The impact of Regulation, Governance, Market Power and Diversification on Bank Performance and Risk

Wentao Hu

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Department of Finance

University of Sussex

WORK NOT SUBMITTED ELSEWHERE FOR EXAMINATION

I hereby declare that this thesis has not been, and will not be, submitted in whole or in part to another University for the award of any other degree.

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UNIVERSITY OF SUSSEX

WENTAO HU

DEGREE OF DOCTOR OF PHILOSOPHY

The impact of Regulation, Governance, Market Power, Diversification and Government Support on Commercial and Saving Bank Performance and Stability

SUMMARY

This thesis examines the impact of banking regulation, external governance and bank-specific variables on commercial and savings bank performance, as estimated by efficiency and financial indicators, in the Asian market, between 2000 and 2012. Furthermore, the thesis analyses the effect of deposit diversification and insurance on the bank's liquidity risk tolerance in G7 and BRICS countries. It further investigates the impact of expected government support on bank risk-taking in China.

Firstly, we examine the impact of Credit Rating Agencies (CRAs) on bank performance in general, and in particular on how this impact can be moderated by the strict regulation of banking criteria and the quality of investor protection embedded in different institutional environments. We find that CRAs enhances bank performance. CRAs as the flexible governance power, their positive monitoring impact is further enhanced by the quality of investor protection but mitigated by the inflexible and strict banking regulations. Secondly, this research investigates the impact of market power and revenue diversification on bank performance and stability. We find that market power could not only improve banking performance, but also increase individual bank fragility in an

emerging market. Although revenue diversification reduces bank efficiency, it improves individual stability.

Thirdly, we study the relationship between liquidity risk, deposit diversification and insurance in 12 countries during the period 2005-2014. We capture liquidity risk by focusing on the unfunded loan commitments. We find that higher diversification in the deposit base can reduce the impact of liquidity demand risk during the crisis by decreasing the cost of funding, increasing the funding inflow, maintaining the total amount of loan lending and enhancing the liquid ratio. Additionally, the results suggest that although deposit insurance has a positive impact during the crisis, its effect cannot mitigate the liquidity demand risk.

Fourthly, this research examines the impacts of expected government support on bank risk-taking behaviour, and in particular how its impact can be stronger in state-owned and large banks. We find that the willingness and capacity of government support enhance bank's risk-taking behaviour through increasing non-performance loan as well as doubtful loan, and decreasing Z-score as well as liquid ratio. This moral hazard problems are further enhanced in state-owned banks and large banks.

Finally, we outline our conclusions along with the limitations of this research and a plan for any future work.

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Chapter 1: Introduction

In this thesis we investigate the effect of credit rating agency (CRA), banking regulation, investor protection and bank-specific characteristics on banking performance as well as bank stability, in emerging economies during the 2000-2012 period. In addition, we examine the impact of deposit diversification and insurance on bank liquidity risk over the 2005-2014 period, when a number of banks in G7 and BRICS countries utilized unfunded commitment loan to improve their liquidity. This line of credit may trigger a potential liquidity problem, especially during the recent global financial crisis. We also analyse whether implicit or expected government support could enhance bank risk-taking in China, where banking sector does not have explicit government support before 2016. As an introduction this section briefly discusses why it is important to analyse the determinant of bank performance as well as the stability of the banks in the emerging market by focusing on both the macro-level (i.e. regulation) and the micro-level (i.e. market power). It further shows why it exhibits a potential liquidity crisis for the banks and how this liquidity risk can be moderated.

A well-developed financial market can contribute to an economy's growth and development (Levine et al., 2000; Hassan et al., 2011), since the financial market is able to execute three important functions to promote growth enhancement. These functions are the following: i) The transmission of ex ante and ex post information about investment as well as capital allocation to investors (Ross, 1989), ii) Promoting saving and increasing the motives of capital operation contributes to balanced economic growth (Levine, 1997; Alfaro et al., 2004), iii) Providing liquidity to facilitate trading, diversification and management of risk (Arestis et al., 2001).

As a result of this, most of the function of the financial market described above are carried out by the banking industry. An effective banking sector is an essential in a well-developed financial market that in turn promote economic growth (Beck and Demirguc-Kunt, 2006; Pascali, 2016). Banking is the most important financial intermediary in the economy by connecting surplus and deficit economic agents (Levine, 2005; Hasan et al., 2009; Craig and Von Peter, 2014). Generally speaking, the bank has two function, such as primary and secondary functions (Ritter et al., 2009; Cassis et al., 2016). As Figure 1. shows, the primary functions include the basis of banking operations such as, acceptance of deposits (i.e. saving, fixed, current and recurring deposits) and granting advances (i.e. overdraft, cash credit, loans and discounting bills). While the second functions include agency functions (i.e. transfer of funds, portfolios management, periodic of payments and collections) and utility functions (i.e. drafts, underwriting, project reports and social welfare programmes).

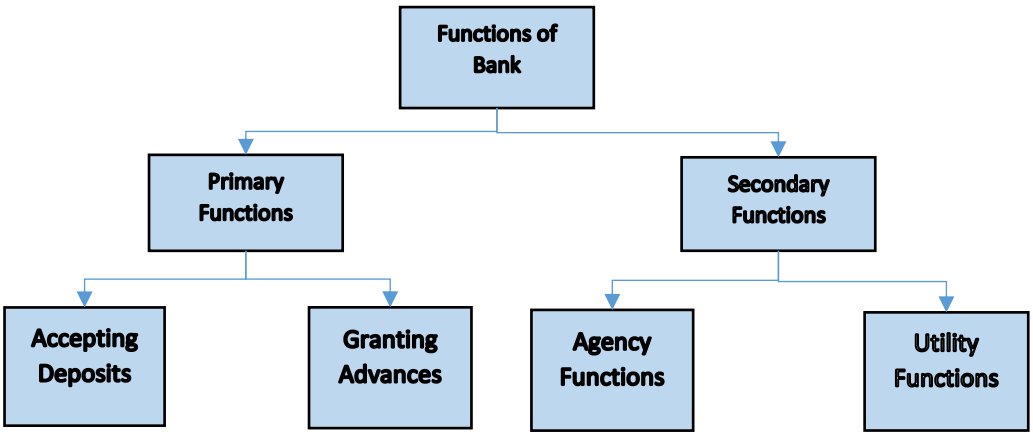

Figure 1. The functions of banks are briefly highlighted in the following Diagram.

As banks among other financial institution carry out these important functions, it is natural to expect that if banks perform poorly, it would have a severely negative impact on the real economy. The recent international crisis is a good example of this (Dell'Ariccia et al., 2008; Ivashina and Scharfstein, 2010). If banks are in a stressed financial position

and lose their credit availability as well as alchemy[1], this negative effect is like a contagion spreading to the rest of the economy (Longstaff, 2010). Generally, this loss of credit availability can lead to a reduction in investment activity and in turn a decrease in economic growth and an increase in the unemployment rate. Particularly, in the case of Lehman Brothers, not only did this bank go into liquidation, but the impact was felt throughout the financial sector both in companies connected and unconnected with this bank (Fernando et al., 2012). Banks that co-syndicate credit lines with Lehman Brothers would be more vulnerable to drawdowns on these credit lines after Lehman's bankruptcy. The credit lines syndicate members would be exposed to additional drawdowns by the failure of Lehman, because the firm may be panicked into choosing to draw on these credit lines (Acharya and Mora, 2015). Other research (e.g. Chakrabaty and Zhang, 2012) also shows that companies that had business relationship with Lehman Brothers encountered severe damage, since they were exposed directly to credit risk. Consequently, those companies exposed to credit loss with Lehman can have a negative impact on the performance of other firms in the same industry, and this negative effect can be contagion across industries, as in the "butterfly effect" (Jorion and Zhang, 2009). Information of the unexpected default of a firm is shared across companies, and thus this information can lead a number of unassociated firms to perform abnormally (Bai et al., 2015). Therefore, the failure of a bank provides a negative signal to the individual investor, other related as well as unrelated companies, and may lead to underperformance, which is more likely to trigger financial panic in the market. As a result, the function of information transmission in the financial market will be damaged by the underperformance of a bank.

The impact of banking crises can increase the probability of fragility in the financial market and destroy economic growth (Demirgüç-Kunt et al., 2006). Previous research

[1] The advantage of attracting deposit ((Acharya and Mora, 2015; King, 2016).

highlights the importance of banks for an economy, and suggests that the underperformance of the banking industry can lead to an increase of borrowing from the government, and experience a 1.6% greater contraction of GDP in growth as in the US (Kroszner et al., 2007). Furthermore, other literatures further indicate that the poor performance of a bank can lead to an increase in public debt and deficit (Lane, 2012), and execute fiscal burden sharing in the European Union (Reinhart and Rogoff, 2011), and an increase of expectations of a future bailout as well as deposit insurance (Corsetti et al., 1999). As the underperformance of the banking sector gives a signal to the financial market, investors lose their confidence and are more likely to withdraw their deposits early, and thus banks will face a shortage of savings and funding (Acharya and Mora, 2015). As a result, among the firms that depend heavily on outside financing, young firms with short histories and firms with a large proportion of hard-to-measure intangible assets, encounter particular difficulty raising funds from banks (Kroszner et al., 2007). This channel of credit contagion decreases savings and may eventually restricts the motives of the capital operation. The second function of the financial market will be deteriorated by the underperformance of the banking sector. Not only is the function of the financial market influenced by the pool performance of banks, the government's function in the real economy is also obviously affected. As an increase in government debt (Reinhart and Rogoff, 2011), can be seen as government intervention in the banking industry in the form of bank bailouts and recapitalization measures. In order to moderate the negative impact of a banking crisis, the costly government intervention has been employed to increase credit supply (Laeven and Valencia, 2013). However, this costly rescue operation will place greater burdens on the government accompanied by a steep reduction in tax revenue and an increase in spending to deal with any economic downturn (Roubini and Sachs, 1989). Therefore, the increase in the government deficit caused by the direct cost of

policies to support the banking industry will reduce economic growth and even lead to unbalanced economic development.

The onset of the 2007 to 2009 crisis was, in effect, a crisis of banks as liquidity providers (Acharya and Mora, 2015), which decreased the stability of the financial market (Diamond and Rajan, 2005; Brunnermeier, 2009). Banks have a natural strength in supplying liquidity to business through credit lines, so that they have no difficulty meeting the credit demands (Gatev and Strahan, 2006). However, after the failure of Lehman Brothers, related and unrelated firms drew heavily on credit lines with the banks (Campello et al., 2011; Berrospide et al., 2012)[2]. Banks honoured their ex ante promises and met this demand at the beginning while as the credit line availability decreased, the synchronized drawdowns such as deposit withdrawals and commitment drawdowns, drove banks to encounter financial stress. As a result, banks would not be treated as a safe haven because of tightened lending and runs on deposits. It is obvious that after the initial subprime shock, investors started to lose confidence in their ability to identify low- from high-risk banks; this leads to huge withdrawals from deposit accounts (Covitz et al., 2013). The ability of banks to diversify or spread the shock across corporations and depositors is disrupted (Acharya et al., 2013a). In particular, the banks with greater credit commitment and fewer core deposit inflows had difficulty to satisfy the liquidity demand. As a bank, the liquidity provider, lost its function, it would broke the fund chain to business, which drove firms facing a shortage of funds into bankruptcy. This negative impact from the banking crisis in 2008 was transmitted to the financial industries, then to the entity industry and trade by the conduction of capital inflowing. Since banking

[2] They suggest that banks that co-syndicate credit lines with Lehman Brothers would be more vulnerable to drawdowns on these credit lines after Lehman's bankruptcy. The credit lines syndicate members would be exposed to additional drawdowns by the failure of Lehman, because the firm may be panicked into choosing to draw on these credit lines.

liquidity is a good predictor of resource allocation, economic growth, capital accumulation, and productivity growth (Levine and Zervos, 1998; Beck and Levine, 2004), the illiquidity of banking will damage the national economic activities. Therefore, if the liquidity of the banking sector is heavily deteriorated, the function of the financial market in providing liquidity to facilitate trading, diversification and management of risk would be disappear, and then the economy would go into recession.

The impact of the underperformance of the banks would be significant in the emerging market, and G7 as well as BRICS countries, if the function of the banking sector is heavily damaged. In the emerging market, the underperformance of the banking industry is like a "time bomb" threatening an economy's development and stability. This is because of the inconsistent creditability of banking in this market (Rojas-Suarez, 2002)[3]. Banks in an emerging market usually face large shocks to their supply of liquidity due to regime shifts, speculative bank runs, "hot money" flows and exchange rate volatility (Khwaja and Mian, 2008)[4]. This will severely damage the banks overall credit worthiness. Since most of the firms in an emerging market heavily rely on the cash inflows from the banking sector, the huge potential credit risk of a bank will further restrict economic growth. It is natural to expect that the underperformance of a bank, particularly a poor performance in a bank lending channel (i.e. bank liquidity shocks), may lead to economic recession in an emerging market (Peek and Rosengren, 2000), and may even transmit liquidity shock across economies (Schnabl, 2012). While in the most sophisticated economies, such as G7 and BRICS countries, the banking industry can not only capture a large amount of the

[3] Generally speaking, these two factors influence the creditability of banks in an emerging market: (1) severe deficiencies in the accounting and regulatory framework and (2) lack of liquid markets for bank shares, subordinated debt and other bank liabilities and assets needed to validate the "real" worth of a bank as opposed to its accounting value.

[4] The average standard deviation of the real cost of deposits is 1 6 percent in G7 countries but 12 9 percent in 25 major emerging markets, and the standard deviation of real demand deposit growth is 14 percent and 24 percent, respectively.

revenue from total financial profit, but also provide a significant number of financial services, such as traditional (i.e. saving, lending, credit and transfer) and untraditional activities (i.e. underwriting, securitizing, sales and trading). Over the last two decades, these economies have been dramatically integrated with the international financial market (Cetorelli and Goldberg, 2011). Not only the United States (US) and the United Kingdom (UK) have an advanced banking system closely connected with the global market, but also the banking system of European countries such as Germany and France (Hölzl, 2006), and BRICS countries (Zhang et al., 2013) is more relevant than in the past. Therefore, it is obvious that the financial market in these economies has greatly expended in both the domestic and the foreign market, and the performance of banks gradually played a leading role in their economic growth, since G7 and BRICS countries experienced financial integration over the last twenty years. These countries need banks to provide high quality financial services, create opportunities for employment, increase revenue and generate prosperity (Berger et al., 2004). International business in these economies also needs banks to supply liquidity and advice for them to carry out cross-border mergers, acquisition as well as greenfield-investment (Amihud et al., 2002). The banking industry in these economies also plays an important role as intermediary to issue new financial products in order to expand market, promote financial globalization and environment conditions i.e. regulation and governance (Mishkin, 2007). Therefore, because of the leading role of the bank in the emerging market, G7 as well as BRICS countries, and the huge impact of banking in the recent financial crisis, the investigation of determinants of the performance of the banking industry is great importance.

This thesis initially focuses on the macro-level determinants that affect banking performance. We mainly analyse the impact of credit rating agencies, banking regulation and investor protection quality on bank performance. The main reason that interests us in

these factors is the limited existing literature on the determinant of credit rating agencies on bank performance, and the lack of any empirical study that considers the emerging market, and the lack of any consensus on banking regulation and the quality of investor protection. In addition, my thesis fills the gap that it may exist over-regulated banking sector in emerging market when the three macro-level factors jointly affect the industry. Different from those inflexible regulations, Credit Rating Agencies (CRAs), advocating for greater self-regulation, are an important and flexible private governance power in the banking industry (Ceuster & Masschelein, 2003). However, the negative role of CRAs in the global financial crisis (Bolton et al., 2012) and the unsatisfactory records (Rojas-Suarez, 2002) raises concerns regarding the quality of the monitoring of CRAs, especially in an emerging market. As a result of the negative role of banks in recent financial crisis, the strengthening of banking regulations (i.e. Basel III) is back in the spotlight. The investigation into the impact of regulation on bank performance is important, and the existing literature neither considers the market discipline (CRAs) nor provides a consensus on this effect[5]. Moreover, an advanced institutional environment is essential in the financial market (Delis, 2012). This is because not only does this investor protection reduce the moral hazard and the adverse selection problem for the investor (Alan and Kumar, 2014; Kumar and Zattoni, 2015), but also provides a flexible private governance power in the banking industry (Demirgüç-Kunt et al., 2008). The first contribution of this

[5] Previous papers (e.g. Barth et al., 2004; Beck et al., 2006a; Berger and Bouwman; 2013) suggest that banking regulation prevent banks from expanding their financial business, in order to weaken banking diversification of their investment portfolio. Thus, banks with more activity regulation may be exposed to less risk from external financial condition and capital markets. Bank supervisors can maintain the efficiency, integrity and transparency of the banking industry and then motivate bank management to provide high quality financial reports. However, others (Barth et al., 2002; VanHoose, 2007; Demirgüç-Kunt et al., 2008) indicate that banking performance and stability are influenced negatively by ACTR, because banks would like to engage in a broad range of activities to generate more funds. Furthermore, banks may be allowed to consolidate on the exploitation of economies of scale and scope by giving fewer regulatory restrictions.

thesis is to investigate the impact of various macro-level factors on banking performance in an emerging market.

Additionally, this thesis also focuses on the micro-level determinants that affect bank performance and stability. We put emphasis on market power, revenue diversification and the unfunded commitment loan and their impact on bank efficiency, stability as well as liquidity. The main reason that interests us in these factors is a lack of consensus on the impact of the two strategies (market power and revenue diversification) particularly in an emerging market, and the lack of any empirical study that considers dynamic panel threshold values. The liquidity shock caused by credit commitment during the financial crisis, also motivates us to analyse the crisis of the bank as liquidity provider. In developed countries, market power drives banks earn monopoly rents and provides "capital buffer" to reduce the negative effect of the financial crisis (Maudos and Fernández de Guevara, 2007; Anginer et al., 2014a). Meanwhile, revenue diversification increases fee income and reduces revenue volatility (Lepetit et al., 2008). However, since many banks are state-owned enterprises an in emerging market (Firth et al., 2008), the impact of market power is more likely to differ from developed countries. It would induce banks to charge higher loan rates leading to greater default (Fiordelisi and Mare, 2014), and revenue diversification involving in security market rises in exposure to systemic shocks (De Jonghe, 2010), especially in the 2007 subprime crisis. As banks in an emerging market usually face severe shocks to performance as well as stability due to regime shifts, speculative bank runs, "hot money" flows and exchange rate volatility (Khwaja and Mian, 2008), it is important to analyse dynamic value changes by employing the model of Kremer et al. (2013). Moreover, the investigation on the impact of credit commitment on bank liquidity is also important, because this effect can dramatically influence the survival and effective-functioning of the banking industry in a financial

crunch (Acharya et al., 2013). If banks exposed to greater undrawn commitments are in a stressed financial condition, they would have to increase the interest rate, face low deposit inflow, reduce lending and suffer low liquid assets, which severely affects their survival (Gatev and Strahan, 2006; Mora, 2010; Acharya et al., 2015). However, there are no research paper, which focuses on how to reduce the liquidity risk caused by credit commitment. The second contribution of this thesis is to analyse the impact of various micro-level factors on the banking performance including a period of economic downturn.

From a methodological point of view, this thesis employs the dynamic threshold methodology as recently developed by (Kremer et al., 2013). This economic technique enables the data employed in this thesis to show when the financial crisis took place, and could identify the possible coefficient changes on the independent variables. This dynamic panel threshold methodology covers a long period of time including both tranquil and turbulent periods, and analyses the presence of possible threshold-effects of bank determinants with respect to bank performance and stability. This methodology investigates the change of the economic condition through changes in the number of banks that belong to each threshold regime. For measuring bank performance, except the financial indicator, we opt for cost inefficiency in chapter 1 and 2. There has been an extensive of banking studies analysing bank performance by using the frontier efficiency estimations (Lozano-Vivas and Pasiouras, 2010; Fiordelisi et al., 2011; Feng and Zhang, 2012; Goddard et al., 2014; Mamatzakis et al., 2015; Silva et al., 2016). The usage of cost efficiency, in chapter 1, is based on the ground that the macro-level variables (CRAs, bank regulation and investor protection) are linked particularly with cost efficiency, and thus would enable us to capture adequately relationships between them and bank performance. In chapter 2 of this thesis, we employ frontier efficiency estimation to investigate the impact of market power and revenue diversification on bank performance.

Besides, in light of the exiting literature (Gaganis and Pasiouras, 2013; Jiang et al., 2013; Luo et al., 2016), we consider the Battese and Coelli (1995) model, which allows for measurement of inefficiency from the best-practice frontier in a single-step estimation that incorporates other factors including country- and bank-specific variables to influence directly the mean inefficiency of banks. We focus on the measures of the banking market competition by estimating the Lerner index as our main indicator. A number of studies to date have provided consistent estimates of the Lerner index across countries in Europe (Beck et al., 2013b; Jiménez et al., 2013; Ryan et al., 2014). In chapter 2, we primarily measure bank risk using the z-score of each bank, which equals the return on assets plus the capital asset ratio divided by the standard deviation of asset returns (Laeven and Levine, 2009; Beck et al., 2013a; Fratzscher et al., 2016; Ahamed and Mallick, 2017). The third contribution of this thesis is that it estimates bank efficiency and examines the determinants of bank performance through employing recent methodology.

This thesis is structured into six chapters. The following chapter, Chapter 2, analyses the impact of CRAs, banking regulation and investor protection on bank performance in the emerging market (11 Asian countries), during the period 2000-2014. We collect our bank data from BankScope. By using the bank-specific data (including input, output and netput indicators) from BankScope, we estimate the cost inefficiency scores employing a stochastic frontier analysis (SFA), which has been broadly used in previous literature (Lozano-Vivas and Pasiouras, 2010; Fiordelisi et al., 2011; Feng and Zhang, 2012; Goddard et al., 2014; Mamatzakis et al., 2015; Silva et al., 2016). Credit Rating Scores are collected from Thomsen Reuters Eikon. We focus on long-term ratings from three dominating CRAs including Fitch Ratings, Moody's and Standard & Poor's (S&P). We therefore construct our key explanatory variable Credit Ratings (CR) as a truncated variable, equal to the average scores issued by these three CRAs during a given year. For

measuring bank regulation, we focus on the restriction activities, capital requirement, supervisory power and private monitoring by following Basel II three pillars. The bank regulation data updated by Demirguc-Kunt et al., (2012) is in the Word Bank database. For measuring investor protection quality, we focus on four institutional environment factors (governance effectiveness, rule of law, regulatory quality and control of corruption). These data are derived from the World Bank database. Macroeconomic data are obtained from the World Development Indicators. For examining the determinants of bank performance, we use the cost inefficiency scores in fixed panel models, dynamic panel models (AB-GMM, IV-GMM) and two-stage IV models. Additionally, we further analyse the impact of a credit rating downgrade and update on bank performance.

The next chapter, chapter 3, shows a comprehensive empirical analysis of the impact of market power and revenue diversification on the bank performance in an emerging market during the period 2000-2012. The bank-specific data are collected from Bankscope and Thomson one banker. We employ frontier efficiency estimation to measure performance, and use the Battese and Coelli (1995) model to analyse the determinant of bank performance in a single-step as robustness tests. We use the cost inefficiency scores in fixed panel models. Dynamic panel models (AB-GMM) and two-stage IV models are also employed in this charter, in order to investigate further endogeneity issues between market power, revenue diversification, and bank inefficiency as well z-score. We focus on the measures of banking market competition by estimating the Lerner index as our main indicator, and measure bank risk using the z-score of each bank. We also employ the dynamic panel threshold model that enables us to estimate the presence of possible threshold-effects of the two main variables (market power and revenue diversification). The strength of using this methodology in this chapter is to capture the possible change of the number of banks that fall with each regime that would imply transformations in the

strategies of market power and revenue diversification of banks. In addition, the bank regulation and institutional environment that influence the banking integration process in an emerging market over the last two decades are considered in the model.

The following chapter, chapter 4, provides an empirical analysis on the effect of an unfunded loan commitment on the liquidity risk of a bank in G7 and BRICS countries over the 2005-2014 period. According to Berger and Bouwman's (2013)[6] study, we suggest that the period between 2008 and 2009 is a crisis, and other years are normal periods because of the yearly data in our database. We collect financial data from various sources including primarily 10-K and 20-F annual reports of SEC's from Bloomberg, Thomson one and BankScope database. We use annual data in order to capture the long-term effect of undrawn credit commitment on bank liquidity risk. Financial data are used to estimate the individual level of liquidity risk, interest rate, deposit inflows, lending amount and liquid ratio for each bank, and regress these indicators and other bank-specific and country-level variables using both fixed effect and dynamic panel models. We capture whether the impact of liquidity risk measured by unfunded commitment can be moderated by deposit diversification and insurance on the following factors: i) interest rate; ii) deposit inflows; iii) lending amounts; iv) liquid ratio during the crisis (2008-2009). In addition, we consider the impact of borrowing from government and others on the liquidity risk as robustness tests, and compare the "moral hazard effect" of deposit insurance and the "stabilization effect" on liquidity risk.

Chapter 5, shows an empirical analysis on the impact of expected government support on bank risk-taking in China from 2010 to 2016. In chapter 4, we find that the explicit government support triggers the "moral hazard" problem, but the impact of government

[6] They suggest that the recent subprime lending crisis occurred between 2007-Q3 and 2009-Q4.

support on bank risk-taking behaviour is ambiguous in the countries without explicit guarantee. Therefore, we analyse whether the implicit (expected) government support could trigger moral hazard problem in China. We collect financial data from various sources including from the Bloomberg, Thomson Reuters Eikon and BankScope database. We measure expected government support using bank-specific ratings information from Moody's. According to the studies (e.g. Gropp et al., 2011; Antzoulatos and Tsoumas, 2014; Correa et al., 2014), we employ a proxy which is the difference between the bank all-in rating and stand-alone rating, to reflect the capacity and willingness of government support. We capture the risk-taking behaviour of the following factors: i) non-performance loan ratio; ii) Z-score; iii) doubtful loan ratio; iv) liquid ratio.

Finally, in chapter 6 we show a summary of the contribution of this thesis and present some policy implications. We also discuss the limitations of this research and thoughts for future research.

Chapter 2: Credit rating agencies and bank performance in emerging economies: the effects of credit rating, bank regulation and investor protection standards

2.1 Introduction

Regulations and supervisions in the banking industry are complex and the costs of understanding and then complying with these rules are extremely high (Marsh & Norman, 2015). Different from those inflexible regulations, Credit Rating Agencies (CRAs), advocating for greater self-regulation, are an important and flexible private governance power in the banking industry (Ceuster & Masschelein, 2003). CRAs' importance in monitoring banks by addressing the issues related to high complexity and serious information asymmetry problems in the industry has been highlighted when Basel II set minimum capital requirements for credit, market, and operational risks. Basel II requires banks to assess these risks using either an "internal ratings based approach" (IRB) or a "standardized approach". If a bank elects to use the standardized approach, Basel II allows it to rely on CRA ratings instead of assessing risks itself using IRB. Despite some large banks will elect to use the internal ratings based approach, the vast majority of banks, especially those in less-developed countries are expected to adopt the simpler standardized approach using CRA ratings where institutional environments for investor protection are weak.

However, the negative role of CRAs in the global financial crisis (Bolton et al., 2012) and the unsatisfactory records of the rating agencies in banking problems in emerging markets (Rojas-Suarez, 2002) raises concerns of CRAs on their monitoring quality in the banking

industry, especially in emerging markets. Also the objective of CRAs, by providing investors with an adequate measurement of the risks involved in banks, may not be in line with that of policy makers' objectives which are to minimize the costs associated with existing financial-markets safety nets (Rojas-Suarez, 2002). It is not clear yet, how CRAs affect bank performance in emerging markets in general and in particular, how the CRAs, as the flexible private monitoring force in the market, interact with inflexible strict bank regulations as well as investor protection standards embodied in different institutional environments. Our research addresses these gaps in the literature and has implications for policymakers in understanding the monitoring properties of CRAs and the overall benefits and costs of the bundle of monitoring and discipline mechanisms related to CRAs, bank regulations and investor protection in the unique banking industry from emerging economies.

We argue that CRAs represent an independent and effective monitoring and discipline power for their rated banks in many emerging economies. Thus CRAs, by issuing their credit ratings, should be able to contribute their sophisticated insights to investors. Thus better informed investors should be able to mitigate agency problems between managers and shareholders (AP1), as well as between managers and debtholders (AP2), and reduce the overall cost of equity and debt capital (Bayoumi et al., 1995; Easley & O'Hara, 2004), which ultimately enhances a banking efficiency. The benefits of CRAs as the effective and flexible private governance enforcers should be further enhanced by high investor protection standards embedded in different institutional environments, which aim to protect shareholders and debtholders. Given the potential conflicts between shareholders' efficiency goals and regulators/societies/debt holders' safety goals, the interaction between CRAs and bank regulation reveals such conflicts, weakening the cost efficiency benefits of CRAs.

We contribute to bank governance literature in a few important ways. First, the majority of previous papers focus on the role of external credit ratings in different financial instruments such as corporate bonds (Güntay and Hackbarth, 2010, White, 2010), sovereign bonds (Hilscher and Nosbusch, 2010; Acharya et al., 2014), debt (Asquith, 2005) and loans (Hasan et al., 2014) and stock markets (Dichev and Piotroski, 2001). We focus on the credit ratings assigned to an individual bank and extend previous literature by focusing the monitoring impact of CRAs on bank performance.

Second, previous research using an isolated monitoring and discipline perspective to examine the impacts of bank regulation (e.g. Barth et al., 2004; Beck et al., 2006b; Pasiouras, 2008; Pasiouras et al., 2009; Berger & Bouwman; 2013), or institutional environment (e.g. Dietsch &Lozano-Vivas 2000; Demirgüç-Kunt et al. 2008; Houston et al., 2011; Delis, 2012) on bank performance. Such an isolated approach generates mixed results and fails to understand what kind of transmission mechanism helps to realize the impact of these industry level or market level factors in affecting bank-level efficiency, and how different aspects of the monitoring and discipline system work together as a bundle to influence bank performance (Barakat and Hussainey, 2013; Bruno and Claessens, 2010; Aslan and Kumar, 2014; Kumar and Zattoni, 2015). By investigating the interaction between CRAs and bank regulation, as well as between CRAs and investor protection embodied in different institutional environments, we not only enhance our understanding of the specific transmission mechanism related to CRAs which helps to realize the impact of bank regulations and investor protections on bank performance. Also we extend previous literature on the impact of a bundle of governance mechanisms on corporate industries (Barakat and Hussainey, 2013; Bruno and Claessens, 2010; Aslan and Kumar, 2014; Kumar and Zattoni., 2015) into this unique banking industry. From a wider governance perspective, we contribute to our understanding on too much regulation

and how this may not represent optimal public policy for bank performance (Barakat and Hussainey, 2013; Bruno and Claessens, 2010).

Third, effectiveness of governance mechanisms may vary across different institutional environments (Aslan and Kumar, 2014; Kumar and Zattoni, 2015). We extend previous research, focusing on advanced economies such as the U.S. and U.K., to emerging economies with different institutional environments. In this paper, we focus on 11 South-East Asian countries where bank regulations and investor protection quality embedded in their institutional environments are much weaker than in advanced economies.

The rest of this paper is structured along the following lines. Section 2.2 provides literature review. Section 2.3 provides our paper hypotheses. Section 2.4 presents the explanatory variables used to investigate the relationship, and discusses the methods used to estimate bank efficiency and to examine the relationship between regulations, bank performance and institutions. Section 2.5 analyses the empirical results. Section 2.6 contains the conclusions.

2.2 Literature review

The previous papers (e.g. Barth et al., 2004; Beck et al., 2006a; Pasiouras, 2008; Pasiouras et al., 2009; Berger and Bouwman; 2013) indicate that banking regulation could have a positive impact on banking operation. They suggest that less regulatory restrictions may lead to moral hazard problems so that managers are willing to exchange private information and conduct insider transactions. These regulations restrict banks expanding their financial business in order to weaken banking diversification of their investment portfolio, and thus banks with more activity regulation may be exposed to less risk from external financial condition and capital markets. Capital requirement helps small banks to increase their probability of survival and market share at all times (during banking

crises, market crises, and normal times). Most importantly, capital enhances the performance of medium and large banks primarily during banking crises. They also suggest that there is a positive relationship between SPR and bank technical efficiency. Bank supervisors can maintain the efficiency, integrity and transparency of the banking industry and then motivate bank management to provide high quality financial reports. In the absence of market discipline mechanisms, managers of firms with more market power may be allowed to pursue their own objectives, thus causing firms' profitability to decline. PMON may establish disclosure requirements for banks, and then allow private agents to assess banking information and transaction costs that could enhance the profitability and productivity of banks. Private monitoring could enhance transparency of banks, through asking banks to disclose information to the private sector and weaken the degree of corruption. However, other literature (Diamond and Rajan, 2001; Barth et al., 2002; VanHoose, 2007; Demirgüç-Kunt et al., 2008) argues that the relationship could not play an effective role in supervising bank performance. Moreover, they also indicate that there is no evidence that regulation can prevent banking crises. They indicate that banking performance and stability are influenced negatively by ACTR, because banks would like to engage in a broad range of activities to generate more funds. Furthermore, banks may be allowed to consolidate on the exploitation of economies of scale and scope by implementing fewer regulatory restrictions. For the capital requirement, it will have an impact on the decision of banks in allocating their asset portfolios. Moreover, it also affects the decision of banks when attracting their sources of funds and large requirements may generate costs or opportunity costs to banks. Implementing capital restrictions will influence banks to expand services and profitability by restricting sources of funds. They also find that there is not a strong association between banking-sector development, performance, and official SPR. The presence of more powerful government supervisors

is linked to higher levels of nonperforming loans and the former could be harmful to the banking-sector development in countries with closed political systems. Private monitoring (PMON) harms managerial initiative and reduces manager incentives to improve bank performance.

The previous literatures (e.g. Dietsch and Lozano-Vivas 2000; Demirgüç-Kunt et al. 2008; Houston et al., 2011; Delis, 2012) has suggested that a bank working in a better institutional environment may face less risk of financial crunch, and even the probability of any moral hazard may be reduced. They indicate that institutional factors, such as low corruption and the high quality of the rule of law, which are prerequisites for embarking on financial reforms, can improve transparency. Financial fragility may be decreased in a country associated with a high quality institutional environment. Significant reform efforts were directly improved by legislation related to the banking industry. Financial reform should be based on a good regulatory and institutional environment. Reform could enhance corporate governance and operational efficiency, and establish a sound supervision mechanism. Better institutional quality at the country level decreases the probability of a country experiencing banking crises. Institutional variables such as governance effectiveness, rule of law, control of corruption and regulatory quality, can be treated as country-level regulation.

2.3 Theoretical framework and hypotheses development

The agency problem arising from the separation of ownership and control is perhaps the defining feature of modern finance (Jensen & Meckling, 1976). In the banking industry, besides the traditional agency problems between management and shareholders (AP1), there are two additional agency conflicts existing among management, shareholders and

debtholders (AP2), and among management, shareholders and financial regulators/society (AP3) (Thanassoulis and Tanaka, 2016). Regarding AP2, the bank executives may take excessive risks at the expense of the debtholders, and ultimately lower the shareholders' value as costs of borrowing rise (Jensen and Meckling, 1976; Hasan et al., 2014; Kisgen and Strahan, 2010). Debt market monitoring over bank management may be compromised given the high information asymmetries and its failure in appropriately pricing risk (Edmans and Liu, 2011; Manso, 2013). Regarding AP3, the so called too-big-to-fail (TBTF) problem, the presence of explicit deposit insurance and the implicit possibility of government bailouts can induce management to take excessive risks at the expense of taxpayers (or the deposit insurance fund), even if the shareholders and debtholders effectively monitor bank managers (Bebchuk and Spamann, 2010; Thanassoulis and Tanaka, 2016).

Credit rating agencies serve as gatekeepers to capital markets by providing opinions via their credit rating scores on the creditworthiness of entities and their financial obligations and reducing informational asymmetries for shareholders, debtholders as well as regulators (Xia 2014; Becker & Milbourn, 2011; Aslan and Kumar, 2014). CRAs, as the sophisticated information collectors and processors, by contributing their superior insights to the market, help shareholders, debtholders as well as regulators become better informed on the intrinsic default risk in the rated banks, improve the effectiveness of existing corporate governance mechanisms (Ashbaugh-Skaife et al., 2006) and the discipline effects from stock markets (Easley and O'Hara, 2004; Zhang et al., 2015); bond markets (Edmans and Liu, 2011), as well as regulators (Thanassoulis and Tanaka, 2016). These should ultimately mitigate all types of agency problems (AP1, AP2 and AP3) in banks (Manso, 2013) by promoting more managerial efforts to improve bank operational efficiency (Bernardo et al., 2004; Garmaise and Natividad, 2010) and mitigate their

excessive risk taking (Thanassoulis and Tanaka, 2016). On the other hand, a good credit rating outcome can also reduce the cost of loans (Hasan, 2014; Kisgen and Strahan, 2010) and improve bank capital structure (Kisgen, 2006), which ultimately increases liquidity (Ericsson and Renault, 2006), enhances bank leading capabilities and helps banks realize the benefits of economies of scale to improve bank performance (Jones, 2000).

However, there are concerns with the CRA monitoring and discipline role on bank management (Bolton et al., 2012). Since rating agencies get paid from borrowers, they are often criticized for being biased in favor of borrowers, for being too slow to downgrade following credit quality deterioration, and for being oligopolists, especially in the global financial crisis (Bolton et al., 2012). Their credit rating records are particularly unsatisfactory in revealing banking problems in emerging markets (Rojas-Suarez, 2002).

Thus, the net impact of CRAs in monitoring and disciplining bank management becomes ultimately an empirical question. Frost (2007) and Manso (2013) argue that the criticism of credit quality deterioration may not be dominating, compared with the benefits of credit ratings as the private flexible monitoring enforcement for investors, debt holders, as well as regulators to mitigate all three types of agency problems in banks. This is especially true when the independence of CRAs can be strengthened in many emerging markets because of the foreign nature of three dominating credit rating players (Fitch Ratings, Moody's and Standard & Poor's (S&P)). Therefore, our first hypothesis is as follows:

Hypothesis 1: *Credit rating agencies improve bank performance in emerging markets.*

2.3.1 The interaction between credit ratings and investor protection quality

Previous research on institutional environments has documented that strong investor protection quality embedded in them can improve firm performance (Alan and Kumar,

2014; Kumar and Zattoni, 2015). The investor protection quality has four main indexes, which are governance effectiveness, rule of law, control of corruption and regulatory quality. Governance effectiveness can be treated as an indicator to solve the principal-agency problem (Williams and Nguyen, 2005) and it could reduce the possibility of a moral hazard problem. For the rule of law, this is one of the most important factors in corporate governance and better corporate governance is highly correlated with better operating performance (Klapper and Love, 2004). Furthermore, controlling shareholders have more incentives to expropriate the benefit from minority shareholders when they invest in a country with a weaker rule of law. Control of corruption can increase the transparency of a banking operation (Demirguc-Kunt et al., 2004; Beck et al., 2006a). Additionally, regulatory quality in terms of more financial transparency is positively associated with banking disclosure (Barth et al., 2013).

However, there is not much research explicitly analyzing the relationship between investor protection quality and bank efficiency in emerging markets in general (Carbo et al. 2009). In theory, strong investor protection embedded in institutional environments by giving strong power to shareholders and debtholders, should mitigate AP1 and AP2 in the banking industry (Jensen and Meckling, 1976). However, it is not clear yet on the specific transmission mechanism to realize the benefits of strong investor protection in the unique banking industry (Demirgüç-Kunt et al. 2008; Schaeck et al., 2009; Delis, 2012； Barth et al., 2001; 2006, 2007; Demirguc-Kunt et al., 2012; Haw et al., 2010). Here we focus on CRAs as the specific transmission mechanism.

The foreign liability of CRAs by affecting their capabilities in processing information and evaluating banks' performance (Bell et al., 2012) can eventually affect their monitoring and discipline impacts on bank management. Strong investor protection by enhancing the information environment and transparency of banking operations (Alan and Kumar, 2014;

Kumar and Zattoni, 2015; Demirgüç-Kunt et al., 2004; Delis, 2012; Beck et al., 2006b; Barth et *al*., 2013) should mitigate foreign liability of credit rating agencies (Bell et al., 2012) so that enhances their capabilities in effectively evaluating bank performance for investors and regulators. Therefore, credit rating agencies, as the independent enforcement power to assess their rated bank's creditworthiness and their financial obligations and contribute their superior insights to the market, should positively interact with strong investor protections and ultimately realize the benefits of strong investor protection quality by mitigating all types of agency problems and enhancing bank efficiency. Therefore, our hypothesis 2 is as follows:

Hypothesis 2: *Credit rating agencies enhance bank performance more when there are stronger investor protections embedded in the institutional environments in emerging markets.*

2.3.2 The interaction between credit rating agencies and bank regulation

Bank regulations are expected by policy makers to be an effective tool in guaranteeing the soundness of the financial system (e.g. Dietsch and Lozano-Vivas 2000; Demirgüç-Kunt et al. 2008; Houston et al., 2011; Delis, 2012). By restricting bank activities from securities underwriting, real estate investment and insurance underwriting, bank regulations mitigate the potential conflicts of interest between these activities and their fundamental banking business (Barth et al., 2004; Demirgüç-Kunt et al., 2008; Barth et al., 2001; Pasiouras et al., 2009; Demirguc-Kunt *et al*., 2012). These can secure bank stability (Barth et al., 2004; Haw et al., 2010) and avoid market crises (Barth et al., 2004; Pasiouras et al., 2009). But their impact on banking performance is mixed (Beck et al.,

2006b; Pasiouras et al., 2009; Diamond and Rajan, 2001; Barth et al., 2002; VanHoose, 2007; Demirgüç-Kunt et al., 2008; Delis et al., 2011).

