the regression results with the same methodology and sampling as Table 2.16. The only difference is that Table 2.17 uses CI5 as a proxy for market concentration, instead of CI3 as per the Table 2.16.

The results from both tables are quite similar in which the coefficients of both market pricing power and market concentration from the four segmented samplings, specifically model S13-HH, S13-HL, S13-LH, S13-LL, S14-HH, S14-HL, S14-LH and S14-LL, are almost the same as those from the all samplings that include 81 countries, specifically model S13-ALL and S14-ALL. Therefore, these findings actually confirm the robustness of the findings in section 2.3.3.2. Also, as the coefficients from the segmented models are almost the same as the original model, it can be concluded that the relationship between bank competition and financial system stability is similar across different market characteristics when they are segmented based on stability and efficiency dimensions.

Table 2.16: Results from Segmented Models (Stability and Efficiency) with CI3

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

Model	**S13-ALL**	**S13-HH**	**S13-HL**	**S13-LH**	**S13-LL**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**	**LI**
Concentration	**CI3**	**CI3**	**CI3**	**CI3**	**CI3**
			Co-efficient		
C	2.8050***	2.7467***	3.6119***	1.9586***	3.5269***
	(0.1533)	(0.2209)	(0.2576)	(0.3592)	(0.4587)
LI	0.6054***	0.1195	0.1603	0.7348***	0.7803**
	(0.1068)	(0.1957)	(0.2092)	(0.1648)	(0.4200)
CI3	-0.3213***	-0.0820	-0.4227***	0.0216	-1.1615**
	(0.0869)	(0.1358)	(0.1438)	(0.2315)	(0.2438)
CIR	-0.4013***	-0.3616***	-0.6171***	-0.4770**	-0.4084
	(0.1089)	(0.1422)	(0.1900)	(0.2029)	(0.3773)
RDI	-0.3736***	-0.0621	0.0051	-0.8774***	-0.4238
	(0.1416)	(0.1925)	(0.2540)	(0.3236)	(0.3756)
NPL	-0.9933***	-0.6206***	-0.9726**	-1.1287***	-0.3912
	(0.1923)	(0.2294)	(0.4067)	(0.3635)	(0.6068)
LNTA	0.0000	0.0000	0.0000	0.0007	-0.0014***
	(0.0000)	(0.0002)	(0.0000)	(0.0005)	(0.0002)
LTA	-0.2177	0.5134**	-0.3322*	-0.0430	-0.6917
	(0.1372)	(0.2136)	(0.1992)	(0.2861)	(0.4683)
GDPG	0.8035***	0.2269	0.3062	1.0896**	2.1510***
	(0.2762)	(0.3188)	(0.7748)	(0.4646)	(0.8560)
CPI	-0.0227	0.1132	-0.7069***	0.0822	1.2587**
	(0.0953)	(0.0969)	(0.2844)	(0.1741)	(0.6450)
R-squared	0.91	0.90	0.80	0.85	0.81
Adj. R-squared	0.90	0.87	0.76	0.82	0.77
F-stat	91.45	39.95	20.69	31.00	17.89
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	0.05	-1.05	-0.20	0.30	0.27
SIC	0.56	-0.45	0.40	0.86	0.92
No. Countries	81	18	22	22	18

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI3 as the proxy for market concentration. Model S13-ALL includes all sampling countries. Model S13-HH includes 18 sampling countries that are categorized as High stability and High efficiency. Model S13-HL includes 22 sampling countries that are categorized as High stability and Low efficiency. Model S13-LH includes 22 sampling countries that are categorized as Low stability and High efficiency. Model S13-LL includes 18 sampling countries that are categorized as Low stability and Low efficiency. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 2.17: Results from Segmented Models (Stability and Efficiency) with CI5

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

Model	S14-ALL	S14-HH	S14-HL	S14-LH	S14-LL
Stability	LNZI	LNZI	LNZI	LNZI	LNZI
Market Power	LI	LI	LI	LI	LI
Concentration	CI5	CI5	CI5	CI5	CI5
			Co-efficient		
C	3.1261***	3.0156***	3.7402***	2.5836***	3.9562***
	(0.1743)	(0.2561)	(0.2903)	(0.4732)	(0.4759)
LI	0.6242***	0.1881	0.1997	0.7486***	0.9244***
	(0.1061)	(0.1960)	(0.2095)	(0.1638)	(0.4149)
CI5	-0.6090***	-0.4075**	-0.4552**	-0.5967	-1.5850***
	(0.1156)	(0.1975)	(0.1879)	(0.3694)	(0.2875)
CIR	-0.4127***	-0.3654***	-0.6514***	-0.4410**	-0.3824
	(0.1080)	(0.1404)	(0.1905)	(0.1998)	(0.3695)
RDI	-0.4029***	0.0080	-0.0847	-0.8769***	-0.3663
	(0.1403)	(0.1878)	(0.2547)	(0.3219)	(0.3686)
NPL	-0.9537***	-0.5864***	-0.9577**	-1.2352***	-0.4624
	(0.1911)	(0.2274)	(0.4154)	(0.3595)	(0.5942)
LNTA	0.0000	0.0000	0.0000	0.0001	-0.0012***
	(0.0000)	(0.0002)	(0.0000)	(0.0006)	(0.0002)
LTA	-0.2652**	0.4207**	-0.3141	-0.0733	-0.7338
	(0.1364)	(0.2122)	(0.2001)	(0.2845)	(0.4579)
GDPG	0.7843***	0.2461	0.2766	1.0225**	1.8509**
	(0.2739)	(0.3118)	(0.7793)	(0.4628)	(0.8387)
CPI	-0.0464	0.0718	-0.6764**	0.0489	1.1775*
	(0.0946)	(0.0981)	(0.2922)	(0.1744)	(0.6304)
R-squared	0.91	0.90	0.80	0.85	0.82
Adj. R-squared	0.90	0.88	0.76	0.82	0.77
F-stat	93.04	40.99	20.38	31.38	18.82
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	0.03	-1.08	-0.18	0.29	0.23
SIC	0.54	-0.48	0.42	0.85	0.88
No. Countries	81	18	22	22	18

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI5 as the proxy for market concentration. Model S13-ALL includes all sampling countries. Model S13-HH includes 18 sampling countries that are categorized as High stability and High efficiency. Model S13-HL includes 22 sampling countries that are categorized as High stability and Low efficiency. Model S13-LH includes 22 sampling countries that are categorized as Low stability and High efficiency. Model S13-LL includes 18 sampling countries that are categorized as Low stability and Low efficiency. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

2.3.4.5 Segmentation Analysis by Region

The third segmentation analysis performed in this section is also to further investigate the robustness of the key findings in section 2.3.3.2 as well as to further explore whether the relationship between bank competition and financial system stability vary across region or not. In this section, the total 81 samplings are separated by their region into four main groups. Table 2.18 presents the list of countries in each region.

Table 2.18: Sampling Countries in each Segment (Region)

Region	Europe	Asia	America	Africa
	EU	AS	AM	AF
	Austria	UAE	Argentina	Angola
	Bosna	Australia	Brasil	Egypt
	Belgium	Azerbaijan	Canada	Ghana
	Bulgaria	Bangladesh	Chile	Kenya
	Belarus	Bahrain	Colombia	Mauritius
	Switzerland	China	CostaRica	Nigeria
	Czech	Georgia	Dominican	Tanzania
	German	Hong Kong	Ecuador	South Africa
	Denmark	Indonesia	Guatemala	Armenia
	Spain	India	Honduras	Moldavia
	France	Jordan	Mexico	Uganda
	England	Japan	Panama	Zambia
	Croatia	South Korea	Peru	
	Hungary	Kazakhstan	Paraguay	
	Italy	Lebanon	El Salvador	
	Luxembourg	Sri Lanka	United States	
	Latvia	Malaysia	Uruguay	
	Netherlands	Nepal	Venezuela	
	Norway	New Zealand		
	Poland	Philippines		
	Portugal	Thailand		
	Romania	Turkey		
	Serbia	Uzbekistan		
	Russian Federation	Vietnam		
	Sweden			
	Slovenia			
	Ukraine			
Total	**27**	**24**	**18**	**12**

Figure 2.7 illustrates the graphical time-series data of competition and stability measures for each region. For structural competition measure, CI3, it is in an obvious

downward trend during the year 2000 to 2013 for all regions. For non-structural competition measure, LI, it is slightly upward trend for all regions even though a moderate variation is observed. For stability measure, LNZI, it is quite stable throughout the year 2000 to 2013 for all regions.

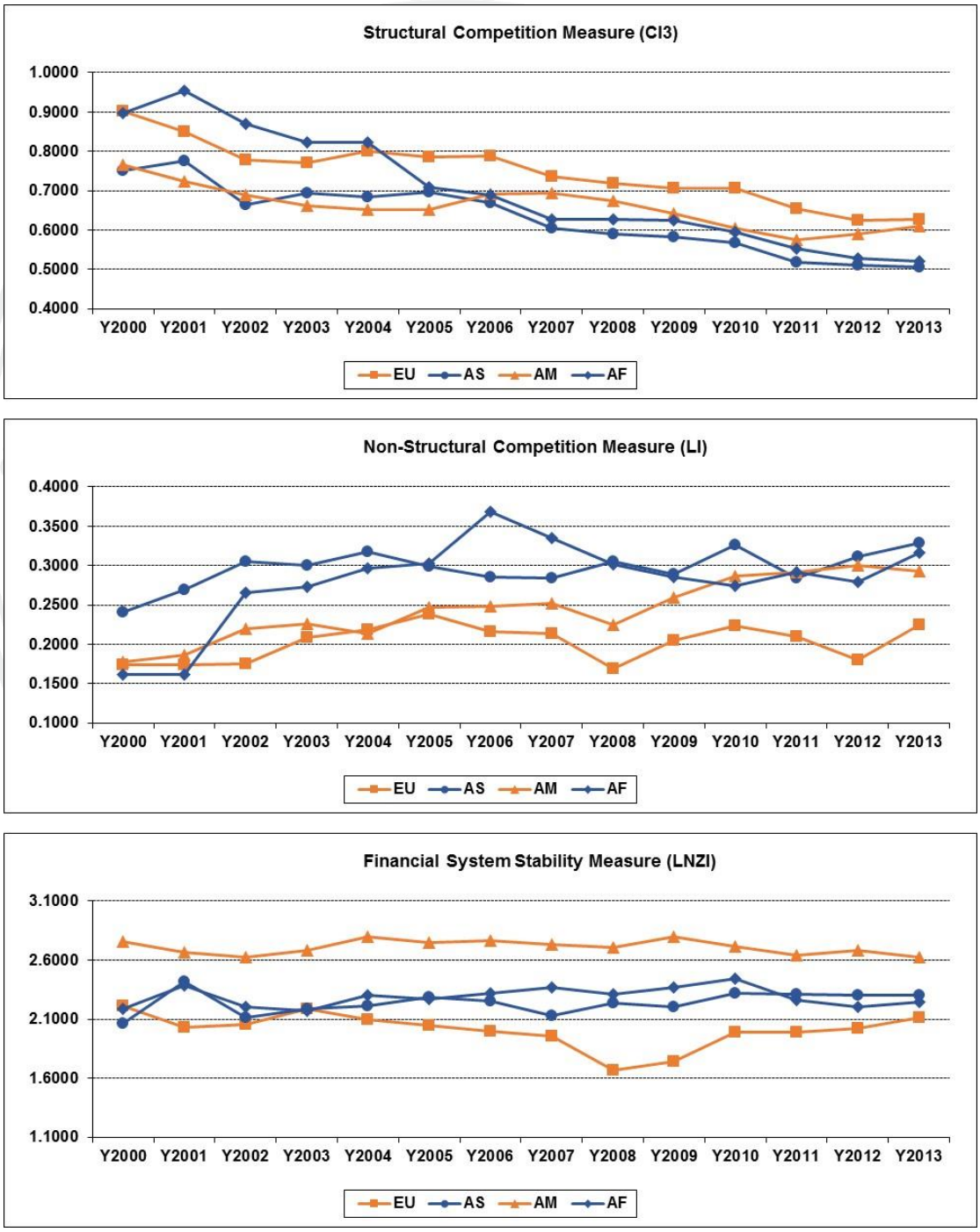

Figure 2.7: Competition and Stability by Segment (Region)

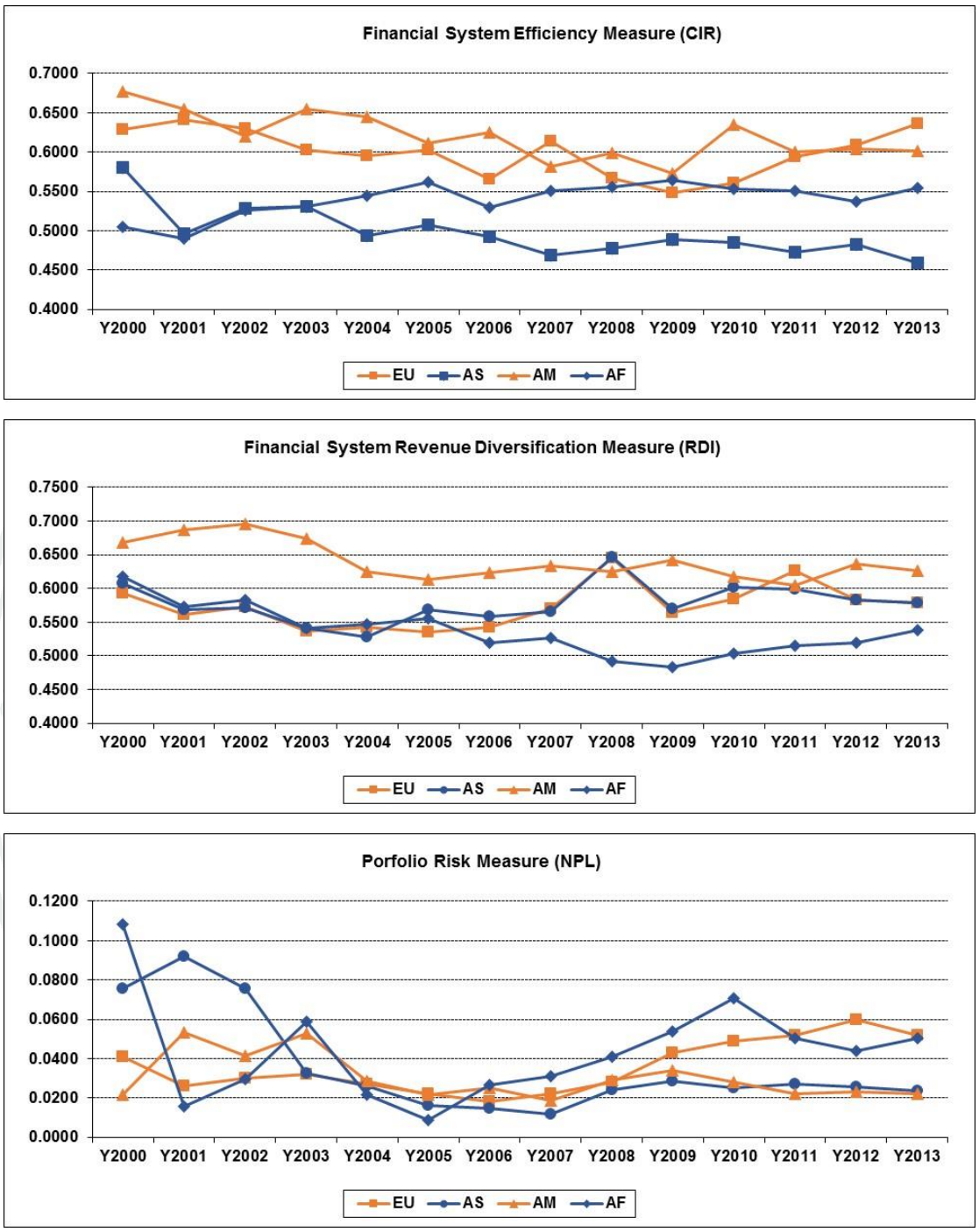

Figure 2.8: Bank-Specific Variables by Segment (Region)

Figure 2.8 illustrates the graphical time-series data of other bank-specific control variables. For efficiency measure, CIR, it is quite stable throughout the year 2000 to 2013 in each region and is in the range of 0.45 to 0.70. Also, revenue diversification measure, RDI, is also quite stable throughout the year 2000 to 2013 even

though a small variation is observed. For portfolio risk measure, NPL, it is in an obvious downward trend.

After classifying the total samplings into four main regions, specifically (1) Europe, (2) Asia, (3) America and (4) Africa, the fixed effect panel regressions are performed similar to section 2.3.3.2. In short, model A11 and A12 in section 2.3.3.2 are replicated using the samplings as segmented.

Table 2.19 presents the regression results from segmented sampling using LI as a proxy for market pricing power and CI3 as a proxy for market concentration. There are five main segmented models. The first model, S15-ALL, is the same as model A11 in section 2.3.3.2 in which all of 81 sampling countries are used. The other four models, specifically S15-EU, S15-AS, S15-AM and S15-AF, use the sampling countries as described in Table 2.18. Also, Table 2.20 present the regression results with the same methodology and sampling as Table 2.19. The only difference is that Table 2.20 uses CI5 as a proxy for market concentration, instead of CI3 as per the Table 2.19.

The results from both tables are quite similar in which the coefficients of both market pricing power and market concentration from the four segmented samplings, specifically model S15-EU, S15-AS, S15-AM, S15-AF, S16-EU, S16-AS, S16-AM and S16-AF, are almost the same as those from the all samplings that include 81 countries, specifically model S15-ALL and S16-ALL. Therefore, these findings truly confirm the robustness of the findings in section 2.3.3.2. Also, as the coefficients from the segmented models are almost the same as the original model, it can be concluded that different geographical regions cannot discriminate the level of relationship between bank competition and financial system stability.

Table 2.19: Results from Segmented Models (Region) with CI3

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

Model	**S15-ALL**	**S15-EU**	**S15-AS**	**S15-AM**	**S15-AF**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**	**LI**
Concentration	**CI3**	**CI3**	**CI3**	**CI3**	**CI3**
			Co-efficient		
C	2.8050***	2.4144***	4.1811***	2.8991***	0.8205*
	(0.1533)	(0.2588)	(0.3767)	(0.3343)	(0.4495)
LI	0.6054***	0.6979***	0.3083	0.9433***	0.5122***
	(0.1068)	(0.1912)	(0.2519)	(0.2078)	(0.1699)
CI3	-0.3213***	-0.2345*	-0.6147***	0.3448	-0.6978**
	(0.0869)	(0.1397)	(0.2387)	(0.2214)	(0.3082)
CIR	-0.4013***	-0.0014	-1.4270***	-0.0150	-0.2044
	(0.1089)	(0.1772)	(0.2589)	(0.2151)	(0.1817)
RDI	-0.3736***	-0.2417	-0.7567**	-0.7240**	0.0743
	(0.1416)	(0.2462)	(0.3235)	(0.3318)	(0.2334)
NPL	-0.9933***	-0.6454**	-1.2346***	-2.0691***	-0.5677**
	(0.1923)	(0.3339)	(0.4351)	(0.5425)	(0.2850)
LNTA	0.0000	-0.0007***	-0.0002	0.0000	0.0025**
	(0.0000)	(0.0002)	(0.0001)	(0.0000)	(0.0010)
LTA	-0.2177	0.0519	-0.8342***	-0.4893*	0.6265***
	(0.1372)	(0.2075)	(0.3318)	(0.2825)	(0.2462)
GDPG	0.8035***	1.5751**	-0.2858	0.9004*	0.1318
	(0.2762)	(0.6544)	(0.5727)	(0.4840)	(0.4017)
CPI	-0.0227	0.0719	0.7876**	-1.1935***	0.2069*
	(0.0953)	(0.1562)	(0.4019)	(0.3195)	(0.1167)
R-squared	0.91	0.87	0.93	0.94	0.97
Adj. R-squared	0.90	0.85	0.91	0.93	0.96
F-stat	91.45	44.65	63.63	79.79	111.16
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	0.05	0.07	0.30	-0.35	-0.73
SIC	0.56	0.59	0.91	0.24	-0.05
No. Countries	81	27	24	18	12

Table presents the fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI3 as the proxy for market concentration. Model S15-ALL includes all sampling countries. Model S15-EU includes 27 sampling countries in Europe. Model S15-AS includes 24 sampling countries in Asia. Model S15-AM includes 18 sampling countries in America. Model S15-AF includes 12 sampling countries in Africa. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 2.20: Results from Segmented Models (Region) with CI5

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

Model	**S16-ALL**	**S16-EU**	**S16-AS**	**S16-AM**	**S16-AF**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**	**LI**
Concentration	**CI5**	**CI5**	**CI5**	**CI5**	**CI5**
			Co-efficient		
C	3.1261***	2.6590***	4.4482***	2.6263***	1.7666***
	(0.1743)	(0.2913)	(0.4435)	(0.4189)	(0.5461)
LI	0.6242***	0.6574***	0.3405	0.9191***	0.5302***
	(0.1061)	(0.1916)	(0.2521)	(0.2069)	(0.1740)
CI5	-0.6090***	-0.4398***	-0.7528***	0.4924	-0.0870
	(0.1156)	(0.1792)	(0.2932)	(0.3345)	(0.4121)
CIR	-0.4127***	-0.0314	-1.4860***	0.0706	-0.2345
	(0.1080)	(0.1771)	(0.2568)	(0.2171)	(0.1852)
RDI	-0.4029***	-0.2828	-0.8000***	-0.6345**	0.0597
	(0.1403)	(0.2460)	(0.3228)	(0.3217)	(0.2386)
NPL	-0.9537***	-0.6411**	-1.2073***	-2.3213***	-0.6743**
	(0.1911)	(0.3319)	(0.4324)	(0.5524)	(0.2871)
LNTA	0.0000	-0.0007***	-0.0002	0.0000	0.0004
	(0.0000)	(0.0002)	(0.0001)	(0.0000)	(0.0009)
LTA	-0.2652**	0.0271	-0.8793***	-0.4760*	0.4932**
	(0.1364)	(0.2040)	(0.3378)	(0.2827)	(0.2526)
GDPG	0.7843***	1.6002***	-0.2486	0.9500**	0.2699
	(0.2739)	(0.6507)	(0.5737)	(0.4849)	(0.4055)
CPI	-0.0464	0.0911	0.7169*	-1.1544***	0.1448
	(0.0946)	(0.1556)	(0.4004)	(0.3201)	(0.1285)
R-squared	0.91	0.87	0.93	0.94	0.97
Adj. R-squared	0.90	0.85	0.91	0.93	0.96
F-stat	93.04	45.17	63.62	79.68	106.42
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	0.03	0.06	0.30	-0.35	-0.68
SIC	0.54	0.58	0.91	0.24	-0.01
No. Countries	81	27	24	18	12

Table presents the fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI3 as the proxy for market concentration. Model S16-ALL includes all sampling countries. Model S16-EU includes 27 sampling countries in Europe. Model S16-AS includes 24 sampling countries in Asia. Model S16-AM includes 18 sampling countries in America. Model S16-AF includes 12 sampling countries in Africa. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

2.3.4.6 Segmentation Analysis by Numbers of Banks

The fourth segmentation analysis performed in this section is also to further investigate the robustness of the key findings in section 2.3.3.2 as well as to document the appropriateness of the usage of variable CI3 and CI5. In this study, as pointed out earlier, CI3 and CI5 are arbitrarily selected as the proxy for market concentration, according to the previous studies. However, it can be argued that the market share of the top three largest banks in large countries (with many banks), such as the U.S., Russia and China, may not mean the same thing as the top three largest banks in small countries (with less banks), such as Angola, Bahrain and Jordan. Therefore, in this section, the total 81 sampling countries are separated by the numbers of banks into three main groups. Table 2.21 presents the list of countries in each segment. After classifying the total samplings into three main groups, specifically (1) Top 25%, (2) Middle 50% and (3) Bottom 25%, the fixed effect panel regressions are performed similar to section 2.3.3.2. In short, model A11 and A12 in section 2.3.3.2 are replicated using the samplings as segmented.

Table 2.22 presents the regression results from segmented sampling using LI as a proxy for market pricing power and CI3 as a proxy for market concentration. There are four main segmented models. The first model, S17-ALL, is the same as model A11 in section 2.3.3.2 in which all of 81 sampling countries are used. The other three models, specifically S17-TOP, S17-MID and S17-BOT, use the sampling countries as described in Table 2.21.

Also, Table 2.23 presents the regression results with the same methodology and sampling as Table 2.22. The only difference is that Table 2.23 uses CI5 as a proxy for market concentration, instead of CI3 as per the Table 2.22.