The objective of policy makers to minimize the costs associated with existing financial-markets safety nets (Rojas-Suarez, 2002) may come at a cost of bank performance (Diamond & Rajan, 2001; Barth et al., 2002; VanHoose, 2007; Demirgüç-Kunt et al., 2008). Particularly, strict restrictive capital requirements may improve bank soundness (Kim et al., 2005; Pasiouras et al., 2009), i.e., mitigating AP3 and AP2, but damage bank lending capabilities (Diamond and Rajan, 2001; VanHoose, 2007), i.e., stimulating AP1. Previous research focusing on the nonbanking sector has highlighted the costs of over-regulation in damaging managerial incentives to exert effort to search for profitable investment projects, and deliver performance (e.g. Chhaochharia and Grinstein, 2007; Bruno and Claessens, 2010; Zhang, 2007). Especially, regulations in the banking industry are complex, and the costs of understanding and then complying with these rules are extremely high (Marsh & Norman, 2015). Such high costs of compliance can damage bank competition advantages and thus lead to lower credit ratings (Pasiouras et al., 2006). Inflexible bank regulations can even stimulate more AP1 agency problems which lead to managerial opportunistic incentives to inappropriately assess operational risk and mislead outsiders via poor and distorted disclosure (Barakat and Hussainey, 2013). This can therefore cause adverse selection problems for CRAs to assess and evaluate bank performance for investors and ultimately enhance costs of borrowing and damage bank performance.

Overall, the objective of CRAs to provide investors with an adequate measurement of the risks involved in banks, may not be in line with policy makers' objectives which are to minimize the costs associated with existing financial-markets safety nets (Rojas-Suarez, 2002). Thus, when such a flexible private enforcement mechanism operates together with

an inflexible and strict bank regulation system, CRAs' benefits in enhancing bank performance for shareholders can be offset, resulting in the mitigation ofAP3 and AP2 at the costs of AP1 and concerns of over-regulation (Marsh & Norman, 2015). Therefore, our third hypothesis is as follows:

Hypothesis 3: *Credit rating agencies enhance bank performance less when bank regulations are stricter in emerging markets.*

2. 4 Data and Methodology

We focus our empirical analysis on all commercial and savings banks listed on stock exchanges from 11 South-East Asian countries including Australia, China, Hong Kong, India, Indonesia, Japan, Sri Lanka, Malaysia, Philippines, Singapore and Thailand, for the period from 2000 to 2012. We collect our bank data from BankScope. Credit Rating Scores are collected from Thomsen Reuters Eikon, and investor protection quality data from the World Bank database. Macroeconomic data are obtained from World Development Indicators. After removing observations with missing variables, we have an unbalanced panel dataset with 2,398 observations including 389 commercial and savings banks.

2. 4.1 Dependent Variable

The dependent variable in the empirical analyses is bank cost inefficiency. A key advantage of the cost efficiency index is that it considers worth, costs, or benefits of a bank at the same time (Shaban and James, 2017), and make the estimates less exposed to the influence of random events and measurement errors (Kumbhakar and Lovell, 2003). Previous studies estimating the efficiency of banks (Brissimis et al., 2008; Delis et al.,

2011) use the technical efficiency measurement. We use the cost efficiency measurement because it is a wider concept than technical efficiency, referring to both technical and allocative efficiency (Pasiouras et al. 2009). Empirically, when analyzing bank cost inefficiency, we opt for stochastic frontier analysis (SFA) rather than data envelop analysis (DEA), following Barth et al. (2002), Pasiouras et al. (2006) and Demirgüç-Kunt et al. (2008). The SFA method is better than the DEA approach because it simultaneously accounts for relevant inputs and outputs of a bank, as well as for differences in the input prices, which allows us to distinguish between inefficiency and other stochastic shocks in the estimation of efficiency scores (Pasiouras et al., 2009). The SFA approach, by incorporating both error and inefficiency in a composite error term, allows us to estimate a global frontier while accounting for cross- country differences (Aigner et al., 1977).

More specifically, the model for examining the cost efficiency frontier is as follows:

$$\ln C_{i,t} = f\left(P_{i,t}Q_{i,t}N_{i,t}Z_{i,t}\right) + v_{i,t} + u_{i,t} \qquad i = 1,2,\dots,N; t = 1,2,\dots,T \qquad (1)$$

Where $C_{i,t}$ the total cost for bank i at year t; $P_{i,t}$ is a vector of inputs; $Q_{i,t}$ denotes a vector of values of outputs, $N_{i,t}$ is a vector of fixed netputs while $Z_{i,t}$ is a vector of control variable. The term $V_{i,t}$ is symmetric error and represents that management of a bank cannot deal with this random fluctuation. $U_{i,t}$ captures the effects of inefficiency relative to the stochastic cost frontier; it is assumed to be independently distributed on one-side, meaning that this effect has the potential to enhance the cost of banks over the best-practice level.

We use the translog specification that results in an empirical cost frontier model:

$$\ln C_{i,t} = \alpha_0 + \sum_i \alpha_i \ln P_{i,t} + \sum_i \beta_i \ln Q_{i,t} + \frac{1}{2}\sum_i \sum_j \alpha_{ij} \ln P_{i,t} \ln P_{j,t}$$
$$+ \frac{1}{2}\sum_i \sum_j \beta_{ij} \ln Q_{i,t} \ln Q_{j,t} + \sum_i \sum_j \delta_{i,t} \ln P_{i,t}\, Q_{j,t} + \sum_i \varphi_i \ln N_{i,t}$$
$$+ \frac{1}{2}\sum_i \sum_j \xi_{i,j} \ln P_{i,t} \ln N_{j,t} + \sum_i \sum_j \delta_{i,j} \ln Q_{i,t} \ln N_{j,t} + \sum_i \varepsilon_i \ln Z_{i,t}$$
$$+ v_{i,t} + u_{i,t} \qquad (2)$$

In terms of the cost frontier model, we not only impose the restrictions of standard linear homogeneity and symmetry, we also consider the time and country effects. As mentioned above, concerning the specification of the efficiency frontier, we decide the bank's total cost (C), which is calculated as a total expense (non-interest expenses plus interest expenses), as the dependent variable. Following Sealey and Lindley (1997), we choose two outputs, which include loans (net of provisions, Q_1) and other earning assets (government securities, bonds, investment, CDs and T-bills, Q_2). Furthermore, consistent with previous studies of bank efficiency, we select the following two inputs: price of labour (P_1), calculated as the ratio of personnel expense to total assets; price of financial capital (P_2), calculated as total interest expense to total interest bearing borrowed funds. It can be seen that equity is an alternative funding for a bank and has the potential of affecting the bank's cost. Following Berger and Mester (1997), we use the equity of each bank in the model as a fixed netput (N) to control for differences in risk preference. Analysing the efficiency frontier in a cross-country sample, it is crucial to control variables that can capture country-level heterogeneity so GDP per capita is chosen as an indicator of the dynamism of each economy.

In order to avoid heterogeneous error, we estimate the bank cost inefficiency (BCIE) separately in the advanced countries group and the developing countries group. Advanced

countries include Australia, Hong Kong China, Japan and Singapore, and others are in developing countries group. The inefficiency scores using the cost efficiency frontier model are summarised in Table 1 by country in Panel A and by year in Panel B accordingly. The full sample overall mean BCIE score equals 0.252, which means on average a bank in our sample needs to improve by 25.2% to achieve its full cost-efficiency. Banks in China are the best performers with inefficiency scores at about 0.201, in line with the results from Berger et al. (2009a). Banks in the Australia are the second best performers with scores around 0.212. Banks in Japan and Singapore have the largest cost inefficiency levels, with scores of 0.268 and 0.259 respectively, in line with the results from Drake et al. (2009). Japan and Singapore, which are well-developed, are prone to establishing investment banks to stimulate their economic evolution and thus their savings and commercial banks may not receive enough attention in terms of efficiency maximization. Our results show that Sri Lanka and India have inefficiency scores 0.231 and 0.251 respectively, in line with Sathye (2003). Compared with the results from Perera et al.'s (2007) study focussing on Sri Lankan and Indian banks before 2004, our results show there is significant bank efficiency improvement in these two countries after 2004.

Table 1, Panel B shows that banks on average have the worst performance in 2003 in South-East Asian countries during the period of 2000-2012, which is similar to the result of Thoraneenitiyan and Avkiran (2009). This reflects that Asian bank industries struggled to improve their low efficiency before the entry of foreign banks (Park and Weber 2006). Table 1 Panel B also shows that on average, banks in South-East Asian countries have better performance in the post- 2007-2008 financial crisis period than the pre financial

crisis period such as year 2006. This shows the impacts of enhanced attention on improving bank efficiency after the financial crisis in Asia (Campello et al. 2010)[7].

Table 1A shows the Chi-square test for Inefficiency. The result indicates Inefficiency scores are homogeneous, as the P-values are higher than 5 percentage. This is because that when we estimate the bank inefficiency (IE) separately in the advanced countries group and the developing countries group.

Table 1 Bank cost inefficiency (BCIE) estimates

Panel A	By Country			
	N	Mean	Min	Max
Advanced countries				
Australia	121	0.212	0.092	0.391
Hong Kong China	148	0.220	0.054	0.552
Japan	111	0.268	0.029	0.817
Singapore	59	0.259	0.047	0.501
Developing countries				
India	531	0.251	0.055	0.707
Indonesia	437	0.249	0.055	0.667
China	464	0.201	0.062	0.613
Sri Lanka	31	0.231	0.092	0.325
Malaysia	63	0.257	0.060	0.455
Philippines	214	0.231	0.064	0.543
Thailand	222	0.255	0.052	0.682
Panel B	By year			
2000	50	0.200	0.060	0.407
2001	74	0.303	0.155	0.447
2002	80	0.306	0.135	0.409
2003	95	0.250	0.117	0.817
2004	130	0.213	0.092	0.469
2005	165	0.220	0.029	0.347
2006	196	0.251	0.103	0.467
2007	207	0.244	0.092	0.635
2008	223	0.239	0.070	0.411
2009	246	0.207	0.066	0.490
2010	273	0.198	0.061	0.278
2011	331	0.225	0.067	0.257
2012	328	0.230	0.073	0.291
Average	2398	0.252	0.029	0.817

[7] Campello et al. (2010) indicated that firms planned deeper cuts in tech spending, employment, and capital spending during the financial crisis in the US, Europe and Asia.

Table 1A

Chi-square test for Inefficiency	
Variables	IE
T-test	1.387
P-value	0.172
Advanced	439
Developing	1959
Number	2398

Notes: 95% Conf. Interval

2.4.2 The Explanatory Variables

We have hypothesized that bank efficiency is related to credit rating scores. A credit rating is an evaluation of the credit risk of a prospective debtor (a bank), predicting their ability to pay back the debt, and an implicit forecast of the likelihood of the debtor defaulting. A rating expresses the likelihood that the rated party will go into default, within a given time-horizon: 1 year (short-term) or above (long-term). We focus on long-term ratings from three dominating CRAs including Fitch Ratings, Moody's and Standard & Poor's (S&P). As Table 2 shows, there are 12 grades in total, with AAA as the highest grade to indicate the lowest default risk, and D as the lowest grade to indicate the highest default risk. Thus, we code these ranking grades using 12 as the highest and 1 as the lowest accordingly. We therefore construct our key explanatory variable Credit Ratings (CR) as a truncated variable, equal to the average scores issued by these three CRAs during a given year, and 0 if there is no coverage by any of these CRAs. The average credit rating score in our sample is 7.721, which is equivalent to BB level, and means that the bank credit quality in South-East Asian countries is still at a low-level.

Table 2

Bank's long-term credit rating grades and definitions

Fitch	Moody's	S&P	Ranking	Definition
AAA	Aaa	AAA	12	Highest quality
AA+	Aa1	AA+	11.5	
AA	Aa2	AA	11	
AA-	Aa3	AA-	10.5	
A+	A1	A+	10	Upper-medium grade, high credit quality
A	A2	A	9.5	
A-	A3	A-	9	Lower-medium grade, high credit quality
BBB+	Baa1	BBB+	8.5	
BBB	Baa2	BBB	8	
BBB-	Baa3	BBB-	7.5	
BB+	Ba1	BB+	7	Speculative grade rating
BB	Ba2	BB	6.5	
BB-	Ba3	BB-	6	
B+	B1	B+	5.5	Highly speculative
B	B2	B	5	
B-	B3	B-	4.5	
CCC+	Caa1	CCC+	4	Significant speculative, Substantial credit risk
CCC	Caa2	CCC	3.5	
CCC-	Caa3	CCC-	3	
CC	Ca	CC	2.5	
C+	C	C+	2	
C	WR	C	1.5	Extremely speculative
DDD		D+	1	
DD/D		D/SD	0.5	Payment default

Our second hypothesis relates to the interaction between CRAs and the standards of investor protection. Following Nguyen et al (2015), Knudsen (2011) and Van Essen et al (2013), three indicators of national governance quality are chosen from the six dimensional World Governance Indicators (WGIs) to measure each country investor protection quality[8], namely Government Effectiveness (GE), Regulatory Quality (RQ),

[8] These World Governance Indicators (WGIs) are the most widely-used indicators in multi-country comparative studies (Ngobo & Fouda, 2012; Kaufmann et al, 2011) and cover six dimensions of national governance quality including: voice and accountability; political stability and absence of violence/terrorism; government effectiveness; regulatory quality; rule of law; and control of corruption. According to Kaufmann et al. (2011, p. 4), the Government Effectiveness index captures "the quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies". The Regulatory Quality index captures "the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development". The Rule of Law index captures "the extent to which agents have confidence in and abide by the rules of society, and in particular the quality of contract enforcement, property rights, the police, and the courts, as well as the likelihood of crime and violence". The Control of Corruption index captures "the extent to which public power is

and the Rule of Law (RL). Given the Control of Corruption (CC) is particularly related to the unique banking industry (Beck et al., 2006a; Barth et al., 2009; Houston et al., 2011; Delis, 2012). We also further add it into our previously selected indicators to construct our four dimensional indicator framework to measure the quality of investor protection for investors in the banking industry of a given country. The indicators are displayed in standard normal units ranging from −2.5 to +2.5, with more positive values indicating better national governance quality (Kaufmann et al, 2011). The indicators are highly correlated (Globerman & Shapiro, 2002) hence, in line with Knudsen (2011), the four indicators are combined to form an aggregate national Investor Protection Index (IPI) by summing these together, IPI-Sum = GE + RQ + RL + CC. Following Globerman and Shapiro (2002), we also combined these four indicators into one index using principal component analysis (IPI-PCA) for our robustness test.

Our third hypothesis relates to the interaction between CRAs and bank regulation strictness. We measure the strictness of bank regulations in a given country using four banking industry-level regulatory indicators, including the level of restrictions on the banks' activities (*ACTR),* capital requirements (*CAPR*), power of the supervisory agencies (*SPR*), and market discipline (*PMON*). Data on bank regulation is obtained from a database that has been updated by Demirguc-Kunt et al. (2012)[9]. In order to analyse the

exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests."

[9] *ACTR* takes values between 3 and 12 with higher values indicating higher restrictions. It includes three standards for evaluating the values, securities, insurance and real estate activities, and its four levels for evaluating are unrestricted (=1), permitted (=2), restricted (=3) or prohibited (=4). Thus, the final assessment for *ACTR* is the summation of the values of securities, insurance and real estate activities. *CAPR* is an indicator of capital requirements, accounting for both overall and initial capital stringency. The overall capital stringency, determines whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy. *CAPR* can take values between 0 and 10 with higher values, suggesting a greater stringent capital requirement. *SPR* is a measure of the power of the supervisory agencies and its values with greater values indicating more power of supervision. It is examined on the basis of the answers and the aim of this measurement is to discover whether the supervisory authorities have the authority to take specific actions to prevent and correct problems. *PMON* is an indicator of market discipline that takes values between 0 and 12. It indicates whether there are

overall effects of bank regulation, we use an aggregate Bank Regulation Index (BRI) by summing these together, BRI-Sum = ACTR + CAPR + SPR + PMON. We also combined these four bank regulation related indicators into one BRI by using principal component analysis (BRI-PCA) for our robustness test.

We control bank specific characteristics as well as country macro economy characteristics which are found to affect bank performance. We use the natural logarithm of total assets to represent the *bank size (BS)* and the ratio of total equity to total assets to control bank capitalization. Delis (2012) points out that large and well-capitalized banks are probably able to access funds at a lower cost, due to scale of economy, lower informational asymmetries and fewer moral hazard problems. We control the *fee income (FI)*, which equals non-interest operating income divided by total assets because it may affect the pricing of loan products. We also control default risk using the ratio of *non-performance loan to total asset (NPL)* because NPL by generating additional expenses, such as labor and storage costs damages bank cost efficiency (Barth et al., 2004). We also control *equity to total asset* (*ETA*) with the expected impact on bank cost inefficiency being positive. This is because internal funds can reduce transaction costs and enhance bank cost efficiency (Barth et al., 2004; 2013). We control *GDP growth*, *private sector credit (PSC)* and *unemployment rate (UR)*, following Barnichon (2010) and Delis, (2012). *Private sector credit (PSC)* represents the level of development of the financial sector with the expected impact being to reduce bank cost inefficiency (Delis, 2012). *GDP growth* and *unemployment rate (UR)* being the other two important country level characteristics, which may affect productivity and efficiency, and ultimately reduce bank cost

incentives for the private monitoring of firms, with higher values indicating more private monitoring. Thus, higher values suggest higher disclosure requirements and more incentives to increase private monitoring.

inefficiency (Barnichon, 2010). Table 3 provides the definitions for all variables and their expected impact on bank cost inefficiency. Tables 4 and 5 provide descriptive statistics for our variables.

Table 3. Definition of the variables.

Variable	**Definition**	**Expected impact on bank cost inefficiency**
BCIE	Bank cost inefficiency estimated using	
CR	Credit ratings are the average value of the long-term rating scores from three companies (Fitch Ratings, Moody's and Standard & Poor's (S&P)).	+
IPI	Investor protection index measuring the standards of investor protections in a given country	+
CR * IPI	The interaction term between CR and IPI	+
BRI	Bank regulation index measuring the strictness of bank industry level regulation in a given country	+
CR* BRI	The interaction term between CR and BRI	-
CRD	Credit rating downgrading measured by negative difference between the credit rating in a given year t and the credit rating in the previous year t-1	-
CRU	Credit rating upgrade measured by positive difference between the credit rating in a given year t and the credit rating in the previous year t-1	+
CRDW	Credit rating downgrading within group is a sub-group of credit rating downgrading focusing on the downgrading in the same group	-
CRDC	Credit rating downgrading cross group is a sub-group of credit rating downgrading focusing on the downgrading across group (i.e. from investment group to speculative group vice versa)	-
CRUW	Credit rating upgrading within group is a sub-group of credit rating upgrading focusing on the downgrading in the same group	+
CRUC	Credit rating upgrading cross group is a sub-group of credit rating upgrading focusing on the downgrading across group (i.e. from investment group to speculative group vice versa)	+
ACTR	ACTR indicates the level of restrictions on the banks' activities	-
CAPR	CAPR is an indicator of capital requirements, accounting for both overall and initial capital stringency	-
SPR	SPR is a measure of the power of the supervisory agencies and its values with greater values indicating more power of supervision	-

PMON	PMON indicates whether there are incentives for the private monitoring of firms, with higher values indicating more private monitoring	-
BS	Bank size is measured by the natural logarithm of total assets	+
FI	Fee income is the ratio of non-interest operating income divided by total assets	+
NPL	Non-performing loan ratio is calculated using non-performing loan divided by total asset	+
ETA	Equity to Assets ratio is measured using equity divided by total assets	-
PSC	Private sector credit is measured by the value of credits extended by all financial intermediaries to the private sector divided by GDP.	-
UR	Unemployment rate measured by the percentage of the total labor force that is unemployed but actively seeking employment and willing to work.	-
GDP	Gross domestic product (GDP) is the monetary value of all the finished goods and services produced within a country's borders in a given year	-

Table 4

Summary statistics						
Variable	N	Mean	P25	Median	p75	STD
Panel A - Estimation of Inefficiency						
Total cost (TC)	2398	12.40	11.08	12.48	13.75	1.979
Price of labour (P1)	2398	0.011	0.006	0.009	0.013	0.009
Price of financial capital (P2)	2398	0.060	0.021	0.040	0.063	0.147
Net loan (Q1)	2398	14.74	13.30	14.85	16.18	2.280
Other earning assets (Q2)	2398	14.35	12.94	14.41	15.80	2.235
Equity (N)	2398	3.340	1.892	3.561	4.501	12.62
GDP per capital	2398	8.792	8.122	8.492	9.114	0.974
Panel B – regulatory and institutional variables						
ACTR	2398	8.485	7.000	9.000	10.00	2.301
CAPR	2398	6.710	6.000	7.000	8.000	1.605
SPR	2398	10.91	9.500	10.00	12.00	1.983
PMON	2398	8.704	8.000	9.000	10.00	1.279
Governance effectiveness	2398	0.315	-0.131	0.017	0.281	0.722
Rule of law	2398	0.055	-0.489	-0.132	0.185	0.781
Control of corruption	2398	-0.099	-0.596	-0.479	-0.278	0.947
Regulatory quality	2398	0.134	-0.331	-0.210	-0.240	0.764

Notes: This table reports summary statistics (number, mean, P25, median, P75, minimum, maximum and standard deviation) for the variables used in measuring bank cost inefficiency, and the summary statistics of regulatory and institutional variables. In the Panel A, units of the variables are as follow: Total cost, Net loan, other earning assets, equity and GDP per capital are logarithm variable; price of financial capital and the price of labor are ratios. In the Panel B, units on the variables are ACTR (activity restrictions), CAPR (capital requirement), SPR (power of the supervisory agencies) and PMON (private monitoring). Other units of the variables are institutional variables, such as governance effectiveness, rule of law, control of corruption and regulatory quality.

Table 5

Summary statistics for determent of cost inefficiency

Variable	N	Mean	P25	Median	P75	STD
Credit ratings (CR)	2398	7.721	6.000	9.000	10.300	3.548
CRD	418	-1.293	-1.000	-1.000	-0.500	1.527
CRU	715	1.311	0.500	1.000	1.400	1.322
CRDW	345	-1.005	-1.000	-1.000	-0.500	0.828
CRDC	73	-.0763	-6.500	-2.000	-1.000	3.264
CRUW	570	1.244	0.500	1.000	1.400	1.068
CRUC	145	4.417	1.000	3.000	8.000	3.689
IPI-Sum	2398	0.405	-1.324	-0.953	0.286	3.163
IPI-PCA	2398	0.172	-0.688	-0.520	0.083	1.592
BRI-Sum	2398	34.479	30.500	34.500	40.000	4.889
BRI-PCA	2398	15.515	13.552	15.270	16.925	2.614
Bank Size (BS)	2398	9.721	9.093	9.758	10.30	0.926
Fee Income (FI)	2398	0.007	0.005	0.006	0.008	0.003
Non-performance loan (NPL)	2398	0.020	0.006	0.011	0.021	0.056
Equity to asset (ETA)	2398	0.109	0.059	0.084	0.123	0.089
Private sector credit (PSC)	2398	4.172	3.437	3.932	4.844	2.991
Unemployment rate (UR)	2398	5.855	4.100	5.246	7.960	2.558
GDP	2398	0.062	0.042	0.063	0.085	0.031

Notes: This table reports summary statistics (number, mean, P25, median, P75, minimum, maximum and standard deviation) for the variables used in this paper. IPI-Sum is an aggregate national governance index provided by Kaufmann et al. (2010), and updated by the World Bank. IPI-PCA is a national governance index using principal component analysis. BRI-Sum is an aggregate national regulation index updated by Demirguc-Kunt et al. (2012) at the World Bank. BRI-PCA is a national regulation index. Other variable definitions refer to Table 3.

Table 6 reports the correlation matrix of variables. All of the variables used in the regression have correlation co-efficiencies lower than 0.65, indicating no serious multicollinearity issues. We also conducted VIF tests, again without detecting multicollinearity problems.

Table 6

Correlation matrix

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1.BCIE	1.00																		
2.CR	-0.08	1.00																	
3.CRD	-0.05	0.20	1.00																
4.CRU	0.07	0.11	0.10	1.00															
5.CRDW	-0.12	0.11	0.47	0.11	1.00														
6.CRDC	-0.17	0.17	0.86	0.05	-0.04	1.00													
7.CRUW	0.21	0.07	0.11	0.43	0.12	0.05	1.00												
8.CRUC	0.11	0.08	0.05	0.87	0.06	0.03	-0.08	1.00											
9..IPI-Sum	0.10	0.22	-0.11	-0.11	0.04	-0.05	-0.09	-0.06	1.00										
10..IPI-PCA	0.10	0.22	-0.11	-0.11	0.08	-0.09	-0.09	-0.11	0.98	1.00									
11.BRI-Sum	-0.12	-0.03	0.04	0.03	0.02	0.03	0.03	0.04	-0.31	-0.31	1.00								
12.BRI-PCA	-0.10	-0.03	0.04	0.01	-0.03	-0.01	0.05	0.06	-0.42	-0.41	0.96	1.00							
13.PSC	0.01	0.28	0.02	-0.03	-0.06	-0.03	0.04	0.02	0.64	0.64	-0.08	-0.10	1.00						
14.UR	-0.02	-0.15	0.09	-0.03	-0.09	0.04	0.07	0.07	-0.42	-0.41	0.03	0.04	-0.54	1.00					
15.BS	-0.10	0.18	-0.02	-0.07	-0.02	-0.04	-0.01	-0.17	0.16	0.16	0.29	0.25	0.37	-0.33	1.00				
16.FI	0.16	-0.13	0.02	0.04	-0.05	0.01	0.02	0.07	-0.16	-0.16	-0.11	-0.12	-0.42	0.33	-0.20	1.00			
17.NPL	0.05	-0.11	-0.12	-0.12	-0.05	-0.05	-0.01	-0.13	-0.08	-0.08	-0.12	-0.10	-0.11	0.03	-0.18	0.09	1.00		
18.ETA	-0.03	0.03	-0.05	-0.05	0.01	-0.01	-0.01	-0.01	0.04	0.04	-0.22	-0.23	-0.03	-0.02	-0.49	0.24	0.17	1.00	
19.GDP	-0.07	0.09	0.04	0.03	0.02	0.10	-0.01	0.02	-0.35	-0.35	0.16	0.23	-0.10	0.08	0.02	-0.15	-0.02	0.02	1.00

Notes: IPI-Sum is an aggregate national governance index provided by Kaufmann et al. (2010), and updated by the World Bank. IPI-PCA is national governance index using principal component analysis. BRI-Sum is an aggregate national regulation index updated by Demirguc-Kunt et al. (2012) at the World Bank. BRI-PCA is national regulation index. Other variable definitions refer to Table 3.

2.4.3 Methodology: Fixed Effect

We estimate two fixed effect panel regression models. Regarding the impacts of CRAs and the interaction between CRAs and investor protection standards, we estimate regression (3) below:

$$BCIE_{i,t} = \beta_0 + \beta_1 CR_{i,c} + \beta_{IPI} IPI_{t,c} + \beta_{CR*IPI} CR_{i,c} * IPI_{t,c} + \beta_2 BS_{i,c} + \beta_3 FI_{i,c} + \beta_4 NPL_{i,c} + \beta_5 ETA_{i,c} + \beta_6 PSC_{t,c} + \beta_7 UR_{t,c} + \beta_8 GDP_{t,c} + \varepsilon_{i,t,c} \quad (3)$$

Regarding the impacts of CRAs and the interaction between CRAs and bank regulation, we estimate regression (4) below:

$$BCIE_{i,t} = \beta_0 + \beta_1 CR_{i,c} + \beta_{BRI} BRI_{t,c} + \beta_{CR*BRI} CR_{i,c} * BRI_{t,c} + \beta_2 BS_{i,c} + \beta_3 FI_{i,c} + \beta_4 NPL_{i,c} + \beta_5 ETA_{i,c} + \beta_6 PSC_{t,c} + \beta_7 UR_{t,c} + \beta_8 GDP_{t,c} + \varepsilon_{i,t,c} \quad (4)$$

In this equation, $BCIE_{i,t}$, which is calculated by the cost frontier model (equation 2) is the value of the cost inefficiency of bank i at time t in country c; ; CR_{tc} is credit ratings. $IPI_{t,c}$ is a set of variables representing the quality of investor protection standards in country c at time t. BRI_{tc} is the regulation variable, and measures the overall quality of supervision for the banking industry in country c at time t; $BS_{i,c}$ is bank size. $FI_{i,c}$ is the ratio of fee income. $NPL_{i,c}$ is the ratio of non-performance loan. $ETA_{i,c}$ is the ratio of equity to total asset. $PSC_{t,c}$ is the index of private sector credit. $UR_{t,c}$ is the unemployment rate. $GDP_{t,c}$ the is growth rate of GDP. $\varepsilon_{i,t,c}$ is the error item.

2.4.4 Dynamic Panel Model

A common problem in using empirical data is autocorrelation and heteroscedasticity, and we eliminate their impact by using fixed effect with robust check. Another important feature of this analysis is that we account for the potential endogeneity of inefficiency. In order to correct for possible endogeneity (Arellano & Bond 1991; Aslan and Kumar, 2014), we estimate the Generalized Method of Moment (GMM) panel regression (5) and (6) below:

$$BCIE_{i,t} = \beta_0 + \beta_1 BCIE_{i,t-1} + \beta_2 CR_{i,c} + \beta_{IPI} IPI_{t,c} + \beta_{CR*IPI} CR_{i,c} * IPI_{t,c} + \beta_3 BS_{i,c} + \beta_4 FI_{i,c} + \beta_5 NPL_{i,c} + \beta_6 ETA_{i,c} + \beta_7 PSC_{t,c} + \beta_8 UR_{t,c} + \beta_9 GDP_{t,c} + \varepsilon_{i,t,c} \quad (5)$$

$$BCIE_{i,t} = \beta_0 + \beta_1 BCIE_{i,t-1} + \beta_2 CR_{i,c} + \beta_{BRI} BRI_{t,c} + \beta_{CR*BRI} CR_{i,c} * BRI_{t,c} + \beta_3 BS_{i,c} + \beta_4 FI_{i,c} + \beta_5 NPL_{i,c} + \beta_6 ETA_{i,c} + \beta_7 PSC_{t,c} + \beta_8 UR_{t,c} + \beta_9 GDP_{t,c} + \varepsilon_{i,t,c} \quad (6)$$

In this equation, $BCIE_{i,t-1}$ is the lag value of the cost inefficiency of bank i at time t in country c.

2.5 Empirical results

2.5.1 The effect of credit ratings, bank regulation and investor protection standards on bank cost inefficiency

The regression results using fixed effect panel estimations are summarized in Table 7. Panel A, Table 7 shows the results using the IPI-Sum and the BRI-Sum calculated using the summarized approach while Panel B, Table 7 shows the results using IPI-PCA and BRI-PCA calculated using the principal component analysis (PCA) approach. These two

approaches generate similar results. Thus, we focus on Panel A to discuss our empirical results.

As Model 1, Table 7 shows, credit ratings is negatively related to bank cost inefficiency and the co-efficiency is highly significant ($\beta_1 = -0.004$， $p < 0.001$). This supports the hypothesis 1 and suggests that credit ratings issued by credit rating agencies improve bank performance by reducing bank cost inefficiency. Investor protection quality is positively related to bank cost inefficiency and the co-efficiency is also highly significant ($\beta_{IPI} = 0.012$， $p < 0.01$). This contrasts with previous results (e.g. Demirgüç-Kunt et al., 2004; Demirgüç-Kunt et al., 2008; Lensink et al., 2008; Delis, 2012). Our results suggest that high investor protection standards represent a net cost burden to banks operating in countries with such standards, thus reducing bank performance by increasing bank cost inefficiency.

Model 2, Table 7 further shows that there is a significant negative interaction between credit ratings and investor protection quality in affecting bank cost inefficiency ($\beta_{CR*IPI} = -0.003$， $p < 0.01$). This supports the hypothesis 2 and suggests that credit ratings improve bank cost efficiency more when there is a higher investor protection embedded in the institutional environment in an emerging market. Previous research from Haw et al. (2010), Demirguc-Kunt et al., (2012) and Delis (2012) highlights that bank competition can be the transmission mechanism utilised to realize the benefits of strong investor protection. From a different perspective, our findings highlight credit rating agencies as being the transmission mechanism, helping to realise the benefits of high investor protection standards embedded in the general institutional environment in emerging markets.

Model 3, Table 7 shows that credit ratings have a significantly negative impact on bank costs inefficiency, again supporting the hypothesis 1. Also it shows that bank regulation quality is negatively related to bank cost inefficiency, and such co-efficiency is highly significant ($\beta_{BRI} = -0.004$， $p < 0.01$). This implies that stricter bank industry regulations help banks to be more specialized in their restricted business area (Barth et al. 2001, Pasiouras et al. 2009 and Demirguc-Kunt et al. 2012), and to be more efficient in utilizing their capital against the risk of insolvency (VanHoose, 2007; Pasiouras et al., 2006) and thus become more cost efficient. This is consistent with the view that bank regulations are beneficial to bank performance (e,g. Barth et al., 2001; Barth et al., 2004; Pasiouras et al., 2009). However, as Model 4, Table 6 shows, there is a positive interaction between credit rating and bank regulation quality in impacting bank cost inefficiency with a highly significant co-efficiency ($\beta_{CR*BRI} = 0.002$， $p < 0.001$). This suggests that strict bank regulation, as a relatively less flexible approach to monitor bank activities, can offset the benefits of credit ratings (which represent a more flexible private monitoring enforcement power) in monitoring banks. In other words, active credit rating agencies and strict bank specific regulations, as a bundle of monitoring systems, may cause over-regulation concerns and not be optimal for bank cost efficiency. The hypothesis 3 is thus supported.

Table 7: Fixed effects panel regression - The effect of credit ratings, bank regulation and investor protection standards on bank cost inefficiency

	Panel A (Sum-Index)				Panel B (PCA-Index)			
	Model (1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CR (β_1)	-0.004***	-0.004***	-0.003***	-0.013***	-0.003***	-0.004***	-0.003***	-0.011***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.002)
IPI (β_{IPI})	0.012***	0.020***			0.030***	0.040***		
	(0.004)	(0.004)			(0.007)	(0.009)		
CR * IPI (β_{CR*IPI})		-0.003***				-0.002***		
		(0.001)				(0.001)		
BRI (β_{BRI})			-0.004***	-0.004***			-0.004***	-0.007***
			(0.001)	(0.001)			(0.001)	(0.001)
CR*BRI (β_{CR*BRI})				0.002***				0.001***
				(0.001)				(0.000)
BS (β_2)	0.011	0.010	0.014	0.016*	0.011	0.010	0.016*	0.015*
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
FI (β_3)	0.004	0.004	0.001	0.002	0.004	0.004	0.002	0.002
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
NPL (β_4)	-0.022	-0.022	-0.030	-0.032	-0.023	-0.022	-0.027	-0.028
	(0.052)	(0.052)	(0.050)	(0.048)	(0.052)	(0.052)	(0.051)	(0.049)
ETA (β_5)	0.024	0.018	0.030	0.028	0.024	0.018	0.031	0.028
	(0.051)	(0.051)	(0.052)	(0.052)	(0.051)	(0.051)	(0.052)	(0.052)
PSC (β_6)	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR (β_7)	-0.001	-0.002*	-0.001*	-0.000	-0.001*	-0.000	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP (β_8)	-0.103***	-0.100***	-0.066*	-0.061*	-0.101***	-0.099***	-0.057*	-0.054*
	(0.034)	(0.033)	(0.034)	(0.034)	(0.034)	(0.033)	(0.035)	(0.031)
R2_adjusted	0.104	0.110	0.122	0.131	0.104	0.114	0.111	0.119
F	11.703	10.625	13.340	12.565	10.138	11.796	12.705	12.228

Notes: The dependent variable bank cost inefficiency is used to reflect a bank's performance; a lower value illustrates better bank performance. Variable definitions refer to Table 2. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

In order to address possible endogeneity issues, we estimate the regression models using the AB-GMM approach. Following Arellano & Bond (1991), we adopt the AB-GMM approach by using the lagged values of the credit ratings, investor protection quality and bank regulation as instrumental variables. To control the autocorrelation of bank cost inefficiency itself, we also add first order lagged values of bank cost inefficiency (L.BCIE) into our regressions. This procedure eliminates the persistent components of the latent or unobservable variables and the error terms, and helps to address the reverse causality issue. The L.BCIE is significantly and positively related to the current bank cost inefficiency while the AR(2) z-value is insignificant. This suggests that previous bank efficiency positively impacts current bank efficiency with a short memory period (i.e., only 1 year) and our first order lagged L.BCIE is enough to capture such short memory period auto-correlation. Overall, the robustness test results in Table 8 are consistent with our previous results in Table 6 and the hypotheses 1, 2, and 3 are fully supported.

Table 8: AB GMM panel regression: The effect of credit ratings, bank regulation and investor protection standards on bank cost inefficiency

	Panel A (Sum-Index)				Panel B (PCA-Index)			
	Model (9)	(10)	(11)	(12)	(13)	(14)	(15)	(16)
CR (β_1)	-0.002***	-0.002***	-0.003***	-0.020***	-0.002***	-0.002***	-0.003***	-0.012***
	(0.001)	(0.001)	(0.001)	(0.004)	(0.001)	(0.000)	(0.001)	(0.003)
IPI (β_{IPI})	0.002**	0.007***			0.003**	0.013***		
	(0.001)	(0.002)			(0.001)	(0.004)		
CR * IPI(β_{CR*IPI})		-0.001***				-0.001***		
		(0.000)				(0.000)		
BRI (β_{BRI})			-0.002***	-0.004***			-0.003***	-0.006***
			(0.000)	(0.001)			(0.000)	(0.001)
CR* BRI(β_{CR*BRI})				0.001***				0.001***
				(0.000)				(0.000)
BS (β_2)	-0.006**	-0.005**	-0.006*	-0.007***	-0.006***	-0.005**	-0.007***	-0.007***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
FI(β_3)	-0.004	0.007	0.012**	0.013***	-0.005	0.007	0.010**	0.011**
	(0.008)	(0.006)	(0.005)	(0.004)	(0.008)	(0.005)	(0.004)	(0.005)
NPL (β_4)	-0.199	0.018	-0.353*	-0.297*	-0.200	0.016	-0.236*	-0.264*
	(0.128)	(0.031)	(0.208)	(0.173)	(0.122)	(0.028)	(0.130)	(0.139)
ETA (β_5)	-0.094**	-0.077**	-0.112**	-0.122***	-0.094**	-0.077**	-0.121**	-0.125**
	(0.038)	(0.032)	(0.055)	(0.040)	(0.037)	(0.035)	(0.048)	(0.049)
PSC (β_6)	-0.001	0.001*	0.001	0.001***	-0.001	0.001*	0.001	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR (β_7)	-0.001*	0.000	-0.001	-0.001	-0.001*	0.001	-0.001	-0.001

	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP (β_8)	0.066**	0.087***	0.084***	0.094***	0.066**	0.088***	0.102***	0.100***
	(0.029)	(0.033)	(0.033)	(0.029)	(0.029)	(0.034)	(0.027)	(0.028)
L.BCIE(β_9)	0.669***	0.616***	0.622***	0.606***	0.670***	0.618***	0.645***	0.638***
	(0.059)	(0.072)	(0.068)	(0.073)	(0.059)	(0.072)	(0.058)	(0.061)
AR(1)	0.000	0.001	0.000	0.000	0.000	0.001	0.000	0.000
AR(2)	0.104	0.780	0.232	0.161	0.103	0.791	0.159	0.135
Hansen(p-value)	0.855	1.000	0.106	0.858	0.862	1.000	0.948	0.904

Notes: The dependent variable bank cost inefficiency is used to reflect a bank's performance; a lower value illustrates better bank performance. Variable definitions refer to Table 2. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

2.5.2 Robustness: Instrumental Variables Estimation

If the credit ratings are determined by a company's operational environment, then the ratings monitoring-performance regression could spuriously pick up the effect of unobserved factors. For example, if a bank needs greater external financing for investment opportunities, it has to have more incentives to improve credit quality, thus inducing a positive relationship between credit ratings and performance. Similarly, country characteristics (economic environment, cultural difference, financial reform and development) may be correlated with both the country environment and the banks' performance (Bruno and Claessens, 2010). In order to eliminate the possible endogeneity of credit ratings, we also use the instrumental variables (IV) approach as an alternative measure.

We run a two-stage least squares instrumental variable analysis (2SLS)[10] by using the lag variable of credit ratings[11], one bank-level variable (liquidity ratio) and one country-level variable (inflation) as our instruments. The liquidity ratio (LR) is measured by dividing liquid assets by total assets in a given year. The inflation ratio is measured by the change in the Consumer Price Index (CPI) between the previous year CPI and the current year CPI divided by the current year CPI in a given year. Liquidity ratio directly highlights whether a bank has sufficient current assets such as cash and quickly saleable securities to satisfy current obligations. This liquidity ratio may directly affect a bank's credibility, thus CRAs evaluation outcome on such bank credibility (Diamond and Rajan, 2001;

[10] We use the Cragg-Donald statistic to assess whether the instruments are weak. When there is one endogenous regressor as in our 2SLS models, the null hypothesis is that the instruments have no explanatory power in the first stage regression. With one endogenous regressor and two excluded instruments, the critical value (Stock–Yogo weak ID test) for the Cragg–Donald statistic for 10% maximal size distortion is 19.93. Since we have two instruments and one endogenous regressor, we use the Sargan test for over-identifying restrictions to assess whether the instruments are uncorrelated with the second-stage error. If the test statistic exceeds the critical value, we reject the null hypotheses that the instruments are uncorrelated with the structural error and conclude that at least one of the instruments is not exogenous.

[11] We use the lag variable of credit ratings as instruments to control the autocorrelation problem.

Pasiouras et al., 2006). However, it does not directly affect how resources in a given bank may be utilized in an efficient and effective manner, i.e., bank cost efficiency (Minetti, 2007). Similarly, inflation by directly affecting the valuation of an asset, may lead to imprudent policies, such as excessive borrowing, and so directly affect the probability of default and ultimately CRAs evaluation outcome on a bank's credibility (David, 2008). Despite that inflation can be a significant determinant of credit spread in developed and developing countries (Butler and Fauver, 2006; Weigel and Gemmill, 2006), it may not directly affect the resource utilization efficiency (Benabou, 1992). Empirically, we find LR and Inflation are not significantly related to bank cost efficiency but are significantly related to CRAs ($p<0.001$). These two IVs related to bank-specific and country-level characteristics are strong instrument variables for CRAs, because the first step F-statistic value are higher than 19.93.

In Table 9, we examine hypotheses 1, 2 and 3, using the exogenous bank-sector liquidity ratio and country-level inflation as instruments. The results are constituent with **H1** that *Credit rating agencies improve bank performance in emerging markets*, and **H2** that *Credit rating agencies enhance bank performance more when there are stronger investor protections embedded in the institutional environments in emerging markets*, and **H3** that *Credit rating agencies enhance bank performance less when bank regulations are stricter in emerging markets.*

Table 9: Instrumental variables Estimiates: The effect of credit ratings, bank regulations and investor protection standards on bank cost inefficiency

	Panel A (Sum-Index)				Panel B (PCA-Index)			
	Model (17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
CR (β_1)	-0.005***	-0.007***	-0.005***	-0.036***	-0.005***	-0.007***	-0.005***	-0.033***
	(0.001)	(0.001)	(0.001)	(0.008)	(0.001)	(0.001)	(0.001)	(0.008)
IPI (β_{IPI})	0.020***	0.029***			0.039***	0.057***		
	(0.003)	(0.004)			(0.006)	(0.009)		
CR * IPI(β_{CR*IPI})		-0.001***				-0.003***		
		(0.000)				(0.001)		
BRI (β_{BRI})			-0.002***	-0.009***			-0.004***	-0.017***
			(0.000)	(0.002)			(0.000)	(0.003)
CR* BRI(β_{CR*BRI})				0.001***				0.002***
				(0.000)				(0.000)
BS (β_2)	0.018**	0.015*	0.020**	0.023***	0.018**	0.015*	0.020**	0.021**
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.009)	(0.009)
FI(β_3)	0.005	0.006	0.002	0.005	0.005	0.006	0.002	0.004
	(0.006)	(0.006)	(0.005)	(0.006)	(0.006)	(0.006)	(0.006)	(0.006)
NPL (β_4)	0.055	0.062	0.029	0.013	0.056	0.062	0.038	0.020
	(0.080)	(0.080)	(0.086)	(0.082)	(0.081)	(0.080)	(0.083)	(0.078)
ETA (β_5)	-0.026	-0.040**	-0.018	-0.035*	-0.025	-0.040**	-0.015	-0.032
	(0.036)	(0.018)	(0.037)	(0.018)	(0.037)	(0.018)	(0.037)	(0.038)
PSC (β_6)	-0.001***	-0.001***	-0.001***	-0.000***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR (β_7)	-0.001*	0.001	-0.001*	0.001	-0.001*	0.001	-0.002*	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP (β_8)	-0.088**	-0.086**	-0.030	-0.025	-0.086**	-0.083**	-0.034	-0.033
	(0.040)	(0.040)	(0.039)	(0.039)	(0.040)	(0.040)	(0.039)	(0.039)

(Continued)

Table 9- *Continued*

	Panel A (Sum-Index)				Panel B (PCA-Index)			
	Model (17)	(18)	(19)	(20)	(21)	(22)	(23)	(24)
Cragg–Donald(F-statistic)	164.766	148.602	170.331	44.397	165.310	146.381	169.373	39.962
Sargan test(p-value)	0.462	0.690	0.135	0.591	0.478	0.708	0.101	0.395
r2_a	0.114	0.123	0.129	0.139	0.114	0.123	0.113	0.095
F	18.454	17.920	24.245	21.685	18.444	17.823	22.317	19.765

Notes: The table reports the second stage of a 2SLS model where the dependent variable is cost inefficiency as used to reflect a bank's performance, which is calculated from the translog cost function (SFA); We use the Cragg–Donald statistic to assess whether the instruments are weak. When there is one endogenous regressor as in our models (i.e., credit ratings), the Cragg–Donald statistic has an F distribution under the null hypothesis that the instruments have no explanatory power in the first stage regression. With one endogenous regressor and two excluded instruments, the critical value (Stock–Yogo weak ID test) for the Cragg–Donald statistic for 10% maximal size distortion is 19.93. Since we have two unique instruments and one endogenous regressor in each IV regression model, we use the Sargan test for over-identifying restrictions to assess whether the instruments are uncorrelated with the second-stage error. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

2.5.3 Robustness: The impact of bank regulation and investor protection standards

Panel-A in Table 10 shows the estimation of the impact of regulation on banking cost inefficiency; this model includes the macroeconomic environment as well as bank specific variables. Furthermore, we analyze the impact of regulations on bank performance during the period 2000-2012, and investigate four standards of the regulations.

As can be seen from the first model, ACTR has a statistically negative effect on cost inefficiency, implying that higher restrictions of activities increase the cost efficiency of banks. This is consistent with the view that more regulations restrict banks' access to entry securities, insurance and real estate markets in order to protect banks from facing more risks (Barth et al. 2001, Pasiouras et al. 2009 and Demirguc-Kunt et al. 2012). This negative impact also indicates that the lower cost may allow banks to utilize their funding sources more effectively, and ensure the stable operation of Asian banks. On the other hand, because of higher restrictions on the banks' activities, banks may reduce their expenditure on employing experts, and thus they have improved cost efficiency.

Similarly, in the second model, the result differs from VanHoose (2007) that CAPR has a significant negative impact on cost efficiency, showing that a lower (higher) capital requirement result in a higher (lower) cost inefficiency. As Pasiouras et al.'s (2006) study shows, restrictive capital requirements may lead to higher levels of bank capital, so that there is a low probability of financial distress. Furthermore, a higher capital requirement can restrict banks to engaging in higher risk activities and ensure a stable performance.

From the third and fourth models, there is significant negative impact on cost inefficiency caused by SPR and PMON, which aligns with Haw (2010) and Delis (2011). The effect of official supervisory action indicates that higher scores may give rise to greater cost

efficiency, meaning that powerful supervision can improve the corporate governance of banks and their functioning (Beck et al. 2006b). It is not unreasonable to suggest that supervisory authorities, who have the ability to take specific action to prevent or correct problems, may promote bank performance and efficiency. Similarly, the effect of PMON suggests that a higher PMON can drive banks to work more effectively. This impact related to the disclosure of accurate information to the public will allow private agents to mitigate asymmetric information (Beck et al. 2006b and Pasiouras et al. 2009). Obviously, as the public become aware of such information, the moral hazard problem and corruption of bank officials will be reduced. Finally, the BRI has a significantly negative impact on cost inefficiency. Our results support the previous studies (e.g. Barth et al., 2004; Beck et al., 2006b; Pasiouras et al., 2009) that bank-level regulation could improve bank performance effectively. At the same time, in terms of the macroeconomic control variables, the variable of private sector credit (*domestic credit to the private sector of GDP*) is significant at the 1% level of each model and has a negative impact on cost inefficiency, which means that this indicator could improve bank performance.

For the country-level regulation, we analyze whether investor protection standards affect bank cost inefficiency in Panel-B. We analyze the impact of investor protection standards on bank performance during the period 2000-2012, and investigate the four standards of protection variables respectively.

The variables, such as governance effectiveness (GE), rule of law (RL), control of corruption (CC), regulatory quality (RQ) and IPI, have a significantly positive impact on bank cost inefficiency. Our findings are different from previous studies (e.g. Demirgüç-Kunt et al., 2004; Demirgüç-Kunt et al., 2008; Demirgüç-Kunt et al., 2013; Lensink et al., 2008; Delis, 2012), which indicate that the quality of protection standards may not

improve bank performance directly. The macroeconomic variable, such as private sector credit, is statistically significant at 1% and unveils a negative impact on bank performance.

The reason for this relationship is that country-level regulation is not like the bank specific regulation (Barth et al., 2002; Barth et al., 2006; Demirgüç-Kunt et al., 2008) and plays a role as investor protection in the financial market (e.g. Demirgüç-Kunt et al., 2008), so that its aim is not to supervise bank performance. Additionally, the results in Table 10 are consistent with the previous findings in Tables 7, 8 and 9 that bank regulations improve bank performance, while the positive impact of investor protection on bank performance should be based on the transmission mechanism (Haw, 2010; Demirguc-Kunt et al., 2012; Delis, 2012), such as competition.

Table 10: Robustness: The impact of bank regulations and investor protection standards on bank cost inefficiency

	Panel A – Regulation index					Panel B – Institution index				
	(1) BCIE	(2) BCIE	(3) BCIE	(4) BCIE	(5) BCIE	(6) BCIE	(7) BCIE	(8) BCIE	(9) BCIE	(10) BCIE
ACTR	-0.002***									
	(0.001)									
CAPR		-0.003***								
		(0.001)								
SPR			-0.006***							
			(0.001)							
PMON				-0.007***						
				(0.001)						
BRI					-0.003***					
					(0.000)					
GE						0.032**				
						(0.016)				
RL							0.020**			
							(0.010)			
CC								0.032***		
								(0.011)		
RQ									0.037***	
									(0.003)	
IPI										0.012***
										(0.004)
PSC	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR	-0.001*	-0.002*	-0.002*	-0.002*	-0.002**	-0.001*	-0.001*	-0.001*	-0.001*	-0.001*
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
BS	0.001	0.004	-0.015*	0.009	0.007	-0.022*	-0.022**	-0.027**	0.002	0.002
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.009)	(0.008)	(0.009)	(0.008)	(0.008)

(Continued)

Table 10-*Continued*

Robustness: The impact of bank regulations and investor protection standards on bank cost inefficiency

	Panel A – Regulation index					Panel B – Institution index				
	(1) BCIE	(2) BCIE	(3) BCIE	(4) BCIE	(5) BCIE	(6) BCIE	(7) BCIE	(8) BCIE	(9) BCIE	(10) BCIE
FI	-0.022*	0.002	0.001	0.001	0.000	0.002	0.003	0.003	0.002	0.002
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
NPL	-0.024	-0.023	-0.029	-0.032	-0.034	-0.021	-0.023	-0.024	-0.022	-0.025
	(0.055)	(0.055)	(0.054)	(0.054)	(0.053)	(0.057)	(0.055)	(0.056)	(0.055)	(0.055)
ETA	0.014	0.017	0.004	0.024	0.019	0.006	0.012	0.009	0.015	0.013
	(0.053)	(0.053)	(0.054)	(0.054)	(0.054)	(0.052)	(0.053)	(0.053)	(0.053)	(0.053)
GDP	-0.086**	-0.082**	-0.060*	-0.048*	-0.031*	-0.115***	-0.091**	-0.097***	-0.081**	-0.091**
	(0.037)	(0.037)	(0.036)	(0.027)	(0.017)	(0.039)	(0.037)	(0.035)	(0.037)	(0.038)
cons	0.182***	0.136**	0.223***	0.143**	0.189***	0.172**	0.149**	0.187***	0.146**	0.141**
	(0.068)	(0.066)	(0.071)	(0.063)	(0.067)	(0.068)	(0.065)	(0.070)	(0.064)	(0.064)
r2_a	0.073	0.069	0.093	0.099	0.099	0.072	0.069	0.076	0.068	0.071
F	7.549	6.869	9.143	8.316	8.681	7.001	6.875	8.119	6.842	6.941

Notes: This table shows the impact of bank specific regulation and institution on cost inefficiency. GE is governance effectiveness. RL is rule of law and CC is control of corruption. RQ is regulatory quality. The first five models (Panel A) are panel regressions with fixed effects for the relationship between bank specific regulation and bank performance. The models (6) to (10) are fixed effect models for the relationship between institutions and bank performance.

2.5.4 Robustness: Whether over-regulation exists between credit ratings and investor protection standards

According to Tables 7, 8 and 9, we find that Credit rating agencies enhance bank performance more when there is stronger investor protection embedded in the institutional environment in emerging markets. In order to test whether over-regulation exists in banking industry, we analyse the relationship between bank cost inefficiency and the interactive term for credit ratings as well as each institutional variable. We focus on the three aspects: rule of law reflecting the quality of the judicial system for controlling moral hazard; control of corruption reflecting the transparency of banking sector; the GR index [12] reflecting the policy implementation of corporate governance and private development.

Table 11 shows that credit ratings could improve bank efficiency. While all institutional variables have a positive impact on cost inefficiency and these results are different from Barth et al. (2004), which means that high investor protection standard represents a net cost burden to banks operating in countries with such standards. However, the interaction between credit ratings and rule of law has a significantly negative impact on cost inefficiency, and the interaction between ratings and corruption has the same effect on bank performance. More importantly, for analysing country-level governance and regulation, we find that the interaction between ratings and GR index has a significantly negative impact on cost inefficiency as well. Therefore, credit ratings could have a positive impact on efficiency and play a role as transmission mechanism for institutions to utilize to improve bank performance in an advanced institutional environment. Our findings show that an advanced institution provides a transparent environment in which

[12] We use an aggregate institution index (Governance effectiveness + Regulatory quality) to reflect the impact of policy on bank governance and regulation.

to improve the strength of competitiveness and financial integration (Haw, 2010; Demirguc-Kunt et al., 2012; Delis, 2012), but it needs an instrument to realise the benefits of high investor protection standards embedded in the general institutional environment in emerging markets (Delis, 2012). This impact is in line with our hypothesis **H2**. There is no over-regulated banking industry if credit ratings and country regulations jointly supervise bank performance.

Table 11: Robustness: The impact of investor protection standards on bank cost inefficiency

	Panel A – Fixed Effect			Panel B – AB GMM		
	(1)	(2)	(3)	(4)	(5)	(6)
	BCIE	BCIE	BCIE	BCIE	BCIE	BCIE
CR	-0.004***	-0.004***	-0.003***	-0.003***	-0.003***	-0.002***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
RL	0.041***			0.026***		
	(0.012)			(0.008)		
CR * RL	-0.004***			-0.002***		
	(0.001)			(0.001)		
CC		0.052***			0.028***	
		(0.013)			(0.010)	
CR * CC		-0.003**			-0.003***	
		(0.001)			(0.001)	
GR			0.042***			0.017***
			(0.009)			(0.006)
GR * GR			-0.002**			-0.001**
			(0.001)			(0.001)
PSC	-0.001***	-0.001***	-0.001***	0.001	-0.001*	-0.001*
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR	-0.000	-0.001*	0.000	-0.001	-0.001	-0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
BS	0.016*	0.010	0.008	-0.008***	-0.005*	-0.005**
	(0.009)	(0.010)	(0.010)	(0.002)	(0.002)	(0.002)
FI	0.003	0.004	0.004	-0.006	0.008	0.003
	(0.008)	(0.008)	(0.008)	(0.008)	(0.006)	(0.008)
NPL	-0.022	-0.021	-0.019	-0.045	-0.007	0.015
	(0.051)	(0.053)	(0.053)	(0.109)	(0.096)	(0.085)
ETA	0.026	0.023	0.016	-0.143***	-0.129***	-0.139***
	(0.052)	(0.051)	(0.051)	(0.041)	(0.046)	(0.044)

(Continued)

Table 11-*Continued*

	Panel A – Fixed Effect			Panel B – AB GMM		
	(1)	(2)	(3)	(4)	(5)	(6)
	BCIE	BCIE	BCIE	BCIE	BCIE	BCIE
GDP	-0.066**	-0.079**	-0.111***	0.059*	0.093**	0.095**
	(0.033)	(0.033)	(0.035)	(0.032)	(0.044)	(0.043)
L.BCIE				0.656***	0.295***	0.282**
				(0.063)	(0.107)	(0.113)
cons	0.059	0.126*	0.118*	0.112**	0.192***	0.157***
	(0.062)	(0.070)	(0.066)	(0.052)	(0.043)	(0.044)
r2_a	0.110	0.107	0.114			
F	10.269	11.741	11.587			
AR(1)				0.000	0.009	0.011
AR(2)				0.106	0.342	0.263
Hansen(p-value)				0.879	1.000	1.000

Notes: This table shows whether credit ratings moderate the impact of investor protection standards on bank performance. RL is rule of law and CC is control of corruption. GR (Governance effectiveness + Regulatory quality) is an aggregate index of governance regulation. We use the GR index to reflect the quality of governance supervision. The first three models in Panel A are panel regressions with fixed effects. The models (4) to (6) are dynamic panel models (GMM) in the Panel B. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

2.5.5 Robustness: Whether over-regulation exists between credit ratings and bank-specific regulations

According to Tables 7, 8 and 9, we find that Credit rating agencies enhance bank performance less when bank regulations are stricter in emerging markets. In order to test whether over-regulation exists in the banking industry, we analyze the relationship between bank cost inefficiency and the interactive term for between credit ratings as well as each of regulatory variable. We focus on these three aspects: whether credit ratings mitigate the impact of bank restrictions; whether credit ratings mitigate the impact of capital requirements; whether credit ratings mitigate the impact of private supervision[13].

Table 12 shows that credit ratings could improve bank performance. Regulatory factors, such as activity restriction, capital requirement and SP index could improve bank performance as well in both models. However, the interaction term between credit ratings and activity restriction has a positive impact on cost inefficiency. It means that credit ratings mitigate the impact of restriction on bank performance, and conflict exists between these two supervision (Chhaochharia and Grinstein, 2007; Bruno and Claessens, 2010). Both of them restrict the bank from taking excessive risk and reduce diversification in the financial service, which reduces the bank profitability. The economic scale that enhances bank efficiency is also influenced by both the market discipline and bank regulation. Furthermore, the impact of capital requirement on bank performance is also mitigated by credit ratings. As higher capital requirement reduces risk-weighted assets and credit ratings reduces risk-taking behaviour, bank would choose conservative strategy that influences profitability and performance (Delis and Kouretas, 2011). Finally, credit ratings also mitigate the impact of the power of private monitoring on bank efficiency. A

[13] We use an aggregate regulation index (SPR + PMON) to reflect the impact of bank private supervision, in order to reflect power of private monitoring and quality of private disclosure.

high level of monitoring and intervention reduce a manager's incentives to exert effort, which worsens a firm's valuation and performance (Zhang, 2007). Therefore, our results support the hypothesis **H3** and suggest that strict bank regulation, as a relatively less flexible approach to monitor bank activities, can offset the benefits of credit ratings (which represent a more flexible approach) in the monitoring of banks. In other words, credit ratings moderate the impact of bank-level regulation on bank performance, and indicate that the banking industry is over-regulated, if credit ratings and bank regulation jointly supervise bank performance. The findings align with the view that well-performance banks with lower regulation, such as capital requirement, are assigned with higher ratings, as capital requirement may increase risk-taking (Pasiouras et al., 2006).

Table 12: Robustness: The impact of bank specific regulations on bank cost inefficiency

	Panel A – Fixed Effect			Panel B – AB GMM		
	(1) BCIE	(2) BCIE	(3) BCIE	(4) BCIE	(5) BCIE	(6) BCIE
CR	-0.008***	-0.005***	-0.009**	-0.005***	-0.008***	-0.011***
	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)
ACTR	-0.006***			-0.003***		
	(0.001)			(0.001)		
CR * ACTR	0.001***			0.001***		
	(0.000)			(0.000)		
CAPR		-0.005***			-0.008***	
		(0.001)			(0.002)	
CR * CAPR		0.001**			0.001***	
		(0.000)			(0.000)	
SP			-0.007***			-0.005***
			(0.002)			(0.001)
CR * SP			0.001*			0.001***
			(0.000)			(0.000)
PSC	-0.001***	-0.001***	-0.001***	0.001***	0.001***	0.001**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR	-0.001	-0.001	-0.000	-0.001	-0.001	-0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
BS	0.016*	0.017*	0.018*	-0.008***	-0.008***	-0.007***
	(0.009)	(0.009)	(0.009)	(0.002)	(0.003)	(0.002)
FI	0.002	0.002	0.001	0.015***	0.013***	0.014***
	(0.008)	(0.008)	(0.008)	(0.004)	(0.004)	(0.004)
NPL	-0.024	-0.023	-0.032	-0.046	-0.186	-0.139
	(0.050)	(0.050)	(0.051)	(0.061)	(0.124)	(0.115)

(Continued)

Table 12-*Continued*

	Panel A – Fixed Effect			Panel B – AB GMM		
	(1) BCIE	(2) BCIE	(3) BCIE	(4) BCIE	(5) BCIE	(6) BCIE
ETA	0.031	0.029	0.060*	-0.114***	-0.139***	-0.111***
	(0.052)	(0.051)	(0.032)	(0.038)	(0.042)	(0.036)
GDP	-0.063*	-0.060*	-0.023	0.095***	0.074***	0.090***
	(0.034)	(0.034)	(0.033)	(0.025)	(0.028)	(0.026)
L.BCIE				0.551***	0.641***	0.561***
				(0.096)	(0.060)	(0.090)
cons	0.109*	0.077	0.121*	0.237***	0.259***	0.295***
	(0.066)	(0.064)	(0.068)	(0.038)	(0.052)	(0.047)
r2_a	0.102	0.102	0.131			
F	11.868	10.830	12.392			
AR(1)				0.001	0.000	0.001
AR(2)				0.687	0.110	0.878
Hansen(p-value)				1.000	0.854	1.000

Notes: This table shows whether credit ratings moderate the impact of regulation on bank performance ACTR is bank restriction on activities. CAPR is capital requirement. SP (SPR+PMON) is an aggregate index of private monitoring. We use SP index to reflect power of private supervision. The first three models in Panel A are panel regressions with fixed effects. The models (4) to (6) are dynamic panel models (GMM) in the Panel B. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

Furthermore, in Table 13, we also use the two exogenous variables as instruments to assess whether exist over-regulated banking industry. Our findings are in line with the results in Tables 5, 6 and 7 that an over-regulated banking industry may exist if crediting ratings and bank-level regulation jointly supervise bank performance. Additionally, the results also support the findings that credit ratings play a role as a transmission mechanism to transfer the positive impact of investor protection to banking sector.

As our research includes the period of crisis, we may need to consider the emergency regulation during the time. Therefore, we add a dummy variable (Crisis(β_9)) to capture this impact. The findings show that bank inefficiency was increased during crisis. Furthermore, since WTO is likely to have an impact on the applications of these regulations, we create a dummy variable WTO(β_{10}) to capture this impact. In order to consider the impact of difference between local and international regulation, we create a dummy variable Regulation-gap(β_{11})[14] to capture it. Finally, we also assess whether the international banks are more likely to be subject to international regulations, by adding a dummy variable International-bank (β_{12})[15]. In Table 14, after capturing these factors, our findings are still in line with the results in Tables 5, 6 and 7, and support our hypotheses **H2** and **H3**.

Moreover, for measuring whether our findings are different in different samples, we run a robustness test by dividing my database into three samples, such as, state-owned, private and quoted banks. In Table 15, the results in model 1 and 2 show that bank efficiency can be improved by crediting rating, investor protection standards and bank regulation. However, the interactional terms in model 1 and 2 do not have significant relationship

[14] Based on the database that has been updated by Demirguc-Kunt et al. (2012), we take a value of one for a country where international regulations are voluntary for all banks while we take a value of zero for a country where international regulations are mandatory for all banks. International regulations are mandatory in a country meaning that local and international regulation are really similarities.
[15] We take a value of one for international banks, otherwise zero.

with bank efficiency, meaning that the moderated role of CRAs in restrict bank regulation and high level institutional environment is not significant. According to past papers (Barth et al., 2004; Beck et al., 2006b; Barth et al., 2007), state-owned bank may be regulated more by government than market discipline, and then the moderated role of CRAs may be ambiguous. In the model 3 and 4, we use sample of private bank to estimate whether our findings are consistent. The results show that bank efficiency does not have significant relationship with CRAs and investor protection standard, but bank regulation could improve bank efficiency. Private banks may suffer less regulation from regulator and they are not forced to use external rating (Firth et al., 2008; De Jonghe et al., 2015). Finally, we use sample of quoted bank to estimate whether our findings are consistent. We find that the results are line with our hypotheses **H1**, **H2** and **H3**, and the moderated role are significant. According to previous papers (Ceuster and Masschelein, 2003; Demirgüç-Kunt and Huizinga, 2004; Karas and Schoors, 2013), quoted banks are subject to market monitoring and they need to be transparent as they need to disclose information. Therefore, the impact of credit rating is obvious in quoted banks, and the monitoring role of CRAs and regulation may be mitigated.

In the Table 16, we have a robustness test by using Non-performance Loan as a dependent variable. In previous models, Non-performance Loan represents the default risk of a bank, while we use this variable as additional measurement of bank performance in Table 16. Lower value of Non-performance Loan means better performance of a bank with less bad loan. The results show that credit rating has a negative impact on Non-performance Loan, which is in line with **H1** that credit rating agencies improve bank performance in emerging markets. Furthermore, The findings in model 2 and 4 support our hypotheses **H2** and **H3** respectively, and show that credit ratings play a role as a transmission mechanism to transfer the positive impact of investor protection to banking sector, and

an over-regulated banking industry may exist if crediting ratings and bank-level regulation jointly supervise bank performance.

Table 13: Instrumental variables Estimates: Whether exists over-regulation between credit ratings, bank-specific and country-level regulation

	(1) BCIE	(2) BCIE	(3) BCIE	(4) BCIE	(5) BCIE	(6) BCIE
CR	-0.067** (0.029)	-0.033*** (0.012)	-0.035* (0.020)	-0.010** (0.004)	-0.016** (0.007)	-0.017** (0.006)
ACTR	-0.046** (0.020)					
CR * ACTR	0.006** (0.003)					
CAPR		-0.030*** (0.011)				
CR * CAPR		0.004** (0.002)				
SP			-0.015** (0.006)			
CR * SP			0.002* (0.001)			
RL				0.066*** (0.019)		
CR * RL				-0.008*** (0.003)		
CC					0.113*** (0.040)	
CR * CC					-0.013** (0.006)	
GR						0.075*** (0.021)
CR * GR						-0.005*** (0.002)

(Continued)

Table 13-*Continued*

	(1) BCIE	(2) BCIE	(3) BCIE	(4) BCIE	(5) BCIE	(6) BCIE
PSC	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR	-0.002*	-0.001*	0.002	0.001	0.001*	0.002*
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
BS	0.035***	0.029***	0.031***	0.034***	0.036**	0.057**
	(0.011)	(0.008)	(0.011)	(0.013)	(0.014)	(0.023)
FI	0.001	0.003**	0.003*	0.003	0.005	0.005
	(0.008)	(0.001)	(0.001)	(0.007)	(0.007)	(0.007)
NPL	-0.036*	-0.023***	-0.034**	-0.021	-0.016	-0.040*
	(0.018)	(0.007)	(0.013)	(0.029)	(0.028)	(0.028)
ETA	0.030**	0.032	0.038	0.051**	0.050**	0.101*
	(0.012)	(0.049)	(0.051)	(0.023)	(0.022)	(0.058)
GDP	-0.003	-0.035	-0.009	-0.032	-0.039	-0.053
	(0.057)	(0.043)	(0.039)	(0.047)	(0.049)	(0.054)
Cragg–Donald(F-statistic)	33.867	53.856	37.156	178.008	114.238	157.270
Sargan test(p-value)	0.169	0.287	0.732	0.666	0.776	0.171
r2_a	0.370	0.630	0.148	0.142	0.105	0.113
F	15.75	16.33	19.92	18.29	15.53	16.65

Notes: The table reports the second stage of a 2SLS model where the dependent variable is bank cost inefficiency used to reflect a bank's performance, which is calculated from translog cost function (SFA). SP (SPR+PMON) is an aggregate index of private monitoring. GR (Governance effectiveness + Regulatory quality) is an aggregate index of governance regulation. We use SP index and GR index to reflect the power of private supervision and quality of governance supervision respectively. We use the Cragg–Donald statistic to assess whether the instruments are weak. When there is one endogenous regressor as in our models (i.e., credit ratings), the Cragg–Donald statistic has an F distribution under the null hypothesis that the instruments have no explanatory power in the first stage regression. With one endogenous regressor and two excluded instruments, the critical value (Stock–Yogo weak ID test) for the Cragg–Donald statistic for 10% maximal size distortion is 19.93. Since we have two unique instruments and one endogenous regressor in each IV regression model, we use the Sargan test for over-identifying restrictions to assess whether the instruments are uncorrelated with the second-stage error. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

Table 14: Robustness check - The effect of credit ratings, bank regulation and investor protection standards on bank cost inefficiency

	Panel A (Sum-Index)				Panel B (PCA-Index)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
CR (β_1)	-0.002***	-0.003***	-0.002***	-0.015***	-0.002***	-0.003***	-0.002***	-0.013***
	(0.001)	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.001)	(0.002)
IPI (β_{IPI})	0.018***	0.023***			0.035***	0.046***		
	(0.004)	(0.005)			(0.009)	(0.010)		
CR * IPI (β_{CR*IPI})		-0.004***				-0.005***		
		(0.001)				(0.002)		
BRI (β_{BRI})			-0.002***	-0.005***			-0.004***	-0.009***
			(0.000)	(0.001)			(0.001)	(0.001)
CR*BRI (β_{CR*BRI})				0.001***				0.001***
				(0.000)				(0.000)
BS (β_2)	0.017*	0.015	0.015	0.019*	0.016	0.016	0.018*	0.017*
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)
FI (β_3)	0.000	0.001	-0.003	-0.002	0.000	0.001	-0.002	-0.002
	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
NPL (β_4)	-0.023	-0.022	-0.027	-0.029	-0.023	-0.022	-0.023	-0.025
	(0.048)	(0.049)	(0.047)	(0.045)	(0.048)	(0.049)	(0.047)	(0.045)
ETA (β_5)	0.027	0.023	0.028	0.027	0.027	0.023	0.030	0.028
	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)
PSC (β_6)	-0.000***	-0.000***	-0.001***	-0.000***	-0.000***	-0.000***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
UR (β_7)	0.000	-0.002*	0.000	0.001	0.000	−0.002*	0.000	0.000
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
GDP (β_8)	-0.117***	-0.108***	-0.057*	-0.059*	-0.115***	-0.107***	-0.070**	-0.064*
	(0.035)	(0.035)	(0.034)	(0.033)	(0.035)	(0.034)	(0.034)	(0.034)
Crisis(β_9)	0.004*	0.004*	0.009***	0.010***	0.005*	0.004*	0.008***	0.009***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)	(0.002)
WTO(β_{10})	0.017	0.015	0.024	0.016	0.018	0.016	0.022	0.012
	(0.020)	(0.021)	(0.019)	(0.019)	(0.021)	(0.021)	(0.020)	(0.019)

(Continued)

Table 14-*Continued*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Regulation-gap(β_{11})	0.015***	0.016***	0.009**	0.009**	0.015***	0.016***	0.009*	0.010**
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)	(0.005)	(0.004)	(0.004)
International-bank(β_{12})	0.010***	0.007***	0.007***	0.008***	0.010***	0.007***	0.006***	0.008***
	(0.002)	(0.002)	(0.002)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)
_cons	-0.027	-0.011	0.052	0.111	-0.027	-0.011	0.044	0.100
	(0.071)	(0.071)	(0.075)	(0.075)	(0.071)	(0.071)	(0.076)	(0.075)
r2_a	0.115	0.108	0.116	0.134	0.095	0.107	0.101	0.117
F	15.5625	16.383	19.9335	18.765	15.6555	16.437	18.946	18.378

Notes: The dependent variable bank cost inefficiency is used to reflect a bank's performance; a lower value illustrates better bank performance. Variable definitions refer to Table 2. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

Table 15: Robustness check - The effect of credit ratings, bank regulation and investor protection standards on bank cost inefficiency on different samples

	State-Owned Bank		Private Bank		Quoted Bank	
	(1)	(2)	(3)	(4)	(5)	(6)
CR (β_1)	-0.010**	-0.012*	0.001	0.003	-0.004***	-0.012***
	(0.005)	(0.007)	(0.002)	(0.008)	(0.001)	(0.003)
IPI (β_{IPI})	-0.041***		0.037		0.020***	
	(0.012)		(0.027)		(0.005)	
CR * IPI (β_{CR*IPI})	-0.001		0.000		-0.003**	
	(0.001)		(0.001)		(0.001)	
BRI (β_{BRI})		-0.004***		-0.004*		-0.004**
		(0.001)		(0.002)		(0.002)
CR*BRI (β_{CR*BRI})		0.001		-0.001		0.002***
		(0.001)		(0.000)		(0.001)
BS (β_2)	-0.001**	-0.001*	-0.002***	-0.002***	-0.001***	-0.001***
	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)
FI (β_3)	0.009**	0.006	-0.001	-0.003	-0.000	-0.000
	(0.004)	(0.004)	(0.005)	(0.004)	(0.001)	(0.001)
NPL (β_4)	0.018	0.034	0.023	0.014	0.015**	0.021***
	(0.029)	(0.034)	(0.022)	(0.020)	(0.006)	(0.006)
ETA (β_5)	-0.011	-0.011	-0.039*	-0.042*	0.015***	0.013***
	(0.014)	(0.014)	(0.019)	(0.021)	(0.004)	(0.004)
PSC (β_6)	-0.072***	-0.060**	-0.945**	-0.362	0.066	0.039
	(0.021)	(0.026)	(0.438)	(0.397)	(0.091)	(0.096)
UR (β_7)	-0.040	0.019	0.775***	0.748***	-0.044	-0.033
	(0.056)	(0.046)	(0.073)	(0.069)	(0.027)	(0.025)
GDP (β_8)	-0.178*	-0.229*	-0.213*	-0.043	-0.089***	-0.033
	(0.108)	(0.129)	(0.118)	(0.161)	(0.034)	(0.034)
_cons	0.044	-0.189	-0.235	0.003	0.120*	0.183***
	(0.285)	(0.425)	(0.161)	(0.160)	(0.064)	(0.071)

N	929	929	634	634	735	735
r2_a	0.432	0.389	0.300	0.421	0.160	0.227
F	63.524	141.164	52.393	47.446	10.690	16.360

Notes: The dependent variable bank cost inefficiency is used to reflect a bank's performance; a lower value illustrates better bank performance. Variable definitions refer to Table 2. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

Table 16: Robustness check - The effect of credit ratings, bank regulation and investor protection standards on Non-Performance Loan

	(1) NPL	(2) NPL	(3) NPL	(4) NPL	(5) NPL	(6) NPL	(7) NPL	(8) NPL
CR (β_1)	-0.003*	-0.001*	-0.001*	-0.023*	-0.003*	-0.003*	-0.001*	-0.011*
	(0.002)	(0.001)	(0.001)	(0.003)	(0.002)	(0.002)	(0.001)	(0.007)
IPI (β_{IPI})	0.006	0.006			0.012	0.012		
	(0.004)	(0.004)			(0.008)	(0.009)		
CR * IPI (β_{CR*IPI})		-0.002*				-0.002*		
		(0.001)				(0.001)		
BRI (β_{BRI})			-0.001**	-0.002***			-0.002**	-0.003***
			(0.000)	(0.001)			(0.001)	(0.001)
CR*BRI (β_{CR*BRI})				0.001*				0.001*
				(0.001)				(0.001)
BCIE	-0.034	-0.035	-0.048	-0.052	-0.035	-0.035	-0.041	-0.045
	(0.081)	(0.083)	(0.084)	(0.083)	(0.082)	(0.083)	(0.081)	(0.080)
PSC	-0.002*	-0.003*	-0.001*	0.000	-0.002	-0.002*	-0.003*	-0.002**
	(0.001)	(0.002)	(0.001)	(0.000)	(0.002)	(0.001)	(0.002)	(0.001)
UR	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
BS	-0.043*	-0.046*	-0.047*	-0.042*	-0.046*	-0.043**	-0.042*	-0.041*
	(0.025)	(0.029)	(0.028)	(0.024)	(0.028)	(0.021)	(0.026)	(0.024)
FI	-0.007	-0.007	-0.008	-0.008	-0.007	-0.007	-0.008	-0.008
	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)	(0.015)
ETA	0.069*	0.069*	0.070*	0.070*	0.069*	0.069*	0.071*	0.070*
	(0.046)	(0.037)	(0.037)	(0.040)	(0.036)	(0.037)	(0.036)	(0.036)
GDP	-0.033*	-0.039*	-0.006	-0.004	-0.037*	-0.039*	-0.011	-0.010
	(0.020)	(0.024)	(0.021)	(0.020)	(0.023)	(0.023)	(0.020)	(0.020)
_cons	0.398*	0.398*	0.427**	0.441**	0.398*	0.399*	0.422**	0.436**
	(0.209)	(0.211)	(0.213)	(0.214)	(0.209)	(0.212)	(0.210)	(0.210)

N	2398	2398	2398	2398	2398	2398	2398	2398
r2_a	0.109	0.108	0.093	0.093	0.109	0.111	0.091	0.101
F	5.076	4.726	4.556	4.174	5.064	4.711	4.569	4.232

Notes: The dependent variable bank cost inefficiency is used to reflect a bank's performance; a lower value illustrates better bank performance. Variable definitions refer to Table 2. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

2.6. Discussions and conclusions

This research examines the impacts of Credit Rating Agencies (CRAs) on bank performance in general, and in particular how their impact can be moderated by bank regulation strictness and investor protection quality embedded in different institutional environments. Using 2398 observations from 389 banks in 11 South-East Asian countries during the period 2000-2012, we find CRAs enhance bank performance. CRAs' positive monitoring impacts are further enhanced by high investor protection standards but mitigated by strict bank regulation.

From a theoretical point of view, we document why CRAs can mitigate different types of agency conflicts and enhance bank performance in the banking industries of emerging economies. More importantly, we reveal CRAs as the transmission mechanism linking bank industry level regulation and country level investor protection to individual bank performance. The interaction between CRAs and investor protection standards mitigates AP1 and AP2, which ultimately enhances bank cost efficiency. The interaction between CRAs and bank regulation reveals the conflicts of regulators and societies and shareholders, which ultimately reduce bank costs efficiency. Thus we enhance our understanding of the overall benefits and costs of monitoring and discipline bundles composed of CRAs, bank regulations and investor protection standards, especially in emerging economies.

Our analysis has important policy implications. From a wider governance perspective, we reveal that too much bank regulation and discipline may not achieve optimal public policy (Barakat and Hussainey, 2013; Bruno and Claessens, 2010). Rather, the banking industry can benefit from less strict bank industry regulations but with a wider coverage of active CRAs to issue the credit ratings for individual banks. Such a monitoring combination or bundle represents a much more efficient system to improve bank performance. However,

for many emerging economies with weak institutional environments, policy makers, by enhancing their overall investor protection standards, can further enhance the benefits of CRAs in their banking industries.

Our research may be extended in several ways. We focus on bank performance, however, further research might also look into bank stability aspects and investigate whether and how CRAs affect the stability of the banking industry. Given the effectiveness of governance mechanisms may vary across different institutional environments (Aslan and Kumar, 2014; Kumar and Zattoni, 2015), our analysis could also be replicated in the context of other emerging (and advanced) economies to establish whether or not our findings are more generally applicable.

Chapter 3: Market power and revenue diversification in South-East Asian countries: the effects of these two strategies on bank performance and stability

3.1 Introduction

As financial liberalisation has increased in emerging markets over the last two decades, the increase in competition from foreign banks drove domestic banks gradually to enhance their market power or increase their non-interest income activities for the purpose of maintaining future cash flows and franchise values (Nguyen et al., 2012). Market power, in developed countries, allows banks to earn monopoly rents (Maudos and Fernández de Guevara, 2007), and provides a "capital buffer" to reduce the deteriorating impact of the financial crunch (Anginer et al., 2014a). Meanwhile, revenue diversification increases fee income and reduces revenue volatility (Lepetit et al., 2008). However, banks with greater market power charge higher loan rates leading to greater default (Fiordelisi and Mare, 2014) and revenue diversification involves in security market rises in exposure to systemic shocks (De Jonghe, 2010), which was especially the case in the 2007 subprime crisis. It raises policymakers' concerns about whether these two banking strategies could still enhance a company's performance and stabilize a financial system, particularly in an emerging market where these two strategies are seen as competent and popular.