Table 2.21: Sampling Countries in each Segment (Numbers of Banks)

Numbers of Banks	Top 25%	Middle 50%		Bottom 25%
	Argentina	UAE	South Korea	Angola
	Austria	Azerbaijan	Kazakhstan	Australia
	Brasil	Bosna	Lebanon	Bulgaria
	Canada	Bangladesh	Sri Lanka	Bahrain
	Switzerland	Belgium	Latvia	CostaRica
	China	Belarus	Malaysia	Georgia
	German	Chile	Nigeria	Ghana
	Dominican	Colombia	Netherlands	Jordan
	France	Czech	Nepal	Mauritius
	England	Denmark	Panama	Norway
	Indonesia	Ecuador	Poland	New Zealand
	India	Egypt	Portugal	Peru
	Italy	Spain	Romania	Paraguay
	Japan	Guatemala	Serbia	Slovenia
	Luxembourg	Hong Kong	Sweden	El Salvador
	Mexico	Honduras	Thailand	Ukraine
	Philippines	Croatia	Turkey	Uruguay
	Russian Federation	Hungary	Tanzania	Uzbekistan
	United States	Kenya	Venezuela	South Africa
			Vietnam	Moldavia
			Armenia	Uganda
				Zambia
Total	**19**	**40**		**22**

The results from both tables are quite similar in which the coefficients of both market pricing power and market concentration from the three segmented samplings, specifically model S17-TOP, S17-MID, S17-BOT, S18-TOP, S18-MID and S18-BOT, are almost the same as those from the all samplings that include 81 countries, specifically model S17-ALL and S18-ALL. Therefore, these findings truly confirm the robustness of the findings in section 2.3.3.2. Also, as the coefficients from the segmented models are almost the same as the original model, it can be concluded that different numbers of banks in a certain country cannot discriminate the level of relationship between bank competition and financial system stability.

Table 2.22: Results from Segmented Models (Numbers of Banks) with CI3

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

Model	**S17-ALL**	**S17-TOP**	**S17-MID**	**S17-BOT**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**
Concentration	**CI3**	**CI3**	**CI3**	**CI3**
		Co-efficient		
C	2.8050***	2.7905***	3.1546***	2.8923***
	(0.1533)	(0.3648)	(0.2535)	(0.3802)
LI	0.6054***	0.8020***	0.3832**	1.0043***
	(0.1068)	(0.2549)	(0.1631)	(0.1838)
CI3	-0.3213***	-0.3415**	-0.5038***	-0.2145*
	(0.0869)	(0.2489)	(0.1342)	(0.1397)
CIR	-0.4013***	-0.3974*	-0.5500***	-0.7389***
	(0.1089)	(0.2289)	(0.1696)	(0.1863)
RDI	-0.3736***	-0.5042	-0.7947***	0.2576
	(0.1416)	(0.3264)	(0.2419)	(0.2080)
NPL	-0.9933***	-2.5871***	-0.5578**	-0.7074**
	(0.1923)	(0.4567)	(0.2895)	(0.3209)
LNTA	0.0000	0.0000	-0.0003	-0.0005
	(0.0000)	(0.0000)	(0.0003)	(0.0009)
LTA	-0.2177	-0.9325***	-0.1660	-0.6633***
	(0.1372)	(0.3613)	(0.1936)	(0.2592)
GDPG	0.8035***	2.5387***	0.4197	0.5141
	(0.2762)	(0.7751)	(0.4080)	(0.4243)
CPI	-0.0227	-0.4631	0.2612	-0.3136**
	(0.0953)	(0.4191)	(0.1418)	(0.1346)
R-squared	0.91	0.90	0.91	0.94
Adj. R-squared	0.90	0.88	0.89	0.93
F-stat	91.45	45.24	64.64	87.44
F-stat (prob.)	0.00	0.00	0.00	0.00
AIC	0.05	0.00	0.20	-0.26
SIC	0.56	0.57	0.76	0.31
No. Countries	81	19	40	22

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI3 as the proxy for market concentration. Model S17-ALL includes all sampling countries. Model S17-TOP includes 19 sampling countries that are in the top 25% based on numbers of banks. Model S17-MID includes 40 sampling countries that are in the middle 50% based on numbers of banks. Model S17-BOT includes 22 sampling countries that are in the top 25% based on numbers of banks. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 2.23: Results from Segmented Models (Numbers of Banks) with CI5

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

Model	**S18-ALL**	**S18-TOP**	**S18-MID**	**S18-BOT**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**
Concentration	**CI5**	**CI5**	**CI5**	**CI5**
			Co-efficient	
C	3.1261***	3.0373***	3.5942***	2.6501***
	(0.1743)	(0.3883)	(0.2864)	(0.5159)
LI	0.6242***	0.7579***	0.3904**	1.0557***
	(0.1061)	(0.2552)	(0.1611)	(0.1817)
CI5	-0.6090***	-0.2570*	-0.8623***	-0.1744
	(0.1156)	(0.1533)	(0.1754)	(0.3768)
CIR	-0.4127***	0.3828	-0.5878***	-0.6979***
	(0.1080)	(0.1285)	(0.1672)	(0.1865)
RDI	-0.4029***	-0.5516*	-0.8001***	0.2458
	(0.1403)	(0.3276)	(0.2389)	(0.2089)
NPL	-0.9537***	-2.4118***	-0.5520**	-0.6802**
	(0.1911)	(0.4602)	(0.2852)	(0.3220)
LNTA	0.0000	0.0000	-0.0005	0.0002
	(0.0000)	(0.0000)	(0.0003)	(0.0008)
LTA	-0.2652**	-0.8901***	-0.2059	-0.6291**
	(0.1364)	(0.3610)	(0.1900)	(0.2641)
GDPG	0.7843***	2.6034***	0.3993	0.4770
	(0.2739)	(0.7685)	(0.4024)	(0.4276)
CPI	-0.0464	-0.4573	0.2404	-0.3205**
	(0.0946)	(0.4177)	(0.1402)	(0.1371)
R-squared	0.91	0.90	0.91	0.94
Adj. R-squared	0.90	0.88	0.90	0.93
F-stat	93.04	45.56	66.42	86.53
F-stat (prob.)	0.00	0.00	0.00	0.00
AIC	0.03	-0.01	0.18	-0.25
SIC	0.54	0.56	0.73	0.32
No. Countries	81	19	40	22

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI5 as the proxy for market concentration. Model S18-ALL includes all sampling countries. Model S18-TOP includes 19 sampling countries that are in the top 25% based on numbers of banks. Model S18-MID includes 40 sampling countries that are in the middle 50% based on numbers of banks. Model S18-BOT includes 22 sampling countries that are in the top 25% based on numbers of banks. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

2.3.4.7 Segmentation Analysis by UN Country Classification

The fifth segmentation analysis performed in this section is also to further investigate the robustness of the key findings in section 2.3.3.2 as well as to explore whether the results can vary across different UN country classification. Specifically, the segmentation performed in this section is to explore whether the relationship between bank competition and financial system stability is the same in developed and developing countries according to the UN classification in 2014. Therefore, the total 81 samplings are separated based on the classification from the UN into two main groups, which are developed and developing countries. For the group of developed countries, it includes most countries in Europe, such as Switzerland, Germany and England, as well as the U.S., Canada and Australia. For the group of developing countries, it includes the countries mostly in Asia and Africa regions.

Table 2.24 presents the list of countries in each segment based on such classification. After classifying the total samplings into two main groups, the fixed effect panel regressions are performed similar to section 2.3.3.2. In short, model A11 and A12 in section 2.3.3.2 are replicated using the samplings as segmented.

Table 2.25 presents the regression results from segmented sampling using LI as a proxy for market pricing power and CI3 as a proxy for market concentration. There are three main segmented models. The first model, S19-ALL, is the same as model A11 in section 2.3.3.2 in which all of 81 sampling countries are used. The other two models, specifically S19-RH and S19-PR, use the sampling countries as described in Table 2.24.

Also, Table 2.26 presents the regression results with the same methodology and sampling as Table 2.25. The only difference is that Table 2.26 uses CI5 as a proxy for market concentration, instead of CI3 as per the Table 2.25.

Table 2.24: Sampling Countries in each Segment (UN Classification)

Status	Developed Countries		Developing Countries	
	Austria	UAE	Hong Kong	Philippines
	Australia	Angola	Honduras	Paraguay
	Belgium	Argentina	Indonesia	Serbia
	Bulgaria	Azerbaijan	India	Russian Federation
	Canada	Bosna	Jordan	El Salvador
	Switzerland	Bangladesh	Kenya	Thailand
	Czech	Bahrain	South Korea	Turkey
	German	Brasil	Kazakhstan	Tanzania
	Denmark	Belarus	Lebanon	Ukraine
	Spain	Chile	Sri Lanka	Uruguay
	France	China	Latvia	Uzbekistan
	England	Colombia	Mauritius	Venezuela
	Croatia	CostaRica	Mexico	Vietnam
	Hungary	Dominican	Malaysia	South Africa
	Italy	Ecuador	Nigeria	Armenia
	Japan	Egypt	Norway	Moldavia
	Luxembourg	Georgia	Nepal	Uganda
	Netherlands	Ghana	Panama	Zambia
	New Zealand	Guatemala	Peru	
	Poland			
	Portugal			
	Romania			
	Sweden			
	Slovenia			
	United States			
Total	**25**		**56**	

The results from both tables are quite similar in which the coefficients of both market pricing power and market concentration from the two segmented samplings, specifically model S19-RH, S19-PR, S20-RH and S20-PR, are almost the same as those from the all samplings that include 81 countries, specifically model S19-ALL and S20-ALL. Therefore, these findings truly confirm the robustness of the findings in section 2.3.3.2. Also, as the coefficients from the segmented models are almost the same as the original model, it can be concluded that the relationship between bank competition and financial system stability is quite in line between developed and developing countries. Nevertheless, there is a little evidence showing that the relationship between market pricing power and financial system stability is stronger in developing countries than in developed countries.

Table 2.25: Results from Segmented Models (UN Classification) with CI3

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

Model	**S19-ALL**	**S19-RH**	**S19-PR**
Stability	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**
Concentration	**CI3**	**CI3**	**CI3**
		Co-efficient	
C	2.8050***	3.6473***	2.4589***
	(0.1533)	(0.3342)	(0.1873)
LI	0.6054***	0.0585**	0.6691***
	(0.1068)	(0.0277)	(0.1146)
CI3	-0.3213***	-0.4853***	-0.2269**
	(0.0869)	(0.1601)	(0.1170)
CIR	-0.4013***	-0.5853***	-0.3908***
	(0.1089)	(0.2347)	(0.1243)
RDI	-0.3736***	-0.7472***	-0.2666*
	(0.1416)	(0.2899)	(0.1618)
NPL	-0.9933***	-1.7655***	-0.7668***
	(0.1923)	(0.5513)	(0.2136)
LNTA	0.0000	0.0000	0.0001
	(0.0000)	(0.0000)	(0.0001)
LTA	-0.2177	-0.4809*	-0.0259
	(0.1372)	(0.2527)	(0.1685)
GDPG	0.8035***	-0.9686	0.9190***
	(0.2762)	(0.9955)	(0.2820)
CPI	-0.0227	1.3477**	-0.0378
	(0.0953)	(0.6298)	(0.0947)
R-squared	0.91	0.86	0.93
Adj. R-squared	0.90	0.84	0.92
F-stat	91.45	37.85	105.25
F-stat (prob.)	0.00	0.00	0.00
AIC	0.05	0.20	-0.03
SIC	0.56	0.75	0.49
No. Countries	81	25	56

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI3 as the proxy for market concentration. Model S19-ALL includes all sampling countries. Model S19-RH includes 25 sampling countries that are classified as developed countries according to the UN classification in 2014. Model S19-PR includes 56 sampling countries that are classified as developing countries according to the UN classification in 2014. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 2.26: Results from Segmented Models (UN Classification) with CI5

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

Model	**S20-ALL**	**S20-RH**	**S20-PR**
Stability	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**
Concentration	**CI5**	**CI5**	**CI5**
		Co-efficient	
C	3.1261***	3.9160***	2.9678***
	(0.1743)	(0.3774)	(0.2267)
LI	0.6242***	0.0573**	0.7063***
	(0.1061)	(0.0279)	(0.1135)
CI5	-0.6090***	-0.6808***	-0.7019***
	(0.1156)	(0.2145)	(0.1635)
CIR	-0.4127***	-0.5945***	-0.4158***
	(0.1080)	(0.2344)	(0.1229)
RDI	-0.4029***	-0.8240***	-0.2851*
	(0.1403)	(0.2897)	(0.1597)
NPL	-0.9537***	-1.7723***	-0.8120***
	(0.1911)	(0.5500)	(0.2109)
LNTA	0.0000	0.0000	0.0001
	(0.0000)	(0.0000)	(0.0001)
LTA	-0.2652**	-0.4865**	-0.1216
	(0.1364)	(0.2517)	(0.1676)
GDPG	0.7843***	-0.9187	0.9311***
	(0.2739)	(0.9946)	(0.2778)
CPI	-0.0464	1.3200**	-0.0778
	(0.0946)	(0.6264)	(0.0941)
R-squared	0.91	0.86	0.93
Adj. R-squared	0.90	0.84	0.93
F-stat	93.04	37.98	108.14
F-stat (prob.)	0.00	0.00	0.00
AIC	0.03	0.20	-0.06
SIC	0.54	0.74	0.47
No. Countries	81	25	56

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using LI as the proxy for market pricing power and using CI5 as the proxy for market concentration. Model S20-ALL includes all sampling countries. Model S20-RH includes 25 sampling countries that are classified as developed countries according to the UN classification in 2014. Model S20-PR includes 56 sampling countries that are classified as developing countries according to the UN classification in 2014. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate) and CPI (consumer price index). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

2.3.4.8 Impact from Financial Crisis in the U.S. in 2008 to the Main Study

It is well aware that there is a severe financial crisis originated in the U.S. in the year 2008, which is a part of the study window. Therefore, it is worthwhile to further investigate whether such crisis has a significant impact to the main results obtained from this essay or not. The analysis is developed by constructing the dummy variable indicating the financial crisis in U.S. during the year 2008. The data is obtained from the Global Financial Development Database, the World Bank.

For the methodology, it is according to the baseline equation illustrated in section 2.2.3 with the additional dummy variable, namely CRISIS. Therefore, the empirical model is as following.

$$Z_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + CRISIS + \varepsilon_{it} \qquad (2.24)$$

where:

Z_{it} is a measure for bank stability of each country i at time t, which is represented by variable LNZI

C_{it} is a measure for bank competition of each country i at time t, which is represented by variable CI3, CI5 or LI

X_{ij} is a set of bank-specific and country-specific control variables, which is represented by variables as described in section 2.2.1.4 and 2.2.1.5

$CRISIS_{ij}$ is a dummy variable indicating financial crisis in the U.S. in 2008

ε_{it} is the error term

Table 2.27 presents the fixed period regression results from augmented models with additional dummy variable indicating financial crisis in the U.S. in 2008. As the coefficient of such dummy variable is insignificantly different from zero, it can be concluded that the financial impact in the U.S. in 2008 does not have significant impact to the main study. That can be partially explained by the fact that the analysis in this essay is at country level. Therefore, the impact from a few countries may not be able to affect the overall samplings.

Table 2.27: Results from Augmented Models with Crisis Dummy

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

Model	**A31**	**A32**	**A33**	**A34**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**HI**	**HI**
Concentration	**CI3**	**CI5**	**CI3**	**CI5**
	Co-efficient		**Co-efficient**	
C	2.8620***	3.1770***	3.1924***	3.4958***
	(0.1506)	(0.1730)	(0.1423)	(0.1672)
LI	0.5655***	0.5734***		
	(0.1010)	(0.1003)		
HI			-0.2174***	-0.2123***
			(0.0674)	(0.0670)
CI3	-0.3217***		-0.3210***	
	(0.0859)		(0.0869)	
CI5		-0.5929***		-0.5768***
		(0.1143)		(0.1156)
CIR	-0.4327***	-0.4497***	-0.6027***	-0.6218***
	(0.1051)	(0.1045)	(0.1015)	(0.1010)
RDI	-0.3725***	-0.4003***	-0.5424***	-0.5723***
	(0.1357)	(0.1347)	(0.1336)	(0.1328)
NPL	-0.9621***	-0.9268***	-1.0998***	-1.0684***
	(0.1880)	(0.1870)	(0.1882)	(0.1873)
LNTA	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
LTA	-0.2248*	-0.2667**	-0.1557	-0.1934
	(0.1307)	(0.1298)	(0.1319)	(0.1311)
GDPG	0.7775***	0.7603***	0.9135***	0.8962***
	(0.2740)	(0.2720)	(0.2768)	(0.2749)
CPI	-0.0361	-0.0579	0.0447	0.0246
	(0.0934)	(0.0928)	(0.0932)	(0.0927)
CRISIS	-0.0279	-0.0176	-0.0189	-0.0092
	(0.0746)	(0.0741)	(0.0754)	(0.0750)
R-squared	0.91	0.92	0.91	0.91
Adj. R-squared	0.90	0.91	0.90	0.90
F-stat	95.09	96.53	92.79	94.02
F-stat (prob.)	0.00	0.00	0.00	0.00
AIC	0.05	0.03	0.07	0.06
SIC	0.55	0.53	0.57	0.56

Table presents the period-fixed effect and cross-sectional-fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using alternative measures of market pricing power (LI and HI) and market concentration (CI3 and CI5). The market pricing power for model A31 and A32 is LI (Lerner index), while that for model A33 and A34 is HI (H-statistic index). The market concentration for model A31 and A33 is CI3 (the concentration index of three-largest banks in a country), while that for model A32 and A34 is CI5 (the concentration index of five-largest banks in a country). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), LTA (loan to asset ratio), GDPG (GDP growth rate), CPI (consumer price index) and CRISIS (dummy variable indicating the financial crisis in the U.S. during 2008-2009). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

2.3.4.9 Simultaneous Equation Regressions

The simultaneous equation regressions performed in this section is also to ensure the robustness of the key findings in section 2.3.3.2 as well as to further explore whether the relationship between bank competition and financial system stability varies when the bank-specific control variables are endogenous in the models.

According to the baseline equation illustrated in section 2.2.3, stability is a function of bank competition, bank-specific control variables and country-specific control variable as following.

$$Stability = f(Competition, BankControls, CountryControls) \quad (2.25)$$

$$Z_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + \varepsilon_{it} \quad (2.26)$$

where:

Z_{it} is a measure for bank stability of each country i at time t, which is represented by variable LNZI

C_{it} is a measure for bank competition of each country i at time t, which is represented by variable CI3, CI5 or LI

X_{ij} is a set of bank-specific and country-specific control variables, which is represented by variables as described in section 2.2.1.4 and 2.2.1.5

ε_{it} is the error term

In order to further investigate whether the results from section 2.3.3.2 are the same as when bank-specific control variables are endogenous in the model, the system of equations are constructed as in equations 2.27 to 2.30.

$$Z_{it} = \beta_0 + \beta_1 MP_{it} + \beta_2 C_{it} + \beta_3 CIR_{it} + \beta_4 RDI_{it} + \beta_5 NPL_{it} + \varepsilon_{it} \quad (2.27)$$

$$CIR_{it} = \beta_0 + \beta_1 MP_{it} + \beta_2 C_{it} + \varepsilon_{it} \quad (2.28)$$

$$RDI_{it} = \beta_0 + \beta_1 MP_{it} + \beta_2 C_{it} + \varepsilon_{it} \quad (2.29)$$

$$NPL_{it} = \beta_0 + \beta_1 MP_{it} + \beta_2 C_{it} + \varepsilon_{it} \quad (2.30)$$

where:

Z_{it} is a measure for bank stability of each country i at time t, which is represented by variable LNZI

MP_{it} is a measure for non-structural bank competition of each country i at time t, which is represented by variable LI or HI

C_{it} is a measure for structural bank competition of each country i at time t, which is represented by variable CI3 or CI5

CIR_{it} is a measure for efficiency of each bank i at time t, which is represented by variable CIR

RDI_{it} is a measure for revenue diversification of each bank i at time t, which is represented by variable RDI

NPL_{it} is a measure for portfolio risk of each bank i at time t, which is represented by variable NPL

ε_{it} is the error term

After the system of equations is constructed, three-stage least square technique is adopted to test for the regression results. Five main instrument variables are also selected and assigned in the same approach as Berger et al. (2009), Amidu and Wolfe (2013) and Beck et al. (2013). The included variables are as followings: (1) Foreign Entry Restriction (denoted as FER hereafter) is the proxy for the barrier to entry. There are three restrictions for the foreign banks to enter to the market, which are acquiring domestic banks, opening their subsidiaries and opening their branches. Dummy value equal to one is assigned per each restriction if a particular country imposes the restriction, zero otherwise. Then, the three dummies are averaged. (2) Non-Bank Activity Restriction (denoted as NBAR hereafter) is the qualitative variable proxy for the restrictions on three non-bank activities, which are security business, insurance business and real estate business. The score is ranging between one and four for each restriction where one means the lowest restriction, and four means the highest restriction. Then, the score will be averaged. (3) Risk Monitoring (denoted as RM hereafter) is the control variable evaluating three main risks whether they are assigned to capital requirements or not. These risks cover credit, market and operational aspects. Dummy value equal to one is assigned to each risk perspective, and zero otherwise.

Then, three dummies are averaged. (4) Percentage of Government-Owned (denoted as PGO hereafter) is the dummy variable reflecting the fraction of banking system's assets in banks that is 50% or more government-owned., and (5) Percentage of Foreign-Owned (denoted as PFO hereafter) is the dummy variable reflecting the fraction of banking system's assets in banks that is 50% or more foreign-controlled. All of the data for instrument variables are from the World Bank Regulation and Supervision Survey conducted in the year 2011.

Table 2.28 presents the regression results from three-stage least square models as per the equation 2.27 to 2.30 Model E11 uses LI as a proxy for market pricing power and uses CI3 as a proxy for market concentration. Model E12 changes the proxy for market concentration to CI5 but still employs LI as a proxy for market pricing power. Model E13 uses HI as a proxy for market pricing power and uses CI3 as a proxy for market concentration. Model E14 changes the proxy for market concentration to CI5 but still employs HI as a proxy for market pricing power.

For model E11 and E12, the empirical results show that when the bank-specific control variables, specifically CIR, ROA and NPL, are regressed simultaneously with both proxies for bank competition, market pricing power and market concentration, the sign of the coefficient of market pricing power proxy, LI, and the coefficient of market concentration proxy, CI3 and CI5, are still the same as that from model A11 and A12 as presented in Table 2.9. That is the sign of the coefficient of market pricing power proxy is positive, while that of the market concentration proxy is negative. Therefore, these results confirm the robustness of the findings from Table 2.9 even when the variables are endogenously regressed.