The previous papers (e.g. Berger, 1995; Fernandez de Guevara et al., 2005; Auh and Menguc, 2006; Koetter et al., 2012) suggest that market power provides incentives for banks to enhance performance for greater profitability. While others (e.g. Berger and Hannan, 1998; Casu and Girardone, 2006; Delis and Tsionas, 2009) argue that higher

market power inspires managers to work on the behalf of owners and as a result they may pursue objectives instead of profit maximization. For revenue diversification, some literature (e.g. Lewellen, 1971; Stein, 1997; Milbourn, 1999) finds that this strategy improves reallocation of resources through the internal capital market and effectively reduces the cost of capital, and construct the scale of operations as well as decrease portfolio risk (Landskroner et al., 2005; Sanya and Wolfe, 2011; Nguyen et al., 2012). However, the resource allocation may increase the probability of malfunctioning capital markets and trigger the moral hazard of managers reducing efficiency (Lamont, 1997; Rajan et al., 2000), and expending activities in different markets enhance the possibility of overall risk (Stiroh, 2006a; Stiroh, 2006b; Stiroh and Rumble, 2006). Diversified banks may raise their leverage and may pursue riskier activities, such as risky lucrative loans or speculative derivatives positions, due to competitive pressures (Demsetz and Strahan, 1997; Deng and Elyasiani, 2008). Obviously, most of the above literature focusing on developed areas still cannot provide a consensus on the impact of market power and revenue diversification, and the relationship between these two strategies remains unexplored and ambiguous. Thus, our study is motivated by these knowledge gaps and examines how banks utilize these strategies to improve performance and decrease fragility.

In developing countries, capital markets are relatively underdeveloped, and banks represent the main providers of credit to the economy (Turk-Ariss, 2010). These areas provide a fertile laboratory for deregulation and financial liberalization, allowing commercial banks to compete in a wider range of market segments (Nguyen et al., 2012), and this process strongly suggests scale economies and consolidation in the banking industry (Stark and Bloom, 1985; Hughes and Mester, 1998). Enhancing market power is one type of consolidation process which can exploit scale economies (Hughes et al., 2001;

Humphrey and Vale, 2004). Given a bank's observable scale economies, an increase in financial capital and non-traditional services could convey a credible signal to depositors and, thus, reduce the probability of a liquidity crisis. Furthermore, as the bank's scale increases, its loan portfolio and deposit base become more diversified, which provides incentives for a bank to diversify their activities that is likely to reduce the marginal cost of risk management (Hughes and Mester, 1998; Hughes et al., 2001).

We contribute to bank strategies literature in a few important ways. First, a majority of the previous papers focus on the impact of market power on net interest margins (Maudos and Fernández-de-Guevara; 2004) and on bank regulation (Beck et al., 2006b). Only two empirical studies show the impact of market power related to diversification, and these analysis were limited to five developed countries (Carbó-Valverde and Rodríguez-Fernández; 2007) and four Asian countries (Nguyen et al., 2012) without considering the whole emerging market. The existing literature focus on the relationship between bank non-interest income and net interest margins (Lepetit et al., 2008), technology advances (DeYoung and Rice 2004) and earnings volatility (Stiroh, 2004; Stiroh and Rumble, 2006). However, they do not consider the bank strategies, such as market power and revenue diversification, as a bundle to influence bank performance and stability at the same time. Our findings suggest that banks utilize market power to enhance its cost efficiency, and the increase of fragility caused by market power can be offset through employing the strategy of diversification at the same time. Secondly, we employ a dynamic panel threshold methodology to identify possible threshold-effects of the two strategies with respect to bank performance and stability over a period of significant liberalization in the emerging market. We find that there exists the values of threshold in the two strategies to achieve desired effect. Finally, we move away from an isolated perspective focusing on bank efficiency (Turk-Ariss, 2010; Lozano-Vivas and Pasiouras,

2010) and stability (Stiroh and Rumble 2006; Nguyen et al., 2012). We consider the banking regulations and institutional environment, since the different monitoring and investor protection quality influences banks' strategy (Barth et al., 2004; Barth et al., 2007; Demirgüç-Kunt et al., 2008; Delis, 2012[16]).

The rest of this chapter is structured along the following lines. Section 3.2 provides our paper hypotheses development. Section 3.3 presents the explanatory variables used to investigate the relationships. Section 3.4 discusses the methods used to estimate the impact of market power and revenue diversification on bank performance and stability. Section 3.5 analyses the empirical results. Section 3.6 is the conclusion.

3.2 Hypothesis development

Recently, there has been a lot of research focusing on what factors can improve bank performance and financial stability, which has not reached a consensus. Our paper contributes to the extant literature by providing theoretical analysis and empirical results to explain how market power and revenue diversification drive bank efficiency and maintain financial stability.

[16] When measuring the countries' characteristics, we need to consider the extent of government involvement in the financial sector, regulation and the degree of regulation of financial market activities. A well-regulated banking industry is an important pre-requisite for a well-functioning financial system. For example, activity restrictions are a key determinant of the scope of a bank's ability to provide fee-paying services. This measure reflects the level of regulatory restrictiveness for bank participation in the securities market, insurance activities, real estate activities, and the ownership of non-financial firms (Barth et al., 2002; Barth, 2004; Beck et al., 2006; Barth et al., 2007; Fu et al., 2014). In order to analyse the benefit of national policy, the previous literature such as Dietsch et al., (2000) and Demirgüç-Kunt et al., (2008) suggest that a bank working in a more conducive institutional environment may face less cost of trade and even the probability of moral hazard may be reduced. Furthermore, Delis (2012) indicates that institutional factors such as low corruption and the high quality of the rule of law, which are prerequisites for embarking on financial reforms, can improve transparency. He believes that bank cannot effectively connect with other financial institutions in a market with a weak legal system and the high level of corruption, especially in developing and transition countries, and hence there is a significant limit of strength of competition.

3.2.1 Market power and bank performance

From a traditional perspective of the connection between market power and efficiency, the arguments in favour of greater competition (lower market power) have been supported by early papers (e.g. Berger and Hannan, 1998; Delis and Tsionas, 2009)[17]. They provide a quiet life theory that when banks have higher market power, there are less incentives for managers to work on the behalf of owners and they may pursue objectives instead of profit maximization, which may increase cost inefficiency. Similarly, Casu and Girardone (2006) use Data Envelopment Analysis methodology and PR H-statistic model to estimate the bank efficiency and competition, and support that if the competition is lower in the market, managers do not have incentives to work as hard to keep costs under control. The early study of Hicks (1935) find that high market power may have a negative impact on bank efficiency, because managers may forgo some of the monopoly rents. Furthermore, lower market power may make a huge contribution to efficiency by reallocating profits from weak bank to strong one (Schaeck and Cihák, 2014), while higher market power gives managers incentives to act on their wealth instead of considering the cost of company (Turk-Ariss, 2010). With innovation intensifying competition, banks may start to react to the competitive stress and improve their product so that efficiency can be improved by less market power (Chen, 2007; Dick and Lehnert, 2010[18]; Duygun et al., 2013).

However, other papers (e.g. Berger, 1995; Fernandez de Guevara et al., 2005; Auh and Menguc, 2006; Maudos and Fernández de Guevara, 2007; Pasiouras, 2008; Schaeck and Cihak, 2010; Koetter et al., 2012) find that market power has a positive effect on

[17] Berger and Hannan (1998) argue that banks not exposed to competition tend to be less efficient than banks subject to more competition. Delis and Tsionas (2009) show a methodology for the joint estimation of market power and efficiency.
[18] Not only can competition raise lending efficiency but also reduce bank probability of credit risk.

efficiency, because firm profitability is positively correlated with market share. The most efficient banks obtain both greater profitability and market shares and, as a consequence the market becomes more concentrated. They also suggest that the managers may have incentives to manage the firm efficiently because the capacity to establish a price above marginal cost generates sufficient profits to justify their management. Comparing to the literature (e.g. Berger and Hannan, 1998; Delis and Tsionas, 2009; Turk-Ariss, 2010), although market power may induce managers to pursue objectives other than the maximization of profit, the objectives includes the growth of the firm, compensation of the staff, or the reduction of labor conflict at the expense of efficiency. As the above-discussion, there is still a strong debate about whether market power improves bank efficiency or decreases that efficiency. Therefore, our first hypothesis is as follows:

Hypothesis 1. *There is a significant relationship between market power and efficiency.*

3.2.2 Revenue diversification and bank performance

The previous papers (e.g. Sanya and Wolfe, 2011; Nguyen et al., 2012) suggest that when a bank expands their services into different activities or industries where competition is high, diversification may enhance its anti-risk capacity and efficiency. Furthermore, diversification creates competitive pressures amongst banks across a wider range of market segments, which increases innovation and efficiency in the provision of services (Landskroner et al., 2005; Acharya et al., 2006; Lepetit et al., 2008). Banks might increase production and sale of fee-based financial services to exploit cost scope economies by sharing input in joint production (Shim, 2013). More importantly, banks can reinforce their role as delegated monitors to increase the volume of intermediation when they

diversify across both interest-and non-interest income activities. Thus, it could limit information asymmetry and then increase the efficiency.

However, the recent papers (e.g. Stiroh, 2006a; Mercieca et al., 2007; Lozano-Vivas and Pasiouras, 2010; Elsas et al., 2012) find that there are no direct diversification benefits within and across business lines and an inverse association between non-interest income and bank performance, comparing to Landskroner et al., (2005) who use the special case of Israel. They suggest that diversification may worsen risk-adjusted performance, particularly when banks over expand into industries where they face higher competition or lack expertise. The subsequent inability to effectively monitor loans may increase asymmetric information between a bank and its pool of borrowers. The effectiveness of a bank does not depend on whether diversification was achieved through organic growth or through M&A activity. In addition, if banks expand new services by using limited internal capital and resource, it would influence profitability and efficiency of existing services. Revenue diversification could not improve the efficiency directly but this strategy could help banks increase their market power in different activities (Turk-Ariss, 2010). As a result, the increase in efficiency has benefited from market power instead of diversification. There is still a strong debate about whether revenue diversification improves bank efficiency or decreases that efficiency. Therefore, our second hypothesis is as follows:

Hypothesis 2. *There is a significant relationship between revenue diversification and efficiency.*

3.2.3 Market power and bank stability

The previous literatures (e.g. Caminal and Matutes, 2002; Beck et al., 2004; Schaeck et al., 2009; Fiordelisi and Mare, 2014)[19] argue that market power may increase bank fragility, because monopoly banks are inclined to take risky loan portfolios and the monitoring cost of these banks is high. Furthermore, banks with more loan market power are in a position to charge higher rates for loan customers, which may increase borrowers' difficulties to repay principals (Boyd and De Nicoló, 2005;[20] Schaeck and Cihak, 2008). As a result of higher interest rates, it may be easy to increase the riskiness of loan portfolios, adverse selection and moral hazard problems. Bank becomes more similar by taking similar action or sharing highly correlated portfolios, which could enhance bank's market power. This similarity caused by high level of market power may make the financial sector more susceptible (Nicoló and Kwast, 2002; Wagner, 2010). Hence, market power may increase the fragility of individual bank. Banks with greater market power are more likely to receive public guarantees, which may encourage risk-taking behaviour and generate a moral hazard problem.

However, the traditional ''competition-fragility" view suggests that market power can allow banks to earn monopoly rents, despite possible ensuing efficiency losses. The previous studies (e.g. Marcus, 1984; Allen and Gale 2004; Jimenez et al., 2010), deem that competition may not be a good tool to ensure bank stability due to lower market power forces banks to reduce their profit margins by taking excessive risk. In a more competitive market, banks may earn less economic rent and be reluctant to conduct

[19] The study of Schaeck et al., (2009) find that financial crisis may be less likely to occur in a more competitive banking industry, or it may need a long to occur, by investigating banks operating in 45 nations over 1980–2005. Fiordelisi and Mare (2014) focus on cooperate banks and suggest that bank market power has negative effect on bank's soundness.

[20] Boyd and De Nicoló (2005) find that market power may be exacerbating moral hazard incentives to shift into riskier projects and possibly resulting in a riskier set of bank clients due to adverse selection considerations.

monitoring, which may give rise to greater fragility. A less concentrated market may be more likely to trigger a financial crunch, since the absence of powerful market leader who could serve as a buffer against deterioration of financial environment. Banks with greater market power may be less likely to suffer financial problem because higher market power may provide a "capital buffer" to reduce the deteriorating effect of the financial crunch (Anginer et al., 2014a; Fu et al., 2014). Additionally, as banks gain market power, their franchise value increases. The increase in the franchise value may create high opportunity costs of bankruptcy so that such banks become more reluctant to engage in risky activities. As the above-discussion, there is still a strong debate about whether market power improves bank stability or decreases that stability. Therefore, our third hypothesis is as follows:

Hypothesis 3. *There is a significant relationship between market power and stability.*

3.2.4 Revenue diversification and bank stability

Cornett et al., (2002) also support the view that revenue diversification is associated with an increased return on assets without any change in bank risk. Based on ensuring bank stability, diversifying portfolios could create extra profit in emerging markets. However, if loan services cannot be monitored effectively, asymmetric information may be increased. If banks diversify their portfolios into the property market like real estate, it would increase illiquidity and banks would not be able to cope with the public panic. It is obvious that diversifying into the security market may increase the volatility of banks' income and the exposure to systemic shocks (Stiroh and Rumble 2006; De Jonghe, 2010). They conclude that generated higher and more volatile returns report a higher probability of insolvency than for banks with traditional product mixes.

However, revenue diversification enables banks to increase their capital buffer, which reduces the probability of fragility (Shim, 2013), and hedges against insolvency risk that reduces the occurrence of costly financial distress (Stiroh, 2006a; Stiroh, 2006b). They consider that expanding banks' activities may reduce risk, with the main risk-reduction gains arising from insurance rather than securities activity. Scida and Vagheti (2018) indicate that bank mergers as a diversification mechanism, through increasing the extent of diversification at individual institutions has positive impact on bank stability. But it may also increase the similarity of banking industry. Furthermore, the literatures (e.g. Sanya and Wolfe, 2011; Lepetit et al., 2008; Nguyen et al., 2012) suggest that the purpose of banks may be not to use revenue diversification to earn economic rent, but they may use these non-profit activities to intentionally reduce their revenue volatility.

Interestingly, if banks involve fewer diversified activities, the gains from diversification are offset by the increased exposure to more volatile non-interest income activities for more diversified US banks (Stiroh and Rumble 2006). More importantly, the studies (e.g. Froot and Stein, 1998; Cebenoyan, and Strahan, 2004) find that banks engaging in active credit risk management can hold riskier loans, while consequently they suggest that diversified banks take on more risk and operate with greater financial leverage. As the above-discussion, there is still a strong debate about whether revenue diversification improves bank stability or decreases that stability. Therefore, our fourth hypothesis is as follows:

Hypothesis 4. *There is a significant relationship between revenue diversification and stability.*

3.3 Data description

3.3.1 Estimating market power, bank performance and stability

We use data on the bank-level variables from BankScope and select the accounting information from 11 South-East Asian countries (Australia, China, Hong Kong China, India, Indonesia, Japan, Sri Lanka, Malaysia, Philippines, Singapore and Thailand) including 329 commercial and saving banks. In terms of the time span of the database, We use the data from the period of 2000 to 2012 and all of them are reported in $US. Panel A, Panel B and Panel C in Table 1 presents the summary values for estimating bank *market power*, *cost inefficiency* and *Z-score*. For evaluating *revenue diversification*, we use the ratio as non-interest income to total assets[21], which is collected from BankScope.

3.3.2 Control variables

3.3.2.1 Regulatory variables

Beck et al., (2006b) indicate that regulations provide a simple robustness test for analysing whether competition and revenue diversification influence financial stability. It also offers additional information about their relationship. Following the studies of Barth et al., (2004), Laeven and Levine (2009) and Pasiouras et al., (2009), we includes four regulatory variables such as *ACTR, CAPR* and *SPR, PMON*[22] for investigating the stability. Information on regulation is obtained from a database, which has been updated

[21] Maudos and Solís (2009) and Nguyen et al., (2012) think that because of BankScope's data limitation, non-interest income may be a good indicator to represent revenue diversification.

[22] ACTR indicates the level of restrictions on the banks' activities. CAPR is an indicator of capital requirements, accounting for both overall and initial capital stringency. For the overall capital stringency, it determines whether the capital requirement reflects certain risk elements and deducts certain market value losses from capital before minimum capital adequacy. SPR is a measure of the power of the supervisory agencies. Greater values indicates more power of supervisions. It is examined on the basis of the answers and the aim of this measurement is to discover whether the supervisory authorities have the authority to take specific actions to prevent and correct problems. PMON indicates whether there are incentives for the private monitoring of firms. A higher value suggests higher disclosure requirements and more incentives to increase private monitoring.

by Demirguc-Kunt et al., (2012) in the World Bank to provide regulatory responses to a broad number of questions. In our sample, regulation denotes a vector of four regulatory indicators. Since the indicators are highly correlated, we use the BRindex as an aggregate regulation index (BRindex = ACTR + CAPR + SPR + PMON). Panel E in Table 1 shows a summary of the regulatory variables.

3.3.2.2 Institutional variables

When estimating the quality of institutions, we use the institutional variables, which are database covered by Abiad et al (2010). These correspond to a number of indices, which evaluate institutional quality in the countries examined. We use five indexes obtained from the World Bank to reflect the institutional environment[23], such as governance effectiveness, rule of law, control of corruption, political stability and regulatory quality. All of them take values between -2.5 and 2.5 with higher values reflecting greater institutional quality. The previous papers (e.g. Beck et al., 2006a; Lensink et al., 2008; Houston et al., 2011; Delis 2012) indicate that the high income countries about the impact of foreign investment on efficiency depends on the quality of institutions. Therefore, it is necessary to control the impact of institutions. Since the indicators are highly correlated, we use an aggregate institutional environment index (IEindex = Governance

[23] Governance effectiveness represents the quality of public services. This variable includes the quality of the civil service and the degree of its independence from political pressure, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies. The variable rule of law, in turn, reflects perceptions of the extent to which agents have confidence in and abide by the rules of society. It also means that it is an assessment of the law's quality, with higher values representing greater quality of the judicial system but lower ratings indicating inferior enforcement. The variable of control of corruption reflects perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption. Political stability reflects perceptions of the likelihood that the government will be destabilized or overthrown by unconstitutional or violent means, including politically-motivated violence and terrorism. Regulatory quality reflects perceptions of the ability of the government to formulate and implement sound policies and regulations that permit and promote private sector development.

Effectiveness + Rule of Law + Control of Corruption + Political stability + Regulatory quality). Panel E in Table 1 shows these variables.

3.3.3 Other control variables

Panel E in Table 1 also shows the other control variables. In this paper, we control a number of macroeconomic and bank-specific variables, which can have an impact on the bank performance. Thus, in order to represent the macroeconomic environment and monetary conditions, we use variables such as *GDP growth*, *inflation* and *domestic credit to the private sector* as control variables, which are obtained from the World Development and the International Monetary Fund indicators. The variable *GDP growth*, and *inflation rate* can represent countries' characteristics respectively, while *domestic credit to the private sector* as a share of GDP represents the level of development of the financial sector. We also control the 'crisis effect. in our model, which is measured as a dummy variable[24]. The crisis dummy is positively and significantly related to bank risk, which implies that banks are more fragile during financial turmoil (Fu et al., 2014).

The control variables of bank-specific variables, which are obtained from BankScope, are used for reflecting individual bank characteristics. We use the natural logarithm of total assets to represent *bank size* and the ratio of total equity to total assets to control *bank capitalization*. Delis (2012) points out that the large and well-capitalized banks are probably able to have access to a cheaper source of funds, due to scale economies, informational asymmetries and moral hazard issues. Furthermore, large banks can play an effective role in institutions in enhancing their effectiveness and may have a positive impact on cost efficiency. Therefore, this control variable can highlight banks'

[24] Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise.

characteristics on certain regulations. In addition, we use the ratio of *liquid assets to total assets* to represent bank liquidity for controlling the differences in bank assets. It is obvious that banks with high levels of liquid assets in cash and government securities may receive lower interest income than banks with less liquid assets.

Table 1

Summary statistics						
Variables	N	Mean	P25	Median	P75	STD
Panel A - Estimation of Market power						
Total cost (TC)	1878	1.741	0.724	1.516	2.662	5.501
Price of loans (W1)	1878	0.033	0.011	0.035	0.039	2.321
Price of labor (W2)	1878	0.103	0.052	0.113	0.151	1.538
Price of capital (W3)	1878	0.022	0.001	0.026	0.041	1.187
Panel B - Estimation of Cost inefficiency						
Total cost (TC)	1878	1.741	0.724	1.516	2.662	5.501
Price of labor (P1)	1878	0.103	0.052	0.113	0.151	1.538
Price of capital (P2)	1878	0.022	0.001	0.026	0.041	1.187
Net loan (Q1)	1878	3.127	1.741	3.667	4.124	4.609
Other earning assets (Q2)	1878	3.131	2.168	2.891	3.891	4.842
Equity (N)	1878	3.134	2.032	2.915	3.517	2.262
GDP per capital	1878	9.350	5.132	8.889	11.22	1.065
Panel C - Estimation of Stability						
ROA	1878	0.012	0.008	0.012	0.015	2.183
Equity to total asset (E/TA)	1878	0.102	0.075	0.121	0.164	2.179
Panel D - Determinant of Efficiency and Stability						
Lerner index	1878	0.430	0.340	0.447	0.534	0.164
RD	1878	0.009	0.002	0.008	0.015	0.126
Panel E – Control variables						
ACTR	1878	8.613	3.415	8.902	10.56	2.331
CAPR	1878	6.743	2.345	7.032	8.994	1.635
SPR	1878	10.19	5.321	11.02	13.68	2.017
PMON	1878	8.768	4.322	8.654	10.88	1.235
BRindex	1878	35.036	32.500	35.000	40.000	4.671

(*Continued*)

Table 1-(*Continued*)

Summary statistics						
Variables	N	Mean	P25	Median	P75	STD
Governance effectiveness	1878	0.281	-0.845	0.199	1.321	0.706
Rule of law	1878	0.153	-1.033	0.245	1.452	0.758
Control of corruption	1878	-0.141	-1.115	-0.169	0.227	0.916
Political stability	1878	-0.645	-1.244	-0.763	-0.477	0.867
Regulatory quality	1878	0.107	-0.333	-0.219	0.237	0.762
IEindex	1878	0.164	-1.001	0.178	1.512	1.243
Crisis dummy	1878	0.199	0.000	0.000	0.000	0.399
GDP %	1878	6.403	3.654	6.548	8.441	0.033
Inflation %	1878	4.942	1.035	5.032	7.652	0.033
Private sector credit	1878	8.792	8.122	8.492	9.114	0.974
Bank Size	1878	9.816	6.541	9.561	11.23	0.855
Liquidity	1878	0.232	0.112	0.255	0.303	0.166
Panel F – Instrument variables						
Fee income	1878	0.007	0.005	0.006	0.008	0.003
Equity to total asset (E/TA)	1878	0.102	0.075	0.121	0.164	2.179
ROE	1878	13.77	7.129	11.36	15.25	25.03
Concentration ratio (CR5)	1878	63.51	21.28	58.31	88.35	14.73

Notes: The table reports summary statistics (number, mean, P25, median, P75, minimum, maximum and standard deviation) for the variables used in estimating bank inefficiency, competition and stability, used in the determinant of inefficiency, competition and stability, and control variables. Units of the variables for estimation are as follows: price of loans, price of capital, price of labor, GDP per capita, ROA and equity to total assets are ratios; Total cost, Net loan, other earning assets and equity are log variables. The variables for determinant efficiency, competition and stability are revenue diversification (RD) and the Lerner index. The control variables are activity restrictions, capital requirement, power of the supervisory agencies and private monitoring. The institutional variables are governance effectiveness, rule of law and control of corruption. BRindex is an aggregate regulation index (BRindex = ACTR + CAPR + SPR + PMON). IEindex is an aggregate institutional environment index (IEindex = Governance Effectiveness + Rule of Law + Control of Corruption + Regulatory quality). GDP growth, inflation and Private sector credit are in % terms. Bank size is the log of variables while CR5, liquidity, ratio of fee income, non-performance to total asset and ROE are simple ratios. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise

Table 2 reports the correlation matrix of variables that are shown in Table 1. Prior to carrying out the data analysis, we check for the issue of multicollinearity. The highest correlation value is between government effectiveness, rule of law, control of corruption, political stability and regulatory quality, which are more than 0.85 respectively. Furthermore, the regulatory variables are also found to have a higher correlation. Therefore, we use the aggregate index, such as BRindex and IEindex, in order to prevent the issue of multicollinearity. However, other values are within an acceptable level because all of them are lower than 0.70.

Table 2

Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
LI	1																					
RD	-0.04	1																				
AR	0.01	-0.08	1																			
CR	-0.06	-0.16	0.26	1																		
SPR	-0.17	0.20	0.18	-0.12	1																	
PM	-0.11	-0.21	0.31	0.52	0.12	1																
BR	-0.12	-0.06	0.75	0.60	0.54	0.66	1															
GE	-0.02	-0.12	-0.57	-0.21	-0.10	0.02	-0.41	1														
RL	-0.03	-0.09	-0.61	-0.20	-0.20	-0.12	-0.50	0.94	1													
CC	-0.04	-0.09	-0.59	-0.18	-0.10	-0.02	-0.40	0.97	0.96	1												
PS	-0.04	-0.20	-0.44	-0.07	-0.20	0.16	-0.28	0.89	0.85	0.88	1											
RQ	-0.05	-0.09	-0.63	-0.22	-0.10	0.01	-0.44	0.97	0.93	0.97	0.88	1										
IE	-0.04	-0.12	-0.58	-0.18	-0.20	0.01	-0.42	0.98	0.96	0.99	0.93	0.98	1									
GDP	0.17	-0.16	0.29	0.29	-0.20	0.25	0.21	-0.30	-0.30	-0.31	-0.15	-0.33	-0.28	1								
IF	-0.09	0.19	0.18	0.01	0.24	-0.15	0.16	-0.43	-0.43	-0.45	-0.58	-0.49	-0.50	0.09	1							
DCR	0.05	-0.31	-0.21	-0.07	-0.40	0.31	-0.22	0.67	0.56	0.60	0.72	0.64	0.66	-0.04	-0.64	1						
BS	0.09	-0.21	0.12	0.18	0.07	0.32	0.24	0.19	0.08	0.17	0.28	0.18	0.19	0.02	-0.27	0.33	1					
LR	0.24	-0.10	-0.12	-0.04	-0.50	-0.09	-0.30	0.12	0.12	0.07	0.12	0.06	0.10	0.25	-0.15	0.23	-0.21	1				

(*Continued*)

Table 2- *Continued*

Correlation matrix																					
FI	-0.01	0.76	-0.15	-0.19	0.27	-0.32	-0.11	-0.10	-0.10	-0.11	-0.27	-0.10	-0.15	-0.24	0.28	-0.44	-0.17	-0.17	1		
ETA	-0.01	0.23	-0.19	-0.06	-0.10	-0.12	-0.21	0.07	0.10	0.06	0.01	0.07	0.06	0.01	-0.01	0.02	-0.47	0.18	0.19	1	
ROE	0.21	0.16	0.08	0.05	0.10	-0.01	0.06	-0.10	-0.09	-0.09	-0.10	-0.11	-0.10	0.09	0.07	-0.11	0.06	0.06	0.09	-0.1	1
CR5	-0.04	-0.18	-0.24	-0.15	0.10	0.33	-004	0.55	0.35	0.51	0.57	0.60	0.53	-0.08	-0.46	0.52	0.33	-0.05	-0.17	-0.04	-0.06	1

Notes: This table reports the correlation matrix of selected variables of banks during 2000–2012. LI is Lerner index. RD is revenue diversification. AR, CR, SPR and PM are activities restriction, capital requirement, supervisor power and private monitoring. BR is BRindex. GE is governance effectiveness. RL is rule of law and CC is control of corruption. PS is political stability. RQ is regulatory quality. IE is IEindex. GDP is GDP ratio IF is inflation. DCR is Private sector credit of GDP. BS is bank size. LR is liquidity ratio. FI is fee income. ETA is equity to total asset. ROE is return on asset. CR5 is concentration ratio.

3.4 Methodology

3.4.1 Estimating market power

In this study, we use the Lerner index to measure banks' market power, according to Turk-Ariss (2010), Anginer et al., (2014a) and Fu et al., (2014). This approach has been widely used in recent bank research, because it captures the capacity of pricing power by evaluating the difference between price and marginal cost. The reason for using the Lerner index is that it is more accurate than the approach of concentration (HHI), according to the studies of Berger and Hannan (1998) and Maudos and Fernández de Guevara (2007). Moreover, the advantage of the Lerner index over other indicators of competition (such as the PR model) is that it allows market power to be proxied at a bank level and its evolution over time can be analysed. We focus on the marginal costs and inputs as well as outputs on the basis of a frontier costs function, like what is usual in the literatures (Turk-Ariss 2010; Fiordelisi and Mare 2014). This value ranges between 0 and 1. If the Lerner index=1, the market is pure monopoly while if the Lerner index=0, the market is perfect competition. This indicator is calculated as follows:

$$LER_{i,t} = \frac{P_{i,t} - MC_{i,t}}{P_{i,t}} \quad (1)$$

where $P_{i,t}$ is the price of the output of bank i at year t, which is calculated as the ratio of total revenue (sum of interest income, operating income and non-interest income) to total asset. and $MC_{i,t}$ is the marginal cost. Higher value implies lower competition. In line with Anginer et al. (2014a), we estimate the conventional marginal cost by using a translog cost function:

$$\ln TC_{i,t}$$
$$= \alpha_0 + \beta_1 \ln Q_{i,t} + \beta_2 (\ln Q_{i,t})^2 + \beta_3 \ln W_{1,i,t} + \beta_4 \ln W_{2,i,t} + \beta_5 \ln W_{3,i,t} + \beta_6 \ln Q_{i,t} ln W_{1,i,t}$$
$$+ \beta_7 \ln Q_{i,t} ln W_{2,i,t} + \beta_8 \ln Q_{i,t} \ln W_{3,i,t} + \beta_9 (\ln W_{1,i,t})^2 + \beta_{10} (\ln W_{2,i,t})^2 + \beta_{11} (\ln W_{3,i,t})^2$$
$$+ \beta_{12} \ln W_{1,i,t} \ln W_{2,i,t} + \beta_{13} \ln W_{1,i,t} \ln W_{3,i,t} + \beta_{14} \ln W_{2,i,t} \ln W_{3,i,t} + \beta_{15} Year\ Dummies$$
$$+ \beta_{15} Country\ Dummies$$
$$+ \epsilon_{i,t} \qquad (2)$$

where $TC_{i,t}$ is total cost, which is calculated as total expense (non-interest expenses plus interest expenses). $Q_{i,t}$ is the quantity of output, which is evaluated as total asset. Consistent with previous studies of bank competition, we select the following three inputs: $W_{1,i,t}$ (the price of loans) is the ratio of interest expense to total assets. $W_{2,i,t}$ (the price of labor) is calculated as the ratio of personnel expense to total assets. $W_{3,i,t}$ (the price of capital) is measured as non-interest expense to total assets. The subscripts i and t mean each bank and year respectively. We also ensure homogeneity in the above formula[25]. According to equation (2), we can estimate the marginal cost as follows:

$$MC_{i,t} = \frac{TC_{i,t}}{Q_{i,t}} [\beta_1 + 2\beta_2 \ln Q_{i,t} + \beta_6 \ln W_{1,i,t} + \beta_7 \ln W_{2,i,t}$$
$$+ \beta_8 \ln W_{3,i,t}] \qquad (3)$$

Lerner index measures are superior to concentration as measures of market power, because it is more inclusive in capturing the factors that drive market power (Borenstein and Bushnell, 1999; Dell'Ariccia, 2001; Carbó-Valverde et al., 2009). Furthermore, Aghion et al. (1996) point out that Lerner Index has several advantages over indicators such as market share since it is a measure that tests differences between prices and

[25] We impose: $\beta_3 + \beta_4 + \beta_5 + 1;\ \beta_6 + \beta_7 + \beta_8 = 0;\ \beta_{10} + \beta_{12} + \beta_{14} = 0;\ \beta_{11} + \beta_{13} + \beta_{14} = 0$

marginal costs and does not depend so critically on geographic and product market definitions. Market share often produces spurious results (Ribon and Yosha, 1999).

3.4.2 Estimating performance

For estimating bank performance, we use cost inefficiency. When analysing bank performance (inefficiency), we opt for stochastic frontier analysis (SFA) rather than data development analysis (DEA). The method of stochastic frontier analysis (SFA) is better than the approach of data development analysis (DEA), as one of the reasons is that it can allow us to distinguish between inefficiency and other stochastic shocks in the estimation of efficiency scores (Pasiouras et al., 2009). In addition to this, our sample selects panel data rather than cross-section data, which is more suitable for the efficiency frontier method[26]. Comparing to other studies (e.g. Brissimis et al., 2008 and Delis et al., 2011)[27] for estimating the efficiency of banks by using productivity measure, we use cost efficiency[28]. In contrast to the study of Barth et al., (2002), Pasiouras et al., (2006) and Demirgüç-Kunt et al., (2008), which mainly use general methods and financial ratios for evaluating bank performance, stochastic frontier analysis (SFA) is more accurate and considers inputs and outputs. The specific model for examining the cost frontier can be written as follows:

[26] The reason why the efficient frontier approach is superior is that it can simultaneously account for relevant inputs and outputs of a bank, as well as for differences in the input prices (Pasiouras et al 2009).
[27] Brissimis et al., (2008) examines bank performance by investigating efficiency, productivity growth and net interest margin, and mainly focuses on the impact of the banking sector reform among European countries. Similarly, Delis et al., (2011) also analyses banking performance through estimating the total factor productivity growth, but the aim of Brissimis et al., (2008) is to examine whether banking industry reform influences banking efficiency.
[28] Cost efficiency is a wider concept than technical efficiency because it refers to both technical and allocative efficiency (Pasiouras et al., 2009).

$$\ln T_{i,t}$$
$$= \alpha_0 + \sum_i \alpha_i \ln P_{i,t} + \sum_i \beta_i \ln Q_{i,t} + \frac{1}{2}\sum_i \sum_j \alpha_{ij} \ln P_{i,t} \ln P_{j,t}$$
$$+ \frac{1}{2}\sum_i \sum_j \beta_{ij} \ln Q_{i,t} \ln Q_{j,t} + \sum_i \sum_j \delta_{i,t} \ln P_{i,t}\, Q_{j,t} + \sum_i \varphi_i \ln N_{i,t}$$
$$+ \frac{1}{2}\sum_i \sum_j \xi_{i,j} \ln P_{i,t} \ln N_{j,t} + \sum_i \sum_j \delta_{i,j} \ln Q_{i,t} \ln N_{j,t} + \sum_i \varepsilon_i \ln Z_{i,t} + \sigma_{i,t}$$
$$+ \mu_{i,t} \qquad (4)$$

where $T_{i,t}$, which is calculated as total expense (non-interest expenses plus interest expenses), is the total cost for bank i at year t; $P_{i,t}$ is a vector of inputs. We select the following two inputs: price of labor (P_1), calculated as the ratio of personnel expense to total assets; price of financial capital (P_2), calculated as total interest expense to total interest bearing borrowed funds; $Q_{i,t}$ denotes a vector of values of outputs. We choose two outputs which include loans (net of provisions) and other earning assets (government securities, bonds, investment, CDs and T-bills); $N_{i,t}$ is a vector of fixed netput[29]; while $Z_{i,t}$ is a vector of control variable. The term $\sigma_{i,t}$ is symmetric error and represents that management of a bank cannot deal with this random fluctuation. $\mu_{i,t}$ captures the effects of inefficiency relative to the stochastic cost frontier[30]. We utilize GDP per capita[31] to capture country-level heterogeneity.

3.4.3 Estimating of stability

For estimating individual bank stability, we use the Z-score, which has been used extensively in the previous literature as a stability indicator (e.g. Laeven and Levine, 2009;

[29] Following Berger and Mester (1997) idea, we use the equity of each bank in the model as a fixed netput (N) to control for differences in risk preferences.
[30] It is assumed to be independently distributed on one-side, meaning that this effect has the potential to enhance the costs of banks over the best-practice level.
[31] GDP per capita may be an indicator of the dynamism of each economy.

Sanya and Wolfe, 2011; Nguyen et al., 2012; Fu et al., 2014). Unlike most of the previous papers using probability of bankruptcy to denote an individual bank's risk, we analyse the insolvency risk of a bank by using Z-score. This method, which is inversely related to the probability of bank insolvency, captures the distance from insolvency, combining accounting measures of profitability, leverage and volatility (Beck et al., 2013a; Uhde and Heimeshoff, 2009). The advantages are as follows: (1) it can avoid the impact of cash flows and stock prices fluctuation; (2) regulators may be more inclined to consider insolvency risk because this indicator may quickly reflect the effect of policy. Following their methodology, we use accounting ratios to estimate the Z-score as follows:

$$Z - score_{i,t} = \frac{ROA_{i,t} + Capital\ assets_{i,t}}{\sigma ROA_{c,t}} \tag{5}$$

where $ROA_{i,t}$ is the return on assets; $Capital\ assets_{i,t}$ is the ratio of equity to total assets; $\sigma ROA_{i,t}$ is the standard deviation of return on assets within each individual country c in time t.

The z-score measures the distance from insolvency (Roy, 1952). Insolvency is defined as a state in which losses surmount equity ($E < \pi$) (where E is equity and π is profits). The probability of insolvency, therefore, can be expressed as $\text{prob}(-\text{ROA} < \text{CAR})$, where ROA ($= \pi/A$) is the return on assets and CAR ($= E/A$) is the capital assets ratio. If profits are normally distributed, then the inverse of the probability of insolvency equals (ROA+CAR)/ σ (ROA), where σ(ROA) is the standard deviation of ROA. The Z-score provides an approach to estimate a bank's soundness and it is inversely related to the probability of a bank's insolvency (Laeven and Levine, 2009).

According to Čihák and Hesse (2010)'s study, an important feature of the z-score is that it is a fairly objective measure of soundness across different groups of financial

institutions. It is an objective measure because it focuses on the risk of insolvency, i.e., on the risk that a bank (whether commercial, stated-own, or other) runs out of capital and reserves. The z-score applies equally to banks that use a high risk/high return strategy and those that use a low risk/row return strategy, provided that those strategies lead to the same risk adjusted returns. If an institution "chooses" to have lower risk-adjusted returns, it can still have the same or higher z-score if it has a higher capitalization. In this sense, the z-score provides an objective measure of soundness.

3.4.4 Fixed effect estimator

3.4.4.1 Determinant of bank performance

$$IE_{i,t} = \alpha_0 + \alpha_1 Bank\ strategy_{i,t} + \alpha_2 M_{t,c} + \alpha_3 B_{i,t,c} + \varepsilon_{i,t,c} \qquad (6)$$

In this equation, $IE_{i,t}$ which is calculated by the translog function model (equation 4), we use cost inefficiency to reflect bank performance. Lower value means greater performance. $Bank\ strategy_{i,t}$ includes two strategies, such as market power and revenue diversification. We use $LER_{i,t}$ to reflect a bank's market power in interest activities. $LER_{i,t}$ which is calculated by the translog function model (the equation 1,2,3) is the value of the competition of a bank i at time t; We use $RD_{i,t}$ to reflect revenue diversification in non-interest activities. $RD_{i,t}$ measures as non-interest income to total assets to present the overall diversification of bank i operation in country c at time t; $M_{t,c}$ is a set of variables reflecting the macroeconomic conditions in country c at time t; $B_{i,t,c}$ is a set of variables representing individual bank characteristics; and $\varepsilon_{i,t,c}$ is the error item.

3.4.4.2 Determinant of bank stability

$$Z - score_{i,t} = \alpha_0 + \alpha_1 Bank\ strategy_{i,t} + \alpha_2 M_{t,c} + \alpha_3 B_{i,t,c} + \varepsilon_{i,t,c} \quad (7)$$

In this equation, we use $Z - score_{i,t}$, which is calculated from equation 5, to reflect bank stability. $Bank\ strategy_{i,t}$ includes two strategies, such as market power and revenue diversification. We use $LER_{i,t}$ to reflect a bank's market power in interest activities. $LER_{i,t}$ which is calculated by the translog function model (the equation 1,2,3) is the value of the competition of bank i at time t; We use $RD_{i,t}$ to reflect revenue diversification in non-interest activities. $RD_{i,t}$ measures as non-interest income to total assets to present the overall diversification of bank i operation in country c at time t; $M_{t,c}$ is a set of variables reflecting the macroeconomic conditions in country c at time t; $B_{i,t,c}$ is a set of variables representing individual bank characteristics; and $\varepsilon_{i,t,c}$ is the error item.

3.4.5 Dynamic Panel Model

For the sake of addressing the simultaneous relationship in the above model, we use a dynamic panel model to eliminate the potential endogenous problem by employing instrumental variables. Therefore, according to Arellano and Bover (1995) approach, we employ an instrumental variable technique with a Generalized Method of Moments (GMM) estimator, for addressing the likely endogeneity in formulas (6) and (7). Furthermore, when facing heteroskedasticity and endogeneity problems, the GMM estimator introduced by Hansen (1982) may be more efficient. The dynamic panel model are as follows:

$$IE_{i,t} = \alpha_0 + \alpha_1 IE_{i,t-1} + \alpha_2 Bank\ strategy_{i,t} + \alpha_3 M_{t,c} + \alpha_4 B_{i,t,c} + \varepsilon_{i,t,c} \quad (8)$$

In this equation, $IE_{i,t}$ is the vector of bank performance as proxied by cost inefficiency. $IE_{i,t-1}$ is the lagged performance independent variable. $Bank\ strategy_{i,t}$ includes two strategies, such as market power and revenue diversification. $M_{t,c}$ is a set of variables reflecting the macroeconomic conditions in country c at time t; $B_{i,t,c}$ is a set of variables representing individual bank characteristics; and $\varepsilon_{i,t,c}$ is the error item.

And:

$$Z - score_{i,t} = \alpha_0 + \alpha_1 Z - score_{i,t-1} + \alpha_2 Bank\ strategy_{i,t} + \alpha_3 M_{t,c} + \alpha_4 B_{i,t,c} + \varepsilon_{i,t,c} \quad (9)$$

In this equation, we use $Z - score_{i,t}$, which is calculated from equation 5, to reflect bank stability. $Z - score_{i,t}$ is the lagged stability independent variable. $Bank\ strategy_{i,t}$ includes two strategies, such as market power and revenue diversification. $M_{t,c}$ is a set of variables reflecting the macroeconomic conditions in country c at time t; $B_{i,t,c}$ is a set of variables representing individual bank characteristics; and $\varepsilon_{i,t,c}$ is the error item.

3.4.6 Instrumental variables estimation

We run a two-stage least squares instrumental variable analysis (2SLS) [32]by using the lag variable of the Lerner index[33], one bank-level variable (ETA) and one country-level variable (CR5) as our instruments to measure the impact of the Lerner index. A higher

[32] We use the Cragg-Donald statistic to assess whether the instruments are weak. When there is one endogenous regressor as in our 2SLS models, the null hypothesis is that the instruments have no explanatory power in the first stage regression. With one endogenous regressor and two excluded instruments, the critical value (Stock–Yogo weak ID test) for the Cragg–Donald statistic for 10% maximal size distortion is 19.93. Since we have two instruments and one endogenous regressor, we use the Sargan test for over-identifying restrictions to assess whether the instruments are uncorrelated with the second-stage error. If the test statistic exceeds the critical value, we reject the null hypotheses that the instruments are uncorrelated with the structural error and conclude that at least one of the instruments is not exogenous.

[33] We use the lag variable of the Lerner index as instruments to control the autocorrelation problem.

bank profitability leads to greater market power and the ratio of equity to total asset is a good proxy for profitability (Mirzaei et al., 2013). Furthermore, a bank's market power is closely related to the industry competition (Carbo-Valverde et al., 2009). If the competition is great in the banking sector, it would give banks an incentive to increase their market share. They also use Lerner index as a competition indicator to reflect a bank's market power and employ CR5 to reflect the degree of competition in the banking system. Therefore, we can account for bank-specific and country-level characteristics to avoid weak instrument biases and invalid inferences.

For analysing the impact of revenue diversification, we run a two-stage least squares instrumental variable analysis (2SLS) by using two bank-level variables (ROE and fee income) as our instruments. ROE is an indicator of Profitability, which encourages banks to diversify their sources of revenue (Albertazzi and Gambacorta, 2009). Additionally, fee income belongs to non-interest income activities, so it affects the degree of revenue diversification. (Nguyen et al., 2012). Therefore, we account for these two bank-specific characteristics to avoid weak instrument biases and invalid inferences.

3.4.7 Robustness: One-step estimation model of efficiency

Except with the two-step estimation to analyse the relationship between inefficiency and external factors. We also employ inefficiency explanatory variables in the specification using the method of Battese and Coelli (1995). Previous papers (e.g. Jiang et *al*., 2013; Tabak et *al*., 2012) suggest that considering external factors for measuring efficiency by using one-step estimation may be more accurate, so that the efficiency score may reflect whether bank performance could be influenced by other external factors. Thus, bank

efficiency can not just can be affected by individual operations. The model for estimation and determinant of bank efficiency is following:

$$Ln(y_{it}) = \beta_0 + Ln(\beta_1 X_{it}) + \beta_3 \gamma_{it} + (V_{it} - U_{it}) \quad (9)$$

where t is a time trend; X_{it} is a vector of external variables. We employ institutional environment variables to control the cross-country heterogeneity of the banking markets. The above papers consider the use of macroeconomic variables in the translog functions to be important for the correct estimation of cross-country efficiency scores.

3.4.8 Dynamic panel threshold model

As a further step, we use a dynamic panel threshold model that enables us to identify any regime shifts due to bank strategy. We build on the dynamic panel threshold model of Kremer et al. (2013) based on the cross-sectional balanced panel threshold methodology introduced by Hansen (1999). This model identifies changes in coefficients of the main regressors of our interest, whilst it detects thresholds and thereby different regimes endogenously. In addition, comparing this to the study of Nguyen et al., (2012), this model can allow us to reveal if and when there is a break in the data process. According to the papers (e.g. Hansen, 1999; Kremer et al., 2013; Mamatzakis and Bermpei, 2016), we would be able to identify the exact value of the structural break, and detect possible shifts. Therefore, the equations are as follows:

$$IE_{i,t} = \mu_1 + \lambda_1 E_{i,t} I(q_{i,t} \leq \gamma) + \delta_1 I(q_{i,t} \leq \gamma) + \lambda_2 E_{i,t} I(q_{i,t} > \gamma) + \varepsilon_{i,t} \quad (10)$$

$$Z - score_{i,t} = \mu_1 + \lambda_1 E_{i,t} I(q_{i,t} \leq \gamma) + \delta_1 I(q_{i,t} \leq \gamma) + \lambda_2 E_{i,t} I(q_{i,t} > \gamma) + \varepsilon_{i,t} \quad (11)$$

where $Performance_{i,t}$ and $Stability_{i,t}$, are the dependent variables and stand for the cost inefficiency and Z-score respectively. μ_1 is the bank-specific fixed effect, while λ_1 and λ_2 stand for the two reverse regression slopes based on the assumption that exists two regimes, $\varepsilon_{i,t}$ is the random error. $E_{i,t}$ is a vector of explanatory variables that include bank-specific and country-level control variables. δ_1 is the regime dependent intercept as introduced by Bick (2007) and its inclusion is essential for estimating both the threshold value and the coefficient magnitude of the two regimes. *I* is the indicator function suggesting the regime specified by the threshold variable $q_{i,t}$ and the threshold value γ .

The $\varepsilon_{i,t}^{*}$ takes the following transformation:

$$\varepsilon_{i,t}^{*} = \sqrt{\frac{T-t}{T-t+1}}\Big[\varepsilon_{i,t} - \frac{1}{T-t}\left(\varepsilon_{i(\mathrm{t+1})} + \cdots + \varepsilon_{i,T}\right)\Big] \qquad (12)$$

In the equation (12) the threshold variable is $q_{i,t}$, and herein refers to the two measures of bank strategy: (1) bank's market power and (2) revenue diversification. γ is the threshold value which would indicate those observations above (high regime) and below the threshold value (low regime). The above dynamic panel threshold model employs a GMM estimation method (Arellano and Bover, 1995) to address issues related to endogeneity and avoid the serial correlation in the transformed errors. The estimation of the threshold variable follows a two-step procedure; in the first step, the estimation of a reduced type regression for the endogenous variable as a function of instruments takes place. The predicted values are used to replace the endogenous variable in the equation (10). Next, we estimate equation (10) for a fixed threshold value where the threshold variable is replaced by its predicted values obtained in the first step. Threshold values are then specified by the minimization of the concentrated sum of squared errors as $\gamma_i^{*} =$

$argmin_{\gamma} S_{i(\gamma)}$ (Chan, 1993). Lastly, slope coefficients λ_1 and λ_2 could be estimated with the usage of the GMM estimator (Caner and Hansen, 2004).

3.5 Empirical results

3.5.1 Summary the estimation of bank market power, inefficiency and financial stability

Table 3 shows a summary of estimation of bank market power, inefficiency and financial stability from 2000 to 2012 including 11 South-East Asian countries. In order to avoid heterogeneous error, we estimate the Lerner index and the bank cost inefficiency (BCIE) separately in the advanced countries group and the developing countries group. Advanced countries include Australia, Hong Kong China, Japan and Singapore, and others are the in developing countries group.

In panel A, values of three indexes vary across countries. The highest value on the Lerner index is China, which means that there is the lowest level of competition in the banking industry. While Australia has the lowest value of the indicator, meaning that competition in the banking sector is fiercest in these 11 countries. The results from the Philippines and Thailand are similar to the studies of Fu et al., (2014) but the value of India is higher that the result of Soedarmono et al., (2013). For bank performance, Indonesia has the lowest cost inefficiency so that their banks need to improve by 20.6% to assess the cost efficiency frontier. Perera et al., (2007) also show that Sri Lanka had an efficiency score higher than 0.78, which is similar with our result. However, banks in Malaysia and India have the largest cost inefficiency levels, with scores of 0.251 and 0.256 respectively, while banks in Australia have the better performance with inefficiency scores at about 0.210 which is a little lower than the results from Berger et al., (2009b). We use Z-score to represent financial stability and find that Indonesia has the largest value (50.17) comparing with

Japan (38.21). It is interesting that Indonesia has a more stable financial market with the lowest cost inefficiency and lower Lerner scores. Hence, we can expect that higher competition and efficiency may improve financial stability.

In panel B, the Z-score decreases dramatically between 2007 and 2009, which implies that the international crunch has a huge impact on bank stability, in this region. This finding is also supported by Fu et al., (2014). When comparing the competition by year, the results show that there is a decreasing trend in the Lerner index during the financial crisis, meaning that competition is declining significantly. In addition, market power is lower between 2002 and 2004, when some South-East Asian countries decrease restrictions for foreign institutions' entry. The rising trend for competition over the same period may be caused by financial liberalization and trade integration in this region (Dooley et al., 2004; Williams and Nguyen 2005)[34].

Table 3A shows the Chi-square test for different samples. The results indicate that Lerner Index and Inefficiency score are homogeneous, as the P-values are higher than 5 percentage. This is because that when we estimate the Lerner index and bank inefficiency (IE) separately in the advanced countries group and the developing countries group. However, in the Chi-square test, the P-value of Z-score shows that it may exist heterogeneous error in two samples, which is lower than 5%. In order to avoid heterogeneous error, we separate our samples into advanced countries group and the developing countries group by using dynamic panel threshold model. Table 3B shows Chi-square test for the differences in means and medians of three independent variables across years.

[34] Major South-East Asian countries enhance volume of trade with US, which increases their foreign exchange reserves and gives them opportunity to improve bank services and competition.

Table 3

Summary of competition, performance and stability

	N	Lerner	IE	Z-score
Panel A: mean by country				
Advanced countries				
Australia	77	0.247	0.210	40.56
Japan	51	0.390	0.217	38.21
Hong Kong	137	0.489	0.233	41.46
Singapore	39	0.443	0.240	48.87
Developing countries				
China	392	0.493	0.226	43.29
India	409	0.462	0.256	41.13
Indonesia	396	0.390	0.206	50.17
Malaysia	54	0.252	0.251	42.97
Philippines	99	0.421	0.242	40.64
Sri Lanka	24	0.336	0.221	39.18
Thailand	200	0.348	0.230	36.82
Panel B: mean by year				
2000	36	0.450	0.193	35.93
2001	56	0.442	0.275	38.78
2002	64	0.411	0.268	40.45
2003	72	0.430	0.222	43.67
2004	104	0.427	0.192	46.23
2005	115	0.445	0.219	44.88
2006	144	0.453	0.255	42.11
2007	159	0.423	0.238	39.46
2008	177	0.421	0.232	36.48
2009	196	0.447	0.201	38.93
2010	217	0.458	0.192	40.25
2011	263	0.430	0.213	43.36
2012	275	0.432	0.220	44.11

Notes: The Lerner is a bank-level indicator of bank competition calculated as difference between price and marginal cost as a percentage of price. The IE (cost inefficiency) is a bank-level indicator of bank performance calculated by stochastic frontier analysis approach. The Z-score is an accounting-based bank level indicator of financial stability. The results are calculated from the total sample, showing the values of each country and each year.

Table 3A

Chi-square test for different samples			
Variables	**Lerner**	**IE**	**Z-score**
T-test	**-1.661**	**1.203**	**6.337**
P-value	**0.097**	**0.229**	**0.000**
Countries (Number)			
Advanced	**304**	**304**	**300**
Developing	**1574**	**1574**	**1570**

Notes: 95% Conf. Interval

Table 3B

Chi-square test across years				
Variables	N	Lerner	IE	Z-score
2000	36	0.365	1.916	4.295*
		0.715	0.055	0.000
2001	56	-0.587	-4.180*	1.144
		0.557	0.000	0.252
2002	64	-2.062*	-3.889*	0.748
		0.039	0.000	0.454
2003	72	-3.201*	0.061	3.546*
		0.001	0.951	0.000
2004	104	-4.364*	3.416*	-2.577*
		0.000	0.000	0.010
2005	115	-1.069	0.390	2.931*
		0.285	0.696	0.003
2006	144	1.212	-4.272*	0.976
		0.225	0.000	0.328
2007	159	0.496	-3.028*	-0.852
		0.619	0.002	0.394
2008	177	1.579	-1.911	2.901*
		0.114	0.056	0.003
2009	196	2.065	2.131*	2.806
		0.039	0.033	0.005
2010	217	0.171	5.087	-1.307
		0.863	0.000	0.191
2011	263	1.067	1.019	-4.717*
		0.285	0.308	0.000
2012	275	0.871	0.495	-3.880
		0.383	0.620	0.000

Notes: Table shows the T-test and P-value. 95% Conf. Interval.

3.5.2 Determinant of bank performance

3.5.2.1 Market power and bank performance

The first three models in Table 4 show the relationship between bank cost inefficiency and market power. It is obvious that a control variable, such as BRindex, is significant at 1% and has a negative impact on cost inefficiency. It means that these results support the study of Barth et al., (2007) that banking regulation could improve bank performance.[35] Furthermore, the macroeconomic variables, such as inflation and Private sector credit of GDP, are significant at 1% and have a negative effect on cost inefficiency. It means that a higher rate of inflation and a higher level of development can enable a boost in economic growth, which can be an incentive for banks to pursue effectiveness. However, the bank specific-level data, such as bank size, has a positive relationship with inefficiency. Large banks may be more likely to a suffer moral hazard problem and lack the incentive to manage effectively (Schaeck and Cihak, 2008). Importantly, the fixed effect model shows that the Lerner index has a negative impact on cost inefficiency in the first model. In the second model, we use the lag variable of cost inefficiency and market power as instruments in the GMM model for dealing with an endogenous problem.[36] The result suggests that the Lerner index is significant at the 1% level and has a negative relationship with cost inefficiency. Finally, by using the lag variable of the Lerner index, one bank-level variable (ETA) and one country-level variable (CR5) as our instruments, the IV model also shows a negative connection between market power and inefficiency.

[35] Restriction on bank activities, capital requirement, powerful agency and private monitoring may improve bank performance Barth et al., (2004). If banks engage in diverse activities such as securities underwriting, real estate investment and insurance underwriting, it may create conflicts of interest with their fundamental business. Capital requirement helps banks to increase their probability of survival and market share. Bank supervisors can maintain the efficiency, integrity and transparency of the banking industry and then motivate bank management to provide high quality financial reports. PMON may establish disclosure requirements for banks, and then allow private agents to assess banking information and transaction costs that could enhance the profitability and productivity of banks.

[36] We test for the relevance of these instruments or the endogeneity of competition using the Arellano-Bond test, which estimates whether autocorrelation exists, and the Hansen test replaces the Sargan test to reveal whether the instruments are valid.

According to the results from models (1) to (3), higher market power can improve bank performance, which is in line with our hypothesis **H1** that there is a significant relationship between market power and efficiency. Higher market power is closely related to profitability and allow banks to earn economic rent so that it may drive a bank to work effectively (Maudos and Fernández de Guevara, 2007; Pasiouras, 2008). Additionally, Banks controlled by an authority may be the performance leader in the sector (Turk-Ariss, 2010). Since our sample focuses on South-East Asian countries and most of them are transition economies, a large majority of banks are dominated by government and occupy a huge proportion of the market share (Claessens and Horen 2014).

3.5.2.1 Revenue diversification and bank performance

The last three models in Table 4 show the relationship between bank cost inefficiency and revenue diversification. It is obvious that the control variables, such as BRindex and inflation, are significant at 1% and have a negative impact on cost inefficiency while bank size has a statistically positive effect on inefficiency. The fixed effect model in the fourth model shows that the coefficient of revenue diversification is significant at the 1% level and positive in relation to cost inefficiency. In the fifth model, we use a lag variable of cost inefficiency and revenue diversification as instruments in the GMM model for dealing with the endogenous problem. This model also displays a positive connection between diversification and cost inefficiency. Finally, we run a two-stage least squares instrumental variable analysis (2SLS) by using two bank-level variables (ROE and fee income) as our instruments. The IV model suggests that revenue diversification decreases bank performance, which is in line with the hypothesis **H2** that there is a significant relationship between revenue diversification and efficiency. Our results are different from the studies (e.g. Landskroner et al. 2005; Acharya et al., 2006; Lepetit et al., 2008),

because diversification may worsen risk-adjusted performance, when banks over expand into industries where they lack expertise, particularly in developing countries. Furthermore, our sample focuses on Asian countries where banks are more likely to suffer asymmetric information in traditional services, let alone new activities.

Table 4

The determinant of Cost Inefficiency

	Fixed effect	GMM	IV	Fixed effect	GMM	IV
	(1)	(2)	(3)	(4)	(5)	(6)
	IE	IE	IE	IE	IE	IE
Lerner	-0.089**	-0.424***	-0.103*			
	(0.036)	(0.071)	(0.054)			
RD				0.777**	2.677***	0.669*
				(0.331)	(0.646)	(0.376)
BRindex	-0.005***	-0.008***	-0.005***	-0.004***	-0.007***	-0.004***
	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)	(0.001)
IEindex	0.001	0.009*	0.007*	0.006	0.008*	0.006*
	(0.006)	(0.005)	(0.004)	(0.005)	(0.004)	(0.004)
Inflation	-0.259***	-0.505***	-0.314***	-0.212**	-0.299**	-0.208***
	(0.094)	(0.145)	(0.079)	(0.091)	(0.149)	(0.072)
GDP	-0.074	0.408***	-0.016	-0.091	0.339***	-0.092
	(0.070)	(0.120)	(0.082)	(0.070)	(0.099)	(0.083)
DCR	-0.001***	-0.001***	-0.001***	-0.001***	-0.000	-0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Bank size	0.030**	0.071***	0.021**	0.037***	0.069***	0.036***
	(0.012)	(0.021)	(0.010)	(0.013)	(0.016)	(0.010)
Liquidity	0.038	0.181***	0.052	0.027	0.032	0.026
	(0.042)	(0.050)	(0.032)	(0.042)	(0.042)	(0.031)
Crisis_dummy	0.002	-0.012	0.004	0.011	0.003	0.007
	(0.004)	(0.043)	(0.016)	(0.044)	(0.005)	(0.012)
L.IE		0.470***			0.553***	
		(0.054)			(0.046)	

(*Continued*)

Table 4-*Continued*

The determinant of Cost Inefficiency						
	Fixed effect	GMM	IV	Fixed effect	GMM	IV
	(1)	(2)	(3)	(4)	(5)	(6)
	IE	IE	IE	IE	IE	IE
_cons	0.264**	-0.068		0.138	-0.339**	
	(0.125)	(0.207)		(0.123)	(0.145)	
N	1878	1469	1401	1878	1469	1847
r2_a	0.116		0.196	0.106		0.109
F	9.351		22.024	11.054		18.337
AR(1)		0.000			0.000	
AR(2)		0.955			0.275	
Hansen(p-value)		0.149			0.117	
Cragg–Donald(F-statistic)			226.645			658.066
Sargan test(p-value)			0.359			0.451

Notes: The table presents coefficients for the relationship between cost inefficiency, competition, revenue diversification (RD). The dependent variables are cost inefficiency used to reflect a bank's performance, which is calculated from translog cost function (SFA); a lower value illustrates greater bank performance. The control variables include regulatory variables, macroeconomic variables and bank specific variables. BRindex is an aggregate regulation index (BRindex = ACTR + CAPR + SPR + PMON). IEindex is an aggregate institutional environment index (IEindex = Governance Effectiveness + Rule of Law + Control of Corruption + Regulatory Quality). DCR is Private sector credit of GDP. We run the Fixed effect model, GMM model and the second stage of a 2SLS model with robust separately. L.IE is the lag variable of cost inefficiency. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. For the GMM model, the Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. We use the Cragg–Donald statistic to assess whether the instruments are weak. When there are two endogenous regressors as in our models (i.e., the Lerner index in model (3) and revenue diversification in model (6)), the Cragg–Donald statistic has an F distribution under the null hypothesis that the instruments have no explanatory power in the first stage regression. With one endogenous regressor and more than one excluded instrument, the critical value (Stock–Yogo weak ID test) for the Cragg–Donald statistic for 10% maximal size distortion is 19.93. Since we have two unique instruments and one endogenous regressor in each IV regression model, we use the Sargan test for over-identifying restrictions to assess whether the instruments are uncorrelated with the second-stage error. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

3.5.3 The determinant of bank stability

3.5.3.1 Market power and bank stability

The first three models in Table 5 show the relationship between bank stability and market power. It is obvious that control variables, such as GDP, Private sector credit of GDP and liquidity, have a significantly positive impact on stability. It means that a higher level of economic growth and development can ensure job creation, investor's confidence and reduce the pressure of shortage of funding, which decreases the probability of the default risk of banks. Greater liquidity is an improved ability to sell assets, and should make banks less vulnerable to liquidity shocks, and is further expected to reduce the level of risk on banks' balance sheets. While the macroeconomic variable (inflation) has a negative impact on bank stability, because excessive inflation gives a sign of recession to the financial market and influences the activities of financial intermediation.

More importantly, the fixed effect model shows that the Lerner index has a negative impact on stability in the first model. In the second mode, we use the lag variable of cost stability and market power as instruments in the GMM model for dealing with the endogenous problem. The result also suggests a negative relationship between Lerner index and stability. Furthermore, we run the two-stage least squares instrumental variable model to analyse the impact of market power on stability, by using the lag variable of the Lerner index, one bank-level variable (ETA) and one country-level variable (CR5) as our instruments. The IV model also shows that higher market power reduces bank stability. The findings from three different models are in line with our hypothesis **H3** that there is a significant relationship between market power and stability. Our results are different from the studies (e.g. Anginer et al., 2014a; Fu et al., 2014), because banks with greater market power are more likely to charge higher rates for loan customers, which increases borrowers' difficulties to repay principals. In addition, banks with greater market power

are more likely to receive public guarantees, which may encourage risk-taking behaviour, generate a moral hazard and adverse selection problems (Boyd and De Nicoló, 2005; Schaeck and Cihak, 2008; Schaeck et al., 2009).

3.5.3.2 Revenue diversification and bank stability

The last three models in Table 5 show the relationship between bank stability and revenue diversification. Similarly, the control variables, such as GDP, private credit sector of GDP and liquidity, have a significantly positive impact on stability. Interestingly, the BRindex are significant at the 5% or 1% level and have a positive relationship with stability from models (4) to (6). Bank regulation restricts banking risk activity, intensifies monitoring and reduces excessive risk-taking behaviour (Barth et al., 2004; Barth et al., 2007), which reduces individual fragility.

More importantly, we use fixed effect, the GMM and IV model[37] to analyse the impact of revenue diversification on stability. The results suggest that there is a significantly positive relationship between revenue diversification and stability, which is in line with our hypotheses **H4**. The strategy of expanding activities helps banks build up their capital buffer (Shim, 2013), and hedge against insolvency risk that reduces the occurrence of costly financial distress (Stiroh, 2006a; Stiroh, 2006b). Our findings are different from the studies (Stiroh and Rumble 2006; De Jonghe, 2010)[38], because the purpose of banks may not use revenue diversification to earn economic rent and they use these non-profits activities to reduce their revenue volatility, particularly in developing countries.

[37] We use lag variable of stability and revenue diversification as instruments in the GMM model for dealing with the endogenous problem. Moreover, we run a two-stage least squares instrumental variable analysis (2SLS) by using two bank-level variables (ROE and fee income) as our instruments.

[38] They suggest that if banks diversify their portfolio into the security market, it may increase the volatility of a bank's income. More volatile returns report a higher probability of insolvency than for banks with traditional product mixes.

Table 5

The determinant of Stability

	Fixed effect	GMM	IV	Fixed effect	GMM	IV
	(1)	(2)	(3)	(4)	(5)	(6)
	Z-sore	Z-sore	Z-sore	Z-sore	Z-sore	Z-sore
Lerner	-0.976*	-0.875*	-27.086*			
	(0.580)	(0.500)	(15.945)			
RD				19.445***	29.179***	19.430***
				(4.303)	(4.155)	(6.962)
BRindex	0.025*	0.042**	-0.098	0.031**	0.028**	0.031***
	(0.014)	(0.021)	(0.073)	(0.014)	(0.014)	(0.012)
IEindex	-0.185**	0.037	-1.473*	-0.114*	0.030	-0.114**
	(0.072)	(0.028)	(0.791)	(0.065)	(0.025)	(0.057)
Inflation	-3.821**	-2.606*	-26.062*	-3.719***	-1.700	-3.719***
	(1.578)	(1.420)	(13.358)	(1.432)	(1.359)	(1.428)
GDP	4.986**	2.773*	11.546**	4.895**	3.155**	4.895**
	(2.027)	(1.590)	(5.420)	(2.015)	(1.588)	(1.980)
DCR	0.024***	0.003*	0.032***	0.024***	0.004**	0.024***
	(0.004)	(0.002)	(0.010)	(0.004)	(0.002)	(0.004)
Bank size	-0.460	-0.298**	-0.950	-0.313	0.124**	-0.313
	(0.298)	(0.143)	(0.732)	(0.304)	(0.062)	(0.284)
Liquidity	0.971*	1.415*	5.154*	0.893*	1.114**	0.893**
	(0.526)	(0.854)	(2.880)	(0.511)	(0.434)	(0.445)
Crisis_dummy	-0.012***	-0.012***	-0.004***	-0.011*	-0.013**	-0.027**
	(0.004)	(0.003)	(0.001)	(0.007)	(0.005)	(0.012)
L. Z-sore		0.242***			0.166***	
		(0.065)			(0.050)	

(*Continued*)

Table 5-*Continued*

The determinant of Stability						
	Fixed effect	GMM	IV	Fixed effect	GMM	IV
	(1)	(2)	(3)	(4)	(5)	(6)
	Z-sore	Z-sore	Z-sore	Z-sore	Z-sore	Z-sore
_cons	3.798	2.863**		1.597	-1.477**	
	(2.879)	(1.284)		(2.857)	(0.741)	
N	1870	1462	1838	1870	1462	1838
r2_a	0.046		0.048	0.053		0.057
F	11.272		2.255	12.882		12.329
AR(1)		0.000			0.000	
AR(2)		0.182			0.100	
Hansen(p-value)		0.935			1.000	
Cragg–Donald(F-statistic)			19.953			651.681
Sargan test(p-value)			0.163			0.247

Notes: The table presents coefficients for the relationship between bank stability, competition, revenue diversification (RD). The dependent variables are the Z-score in used to reflect individual bank's stability; a higher value illustrates greater bank stability. The control variables include regulatory variables, macroeconomic variables and bank specific variables. BRindex is an aggregate regulation index (BRindex = ACTR + CAPR + SPR + PMON). IEindex is an aggregate institutional environment index (IEindex = Governance Effectiveness + Rule of Law + Control of Corruption + Regulatory Quality). DCR is Private sector credit of GDP. We run the Fixed effect model, the GMM model and the second stage of a 2SLS model with robustness separately. L.Z-score is the lag variable of Z-score. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. For the GMM model, the Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. We use the Cragg–Donald statistic to assess whether the instruments are weak. When there are two endogenous regressor as in our models (i.e., the Lerner index in model (3) and revenue diversification in model (6)), the Cragg–Donald statistic has an F distribution under the null hypothesis that the instruments have no explanatory power in the first stage regression. With one endogenous regressor and more than one excluded instrument, the critical value (Stock–Yogo weak ID test) for the Cragg–Donald statistic for 10% maximal size distortion is 19.93. Since we have two unique instruments and one endogenous regressor in each IV regression model, we use the Sargan test for over-identifying restrictions to assess whether the instruments are uncorrelated with the second-stage error. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

3.5.4 Robustness: one-step estimation model of efficiency

Maximum-likelihood (ML) estimates of parameters are obtained using FRONTIER4.1 (Coelli, 1996). Table 6 reports estimation results from the cost frontier. We use bank specific and macroeconomic variables as control variables for estimating the efficiency score. For the advanced countries, estimated average cost efficiency are 0.811 and 0.779 respectively in the first two models. While the efficiency scores are 0.765 and 0.738 in developing countries. The scores are similar with the results from the translog cost function model in Table 3. All models in Table 6 include external factors. Based on the papers (e.g. Jiang et *al*., 2013; Tabak et *al*., 2012), they suggest that except banking internal factors, external factors may also directly affect the bank performance. In models (1) and (3), the Lerner index has a positive impact on cost efficiency, which is similar to the finding in Table 4. Thus, the finding is in line with our hypothesis **H1** that there is a significant relationship between market power and efficiency. It also supports the views of previous studies (e.g. Maudos and Fernández de Guevara, 2007; and Pasiouras, 2008) that if banks occupy huge proportion of market share, they would like to improve their performance to maintain their market power, particularly in the Asian market. However, the models (2) and (3) show that revenue diversification has a negative relationship with bank efficiency. Our finding is different from the studies (e.g. Landskroner et al., 2005; Acharya et al., 2006). Revenue diversification may trigger a cost for expanding a new service, branch and transaction so that the cost efficiency may be reduced by higher original investment and operating expense (Elsas et al., 2012). Therefore, the results from the one-step estimation model are similar to the findings from Table 4 that market power can improve their efficiency while revenue diversification increase inefficiency. We run a robustness test by dividing my database into three sub-samples, such as, state-owned, private and quoted banks. The results are no difference between these three sub-samples.

Table 6

Robustness: The determinant of efficiency (one step model)				
	Advanced countries		Developing countries	
	(1)	(2)	(3)	(4)
	CE	CE	CE	CE
Ln(cost)	0.117***	0.173***	0.221***	0.321**
	(0.029)	(0.048)	(0.103)	(0.158)
Constant	1.715*	1.320***	0.825*	1.665**
	(0.720)	(0.427)	(0.442)	(0.678)
External factors:				
Lerner	0.154***		0.234**	
	(0.045)		(0.102)	
RD		-0.123**		-0.201**
		(0.062)		(0.098)
Brindex	0.256*	0.225***	0.524**	0.152*
	(0.134)	(0.098)	(0.247)	(0.088)
Ieindex	-0.110	-0.153	-0.217	-0.135
	(0.134)	(0.564)	(0.365)	(0.099)
Inflation	-0.045*	-0.054	-0.053	-0.065
	(0.028)	(0.076)	(0.086)	(0.061)
GDP	0.006**	0.004**	0.002*	0.004***
	(0.003)	(0.002)	(0.001)	(0.001)
DCR	0.001*	0.005***	0.004***	0.002**
	(0.001)	(0.002)	(0.001)	(0.001)
Bank size	0.031	0.002**	0.011**	0.005*
	(0.055)	(0.001)	(0.005)	(0.003)
Liquidity	0.022	0.073*	0.076	0.033
	(0.057)	(0.041)	(0.072)	(0.051)
Crisis_dummy	0.012	0.022	0.026	0.102
	(0.011)	(0.016)	(0.031)	(0.086)
Sigma-squared	0.242***	0.545**	0.349**	0.335**
	(0.083)	(0.295)	(0.173)	(0.097)
Gamma	0.281**	1.514**	0.372*	1.122**
	(0.122)	(0.733)	(0.202)	(0.582)
Log likelihood	-2897.9	-4862.3	-3125.3	-4385.7
Mean efficiency	0.811	0.779	0.765	0.738
N	304	304	1574	1574

Notes: The table presents the relationship between cost efficiency, competition and revenue diversification (RD). Advanced countries include Australia, Hong Kong China, Japan and Singapore, and others are in the developing countries group. The bank specific control variables Bank size and liquidity. Macroeconomic variables include BRindex; Inflation; GDP; DCR is Private sector credit of GDP. Sigma-squared is the sum of variance of error terms. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. The ratio between the variance of the inefficiency variance and total variance is equal to Gamma. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

3.5.5 Dynamic threshold results

Our results in the fixed effect model indicate the presence of an impact of market power on efficiency and stability respectively, and the presence of an impact of revenue diversification on efficiency and stability as well. Based on these results and the discussion above, we believe that there is a threshold value of the two strategies creates a different effect on bank performance and stability. Therefore, we implement the dynamic panel threshold model introduced by Kremer et al. (2013) which allow us to identify the presence of potential threshold-effects of the two strategies with regard to bank efficiency and stability. This potential effect would be able to allow us to analyse in depth a period of structural changes for banking institutions. We use the two banking strategies, such as market power and revenue diversification, as threshold variables.

3.5.5.1 Market power and bank performance

In Table 7, our dynamic threshold analysis reveals threshold values of the Lerner index to be 0.37575 in the advanced countries group and 0.33547 in the developing countries group respectively. These values split the sample of 1878 observations into two regimes. For the advanced countries, the high regime comprises 304 observations based on the level of the market power is above the 0.37575, while the rest of the observations (124) belongs to the low regime, whereby the value of market power is below the 0.37575. These results show that market power has a significantly negative relationship with bank inefficiency in both regimes in the advanced countries group. However, the market power is more significantly negative related with bank inefficiency when the coefficient estimate is λ_2=-0.351 in the high regime. It means that a 1% increase of market power is related with 0.351 percentage point decrease in cost inefficiency.

For the developing countries group, our results show that market power has a significantly negative relationship with bank inefficiency in the high regime and the coefficient estimate is λ_2=-0.149. It means that a 1% increase in market power is related with a 0.149 percentage point decrease in cost inefficiency. While the negative relationship between market power and cost inefficiency is not significant in the low regime and the coefficient estimate is λ_1=-0.027. Thus, our findings are in line with our hypotheses **H1,** and suggest that a positive relationship between market power and bank performance would be more pronounced under higher levels of market power.

At the same time, we also find a negative relationship between the BRindex and inflation and private sector credit of GDP and cost inefficiency. In addition, we observe both the IEindex and bank size are associated positively with cost inefficiency. All these results are consistent with our previous findings. Furthermore, **Fig. 1.** and **2.** describe the volatility of market power and suggests a threshold value to distinguish from a low to a high regime.

Table 7

Results of dynamic panel threshold estimation with the Lerner index as a threshold variable on cost inefficiency

Threshold estimate				
Countries	Advanced		Developing	
Lerner	0.37575		0.33547	
95%Confidence interval	(0.35268-0.37819)		(0.21299-0.39632)	
Impact of Lerner		S.E		S.E
λ_1	-0.221*	(0.132)	-0.027	0.059
λ_2	-0.351**	(0.142)	-0.149***	(0.039)
Impact of covariates		S.E		S.E
ETA	0.333	(0.579)	0.141	(0.192)
BRindex	-0.049*	(0.027)	-0.175***	(0.027)
IEindex	0.061***	(0.018)	0.001	(0.003)
Inflation	1.186	(0.354)	-0.367***	(0.076)
GDP	-0.111	(0.098)	0.009	(0.089)
DCR	-0.241***	(0.085)	-0.183***	(0.027)
Bank size	0.101**	(0.053)	0.059***	(0.015)
Liquidity	0.123*	(0.071)	0.001	(0.039)
Crisis_dummy	0.033	(0.021)	0.027	(0.033)
δ	-0.102	(0.094)	-0.021	(0.024)
Observations	304		1574	
Low regime	124		345	
High regime	180		1229	

Notes: The table presents the estimations for the dynamic panel threshold model. Each regime has at least 5% of the observations (Hansen, 1999). Advanced countries include Australia, Hong Kong China, Japan and Singapore, and others are the in developing countries group. We denote as dependent variable banks' performance ($IE_{i,t}$), whilst as the threshold and the regime dependent variable we impose the bank's Lerner index ($Lerner_{i,t}$) which represents market power. Following Bick (2007), the model accounts for regime dependent intercepts (δ). Our dependent variable is cost inefficiency. Our independent variables of our main interest: Lerner index. Other bank-specific independent control variables: bank size (log of total asset); liquidity (liquid asset to total asset). Country level and state level independent variables: BRindex, IEindex, inflation GDP and DCR (Private sector credit of GDP). ETA (equity to total asset) is an endogenous variable. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. We check that there is not a high level of correlation between the variables used in the models. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level. Robust standard errors given are in parentheses.

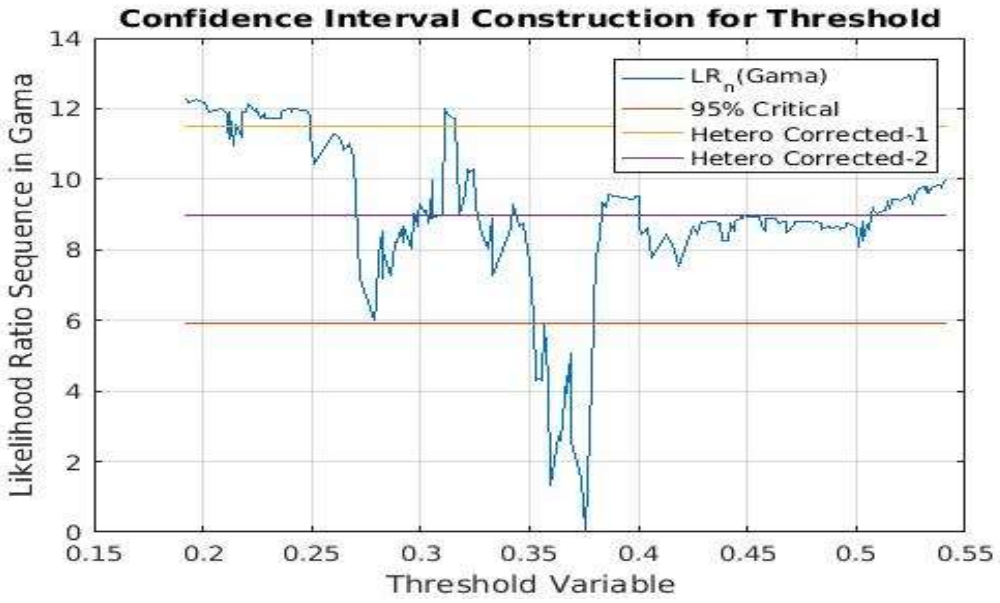

Fig. 1. Threshold value of the Lerner index (bank's market power) and the classification of low and high regime in advanced countries.

Notes: The figure shows the threshold value of the Lerner index on bank performance (cost inefficiency) which splits into the high and low regimes (2000-2012).

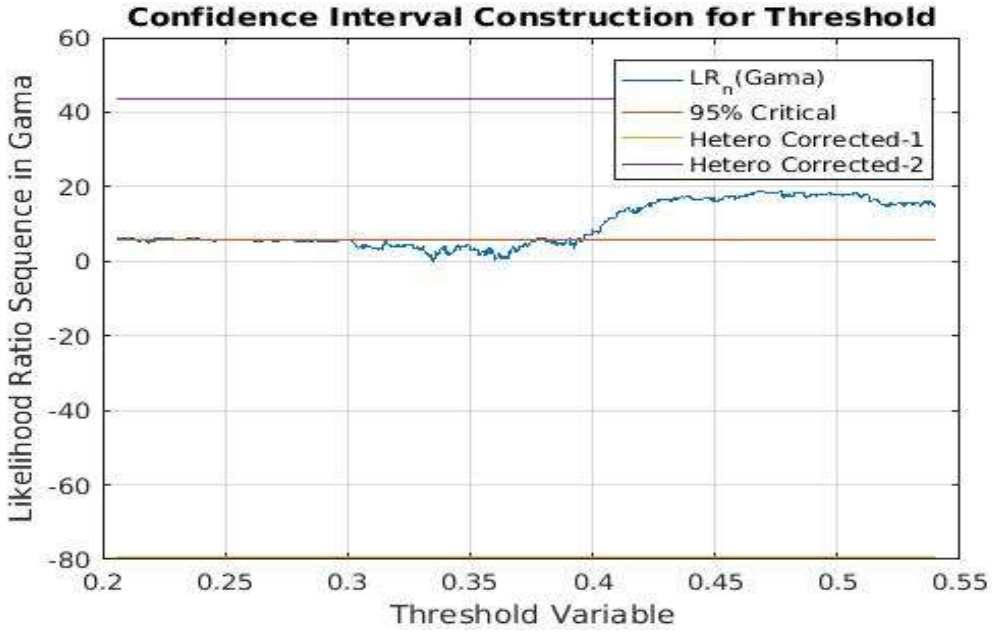

Fig. 2. Threshold value of the Lerner index (bank's market power) and the classification of low and high regimes in developing countries.

Notes: The figure shows the threshold value of the Lerner index on bank performance (cost inefficiency) which splits into the high and low regimes (2000-2012).

In Table 8, the percentage of banks classified as low-regime is consistently below the percentage of banks classified as high-regime with respect to the Lerner index. There is a significantly negative trend in the number of banks with greater market power after the recent financial crisis.

Table 8 Dynamic Threshold Analysis: classification of banks into the two identified regimes based on threshold value of Lerner index

Threshold: Lerner index (Market power)													
Advanced countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	35%	36%	37%	42%	35%	29%	36%	31%	35%	37%	41%	47%	38%
High regime	65%	64%	53%	58%	65%	71%	64%	69%	65%	63%	59%	53%	62%
Developing countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	25%	16%	11%	11%	12%	17%	26%	27%	26%	30%	24%	27%	27%
High regime	75%	84%	89%	89%	88%	83%	74%	73%	74%	70%	76%	73%	73%

Notes: The table shows the classification of the bank based on the Lerner index threshold value that we obtained following Kremer's et al. (2013) threshold model for the dynamic panel. The dependent of the dynamic panel threshold model is bank cost inefficiency.