Table 2.28: Regression Results from Simultaneous Equations Models

EQ1: Stability = C(1) + C(2)*Market Power + C(6)*Concentration + C(3)*CIR + C(4)*RDI + C(5)*NPL

EQ2: CIR = C(7) + C(8)*Market Power + C(9)*Concentration

EQ3: RDI = C(10) + C(11)*Market Power + C(12)*Concentration

EQ4: NPL = C(13) + C(14)*Market Power + C(15)*Concentration

Model	**E11**	**E12**	**E13**	**E14**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**HI**	**HI**
Concentration	**CI3**	**CI5**	**CI3**	**CI5**
	Co-efficient		**Co-efficient**	
C(1)	0.3662 (1.0507)	-0.4570 (1.2952)	1.5980 (1.2725)	1.7159 (1.3582)
C(2)_MP	3.4697*** (1.2137)	3.1377*** (1.1370)	-10.5341*** (2.3243)	-7.6584*** (1.8696)
C(6)_Con	-2.3906*** (0.7740)	-1.2093 (0.8573)	-5.1380*** (1.4218)	-3.4164*** (1.3169)
C(3)_CIR	5.1741*** (1.6190)	5.5756*** (1.6703)	12.5294*** (2.3077)	9.7763*** (2.0620)
C(4)_RDI	1.8982* (1.0432)	1.6246 (1.0401)	1.1118 (1.2282)	0.9494 (1.1509)
C(5)_NPL	-31.4538*** (2.8621)	-27.1206*** (2.7684)	-40.4105*** (4.1080)	-32.7848*** (3.5108)
C(7)	0.7282*** (0.0448)	0.8038*** (0.0616)	0.4282*** (0.1143)	0.4735*** (0.1383)
C(8)_CIR_MP	-0.5834*** (0.0990)	-0.5641*** (0.0977)	0.5721*** (0.2085)	0.5430*** (0.1941)
C(9)_CIR_Con	-0.0277 (0.0639)	-0.1201 (0.0735)	0.0642 (0.1327)	0.0047 (0.1436)
C(10)	0.5720*** (0.0458)	0.5726*** (0.0594)	0.3047*** (0.0934)	0.2972*** (0.1079)
C(11)_RDI_MP	-0.5212*** (0.1014)	-0.4799*** (0.0946)	0.5106*** (0.1717)	0.4576*** (0.1530)
C(12)_RDI_Con	0.2098*** (0.0652)	0.1619** (0.0707)	0.2912*** (0.1086)	0.2624** (0.1124)
C(13)	0.1531*** (0.0170)	0.2080*** (0.0233)	0.1992*** (0.0291)	0.2609*** (0.0364)
C(14)_NPL_MP	-0.0156 (0.0377)	-0.0335 (0.0370)	-0.1216** (0.0531)	-0.1232** (0.0511)
C(15)_NPL_Con	-0.1514*** (0.0244)	-0.1874*** (0.0278)	-0.1928*** (0.0338)	-0.2347*** (0.0378)

Table presents the results from three-stage least square regressions of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using alternative measures of market pricing power (LI and HI) and market concentration (CI3 and CI5). The market pricing power for model E11 and E12 is LI (Lerner index), while that for model E13 and E14 is HI (H-statistic index). The market concentration for model E11 and E13 is CI3 (the concentration index of three-largest banks in a country), while that for model E12 and E14 is CI5 (the concentration index of five-largest banks in a country). These models are also regressed simultaneously with endogenous bank-specific control variables, specifically CIR (cost to income ratio), RDI (revenue diversification index) and NPL (non-performing loan ratio) in EQ1. In EQ2 to EQ4, dependent variables become CIR, RDI and NPL instead, and the common independent variables are market pricing power and market concentration. The instrument variables used in these models are (1) foreign entry restriction (FER), (2) non-bank activity restriction (NBAR), (3) risk monitoring (RM), (4) percentage of government-owned (PGO) and (5) percentage of foreign-owned (PFO). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Similarly, for model E13 and E14, the empirical results show that when the bank-specific control variables, specifically CIR, ROA and NPL, are regressed simultaneously with both proxies for bank competition, market pricing power and market concentration, the sign of the coefficient of market pricing power proxy, HI, and the coefficient of market concentration proxy, CI3 and CI5, are still the same as that from model A13 and A14 as presented in Table 2.9. That is the sign of the coefficient of both market pricing power and market concentration proxies is negative. Therefore, these results confirm the robustness of the findings from Table 2.9 even when the variables are endogenously regressed.

The results from simultaneously equation do not only confirm the robustness of the findings in previous section, but they also have another remarkable implication. That is when the coefficients of market pricing power and market concentration in EQ2 to EQ4, specifically C(8), C(9), C(11), C(12), C(14) and C(15), are statistically different from zero, it means that market pricing power and market concentration do not only affect the financial system stability, but they also affect the financial system performance through the efficiency, revenue diversification and portfolio risk as well. More specifically, market pricing power has a positive relationship with financial system efficiency as the sign of C(8) in model E11 and E12 is negative. By increasing market pricing power, it is associated with lower CIR. In other words, increasing market pricing power can increase financial system efficiency.

In addition, market pricing power also has a positive relationship with revenue diversification as the sign of C(11) in model E11 and E12 is negative and statistically different from zero. Even though the market pricing power affect both efficiency and revenue diversification, the relationship with portfolio risk is not robust. Also, the impact of market concentration to those bank-specific control variables is on the opposite side as market pricing power. In fact, this finding can confirm the previous conclusion that there are two angles of the competition, which are market pricing power and market concentration. The results from model E13 and E14 also confirm the robustness of the results from model E11 and E12.

2.4 Conclusion

This essay contributes to the existing literature gap by exploring the linkage between bank competition, using both structural and non-structural approaches, and financial system stability. To date, there are many papers investigating the relationship between bank competition and financial system stability. However, as the competition cannot be measured directly, researchers need to identify the proxy for this factor first.

Even though there are substantial researches in this area, there are not so many empirical evidences documenting for the impact of competition under structural and non-structural approaches separately on financial system stability. In this essay, both micro bank-level and macro country-level data from a selected sample of 81 countries including both developed and developing countries during the year 2000 to 2013 are used. The data at bank-level is aggregated to be at country-level. Then, the pooled regression with cross-section and period fixed effects technique is conducted to analyze cross-country information. The stylized facts obtaining from the study can be summarized as followings.

Firstly, the proxies for bank competition, specifically market concentration and market pricing power, indeed have the opposite effect on financial system stability. The empirical results in section 2.3 show that the traditional measure of competition, namely market concentration, has a negative relationship with financial system stability. That is, when the market becomes more concentrated, the system becomes more fragile. Alternatively, the recent measure of competition, the market pricing power, has a positive relationship with financial system stability. It is obvious that when banks have higher pricing power, the system becomes more stable.

Secondly, these two measures of competition together with three bank-specific control variables; bank efficiency, revenue diversification and portfolio risk, can explain the variation of financial system stability in the sampling countries and periods. The results in section 2.3 show that bank efficiency and revenue diversification have a positive relationship with financial system stability. On the other hand, portfolio risk has a negative relationship with system stability, intuitively. The results are robust when the proxies for the main measures, such as competition and stability, are specified differently. In addition, all of the key variables are constructed as the system of equations, and three-stage least square technique is adopted to ensure the robustness of

the results from section 2.3. The results from such endogenous models are consistent with the original findings.

Thirdly, when all the countries are segmented into four main groups based on two important dimensions, specifically accessibility to funding via banking industry and size of the credit offered by banks relative to GDP, the results from three subgroups, specifically High accessibility and Small credit size, Low accessibility and Big credit size and Low accessibility and Small credit size, are the same as those from total 81 sampling countries. However, the coefficient of market pricing power in one subgroup, specifically High accessibility and Big credit size, is negative, and it is different from other models. This can be interpreted that the relationship between market pricing power and financial system stability is negative. On the contrary, when all the countries are segmented into four main groups based on another pair of important dimensions, specifically stability and efficiency, the results from all of the subgroups remain the same as those from total 81 sampling countries. Likewise, when all the countries are segmented based on (1) regions, (2) numbers of banks and (3) UN classification, the results from all of the subgroups remain the same as those from total 81 sampling countries. Therefore, the results from the segmentation analyses can be documented that the relationship between market pricing power and financial system stability is not necessarily be the same across different market characteristics.

From all of the above findings, it can be concluded that there are actually two angles of competition; the market concentration and the market pricing power. As the impacts of these two angles of competition are actually on the opposite side, they indeed have important policy implications. In order to enhance the stability of the financial system, the policy makers need to consider the policy that (1) makes the market to be less monopolized by a few key players and (2) ensures that all players have enough margins to withstand economic fluctuation. Yet, these policy implications are drawn from the cross-country investigations in selected 81 sampling countries. The final implication to the policy makers is that the relationship between bank competition and financial system stability may not necessarily be the same across all countries, and the in-depth segmentation analysis is recommended before launching the policy that may affect the competition in financial industry.

CHAPTER 3

THE SECOND ESSAY
"Bank Competition and Economic Growth: A Cross-Country Investigation"

Existing theoretical frameworks still provide an inconclusive relationship between bank competition and economic growth. This topic is still a controversial issue between researchers. On one side, the view of more-competition-less-growth, according to Rajan (1992), suggests that more competitive banking industries will provide less amount of loan issued to firms because they have less incentive to invest in close relationships with them. As a result, firms that heavily rely on external financing should grow slowly. On the opposite side, the view of more-competition-more-growth, according to Boot and Thakor (2000), suggests that more competitive banking industries will provide more loan to firms because they need to compete more with each other. As a result, firms that heavily rely on external financing should grow faster. This essay will, therefore, contribute to the existing literature gap by investigating the linkage between bank competition and economic growth, using both structural and non-structural approaches. The model that can explain the variation of economic growth in 81 countries throughout the globe during the period 2000 to 2013 will be proposed correspondingly.

The remaining of this essay is structured as followings. Section 3.1 summarizes the existing literature of the studies under bank competition and economic growth nexus. Section 3.2 describes how the variables are constructed, econometric methodology and data. Then, section 3.3 presents and discusses the empirical results. The findings and implications are concluded in section 3.4.

3.1 Literature Review

According to the literature review in section 2.1.1, it has been concluded that there are two different angles to view competition. The first one is from the structural approach, namely market concentration. The proxy used is, for example, concentration index. The second one is from the non-structural approach, namely market pricing power. The proxy used is, for example, Lerner index. Also, the empirical results on the degree of competition actually depend on the proxy used as well as the model specification.

For the relationship between bank competition and economic growth, it is still a controversial issue among researchers due to the complexity in the computation of competition measurement. Also, there are two schools of thoughts pertaining to the linkage between bank competition and economic growth. On one side, according to Rajan (1992), it is suggested that more competitive banking industry will result in lower economic growth as banks have less incentive to provide loan to firms. On the opposite side, according to Boot and Thakor (2000), it is suggested that more competitive banking industry will result in higher economic growth as banks have more incentive to provide loan to firms. The empirical evidence in this area is still unclear about the true relationship between the competition in banking sector and economic growth, and there are still limited numbers of cross-country investigation on this topic.

Among a few of them, Cetorelli and Gambera (2001) conduct an empirical investigation and document that bank competition (as measured by concentration) has a negative effect on overall economic growth. By using similar data and methodology, Deidda and Fattouh (2002) also find that bank competition (as measured by concentration) has a negative effect on per capita growth in low-income countries even though there is no significant relationship in high-income countries.

Calderon and Liu (2003) investigate the relationship between financial sector development and industrial growth. Their 109 sample countries cover both developed and developing countries during the year 1960 to 1994. They find that there is a positive relationship between financial sector development and industrial growth for most of the countries. Claessens and Laeven (2005) study the relationship between bank competition and economic growth. They first estimate the H-statistic index, a measure

of market competition, using the Panzar-Rosse's approach. Then, they relate this estimated measure to the economic growth. By employing the sample size that includes 16 countries during the year 1994 to 2001, they conclude that greater bank competition allows financially dependent industries to grow faster.

Soedarmono (2010) studies the relationship between bank competition and economic growth using a sample of 17 Asian countries during the period 1999 to 2007. He finds that generally bank competition (as measured by market power) has a U-shaped relationship with economic growth, but such competition tends to have a positive effect on economic growth over time. Also, Asante et al. (2011) conduct the research on the relationship between bank competition, stock market development and economic growth in Ghana during the period 1992 to 2009. After adopting Granger Causality test, ARDL model and OLS technique, they find that bank competition and stock market development is the cause of economic growth in Ghana during the sampling periods. Eventually, they conclude that bank competition is favorable for economic growth in Ghana in the long run.

Recently, Ajisafe and Ajide (2014) carry out a research on bank competition and economic growth in Nigeria during the period 1986 to 2012 using Vector Error Correction (VEC) model and the co-integration test. They find that bank competition has a first order positive effect on economic growth both in the short run and in the long run. Therefore, they eventually suggest that increasing the competitive environment of the banking sector will lead to an increase in economic growth.

As stated by the above empirical findings, it can be confirmed that the relationship between bank competition and economic growth exist. However, there has not yet been adduced to conclude the effect of bank competition to economic growth due to the complexity of competition measurements and samplings used in the analysis.

3.2 Data and Methodology

3.2.1 Variable Specifications

The variables used in this essay can be categorized into five main groups. The first one is the competition measurement under the structural approach or market concentration. The proxy under this category is the concentration index. The second group is the competition measurement under the non-structural approach or market pricing power. The proxy under this category is the Lerner index. The third group explains the economic growth measure. The bank-specific control variables, such as efficiency, revenue diversification, portfolio risk and bank size, are illustrated in the fourth group. The fifth group presents the control variables reflecting different market characteristics. This group of variables will be used to construct dummy variables.

3.2.1.1 Structural Competition Measure

A. Concentration Index

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

$$CI_t = \sum_{i}^{n} s_{it} w_{it} \qquad (3.1)$$

where:

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

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

n is the number of banks in the market under consideration

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

$$CI_{kt} = \sum_{i=1}^{k} s_{it} \qquad (3.2)$$

There is no specific rule to determine the optimal number of k. The index is in a range between zero and one, and it can be interpreted as following. If it is equal to one, it means that the banks included in the computation make up the entire industry. As a result, the competition is at the lowest in this case. On the other hand, if it approaches zero, it means that there exists the infinite number of very small banks in the market given that the k chosen banks for the computation is relatively small comparing to the total number of banks. As a result, the competition is at the highest in this case.

Even though there is no rule determining the optimal value of k, in order to align with other existing literature, such as Bikker and Haaf (2000), Claessens and Laeven (2004), Casu and Girarone (2006) and so on, k=3 and k=5 will be arbitrarily applied in this research (denoted as CI3 and CI5 hereafter).

3.2.1.2 Non-Structural Competition Measure

B. Lerner Index

The Lerner Index (denoted as LI hereafter) provides a direct measure of the degree of market power as it represents the mark-up of price over marginal cost. It is calculated by taking the difference between price of the output and the marginal cost that produces such output and then dividing by the price. The interpretation of this index is that when there is no mark-up (LI = zero), it means the market is very competitive. When LI is higher, it means higher market power. As a result, the competition is lower. LI can be computed as in equation 3.3.

$$LI_t = \frac{P_{it} - MC_{it}}{P_{it}} \qquad (3.3)$$

where:

P_{it} is the price of each bank i at time t, which is calculated by the number of total revenue divided by total asset

MC_{it} is the marginal cost of each bank i at time t, which is derived from a translog cost function that includes three costs and several control variables. The translog cost function can be illustrated as in equation 3.4.

$$\ln TC_{i,t} = \alpha_o + \alpha_1 \ln TA_{it} + \alpha_2 (\ln TA_{it})^2 + \sum_{j=1}^{3} \beta_j \ln w_{it}^j + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln w_{it}^j \ln w_{it}^k + \sum_{j=1}^{3} \gamma_j \ln w_{it}^j \times \ln TA_{it} + \varepsilon_{it} \quad (3.4)$$

where:

TC_{it} is the total cost of each bank i at time t

w_{it} is the price of three inputs, which are deposit fund, labor and fixed asset

w_{it}^1 is the price of deposit, which is the ratio of interest expense to total deposit

w_{it}^2 is the price of labor, which is the ratio of personal expense to total asset

w_{it}^3 is the price of fixed asset, which is the ratio of operating expense to total fixed asset

TA_{it} is the total asset

ε_{it} is the error term

In order to obtain a valid cost function, the following restrictions in the translog cost function need to be imposed.

$$\sum_{j=1}^{3} \beta_j = 1 \quad (3.5)$$

$$\sum_{j=1}^{3} \gamma_j = 0 \quad (3.6)$$

$$\sum_{j=1}^{3} \beta_{jk} = 0 \text{ for } \forall k \in \{1,2,3\} \quad (3.7)$$

After imposing the above restrictions, marginal cost can be obtained as following.

$$MC_{it} = \frac{\partial TC_{it}}{\partial TA_{it}} = \frac{TC_{it}}{TA_{it}} \left(\hat{\alpha}_1 + 2\hat{\alpha}_2 \ln TA_{it} + \sum_{j=1}^{2} \gamma_j \ln \frac{w_{it}^j}{w_{it}^3} \right) \quad (3.8)$$

3.2.1.3 Economic Growth Measure

C. GDP Growth Rate

This variable is used as a dependent variable to be tested. It reflects general economic development, macroeconomic stability and institutional framework as these are likely to affect banking system performance in a country. The rate of real GDP growth rate (denoted as GDPG hereafter) is used as a proxy.

3.2.1.4 Bank-Specific Control Variables

D. Cost to Income Ratio

Cost to Income Ratio (denoted as CIR hereafter) is one of the most popular efficiency measurements of the bank. It is calculated as total cost over total income. So, it measures how well the expense is utilized per one unit of revenue, and the higher the ratio is, the less efficient the bank becomes.

E. Revenue Diversification Index

Revenue Diversification Index (denoted as RDI hereafter) is calculated by using Hirschman Herfindahl approach for each bank. It accounts for the diversification between interest and non-interest income. The higher RDI ratio means higher revenue concentration and hence lower revenue diversification.

$$RDI_{it} = \left(\frac{NII_{it}}{TR_{it}}\right)^2 + \left(\frac{FI_{it}}{TR_{it}}\right)^2 + \left(\frac{TI_{it}}{TR_{it}}\right)^2 \quad (3.9)$$

where:

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

NII_{it} is the net interest income of each bank i at time t, which is computed by interest income minus interest expense

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

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

F. Non-Performing Loan Ratio

Non-Performing Loan ratio (denoted as NPL hereafter) is used to proxy for loan portfolio risk. This proxy indeed takes into account that (1) the risk should not imply a higher risk of bank failure if the asset allocation tilts towards a larger holding of risk-free assets and (2) the measures at best should capture the default risk related to the loan portfolio. This measure can be computed as NPL over total loan, and the higher ratio means higher portfolio risk.

G. Bank Size

It is the total asset held by each bank. The variable is presented in logarithmic form (denoted as LNTA hereafter).

H. Bank Account Per 1,000 Adults

It is the percentage of population having banking accounts per 1,000 adults (denoted as BAPA hereafter).

3.2.1.5 Control Variables to Construct Dummy Variables

In order to investigate the relationship between competition and economic growth in different market characteristics, dummy variables will be constructed to segregate those characteristics between each country. There are four different dimensions to be explored. The first one is the accessibility to the funding via financial market. The proxy for this accessibility dimension is the percentage of firms using banks to finance working capital (short-term) and investment (long-term). The second dimension to be explored is the size of financial market relative to GDP. This dimension can be represented by the ratio of credit to private sector over GDP. The third dimension is stability, which can be represented by the Z-score index. The last dimension is efficiency, which can be represented by the Return on Asset.

I. Proportion of Firms using Banks to Finance Working Capital

This variable represents the short-term accessibility of financial market. It is the percentage of firms using banks to finance their working capital (denoted as FBFW

hereafter). The dummy variable is constructed by separating the high value of FBFW, specifically top 25%. In other word, dummy variable is equal to one if FBFW is in the top 25% of total sampling. This dummy variable is denoted as FBFWH.

J. Proportion of Firms using Banks to Finance Investment

This variable represents the long-term accessibility of financial market. It is the percentage of firms using banks to finance the purchase of fixed asset (denoted as FBFI hereafter). The dummy variable is constructed by separating the high value of FBFI, specifically top 25%. In other word, dummy variable is equal to one if FBFI is in the top 25% of total sampling. This dummy variable is denoted as FBFIH.

K. Credit to Private Sector Ratio

This variable represents the size of financial market relative to GDP. It is the percentage of credit offered by financial sector to private sector over GDP (denoted as CPSR hereafter). The dummy variable is constructed by separating the high value of CPSR, specifically top 25%. In other word, dummy variable is equal to one if CPSR is in the top 25% of total sampling. This dummy variable is denoted as CPSRH.

L. Z-score Index

Logarithmic form of Z-score Index (denoted as LNZI hereafter) represents the stability of financial market. It assesses the overall stability at the bank level and combines the indicators of profitability, leverage and return volatility into one variable. Mathematically, it measures the number of standard deviation that a bank's profit must fall to drive it into insolvency. The index potentially measures the accounting distance to default for a given institution, and it is calculated as following.

$$LNZI_{it} = Ln\left(\frac{ROA_{it} + ETA_{it}}{SD(ROA)_{it}}\right) \tag{3.10}$$

where:

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

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

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

The interpretation of LNZI is that the higher LNZI, the lower probability of insolvency risk. The dummy variable is constructed by separating the high value of LNZI, specifically top 25%. In other word, dummy variable is equal to one if LNZI is in the top 25% of total sampling. This dummy variable is denoted as LNZIH.

M. Return on Asset

This variable represents the efficiency of financial market. It is the percentage of net income over average total asset (denoted as ROA hereafter). The higher the ratio is, the more efficient the financial market is. The dummy variable is constructed by separating the high value of ROA, specifically top 25%. In other word, dummy variable is equal to one if ROA is in the top 25% of total sampling. This dummy variable is denoted as ROAH.

3.2.2 Data

This essay uses both micro bank-level and macro country-level data during the period 2000 to 2013. The micro bank-level data is extracted from Bankscope Database. All data are reported in USD currency and are expressed in constant prices where appropriate. The sample is limited to the commercial banks, and the countries that have banks less than ten banks in the industry will also be excluded. Also, in order to align the analysis at country level, bank-level data are aggregated into country level. The macro country-level data is mainly obtained from the latest update of the World Development Indicators Database (WDID) and Global Financial Development Database (GFDD) from the World Bank. The details of variables used and their source are summarized in Table 3.1.

Table 3.2 presents the list of countries in the sample and the numbers of banks as of 2013. The numbers of banks are in the range of the lowest 10 banks in Angola, Bahrain, Jordan, El Salvador and Uzbekistan to the highest 6,073 banks in the U.S. Most of the sampling countries contain banks no more than 100, except China, Japan, Russia and the U.S. Total numbers of banks in the sampling year 2013 are at 8,968.

Table 3.1: Variables used and their Source

Variable	Description	Sample Period	Data Source
Group A: Structural Competition Measures			
CI3	Concentration index of 3 largest banks	2000-2013	Bankscope Database, Bureau Van Dijk
CI5	Concentration index of 5 largest banks	2000-2013	Bankscope Database, Bureau Van Dijk
Group B: Non-Structural Competition Measure			
LI	Lerner index	2000-2013	Global Financial Development Database, World Bank
Group C: Economic Growth Measure			
GDPG	GDP growth rate	2000-2013	World Development Indicators Database, World Bank
Group D: Bank-Specific Control Variables			
CIR	Cost to income ratio	2000-2013	Global Financial Development Database, World Bank
RDI	Revenue diversification index	2000-2013	Bankscope Database, Bureau Van Dijk
NPL	Non-performing loan to total loan ratio	2000-2013	Global Financial Development Database, World Bank
LNTA	Logarithmic form of total asset	2000-2013	Bankscope Database, Bureau Van Dijk
BAPA	Bank accounts per 1,000 adults	2000-2013	Global Financial Development Database, World Bank
Group E: Control Variables to Construct Dummy Variables			
FBFW	Proportion of firms using banks to finance working capital	2000-2013	Global Financial Development Database, World Bank
FBFI	Proportion of firms using banks to finance investment	2000-2013	Global Financial Development Database, World Bank
CPSR	Ratio of credit issued by financial sector to private sector	2000-2013	Global Financial Development Database, World Bank
LNZI	Logarithmic form of Z-score index	2000-2013	Global Financial Development Database, World Bank
ROA	Return on Asset	2000-2013	Global Financial Development Database, World Bank

Table 3.2: Numbers of Banks by Country as of 2013

Country Name	Country Code	Numbers of Bank	Country Name	Country Code	Numbers of Bank	Country Name	Country Code	Numbers of Bank
UAE	AE	15	Guatemala	GT	17	Paraguay	PY	11
Angola	AO	10	Hong Kong	HK	26	Romania	RO	16
Argentina	AR	31	Honduras	HN	14	Serbia	RS	23
Austria	AT	52	Croatia	HR	25	Russia	RU	784
Australia	AU	12	Hungary	HU	14	Sweden	SE	21
Azerbaijan	AZ	19	Indonesia	ID	55	Slovenia	SI	12
Bosna	BA	17	India	IN	50	El Salvador	SV	10
Bangladesh	BD	15	Italy	IT	65	Thailand	TH	17
Belgium	BE	19	Jordan	JO	10	Turkey	TR	24
Bulgaria	BG	13	Japan	JP	107	Tanzania	TZ	19
Bahrain	BH	10	Kenya	KE	26	Ukraine	UA	12
Brasil	BR	64	South Korea	KR	15	United States	US	6,073
Belarus	BY	17	Kazakhstan	KZ	23	Uruguay	UY	13
Canada	CA	35	Lebanon	LB	18	Uzbekistan	UZ	10
Switzerland	CH	80	Sri Lanka	LK	16	Venezuela	VE	21
Chile	CL	22	Luxembourg	LU	32	Vietnam	VN	29
China	CN	119	Latvia	LV	16	South Africa	ZA	12
Colombia	CO	20	Mauritius	MU	13	Armenia	AM	15
CostaRica	CR	13	Mexico	MX	37	Moldavia	MD	11
Czech	CZ	14	Malaysia	MY	21	Uganda	UG	13
German	DE	82	Nigeria	NG	17	Zambia	ZM	12
Denmark	DK	29	Netherlands	NL	23			
Dominican	DO	31	Norway	NO	13			
Ecuador	EC	16	Nepal	NP	27			
Egypt	EG	20	New Zealand	NZ	12			
Spain	ES	25	Panama	PA	29			
France	FR	91	Peru	PE	13			
England	GB	87	Philippines	PH	34			
Georgia	GE	12	Poland	PL	25			
Ghana	GH	13	Portugal	PT	14	**Total**		**8,968**

3.2.3 Methodology

The theoretical framework pertaining to the relationship between bank competition and economic growth is from the Solow Growth model, which can be written as following.

$$Y = AK^{\alpha}L^{1-\alpha} \tag{3.11}$$

where:

Y is total production output

A is technology given in the economy

K is total capital generated from financial industry

L is total labor

α is restricted to be between 0 and 1

By assuming $\alpha = 1$, equation 3.11 becomes as following.

$$Y = AK \tag{3.12}$$

After incorporating bank competition variable and other bank-specific control variables into equation 3.12, the baseline equation can be rewritten as in equation 3.13. In principle, economic growth is a function of bank competition and a series of bank-specific control variables.

$$Growth = f(Competition, BankControlVariables) \tag{3.13}$$

The empirical model can be illustrated as following**.**

$$G_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + \varepsilon_{it} \tag{3.14}$$

Also, in order to account for period fixed effect, time variable is added into equation 3.14. The final baseline model is illustrated as following in which T is the time dummy variable.

$$G_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + T + \varepsilon_{it} \tag{3.15}$$

where:

G_{it} is a measure for economic growth of each country i at time t, which is represented by variable GDPG

C_{it} is a measure for bank competition of each country i at time t, which is represented by variable LI, CI3 or CI5

X_{ij} is a set of bank-specific control variables, which is represented by variables as described in section 3.2.1.4

ε_{it} is the error term

Finally, in order to investigate whether the relationship between competition and economic growth is the same in different country characteristics or not, the dummy variable is added into the empirical models.

$$G_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + T + D + \varepsilon_{it} \quad (3.16)$$

where:

G_{it} is a measure for economic growth of each country i at time t, which is represented by variable GDPG

C_{it} is a measure for bank competition of each country i at time t, which is represented by variable LI, CI3 or CI5

X_{ij} is a set of bank-specific control variables, which is represented by variables as described in section 3.2.1.4

D is a set of dummy variables, which is represented by variables as described in section 3.2.1.5

ε_{it} is the error term

3.3 Empirical Results

3.3.1 Descriptive Statistics

Table 3.3 illustrates average measures by countries during the period 2000 to 2013. For the structural competition measure or the market concentration, the top three countries with the highest CI3 are Norway, Switzerland and Portugal, while those with the highest CI5 are South Africa, Norway and Uzbekistan in which the value is more than 90%. It can be interpreted that the market structure of these countries are almost monopoly. The top three countries with the lowest CI3 and CI5 are U.S., India and Russia in which the value is around 40% to 50%. So, the markets in these countries are

characterized as monopolistic competition. For the non-structural competition measure or the market pricing power, the top three countries with the highest LI are Hong Kong, UAE and Angola. This means that these countries have high market pricing power, which can be implied that the market that they operate in is less competitive. On the other hand, the top three countries with the lowest LI are Mexico, German and Italy. This means that these countries have low market pricing power, which can be implied that the market that they operate in is more competitive.