3.5.5.2 Revenue diversification and bank performance

In the table 9, the threshold analysis reveals a threshold value of the revenue diversification to be 0.00216 in the advanced countries group. This value splits the sample 304 observations into two regimes. The high regime includes all the observations in which the value of the revenue diversification is above the 0.00216. While the rest of the observations belongs to the low regime, whereby the threshold value is below the 0.00216. In this group, the revenue diversification has a significantly positive relationship with bank inefficiency in both regimes, while the positive association is more pronounced in the low regime when the coefficient estimate is λ_1 =4.736. However, the positive relationship is not significant in the low regime and the coefficient estimate is λ_1=1.845 in the low regime in developing countries group, and the positive association is more pronounced in the high regime when the coefficient estimate is λ_2=1.212.

Therefore, our findings not only support our hypotheses **H2**, but also suggest that the positive relationship between revenue diversification and bank inefficiency is more pronounced in advanced economies in the low regime while this relationship is more pronounced in the high regime in developing countries.

At the same time, we also find a negative relationship between the BRindex and inflation and private sector credit of GDP and cost inefficiency. In addition, we observe bank size and IEindex are associated positively with cost inefficiency. All these results are consistent with our previous findings. Furthermore, **Fig. 3.** and **4.** describe the volatility of revenue diversification and suggest a threshold value to distinguish it from low to high regimes.

Table 9

Results of dynamic panel threshold estimation with revenue diversification as threshold variable on cost inefficiency

Threshold estimate				
Countries	Advanced		Developing	
Revenue diversification	0.00216		0.00966	
95%Confidence interval	(0.00201-0.00232)		(0.00923-0.01042)	
Impact of revenue diversification		S.E		S.E
λ_1	4.736***	(1.807)	1.845	(1.361)
λ_2	1.336**	(0.560)	1.212***	(0.289)
Impact of covariates		S.E		S.E
ETA	0.644	(0.484)	0.135	(0.189)
BRindex	-0.016	(0.049)	-0.151***	(0.027)
IEindex	0.045**	(0.018)	0.006**	(0.003)
Inflation	-1.338***	(0.312)	-0.241***	(0.077)
GDP	-0.113	(0.101)	-0.035	(0.086)
DCR	-0.338***	(0.063)	-0.158***	(0.026)
Bank size	0.171***	(0.046)	0.062***	(0.015)
Liquidity	0.145**	(0.073)	-0.027	(0.038)
Crisis_dummy	0.066	(0.070)	0.077	(0.051)
δ	-0.048	(0.033)	0.026**	(0.013)
Observations	304		1574	
Low regime	40		841	
High regime	264		733	

Notes: The table presents the estimations for the dynamic panel threshold model. Each regime has at least 5% of the observations (Hansen, 1999). Advanced countries include Australia, Hong Kong China, Japan and Singapore, and others are in the developing countries group. We denote as dependent variable banks' performance ($IE_{i,t}$), whilst as the threshold and the regime dependent variable we impose the bank's revenue diversification ($RD_{i,t}$) which represents non-interest income activities. Following Bick (2007), the model accounts for regime dependent intercepts (δ). Our dependent variable is cost inefficiency. Independent variables of our main interest: revenue diversification. Other bank-specific independent control variables: bank size (log of total asset); liquidity (liquid asset to total asset). Country level and state level independent variables: BRindex, IEindex, inflation GDP and DCR (Private sector credit of GDP). ETA (equity to total asset) is an endogenous variable. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. We check that there is not a high level of correlation between the variables used in the models. ***Statistical significance at the 1% level. Our **Statistical significance at the 5% level. *Statistical significance at the 10% level. Robust standard errors given are in parentheses.

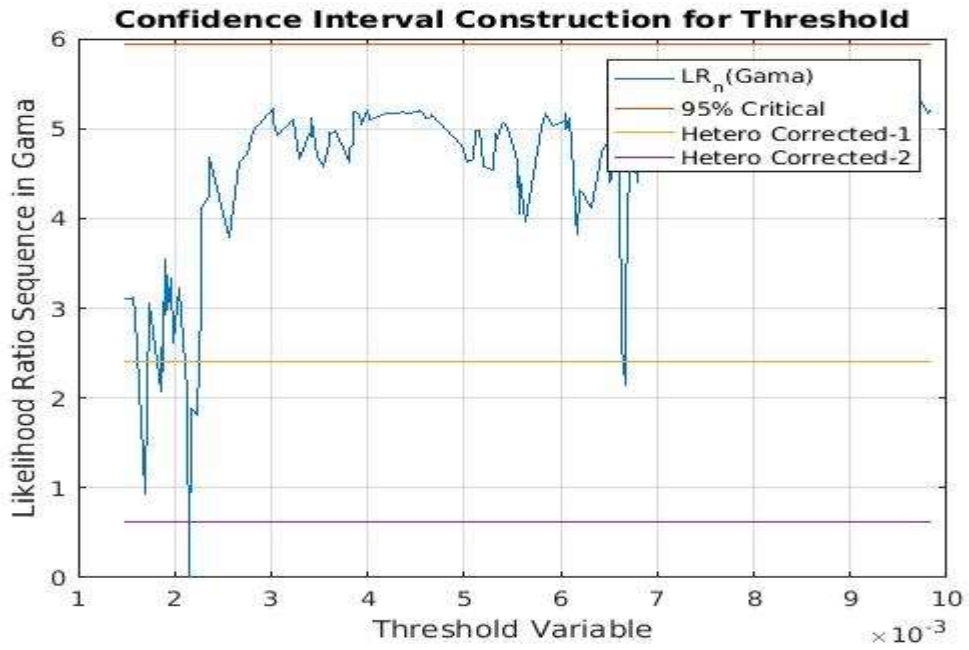

Fig. 3. Threshold value of revenue diversification (bank's non-interest income activities) and the classification of low and high regime in advanced countries.

Notes: The figure shows the threshold value of revenue diversification on bank performance (cost inefficiency) which splits into the high and low regimes (2000-2012).

Fig. 4. Threshold value of revenue diversification (bank's non-interest income activities) and the classification of low and high regime in developing countries.

Notes: The figure shows the threshold value of revenue diversification on bank performance (cost inefficiency) which splits into the high and low regimes (2000-2012).

In Table 10, the percentage of banks classified as low-regime is consistently below the percentage of banks classified as high-regime in advanced countries. While the low-regime is consistently above the high-regime in developing countries.

Table 10 Dynamic Threshold Analysis: classification of banks into the two identified regimes based on threshold value of Revenue diversification

Threshold: Revenue diversification													
Advanced countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	25%	20%	17%	15%	13%	22%	20%	7%	18%	21%	13%	9%	9%
High regime	75%	80%	83%	85%	87%	78%	80%	93%	82%	89%	87%	81%	81%
Developing countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	51%	53%	57%	51%	51%	50%	53%	53%	58%	55%	52%	67%	60%
High regime	49%	47%	43%	49%	49%	50%	47%	47%	42%	45%	48%	33%	40%

Notes: The table shows the classification of the bank based on the threshold value of revenue diversification that we obtained following Kremer's et al. (2013) threshold model for the dynamic panel. The dependent of the dynamic panel threshold model is bank cost inefficiency.

3.5.5.3 Market power and bank stability

In Table 11, the threshold analysis reveals a threshold value of the market power to be 0.47488 in the advanced countries group. This value splits the sample 304 observations into two regimes. The high regime includes all the observations in which the value of the revenue diversification is above 0.47488. While the rest of observations belongs to the low regime, whereby the threshold value is below 0.47488. In this group, the market power is has a significantly negative relationship with bank stability in lower regimes and the coefficient estimate is λ_1=-5.562, while the positive association is not significant in the low regime.

For the developing countries, the threshold analysis reveals a threshold value of the market power to be 0.28825, which splits the observation (1574) into two regimes. Our results show that market power has a significantly negative relationship with bank stability in the low regime and the coefficient estimate is λ_1=-3.929. It means that a 1%

increase in market power is associated with a 3.929 percentage point decrease in stability. However, there is no significantly positive relationship between market power and stability in the high regime and the coefficient estimate is λ_2=2.801. Thus, our results are in line with our hypotheses **H3**, and suggest that the negative relationship between market power and stability is more pronounced in low regime.

At the same time, consistent with our previous findings, BRindex, GDP and DCR are related positively with bank stability. Moreover, we find that inflation is significant at 10% level and has a negative link with stability. Finally, **Fig. 5. a**nd **6.** describe the volatility of market power and suggests a threshold value to distinguish from a low to a high regime.

Table 11

Results of dynamic panel threshold estimation with the Lerner index as a threshold variable on stability

Threshold estimate				
Countries	Advanced		Developing	
Lerner index	0.47488		0.28825	
95%Confidence interval	(0.47230-0.53445)		(0.20664-0.32231)	
Impact of Lerner		S.E		S.E
λ_1	-5.562*	(3.485)	-3.929***	(0.771)
λ_2	4.166	(4.150)	2.801	(1.869)
Impact of covariates		S.E		S.E
ETA	-27.612*	(16.372)	-1.050	(2.801)
BRindex	2.762*	(1.547)	0.848***	(0.421)
IEindex	1.487	(1.462)	0.148	(0.160)
Inflation	-3.121***	(1.021)	-1.028	(1.363)
GDP	15.618***	(3.958)	2.860**	(1.403)
DCR	10.039***	(2.742)	2.351***	(0.633)
Bank size	-4.583**	(1.851)	-0.318	(0.471)
Liquidity	1.722	(2.800)	0.389	(0.354)
Crisis_dummy	-0.011*	(0.006)	-0.018**	(0.007)
δ	1.111	(2.268)	1.571***	(0.324)
Observations	304		1574	
Low regime	180		206	
High regime	124		1368	

Notes: The table presents the estimations for the dynamic panel threshold model. Each regime has at least 5% of the observations (Hansen, 1999). Advanced countries include Australia, Hong Kong China, Japan and Singapore, and others are in the developing countries group. We denote as dependent variable banks' stability($Z - score_{i,t}$), whilst as the threshold and the regime dependent variable we impose the bank's Lerner index ($Lerner_{i,t}$) which represents market power. Following Bick (2007), the model accounts for regime dependent intercepts (δ). Our dependent variable is Z-score. Our independent variables of our main interest: Lerner index. Other bank-specific independent control variables: bank size (log of total asset); liquidity (liquid asset to total asset). Country level and state level independent variables: BRindex, IEindex, inflation GDP and DCR (Private sector credit of GDP). ETA (equity to total asset) is an endogenous variable. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. We check that there is not a high level of correlation between the variables used in the models. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level. Robust standard errors given are in parentheses.

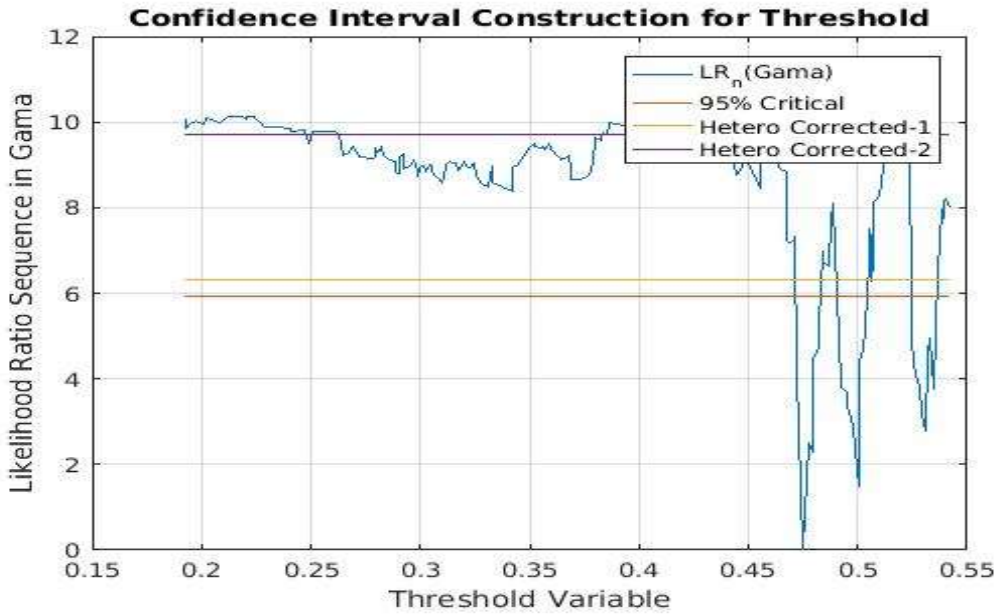

Fig. 5. Threshold value of Lerner index (bank's market power) and the classification of low and high regime in advanced countries.

Notes: The figure shows the threshold value of Lerner index on bank stability (Z-score) which splits into the high and low regimes (2000-2012).

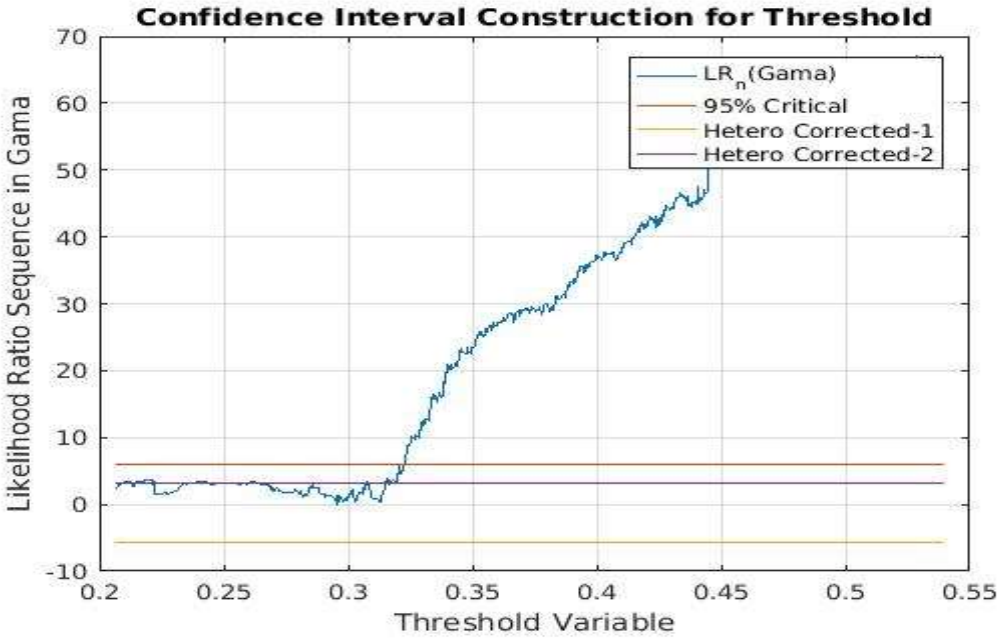

Fig. 6. Threshold value of Lerner index (bank's market power) and the classification of low and high regimes in developing countries.

Notes: The figure shows the threshold value of the Lerner index on bank stability (Z-score) which splits into the high and low regimes (2000-2012).

In Table12, the percentage of banks classified as low-regime is consistently below the percentage of banks classified as high-regime with respect to the Lerner index after a financial crisis in the advanced countries group. In the developing countries group, the percentage of banks classified as low-regime is consistently below the percentage of banks classified as high-regime. There is a stable trend in the number of banks with greater market power after the recent financial crisis.

Table 12 Dynamic Threshold Analysis: classification of banks into the two identified regimes based on threshold value of Lerner index

Threshold: Lerner index (Market power)													
Advanced countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	45%	56%	60%	62%	58%	53%	61%	59%	55%	51%	49%	48%	46%
High regime	55%	44%	40%	38%	42%	47%	39%	41%	45%	49%	51%	52%	54%
Developing countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	22%	16%	10%	10%	9%	12%	21%	19%	20%	21%	21%	18%	20%
High regime	78%	84%	90%	90%	91%	88%	79%	81%	80%	79%	79%	82%	80%

Notes: The table shows the classification of the bank based on the Lerner index threshold value that we obtained following Kremer's et al. (2013) threshold model for the dynamic panel. The dependent of the dynamic panel threshold model is bank stability (Z-score).

3.5.5.4 Revenue diversification and bank stability

In Table 13, the threshold analysis reveals a threshold value of the revenue diversification to be 0.00787 in the advanced countries group. This value splits the sample 304 observations into two regimes. The high regime includes all the observations in which the value of the revenue diversification is above the 0.00787. While the rest of the observations belong to the low regime, whereby the threshold value is below the 0.00787. In this group, the revenue diversification has a significantly positive relationship with bank stability in lower regimes and the coefficient estimate is λ_1=27.851, which means that a 1% increase in revenue diversification is associated with a 3.929 percentage point

increase in stability. However, the positive association is not significant in the low regime. The positive association is more pronounced in the low regime in advanced countries.

For the developing countries, the threshold analysis reveals a threshold value of the revenue diversification to be 0.00131. Our findings suggest that the revenue diversification has a positive relationship with bank stability for both regimes. In particular, coefficient estimates on the association between diversifying strategy and bank stability are λ_2=19.698 for the high regime and λ_1=14.449 for the low regime in the developing group. Interestingly, we find that based on the terms of magnitude, the diversifying strategy has a stronger relationship with bank stability for banks that belong to the high regime compared to those that belong to the low regime. Thus, the positive association is more pronounced in the high regime.

According to the results in Table 13, we find that lower revenue diversification in advanced countries could improve stability while a greater diversifying strategy could reduce bank fragility in developing countries. Banks' diversification in developed economies may involve many risky investments, such as securitization and real estate (Stiroh and Rumble 2006). Greater diversification may provide the incentive for a bank to take more risk. However, in developing countries, there are few risky investing markets and banks' activities are restricted by government (Nguyen et al., 2012). The purpose of banks using these non-profits activities is to reduce their revenue volatility (Lepetit et al., 2008; Sanya and Wolfe, 2011). Thus, greater diversification could improve bank stability in emerging markets. As a result, our findings are in line with our hypotheses **H4** that revenue diversification has a significant impact on bank stability.

Finally, **Fig. 7. a**nd **8.** describe the volatility of revenue diversification and suggests a threshold value to distinguish it from a low to a high regime.

Table 13

Results of dynamic panel threshold estimation with revenue diversification as a threshold variable on stability

Threshold estimate				
Countries	Advanced		Developing	
Revenue diversification	0.00787		0.00131	
95%Confidence interval	(0.00787-0.00823)		(0.00130-0.00160)	
Impact of revenue diversification		S.E		S.E
λ_1	27.851**	(11.786)	14.449*	(8.619)
λ_2	5.71	(13.937)	19.698***	(5.294)
Impact of covariates		S.E		S.E
ETA	-18.845	(12.631)	2.529	(2.792)
BRindex	2.422*	(1.373)	0.438	(0.437)
IEindex	1.314**	(0.433)	0.190***	(0.056)
Inflation	-27.412***	(6.971)	-3.212**	(1.266)
GDP	15.913***	(3.415)	-1.402	(1.441)
DCR	8.066***	(1.888)	1.865***	(0.625)
Bank size	-3.728**	(1.450)	-0.271	(0.451)
Liquidity	1.463	(2.907)	1.047***	(0.355)
Crisis_dummy	-0.052*	(0.028)	-0.267**	(0.135)
δ	-0.337	(0.587)	-0.658	(0.595)
Observations	304		1574	
Low regime	175		92	
High regime	129		1482	

Notes: The table presents the estimations for the dynamic panel threshold model. Each regime has at least 5% of the observations (Hansen, 1999). Advanced countries include Australia, Hong Kong China, Japan and Singapore, and others are in the developing countries group. We denote as dependent variable banks' stability (log of $Z - score_{i,t}$), whilst as the threshold and the regime dependent variable we impose the bank's revenue diversification ($RD_{i,t}$) which represents non-interest income activities. Following Bick (2007), the model accounts for regime dependent intercepts (δ). Our dependent variable is Z-score. Our independent variables of our main interest: revenue diversification. Other bank-specific independent control variables: bank size (log of total asset); liquidity (liquid asset to total asset). Country level and state level independent variables: BRindex, IEindex, inflation GDP and DCR (Private sector credit of GDP). ETA (equity to total asset) is an endogenous variable. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. We check that there is not a high level of correlation between the variables used in the models. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level. Robust standard errors given are in parentheses.

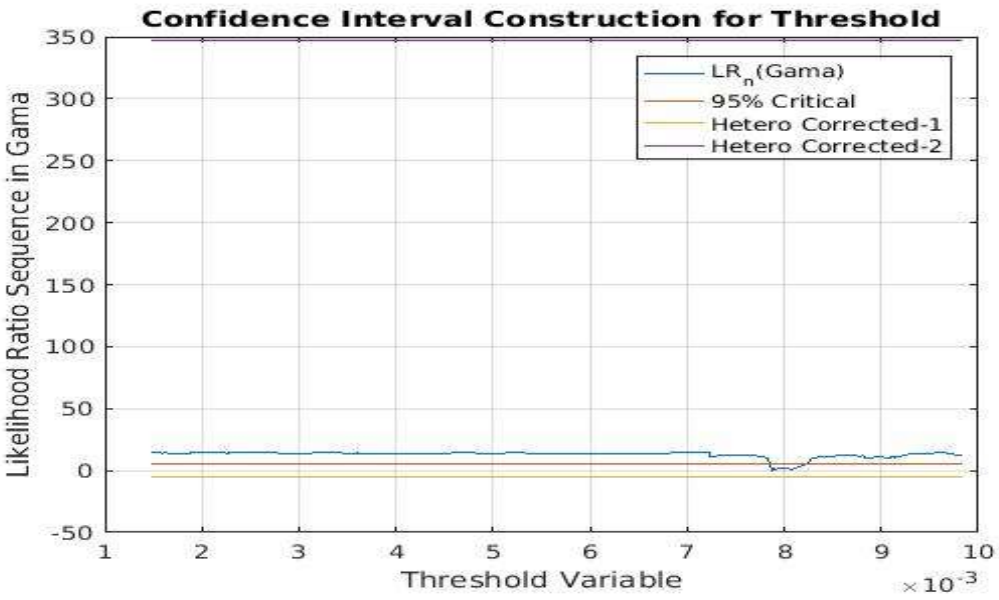

Fig. 7. Threshold value of revenue diversification (bank's non-interest income activities) and the classification of low and high regime in advanced countries.

Notes: The figure shows the threshold value of revenue diversification on bank stability (log of Z-score) which splits into the high and low regimes (2000-2012).

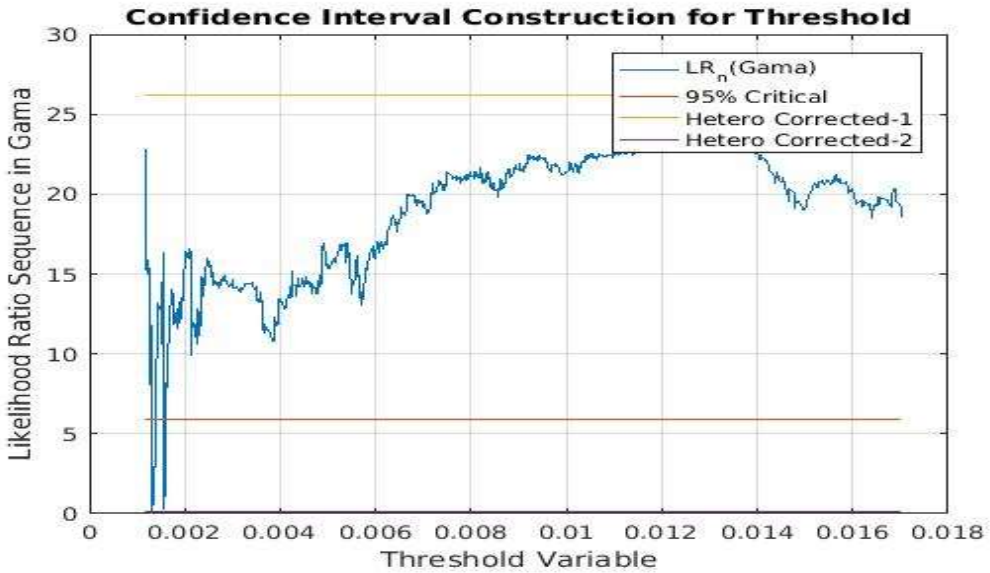

Fig. 4. Threshold value of revenue diversification (bank's non-interest income activities) and the classification of low and high regime in developing countries.

Notes: The figure shows the threshold value of revenue diversification on bank stability (log of Z-score) which splits into the high and low regimes (2000-2012).

In Table 14, the percentage of banks classified as low-regime is consistently above the percentage of banks classified as high-regime with respect to revenue diversification before the financial crisis, in advanced countries. However, the percentage of banks classified as low-regime is consistently below the percentage of banks classified as high-regime during the period 2000-2012.

Table 14 Dynamic Threshold Analysis: classification of banks into the two identified regimes based on threshold value of Revenue diversification

Threshold: Revenue diversification													
Advanced countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	46%	44%	45%	50%	51%	42%	48%	44%	47%	51%	55%	58%	56%
High regime	54%	56%	55%	50%	49%	58%	52%	56%	53%	49%	45%	42%	44%
Developing countries													
	2000	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Low regime	6%	4%	5%	6%	1%	2%	6%	4%	7%	7%	8%	6%	6%
High regime	94%	96%	95%	94%	99%	98%	94%	96%	93%	93%	92%	94%	94%

Notes: The table shows the classification of the bank based on the threshold value of revenue diversification that we obtained following Kremer's et al. (2013) threshold model for the dynamic panel. The dependent of the dynamic panel threshold model is bank stability (Z-score).

3.5.6 Robustness: the interactive term for effect

The results from models (1) to (3) estimate the association between bank performance, market power and revenue diversification in Table 15. Market power and revenue diversification have a negative and positive impact on cost inefficiency, which are in line with my previous findings in Table 4. It is interesting that the interactive term for between Lerner index and revenue diversification has a significantly negative impact on bank inefficiency. As we know, market power has a positive effect on efficiency, because firm profitability is positively correlated with market share (Maudos and Fernández de Guevara, 2007; Pasiouras, 2008; Schaeck and Cihak, 2010; Koetter et al., 2012). While over-diversifying may reduce bank efficiency because it may reduce bank concentration on traditional service (Lozano-Vivas and Pasiouras, 2010). However, our results suggest

that a bank with a higher market power implementing the individual strategy (revenue diversification) can still improve its performance. It is reasonable that according to the results from the dynamic panel threshold mode, higher market power may drive a bank to reach an optimal level of economic scale. Therefore, banks diversifying their revenue based on the original cost could make better use of the opportunity cost, which may reduce cost inefficiency.

The last three models in Table 15 show that the two strategies (market power and revenue diversification) have a different effect on bank stability, which is in line with our previous findings in Table 5. Banks with more loan market power are in a position to charge higher rates for loan customers, which may increase borrowers' difficulties to repay principals (Schaeck and Cihak, 2008; Fiordelisi and Mare, 2014). While revenue diversification helps banks build up their capital buffer, which reduces the probability of fragility (Shim, 2013). It is interesting that the interactive term for Lerner index and institutions has a positive impact on bank stability. Thus, a bank with higher market power can implement the individual strategy (revenue diversification) to improve its stability. As the results in Table 13 shows, banks with a higher level of diversification ratio in high regime could ensure a stable environment. Generally, banks in developing countries employ market power to earn economic rent and control the market benefit. Likewise banks may not use revenue diversification to earn economic rent and use these non-profits activities to indeed reduce their revenue volatility (Sanya and Wolfe, 2011; Nguyen et al., 2012). Therefore, banks could comprise these two strategies to enhance performance and reduce probability of fragility.

Table 15

Robustness: Interaction effect of Lerner index and revenue diversification

	Fixed effect	GMM	IV	Fixed effect	GMM	IV
	(1)	(2)	(3)	(4)	(5)	(6)
	IE	IE	IE	Z-sore	Z-sore	Z-sore
Lerner*RD	-1.556**	-12.611**	-7.462***	31.364***	41.546*	190.666**
	(0.623)	(5.190)	(1.422)	(10.090)	(23.528)	(76.982)
Lerner	-0.064*	-0.158**	0.033	-1.479**	-1.694*	-13.223***
	(0.035)	(0.077)	(0.058)	(0.609)	(1.025)	(4.849)
RD	1.137***	7.117***	4.337***	12.873***	20.878*	-19.908
	(0.318)	(2.639)	(0.634)	(3.636)	(11.224)	(26.662)
BRindex	-0.005***	-0.003***	-0.004***	0.025**	0.030	-0.023
	(0.001)	(0.001)	(0.001)	(0.013)	(0.026)	(0.023)
IEindex	0.002	-0.001	0.011***	-0.158**	0.151**	-0.591***
	(0.006)	(0.001)	(0.004)	(0.071)	(0.073)	(0.201)
Inflation	-0.269***	-0.334***	-0.322***	-4.905***	-2.464	-14.550***
	(0.091)	(0.100)	(0.074)	(1.527)	(2.233)	(4.218)
GDP	-0.074	0.189***	-0.028	5.256***	-0.047	8.154***
	(0.069)	(0.068)	(0.078)	(2.011)	(2.015)	(2.660)
DCR	-0.001***	-0.000*	-0.001***	0.024***	-0.003	0.027***
	(0.000)	(0.000)	(0.000)	(0.004)	(0.004)	(0.005)
Bank size	0.033**	0.018**	0.031***	-0.275	0.202**	-0.154
	(0.013)	(0.008)	(0.010)	(0.304)	(0.099)	(0.357)
Liquidity	0.044	0.158***	0.055*	0.999*	2.337***	2.216***
	(0.041)	(0.048)	(0.030)	(0.525)	(0.659)	(0.837)
Crisis_dummy	(0.022)	0.041**	0.018	-0.084***	-0.029***	-0.036***
	(0.025)	(0.017)	(0.051)	(0.025)	(0.010)	(0.012)
L.Inefficiency		0.448***				
		(0.055)				
L.Z-score					0.357***	
					(0.093)	

(*Continued*)

Table 15-*Continued*

Robustness: Interaction effect of Lerner index and revenue diversification						
	Fixed effect	GMM	IV	Fixed effect	GMM	IV
	(1)	(2)	(3)	(4)	(5)	(6)
	IE	IE	IE	Z-sore	Z-sore	Z-sore
_cons	0.219*	0.099		1.930	-1.485	
	(0.129)	(0.083)		(2.957)	(1.050)	
N	1878	1469	1401	1870	1462	1838
r2_a	0.128		0.071	0.062		-0.787
F	11.659		36.210	13.386		6.851
AR(1)		0.001			0.000	
AR(2)		0.388			0.169	
Hansen(p-value)		0.830			0.291	
Cragg–Donald(F-statistic)			141.002			27.964
Sargan test(p-value)			0.100			0.101

Notes: The table presents the interaction effect of Lerner index and revenue diversification (RD). In the first three mdoels, the dependent variables are cost inefficiency used to reflect a bank's performance, which is calculated from the translog cost function (SFA); a lower value illustrates greater bank performance. The control variables include regulatory variables, macroeconomic variables and bank specific variables. From the models (4) to (6), the dependent variables are Z-score used to reflect individual bank's stability; a higher value illustrates greater bank stability. The control variables include regulatory variables, macroeconomic variables and bank specific variables. BRindex is an aggregate regulation index (BRindex = ACTR + CAPR + SPR + PMON). IEindex is an aggregate institutional environment index (IEindex = Governance Effectiveness + Rule of Law + Control of Corruption + Regulatory Quality). DCR is Private sector credit of GDP. We run the Fixed effect model, the GMM model and the second stage of a 2SLS model with robust separately. L.IE is the lag variable of cost inefficiency. L.Z-score is the lag variable of Z-score. Crisis is a dummy variable that takes a value of one for the years 2008–2009 and zero otherwise. For the GMM model, the Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. We use the Cragg–Donald statistic to assess whether the instruments are weak. When there is two endogenous regressor as in our models (i.e., Lerner index in model (3) and revenue diversification in model (6)), the Cragg–Donald statistic has an F distribution under the null hypothesis that the instruments have no explanatory power in the first stage regression. With one endogenous regressor and more than one excluded instrument, the critical value (Stock–Yogo weak ID test) for the Cragg–Donald statistic for 10% maximal size distortion is 19.93. Since we have two unique instruments and one endogenous regressor in each IV regression model, we use the Sargan test for over-identifying restrictions to assess whether the instruments are uncorrelated with the second-stage error. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

3.6 Conclusion

This paper analyses whether the two strategies, such as market power and revenue diversification, influence bank performance and stability, by using data from 11 South-East Asian countries during the period from 2000 to 2012. First, we find that market power could improve bank performance but increase individual bank fragility in an emerging market. In other words, market power may attract managers to pursue the maximization of profit and reduction of labor conflict at the expense of efficiency, but it provides incentives for managers to take excessive risk. Second, although revenue diversification reduces banks efficiency, it improves individual stability. When a bank expands its service in a new industry, it may use resources from its traditional activity and increase cost inefficiency, but the bank could participate in non-profit activities to reduce its revenue volatility at the same time. Our findings not only provide support for the neutral view of the competition-fragility theories applying to the emerging market, but also suggest that market power and revenue diversification should be simultaneously employed as a bundle to improve bank efficiency and stability. More interestingly, the dynamic panel threshold analysis further reveals important changes in the percentages of banks that fall within each threshold regime before and after the financial crisis. Finally, our results suggest that the positive effect of the two strategies is more significant in a well regulated market after controlling the macroeconomic, institutional and bank-specific factors.

These findings provide some important implications for bank managers and regulators in emerging markets. First, to improve efficiency and stability at the same time, bank managers should expand their market share and diversify their activities at the same time. As financial liberalisation increases in an emerging market, to prevent the competition from foreign banks, managers consolidate market power through merger and acquisition.

Simultaneously, managers should expand services in not-profit activity in order to offset portfolio risk caused by market power.

For regulators, our findings highlight that a prudential banking regulation is a pre-requisite for banks to employ individual strategy. A certain level of entry restriction is needed for foreign bank entrants, in order to protect domestic small banks with lower market power and maintain financial soundness. Second, regulators should adjust an appropriate capital requirement and encourage banks to diversify their non-interest activities instead of only focusing on traditional lending services. However, regulators still need to issue some regulations to restrict larger banks' activities, since the institutional environment in an emerging market is little far from complete, which may provider a wrong incentive to take excessive risk. In addition, when strengthening the regulation and monitoring, policymakers should ensure a good quality of institutions in an emerging market, through improving the efficiency of the government, issuing prudential law and reducing corruption, because the quality of investor protection is still at a low-level and even has a negative impact on bank performance and stability. Finally, policymakers should encourage financial innovations among banks based on prudential regulation to allow resource allocation within an economy effectively, in order to expand their services, reduce non-performance loans and exploit economies of scale.

Chapter 4: Do deposit diversification and insurance reduce the impact of liquidity risk on interest expense, deposit inflow, lending amounts and liquid ratio? Evidence from G7 and BRICS countries.

4.1 Introduction and Literature review

The liquidity of banks is the lifeblood of financial markets, since banks resembled liquidity regulators to satisfy the supply and demand of funding, particularly in a financial crisis. As we know, the international financial crisis during the period between 2007 and 2009 brought massive devastation to global economies. Financial and related markets around the world experienced credit boom and a banking panic that were triggered by the meltdown of securitized products and subprime mortgages. This global crunch raised a lot of concern about the liquidity of financial institutions. Fiordelisi and Mare (2014) believe that the liquidity of banks is a red flag that implies financial fragility. Furthermore, the banking industry provides credit to the corporate sector. Briefly, banks definitely play a role as liquidity providers in the financial system.

The argument against why banks can work as liquidity providers is that banks with natural strength can offer liquidity to business via credit lines commitments (Acharya and Mora, 2015). For other financial institutions, liquidity management tools (e.g. credit lines) are essential components of their corporate policy (Lins *et al*., 2010). Under a credit line contract, a bank provides the firm with loan funds when the firm faces a liquidity shortfall. In exchange, the bank charges a commitment fee as compensation for guaranteeing a loan for the firm at a specific date in the future. Consequently, credit lines have become an

important source of firm financing (Sufi, 2009) and play an important role in bank lending services (Ivashina and Scharfstein 2010). Firms would like to use credit lines to manage their liquidity needs because they find it costly to hold cash. Moreover, banks may use credit commitment to enhance their liquidity, which expands their services and increases profit (Acharya *et al*., 2013a).

During periods of normality, establishing credit commitments is a benefit for banks to provide liquidity to businesses. Gatev and Strahan (2006) suggest that banks have no difficulty meeting the increased credit demands, even if they experience significant and synchronized drawdowns during market stress. Furthermore, Gatev et al. (2009) find that deposit-taking and commitment drawdowns are negatively related. They think that banks may be seen as a safe haven because of deposit insurance, when investors and depositors forecast high risks in other investments.

However, the period 2007-2009 was a period of crisis for banks as liquidity providers, which decreased the stability of the financial market (Brunnermeier, 2009). Banks may not be treated as a safe haven because of tightened lending and runs on deposits. It is obvious that after the initial subprime shock, investors started to lose confidence in their ability to identify low- from high-risk banks; this leads to huge withdrawals from deposit accounts (Covitz et al., 2013). Additionally, banks that co-syndicate credit lines with Lehman Brothers would be more vulnerable to drawdowns on these credit lines after Lehman's bankruptcy. The credit lines syndicate members would be exposed to additional drawdowns by the failure of Lehman, because the firm may be panicked into choosing to draw on these credit lines.

The banking panic in the Autumn of 2008 threw economies around the world into severe recession (Ivashina and Scharfstein, 2010[39]). This meltdown increased the insolvency and illiquidity risk of banks. Moreover, Acharya et al. (2013b) agree that a significant portion of firm's "toxic" liabilities transfer to bank balance sheets; this may increase the pressure for banks to conduct their commitment obligations. It may then increase the solvency risk of these firms as well. As the solvency risk of a bank increases, it may offer higher interest rates to attract deposits.

Acharya and Mora (2015) find that a bank with greater pre-existing commitments increased deposit rates far more dramatically than those with lower commitments. They also find that banks with unused commitments lost their systematic advantage at gaining core deposits (including transaction, saving and time deposit). Banks with fewer core deposit inflows have to seek brokered deposits to satisfy the liquidity demands. Additionally, banks with high pre-existing commitments reduce overall credit (the sum of loans and commitments). They agree that the spread between loans and deposits is widened in commitment-exposed banks, and it means that banks are unable to meet liquidity agreements with deposit funding alone. Additionally, compared with previous crises, banks did not expand total loans and credit lines, but they utilized support from government and government agencies to cover a majority of liquidity commitments.[40] Accordingly, the financial crunch was banks' liquidity crisis between 2007 and 2009.

[39] They consider the impact of credit-line drawdowns on new lending but do not directly observe credit-line drawdowns.

[40] Tanking the example of the US, Acharya and Mora (2015) indicate that Federal Reserve loans increased $559 billion between 2007 and 2009, and 65% of non-deposit borrowing of commitment-exposed banks came from Federal Home Loan Bank (FHLB). It is obvious that the banking industry was heavily reliant on Federal sources of funds.

Although the liquidity demand risk[41] did exist between 2007 and 2009, it just focused on the US. Longstaff (2010) indicates that the subprime crisis in the US was transmitted to other countries so that it became a global financial turmoil. In this case, there may also exist a liquidity demand risk of banks in other regions in the world. Our first contribution is that banks in other countries may also be confronted by liquidity demand risk during this financial disaster. Because of banks' exposure to more credit commitments, the probability of withdrawals and drawdowns may be higher. When funding conditions are stressed, banks would confront runs on deposit and huge drawdowns on commitments. Therefore, this is liquidity demand risk of banks during the crisis.

As mentioned above, potential liquidity demand risk forces banks to increase their deposit rate or even ask for help from the government; this demand risk is caused by a lack of funding. During normal periods, banks have sufficient funding resources, such as retail and wholesale funding, corporate deposits and deposits from other banks. However, the onset of the 2007 - 2009 financial crisis triggered runs on deposits, which increased the difficulty for banks to supply liquidity to the financial markets. Banks then needed to increase their costs to attract deposits. During a crisis, banks with more sources of funding may be able to use lower interest rates to gain deposits, when compared to banks with fewer sources of funding (Grossman, 1994)[42].

However, Laeven and Levine (2007) indicated that diversification may bring advantages for banks when they were in financial distress, because not only can it reduce non-systematic risk but also provide cost saving and opportunities for banks to expropriate

[41] This risk is defined by Acharya and Mora (2015) that when funding conditions are stressed, firms' uncertainty to demand liquidity from banks by using pre-existing loan commitments, triggers this demand risk.

[42] Grossman (1994) suggests that banks that have a more diversified deposit base may be less likely to fail due to purely local deposit runs. The banks have better supply capacity since it is easy for them to attract funding.

financing resources. It could conjecture that although banks may be confronted with a shortage of funds, they could use diversified portfolios as a buffer to access to additional capital. Therefore, our second contribution is that diversification in a deposit base may provide a buffer so that it may reduce the cost of funding and decrease the impact of liquidity demand pressure.

Previous papers (e.g. Ivashina and Scharfstein, 2010) also support that banks with low deposits will decrease their lending. They use the failure of Lehman Brothers to suggest that banks with more revolving credit may be under pressure to cut corporate lending. However, if the banks have sufficient funding resources, they may be able to maintain previous lending decisions. De Haas and Iman Van (2014) suggest that access to a stable deposit base was particularly important during a crisis when wholesale funding dried up, because a diversified deposit base may allow banks to use spare money to sustain the original lending strategy. Our third contribution is that the diversified deposit base may provide additional channels for banks to access to funding so they are able to maintain their original lending strategy.