For the economic growth, the top three countries with the highest average GDP growth rate are Azerbaijan, China and Angola, while those with the lowest one are Italy, Portugal and Denmark in which all of them are in Europe. For efficiency measures, CIR is at the lowest in UAE indicating the highest efficiency level, while it is at the highest in German indicating the lowest efficiency level. For revenue diversification measure, RDI is at the highest in Guatemala indicating the lowest level of revenue diversification, while it is at the lowest in the U.S. indicating the highest level of revenue diversification. For portfolio risk measure, NPL ratio is at the highest level in Egypt, while it is at the lowest in Luxembourg.

Table 3.4 presents the overall descriptive statistics of all variables across time and across countries. For group A, the mean of CI3 and CI5 are at 0.69 and 0.83 respectively, and they are quite close to their median. For group B, the mean of LI is at 0.24 and in the range of -0.62 to 0.84, which means that on average a banking industry can do the pricing 24% higher than their marginal cost. It can also be interpreted that the market structure in this sample is under monopolistic competition. For economic growth measure in group C, the sample mean of GDPG is at 4.15%, and it varies between -14.80 to 34.50. For bank-specific variables in group D, the sample mean of CIR is at 0.57. This can be interpreted that on average, banks spend 57% of their revenue to the expense. For revenue diversification measure, the mean of RDI is at 0.59 and in the range between 0.38 (much diversified revenue) to 1.00 (perfect concentrated revenue).

Table 3.3: Average Measures by Country during the Period 2000 to 2013

Country Name	Country Code	Average Measures by Country during the Period 2000 to 2013						
		Structural Competition		Non-Structural Competition	Economic Growth Measure	Efficiency Measure	Diversification Measure	Portfolio Risk Measure
		CI3	CI5	LI	GDPG	CIR	RDI	NPL
UAE	AE	0.6269	0.8187	0.4517	0.0478	0.3102	0.5285	0.0878
Angola	AO	0.8858	0.9620	0.4386	0.0811	0.4448	0.5165	0.0000
Argentina	AR	0.4959	0.6772	0.1489	0.0312	0.6429	0.5580	0.0717
Austria	AT	0.8191	0.8774	0.2011	0.0161	0.6235	0.6377	0.0243
Australia	AU	0.7441	0.9499	0.1171	0.0306	0.4960	0.6256	0.0104
Azerbaijan	AZ	0.7736	0.8504	0.3295	0.1229	0.5840	0.5588	0.0174
Bosna	BA	0.6109	0.7625	0.1580	0.0364	0.6484	0.5574	0.0903
Bangladesh	BD	0.5543	0.7140	0.3287	0.0572	0.4732	0.4752	0.1130
Belgium	BE	0.7638	0.9236	0.1411	0.0155	0.6437	0.6935	0.0269
Bulgaria	BG	0.7054	0.8714	0.2409	0.0380	0.5372	0.5419	0.0744
Bahrain	BH	0.8418	0.9720	0.3805	0.0501	0.3576	0.5422	0.0197
Brasil	BR	0.6408	0.7743	0.2235	0.0359	0.6104	0.7829	0.0397
Belarus	BY	0.8554	0.9392	0.2849	0.0633	0.6558	0.4855	0.0518
Canada	CA	0.8328	0.9541	0.2277	0.0221	0.5847	0.7473	0.0093
Switzerland	CH	0.9512	0.9659	0.1184	0.0196	0.7671	0.6342	0.0120
Chile	CL	0.4665	0.7202	0.2813	0.0417	0.5174	0.5867	0.0168
China	CN	0.6456	0.8094	0.3338	0.0990	0.4434	0.7336	0.1013
Colombia	CO	0.7239	0.8595	0.2970	0.0435	0.6121	0.5291	0.0479
CostaRica	CR	0.7174	0.8595	0.1987	0.0420	0.6920	0.6547	0.0196
Czech	CZ	0.7790	0.8829	0.2327	0.0265	0.5277	0.5733	0.0702
German	DE	0.8295	0.9008	0.0664	0.0119	0.7780	0.6498	0.0376
Denmark	DK	0.7616	0.8644	0.2503	0.0084	0.6086	0.5824	0.0197
Dominican	DO	0.8278	0.9219	0.2181	0.0467	0.7243	0.6958	0.0422
Ecuador	EC	0.7211	0.8453	0.1989	0.0432	0.7223	0.5755	0.0728
Egypt	EG	0.6528	0.7788	0.0927	0.0429	0.4703	0.5657	0.1674
Spain	ES	0.8589	0.9438	0.2869	0.0160	0.5346	0.6177	0.0301
France	FR	0.5013	0.6423	0.1386	0.0135	0.6705	0.5810	0.0400
England	GB	0.5967	0.7604	0.2030	0.0181	0.5901	0.5996	0.0248
Georgia	GE	0.7074	0.8859	0.3023	0.0587	0.5431	0.5499	0.0406
Ghana	GH	0.7658	0.8536	0.3244	0.0659	0.5223	0.4642	0.1406
Guatemala	GT	0.7305	0.8492	0.0000	0.0342	0.6966	0.8061	0.0336
Hong Kong	HK	0.7001	0.8145	0.4861	0.0418	0.5045	0.5718	0.0241
Honduras	HN	0.6371	0.8275	0.1949	0.0415	0.6080	0.6819	0.0286
Croatia	HR	0.6883	0.8552	0.2724	0.0183	0.5578	0.5256	0.0891
Hungary	HU	0.6201	0.8143	0.1797	0.0192	0.6214	0.4964	0.0634
Indonesia	ID	0.5118	0.6642	0.2601	0.0536	0.5099	0.6924	0.0956
India	IN	0.4073	0.5060	0.2440	0.0692	0.4969	0.5358	0.0565
Italy	IT	0.8237	0.8712	0.0843	0.0022	0.6489	0.5667	0.0854
Jordan	JO	0.8858	0.9481	0.3221	0.0540	0.4811	0.5292	0.0985
Japan	JP	0.4897	0.5930	0.3617	0.0092	0.5764	0.7501	0.0346
Kenya	KE	0.5690	0.7190	0.3319	0.0432	0.5639	0.5632	0.1131
South Korea	KR	0.5155	0.7536	0.3188	0.0443	0.4575	0.6641	0.0181
Kazakhstan	KZ	0.6405	0.7921	0.2788	0.0791	0.5035	0.5461	0.0761
Lebanon	LB	0.5294	0.7396	0.1600	0.0469	0.5507	0.5848	0.0838
Sri Lanka	LK	0.6806	0.8151	0.2080	0.0564	0.6375	0.5686	0.0093
Luxembourg	LU	0.5503	0.7010	0.1831	0.0302	0.4256	0.6165	0.0036
Latvia	LV	0.6673	0.8364	0.2434	0.0427	0.5464	0.4840	0.0539
Mauritius	MU	0.6800	0.8563	0.2941	0.0408	0.4478	0.6094	0.0173
Mexico	MX	0.6155	0.8095	0.0000	0.0235	0.6292	0.6038	0.0296
Malaysia	MY	0.6975	0.8039	0.2967	0.0506	0.3784	0.5639	0.0839
Nigeria	NG	0.7337	0.8303	0.1826	0.0798	0.5751	0.4793	0.1437
Netherlands	NL	0.9240	0.9716	0.1765	0.0126	0.6421	0.5822	0.0191
Norway	NO	0.9756	0.9889	0.2769	0.0169	0.5308	0.7612	0.0121
Nepal	NP	0.4613	0.6323	0.2935	0.0413	0.4537	0.5612	0.0000
New Zealand	NZ	0.6803	0.9375	0.1652	0.0252	0.6147	0.5956	0.0065
Panama	PA	0.6061	0.7344	0.3654	0.0657	0.5368	0.6479	0.0226
Peru	PE	0.7968	0.9197	0.3758	0.0551	0.5501	0.6536	0.0511
Philippines	PH	0.5129	0.6791	0.2005	0.0497	0.6036	0.4819	0.0991
Poland	PL	0.6323	0.7640	0.2333	0.0362	0.6181	0.5260	0.0880
Portugal	PT	0.9346	0.9724	0.1907	0.0031	0.5608	0.5850	0.0406
Paraguay	PY	0.6299	0.8381	0.1190	0.0359	0.7254	0.6325	0.0632
Romania	RO	0.7735	0.8916	0.1823	0.0371	0.5752	0.5131	0.0708
Serbia	RS	0.5476	0.6933	0.1727	0.0396	0.6756	0.6062	0.1287
Russia	RU	0.4384	0.5271	0.1692	0.0488	0.7074	0.6059	0.0539
Sweden	SE	0.8976	0.9397	0.2863	0.0213	0.6282	0.5751	0.0095
Slovenia	SI	0.6435	0.7802	0.2187	0.0202	0.5705	0.5394	0.0558
El Salvador	SV	0.8227	0.9707	0.3107	0.0194	0.5319	0.7592	0.0271
Thailand	TH	0.5507	0.7852	0.3142	0.0438	0.5381	0.5735	0.0847
Turkey	TR	0.6256	0.7931	0.4041	0.0442	0.4499	0.6376	0.0723
Tanzania	TZ	0.6462	0.7947	0.2694	0.0655	0.5479	0.5032	0.0176
Ukraine	UA	0.7934	0.9327	0.1670	0.0406	0.5903	0.5078	0.1604
United States	US	0.3922	0.4852	0.2762	0.0186	0.5868	0.0154	0.0219
Uruguay	UY	0.6345	0.8411	0.1471	0.0307	0.7198	0.5973	0.0621
Uzbekistan	UZ	0.9194	0.9758	0.2736	0.0702	0.6498	0.5066	0.0090
Venezuela	VE	0.4670	0.6760	0.2831	0.0353	0.5941	0.6392	0.0343
Vietnam	VN	0.6812	0.7691	0.2181	0.0641	0.4377	0.7025	0.0088
South Africa	ZA	0.8446	0.9946	0.1826	0.0333	0.5711	0.5396	0.0303
Armenia	AM	0.6382	0.7998	0.3205	0.0744	0.5527	0.5404	0.0467
Moldavia	MD	0.7594	0.8974	0.3077	0.0495	0.5259	0.4435	0.0907
Uganda	UG	0.6962	0.8646	0.1624	0.0674	0.5391	0.6317	0.0418
Zambia	ZM	0.6310	0.8649	0.1975	0.0691	0.6479	0.5508	0.0288

Table 3.4: Descriptive Statistics

Variable	Observation	Mean	Median	Max	Min	Stdev	Skewness	Kurtosis
Group A: Structural Competition Measures								
CI3	1,044	0.6921	0.6827	1.0000	0.2475	0.1751	0.0540	2.2076
CI5	1,044	0.8283	0.8459	1.0000	0.3681	0.1369	-0.7566	3.1507
Group B: Non-Structural Competition Measure								
LI	1,134	0.2392	0.2427	0.8351	-0.6232	0.1326	-0.5437	6.4776
Group C: Economic Growth Measure								
GDPG	1,134	0.0415	0.0403	0.3450	-0.1480	0.0406	0.6950	11.0044
Group D: Bank-Specific Control Variables								
CIR	1,134	0.5707	0.5682	2.1809	0.0325	0.1328	1.5815	22.4192
RDI	1,042	0.5922	0.5808	1.0000	0.3830	0.0986	0.5827	3.3989
NPL	1,134	0.0521	0.0300	0.3730	0.0041	0.0623	2.0874	7.7924
LNTA	1,134	1,112	178	74,021	0	7537	9	80
BAPA	1,134	186	0	3,368	0	430	3	19
Group E: Control Variables to Construct Dummy Variables								
FBFW	868	35.8823	36.2000	72.4000	4.3000	14.4937	0.2110	2.8929
FBFI	868	32.9403	34.3000	74.4000	2.7000	14.4347	0.1713	2.8164
CPSR	1,134	62.0387	44.4550	219.2800	12.8092	49.2295	0.9666	3.0816
LNZI	1,114	2.1755	2.2558	3.7075	-1.3310	0.7645	-0.5715	3.2057
ROA	1,134	0.0124	0.0114	0.0809	-0.0670	0.0134	-0.0816	8.9891

For control variables to construct dummy variables in group E, the mean of FBFW is at 35.9. The minimum and maximum are 4.3 are 72.4 respectively. This means that on average, firms can access to short-term funding via banking industry by 35.9%, and this accessibility varies from 4.3% to 72.4%. This descriptive statistic of FBFW is quite in line with that of FBFI in which the mean value is around 32.9. The minimum and maximum are 2.7 and 74.4 respectively. The statistics from these two variables can imply that on average, the accessibility to short-term funding is slightly higher than that to long-term one. The mean of CPSR, the percentage of credit offered by financial sector to private sector to GDP, is at 62.0, and it is in the range between 0.0 and 219.3. Lastly, the sample mean of ROA is at 0.01, which can be interpreted that on average the bank's asset can generate profits by approximately 1%.

3.3.2 Preliminary Investigation

3.3.2.1 Correlation Matrix

Table 3.5 presents the correlation matrix between each individual series. As expected, the correlation between both market concentration measures, CI3 and CI5, is extremely high at 94%. This is simply due to the fact that CI3 is the concentration index

of the three-largest banks in a country, while CI5 is that of the five-largest banks. The second highest correlation is between LI and efficiency measure, CIR. The correlation between them is at 45%. Also, the correlation between structural competition measures or market concentration and non-structural competition measures or market pricing power shows almost no relationship as the correlation is only -4%. Lastly, the control variables to construct dummy variables, specifically FBFW, FBFI, CPSR, LNZI and ROA, have only small correlation with other variables. However, the correlation of FBFW and FBFI is as high as 73%. This is expected because both series are the percentage of firms using funding from bank but the objective of the first one is for investment (long-term funding), while that of the second one is for working capital (short-term funding).

Table 3.5: Correlation Matrix

	CI3	CI5	LI	GDPG	CIR	RDI	NPL	LNTA	BAPA	FBFW	FBFI	CPSR	LNZI	ROA
CI3	1.00	0.94	-0.03	0.08	0.07	-0.03	0.02	-0.40	-0.16	-0.05	-0.08	-0.04	0.07	0.05
CI5		1.00	-0.03	0.05	0.06	-0.04	0.01	-0.46	-0.11	0.01	-0.05	-0.03	0.04	0.05
LI			1.00	0.22	-0.48	-0.22	-0.21	-0.04	0.12	0.08	0.09	0.01	0.06	0.41
GDPG				1.00	-0.14	-0.12	-0.17	-0.03	-0.06	-0.17	-0.16	-0.23	-0.03	0.33
CIR					1.00	0.10	0.13	-0.05	-0.06	0.04	0.01	-0.22	-0.05	-0.25
RDI						1.00	-0.09	0.29	-0.14	0.13	-0.10	0.15	0.26	-0.17
NPL							1.00	-0.07	-0.01	-0.01	0.11	-0.01	-0.12	-0.26
LNTA								1.00	-0.01	0.00	0.02	0.31	0.14	-0.17
BAPA									1.00	0.07	0.12	0.04	-0.13	-0.05
FBFW										1.00	0.74	0.19	0.07	-0.08
FBFI											1.00	0.25	0.01	-0.12
CPSR												1.00	0.21	-0.34
LNZI													1.00	0.11
ROA														1.00

Table presents correlation matrix between individual data series. CI3 and CI5 are the concentration index of the three- and five-largest banks in a country. LI is the Lerner Index. GDPG is the GDP Growth Rate. CIR is the Cost to Income Ratio. RDI is the Revenue Diversification Index. NPL is the Non-Performing Loan Ratio. LNTA is the logarithmic form of Total Asset. BAPA is the percentage of population having bank accounts per 1,000 adults. FBFW is the proportion of firms using banks to finance working capital. FBFI is the proportion of firms using banks to finance investment. CPSR is the ratio of credit offered by financial sector to private sector over GDP. LNZI is the logarithmic form of Z-score index. ROA is the Return on Assets.

3.3.2.2 Panel Unit Root Tests

Stationarity is one of the important characteristics of time-series and panel data. The standard estimation methodologies and related statistical inference require the data to be stationary. Therefore, in order to ensure that the data used in the analysis is free from unit root problem, four panel unit root tests, namely Levin, Lin and Chu test, Im, Pesaran and Shin test, ADF-Fisher test and PP-Fisher test, are conducted. The results

are presented in Table 3.6. From the table, it shows that by using Levin, Lin and Chu's common unit root test, all of the data series are integrated of order zero, except LNTA. Also, by using individual unit root tests, most of the data series, except LNTA and BAPA, are still free from unit root at level. For those series that have unit root at level, they all become integrated of order one (not presented in the table).

Table 3.6: Panel Unit Root Tests

	Levin, Lin and Chu t-stat	Im, Pesaran and Shin W-stat	ADF-Fisher Chi-square	PP-Fisher Chi-square	Levin, Lin and Chu t-stat (prob.)	Im, Pesaran and Shin W-stat (prob.)	ADF-Fisher Chi-square (prob.)	PP-Fisher Chi-square (prob.)
CI3	-2.91	-8.42	329.45	647.40	0.00	0.00	0.00	0.00
CI5	-6.72	-7.99	321.33	693.93	0.00	0.00	0.00	0.00
LI	-10.94	-5.73	280.16	333.82	0.00	0.00	0.00	0.00
GDPG	-12.37	-7.12	298.12	447.97	0.00	0.00	0.00	0.00
CIR	-9.28	-5.21	274.29	332.27	0.00	0.00	0.00	0.00
RDI	-7.50	-4.46	236.78	322.00	0.00	0.00	0.00	0.00
NPL	-13.48	-5.44	305.08	325.80	0.00	0.00	0.00	0.00
LNTA	-6.86	4.17	90.70	127.46	0.00	1.00	1.00	0.98
BAPA	0.73	3.96	29.71	24.40	0.77	1.00	1.00	1.00

Table presents the panel unit root tests for each series using four methodologies: Levin, Lin and Chu t-stat test, Im, Pesaran and Shin W-stat test, ADF-Fisher Chi-square test and PP-Fisher Chi-square test. Null hypothesis indicates the series has unit root at level.

3.3.3 Main Results

3.3.3.1 Standard Models

Table 3.7 presents the summary of fixed effect panel regression results from standard models with economic growth as a dependent variable and various competition measures as an independent variable together with other bank-specific control variables. Model P11 uses LI as a competition representative, and its coefficient is statistically different from zero and positive. This can be interpreted that higher economic growth is associated with higher market pricing power or lower contestability in the banking market. The finding from this empirical result is, therefore, supports the view of more-competition-less-growth. In other words, when banks have more market pricing power (less market competition), they have more incentive to lend more money to firms because they know that they can generate more profits from these clients.

Table 3.7: Regression Results from Standard Models

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables

Model	**P11**	**P12**	**P13**	**P14**	**P15**
Market Power	**LI**			**LI**	**LI**
Concentration		**CI3**	**CI5**	**CI3**	**CI5**
			Co-efficient		
C	0.0785***	0.1168***	0.1243***	0.0855***	0.0926***
	(0.0105)	(0.0095)	(0.0111)	(0.0113)	(0.0128)
LI	0.0483***			0.0486***	0.0482***
	(0.0098)			(0.0098)	(0.0098)
CI3		-0.0102		-0.0109	
		(0.0069)		(0.0068)	
CI5			-0.0168**		-0.0166**
			(0.0086)		(0.0085)
CIR	-0.0232**	-0.0450***	-0.0455***	-0.0221**	-0.0229**
	(0.0102)	(0.0092)	(0.0091)	(0.0102)	(0.0101)
RDI	-0.0563***	-0.0667***	-0.0672***	-0.0564***	-0.0570***
	(0.0116)	(0.0115)	(0.0115)	(0.0116)	(0.0116)
NPL	-0.0301	-0.0542***	-0.0545***	-0.0327*	-0.0330*
	(0.0196)	(0.0194)	(0.0194)	(0.0197)	(0.0196)
LNTA	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
R-squared	0.29	0.27	0.27	0.29	0.29
Adj. R-squared	0.27	0.26	0.26	0.27	0.27
F-stat	21.49	19.92	20.03	20.58	20.66
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	-3.86	-3.83	-3.83	-3.86	-3.86
SIC	-3.76	-3.74	-3.74	-3.76	-3.76

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). The dependent variable for model P11 to P15 is GDPG. The main independent variable for model P11 is LI (Lerner index, which measures the degree of market pricing power or non-structural competition approach). The main independent variable for model P12 is CI3 (concentration index of three-largest banks in a country, which measures market concentration or structural competition approach). The main independent variable for model P13 is CI5 (concentration index of five-largest banks in a country, which measures market concentration or structural competition approach). The main independent variables for model P14 are LI and CI3. The main independent variables for model P15 are LI and CI5. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

As a result, when firms receive funding from banks, they can deliver more goods and services. This will later foster economic growth as a whole. Besides competition measure, other independent variables, namely CIR and RDI, also statistically different

in model P11. Negative coefficient of CIR can be intuitively interpreted that when the banking industry becomes more efficient, it will be associated with higher economic growth. This can be explained by the fact that when banks are more efficient, it implies that they serve their clients better given certain costs. Likewise, negative coefficient of RDI can be interpreted that when banks diversify their sources of revenue, it usually associated with higher economic growth.

Model P12 and P13 use CI3 and CI5 as a competition representative, respectively. The results, however, are inconclusive. Disappointedly, the coefficient of CI3 is not statistically different from zero even though that of CI5 is negative and statistically different from zero. Negative coefficient of CI5 implies that when banking industry is more concentrated (less market competition), it is associated with lower economic growth. Hence, it supports the view of more-competition-more-growth. In other words, when there are many banks in the industry, they need to compete with each other to provide more loan to firms. Therefore, it is more convenient for firms to get funding and expand their businesses.

Another striking finding from model P11 to P13 is that the results from non-structural competition measure (LI) and structural competition measures (CI3 and CI5) are opposite. When using market pricing power (LI), the result supports more-competition-less-growth hypothesis. On the contrary, when using market concentration (CI3 and CI5), the result supports more-competition-more-growth hypothesis. The opposite result of non-structural and structural competition measures can be partially explained by the fact that these measures represent competition in two different angles. On one side, the structural approach or market concentration, considers solely the concentration of the market. On the other side, the non-structural approach or market pricing power, considers the pricing power of banks in the market. Therefore, it is possible that when the market becomes more concentrated, the pricing power does not necessarily increase. Therefore, it is possible that the effect from increasing market pricing power and increasing market concentration can be in the opposite direction.

In order to confirm the above findings, model P14 and P15 include both market pricing power and market concentration in one single model. Model P14 uses CI3 as market concentration measure, while model P15 uses CI5 as market concentration measure. The results are the same as those from model P11 to P13.

3.3.3.2 Standard Models with Dummy Variable

Table 3.8 and 3.9 explore another level of competition-growth nexus by investigating whether the relationship between competition and economic growth in different market characteristic is different or not. Dummy variables are constructed to separate different market characteristic in four different dimensions, which are (1) accessibility, (2) size of credit offered by financial sector to private sector, (3) stability and (4) efficiency.

The result of the first dimension is presented in model D11-12 and D21-22. In model D11 and D21, the short-term accessibility is studied by the variable FBFWH. The coefficient of the main independent variables, such as LI, CI, CIR, RDI, NPL and LNTA, are still the same as in the simple model. The new finding from these standard models with dummy variable is that the coefficient of the dummy variable FBFWH is negative and statistically different from zero. This can be interpreted that the relationship between competition and economic growth is stronger in countries with lower accessibility to short-term funding. Likewise, the coefficient of dummy variable FBFIH is negative and statistically different from zero. This can be interpreted that the relationship between competition and economic growth is stronger in countries with lower accessibility to long-term funding.

The result of the second dimension is presented in model D13 and D23. In model D13 and D23, the size of credit offered by financial sector to private sector is studied by the variable CPSRH. The coefficient of the main independent variables, such as LI, CI, CIR, RDI, NPL and LNTA, are still the same as in the simple model.

Table 3.8: Regression Results from Standard Models with Dummy and CI3

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Dummy Variable

Model	**D11**	**D12**	**D13**	**D14**	**D15**
Market Power	**LI**	**LI**	**LI**	**LI**	**LI**
Concentration	**CI3**	**CI3**	**CI3**	**CI3**	**CI3**
Dummy	**FBFWH**	**FBFIH**	**CPSRH**	**LNZIH**	**ROAH**
			Co-efficient		
C	0.0847***	0.0898***	0.0810***	0.0855***	0.0747***
	0.0111	0.0110	0.0111	0.0114	0.0111
LI	0.0487***	0.0492***	0.0481***	0.0486***	0.0317***
	0.0096	0.0095	0.0096	0.0099	0.0098
CI3	-0.0058	-0.0078	-0.0034	-0.0109	-0.0090
	0.0066	0.0066	0.0067	0.0068	0.0066
CIR	-0.0251***	-0.0276***	-0.0251***	-0.0220**	-0.0187*
	0.0099	0.0098	0.0100	0.0103	0.0099
RDI	-0.0449***	-0.0474***	-0.0455***	-0.0565***	-0.0463***
	0.0114	0.0112	0.0114	0.0118	0.0113
NPL	-0.0500***	-0.0478***	-0.0481***	-0.0327*	-0.0239
	0.0193	0.0191	0.0193	0.0197	0.0192
LNTA	-0.0000**	-0.0000**	-0.0000*	-0.0000***	-0.0000***
	0.0000	0.0000	0.0000	0.0000	0.0000
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000
	0.0000	0.0000	0.0000	0.0000	0.0000
D	-0.0162***	-0.0188***	-0.0189***	0.0001	0.0197***
	0.0022	0.0022	0.0027	0.0026	0.0025
R-squared	0.32	0.34	0.32	0.29	0.33
Adj. R-squared	0.31	0.32	0.31	0.27	0.31
F-stat	23.19	24.60	22.82	19.58	23.57
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00
AIC	-3.91	-3.93	-3.90	-3.85	-3.91
SIC	-3.80	-3.82	-3.80	-3.75	-3.81

Table presents the fixed effect panel regression results of economic growth (GDPG) using a combination of competition measures (LI and CI3). The dependent variable for model D11 to D15 is GDPG. The main independent variable of market pricing power for model D11 to D15 is LI (Lerner index). The main independent variable of market concentration for model D11 to D15 is CI3 (concentration index of three-largest banks). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Dummy variable for model D11 is FBFWH (top 25% of countries with high percentage of firms using bank to finance working capital). Dummy variable for model D12 is FBFIH (top 25% of countries with high percentage of firms using bank to finance investment). Dummy variable for model D13 is CPSRH (top 25% of countries with high ratio of credit offered by financial sector to private sector to GDP). Dummy variable for model D14 is LNZIH (top 25% of countries with high logarithmic form of Z-score index). Dummy variable for model D15 is ROAH (top 25% of countries with high return on asset). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 3.9: Regression Results from Standard Models with Dummy and CI5

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Dummy Variable

Model	**D21**	**D22**	**D23**	**D24**	**D25**
Market Power	**LI**	**LI**	**LI**	**LI**	**LI**
Concentration	**CI5**	**CI5**	**CI5**	**CI5**	**CI5**
Dummy	**FBFWH**	**FBFIH**	**CPSRH**	**LNZIH**	**ROAH**
			Co-efficient		
C	0.0891***	0.0973***	0.0862***	0.0926***	0.0825***
	(0.0124)	(0.0123)	(0.0125)	(0.0128)	(0.0125)
LI	0.0485***	0.0489***	0.0480***	0.0483***	0.0312***
	(0.0096)	(0.0095)	(0.0096)	(0.0099)	(0.0098)
CI5	-0.0096*	-0.0147*	-0.0086	-0.0166**	-0.0160**
	(0.0084)	(0.0082)	(0.0084)	(0.0086)	(0.0083)
CIR	-0.0256***	-0.0282***	-0.0252***	-0.0227***	-0.0193**
	(0.0099)	(0.0098)	(0.0099)	(0.0103)	(0.0099)
RDI	-0.0453***	-0.0479***	-0.0460***	-0.0573***	-0.0469***
	(0.0114)	(0.0112)	(0.0114)	(0.0118)	(0.0113)
NPL	-0.0502***	-0.0486***	-0.0487***	-0.0330*	-0.0245
	(0.0193)	(0.0190)	(0.0193)	(0.0197)	(0.0191)
LNTA	-0.0000**	-0.0000**	-0.0000*	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D	-0.0161***	-0.0188***	-0.0187***	0.0003	0.0197***
	(0.0022)	(0.0022)	(0.0027)	(0.0026)	(0.0025)
R-squared	0.3236	0.3373	0.3202	0.2881	0.3279
Adj. R-squared	0.3096	0.3237	0.3062	0.2734	0.3141
F-stat	23.2323	24.7222	22.8757	19.6549	23.6987
F-stat (prob.)	0.0000	0.0000	0.0000	0.0000	0.0000
AIC	-3.9070	-3.9275	-3.9020	-3.8559	-3.9135
SIC	-3.8025	-3.8231	-3.7975	-3.7514	-3.8090

Table presents the fixed effect panel regression results of economic growth (GDPG) using a combination of competition measures (LI and CI5). The dependent variable for model D21 to D25 is GDPG. The main independent variable of market pricing power for model D21 to D25 is LI (Lerner index). The main independent variable of market concentration for model D21 to D25 is CI5 (concentration index of five-largest banks). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Dummy variable for model D21 is FBFWH (top 25% of countries with high percentage of firms using bank to finance working capital). Dummy variable for model D22 is FBFIH (top 25% of countries with high percentage of firms using bank to finance investment). Dummy variable for model D23 is CPSRH (top 25% of countries with high ratio of credit offered by financial sector to private sector to GDP). Dummy variable for model D24 is LNZIH (top 25% of countries with high logarithmic form of Z-score index). Dummy variable for model D25 is ROAH (top 25% of countries with high return on asset). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

The new finding from these standard models with dummy variable is that the coefficient of the dummy variable CPSRH is negative and statistically different from zero. This can be interpreted that the relationship between competition and economic growth is stronger in countries with smaller size of credit offered by financial sector to private sector.

The result of the third dimension is presented in model D14 and D24. In model D14 and D24, the stability of financial sector is studied by the variable LNZIH. The coefficient of the main independent variables, such as LI, CI, CIR, RDI, NPL and LNTA, are still the same as in the simple model even though the coefficient of dummy variable LNZIH is not statistically different from zero. So, it can be concluded that the relationship between competition and economic growth is the same across countries with different stability levels.

The result of the last dimension is presented in model D15 and D25. In model D15 and D25, the efficiency of financial sector is studied by the variable ROAH. The coefficient of the main independent variables, such as LI, CI, CIR, RDI, NPL and LNTA, are still the same as in the simple model. The new finding from these standard models with dummy variable is that the coefficient of the dummy variable ROAH is positive and statistically different from zero. This can be intuitively interpreted that the relationship between competition and economic growth is stronger in countries with more efficient financial market.

Based on the above findings, it can be concluded that the relationship between competition and economic growth differ in different market characteristics. Therefore, the policy makers of each country need to take these facts into consideration before developing the policy as well.

3.3.3.3 Interacted Models with Dummy Variables

Table 3.10 to 3.14 investigate whether there exists any change in the relationship between bank competition and economic growth after incorporating the interaction terms from different dummy variables, which reflect different market characteristics. As tested in section 3.3.3.2, there are four different dimensions to be investigated, which are (1) accessibility, (2) size of credit offered by financial sector to

private sector, (3) stability and (4) efficiency. After specifying the dummy variables, the interaction term between dummy variable and competition measures, specifically market pricing power and market concentration, are added into the model.

The result of the first dimension, which is the short-term accessibility, is presented in Table 3.10. In the table, there are seven main models. The simplest models are model I11 to I13, which contain one competition measure and one interaction term per one model. In model I14 to I17, both structural and non-structural measures of competition are included in one model. Then, the interaction term between competition measure and dummy variable is added into the model. The regression results, however, show that all of the interaction terms are insignificantly different from zero for every model. Hence, the interpretation from section 3.3.3.2 can be used for this dimension.

The result of the second dimension, which is the long-term accessibility, is presented in Table 3.11. The structure of the table is the same as previous dimension, in which there are seven main models shown in the table. The simplest models are model I21 to I23, which contain one competition measure and one interaction term per one model. In model I24 to I27, both structural and non-structural measures of competition are included in one model. Then, the interaction term between competition measure and dummy variable is added into the model. Similar to the previous dimension, the regression results show that all of the interaction terms are insignificantly different from zero for every model. Hence, the interpretation from section 3.3.3.2 can also be used for this dimension.

The result of the third, fourth and fifth dimension, which is the size of credit offered to private sector, stability and efficiency, is presented in Table 3.12, 3.13 and 3.14 respectively. The structure of the table is the same as previous two dimensions, in which there are seven main models shown in the table. The simplest models are model I31 to I33, I41 to I43 and I51 to I53 in which one competition measure and one interaction term are contained in the model. In model I34 to I37, I44 to I47 and I54 and I57, both structural and non-structural measures of competition are included in one model. Then, the interaction term between competition measure and dummy variable is added into the model.

Table 3.10: Regression Results from Interacted Models with FBFWH Dummy

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Dummy Variable + Interaction Term

Model	I11	I12	I13	I14	I15	I16	I17
Market Power	LI			LI	LI	LI	LI
Concentration		CI3	CI5	CI3	CI5	CI3	CI5
Dummy	FBFWH	FBFWH	FBFWH	FBFWH	FBFWH	FBFWH	FBFWH
				Co-efficient			
C	0.0815***	0.1168***	0.1282***	0.0854***	0.0963***	0.0852***	0.0898***
	(0.0102)	(0.0102)	(0.0121)	(0.0118)	(0.0135)	(0.0111)	(0.0125)
LI	0.0452***			0.0487***	0.0485***	0.0453***	0.0450***
	(0.0108)			(0.0096)	(0.0096)	(0.0108)	(0.0108)
CI3		-0.0060		-0.0066		-0.0058	
		(0.0085)		(0.0084)		(0.0066)	
CI5			-0.0183*		-0.0180*		-0.0097
			(0.0106)		(0.0105)		(0.0084)
CIR	-0.0248***	-0.0482***	-0.0490***	-0.0253***	-0.0262***	-0.0241**	-0.0245***
	(0.0100)	(0.0090)	(0.0089)	(0.0100)	(0.0099)	(0.0100)	(0.0100)
RDI	-0.0450***	-0.0553***	-0.0556***	-0.0450***	-0.0453***	-0.0452***	-0.0457***
	(0.0114)	(0.0114)	(0.0113)	(0.0114)	(0.0114)	(0.0114)	(0.0114)
NPL	-0.0498***	-0.0712***	-0.0707***	-0.0497***	-0.0491***	-0.0510***	-0.0512***
	(0.0193)	(0.0191)	(0.0191)	(0.0194)	(0.0193)	(0.0194)	(0.0194)
LNTA	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D	-0.0193***	-0.0178**	-0.0342***	-0.0176**	-0.0342***	-0.0000***	-0.0000***
	(0.0047)	(0.0091)	(0.0137)	(0.0089)	(0.0136)	(0.0047)	(0.0047)
D*Market Power	0.0119					0.0120	0.0123
	(0.0175)					(0.0175)	(0.0175)
D*Concentration		0.0022	0.0217	0.0020	0.0218		
		(0.0126)	(0.0163)	(0.0125)	(0.0161)		
R-squared	0.32	0.31	0.31	0.32	0.32	0.32	0.32
Adj. R-squared	0.31	0.29	0.29	0.31	0.31	0.31	0.31
F-stat	23.17	21.42	21.60	22.12	22.28	22.15	22.19
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-3.91	-3.88	-3.88	-3.90	-3.91	-3.91	-3.91
SIC	-3.80	-3.78	-3.78	-3.80	-3.80	-3.80	-3.80

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). The dependent variable for model I11 to I17 is GDPG. The main independent variable of market pricing power for model I11 to I17 is LI (Lerner index). The main independent variable of market concentration for model I12, I14 and I16 is CI3 (concentration index of three-largest banks). The main independent variable of market concentration for model I13, I15 and I17 is CI5 (concentration index of five-largest banks). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Dummy variable used in model I11 to I17 is FBFWH (top 25% of countries with high percentage of firms using bank to finance working capital). Model I11 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Model I12 and I14 contain the interaction term between dummy variable, FBFWH, and market concentration, CI3. Model I13 and I15 contain the interaction term between dummy variable, FBFWH, and market concentration, CI5. Model I16 and I17 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 3.11: Regression Results from Interacted Models with FBFIH Dummy

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Dummy Variable + Interaction Term

Model	I21	I22	I23	I24	I25	I26	I27
Market Power	LI			LI	LI	LI	LI
Concentration		CI3	CI5	CI3	CI5	CI3	CI5
Dummy	FBFIH	FBFIH	FBFIH	FBFIH	FBFIH	FBFIH	FBFIH
				Co-efficient			
C	0.0858***	0.1187***	0.1316***	0.0881***	0.1004***	0.0906***	0.0982***
	(0.0102)	(0.0104)	(0.0126)	(0.0119)	(0.0139)	(0.0110)	(0.0124)
LI	0.0449***			0.0491***	0.0490***	0.0454***	0.0449***
	(0.0111)			(0.0095)	(0.0095)	(0.0111)	(0.0111)
CI3		-0.0038		-0.0057		-0.0076	
		(0.0088)		(0.0087)		(0.0066)	
CI5			-0.0174		-0.0182*		-0.0147*
			(0.0111)		(0.0110)		(0.0083)
CIR	-0.0274***	-0.0504***	-0.0512***	-0.0274***	-0.0283***	-0.0266***	-0.0271***
	(0.0099)	(0.0089)	(0.0089)	(0.0099)	(0.0098)	(0.0100)	(0.0099)
RDI	-0.0480***	-0.0573***	-0.0585***	-0.0471***	-0.0482***	-0.0481***	-0.0487***
	(0.0113)	(0.0112)	(0.0112)	(0.0112)	(0.0112)	(0.0113)	(0.0113)
NPL	-0.0481***	-0.0696***	-0.0704***	-0.0480***	-0.0487***	-0.0496***	-0.0506***
	(0.0192)	(0.0188)	(0.0188)	(0.0191)	(0.0191)	(0.0193)	(0.0193)
LNTA	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**	-0.0000**
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D	-0.0218***	-0.0138	-0.0231**	-0.0156**	-0.0251**	-0.0000***	-0.0000***
	(0.0046)	(0.0089)	(0.0134)	(0.0088)	(0.0132)	(0.0046)	(0.0046)
D*Market Power	0.0120					0.0112	0.0117
	(0.0170)					(0.0170)	(0.0170)
D*Concentration		-0.0071	0.0053	-0.0046	0.0076		
		(0.0125)	(0.0160)	(0.0124)	(0.0158)		
R-squared	0.34	0.32	0.32	0.34	0.34	0.34	0.34
Adj. R-squared	0.32	0.30	0.31	0.32	0.32	0.32	0.32
F-stat	24.53	22.74	22.87	23.46	23.59	23.48	23.61
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-3.92	-3.90	-3.90	-3.92	-3.93	-3.92	-3.93
SIC	-3.82	-3.80	-3.80	-3.81	-3.82	-3.82	-3.82

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). The dependent variable for model I22 to I27 is GDPG. The main independent variable of market pricing power for model I22 to I27 is LI (Lerner index). The main independent variable of market concentration for model I22, I24 and I26 is CI3 (concentration index of three-largest banks). The main independent variable of market concentration for model I23, I25 and I27 is CI5 (concentration index of five-largest banks). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Dummy variable used in model I22 to I27 is FBFIH (top 25% of countries with high percentage of firms using bank to finance investment). Model I22 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Model I22 and I24 contain the interaction term between dummy variable, FBFWH, and market concentration, CI3. Model I23 and I25 contain the interaction term between dummy variable, FBFWH, and market concentration, CI5. Model I26 and I27 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 3.12: Regression Results from Interacted Models with CPSRH Dummy

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Dummy Variable + Interaction Term

Model	**I31**	**I32**	**I33**	**I34**	**I35**	**I36**	**I37**
Market Power	**LI**			**LI**	**LI**	**LI**	**LI**
Concentration		**CI3**	**CI5**	**CI3**	**CI5**	**CI3**	**CI5**
Dummy	**CPSRH**	**CPSRH**	**CPSRH**	**CPSRH**	**CPSRH**	**CPSRH**	**CPSRH**
				Co-efficient			
C	0.0796***	0.1018***	0.1088***	0.0734***	0.0804***	0.0814***	0.0864***
	(0.0104)	(0.0097)	(0.0115)	(0.0113)	(0.0129)	(0.0112)	(0.0125)
LI	0.0462***			0.0459***	0.0460***	0.0465***	0.04667***
	(0.0104)			(0.0096)	(0.0096)	(0.0104)	(0.0104)
CI3		0.0107		0.0086		-0.0030	
		(0.0078)		(0.0077)		(0.0068)	
CI5			0.0020		0.0000		-0.0082
			(0.0096)		(0.0095)		(0.0085)
CIR	-0.0253***	-0.0420***	-0.0445***	-0.0210**	-0.0235**	-0.0250***	-0.0251***
	(0.0099)	(0.0091)	(0.0090)	(0.0100)	(0.0100)	(0.0100)	(0.0099)
RDI	-0.0459***	-0.0590***	-0.0591***	-0.0491***	-0.0488***	-0.0460***	-0.0463***
	(0.0115)	(0.0113)	(0.0114)	(0.0114)	(0.0115)	(0.0115)	(0.0115)
NPL	-0.0486***	-0.0698***	-0.0695***	-0.0495***	-0.0491***	-0.0490***	-0.0494***
	(0.0194)	(0.0190)	(0.0190)	(0.0193)	(0.0193)	(0.0195)	(0.0195)
LNTA	-0.0000*	-0.0000*	-0.0000*	-0.0000*	-0.0000*	-0.0000*	-0.0000*
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D	-0.0215***	0.0165	0.0208	0.0129	0.0125	-0.0000***	-0.0000***
	(0.0058)	(0.0107)	(0.0167)	(0.0107)	(0.0166)	(0.0059)	(0.0059)
D*Market Power	0.0099					0.0085	0.0071
	(0.0213)					(0.0215)	(0.0215)
D*Concentration		-0.0492***	-0.0466**	-0.0440***	-0.0369*		
		(0.0144)	(0.0194)	(0.0143)	(0.0193)		
R-squared	0.32	0.31	0.31	0.33	0.32	0.32	0.32
Adj. R-squared	0.31	0.30	0.29	0.31	0.31	0.31	0.31
F-stat	22.82	21.91	21.56	22.39	22.06	21.77	21.82
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-3.90	-3.89	-3.89	-3.91	-3.90	-3.90	-3.90
SIC	-3.80	-3.78	-3.78	-3.80	-3.79	-3.79	-3.79

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). The dependent variable for model I33 to I37 is GDPG. The main independent variable of market pricing power for model I33 to I37 is LI (Lerner index). The main independent variable of market concentration for model I32, I34 and I36 is CI3 (concentration index of three-largest banks). The main independent variable of market concentration for model I33, I35 and I37 is CI5 (concentration index of five-largest banks). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Dummy variable used in model I33 to I37 is CPSRH (top 25% of countries with high ratio of credit offered by financial sector to private sector to GDP). Model I33 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Model I32 and I34 contain the interaction term between dummy variable, FBFWH, and market concentration, CI3. Model I33 and I35 contain the interaction term between dummy variable, FBFWH, and market concentration, CI5. Model I36 and I37 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 3.13: Regression Results from Interacted Models with LNZIH Dummy

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Dummy Variable + Interaction Term

Model	**I41**	**I42**	**I43**	**I44**	**I45**	**I46**	**I47**
Market Power	**LI**			**LI**	**LI**	**LI**	**LI**
Concentration		**CI3**	**CI5**	**CI3**	**CI5**	**CI3**	**CI5**
Dummy	**LNZIH**	**LNZIH**	**LNZIH**	**LNZIH**	**LNZIH**	**LNZIH**	**LNZIH**
				Co-efficient			
C	0.0778***	0.1126***	0.1163***	0.0801***	0.0830***	0.0848***	0.0919***
	(0.0106)	(0.0100)	(0.0117)	(0.0119)	(0.0134)	(0.0115)	(0.0129)
LI	0.0508***			0.0494***	0.0494***	0.0513***	0.0507***
	(0.0115)			(0.0099)	(0.0098)	(0.0114)	(0.0114)
CI3		-0.0063		-0.0064		-0.0109	
		(0.0074)		(0.0074)		(0.0068)	
CI5			-0.0096		-0.0088		-0.0166**
			(0.0093)		(0.0092)		(0.0086)
CIR	-0.0233**	-0.0448***	-0.0454***	-0.0208**	-0.0216**	-0.0220**	-0.0227**
	(0.0103)	(0.0093)	(0.0092)	(0.0104)	(0.0103)	(0.0103)	(0.0103)
RDI	-0.0560***	-0.0641***	-0.0637***	-0.0543***	-0.0538***	-0.0563***	-0.0571***
	(0.0118)	(0.0118)	(0.0118)	(0.0119)	(0.0119)	(0.0118)	(0.0118)
NPL	-0.0298	-0.0526***	-0.0523***	-0.0305	-0.0300	-0.0323	-0.0327*
	(0.0197)	(0.0194)	(0.0194)	(0.0197)	(0.0197)	(0.0197)	(0.0197)
LNTA	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D	0.0018	0.0141	0.0379**	0.0178	0.0432**	0.0000	0.0000
	(0.0049)	(0.0116)	(0.0185)	(0.0114)	(0.0183)	(0.0049)	(0.0049)
D*Market Power	-0.0078					-0.0080	-0.0075
	(0.0177)					(0.0177)	(0.0177)
D*Concentration		-0.0214	-0.0460**	-0.0254	-0.0513**		
		(0.0162)	(0.0219)	(0.0160)	(0.0216)		
R-squared	0.29	0.27	0.27	0.29	0.29	0.29	0.29
Adj. R-squared	0.27	0.26	0.26	0.27	0.28	0.27	0.27
F-stat	19.42	18.11	18.38	18.83	19.10	18.68	18.75
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-3.85	-3.83	-3.83	-3.86	-3.86	-3.85	-3.85
SIC	-3.75	-3.73	-3.73	-3.75	-3.75	-3.74	-3.74