The cost of funding and lending strategies are essential factors that may influence banks' performance, but the most important factor is liquidity. Banks must have sufficient liquidity to survive when their financial condition is distressed. Some papers (e.g. Diamond and Rajan, 2005; Brunnermeier, 2009) suggest that if the banks cannot fulfil their obligation to provide liquidity to the financial markets, they may also be struggling against liquidity problems themselves. Rochet and Vives (2004) indicate that these banks may become illiquid if investors received a negative signal on the future realization of return on the banks' assets and withdraw early. It is reasonable to assume that if a large number of pre-existing commitments appear in a bank, it may be like a potential time bomb when the bank loses its advantage in attracting funding. However, if the banks are

able to maintain their advantages, it may reduce the risk of liquidity even though they are involved in an economic downturn. Banks with more channels to attract funding may increase their ability to insure against liquidity problems. Furthermore, it is worth mentioning that even solvent banks need a diversification strategy. Our fourth contribution is that diversification may give more opportunity for banks to access capital so that it may reduce the possibility of illiquidity.

In addition to analysing the structure of the deposit base, we also consider the impact of deposit insurance. Some papers (e.g. Chernykh and Cole, 2011; Anginer et al., 2014b) find that the "stabilization" effect of deposit insurance protects the interests of unsophisticated depositors and helps prevent bank runs which can improve social welfare. However, our finding is different from the study of those who found that deposit insurance could restore depositor confidence and avert panic in the banking sector. Because the lack of market discipline of deposit insurance may lead to excessive risk taking culminating in banking crises (Demirguc-Kunt and Huizinga, 2004; Ioannidou and Penas, 2010), and the "safety net" may create aggravate the "moral hazard effect". Finally, our fifth contribution is that deposit insurance may operate in the opposite direction, which causes banks to be more likely to suffer liquidity demand risk. Our findings show that the "moral hazard effect" of deposit insurance is greater than the "stabilization effect" on liquidity demand risk.

The remainder of this paper is structured along the following lines. Section 4.2 provides our paper's hypotheses. Section 4.3 gives the data description and methodology. Section 4.4 analyses the empirical results. Section 4.5 contains the conclusions.

4.2 Hypothesis development

4. 2.1 Relationship between diversification and cost of deposit

When the run on deposits erupted, banks with high pre-existing commitments had to increase their deposit rate to attract funding in order to relieve the demand pressure. In contrast to wholesale and corporate funding, deposits provide a relatively cheap source of funding for banks. Therefore, banks were willing to meet the demand by increasing the costs of their deposits. However, if banks had a diversified deposit base, they may receive the benefit from cost saving (Laeven and Levine, 2007). If this were the case, banks would move away from the more expensive sources of funding and there would be additional demand for cheaper types of funding. It is reasonable that if a bank has limited funding sources, it has to raise expenses to absorb sufficient funding to meet liquidity demand; otherwise it would face an insolvency problem. Traditional theory supports the idea that the rate of interest depends on the present supply of money and the demand schedule (Keynes, 1937).

Although Cerasi and Daltung (2000) argue that diversification may increase the cost of portfolios, such as monitoring costs and transaction costs, these costs may be eliminated by savings from lower deposit rates. Moreover, Hughes and Mester (2013) find that diversification may help banks to take advantage of economies of scale. It is obvious that economies of scale derived from a larger portfolio of loans and a larger base of deposits not only reduce the probability of default risk of loans, but also utilize lower monitoring costs to obtain greater capital inflows. This is also the reason why Ellul and Yerramilli (2013) suggest that diversification may provide more incentives for investors to deal with higher risks. Thus, we can anticipate that if banks have a diversified deposit base and could provide sufficient supply to borrowers, they would obtain extra benefits during a crisis. Therefore, our first hypothesis is as follows:

Hypothesis 1*: When banks have a diversified deposit base, the impact of a bank's liquidity demand risk on the costs of deposit is reduced during the crisis.*

4.2.2 Relationship between diversification and deposit inflow

Previous papers (e.g. Diamond and Rajan 2005; Acharya *et al*. 2013) indicate that banks might be unable to guarantee liquidity since the demand for funds under the outstanding lines (drawdowns) may exceed the supply of funds. When the realized liquidity demand exceeds supply, banks have to fail. This means that if banks with a limited deposit base cannot fulfil the demand of loan commitments, they would go bankrupt. However, if banks have plenty of funding sources, they may be able to relieve the demand pressure. For example, if massive commitment drawdowns occur at the onset of a crisis, banks with limited retail deposits would utilize the deposits from the government or other banks to meet this demand. Furthermore, Hahm *et al*. (2013) support that when credit is growing faster than the pool of available retail deposits, the bank will turn to other sources of funding to support its credit growth. It is obvious that banks with a diversified funding base may increase their capacity of supply.

Additionally, the traditional theory of Hughes *et al*. (1996) suggest that interstate branching was better than intrastate branching because it's extensive branching network lowers the relative deposit volatility. It means that geographic diversification of deposit base may increase liquid asset and deposit inflow. The increase in number of branches could diversify deposit base. It can believe that diversification of deposit may increase capital inflow. However, banks with a diversified funding model may rely less on deposits and more on short-term borrowing (King, 2013). They think that relying on short-term funding could increase the liquidity. But during the crisis, banks in many countries

suffered liquidity shortages and were unable to rollover their borrowing short-term debt (Acharya and Merrouche, 2013). Therefore, when the funding condition was stressed, banks with a diversified funding base still need to rely on deposits.

Although Wagner (2011) argues that bankruptcy may be driven by insolvency and not necessarily because of the result of under-diversification, this paper ignores the stressed funding condition. As mentioned above, a bank with an undiversified deposit base may be illiquid, because it may be difficult to attract capital when investors lose confidence in a financial market. If the bank has many pre-existing commitments, it cannot fulfil its obligations to meet the demand[43] and will become bankrupt. The studies of Rochet and Vives (2004) also support the view that a bank's liquidity demand risk can be collapsed into solvency risk.

Furthermore, Rossi *et al*. (2009) find that although diversification in portfolios cannot improve the cost efficiency and reduce the cost of operations, it may reduce a bank's realized ex-post risk because of sufficient funding inflow. Briefly, it is reasonable that diversification may play a role as a buffer when banks face heavy demand pressure. Therefore, our second hypothesis is as follows:

Hypothesis 2*: When banks have a diversified deposit base, the impact of a liquidity demand risk on deposit inflows is reduced during the crisis.*

4.2.3 Relationship between diversification and lending decision

As mentioned above, banks with large pre-existing commitments reduced their overall credit (the sum of loans and commitments) by cutting down the extension of new loan commitments and term loans. Since the shortfall between lending and deposits was

[43] According to economic theory, there should be an equilibrium between supply and demand (Lange, 1936).

widened, banks were unable to meet lending demands with deposits alone. Lending decisions suffered dual influences of commitment drawdowns and runs on deposits. Similarly, Brei and Schclarek (2015) suggest that if banks suffer fewer deposit withdrawals, they would provide more loans to the real sector during the crisis. However, Diamond and Dybvig (1983) oppose that bank runs cause real economic problems, and even "healthy" banks can fail. It is reasonable that even "healthy" banks suffer large withdrawals, even while commitment-exposed banks can suffer fewer. As a consequence, Brei and Schclarek (2015) put forward another finding that if banks have a stable deposit base, they can insulate their slowdown of lending. It means that banks with abundant deposits are able to supply the lending demand during the recession. According to Grossman's (1994) study, it may be easier for banks with a more diversified deposit base to attract funding so that they have sufficient funding sources (lower supply risk) sustaining their lending schedule. This conjecture is related to the studies of Kang (2013) and García-Kuhnert *et al*. (2015)[44] that diversification could mitigate risk exposure on lending. Therefore, our third hypothesis is as follows:

Hypothesis 3*: When banks have a diversified deposit base, the impact of a bank's liquidity demand risk on lending decisions is reduced during the crisis.*

4. 2.4 Relationship between diversification and liquidity risk

The liquidity risk arises as a result of banks that are in financial straits and find it difficult to liquidate their assets in financial markets, especially when there is a run on deposits. Liquidity demand risk means that banks with pre-existing loan commitments cannot fulfil the contractual obligation of these credit lines, when the funding condition is stressed

[44] Kang (2013) and García-Kuhnert *et al*. (2015) suggest that diversification brings benefits to stakeholders and shareholders by adjusting risk respectively. According to the impact of diversification on risk-taking, we can expect that a diversified deposit base may reduce the possibility and risk of funding shortages.

(Acharya and Mora, 2015). There is no doubt that if banks fail to honour the pre-existing credit commitments, depositors may receive a bad signal on these banks' condition, which may trigger a run on deposits. Because of banks' exposure to liquidity demand risk (a large number of undrawn credit commitments), they would take offsetting draws on its liquid assets and borrowings for the sake of controlling liquidity risks. Actually, banks may become involved in a liquidity bottleneck since the funding condition is stressed in the market during the crisis. Therefore, liquidity risk may be influenced by the synergistic effect of the potential liquidity demand risk and the run on deposits.

In addition, some papers (e.g. Rochet and Vives 2004; Diamond and Rajan 2005) find that banks with a higher illiquidity risk may react to the liquidity demand risk by raising deposit rates more than banks with lower illiquidity risk. They also suggest that investors may withdraw early by realizing a negative signal on the future return on a bank's assets, which may make a "healthy" bank illiquid. Therefore, there is a relationship between liquidity demand risk and liquidity risk.

Based on the study of Hughes *et al*. (1996), liquidity risk can be reduced when the deposit base is diversified by increasing the number of branches and deposit accounts. In addition, DeYoung and Torna (2013) imply that non-traditional banking activities may be able to increase the higher illiquidity risk than traditional banking activities. Obtaining deposits is a traditional service, and if banks could diversify their deposit base, they would be able to control the insolvency risk effectively. Combining with the studies of Kang (2013) and García-Kuhnert *et al*. (2015), we anticipate that if banks make a diversification in their deposit base, it would reduce the risk of funding shortages, and then banks with enough deposit supply to meet liquidity demand may transmit a good signal for investors so that it may reduce the market panic and risk of illiquidity. Therefore, our fourth hypothesis is as follows:

Hypothesis 4*: When banks have a diversified deposit base, the impact of a liquidity demand risk on liquidity ratio is reduced during the crisis.*

4.2.5 Relationship between insurance and liquidity risk

Many previous papers (e.g. Demirguc-Kunt and Huizinga, 2004; Karas *et al*., 2013; Anginer et al., 2014b) suggest that deposit insurance could restore depositor confidence and avert panic in the banking sector. They also find that explicit deposit insurance reduces the deposit interest rates required and increases the deposit inflows. Pennacchi, (2006) deems that deposit insurance could hedge liquidity risk. These positive stabilization effect of deposit insurance is important during financial downturns.

However, there is also a considerable consensus in the literature that deposit insurance exacerbates moral hazard problems in the banking sector by incentivizing banks to take on excessive risk. The papers (e.g. Demirguc-Kunt and Huizinga, 2004; Anginer et al., 2014b) support the view that deposit insurance can protect the interest of depositors and reduce the possibility of bank runs, but they also argue that the lack of market discipline on this "safety net" leads to excessive risk taking culminating in banking crises. Therefore, banks with deposit insurance may be immoderate to increase lending and issue commitment loans, which raise the potential of liquidity risk. Furthermore, when deposits are insured, however, bank depositors lack incentives to monitor (Ioannidou and Penas, 2010; Gorton and Metrick, 2013; Shapiro and Skeie, 2015). If depositors try to limit bank risk, interest rates may be increased, which enhance the cost of funding. It is reasonable that the "moral hazard" effect of deposit insurance may trigger the huge financial problem. Therefore, our fifth hypothesis is as follows:

Hypothesis 5*. The "moral hazard" effect of deposit insurance may be greater than the "stabilization effect" on the liquid demand risk during the crisis.*

4.3 Data description and Methodology

4.3.1 Data description

This paper uses bank-level variables, collected from the annual Reports accessed by Bloomberger. Our database includes 12 countries (Brazil, Canada, China, France, Germany, India, Italy, Japan, Russia, United Kingdom, United States, South Africa); these countries belong to the G7 or BRICS groups respectively. Since the financial crisis in 2007-2009 was an international level crunch, our database is typical in representing worldwide economic conditions. Furthermore, the G7 and BRICS groups are the countries whose financial actions could have a significant impact on the global economy. We use data from the period 2005 -2014 because we can divide the period into two groups; financial crisis and normal times respectively. According to Berger and Bouwman's (2013)[45] study, we suggest that the period between 2008 and 2009 is a crisis and other years are normal periods because of the yearly data in our database. Through dividing into two groups, we can estimate whether the recent crisis is a special case that a crisis of liquidity providers. Table 1 shows the variable definitions.

[45] They suggest that the recent subprime lending crisis occurred between 2007-Q3 and 2009-Q4.

Table 1

Variables	
Interest rate, time deposit rate	Time deposits (also known as certificate of deposit or term deposits). Interest expense on time deposits is divided by annual average time deposits. Expressed as % annual rate and collected from the annual report.
Deposits inflow ratio	The deposits inflow ratio is measured as the difference between this year total deposit and last year total deposits divided by this year total deposit. Collected from the annual report.
Lending decision	Lending decision which is a ratio that the difference between this year total loans and last year total loans, divided by this year total assets. Collected from the annual report.
Liquidity ratio	Liquidity ratio is measured as liquid assets to total assets. Collected from the annual report.
Unfunded commitment ratio	Unfunded commitment ratio (also known as undrawn commitments, unused commitments or guaranteed commitments) is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. Collected from the annual report.
Deposit diversification (-HHI)	Deposit diversification is measured by (-HHI). This ratio includes personal deposits, deposits from banks, corporate deposits and other deposits.
Deposit insurance	Natural logarithm of deposit insurance. Collected from the World Bank.
Bank level control variables	
Non-performing loan ratio	Non-performing loan ratio is measured as loan loss provision divided by total loans. Collected from the annual report.
ETA ratio	ETA ratio is measured as total equity to total assets and used to reflect the difference of bank size. Collected from the annual report.
Bank size	Bank size is the natural logarithm of total assets. Collected from the annual report.
Government borrowings	Government borrowings is measured as government borrowings to total assets. Collected from the annual report.
Other borrowings	Other borrowings (including short-term borrowings) is measured as other borrowings to total assets. Collected from the annual report.
Country level control variables	
GDP growth rate	The GDP growth rate is expressed as annual rate collected from the World Bank.
Inflation rate	Inflation rate is expressed as annual rate collected from the World Bank.

The main deposit rate used in the analysis is the rate on time deposits. It is the implicit rate based on annual reports, represented as interest expenses on the deposits divided by the interest-bearing deposits. We use banks' undrawn commitments ratio to represent the exposure to liquidity demand risk[46]. The ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments.[47] As mentioned above, when runs on deposits occurred, banks with more pre-existing commitments would have been more likely to be exposed to drawdown. For estimating the diversification, we subdivide the total deposits into personal deposits, deposits from bank, corporate deposits and other deposits. Through subdividing, we can analyse whether a diversified deposit base could provide a sufficient supply to liquidity demand.

We also consider a bank's liquidity and solvency factors, including liquidity asset and non-performing loans. We choose the variable non-performing loans to total asset, which is a proxy for default risk.[48] We use the ratio of liquid assets to total assets to represent bank liquidity for controlling the differences in bank liquidity risk.[49] For estimating the bank size, we use the natural logarithm of total assets and the ratio of total equity to total assets. Large banks may be big enough to be considered "too-big-to-fail", so we need to control their bank size. Additionally, we also use the indicators of government borrowing and other borrowings as control variables to distinguish the different characteristics of banks' capital inflows. For controlling different characters at the country level, we use variables GDP growth rate and inflation rate to reflect the macroeconomic environment.

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[46] Liquidity demand risk is when banks with pre-existing loan commitments cannot fulfil the contractual obligation of these credit lines, when funding conditions are stressed.

[47] We excludes credit card commitments. This measure follows the studies of Gatev and Strahan (2006) and Acharya and Mora (2015), because most credit card commitments are unlikely to be drawn.

[48] Shim (2013) and Bennett *et al*. (2015) indicate that non-performing loans are a good indicator of a bank's individual risk in times of crisis. They think that a large increase in non-performing loans at the beginning of a crisis may cause a deterioration in asset and increase the probability of bankruptcy.

[49] We control liquidity risk and bank size following the measures of Demirguc-Kunt *et al*. (2013). They suggest that liquidity asset ratio is a good index for estimating whether financial institutions have the necessary assets on hand to deal with a sudden shortage of funds.

4.3.2 Methodology

4.3.2.1 Diversification measure

According to the studies of De Jonghe *et al*. (2015) and García-Kuhnert *et al*. (2015), we use the Herfindahl Hirschmann Index (-HHI) measure for each bank in order to estimate whether they have a diversified deposit base. If banks have higher values in (-HHI), which means that they have a diversified deposit base and a diversified loan portfolio respectively, they are more likely to face a lower supply risk. The formula for estimating deposit -HHI (HHI_{DEP}) for each bank is as follows:

$$(-HHI_{DEP,i,t}) = \left(\frac{PERSONAL_{i,t}}{TOTAL_{\ i,t}} + \frac{BANK_{i,t}}{TOTAL_{\ i,t}} + \frac{CORPORATE_{i,t}}{TOTAL_{\ i,t}} + \frac{OTHERS_{i,t}}{TOTAL_{\ i,t}}\right) * (-1) \quad (1)$$

where $TOTAL$ is total deposit and total borrowings (government borrowings and other borrowings); $PERSONAL_{i,t}$ is individual deposit; $BANK_{i,t}$ is deposit from banks or financial institutions; $CORPORATE_{i,t}$ is the corporate deposit; $OTHERS_{i,t}$ is other deposit..

4.3.2.2 The impact of diversification on liquidity demand risk

We investigate whether banks with a diversified deposit base could suffer a lower impact of liquidity demand risk during the crisis. Therefore, we use deposit rate, deposit inflows, lending amounts and liquid ratio as the dependent variables to test whether a diversified base is a buffer when banks face liquidity demand pressures. Therefore, the model is as follows:

$$Dependent\ variables\ (Time\ interest\ rate, Deposit\ inflows, Lending\ amounts\ and\ liquid\ ratio)$$
$$= \beta_0 + \beta_1(-HHI)_{DEP,t-1} + \beta_2(-HHI)_{DEP,t-1} \times Crisis_t$$
$$+ \beta_3(-HHI)_{DEP,t-1} Liquidity\ Demand\ Risk_{i,\,t-1}$$
$$+ \beta_4(-HHI)_{DEP,t-1} Liquidity\ Demand\ Risk_{i,\,t-1} \times Crisis_t$$
$$+ \beta_5 Liquidity\ Demand\ Risk_{i,t-1} + \beta_6 liquidity\ Demand\ Risk_{i,\,t-1} \times Crisis_t$$
$$+ \ Controls\ _{i,t}$$
$$+ \sigma_{i,t} \qquad (2)$$

where $(-HHI)_{DEP,t-1}$ represents the diversification of deposit calculated by equation (1) times minus one. $Liquidity\ Demand\ Risk_{i,t-1}$ is the ratio of unused loan commitments to the sum of loans and unused commitments in $year_{t-1}$; $Controls\ _{i,t-1}$ is the control variable in $year_{t-1}$.

Firstly, when the funding condition is stressed, banks need to increase their deposit rate in order to obtain deposit inflows to cover the pre-existing commitments demand. Therefore, we use time interest rate as the dependent variable to estimate the impact of diversification on liquidity demand risk. $Deposit\ Rate_{i,t}$ is deposit rate (time deposit rate).

Secondly, we use deposit inflow as the dependent variable to estimate whether Banks with more pre-existing loan commitments may confront a shortage of deposits during the financial crisis. The systemic expected shortfall will force banks to experience a capital shortage during a crisis. This shortage of capital is not only dangerous for an individual bank, but also becomes dangerous for the global economy if the banking industry is undercapitalized. Furthermore, deposits are one of the most important channels for banks to attract capitals. Obviously, if a “healthy” bank lacks sufficient deposit inflows; even it

may confront liquidity pressure, let alone a bank with potential liquidity demand risk (commitment-exposed banks). $Deposit\ inflows_{i,t}$ is a ratio of the difference between total deposits in $year_t$ and total deposits in $year_{t-1}$ divided by total deposits in $year_t$.

Thirdly, in addition to test deposit actions, we test the banks' lending decisions. As mentioned above, when the funding condition is stressed, banks may reduce making loans in order to sustain sufficient funding to meet demand pressure. However, there is no consensus on what can help banks' lending decisions during a crisis. We expect that if banks have sufficient funding, they would like to maintain their lending. Therefore, we also use a diversification measure to estimate whether a lower supply risk can improve lending decisions. $Lending\ Decisions_{i,t}$ is a ratio of the difference between total loans in $year_t$ and total loans in $year_{t-1}$ divided by total assets in $year_t$.

Finally, we test whether, when banks have a diversified deposit base, the impact of a bank's liquidity demand risk on liquidity risk is reduced. As mentioned above, liquidity demand risk may increase liquidity risk; but there is no consensus on whether banks with a diversified deposit base could reduce the impact of liquidity demand risk on liquidity risk. $Liquidity\ risk_{i,t}$ is represented as a ratio of liquid asset to total asset in $year_t$.

4.3.2.3 The impact of insurance on liquidity demand risk

We investigate whether banks with a deposit insurance could suffer a lower impact of liquidity demand risk or this "safety net" may have an opposite effect, during the crisis. Therefore, we also use deposit rate, deposit inflows, lending amounts and liquid ratio as the dependent variables to test whether "moral hazard" effect of deposit insurance may be greater than the "stabilization effect". Therefore, the model is as follows:

$$Dependent\ variables\ (Time\ interest\ rate, Deposit\ inflows, Lending\ amounts$$

$$
\begin{aligned}
& and\ Liquid\ ratio) \\
& = \beta_0 + \beta_1 Deposit\ insurance_{t-1} + \beta_2 Deposit\ insurance_{t-1} \times Crisis_t \\
& + \beta_3 Deposit\ insurance_{t-1} Liquidity\ Demand\ Risk_{i,\,t-1} \\
& + \beta_4 Deposit\ insurance_{t-1} Liquidity\ Demand\ Risk_{i,\,t-1} \times Crisis_t \\
& + \beta_5 Liquidity\ Demand\ Risk_{i,t-1} + \beta_6 liquidity\ Demand\ Risk_{i,\,t-1} \times Crisis_t \\
& + \ Controls\ _{i,t} \\
& + \sigma_{i,t} \qquad (3)
\end{aligned}
$$

where $Deposit\ insurance_{t-1}$ is the natural logarithm of deposit insurance in $year_{t-1}$. $Liquidity\ Demand\ Risk_{i,t-1}$ is the ratio of unused loan commitments to the sum of loans and unused commitments in $year_{t-1}$; $Controls\ _{i,t-1}$ is the control variables in $year_{t-1}$; $Deposit\ Rate_{i,t}$ is deposit rate (time deposit rate); $Deposit\ inflows_{i,t}$ is a ratio of the difference between total deposits in $year_t$ and total deposits in $year_{t-1}$ divided by total deposits in $year_t$; $Lending\ Decisions_{i,t}$ is a ratio of the difference between total loans in $year_t$ and total loans in $year_{t-1}$ divided by total assets in $year_t$; $Liquidity\ risk_{i,t}$ is represented as a ratio of liquid asset to total asset in $year_t$.

4.3.2.4 Dynamic Panel Model

For the sake of further examination into the impact of deposit diversification and insurance on liquidity demand risk, we use a dynamic panel model to eliminate potential endogenous problems by employing instrumental variables. We employ an instrumental variable technique with a Generalized Method of Moments (GMM) estimator and account for the presence of autocorrelation and heteroscedasticity. Furthermore, this model enhances the significance of the impact of the interactive term for during the crisis.

4.4 Empirical results

4.4.1 Summary statistics

Table 2 provides the summary statistics of variables used in this paper. An average bank in the sample has an unfunded commitment ratio of 0.105, time deposit interest expense of 0.023, Non-performance loan of 0.006, and a liquid ratio of 0.169. Comparing these numbers to those in previous studies such as Acharya and Mora (2015), their values are a little lower because our sample includes some developing countries. For example, banks in India and China usually conduct traditional services for a living so they may issue fewer credit commitments. In addition, traditional services bring an advantage for attracting capital for them so that the interest rates are lower

Table 2

Summary statistics

Variable	N	Mean	P25	Median	P75	STD
Time expense	1200	0.023	0.008	0.014	0.024	0.028
Deposit inflows	1080	0.128	-0.002	0.083	0.175	0.547
Lending Decisions	1080	0.040	-0.006	0.033	0.083	0.101
Liquid ratio	1200	0.169	0.05	0.134	0.248	0.147
Unfunded commitments	1200	0.105	0.017	0.054	0.159	0.128
Deposit (-HHI)	1200	-0.732	-0.854	-0.771	-0.652	0.171
Deposit insurance	1200	8.676	7.683	10.666	11.643	4.321
Non-performing loan	1200	0.022	0.002	0.006	0.014	0.086
ETA ratio	1200	0.102	0.047	0.067	0.119	0.103
Government borrowings	1200	0.010	0	0	0.051	0.002
Other borrowings	1200	0.005	0	0	0.011	0.031
Total asset	1200	17.276	14.981	16.903	19.865	2.912
GDP growth rate	1200	0.031	0.011	0.024	0.051	0.039
Inflation rate	1200	0.037	0.016	0.027	0.054	0.032

Notes: This table reports summary statistics (number, mean, P25, median, P75, minimum, maximum and standard deviation) for the variables used in this paper. The sample consist of 1200 banks in 12 countries over the time period 2005-2014. Time expense is that interest expense on time deposits is divided by annual average time deposits. Deposit inflows is a ratio that the difference between total deposits in $year_t$ and total deposits in $year_{t-1}$ divided by total deposits in $year_t$. Lending Decisions is a ratio that the difference between total loans in $year_t$ and total loans in $year_{t-1}$ divided by total assets in $year_t$. Liquid ratio is liquid asset to total asset. Equity to asset is total equity divided by total assets. Unfunded commitments is a ratio that is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. Deposit (-HHI) is a proxy for representing diversification in a deposit base Non-performing loan is loan loss provision divided by total loans. Government borrowings and other borrowings are expressed as a ratio. Total asset is the log value of total assets. GDP growth rate and inflation rate are expressed as an annual rate.

Table 3 reports the correlation matrix of variables that are shown in table 2. Before the data analysis, we check for the issue of multicollinearity. The highest correlation value is between total assets and equity to total assets, which is 0.512, while these values are within an acceptable level.

Table 3

Correlation matrix

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Time expense	1													
2	Deposit inflows	-0.043	1												
3	Lending Decisions	-0.011	0.213	1											
4	Liquid ratio	0.010	-0.046	-0.021	1										
5	Unfunded commitments	-0.030	0.016	-0.001	0.11	1									
6	Deposit (-HHI)	0.181	0.034	0.080	-0.171	-0.012	1								
7	Deposit insurance	0.102	-0.058	-0.139	-0.132	0.207	-0.235	1							
8	Non-performing loan	-0.003	0.078	-0.071	0.101	0.019	-0.076	0.018	1						
9	ETA ratio	0.087	-0.040	-0.052	0.053	-0.019	-0.006	-0.037	0.173	1					
10	Government borrowings	0.063	-0.011	0.063	0.031	0.229	-0.096	0.053	0.017	0.229	1				
11	Other borrowings	-0.029	0.009	0.068	0.008	-0.009	0.031	-0.020	0.013	0.056	0.268	1			
12	Total asset	-0.166	0.068	-0.063	-0.024	-0.039	0.058	-0.044	-0.167	-0.512	-0.238	0.004	1		
13	GDP growth rate	-0.091	0.115	0.260	-0.091	-0.109	0.109	-0.550	-0.087	-0.039	-0.075	0.011	0.045	1	
14	Inflation rate	0.083	0.050	0.008	-0.12	-0.051	0.257	-0.336	0.043	0.123	0.025	0.147	-0.110	0.333	1

Note: This table reports the correlation matrix of selected variables of banks during 2005–2014. All correlations above 0.6 are significant at least at 0.10 level.

4.4.2 Relationship between unfunded commitment ratio, diversification and time expense ratio

Table 4 shows the impact of an unfunded commitment ratio on deposit rates. Models 1, 2 and 3 report the results for fixed effect model, while the last three models show those for GMM model. The table show that there is a negative relationship between the unfunded commitment ratio and deposit interest rates during normal times. This means that it is not necessary for banks with pre-existing undrawn commitments to increase deposit rates to attract capital for fulfilling the credit obligations during normal periods. However, the interesting thing is that all the models show a significant positive relationship between the interactive term for an unfunded commitment ratio and the crisis dummy and deposit interest rates (ρ <0.01). This means that banks with greater pre-existing commitments raise interest rates to obtain funding during crisis periods. The finding also supports other studies (e.g., Gatev and Strahan, 2006; Acharya and Mora, 2015) that the banks may borrow from outside to make good on promised loans. Furthermore, the results argue with the study of Avery and Berger (1991). They indicate that credit commitment loans could be safer or riskier because the credit risk depends on the selection of borrowers. However, they ignore the distressed financial condition that may instigate good borrowers and poor borrowers to execute the commitments at the same time. Therefore, banks with greater pre-existing loan commitments offer higher deposit rates to attract funding during crisis periods.

Model 3, Table 4 further shows the impact of diversification on interest rates. There is a negative relationship between $Deposit\ (-HHI)_{t-1}$ and time expense ratio. This means that banks diversify in deposits base may reduce interest expense. These results support the theory of Hann et al., (2013) that diversification may reduce the cost of capital. The more interesting thing is that the interactive term for deposit diversification and the crisis

dummy ($Deposit\ (-HHI)_{t-1} * crise$) has a negative relationship with the interest expense. Furthermore, the interaction between unfunded commitment ratio, deposit diversification and crisis dummy ($Deposit\ (-HHI_{t-1}) * Unfunded\ ratio\ _{t-1} * crise$) has a negative effect on time expense ratio. The results align with hypothesis **H1**, that banks with a diversified deposit base have low costs of deposit, but this phenomenon just appears during a period of financial crisis.

According to the studies of Brunnermeier (2009) and Covitz *et al*. (2013), investors lost confidence in financial markets and the banking sector, and even depositors were leaving banks, let alone banks could be easily access to capital. Furthermore, lower diversification in a deposit base means that banks have fewer channels to access capital when the funding condition is stressed. The reason why our finding is different from the study of Singhal and Zhu (2013)[50] is that a bank is a special firm that works as a financial intermediary by obtaining capital and lending it to borrowers. It is reasonable that the cost of funding for banks may be reduced as long as they maintain a good capital turnover. Therefore, it can be expected that higher diversification (lower concentration) on a deposit base may reduce the cost of capital (decrease of deposit rates).

[50] Singhal and Zhu (2013) suggest that diversified firms may have higher costs when facing potential bankruptcy, because of inefficient segment investment.

Table 4

The relationship between deposit expense rate and interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Time expense ratio	(2) Time expense ratio	(3) Time expense ratio	(4) Time expense ratio	(5) Time expense ratio	(6) Time expense ratio
$Deposit\ (-HHI)_{t-1}$		-0.007	-0.014*		-0.047***	-0.056***
		(0.009)	(0.008)		(0.011)	(0.021)
$Deposit\ (-HHI)_{t-1} * crise$		-0.024***	-0.042***		-0.015**	-0.053***
		(0.009)	(0.013)		(0.007)	(0.018)
$Deposit\ (-HHI_{t-1})* Unfunded\ ratio_{t-1}$			-0.157***			0.319
			(0.054)			(0.206)
$Deposit\ (-HHI_{t-1}) * Unfunded\ ratio_{t-1} * crise$			-0.643***			-1.707***
			(0.158)			(0.560)
$Unfunded\ ratio_{t-1}$	-0.078**	-0.083**	-0.111***	-0.031**	-0.041**	-0.127***
	(0.030)	(0.039)	(0.033)	(0.014)	(0.018)	(0.048)
$Unfunded\ ratio_{t-1} * crise$	0.096***	0.076***	0.149***	0.074***	0.038***	0.247***
	(0.013)	(0.014)	(0.016)	(0.011)	(0.012)	(0.066)
$NPL\ ratio_{t-1}$	0.002*	0.000	-0.001	-0.006	-0.003	-0.003
	(0.001)	(0.002)	(0.002)	(0.008)	(0.006)	(0.008)
ETA_{t-1}	0.005	0.005	0.006	-0.072**	-0.046*	-0.027*
	(0.006)	(0.006)	(0.006)	(0.030)	(0.024)	(0.016)
$Total\ assets_{t-1}$	0.001	0.001	0.001	-0.003**	-0.002*	-0.001
	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
$GDP\ growth_{t-1}$	-0.022*	-0.024*	-0.029*	0.056**	0.056	0.007
	(0.013)	(0.013)	(0.016)	(0.024)	(0.045)	(0.026)

(*Continued*)

Table 4-*Continued*

The relationship between deposit expense rate and interactive term for$unfunded\ commitment\ ratio_{t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Time expense ratio	(2) Time expense ratio	(3) Time expense ratio	(4) Time expense ratio	(5) Time expense ratio	(6) Time expense ratio
$Inflation_{t-1}$	0.021	-0.008	-0.008	0.035	0.012	0.126**
	(0.027)	(0.029)	(0.029)	(0.036)	(0.031)	(0.050)
$L.Time\ expense\ ratio_t$				0.248***	0.148**	0.115*
				(0.091)	(0.073)	(0.061)
_cons	0.022	0.021	0.015	0.085***	0.079***	0.066***
	(0.026)	(0.026)	(0.028)	(0.027)	(0.029)	(0.025)
N	1080	1080	1080	1080	960	1080
r2_a	0.072	0.078	0.085			
F	26.587	23.767	22.912			
AR(1)				0.091	0.100	0.099
AR(2)				0.412	0.659	0.876
Hansen (p-value)				1.000	0.280	0.277

Note: This table shows the results relating to the reaction on deposit rates to a bank's unfunded loan commitments, deposit diversification and interaction between them during the crisis. The dependent variables are interest expense rate of time deposits expressed as % annual rate. Deposit (-HHI) is an indicator of diversification, which is a ratio that the ratio of deposit HHI times (-1). Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel model (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.3 Relationship between unfunded commitment ratio, diversification and deposit inflows

Table 5 shows the impact of interaction between diversification and unfunded commitment ratio on deposit inflows. First of all, there is a negative relationship between deposit inflows and pre-existing unfunded loan commitments $Unfunded\ ratio_{\ t-1} * crise$. This means that banks with greater pre-existing commitments face a shortage of deposits during crisis periods. When the funding condition is stressed, depositors lose their confidence in the banking industry and financial markets (Brunnermeier, 2009), and then banks lose their advantage in obtaining capital during this period (Gatev and Strahan, 2006), worse still, banks have signed commitment contracts with borrowers (Acharya and Mora, 2015). As a result, the dual pressure of commitment drawdowns and a shortage of deposits leads banks to liquidity risk.

Interestingly, models 2, 3, 5 and 6 show that $Deposit\ (-HHI)_{t-1}$ is statistically significant at the 5 % level and has a negative impact on deposit inflows. This means that banks with an undiversified deposit base in previous years may reduce deposit inflows in the normal time. According to Brav's (2009)[51] theory, it is reasonable that concentration could have a positive effect on capital inflows. Furthermore, Kahle and Stulz (2013) put forward a similar viewpoint that if the firm has a good relationship with a bank, it could reduce capital expenditure and is more likely to receive funding from banks. Similarly, we can expect that if the bank has a good relationship with a few depositors, it could be more likely to access capital from them.

[51] Brav (2009) indicates that ownership concentration is an important friction because not only can it reduce the cost of accessing capital, but also help firms to be more likely to access external capital.

However, the results show that the interactive term $Deposit\ (-HHI)_{t-1} * crise$ is statistically significant at the 1% level, and has a positive relationship with deposit inflows. This suggests that if banks diversify their deposit base, they could attract sufficient capital during the financial crunch. In other words, when the funding condition is stressed and even runs on deposit appear in market, the banks lose their advantage at obtaining capital. Good relationships with specific depositors may be unable to raise their confidence in financial markets. However, banks with a diversified deposit base may relieve the pressure of funding shortages during the crisis; this is because they have more channels through which to access capital. This is also the reason why Disyatat (2011) concludes that the channel is more important when the financial system is repressed. Therefore, it is reasonable that banks with a diversified deposit base may reduce the probability of funding shortages.

Table 5 also shows the relationship between deposit inflows, liquidity demand risk and diversification. The findings in Table 5 support the idea that banks may not confront liquidity demand risk and those with an undiversified deposit base may be more likely to attract capital in normal periods. However, interestingly modes 3 and 6 show that the interactive term for unfunded commitment and deposit diversification and crisis dummy ($Deposit\ (-HHI_{t-1}) * Unfunded\ ratio\ _{t-1} * crise$) are statistically significant and have a positive effect on deposit inflows during the crisis (β=7.671, ρ<0.01; β=26.563, ρ<0.01 respectively). This finding aligns with hypothesis **H2**, that when banks have a diversified deposit base, the impact of a bank's liquidity demand risk on deposit inflows is reduced.

Combining the results in Tables 4 and 5, we can expect that diversification may reduce the impact of liquidity demand risk on the cost of funding and funding shortages. It is also the reason why the channel is more important when the funding condition is stressed

(Disyatat, 2011). A diversified deposit base may offer extra channels for banks to attract deposits. It may relieve the pressure of funding demand, and even decrease costs for accessing capital when the financial system is distressed.

Table 5

The relationship between $Deposit\ inflows_t$ and interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Deposit inflows	(2) Deposit inflows	(3) Deposit inflows	(4) Deposit inflows	(5) Deposit inflows	(6) Deposit inflows
$Deposit\ (-HHI)_{t-1}$		-0.172**	-0.181**		-0.128*	-0.254*
		(0.068)	(0.091)		(0.072)	(0.137)
$Deposit\ (-HHI)_{t-1} * crise$		0.372***	0.601***		0.274**	0.925***
		(0.127)	(0.137)		(0.135)	(0.134)
$Deposit\ (-HHI_{t-1})* Unfunded\ ratio_{t-1}$			-0.472			-7.258***
			(0.607)			(1.944)
$Deposit\ (-HHI_{t-1}) * Unfunded\ ratio_{t-1} * crise$			7.671***			26.563***
			(1.803)			(6.819)
$Unfunded\ ratio_{t-1}$	0.419***	0.169*	0.254*	0.278***	0.263**	1.342***
	(0.151)	(0.098)	(0.137)	(0.074)	(0.106)	(0.403)
$Unfunded\ ratio_{t-1} * crise$	-0.928***	-0.725***	-1.542***	-0.815***	-0.569***	-3.724***
	(0.119)	(0.160)	(0.228)	(0.113)	(0.161)	(0.811)
$NPL\ ratio_{t-1}$	-0.012	-0.012	-0.005	-0.083**	-0.074**	-0.075
	(0.030)	(0.025)	(0.025)	(0.034)	(0.036)	(0.048)
ETA_{t-1}	0.154	0.169*	0.169*	0.033	0.026	0.045
	(0.099)	(0.101)	(0.104)	(0.101)	(0.111)	(0.128)
$Total\ assets_{t-1}$	-0.004	-0.007	-0.007	0.001	0.001	0.001
	(0.007)	(0.008)	(0.008)	(0.002)	(0.002)	(0.003)
$GDP\ growth_{t-1}$	-0.277**	-0.252**	-0.177*	-0.524**	-0.357*	-0.290
	(0.112)	(0.114)	(0.100)	(0.225)	(0.200)	(0.204)
$Inflation_{t-1}$	0.130	0.529**	0.521**	0.359**	0.397***	0.231
	(0.301)	(0.253)	(0.256)	(0.155)	(0.135)	(0.148)

(*Continued*)

Table 5-*Continued*

The relationship between $Deposit\ inflows_t$ and interactive term for $unfunded\ commitment\ ratio_{\ t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Deposit inflows	(2) Deposit inflows	(3) Deposit inflows	(4) Deposit inflows	(5) Deposit inflows	(6) Deposit inflows
$L.Deposit\ inflows_t$				0.178***	0.148*	0.129*
				(0.068)	(0.076)	(0.076)
_cons	0.120	0.231	0.220	0.029	0.004	0.030
	(0.127)	(0.142)	(0.139)	(0.047)	(0.058)	(0.065)
N	1080	1080	1080	840	840	840
r2_a	0.252	0.306	0.339			
F	15.748	15.812	16.007			
AR(1)				0.015	0.015	0.017
AR(2)				0.232	0.180	0.492
Hansen (p-value)				0.398	0.450	0.403

Note: This table shows the results relating to the reaction on deposit inflow ratio to a bank's unfunded loan commitments, deposit diversification and interaction between them during the crisis. The dependent variables are deposited inflow ratios, which are ratios that the difference between total deposits in $year_t$ and total deposits in $year_{t-1}$, divided by total deposits in $year_t$. Deposit (-HHI) is an indicator of diversification, which is a ratio that the ratio of deposit HHI times (-1). Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models (Panel A) are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.4 Relationship between unfunded commitment ratio, diversification and lending amounts

Table 6 shows the relationship between lending decisions, unfunded loan commitments and deposit diversification respectively. First, in all models, the ratios of undrawn loan commitments are statistically significant at the 1% level, and have a positive effect on lending decisions. This suggests that banks with greater pre-existing loan commitments may increase their lending during normal periods. The increase of lending is caused by loan commitments that are converted to loans (Acharya and Mora, 2015). There is no significant relationship between lending decisions and deposit diversification during normal periods.