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). The dependent variable for model I44 to I47 is GDPG. The main independent variable of market pricing power for model I44 to I47 is LI (Lerner index). The main independent variable of market concentration for model I42, I44 and I46 is CI3 (concentration index of three-largest banks). The main independent variable of market concentration for model I43, I45 and I47 is CI5 (concentration index of five-largest banks). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Dummy variable used in model I44 to I47 is LNZIH (top 25% of countries with high logarithmic form of Z-score index). Model I44 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Model I42 and I44 contain the interaction term between dummy variable, FBFWH, and market concentration, CI3. Model I43 and I45 contain the interaction term between dummy variable, FBFWH, and market concentration, CI5. Model I46 and I47 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 3.14: Regression Results from Interacted Models with ROAH Dummy

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Dummy Variable + Interaction Term

Model	**I51**	**I52**	**I53**	**I54**	**I55**	**I56**	**I57**
Market Power	**LI**			**LI**	**LI**	**LI**	**LI**
Concentration		**CI3**	**CI5**	**CI3**	**CI5**	**CI3**	**CI5**
Dummy	**ROAH**	**ROAH**	**ROAH**	**ROAH**	**ROAH**	**ROAH**	**ROAH**
				Co-efficient			
C	0.0694***	0.0966***	0.1065***	0.0782***	0.0879***	0.0752***	0.0831***
	(0.0103)	(0.0097)	(0.0115)	(0.0112)	(0.0128)	(0.0112)	(0.0125)
LI	0.0290***			0.0316***	0.0308***	0.0294***	0.0288***
	(0.0112)			(0.0098)	(0.0098)	(0.0112)	(0.0112)
CI3		-0.0153**		-0.0159**		-0.0090	
		(0.0074)		(0.0074)		(0.0066)	
CI5			-0.0237***		-0.0233***		-0.0160**
			(0.0093)		(0.0093)		(0.0083)
CIR	-0.0199**	-0.0315***	-0.0323***	-0.0176*	-0.0188*	-0.0189*	-0.0196**
	(0.0099)	(0.0090)	(0.0089)	(0.0099)	(0.0099)	(0.0099)	(0.0099)
RDI	-0.0459***	-0.0505***	-0.0515***	-0.0451***	-0.0462***	-0.0460***	-0.0466***
	(0.0113)	(0.0112)	(0.0112)	(0.0113)	(0.0113)	(0.0113)	(0.0113)
NPL	-0.0225	-0.0383**	-0.0385**	-0.0258	-0.0261	-0.0247	-0.0254
	(0.0192)	(0.0188)	(0.0188)	(0.0191)	(0.0191)	(0.0193)	(0.0192)
LNTA	-0.0000***	-0.0000***	-0.0000**	-0.0000***	-0.0000***	-0.0000***	-0.0000***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
D	0.0175***	0.0021	-0.0051	0.0005	-0.0057	-0.0000***	-0.0000***
	(0.0059)	(0.0098)	(0.0151)	(0.0098)	(0.0150)	(0.0059)	(0.0059)
D*Market Power	0.0081					0.0081	0.0083
	(0.0190)					(0.0190)	(0.0190)
D*Concentration		0.0283**	0.0322*	0.0281**	0.0308*		
		(0.0139)	(0.0180)	(0.0139)	(0.0179)		
R-squared	0.33	0.32	0.32	0.33	0.33	0.33	0.33
Adj. R-squared	0.31	0.31	0.31	0.31	0.32	0.31	0.31
F-stat	23.45	23.13	23.21	22.75	22.80	22.49	22.61
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-3.91	-3.91	-3.91	-3.91	-3.91	-3.91	-3.91
SIC	-3.81	-3.80	-3.80	-3.80	-3.81	-3.80	-3.80

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). The dependent variable for model I51 to I57 is GDPG. The main independent variable of market pricing power for model I11 to I57 is LI (Lerner index). The main independent variable of market concentration for model I52, I54 and I56 is CI3 (concentration index of three-largest banks). The main independent variable of market concentration for model I53, I55 and I57 is CI5 (concentration index of five-largest banks). These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and BAPA (percentage of population having bank accounts per 1,000 adults). Dummy variable used in model I51 to I57 is ROAH (top 25% of countries with high return on asset). Model I51 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Model I52 and I54 contain the interaction term between dummy variable, FBFWH, and market concentration, CI3. Model I53 and I55 contain the interaction term between dummy variable, FBFWH, and market concentration, CI5. Model I56 and I57 contains the interaction term between dummy variable, FBFWH, and market pricing power, LI. Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Contrary to the previous two dimensions, the regression results show that some of the interaction terms are significantly different from zero for some models. Also, the signs of the coefficient of such interaction terms are also the same as the result in section 3.3.3.2. Therefore, it can be confirmed that the results in section 3.3.3.2 are quite robust and sufficient.

In summary, adding the interaction terms into the models that contain significant dummy variable does not increase any explanatory power of the model as a whole. Therefore, the interpretation of the results in section 3.3.3.2 is adequate for the final concluding remarks.

3.3.4 Robustness Checks

3.3.4.1 Augmented Models with Growth Determinants

Even though the standard models in section 3.3.3.1 are good enough to get meaningful interpretable results, one of the main weaknesses is their relatively low R-squared. According to the Table 3.7, the R-squared from five standard models is in the range of 0.27 to 0.29 only. One of possible explanation is that the independent variables are not adequately able to explain the variation of the economic growth. Therefore, this section aims to perform the augmentation to the model by adding three more growth determinants, as previously documented in economic literature, into the standard models.

The first determinant is the inflation rate. Usually, lower and more stable inflation can result in the reduction of economic uncertainty the enhancement of price mechanism efficiency, which eventually can lead to more growth. This factor is represented by Consumer Price Index (denoted as CPI hereafter). The second determinant is the education level of population, which can have a positive effect to the human capital. This factor can be represented by the proportion of school enrollment (denoted as EDU hereafter). The third determinant is research and development. The expenditure on R&D can be considered as one form of investment that can subsequently transfer to technology. There seems to be a consensus among researchers that higher research and development expenditure is normally associated with higher growth, given

other things constant. This factor can be represented by the proportion of R&D expenditure over GDP (denoted as RDEX hereafter). The historical data by countries during the year 2000 to 2013 are obtained from the World Development Indicator, the World Bank.

Table 3.15 presents the regression results from the augmented models with three growth determinants as described earlier. The results confirm the robustness of the competition measures, specifically market pricing power and market concentration. The sign of such measures is similar to that from the standard models as shown in Table 3.7. Therefore, it can be concluded that the interpretation from the standard models is robust.

Nevertheless, it has to be admitted that by adding three more growth determinants, it can indeed improve the explanatory power of the models. The R-squared from the augmented models significantly increase to the range of 0.36 to 0.38, comparing to 0.27 to 0.29 from standard models. The sign of both EDU and RDEX is positive and statistically different from zero, which is in line with previous literature and economic theory. Still, the coefficient of CPI is not statistically different from zero for all of the five augmented models.

Table 3.15: Regression Results from Augmented Models

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Growth Determinants

Model	A11	A12	A13	A14	A15
Market Power	LI			LI	LI
Concentration		CI3	CI5	CI3	CI5
			Co-efficient		
C	0.0789***	0.1118***	0.1224***	0.0816***	0.0918***
	(0.0099)	(0.0091)	(0.0105)	(0.0107)	(0.0119)
LI	0.0485***			0.0486***	0.0484***
	(0.0093)			(0.0093)	(0.0093)
CI3		-0.0037		-0.0043	
		(0.0065)		(0.0064)	
CI5			-0.0155*		-0.0152*
			(0.0081)		(0.0080)
CIR	-0.0121	-0.0345***	-0.0344***	-0.0117	-0.0118
	(0.0096)	(0.0086)	(0.0086)	(0.0096)	(0.0095)
RDI	-0.0397***	-0.0491***	-0.0496***	-0.0398***	-0.0403***
	(0.0110)	(0.0111)	(0.0110)	(0.0111)	(0.0110)
NPL	-0.0483***	-0.0714***	-0.0733***	-0.0492***	-0.0510***
	(0.0185)	(0.0183)	(0.0183)	(0.0186)	(0.0186)
LNTA	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CPI	-0.0080	-0.0015	-0.0017	-0.0078	-0.0080
	(0.0092)	(0.0092)	(0.0092)	(0.0092)	(0.0092)
EDU	0.0178***	0.0170***	0.0171***	0.0178***	0.0178***
	(0.0027)	(0.0027)	(0.0027)	(0.0027)	(0.0027)
RDEX	1.0879***	1.0967***	1.0985***	1.0773***	1.0808***
	(0.1285)	(0.1311)	(0.1300)	(0.1295)	(0.1284)
R-squared	0.3819	0.3653	0.3674	0.3822	0.3841
Adj. R-squared	0.3684	0.3514	0.3536	0.3680	0.3700
F-stat	28.2252	26.2910	26.5310	27.0033	27.2275
F-stat (prob.)	0.0000	0.0000	0.0000	0.0000	0.0000
AIC	-3.9946	-3.9681	-3.9681	-3.9932	-3.9963
SIC	-3.8842	-3.8577	-3.8577	-3.8779	-3.8811

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). The dependent variable for model A11 to A15 is GDPG. The main independent variable for model A11 is LI (Lerner index, which measures the degree of market pricing power or non-structural competition approach). The main independent variable for model A12 is CI3 (concentration index of three-largest banks in a country, which measures market concentration or structural competition approach). The main independent variable for model A13 is CI5 (concentration index of five-largest banks in a country, which measures market concentration or structural competition approach). The main independent variables for model A14 are LI and CI3. The main independent variables for model A15 are LI and CI5. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), BAPA (percentage of population having bank accounts per 1,000 adults) as well as three growth determinants: CPI (consumer price index), EDU (proportion of school enrollment over total population) and RDEX (proportion of R&D expenditure over GDP). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

3.3.4.2 Segmentation Analysis by UN Country Classification

The segmentation analysis performed in this section aims to further investigate the robustness of the key findings in section 3.3.3.1 and 3.3.4.1 in developed and developing countries. Specifically, the segmentation performed in this section is to explore whether the relationship between bank competition and economic growth is the same in developed and developing countries, according to the UN classification in 2014, or not. Therefore, the total 81 samplings are separated based on the classification from the UN into two main groups, which are developed and developing countries. For the group of developed countries, it includes most countries in Europe, such as Switzerland, Germany and England, as well as the U.S., Canada and Australia. For the group of developing countries, it includes the countries mostly in Asia and Africa regions.

Table 3.16 presents the list of countries in each segment based on such classification. After classifying the total samplings into two main groups, the fixed effect panel regressions are performed similar to section 3.3.4.1. In short, model A14 and A15 in section 3.3.4.1 are replicated using the samplings as segmented.

Table 3.17 presents the regression results from segmented sampling using LI as a proxy for market pricing power, CI3 as a proxy for market concentration for the first panel and CI5 as a proxy for market concentration for the second panel. There are three main segmented models in each panel. The first models, S11-ALL and S12-ALL, are the same as model A14 and A15 in section 3.3.4.1 in which all of 81 sampling countries are used. The rest of the models, specifically S11-RH, S11-PR, S12-RH and S12-PR, use the sampling countries as described in Table 3.16.

Table 3.16: Sampling Countries in each Segment (UN Classification)

Status	Developed Countries		Developing Countries	
	Austria	UAE	Hong Kong	Philippines
	Australia	Angola	Honduras	Paraguay
	Belgium	Argentina	Indonesia	Serbia
	Bulgaria	Azerbaijan	India	Russian Federation
	Canada	Bosna	Jordan	El Salvador
	Switzerland	Bangladesh	Kenya	Thailand
	Czech	Bahrain	South Korea	Turkey
	German	Brasil	Kazakhstan	Tanzania
	Denmark	Belarus	Lebanon	Ukraine
	Spain	Chile	Sri Lanka	Uruguay
	France	China	Latvia	Uzbekistan
	England	Colombia	Mauritius	Venezuela
	Croatia	CostaRica	Mexico	Vietnam
	Hungary	Dominican	Malaysia	South Africa
	Italy	Ecuador	Nigeria	Armenia
	Japan	Egypt	Norway	Moldavia
	Luxembourg	Georgia	Nepal	Uganda
	Netherlands	Ghana	Panama	Zambia
	New Zealand	Guatemala	Peru	
	Poland			
	Portugal			
	Romania			
	Sweden			
	Slovenia			
	United States			
Total	**25**		**56**	

According to the empirical results from Table 3.17, the coefficient of both competition measures, market pricing power and market concentration, is the same for both developed and developing countries. These results are also the same as when the total 81 sampling countries are used. Therefore, the results from this segmentation confirm the robustness of the augmented models as illustrated in section 3.3.4.1.

Table 3.17: Results from Segmented Models (UN Classification)

GDP Growth = C + Market Power + Concentration + Bank-Specific Variables + Growth Determinants

Model	S11-ALL	S11-RH	S11-PR	S12-ALL	S12-RH	S12-PR
Market Power	LI	LI	LI	LI	LI	LI
Concentration	CI3	CI3	CI3	CI5	CI5	CI5
C	0.0816***	0.0506***	0.0804***	0.0918***	0.0529***	0.0782***
	(0.0107)	(0.0116)	(0.0150)	(0.0119)	(0.0134)	(0.0172)
LI	0.0486***	0.0151*	0.0260**	0.0484***	0.0149*	0.0277**
	(0.0093)	(0.0132)	(0.0133)	(0.0093)	(0.0133)	(0.0134)
CI3	-0.0043	-0.0125**	-0.0377***			
	(0.0064)	(0.0062)	(0.0103)			
CI5				-0.0152*	-0.0108*	-0.0327***
				(0.0080)	(0.0082)	(0.0132)
CIR	-0.0117	-0.0099	-0.0123	-0.0118	-0.0067	-0.0125
	(0.0096)	(0.0106)	(0.0129)	(0.0095)	(0.0104)	(0.0130)
RDI	-0.0398***	-0.0302**	-0.0844***	-0.0403***	-0.0309**	-0.0827***
	(0.0111)	(0.0127)	(0.0159)	(0.0110)	(0.0128)	(0.0160)
NPL	-0.0492***	-0.0858***	-0.0405*	-0.0510***	-0.0847***	-0.0419*
	(0.0186)	(0.0263)	(0.0241)	(0.0186)	(0.0265)	(0.0243)
LNTA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
BAPA	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
CPI	-0.0078	0.0478*	-0.0166	-0.0080	0.0470*	-0.0147
	(0.0092)	(0.0283)	(0.0107)	(0.0092)	(0.0284)	(0.0107)
EDU	0.0178***	0.0029	0.0162***	0.0178***	0.0026	0.0163***
	(0.0027)	(0.0025)	(0.0042)	(0.0027)	(0.0025)	(0.0042)
RDEX	1.0773***	0.5425***	0.2124	1.0808***	0.5544***	0.1136
	(0.1295)	(0.1228)	(0.3224)	(0.1284)	(0.1247)	(0.3223)
R-squared	0.38	0.65	0.33	0.38	0.65	0.32
Adj. R-squared	0.37	0.62	0.30	0.37	0.62	0.29
F-stat	27.00	24.64	13.17	27.23	24.36	12.70
F-stat (prob.)	0.00	0.00	0.00	0.00	0.00	0.00
AIC	-3.99	-5.27	-3.78	-4.00	-5.27	-3.77
SIC	-3.88	-5.00	-3.61	-3.88	-4.99	-3.60

Table presents the fixed effect panel regression results of economic growth (GDPG) using alternative measures of competition (LI, CI3 and CI5). Model S11-ALL and S12-ALL includes all sampling countries. Model S11-RH and S12-RH includes 25 sampling countries that are classified as developed countries according to the UN classification in 2014. Model S11-PR and S12-PR includes 56 sampling countries that are classified as developing countries according to the UN classification in 2014. These models are also regressed on common independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets), BAPA (percentage of population having bank accounts per 1,000 adults) as well as three growth determinants: CPI (consumer price index), EDU (proportion of school enrollment over total population) and RDEX (proportion of R&D expenditure over GDP). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Nevertheless, there is one striking result observed from this segmentation analysis. It seems to be that for developing countries, the impact from education to economic growth is much stronger than the impact from R&D expenditure. On the other hand, for developed countries, the impact from R&D expenditure to economic growth is much stronger than the impact from competition. In addition, for developed countries, the augmented models can well explain the variation of economic growth as the R-squared significantly improves to 0.65, comparing to 0.38 when the total 81 sampling countries are used.

3.4 Conclusion

This essay contributes to the existing literature gap by exploring the linkage between bank competition, using both structural and non-structural approaches, and economic growth. To date, there are only a few empirical studies investigating the relationship between them. Also, as the competition cannot be measured directly, researchers need to identify the proxy for this factor first. While there are substantial researches in this area, there are limited empirical evidences documenting for the impact of competition under structural and non-structural approaches separately on economic growth. In this essay, both micro bank-level and macro country-level data from a selected sample of 81 countries during the year 2000 to 2013 are used. The data at bank-level is aggregated to be at country-level, then the fixed effect regression analysis is conducted to examine cross-country information. The stylized facts obtaining from the study can be summarized as followings.

Firstly, the proxies for bank competition, specifically the market concentration and market pricing power, indeed have the opposite effect on economic growth. The empirical results in section 3.3 show that the structural competition measure, specifically CI5, has a negative relationship with economic growth. That is, when the market becomes more concentrated, it is associated with lower economic growth. Therefore, more-competition-more-growth hypothesis is supported. On the other hand, the non-structural competition measure, specifically LI, has a positive relationship with economic growth. That is, when banks have more pricing power, it is associated with

higher economic growth. Therefore, more-competition-less-growth hypothesis is supported.

Secondly, these two measures of competition together with three bank-specific control variables; bank efficiency, revenue diversification and portfolio risk, can explain the variation of economic growth in the sampling countries and periods. The results in section 3.3 show that all of these bank-specific control variables have a negative relationship with economic growth. Specifically, when CIR, RDI and NPL increase, it is associated with lower economic growth. The results are also robust when the proxies for competition measures are specified differently.

Thirdly, as the dummy variables for high access to finance (FBFWH and FBFIH) and high credit to private sector (CPSRH) are negative and statistically different from zero, it can be concluded that the relationship between competition and economic growth is stronger in countries with lower access to bank funding and lower credit to private sector relatively to GDP. Also, the dummy variable for high banking system efficiency (ROAH) is positive and statistically different from zero, it can be concluded that the relationship between competition and economic growth is stronger in countries with more efficient banking system.

From the above findings, it can be concluded that there are actually two angles of competition; the market concentration and the market pricing power. As the impacts of these two angles of competition can produce opposite effect on economic growth, they indeed have important policy implications. In order to promote economic growth, the policy makers need to consider the policy that (1) makes the banking industry to be less monopolized by a few key players and (2) ensures that all players have enough margins (incentive) to provide loan to private sector. Additionally, this policy is more effective in countries with lower level of accessibility to bank funding, lower credit to private sector and more efficient banking system.

CHAPTER 4

THE THIRD ESSAY

"The Linkage between Bank Competition and Financial Stability: The Case of Thailand"

The establishment of ASEAN Economic Community (AEC) and the deregulation of financial services in the ASEAN countries are expected to result in significant changes in Thai banking industry in the coming years. By removing the barrier to entry, increasing cross-border capital flows and enhancing market contestability, the community aims to foster the competition in the national banking industry. Similar to the European Union (EU), this pro-competitive deregulation process will increase the level of competition, particularly in non-traditional and non-interest bearing areas of banking activities (Goddard et al., 2001). One of the consequences is already apparent in the recent wave of mergers and acquisitions in the Thai banking industry. This process of concentration may inevitably affect the competition in the banking market, and the competition in the financial sector matters for a number of ways, such as (1) the efficiency of the production of financial services, (2) the quality of financial products and (3) the degree of product innovation in the sector.

Intuitively, one may expect that an increase in competition in the financial market may lead to lower costs and increase efficiency, despite the fact that financial products are not homogeneous. However, recent researches illustrate that the relationship between bank competition, performance and financial system stability are more complex (Vives, 2001). Therefore, the view that competition is unambiguously good in banking industry is more naive than in other industries, and vigorous rivalry may not be the first best for financial sector performance (Claessens and Laeven, 2004).

Due to the above complexities on competition in the banking industry, several questions may arise in response to the developments of financial industry. For example,

should the concentration be slowed down? What is the current level of competition in the banking industry? Is there any additional measures needed to ensure sufficient competition and efficient operation?

To evaluate the effectiveness of the implications of those developments, it is necessary to assess the current market structure of Thai banking industry as well as the behavior of market participants. This is to evaluate the current degree of competition and financial stability as well as to investigate the linkage between them.

Nevertheless, there are still only a limited number of existing empirical studies that investigate these issues in Thailand. Therefore, this essay aims to focus on the time-series analysis on the following aspects (1) to explore the current level of the degree of competition and stability in Thai banking industry, (2) to investigate the relationship among them and (3) to propose the policy implication.

The remaining of this essay is structured as followings. Section 4.1 summarizes the existing literature of the studies under bank competition and financial system stability nexus in Thailand. Section 4.2 describes how the variables are constructed, econometric methodology and data. Then, section 4.3 presents and discusses the empirical results. The findings and implications are concluded in section 4.4

4.1 Literature Review

According to the literature review in section 2.1.1, it has been concluded that there are two different angles to view competition. The first one is from the structural approach, namely market concentration. The proxy used is, for example, concentration index. The second one is from the non-structural approach, namely market pricing power. The proxy used is, for example, Lerner index. Also, the empirical results on the degree of competition actually depend on the proxy used as well as the model specification.

In Thailand, there are only limited quantitative studies about the degree of competition in the banking industry. Among the few existing ones, the seminal work of Chantapong (2003) adopts the regression analysis to investigate the performance of domestic and foreign banks in terms of their profitability, operational costs, quality of credit and commitment to the Thai economy. The major conclusion is as following (1)

Foreign banks were more profitable than domestic banks, (2) Both domestic and foreign banks improved their profitability after the East Asian financial crisis, and (3) The gap between the profitability of domestic and foreign banks narrowed after the crisis.

More recently, Okuda and Rungsomboon (2004a) estimate cost functions of foreign and local commercial banks in Thailand and evaluate changes in cost efficiencies. Additionally, Okada and Rungsomboon (2004b) investigate the effects of foreign bank penetration through the financial reforms. Panel data of 17 domestic commercial banks during the year 1990 to 2002 is used as a sample. Their paper examines the different factors that may affect bank performance, which include (1) changes in the foreign ownership of the banks and (2) financial regulations and market structure. They find that an increase in the presence of foreign banks in terms of number of banks is usually associated with (1) an increase in personal expenses, (2) a decrease in profits and (3) an increase in the interest spread of local banks.

In contrast to the narrow scope of Okuda and Rungsomboon (2004b) on the effects of foreign bank entries, Kubo (2005) considers the effect of overall financial reforms, including the changes in the ownership structure on the degree of competition in the banking industry before and after the East Asian financial crisis. After the crisis, there have been substantial changes in competitive environment in Thai banking industry, which includes a decline in the family ownership of banks as well as the arrival of new foreign entrants. In the study, the model of Bresnahan (1989) has been applied to the panel data of Thai commercial banks during the year 1992 to 2004. The estimated Lerner index indicates the possibility of a decline in the degree of competition after the financial crisis.

Due to the lack of the research on the Thai banking industry in the perspective of the degree of competition, this essay will be able to contribute to the existing literature by (1) studying the time-series analysis of the relationship between bank competition and the linkage to financial stability and (2) attempting to propose a policy implication.

4.2 Data and Methodology

4.2.1 Variable Specifications

The variables used in this essay can be categorized into four main groups. The first one is the competition measurement under the structural approach (namely market concentration), while that under non-structural approach (namely market pricing power) is described in the second group. The third group illustrates the stability measure (namely Lerner index). The bank efficiency, revenue diversification and portfolio risk together with other bank-specific control variables are presented in the last group.

4.2.1.1 Structural Competition Measure

A. Concentration Index

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

$$CI_t = \sum_{i}^{n} s_{it} w_{it} \qquad (4.1)$$

where:

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

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

n is the number of banks in the market under consideration

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

$$CI_{kt} = \sum_{i=1}^{k} s_{it} \qquad (4.2)$$

There is no specific rule to determine the optimal number of k. The index is in a range between zero and one, and it can be interpreted as following. If it is equal to

one, it means that the banks included in the computation make up the entire industry. As a result, the competition is at the lowest in this case. On the other hand, if it approaches zero, it means that there exists the infinite number of very small banks in the market given that the k chosen banks for the computation is relatively small comparing to the total number of banks. As a result, the competition is at the highest in this case.

Even though there is no rule determining the optimal value of k, in order to align with other existing literature, such as Bikker and Haaf (2000), Claessens and Laeven (2004), Casu and Girarone (2006) and so on, k=3 and k=5 will be arbitrarily applied in this research (denoted as CI3 and CI5 hereafter).

4.2.1.2 Non-Structural Competition Measure

B. Lerner Index

The Lerner Index (denoted as LI hereafter) provides a direct measure of the degree of market power as it represents the mark-up of price over marginal cost. It is calculated by taking the difference between price of the output and the marginal cost that produces such output and then dividing by the price. The interpretation of this index is that when there is no mark-up (LI = zero), it means the market is very competitive. When LI is higher, it means higher market power. As a result, the competition is lower. LI can be computed as in equation 4.3.

$$LI_t = \frac{P_{it} - MC_{it}}{P_{it}} \qquad (4.3)$$

where:

P_{it} is the price of each bank i at time t, which is calculated by the number of total revenue divided by total asset

MC_{it} is the marginal cost of each bank i at time t, which is derived from a translog cost function that includes three costs and several control variables. The translog cost function can be illustrated as in equation 4.4.

$$\ln TC_{i,t} = \alpha_o + \alpha_1 \ln TA_{it} + \alpha_2 (\ln TA_{it})^2 + \sum_{j=1}^{3} \beta_j \ln w_{it}^j + \sum_{j=1}^{3}\sum_{k=1}^{3} \beta_{jk} \ln w_{it}^j \ln w_{it}^k + \sum_{j=1}^{3} \gamma_j \ln w_{it}^j \times \ln TA_{it} + \varepsilon_{it} \quad (4.4)$$

where:

TC_{it} is the total cost of each bank i at time t

w_{it} is the price of three inputs, which are deposit fund, labor and fixed asset

w_{it}^1 is the price of deposit, which is the ratio of interest expense to total deposit

w_{it}^2 is the price of labor, which is the ratio of personal expense to total asset

w_{it}^3 is the price of fixed asset, which is the ratio of operating expense to total fixed asset

TA_{it} is the total asset

ε_{it} is the error term

In order to obtain a valid cost function, the following restrictions in the translog cost function need to be imposed.

$$\sum_{j=1}^{3} \beta_j = 1 \quad (4.5)$$

$$\sum_{j=1}^{3} \gamma_j = 0 \quad (4.6)$$

$$\sum_{j=1}^{3} \beta_{jk} = 0 \text{ for } \forall k \in \{1,2,3\} \quad (4.7)$$

After imposing the above restrictions, marginal cost can be obtained as following.

$$MC_{it} = \frac{\partial TC_{it}}{\partial TA_{it}} = \frac{TC_{it}}{TA_{it}} \left(\widehat{\alpha}_1 + 2\widehat{\alpha}_2 \ln TA_{it} + \sum_{j=1}^{2} \gamma_j \ln \frac{w_{it}^j}{w_{it}^3} \right) \quad (4.8)$$

4.2.1.3 Stability Measure

C. Z-score Index

The Z-score Index (denoted as ZI hereafter) assesses the overall stability at the bank level, as documented by Boyd et al. (2006) and Berger et al. (2009). This measure

of bank stability combines the indicators of profitability, leverage and return volatility into a single factor. Mathematically, it measures the number of standard deviation that a bank's profit must fall to drive it into insolvency. The index potentially measures the accounting distance to default for a given institution, and it is calculated as following.

$$ZI_{it} = \frac{ROA_{it} + ETA_{it}}{SD(ROA)_{it}} \quad (4.9)$$

where:

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

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

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

The interpretation of Z-score Index is that the higher ZI, the lower probability of insolvency risk.

4.2.1.4 Bank-Specific Control Variables

D. Cost to Income Ratio

Cost to Income Ratio (denoted as CIR hereafter) is one of the most popular efficiency measurements of the bank. It is calculated as total cost over total income. So, it measures how well the expense is utilized per one unit of revenue, and the higher the ratio is, the less efficient the bank becomes.

E. Revenue Diversification Index

Following Mercieca et al. (2007), Revenue Diversification Index (denoted as RDI hereafter) is calculated by using Hirschman Herfindahl approach for each bank. It accounts for the diversification between interest and non-interest income. The higher RDI ratio means higher revenue concentration and hence lower revenue diversification.

$$RDI_{it} = \left(\frac{NII_{it}}{TR_{it}}\right)^2 + \left(\frac{FI_{it}}{TR_{it}}\right)^2 + \left(\frac{TI_{it}}{TR_{it}}\right)^2 \quad (4.10)$$

where:

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

NII_{it} is the net interest income of each bank i at time t, which is computed by interest income minus interest expense

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

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

F. Non-Performing Loan

Non-Performing Loan ratio (denoted as NPL hereafter) is used to proxy for loan portfolio risk. This proxy indeed takes into account that (1) the risk should not imply a higher risk of bank failure if the asset allocation tilts towards a larger holding of risk-free assets and (2) the measures at best should capture the default risk related to the loan portfolio. This measure can be computed as NPL over total loan, and the higher ratio means higher portfolio risk.

G. Bank Size

It is the total asset held by each bank. The variable is presented in logarithmic form (denoted as LNTA hereafter).

H. Loan to Asset Ratio

It is the total loan divided by total asset by each bank (denoted as LTA hereafter).

4.2.2 Data

This essay uses micro bank-level data during the period 2000 to 2013 from Bankscope Database. All data are reported in USD currency and are expressed in constant prices where appropriate. The sample is limited to 15 commercial banks in Thailand as listed in Table 4.1. Also, the list of variables used in the study is summarized in Table 4.2.

Table 4.1: List of Commercial Banks in Thailand used in the Study

Bank Name	Bank Code
Bangkok Bank PCL	BBL
Siam Commercial Bank PCL	SCB
Krungthai Bank PCL	KTB
Kasikorn Bank PCL	KB
Bank of Ayudhya PCL	BAY
Thanachart Bank PCL	TB
TMB Bank PCL	TMB
United Overseas Bank (Thai) PCL	UOB
Tisco Bank PCL	TIS
CIMB Bank (Thai) PCL	CIMB
Standard Chartered Bank (Thai) PCL	SCBT
Kiatnakin Bank PCL	KK
ICBC (Thai) PCL	ICBC
Land and Houses Bank PCL	LH
Mega International Commercial Bank PCL	MICB

Table 4.2: Variables used and their Source

Variable	Description	Sample Period	Data Source
Group A: Structural Competition Measures			
CI3	Concentration index of 3 largest banks	2000-2013	Bankscope Database, Bureau Van Dijk
CI5	Concentration index of 5 largest banks	2000-2013	Bankscope Database, Bureau Van Dijk
Group B: Non-Structural Competition Measure			
LI	Lerner index	2000-2013	Bankscope Database, Bureau Van Dijk
Group C: Stability Measure			
LNZI	Logarithmic form of Z-score index	2000-2013	Bankscope Database, Bureau Van Dijk
Group D: Bank-Specific Control Variables			
CIR	Cost to income ratio	2000-2013	Bankscope Database, Bureau Van Dijk
ROA	Return on asset	2000-2013	Bankscope Database, Bureau Van Dijk
RDI	Revenue diversification index	2000-2013	Bankscope Database, Bureau Van Dijk
NPL	Non-performing loan to total loan ratio	2000-2013	Bankscope Database, Bureau Van Dijk
LNTA	Logarithmic form of total asset	2000-2013	Bankscope Database, Bureau Van Dijk
LTA	Loan to asset ratio	2000-2013	Bankscope Database, Bureau Van Dijk

4.2.3 Methodology

The following baseline equation is used to test the relationship between bank competition and financial system stability in Thailand. In principle, financial system stability is a function of bank competition and a series of bank-specific control variables.

$$Stability = f(Competition, BankControls) \quad (4.11)$$

The empirical model can be illustrated as following**.**

$$Z_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + \varepsilon_{it} \quad (4.12)$$

Also, in order to account for period fixed effect, time variable is added into equation 4.12. The final baseline model is illustrated as following in which *D* is the time dummy variable.

$$Z_{it} = \beta_0 + \beta_1 C_{it} + \sum_{j=2}^{k} \beta_j X_{ij} + D + \varepsilon_{it} \quad (4.13)$$

where:

Z_{it} is a measure for bank stability of each bank i at time t, which is represented by variable LNZI

C_{it} is a measure for bank competition of each bank i at time t, which is represented by variable LI

X_{ij} is a set of bank-specific control variables, which is represented by variables as described in section 4.2.1.4

ε_{it} is the error term

4.3 Empirical Results

4.3.1 Descriptive Statistics

Table 4.3 presents data by banks as of the year 2013. The top five largest banks by asset size are Bangkok Bank, Siam Commercial Bank, Krungthai Bank, Kasikorn Bank and Bank of Ayudhya, which are all domestic banks. Correspondingly, these top five largest banks by asset size are also the top five revenue and net interest income generator.

Table 4.3: Data by Bank as of the Year 2013

Bank Name	Bank Code	Data by Bank as of the Year 2013 (mil USD)						
		Bank's Balance Sheet					Bank's P&L	
		Total Asset	Total Loan	Total NPL	Total Funding	Total Equity	Total Revenue	Total NII
Bangkok Bank PCL	BBL	79,129	53,413	2,821	67,698	9,022	2,872	1,703
Siam Commercial Bank PCL	SCB	77,230	52,883	1,838	63,506	7,557	3,996	2,225
Krungthai Bank PCL	KTB	76,638	52,146	1,884	68,038	6,280	2,932	1,965
Kasikorn Bank PCL	KB	69,790	43,853	1,374	54,996	7,223	3,861	2,219
Bank of Ayudhya PCL	BAY	35,948	28,753	1,188	30,454	3,707	2,134	1,370
Thanachart Bank PCL	TB	31,644	24,067	908	27,000	2,963	1,972	812
TMB Bank PCL	TMB	23,336	15,222	959	19,708	1,884	958	635
United Overseas Bank (Thai) PCL	UOB	12,430	7,769	211	10,985	1,137	390	315
Tisco Bank PCL	TIS	10,423	8,558	176	9,603	596	378	245
CIMB Bank (Thai) PCL	CIMB	8,523	5,214	161	7,547	665	339	199
Standard Chartered Bank (Thai) PCL	SCBT	7,758	3,172	232	6,181	1,214	430	272
Kiatnakin Bank PCL	KK	7,592	5,815	222	5,969	1,071	461	254
ICBC (Thai) PCL	ICBC	5,385	4,204	104	4,817	493	154	126
Land and Houses Bank PCL	LH	4,532	3,159	44	4,067	411	106	85
Mega International Commercial Bank PCL	MICB	535	419	10	359	163	18	13

Table 4.4 illustrates average measures by bank during the period 2000 to 2013. LNZI, which is a proxy for stability, is at the lowest at TMB Bank indicating the highest probability of insolvency risk, while it is at the highest at Mega International Commercial Bank indicating the lowest probability of insolvency risk. CIR, which is a proxy for efficiency, is highest at TMB Bank indicating the least efficient bank, while it is at the lowest at Mega International Commercial Bank indicating the most efficient bank. RDI, which is a proxy for revenue diversification, is at the highest at Land and Houses Bank indicating the least revenue's source diversification, while it is at the lowest at Standard Chartered Bank (Thai) indicating the most revenue's source diversification. NPL, which is a proxy for portfolio risk, is at the lowest at Land and Houses Bank indicating the lowest portfolio risk, while it is at the highest at ICBC (Thai) indicating the highest portfolio risk. From all of the information, it is quite interesting to note that almost every outliner (maximum and minimum) in each measurement is from small- and medium- sized banks. In addition, the average value of LI, which is a proxy for market pricing power, is all positive in the big four banks. However, some of medium- and small-sized banks have negative value on average during the period 2000 to 2013. This means that these banks set the price below their marginal cost on average. After investigating, it is found that such negative value is resulted from a few year in early 2000's, which is the post Asian financial crisis period.

Table 4.4: Average Measures by Bank during the Period 2000 to 2013

Bank Name	Bank Code	Average Measures by Bank during the Period 2000 to 2013				
		Non-Structural Competition	Stability Measure	Efficiency Measure	Diversification Measure	Portfolio Risk Measure
		LI	LNZI	CIR	RDI	NPL
Bangkok Bank PCL	BBL	0.1914	3.86	0.4868	0.4831	0.0848
Siam Commercial Bank PCL	SCB	0.3245	3.22	0.4474	0.4650	0.0691
Krungthai Bank PCL	KTB	0.1415	3.24	0.5872	0.6526	0.0470
Kasikorn Bank PCL	KB	0.1965	3.19	0.5184	0.5172	0.0660
Bank of Ayudhya PCL	BAY	-0.2916	2.72	0.6553	0.5565	0.0507
Thanachart Bank PCL	TB	0.1521	3.31	0.5757	0.5216	0.0330
TMB Bank PCL	TMB	-0.4541	1.10	0.8162	0.5400	0.0676
United Overseas Bank (Thai) PCL	UOB	-0.1502	2.94	0.6746	0.5707	0.0535
Tisco Bank PCL	TIS	-0.0879	3.09	0.4606	0.5621	0.0440
CIMB Bank (Thai) PCL	CIMB	-0.7531	1.29	0.7878	0.7044	0.1252
Standard Chartered Bank (Thai) PCL	SCBT	0.3777	4.10	0.3810	0.4427	0.0468
Kiatnakin Bank PCL	KK	0.1613	3.52	0.4107	0.5230	0.0451
ICBC (Thai) PCL	ICBC	-0.7213	3.17	0.6531	0.6445	0.1688
Land and Houses Bank PCL	LH	-2.6086	3.52	2.7520	0.8073	0.0121
Mega International Commercial Bank PCL	MICB	0.2541	4.28	0.3731	0.6506	0.0201

Table 4.5 presents the overall descriptive statistics of all variables used in this essay. For structural competition measure, CI3 and CI5, the mean is at 0.55 and 0.79 respectively. This means that the market share from the top 3 largest banks covers 55% of total industry, and that from the top 5 one covers almost 80% of total industry during the period 2000 to 2013. For non-structural competition measure, LNZI, the mean is at 0.31, and it is in the range of 0.04 to 0.42. This means that on average banks in Thailand set their product price 31% above the marginal cost. It can also be interpreted that the market structure in Thailand is under monopolistic competition. For stability measure, LNZI, the mean is around 0.97. For efficiency measure, CIR, the mean is around 0.54. This can be interpreted that for every one unit of bank revenue, it is spent 0.54 unit as the expense on average. For revenue diversification measure, RDI, the mean is at 0.29 and in the range between 0.23 (much diversified revenue sources) to 0.36 (less diversified revenue sources). For portfolio risk, NPL, the mean is around 0.08, which can be implied that on average banks in Thailand have 8% of NPL in their portfolio.

Table 4.5: Descriptive Statistics

Variable	Observation	Mean	Median	Max	Min	Stdev	Skewness	Kurtosis
Group A: Structural Competition Measures								
CI3	14	0.5507	0.5420	0.6022	0.5122	0.0353	0.3651	1.5500
CI5	14	0.7852	0.7840	0.8327	0.7432	0.0348	0.1011	1.3599
Group B: Non-Structural Competition Measure								
LI	183	0.3142	0.3647	0.4206	0.0358	0.1182	-1.4149	3.7402
Group C: Stability Measure								
LNZI	182	0.9723	1.0308	1.2850	0.3003	0.2805	-1.1114	3.4161
Group D: Bank-Specific Control Variables								
CIR	183	0.5381	0.5111	0.7385	0.4267	0.0933	1.2976	3.5613
RDI	191	0.2865	0.2889	0.3561	0.2293	0.0413	-0.0301	1.9167
NPL	191	0.0847	0.0800	0.1770	0.0230	0.0513	0.4231	1.9937
LNTA	191	215.74	212.93	274.71	170.97	41.7066	0.2969	1.5693
LTA	191	0.6994	0.6961	0.7503	0.6473	0.0315	0.0821	1.9324

4.3.2 Preliminary Investigation

4.3.2.1 Correlation Matrix

Table 4.6 presents the correlation matrix between each individual series. Panel A shows the correlation at bank level. The highest correlation observed from this table is between market pricing power, LI, and efficiency measure, CIR. Also, another pair of variables that has correlation above 50% is stability measure, LNZI, and efficiency measure, CIR. This can be a preliminary evidence showing that there exist the relationship among competition, stability and efficiency even though the full regression tests need to be performed in the subsequent section.

The matrix at country level is shown in panel B. As expected the correlation between both market concentration measures, CI3 and CI5, is extremely high at 97%. This is simply due to the fact that CI3 is the concentration index of the three-largest banks in a country, while CI5 is that of the five-largest banks. The second highest correlation is between NPL and market concentration measures, CI3 and CI5. The correlation between NPL and CI3 is at 95%, while that between NPL and CI5 is at 91%. Also, the correlation between bank size, LNTA, and market concentration measures, CI3 and CI5, is also above 90% with negative sign. For stability measure, LNZI, is also highly correlated with market concentration measures, CIR, NPL and LNTA. This can be a preliminary evidence showing that there exist the relationship between stability

and other factors even though the full regression tests need to be performed in the next section.

Table 4.6: Correlation Matrix

Panel A: Bank Level								
			LI	**LNZI**	**CIR**	**RDI**	**NPL**	**LNTA**	**LTA**
LI			1.00	0.51	-0.89	-0.50	-0.31	0.24	-0.11
LNZI				1.00	-0.51	-0.16	-0.37	0.11	0.10
CIR					1.00	0.53	0.28	-0.10	0.03
RDI						1.00	0.18	-0.20	0.14
NPL							1.00	-0.19	0.15
LNTA								1.00	-0.26
LTA									1.00

Panel B: Country Level									
	CI3	**CI5**	**LI**	**LNZI**	**CIR**	**RDI**	**NPL**	**LNTA**	**LTA**
CI3	1.00	0.97	-0.76	-0.88	0.75	0.52	0.95	-0.92	0.48
CI5		1.00	-0.71	-0.82	0.72	0.42	0.91	-0.94	0.56
LI			1.00	0.91	-0.95	-0.32	-0.74	0.66	0.04
LNZI				1.00	-0.87	-0.39	-0.93	0.81	-0.28
CIR					1.00	0.26	0.72	-0.68	-0.11
RDI						1.00	0.42	-0.21	0.17
NPL							1.00	-0.93	0.56
LNTA								1.00	-0.59
LTA									1.00

Table presents correlation matrix between individual data series. CI3 and CI5 are the concentration index of the three- and five-largest banks in a country. LI is the Lerner Index. LNZI is the logarithmic form of Z-Score Index. CIR is the Cost to Income Ratio. RDI is the Revenue Diversification Index. NPL is the Non-Performing Loan Ratio. LNTA is the logarithmic form of Total Asset. LTA is the Loan to Asset Ratio.

4.3.2.2 Panel Unit Root Tests

Stationarity is one of the important characteristics of time-series and panel data. The standard estimation methodologies and related statistical inference require the data to be stationary. Therefore, in order to ensure that the data used in the analysis is free from unit root problem, four panel unit root tests, namely Levin, Lin and Chu test, Im, Pesaran and Shin test, ADF-Fisher test and PP-Fisher test, are conducted. The results

are presented in Table 4.7. From the table, it shows that by using Levin, Lin and Chu's common unit root test, all of the data series are integrated of order zero, except LNTA. Also, by using individual unit root tests, most of the data series, except NPL and LNTA, are still free from unit root at level. For those series that have unit root at level, they all become integrated of order one (not presented in the table).

Table 4.7: Panel Unit Root Tests

Null: Unit Root at Level

	Levin, Lin and Chu t-stat	Im, Pesaran and Shin W-stat	ADF-Fisher Chi-square	PP-Fisher Chi-square	Levin, Lin and Chu t-stat (prob.)	Im, Pesaran and Shin W-stat (prob.)	ADF-Fisher Chi-square (prob.)	PP-Fisher Chi-square (prob.)
LI	-79.39	-27.48	131.82	162.67	0.00	0.00	0.00	0.00
LNZI	-3.95	-1.04	41.15	64.03	0.00	0.15	0.08	0.00
CIR	-1,159.80	-219.23	149.15	142.93	0.00	0.00	0.00	0.00
RDI	-10.50	-7.16	103.48	126.41	0.00	0.00	0.00	0.00
NPL	-2.15	-0.94	35.08	36.75	0.02	0.17	0.42	0.34
LNTA	0.36	3.02	21.44	33.68	0.64	1.00	0.95	0.48
LTA	-4.64	-2.87	55.39	63.65	0.00	0.00	0.01	0.00

Table presents the panel unit root tests for each series using four methodologies: Levin, Lin and Chu t-stat test, Im, Pesaran and Shin W-stat test, ADF-Fisher Chi-square test and PP-Fisher Chi-square test. Null hypothesis indicates the series has unit root at level.

4.3.3 Main Results

4.3.3.1 Time-Series Analysis

Figure 4.1 illustrates the graphical time-series analysis of competition and stability measures. For structural competition measures, CI3 and CI5, they are quite stable during the year 2000 to 2013. The measures are around 0.5 for CI3 and 0.7 for CI5. This means that during this period, the market share of 3-largest and 5-largest banks in Thailand is quite stable. However, the non-structural competition measure, LI, shows an obvious increasing trend. The measure is less than 0.1 in the year 2000, a few years after the Asian financial crisis, but it increases to 0.4 in the year 2004. The measure remains around 0.4 until the year 2013. For stability measure, LNZI, it shows the same trend as non-structural competition measure, LI.

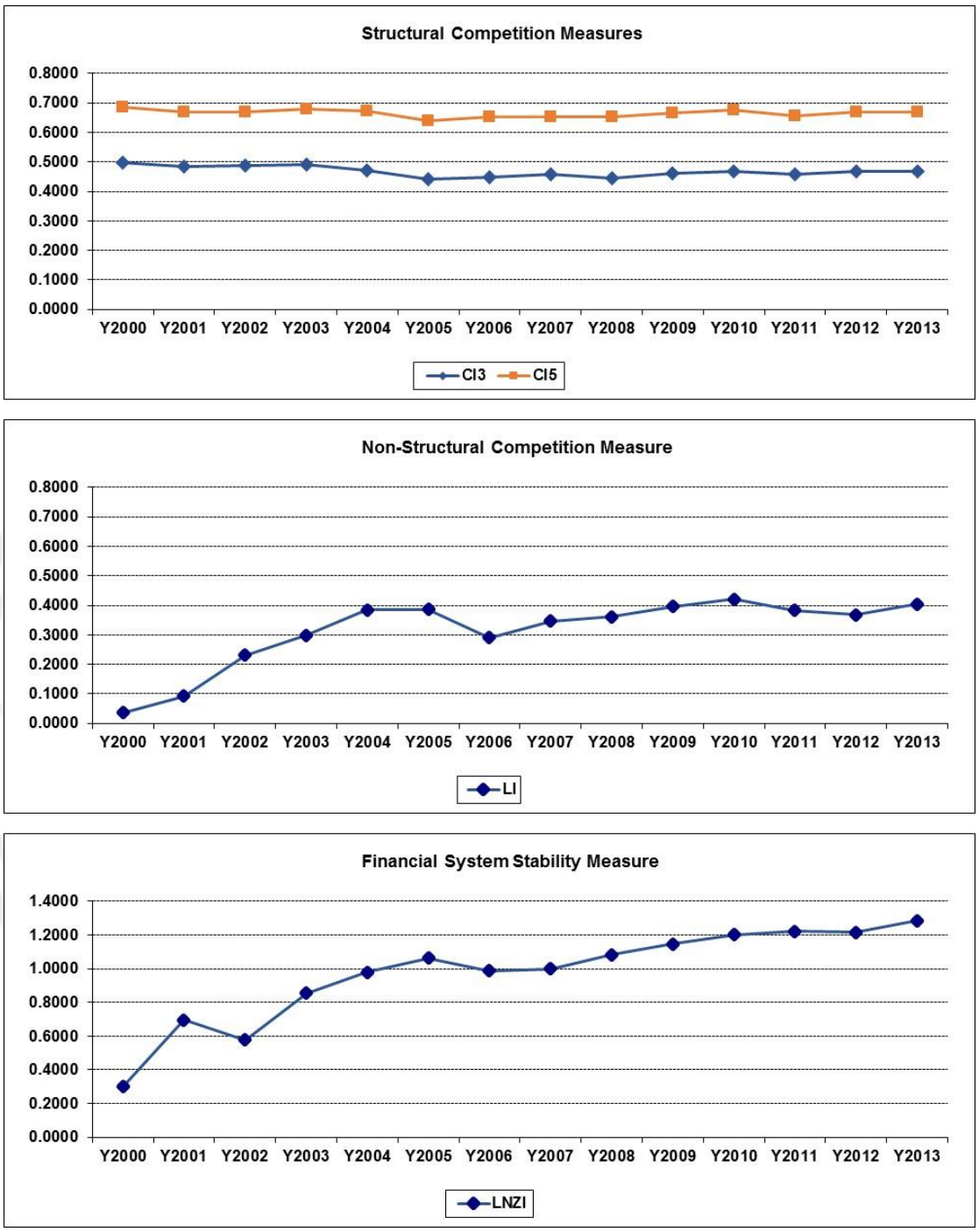

Figure 4.1: Competition and Stability in Thailand during 2000-2013

Figure 4.2 illustrates the graphical time-series analysis of other bank-specific control variables. For efficiency measure, CIR, it is in a downward trend. This is an evidence showing that Thai banking industry in the year 2013 is far more efficient than in the year 2000. Similar conclusion can be drawn from NPL graph as the graph is in a

sharp downward trend after the year 2000. For revenue diversification, it is in the range of 0.6 +/- 0.1 during the year 2000 to 2013.

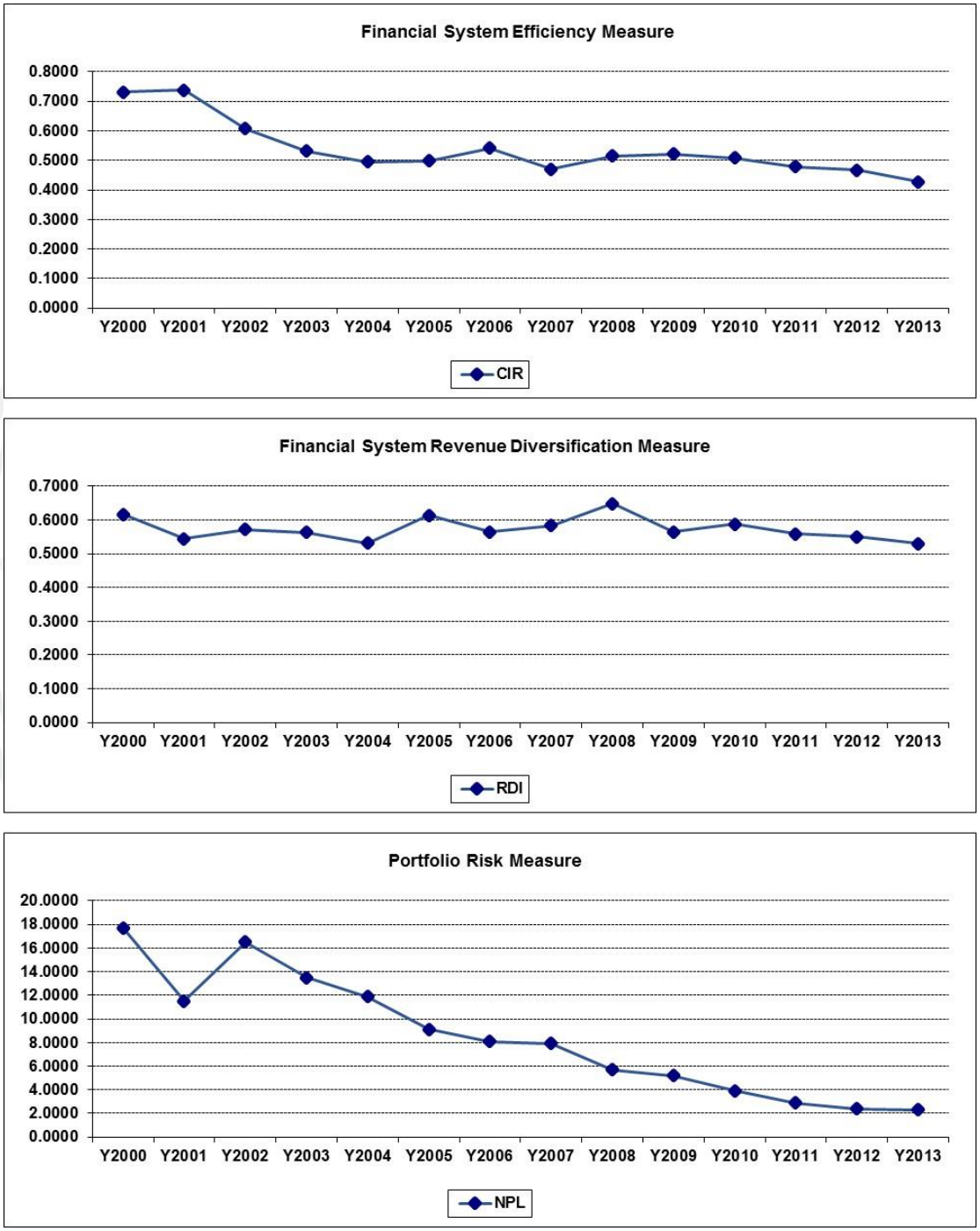

Figure 4.2: Bank-Specific Variables in Thailand during 2000-2013

4.3.3.2 Regression Analysis

In order to firmly document the relationship between the market pricing power and financial system stability in Thailand, the regression analysis has to be performed. Table 4.8 presents the summary of fixed effect panel regression results from 15 sampling banks in Thailand during the period 2000 to 2013. The main findings from this table can be documented as following.

Firstly, as the sign of the coefficient of LI is negative and statistically different from zero, it means that when the market pricing power increases, it decreases the stability of the financial system. In other words, when the competition decreases, it decreases the stability. Hence, this finding supports competition-stability hypothesis, and it is also consistent with the finding in section 2.3.4.3 in which the sign of LI from the countries in high accessibility and big credit market size relative to country's GDP segment is also negative and statistically different from zero.

Secondly, this non-structural competition measure together with other four bank-specific control variables, specifically CIR, NPL, LNTA and LTA, can explain the variation of financial system stability in Thailand during the year 2000 to 2013. The R-squared of around 0.77 and significant F-statistic also confirms the practicality of this empirical model. Furthermore, as the coefficient of CIR and NPL is negative and statistically different from zero, it means that higher efficiency in banking industry and lower portfolio risk can enhance the stability in Thai banking industry.

4.3.3.3 Comparative Analysis

This section is constructed in order to further explore the linkage between market pricing power and stability in Thailand against other countries in the South East Asian region. The micro bank-level data during the period 2000 to 2013 of each selected countries are retrieved from Bankscope Database. The methodology is similar to section 4.2.3. Due to the completeness of data availability, the selected South East Asian countries are Malaysia, Philippines and Indonesia.

Table 4.8: Regression Results from Thailand

Stability = C + Market Power + Bank-Specific Variables

Model	**TH11**
Stability	**LNZI**
Market Power	**LI**
	Co-efficient
C	15.7298*** (4.9013)
LI	-0.4125* (0.2407)
CIR	-2.1521*** (0.6584)
RDI	0.6511 (0.6722)
NPL	-4.3795*** (1.4576)
LNTA	-0.8857*** (0.2959)
LTA	3.6750*** (1.0757)
R-squared	0.77
Adj. R-squared	0.72
F-stat	14.48
F-stat (prob.)	0.00
AIC	2.83
SIC	3.45

Table presents the fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using market pricing power (LI) as a main independent variable. This model is also regressed on other bank-specific independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and LTA (loan to asset ratio). Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 4.9: Regression Results from Thailand and Selected SEA Countries

Stability = C + Market Power + Bank-Specific Variables

Model	**TH11**	**MY11**	**PH11**	**ID11**
Stability	**LNZI**	**LNZI**	**LNZI**	**LNZI**
Market Power	**LI**	**LI**	**LI**	**LI**
	Co-efficient		**Co-efficient**	
C	15.7298*** (4.9013)	23.6058*** (3.0536)	10.8766* (5.8598)	10.2880*** (1.7444)
LI	-0.4125* (0.2407)	0.4801** (0.3377)	0.6978** (0.3082)	0.1458*** (0.0373)
CIR	-2.1521*** (0.6584)	1.0431 (0.7981)	-0.3063* (0.1644)	-0.9330*** (0.2287)
RDI	0.6511 (0.6722)	0.1573 (0.2387)	0.2758 (1.0638)	0.8079** (0.3909)
NPL	-4.3795*** (1.4576)	-1.2048 (19.4524)	8.3625 (19.2410)	-1.5035** (0.6999)
LNTA	-0.8857*** (0.2959)	-1.2830*** (0.1780)	-0.4566 (0.3828)	-0.4889*** (0.1158)
LTA	3.6750*** (1.0757)	-1.5407** (0.5712)	-2.9695*** (0.9223)	-0.1845 (0.3620)
R-squared	0.77	0.70	0.63	0.56
Adj. R-squared	0.72	0.69	0.54	0.49
F-stat	14.48	10.34	6.42	8.59
F-stat (prob.)	0.00	0.00	0.00	0.00
AIC	2.83	2.78	2.74	2.76
SIC	3.45	3.48	3.41	3.31
No. Banks	15	21	34	55

Table presents the fixed effect panel regression results of bank stability measure (LNZI, which is the logarithmic form of Z-score index) using market pricing power (LI) as a main independent variable. This model is also regressed on other bank-specific independent variables: CIR (cost to income ratio), RDI (revenue diversification index), NPL (non-performing loan ratio), LNTA (logarithmic form of total assets) and LTA (loan to asset ratio). Table contains four main models for four countries. Model T11 is the regression result from Thailand. Model MY11 is the regression result from Malaysia. Model PH11 is the regression result from Philippines. Model ID11 is the regression result from Indonesia. Standard errors are in parentheses. *, ** and *** indicate statistical significance at the 10%, 5% and 1% levels.

Table 4.9 presents the comparative summary of fixed effect panel regression results from Thailand and additional three South East Asian countries. The main findings from this table can be documented as following.

Firstly, the coefficient of LI is positive and statistically different from zero for the additional three South East Asian countries, it means that when the market pricing power increases, it increases the stability of the financial system. In other words, when

the competition decreases, it increases the stability. Hence, this finding supports the traditional competition-fragility hypothesis.

Secondly, this non-structural competition measure together with other four bank-specific control variables, specifically CIR, NPL, LNTA and LTA, can well explain the variation of financial system stability in these three countries during the year 2000 to 2013 as the R-squared is in the range of around 0.6 to 0.7. Based on these two main findings, it can be concluded that the impact from market pricing power may differ across countries. Therefore, it is worthwhile to further investigate the existing rules and regulations in banking industry in Thailand against those in other South East Asian countries.

The qualitative comparative study is further performed by obtaining the data from the latest World Bank Regulation and Supervision Survey conducted in 2011 and released in 2013. The full survey actually covers approximately 270 questions in 14 dimensions for 143 countries. However, for the purpose of precise comparison, only a certain relevant questions are selected to be discussed in this essay.

Table 4.10 presents the summary of existing rules and regulations in the banking sector for Thailand, Malaysia, Philippines and Indonesia, which covers four main areas: (1) Permission to enter into banking sector, (2) Permission to do businesses, (3) Existing structure of banking sector and (4) Existing capital requirement. The main findings from this table can be documented as following.

For part A, it indicates that the central bank of all selected countries in the South East Asian region indeed plays a crucial role to grant the commercial bank license to the interested entities. Also, except for Indonesia, the granting agency has the authority to take legal action against entities that undertake banking activities without a given license. Also, during the year 2006 to 2010, Thailand receives three applications for commercial banks from domestic entities, and all of them is granted the license. For Malaysia and Philippines, there is no such application from domestic entity, but for Indonesia, the license is granted as many as 18. Furthermore, during the same period, Thailand receives seven applications from foreign banks to enter into the market, and all of them are granted the license. Again, there is no such application in the Philippines, but for Malaysia and Indonesia, the license is granted as many as 18 and 16 respectively.

Table 4.10: Summary of Comparative Banking Regulations

	Thailand	Malaysia	Philippines	Indonesia
Part A: Permission to Enter into Banking Sector				
1.1 Agency that grants commercial banking licenses	Ministry of Finance with recommendation by the Bank of Thailand	Ministry of Finance with recommendation by the Bank Negara Malaysia	The Bangko Sentral ng Pilipinas	Bank Indonesia
1.2 Authority to take legal action against entities that undertake banking activities without a given license	Yes	Yes	Yes	No
1.3 Applications for commercial banking licenses from domestic entities in the past 5 years (2006-2010)				
a. Received	3.00	0.00	0.00	22.00
b. Denied	0.00	0.00	0.00	3.00
c. Withdrawn	0.00	0.00	0.00	1.00
d. Accepted	3.00	0.00	0.00	18.00
1.4 Applications from foreign banks to enter into the market in the past 5 years (2006-2010)				
a. Received	7.00	18.00	0.00	16.00
b. Denied	0.00	0.00	0.00	0.00
c. Withdrawn	0.00	0.00	0.00	0.00
d. Accepted	7.00	18.00	0.00	16.00
1.5 Prohibition of foreign entities from entering the market through the following channels				
a. Acquisition	No	No	No	No
b. Subsidiary	No	No	Yes	No
c. Branch	No	Yes	Yes	No
Part B: Permission to do Non-Bank Activities				
2.1 Permission to engage in the following activities				
a. Security business	Yes	Yes	Yes	Yes
b. Insurance business	Yes	Yes	Yes	Yes
c. Real estate business	No	No	Yes	Yes
d. Other non-bank business	No	No	Yes	No
Part C: Existing Structure of Banking Sector				
3.1 Proportion of government-controlled				
a. Year 2008	22.2%	0.0%	12.8%	38.2%
b. Year 2009	21.7%	0.0%	13.0%	39.7%
c. Year 2010	17.5%	0.0%	12.5%	38.4%
3.2 Proportion of foreign-controlled				
a. Year 2008	5.9%	22.4%	11.5%	32.7%
b. Year 2009	7.2%	21.7%	10.8%	32.4%
c. Year 2010	6.8%	21.6%	11.8%	34.2%
Part D: Existing Capital Requirement				
4.1 Minimum regulatory capital				
a. Year 2008	8.5%	8.0%	10.0%	8.0%
b. Year 2009	8.5%	8.0%	10.0%	8.0%
c. Year 2010	8.5%	8.0%	10.0%	8.0%
4.2 Actual regulatory capital				
a. Year 2008	14.1%	12.7%	14.7%	16.8%
b. Year 2009	16.1%	14.7%	14.9%	17.4%
c. Year 2010	16.2%	14.8%	16.0%	17.2%

Source: The World Bank Regulation and Supervision Survey, 2013.
Note: A response was also provided by Singapore but only on a confidential basis.

Based on this comparative data, it can be implied that the competition in the banking industry of Malaysia and Indonesia should be higher in the coming years due to the new competitors. Also, these two markets seem to be quite attractive to the foreign banks. For Thailand, the rules and regulations to enter into banking industry is quite in line with peers, and the new joiners from both domestic and international are relatively moderate.

For part B, it shows that for all selected countries, banks are able to engage in both security and insurance businesses after requesting for the permission. However, banks in Thailand and Malaysia are not eligible to engage in the real estate business even though those in Philippines and Indonesia can. Based on this information, the permission to engage in non-traditional banking activities in Thailand is quite in line with peers.

The existing structure of banking industry is summarized in part C. In Thailand, there exists the obvious downward trend in the proportion of government-controlled banks during the year 2008 to 2010. For Philippines and Indonesia, such proportion is quite stable in this period. The downward trend in the proportion of government-controlled banks may stimulate more competition in the financial industry in Thailand. Unlike the proportion of government-controlled banks, the proportion of foreign-controlled banks increases gradually from 5.9 percent in 2008 to 6.8 percent in 2010 in Thailand. Still, this proportion is still very small comparing to the rest of the peers in which the proportion of foreign-controlled banks is in the range of 15 to 17 percent. This lower proportion of foreign-controlled banks in Thailand may reflect the fact that the banking market in Thailand does not seem very attractive to the foreign banks, especially in the retail banking business in which the numbers of local branches are still one of the key success factor to reach out retail customer base.

Part D presents the existing regulatory capital requirement of each country. The result shows that the minimum requirement of 8.5 percent for Thailand is quite in line with the others. Also, the actual regulatory capital for all of the countries are above the minimum requirement, and the upward trend is also observed for all countries. This can be one of the evidences showing the healthiness of financial sector in this region.

Based on these findings, it can be concluded that the rules and regulations to enter into the banking industry in Thailand is quite in line with other countries in the

South East Asian region. Also, the authorizing agency also grants several commercial bank licenses to the new comers from both domestic and international entities during the year 2006 to 2010. Still, the applications from international entities are quite small relatively to Malaysia and Indonesia. Lastly, the permission to engage in non-bank activities in Thailand is also in line with other countries in the South East Asian region. This fact can lead to the conclusion that the contestability environment in the banking industry in Thailand is quite moderate, but it is slightly lower comparing to other countries in the same region.

4.4 Conclusion

This essay contributes to the existing literature by exploring the linkage between bank competition, using both structural and non-structural approaches, and financial system stability in Thailand. To date, there are only a few empirical studies investigating the relationship between them. Also, as the competition cannot be measured directly, researchers need to identify the proxy for this factor first. While there are substantial researches in this area, there are limited empirical evidences documenting for the impact of competition under structural and non-structural approaches separately. In this essay, micro bank-level data from a selected sample of 15 banks in Thailand during the year 2000 to 2013 are used. The facts obtaining from the study can be documented as followings.

Firstly, from the graphical time-series analysis of competition and stability measures, it shows that the structural competition measures, CI3 and CI5, are quite stable during the year 2000 to 2013. This means that during this period, the market share of 3-largest and 5-largest banks in Thailand is quite stable. However, the non-structural competition measure, LI, shows an obvious increasing trend. The measure is less than 0.1 in the year 2000, a few years after the Asian financial crisis, but it increases to 0.4 in the year 2004. The measure remains around 0.4 until the year 2013. For stability measure, LNZI, it shows the same trend as non-structural competition measure, LI. Therefore, it can be preliminarily concluded that there exists no relationship between the structural competition measure and the stability measure. However, the relationship between non-structural competition measure and the stability may exist.

Secondly, from the fixed effect panel regression analysis, it confirms the relationship between non-structural competition measure, LI, and the stability measure, LNZI. As the sign of the coefficient of LI is negative and statistically different from zero, it means that when the market pricing power increases, it decreases the stability of the financial system. In other words, when the competition decreases, it decreases the stability. Hence, this finding supports competition-stability hypothesis, and it is also consistent with the finding in section 2.3.4.3 in which the sign of LI from HB segment is also negative and statistically different from zero.

Thirdly, from the comparative analysis, it can be documented that the linkage between non-structural competition measure, LI, and the stability measure, LNZI, can vary across different countries, according to the results from Thailand and other selected South East Asian countries, namely Malaysia, Philippines and Indonesia. Still, the results confirm that the relationship between non-structural competition and stability exist in these countries. Moreover, based on the qualitative study of the existing rules and regulations in the banking industry in Thailand against these countries, it can be documented that the current rules and regulations to enter into the banking industry in Thailand is quite in line with other countries. Nevertheless, the applications from international entities to enter into the financial sector are still quite small relatively to Malaysia and Indonesia. Lastly, the permission to engage in non-bank activities in Thailand is also in line with other countries in the South East Asian region. This fact can lead to the conclusion that the contestability environment in the banking industry in Thailand is quite moderate, but it is slightly lower comparing to other countries in the same region.

From the above findings, the policy implications for Thailand can be documented as followings. Due to the fact that the structural competition level in Thai banking industry is quite stable, it is may not be relevant to the financial system stability. Therefore, the policy makers should consider the non-structural measure as the proxy for competition in Thailand instead. In addition, according to the empirical investigation, it can be concluded that the policy that encourages the competition and efficiency in Thai banking industry should also enhance the financial system stability as a whole as well. Therefore, such policy is recommended for the case of Thailand.

CHAPTER 5

CONCLUSION AND POLICY IMPLICATION

5.1 Summary of the Findings

In summary, the overall findings from this dissertation can be separated into three main parts from three essays. The first essay contributes to the existing literature gap by exploring the linkage between bank competition, using both structural and non-structural approaches, and financial system stability. The sampling used in the essay includes 81 countries covering developed and developing countries during the period 2000 to 2013. The data at bank-level is aggregated to be at country-level. Then, the pooled regression with fixed effects technique is conducted to analyze cross-country information. The following conclusions can be drawn from the empirical results.

First, the proxies for bank competition in the market concentration and market pricing power approach indeed have the opposite effect on financial system stability. Specifically, the traditional measure of competition, namely market concentration, has a negative relationship with financial system stability. That is, when the market becomes more concentrated, the system becomes more fragile. Therefore, the competition-stability hypothesis is supported. On the other hand, the recent measure of competition, the market pricing power, has a positive relationship with financial system stability. It is obvious that when banks have higher pricing power, the system becomes more stable. Therefore, the competition-fragility hypothesis is supported. Second, these two measures of competition together with three bank-specific control variables; bank efficiency, revenue diversification and portfolio risk, which can explain the variation of financial system stability in the sampling countries and periods. Third, when the overall samplings are segmented by two important dimensions, such as accessibility and credit size relative to GDP or stability and efficiency, the relationship between bank competition and financial system stability may not necessarily be the same as the results from unsegmented samplings.

The second essay creates the contributions to the existing literature gap by exploring the linkage between bank competition, using both structural and non-structural approaches, and economic growth. The sampling used in the essay is the same as the first essay. It includes 81 countries covering developed and developing countries during the period 2000 to 2013. The data at bank-level is also aggregated to be at country-level. Then, the pooled regression with fixed effects technique is conducted to analyze cross-country information. The following conclusions can be drawn from the empirical results. First, the proxies for bank competition, specifically the market concentration and market pricing power, indeed have the opposite effect on economic growth. Specifically, the traditional measure of competition, namely market concentration, has a negative relationship with economic growth. That is, when the market becomes more concentrated, it is associated with lower economic growth. Therefore, more-competition-more-growth hypothesis is supported. On the other hand, the non-structural competition measure, specifically LI, has a positive relationship with economic growth. That is, when banks have more pricing power, it is associated with higher economic growth. Therefore, more-competition-less-growth hypothesis is supported. Second, these two measures of competition together with three bank-specific control variables; bank efficiency, revenue diversification and portfolio risk, which can explain the variation of financial system stability in the sampling countries and periods. Third, when the dummy variables represented for four important dimensions; accessibility, size of credit relative to GDP, efficiency and portfolio risk are tested whether the relationship between bank competition and economic growth varies across different market characteristics or not, it is found such relationship is stronger in countries with lower access to bank funding, lower credit to private sector relatively to GDP and more efficient banking system.

The third essay contributes to the existing literature by exploring the linkage between bank competition and financial system stability in Thailand. The sampling used in the essay includes 15 commercial banks in Thailand during the period 2000 to 2013. The pooled regression with fixed effects technique is conducted to analyze such information. The following conclusions can be drawn from the empirical results. First, the proxy for bank competition under structural approach, specifically CI, is quite stable during the observation period. Therefore, it does not have any relationship with

financial system stability in Thailand. On the other hand, the proxy for bank competition under non-structural approach, specifically LI, has a negative relationship with financial system stability. That is, when banks in Thailand have more market pricing power, the system becomes more fragile. Therefore, the competition-stability hypothesis is supported.

5.2 Policy Implication

According to the findings from the first essay, it can be concluded that there are actually two angles of competition; the market concentration and the pricing power. As the impacts of these two angles of competition are on the opposite side, they indeed have important policy implications. In order to enhance the stability of the financial system, the policy makers need to consider the policy that (1) makes the market to be less monopolized by a few key players and (2) ensures that all players have enough margins to withstand economic fluctuation. Yet, these policy implications are drawn from the cross-country investigations in selected 81 sampling countries. The final implication to the policy makers is that the relationship between bank competition and financial system stability may not necessarily be the same across all countries, and the in-depth segmentation analysis is recommended before launching the policy that may affect the competition in financial industry.

According to the findings from the second essay, it can be confirmed that there are actually two angles of competition as stated above. Also, as the impacts of these two angles of competition can produce opposite effect on economic growth, they indeed have important policy implications. In order to promote economic growth, the policy makers need to consider the policy that (1) makes the banking industry to be less monopolized by a few key players and (2) ensures that all players have enough margins (incentive) to provide loan to private sector. Additionally, this policy is more effective in countries with lower level of accessibility to bank funding, lower credit to private sector and more efficient banking system.

Lastly, according to the findings from the third essay, the policy implications for Thailand can be documented as followings. Due to the fact that the structural competition level in Thai banking industry is quite stable, it is may not be relevant to

the financial system stability. Therefore, the policy makers should consider the non-structural measure as the proxy for competition in Thailand instead. In addition, the policy that encourages the competition and efficiency in Thai banking industry can enhance the financial system stability as a whole. Therefore, such policy is recommended for the case of Thailand.

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