However, the interactive term for unfunded commitment and crisis dummy ($Unfunded\ ratio_{\ t-1} * crise$) have a negative relationship with lending. This means that banks with higher liquidity demand risk, reduce the extension of new loans. It is reasonable that when the funding condition is stressed, banks are unable to meet their commitment lending needs with deposit funding, let alone making some new loans (Ivashina, and David, 2010). Moreover, models 2, 3, 5 and 6 show that the interactive term for deposit diversification and crisis dummy $Deposit\ (-HHI)_{t-1} * crise$ have a positive relationship with lending, which means that a higher diversification on deposits may increase the number of new loans during a crisis.

Models 3 and 6, Table 6 further shows whether diversification could reduce the impact of potential liquidity demand risk on lending decisions. The interactive term for unfunded commitment and deposit diversification and crisis dummy ($Deposit\ (-HHI_{t-1}) * Unfunded\ ratio_{\ t-1} * crise$) have a positive effect on lending decisions and the co-efficiency are also highly significant (β=4.457, ρ<0.01; β=12.022, ρ<0.01) respectively. This aligns with hypothesis **H3**, that diversification could reduce the impact of liquidity

demand risk on lending decisions during a financial crunch, compared to the interaction terms without a crisis dummy. The results in Table 6 contrast with previous results (e.g. Brunnermeier, 2009; Ivashina, and David, 2010; Acharya et al., 2013; Acharya and Mora, 2015) that commitment-exposed banks may reduce their lending because of funding shortages. However, diversification increases the probability of accessing capital. It is possible that banks with more channels to attract funding may be more likely to deal with the synergy between deposit-taking and commitment-lending; they may have spare funding to make new loans. Therefore, diversification may help banks to maintain their original lending decisions.

Table 6

The relationship between $lending\ decision_t$ and interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Lending decision	(2) Lending decision	(3) Lending decision	(4) Lending decision	(5) Lending decision	(6) Lending decision
$Deposit\ (-HHI)_{t-1}$		-0.049	-0.009		-0.009	-0.002
		(0.051)	(0.066)		(0.031)	(0.029)
$Deposit\ (-HHI)_{t-1} * crise$		0.123**	0.249***		0.084**	0.429***
		(0.054)	(0.088)		(0.042)	(0.135)
$Deposit\ (-HHI_{t-1})* Unfunded\ ratio_{t-1}$			-0.929			-1.205*
			(0.630)			(0.649)
$Deposit\ (-HHI_{t-1}) * Unfunded\ ratio_{t-1} * crise$			4.457***			12.022***
			(1.174)			(3.366)
$Unfunded\ ratio_{t-1}$	0.291***	0.217*	0.380***	0.164***	0.151**	0.278**
	(0.107)	(0.120)	(0.142)	(0.062)	(0.069)	(0.137)
$Unfunded\ ratio_{t-1} * crise$	-0.674***	-0.604***	-1.108***	-0.577***	-0.514***	-1.813***
	(0.084)	(0.104)	(0.136)	(0.080)	(0.090)	(0.391)
$NPL\ ratio_{t-1}$	0.015	0.016	0.020	-0.029	-0.031	-0.024
	(0.020)	(0.018)	(0.017)	(0.030)	(0.028)	(0.030)
ETA_{t-1}	0.091	0.095	0.091	-0.095	-0.038	-0.020
	(0.094)	(0.096)	(0.098)	(0.107)	(0.047)	(0.050)
$Total\ assets_{t-1}$	-0.017***	-0.018***	-0.020***	-0.001	0.000	0.000
	(0.006)	(0.006)	(0.006)	(0.002)	(0.002)	(0.002)
$GDP\ growth_{t-1}$	-0.310***	-0.302***	-0.267***	-0.616***	-0.568***	-0.425***
	(0.080)	(0.078)	(0.075)	(0.150)	(0.140)	(0.131)
$Inflation_{t-1}$	0.191	0.323**	0.323**	0.746***	0.756***	0.539**
	(0.140)	(0.153)	(0.150)	(0.263)	(0.231)	(0.220)

(*Continued*)

Table 6-*Continued*

The relationship between $lending\ decision_t$ and interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Lending decision	(2) Lending decision	(3) Lending decision	(4) Lending decision	(5) Lending decision	(6) Lending decision
$L.Lending\ decision_t$				0.265***	0.260***	0.227***
				(0.054)	(0.054)	(0.046)
_cons	0.329***	0.363***	0.395***	0.055	0.032	0.046
	(0.102)	(0.109)	(0.108)	(0.048)	(0.035)	(0.033)
N	1080	1080	1080	960	960	960
r2_a	0.308	0.320	0.351			
F	13.948	17.393	12.289			
AR(1)				0.000	0.000	0.000
AR(2)				0.800	0.975	0.240
Hansen (p-value)				0.427	0.754	0.811

Note: This table shows the results relating to the reaction on lending decision to a bank's unfunded loan commitments, deposit diversification and interaction between them during the crisis. The dependent variables are lending decision which is a ratio that the difference between total loans in $year_t$ and total loans in $year_{t-1}$, divided by total assets in $year_t$. Deposit (-HHI) is an indicator of diversification, which is a ratio that the ratio of deposit HHI times (-1). Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models (Panel A) are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.5 Relationship between unfunded commitment ratio, diversification and liquid ratio

Table 7 shows the relationship between liquidity risk, liquidity demand risk and deposit concentration respectively. As models from 1 to 6 show, there is a positive relationship between the liquid ratio and undrawn commitment ratio ($Unfunded\ ratio_{t-1}$). This means that banks with greater pre-existing loan commitments may not face illiquidity problem in the normal times. However, the interactive term for unfunded commitment ratio and crisis dummy ($Unfunded\ ratio_{t-1} * crise$) have a negative relationship with the liquid ratio ($\rho<0.01$). It is obvious that liquidity demand risk may transfer to liquidity risk during a crisis. When the funding condition is stressed and banks confront a shortage of capital, commitment-exposed banks need to take offsetting draws on their liquid assets (Gatev and Strahan, 2006; Acharya and Mora, 2015). Therefore, this may increase the liquidity risk during a crisis.

Similarly, models 3, 5 and 6 show that the interactive term for deposit diversification and crisis dummy ($Deposit\ (-HHI)_{t-1} * crise$) have a positive connection with liquid ratio, and suggest that a higher diversification (lower concentration) on deposits may increase the liquidity risk during a crisis, while higher concentration on specific deposits increases liquidity in the normal times. As shown in Table 5, diversification could help banks increase deposit inflows during a financial crunch, therefore, banks may decrease their liquidation on liquid assets to meet funding demands.

The model 3 and 6, Table 7 further show that the interactive terms $Deposit\ (-HHI_{t-1}) * Unfunded\ ratio_{t-1} * crise$ have a positive connection with liquid ratio and the co-efficiency are also highly significant in these two models ($\beta=2.988$, $\rho<0.05$; $\beta=9.956$, $\rho<0.01$) respectively. It means that diversification could reduce the impact of liquidity demand risk on the liquidity risk during the crisis. As shown in the table, the liquidity

demand risk may transfer to liquidity risk while diversification may help banks maintain their liquidity during a crisis. Previous research from Hughes *et al*. (1996), Kang (2013) and García-Kuhnert et al. (2015) highlights that firms can realize the benefit of diversification through adjusting portfolios risk. From a different perspective, our findings highlight the deposit base as being a portfolio, helping to realize the benefit of diversification on liquidity risk. We can therefore expect that if banks make a diversification in their deposit base, it would reduce the risk of funding shortages, and banks may then be able to meet liquidity demand. This action may send a good signal to investors and could therefore reduce market panic and risk of liquidity. Therefore, this finding aligns with hypothesis **H4**, that when banks have a diversified deposit base, the impact of bank's liquidity demand risk on liquidity ratio is reduced.

Table 7

The relationship between $Liquid\ ratio_{t}$ and interactive term for $unfunded\ commitment\ ratio_{\ t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Liquid ratio	(2) Liquid ratio	(3) Liquid ratio	(4) Liquid ratio	(5) Liquid ratio	(6) Liquid ratio
$Deposit\ (-HHI)_{t-1}$		-0.198***	-0.112*		-0.261***	-0.131*
		(0.058)	(0.065)		(0.079)	(0.079)
$Deposit\ (-HHI)_{t-1} * crise$		0.082	0.158*		0.243*	0.497***
		(0.058)	(0.081)		(0.139)	(0.103)
$Deposit\ (-HHI_{t-1})* Unfunded\ ratio_{\ t-1}$			-1.471**			-1.544*
			(0.707)			(0.920)
$Deposit\ (-HHI_{t-1}) * Unfunded\ ratio_{\ t-1} * crise$			2.988**			9.956***
			(1.212)			(1.539)
$Unfunded\ ratio_{\ t-1}$	0.563***	0.317**	0.574***	0.312***	0.196**	0.459*
	(0.159)	(0.149)	(0.162)	(0.071)	(0.099)	(0.255)
$Unfunded\ ratio_{\ t-1} * crise$	-0.695***	-0.710***	-1.087***	-0.544***	-0.517***	-1.577***
	(0.061)	(0.074)	(0.148)	(0.054)	(0.081)	(0.162)
$NPL\ ratio_{t-1}$	0.020	0.006	0.010	0.000	0.001	0.007
	(0.046)	(0.043)	(0.044)	(0.025)	(0.031)	(0.028)
ETA_{t-1}	-0.143**	-0.133*	-0.142**	-0.008	-0.003	0.004
	(0.072)	(0.071)	(0.072)	(0.066)	(0.064)	(0.073)
$Total\ assets_{t-1}$	-0.001	-0.002	-0.007	0.000	0.000	0.002*
	(0.007)	(0.006)	(0.006)	(0.002)	(0.002)	(0.001)
$GDP\ growth_{\ t-1}$	-0.072	-0.071	-0.059	-0.488***	-0.393***	-0.355***
	(0.070)	(0.061)	(0.065)	(0.108)	(0.095)	(0.083)
$Inflation_{\ t-1}$	0.071	0.138*	0.143*	0.322**	0.420*	0.221*
	(0.107)	(0.077)	(0.077)	(0.137)	(0.245)	(0.134)

(*Continued*)

Table 7-*Continued*

The relationship between $Liquid\ ratio_{t}$ and interactive term for $unfunded\ commitment\ ratio_{\ t-1}$ and $deposit\ diversification\ (-HHI)_{t-1}$

	Panel A – Fixed Effect			Panel B – GMM model		
	(1) Liquid ratio	(2) Liquid ratio	(3) Liquid ratio	(4) Liquid ratio	(5) Liquid ratio	(6) Liquid ratio
$L.Liquid\ ratio_{t}$				0.466***	0.363***	0.378***
				(0.054)	(0.065)	(0.048)
_cons	0.195*	0.274***	0.347***	0.087**	0.176***	0.155***
	(0.106)	(0.097)	(0.090)	(0.036)	(0.041)	(0.037)
N	1080	1080	1080	1080	1080	1080
r2_a	0.365	0.404	0.434			
F	25.703	25.111	22.478			
AR(1)				0.032	0.035	0.041
AR(2)				0.845	0.867	0.762
Hansen (p-value)				0.771	0.745	0.692

Note: This table shows the results relating to the reaction on liquid ratio to a bank's unfunded loan commitments, deposit diversification and interaction between them during the crisis. The dependent variables are liquid ratios that is liquid assets to total assets. It is the indicator of liquidity risk. Deposit (-HHI) is an indicator of diversification, which is a ratio that the ratio of deposit HHI times (-1). Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models (Panel A) are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.6 Additional results

Above we show the empirical results that diversification could mitigate the impact of liquidity demand risk during the crisis through decreasing the cost of funding, increasing the funding inflow, maintaining the total amount of loan lending and enhancing the liquid ratio. We also provide additional estimation to show whether bank increases diversification to mitigate the liquidity risk during crisis. Comparing to the four types of deposits[52], we analyse whether bank increases other funding inflows.

Table 8 shows that a high commitments exposed bank significantly increased its growth of government borrowings and other borrowings during the crisis. While a bank, in the normal time, is not in financial distress, so that it may not rely on other funding borrowings and increase the funding diversification. Therefore, these results support that banks need to increase the funding diversification, such as the increase of government and other borrowings, in order to attract sufficient capital to satisfy the liquidity demand.

[52] The main four type of deposit are individual deposit, deposit from banks or financial institutions, the corporate deposit and other deposit.

Table 8

The relationship between outside funding and between $unfunded\ commitment\ ratio_{\ t-1}$

	Panel A – Fixed Effect		Panel B – GMM model	
	(1) Government borrowings	(2) Other borrowings	(3) Government borrowings	(4) Other borrowings
$Unfunded\ ratio_{\ t-1}$	-0.033*	-0.027**	-0.025***	-0.034**
	(0.017)	(0.014)	(0.009)	(0.015)
$Unfunded\ ratio_{\ t-1} * crise$	0.142***	0.091***	0.101***	0.090***
	(0.016)	(0.011)	(0.014)	(0.013)
$NPL\ ratio_{t-1}$	0.012**	0.017***	0.010**	-0.028***
	(0.005)	(0.005)	(0.004)	(0.005)
ETA_{t-1}	0.025**	0.004	0.010	0.009
	(0.011)	(0.008)	(0.008)	(0.009)
$Total\ assets_{t-1}$	-0.005**	-0.006***	-0.001*	-0.001*
	(0.002)	(0.002)	(0.000)	(0.000)
$GDP\ growth_{\ t-1}$	-0.003	0.004	0.244***	0.061***
	(0.021)	(0.013)	(0.033)	(0.017)
$Inflation_{\ t-1}$	0.073**	0.088**	-0.222***	-0.071
	(0.029)	(0.044)	(0.048)	(0.054)
$L.Givernment\ borrowings_t$			0.732***	
			(0.032)	
$L.Other\ borrowings_t$				0.347***
				(0.067)
_cons	0.107***	0.110***	0.012*	0.018***
	(0.039)	(0.036)	(0.007)	(0.007)
N	1080	1080	840	840
r2_a	0.254	0.198		
F	18.199	18.273		
AR(1)			0.005	0.062
AR(2)			0.115	0.302
Hansen (p-value)			0.471	0.114

Note: This table shows the relationship between the outside funding and a bank's unfunded loan commitments during the crisis. The dependent variables are government borrowings and other borrowings, which are the borrowings to total assets respectively. Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first two models (Panel A) are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (3) to (4) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.7 Relationship between unfunded commitment ratio, deposit insurance and time expense ratio

As mentioned above, the liquidity demand risk exists in the banking industry and it may trigger an increase in the probability of liquidity during a crisis. We find that the structure of the deposit base may bring an advantage for banks when they face the synergy effect of commitment needs and runs on deposit. This is an individual's strategy for banks to handle the potential liquidity risk and panic. In addition, Anginer et al. (2014b) suggest that deposit insurance could restore depositor confidence and avert panic in the banking sector. At the country level, we also need to consider whether deposit insurance could play its role effectively.

Table 9 shows the impact of deposit insurance on time expense ratio. Models 2, 3, 5 and 6 show that deposit insurance has a negative impact on interest rates (β=-0.001, ρ<0.01), and suggest that deposit insurance could restore investor confidence (e.g. Demirguc-Kunt and Huizinga, 2004; Karas *et al*., 2013). This "safety net" may bring a positive signal for depositors so that it may reduce the possibility of bank runs, and the stabilization effect of deposit insurance is, naturally, more important during economic downturns when contagious bank runs are more likely to occur (Anginer et al., 2014b). Banks suffer less pressure from shortage of deposits and may decrease the cost of funding.

However, as models 3 and 6, Table 9 show, the interactive term for deposit insurance and unfunded commitment ratio and crisis dummy ($Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1} * crise$) has a positive connection with time expense ratio and the co-efficiency are also highly significant (β=0.006, ρ<0.01; β=0.007, ρ<0.01) respectively. The funding suggests that banks with greater exposed commitments may still have to increase the interest rate to access funding, even though they are secured by deposit insurance, and the uncertainty of deposit insurance may be leading to distortions and

inefficiencies in the banking sector (Barth et al., 2004). Therefore, the “stabilization effect” of deposit insurance may not mitigate the impact of liquidity demand risk.

Table 9

The relationship between deposit expense rate and interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $Deposit\ insurance_{t-1}$

	Panel A – Fixed effect			Panel B – GMM model		
	(1) Time expense ratio	(2) Time expense ratio	(3) Time expense ratio	(4) Time expense ratio	(5) Time expense ratio	(6) Time expense ratio
$L.Time\ expense\ ratio_t$				0.936***	0.911***	0.895***
				(0.040)	(0.049)	(0.049)
$Deposit\ insurance_{t-1}$		0.003	0.004		0.001***	0.002***
		(0.003)	(0.004)		(0.000)	(0.001)
$Deposit\ insurance_{t-1} * crise$		-0.001**	-0.001***		-0.001***	-0.001***
		(0.000)	(0.000)		(0.000)	(0.001)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1}$			-0.005**			-0.007**
			(0.003)			(0.003)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1} * crise$			0.006***			0.007***
			(0.002)			(0.002)
$Unfunded\ ratio_{t-1}$	-0.052**	-0.051**	-0.062***	-0.008***	-0.015**	0.052**
	(0.024)	(0.023)	(0.016)	(0.004)	(0.007)	(0.025)
$Unfunded\ ratio_{t-1} * crise$	0.063***	0.046**	0.042**	0.028**	0.012**	0.022***
	(0.017)	(0.023)	(0.021)	(0.014)	(0.005)	(0.006)
$NPL\ ratio_{t-1}$	-0.007*	-0.010***	-0.010***	-0.003**	-0.003**	-0.010*
	(0.004)	(0.004)	(0.004)	(0.001)	(0.001)	(0.006)
ETA_{t-1}	-0.028	-0.031	-0.032	0.026	0.002	0.008
	(0.033)	(0.035)	(0.035)	(0.028)	(0.005)	(0.008)

(*Continued*)

Table 9-*Continued*

	Panel A – Fixed effect			Panel B – GMM model		
	(1) Time expense ratio	(2) Time expense ratio	(3) Time expense ratio	(4) Time expense ratio	(5) Time expense ratio	(6) Time expense ratio
$Total\ assets_{t-1}$	-0.001*	-0.003*	-0.003*	-0.003**	-0.001**	-0.001**
	(0.000)	(0.002)	(0.001)	(0.001)	(0.000)	(0.000)
$GDP\ growth_{t-1}$	0.037**	0.027**	0.023***	0.142***	0.120***	0.143***
	(0.019)	(0.010)	(0.008)	(0.041)	(0.028)	(0.042)
$Inflation_{t-1}$	-0.070**	-0.060	-0.060	-0.048**	0.006	0.013
	(0.025)	(0.059)	(0.058)	(0.018)	(0.061)	(0.064)
_cons	0.057***	0.065**	0.047***	-0.008***	-0.006**	-0.021**
	(0.014)	(0.029)	(0.022)	(0.003)	(0.003)	(0.010)
N	1080	1080	1080	960	960	960
r2_a	0.150	0.160	0.163			
AR(1)				0.001	0.001	0.001
AR(2)				0.568	0.540	0.446
Hansen (p-value)				0.327	0.235	0.281

Note: This table shows the results relating the reaction on deposit rate to a bank's unfunded loan commitments, deposit insurance and interaction between them during the crisis. The dependent variables are interest expense rate of time deposits expressed as % annual rate. Deposit insurance is the log value of the insurance amount for each country. Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel model (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.8 Relationship between unfunded commitment ratio, deposit insurance and deposit inflows

Banks with greater previous unfunded commitments may face deposit shortages so that their deposit inflows is decreased (Acharya and Mora, 2015). As models 2, 3, 5 and 6, Table 10 show, the interactive term for deposit insurance and crisis dummy ($Deposit\ insurance_{t-1} * crise$) has a positive relationship with deposit inflows. The result suggests that the "stabilization effect" of deposit guarantee could restore investors' confidence so that the amounts of deposit inflow still increases during the crisis (Chernykh and Cole, 2011; Karas *et al*., 2013). However, models 3 and 6 show that the interactive term for deposit insurance and unfunded ratio and crisis dummy ($Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1} * crise$) have a negative relationship with deposit inflows and the co-efficiency are also highly significant (β=-0.068, ρ<0.05; β=-0.055, ρ<0.05) respectively, and suggest that this "stabilization effect" of deposit insurance could not mitigate the impact of undrawn loan commitments in the crisis,

Moreover, as models 2, 3, 5 and 6, Table 10 show, $Deposit\ insurance_{t-1}$has a negative relationship with deposit inflows, which means that banks may rely less on the deposits and more on shorter-maturity funding in the normal period (King, 2013),. Short-term funding could improve banks' liquidity and increase the flexibility of making new loans. Previous papers (e.g. Ioannidou and Penas, 2010; Gorton and Metrick, 2013) suggest that the "moral hazard" effect of deposit insurance provides incentives for banks to take excessive risk, for example of overusing unfunded loan commitments. As a result, banks may use more short-term funding to support their excessive risk-taking (King, 2013), and this "moral hazard" behaviour creates potential liquidity demand risk (Demirguc-Kunt and Kane, 2002; Acharya and Mora, 2015). Therefore, the "moral hazard" effect of

deposit insurance inspires banks to rely less deposit inflows and more on short-maturity funding in the normal times.

Table 10

The relationship between deposit inflow interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $Deposit\ insurance_{t-1}$

	Panel A – Fixed effect			Panel B – GMM model		
	(1) Deposit inflows	(2) Deposit inflows	(3) Deposit inflows	(4) Deposit inflows	(5) Deposit inflows	(6) Deposit inflows
$L.Deposit\ inflows_t$				0.026***	0.006***	0.024***
				(0.007)	(0.002)	(0.008)
$Deposit\ insurance_{t-1}$		-0.057***	-0.045**		-0.006**	-0.023***
		(0.021)	(0.018)		(0.003)	(0.008)
$Deposit\ insurance_{t-1} * crise$		0.009***	0.010***		0.011***	0.009**
		(0.003)	(0.004)		(0.003)	(0.005)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1}$			0.112**			0.089**
			(0.046)			(0.041)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1} * crise$			-0.068***			-0.055***
			(0.020)			(0.020)
$Unfunded\ ratio_{t-1}$	0.252**	0.247*	0.312**	0.060**	0.139*	0.726**
	(0.112)	(0.143)	(0.142)	(0031)	(0072)	(0.308)
$Unfunded\ ratio_{t-1} * crise$	-0.478**	-0.209**	-0.829***	-0.359***	-0.321**	-0.410***
	(0.241)	(0.101)	(0.253)	(0.134)	(0.150)	(0.124)
$NPL\ ratio_{t-1}$	0.830***	0.891***	0.893***	0.587***	0.696***	-0.239**
	(0.160)	(0.165)	(0.169)	(0.187)	(0.203)	(0.105)
ETA_{t-1}	0.237	0.305	0.302	-0.190	-0.060	0.045
	(0.225)	(0.220)	(0.226)	(0.345)	(0.232)	(0.169)

(*Continued*)

Table 10-*Continued*

	Panel A – Fixed effect			Panel B – GMM model		
	(1) Deposit inflows	(2) Deposit inflows	(3) Deposit inflows	(4) Deposit inflows	(5) Deposit inflows	(6) Deposit inflows
$Total\ assets_{t-1}$	-0.286**	-0.249**	-0.245**	0.012*	0.013*	0.002**
	(0.129)	(0.124)	(0.119)	(0.007)	(0.008)	(0.001)
$GDP\ growth_{t-1}$	-0.538	-0.191	-0.128	-0.566	-0.486	-1.023**
	(0.469)	(0.509)	(0.534)	(0.450)	(0.500)	(0.455)
$Inflation_{t-1}$	0.292**	0.100**	0.233*	0.849**	0.526***	1.572***
	(0.139)	(0.054)	(0.129)	(0.421)	(0.173)	(0.501)
_cons	4.968**	4.816**	4.644**	-0.329*	-0.067***	0.305**
	(2.137)	(2.103)	(1.887)	(0.170)	(0.019)	(0.132)
N	1080	1080	1080	960	960	960
r2_a	0.152	0.154	0.154			
AR(1)				0.015	0.011	0.017
AR(2)				0.700	0.512	0.334
Hansen (p-value)				0.479	0.787	0.228

Note: This table shows the results relating to the reaction on deposit inflow ratio to a bank's unfunded loan commitments, deposit insurance and interaction between them during the crisis. The dependent variables are deposited inflow ratios, which are ratios that the difference between total deposits in $year_t$ and total deposits in $year_{t-1}$, divided by total deposits in $year_t$. Deposit insurance is the log value of insurance amount for each country. Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel model (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.9 Relationship between unfunded commitment ratio, deposit insurance and lending decisions

As Table 11 shows, the negative relationship between $Unfunded\ ratio_{\ t-1} * crise$ and lending decision suggests that the increase of lending from banks with deposit insurance is caused by loan commitments that are converted to loans during ordinary periods Acharya et al. (2013a), while they are exposed to higher liquidity demand risk thus reducing the extension of new loans during a crisis (Acharya and Mora, 2015). However, model 3 and 6 in Table 11 show that the interactive term for deposit insurance and unfunded ratio and crisis dummy ($Deposit\ insurance_{t-1} * Unfunded\ ratio_{\ t-1} * crise$) have a negative relationship with lending decision and the co-efficiency are also highly significant (β=-0.027, ρ<0.01; β=-0.073, ρ<0.01) respectively, and suggests that deposit insurance could not increase the lending amounts and this "safety net" could not mitigate the impact of liquidity demand risk, during the crisis. In addition, the interactive term $Deposit\ insurance_{t-1} * crise$ has a negative relationship with lending decision in models 2, 3, 5 and 6, which means that the "stabilization effect" of deposit insurance is not constant and may be distorted by other factors (Demirguc-Kunt and Kane, 2002; Hovakimian et al., 2003).

Moreover, as models 2, 3, 5 and 6, Table 11 show, $Deposit\ insurance_{t-1}$has a positive relationship with lending decision, which means that deposit insurance could inspire bank to make more loans in normal times. Because of the lack of market discipline, deposit insurance incentivizing banks for excessive lending will lead to excessive risk taking culminating in banking crisis. (Demirguc-Kunt and Kane, 2002). This moral hazard problem in lending will be exacerbated by deposit insurance in the normal times and is associated with a higher likelihood of the banking crisis (Demirguc-Kunt and Detragiache, 2002; Shapiro and Skeie, 2015). As a result, over-lending along with unfunded loan

commitments increase potential liquidity risk when banks suffer shortage of funding. The liquidity risk exacerbated by the “moral hazard effect” of deposit insurance could not be mitigated by the “stabilization effect” during the crisis.

Table 11

The relationship between lending decision and interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $Deposit\ insurance_{t-1}$

	Panel A – Fixed effect			Panel B – GMM model		
	(1) Lending decision	(2) Lending decision	(3) Lending decision	(4) Lending decision	(5) Lending decision	(6) Lending decision
$L.Lending\ decision_t$				0.066***	0.079***	0.063***
				(0.012)	(0.021)	(0.017)
$Deposit\ insurance_{t-1}$		0.021***	0.024***		0.002**	0.005***
		(0.008)	(0.008)		(0.001)	(0.002)
$Deposit\ insurance_{t-1} * crise$		-0.003***	-0.004***		-0.003***	-0.005**
		(0.001)	(0.001)		(0.001)	(0.002)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1}$			0.039**			0.039***
			(0.010)			(0.011)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1} * crise$			-0.027***			-0.073***
			(0.011)			(0.019)
$Unfunded\ ratio_{t-1}$	0.088***	0.093***	0.272**	0.034**	0.055**	0.365***
	(0.020)	(0.024)	(0.135)	(0.018)	(0.024)	(0.136)
$Unfunded\ ratio_{t-1} * crise$	-0.087***	-0.028***	-0.196***	-0.115**	-0.088**	-0.569**
	(0.029)	(0.007)	(0.067)	(0.054)	(0.037)	(0.283)
$NPL\ ratio_{t-1}$	-0.012	0.008	0.007	-0.006	0.028	-0.258
	(0.017)	(0.019)	(0.020)	(0.031)	(0.027)	(0.328)
ETA_{t-1}	0.009	0.036	0.036	-0.454***	-0.229*	-0.028
	(0.090)	(0.087)	(0.088)	(0.146)	(0.122)	(0.062)

(*Continued*)

Table 11-*Continued*

	Panel A – Fixed effect			Panel B – GMM model		
	(1)	(2)	(3)	(4)	(5)	(6)
	Lending decision	Lending decision	Lending decision	Lending decision	Lending decision	Lending decision
$Total\ assets_{t-1}$	-0.102***	-0.088***	-0.091***	-0.011***	-0.006**	-0.004**
	(0.011)	(0.012)	(0.012)	(0.003)	(0.003)	(0.002)
$GDP\ growth_{t-1}$	-0.129	-0.005	-0.006	0.349*	0.412**	0.362*
	(0.125)	(0.135)	(0.138)	(0.185)	(0.180)	(0.205)
$Inflation_{t-1}$	0.204*	0.130	0.176	0.539*	0.271	0.133
	(0.106)	(0.135)	(0.138)	(0.285)	(0.214)	(0.240)
_cons	1.797***	1.741***	1.802***	0.224***	0.092***	0.096**
	(0.198)	(0.189)	(0.202)	(0.062)	(0.033)	(0.045)
N	1080	1080	1080	960	960	960
r2_a	0.167	0.180	0.183			
AR(1)				0.001	0.000	0.001
AR(2)				0.259	0.404	0.376
Hansen (p-value)				0.527	0.733	0.456

Note: This table shows the results relating the reaction on deposit inflow ratio to a bank's unfunded loan commitments, deposit insurance and interaction between them during the crisis. The dependent variables are lending decision, which is a ratio that the difference between total loans in $year_t$ and total loans in $year_{t-1}$, divided by total assets in $year_t$. Deposit insurance is the log value of insurance amount for each country. Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models are panel regressions with fixed effects during the period 2005 – 2014 and regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel model (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.4.10 Relationship between unfunded commitment ratio, deposit insurance and liquid ratio

Banks with greater previous unfunded commitments may face deposit shortages and they may cash liquid asset to fulfil the obligation of loans (Gatev and Strahan, 2006; Acharya and Mora, 2015), so that there is a negative relationship between $Unfunded\ ratio_{\ t-1} * crise$ and liquid ratio. As models 2, 3, 5 and 6, Table 12 show, the interactive term $Deposit\ insurance_{t-1} * crise$ has a positive relationship with the liquid ratio. The result suggests that deposit insurance protects the interests of unsophisticated depositors and helps prevent bank runs, which can improve social welfare (Chernykh and Cole, 2011). This positive stabilization effect of deposit insurance is, naturally, more important during economic downturns when contagious bank runs are more likely to occur (Anginer et al., 2014b).

However, models 3 and 6, Table 12 show that the interactive term for deposit insurance and unfunded ratio and crisis dummy ($Deposit\ insurance_{t-1} * Unfunded\ ratio_{\ t-1} * crise$) have a negative relationship with liquid ratio and co-efficiency are also highly significant (β=-0.035, ρ<0.05; β=-0.016, ρ<0.05) respectively, and suggest that although deposit insurance helps banks realize the benefit of stabilization effect of deposit insurance, this "safety net" could not mitigate the impact of unused commitments on liquid ratio. Moreover, interestingly, models 2, 3, 5 and 6 show that $Deposit\ insurance_{t-1}$ has a negative effect on liquid ratio. This finding suggests that banks with deposit guarantee may take excessive risk, in the normal times (Anginer et al., 2014b). They would like to use all funding to make loans and investments, instead of increasing liquid asset to against shortage of deposit. Since banks think that deposit insurance could provide a funding guarantee, they would reduce the requirement of liquid asset for preventing the banks run.

Table 12

The relationship between liquid ratio and interactive term for $unfunded\ commitment\ ratio_{t-1}$ and $Deposit\ insurance_{t-1}$

	Panel A – Fixed effect			Panel B – GMM model		
	(1) Liquid ratio	(2) Liquid ratio	(3) Liquid ratio	(4) Liquid ratio	(5) Liquid ratio	(6) Liquid ratio
$L.Liquid\ ratio_t$				0.744***	0.784***	0.750***
				(0.086)	(0.054)	(0.077)
$Deposit\ insurance_{t-1}$		-0.009***	-0.027**		-0.002**	-0.002**
		(0.003)	(0.011)		(0.001)	(0.001)
$Deposit\ insurance_{t-1} * crise$		0.002**	0.002***		0.001*	0.005***
		(0.001)	(0.001)		(0.001)	(0.002)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1}$			0.094**			0.006**
			(0.043)			(0.003)
$Deposit\ insurance_{t-1} * Unfunded\ ratio_{t-1} * crise$			-0.035***			-0.016**
			(0.010)			(0.007)
$Unfunded\ ratio_{t-1}$	0.164***	0.176***	0.701*	0.070**	0.063**	0.122**
	(0.084)	(0.050)	(0.384)	(0.034)	(0.024)	(0.052)
$Unfunded\ ratio_{t-1} * crise$	-0.138***	-0.134**	-0.352***	-0.109***	-0.059***	-0.168**
	(0.037)	(0.062)	(0.096)	(0.042)	(0.019)	(0.078)
$NPL\ ratio_{t-1}$	-0.190**	-0.187**	-0.189**	-0.335**	-0.050**	-0.374**
	(0.087)	(0.084)	(0.079)	(0.145)	(0.021)	(0.157)
ETA_{t-1}	0.030	0.043	0.043	0.012	-0.112*	0.004
	(0.119)	(0.115)	(0.115)	(0.064)	(0.060)	(0.064)

(*Continued*)

Table 12-*Continued*

	Panel A – Fixed effect			Panel B – GMM model		
	(1) Liquid ratio	(2) Liquid ratio	(3) Liquid ratio	(4) Liquid ratio	(5) Liquid ratio	(6) Liquid ratio
$Total\ assets_{t-1}$	-0.022**	-0.016*	-0.021**	-0.002*	-0.003*	-0.004**
	(0.010)	(0.010)	(0.010)	(0.002)	(0.002)	(0.002)
$GDP\ growth_{t-1}$	0.055**	0.103	0.088	0.092*	-0.196	0.040
	(0.026)	(0.103)	(0.095)	(0.056)	(0.159)	(0.138)
$Inflation_{t-1}$	0.199	0.162	0.219	-0.252	0.242	0.039
	(0.150)	(0.161)	(0.159)	(0.269)	(0.257)	(0.227)
_cons	0.535***	0.510***	0.656***	0.152***	0.077***	0.012***
	(0.174)	(0.166)	(0.189)	(0.044)	(0.025)	(0.004)
N	1080	1080	1080	960	960	960
r2_a	0.160	0.161	0.160			
AR(1)				0.007	0.005	0.007
AR(2)				0.527	0.305	0.524
Hansen (p-value)				0.346	0.100	0.494

Note: This table shows the results relating the reaction on liquid ratio to a bank's unfunded loan commitments, deposit insurance and interaction between them during the crisis. The dependent variables are liquid ratios that liquid assets to total assets. It is the indicator of liquidity risk. Deposit insurance is the log value of insurance amount for each country. Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk The first three models (Panel A) are panel regressions with fixed effects during the period 2005 – 2014 and the regressions use phase of the crisis: 2008 and 2009. The models (4) to (6) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

According to Table from 9 to 12, deposit insurance could have a positive effect on banks during the crisis, but it may also bring a wrong signal for banks to take excessive risk in the normal time. This "moral hazard" effect potentially increases the liquidity risk, since bank depositors lack incentives to monitor when deposits are insured (Demirguc-Kunt and Huizinga, 2004; Ioannidou and Penas, 2010). When the condition of financial funding is stressed, the "stabilization" effect could not mitigate the liquidity risk. Overall, although deposit insurance may be implemented to ensure the stability of the banking industry (Anginer et al., 2014b), banks misuse this advantage to overdraft their risk tolerance (Demirguc-Kunt and Kane, 2002), and the lack of market discipline leads to excessive risk taking culminating in banking crises (Demirguc-Kunt and Detragiache, 2002; Barth et al., 2004). Therefore, this finding aligns with the hypothesis **H5** that the "moral hazard" effect of deposit insurance may be greater than the "stabilization effect" on the liquid demand risk during the crisis.

4.4.11 Robustness Tests

Above we show empirically that the impact of liquidity demand risk can be reduced by deposit diversification. For testing the hypothesis that the impact of a bank's unfunded commitment on costs of deposit can be reduced during a crisis, we also use the interest rates of the core deposit[53] and demand deposit as the dependent variable. As models 1 and 5, Table 13 show, the interactive term ($Unfunded\ ratio_{\ t-1} * crise$) has a positive connection with time expense ratio, while it has a negative relationship with deposit inflows. The results also align with our hypothesis 1 and 2. For estimating the impact of deposit insurance, we also divided the countries into two groups. The first group contains

[53] Core deposit are the sum of time deposits and saving deposits.

countries that have deposit insurance while the second group is countries that do not have deposit insurance. According to Table 13, we find that banks in a country with deposit insurance may be more likely to suffer liquidity demand risk than banks in a country without this safety net. The results also support the hypothesis that the “moral hazard” effect of deposit insurance dominates in normal time while the “stabilization” effect dominates in the financial downturn.

Table 13

The impact of $Unfunded\ ratio_{t-1}$ on interest expense and deposit inflows in different groups

Dependent variables	Time expense ratio		Deposit inflows	
	(1) With deposit insurance	(2) Without deposit insurance	(5) With deposit insurance	(6) Without deposit insurance
$Unfunded\ ratio_{t-1}$	-0.045**	-0.062**	0.371**	0.564**
	(0.023)	(0.024)	(0.147)	(0.237)
$Unfunded\ ratio_{t-1} * crise$	0.055***	-0.026	-0.723***	-0.757
	(0.019)	(0.017)	(0.202)	(1.229)
$NPL\ ratio_{t-1}$	-0.021	0.010*	0.395	-0.240
	(0.016)	(0.006)	(0.285)	(0.397)
ETA_{t-1}	-0.038	-0.007**	-0.125	-0.040*
	(0.026)	(0.003)	(0.276)	(0.024)
$Total\ assets_{t-1}$	0.001*	0.002*	0.001*	-0.001
	(0.000)	(0.001)	(0.001)	(0.067)
$GDP\ growth_{t-1}$	0.020*	0.094**	0.642***	-0.076*
	(0.012)	(0.035)	(0.216)	(0.034)
$Inflation_{t-1}$	-0.107**	0.064***	0.186*	-0.491*
	(0.050)	(0.022)	(0.074)	(0.260)
_cons	0.195***	0.034**	7.026**	1.215*
	(0.059)	(0.016)	(3.217)	(0.696)
N	882	198	882	198
r2_a	0.107	0.090	0.113	0.116

Note: This table shows the impact of unfunded commitment t-1 on interest expense and deposit inflows in different groups during the crisis. The dependent variables interest expense rate of time deposits expressed as % annual rate and deposit inflows ratio. Unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk. 12 countries are divided into two groups. The first groups are countries with deposit insurance and second groups are countries without deposit insurance. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

For analysing the impact of deposit diversification and insurance on the liquidity demand risk, we also consider the period of normal times and separate the period into two groups[54]. Table 14 shows the impact of liquidity demand risk, deposit diversification, deposit insurance prior and after the crisis on interest expense, deposit inflow, lending amount and liquid ratio. Before and after the crisis, the $Unfunded\ ratio_{t-1}$ could reduce interest expense and increase the deposit inflow, lending amount and liquidity. For the deposit diversification, it increases the interest expense during the normal period. This cost may be treated by banks as a fixed expense for enhancing liquidity (Cerasi and Daltung 2000). However, the impact of deposit diversification on the unfunded loan commitments is not obvious in normal time, since banks may not suffer a shortage of funding (Gatev *et al*., 2009, Acharya and Mora, 2015). It is interesting that deposit insurance has a negative effect on interest expense, deposit inflow and liquid ratio prior to crisis while it increases the lending amount. It means that it may bring an incentive for banks to take excessive risk before the crisis, which may exist as a "moral hazard" based on the study of Anginer et al. (2014b). However, after a crisis, deposit insurance could continue to have "stabilization effect" on banks.

[54] The first groups are the years before the crisis (2005 to 2007). The second groups are the years after the crisis (2010 to 2014).

Table 14

The impact of $Unfunded\ ratio_{t-1}$, $deposit\ diversification\ (-HHI)_{t-1}$, $Deposit\ insurance_{t-1}$ prior and after the crisis

	Time expense ratio		Deposit inflows		Lending decision		Liquid ratio	
	(1) Prior the crisis	(2) After the crisis	(3) Prior the crisis	(4) After the crisis	(5) Prior the crisis	(6) After the crisis	(7) Prior the crisis	(8) After the crisis
$Unfunded\ ratio_{t-1}$	-0.075**	-0.045*	13.06*	1.830*	2.080***	0.297*	0.115**	0.779*
	(0.037)	(0.024)	(8.005)	(1.153)	(0.623)	(0.154)	(0.053)	(0.468)
$Deposit\ (-HHI_{t-1})$	0.015**	0.016*	-0.941*	-0.995*	0.262	-0.045	-0.167*	-0.235**
	(0.007)	(0.009)	(0.475)	(0.522)	(0.229)	(0.080)	(0.091)	(0.102)
$Deposit\ (-HHI_{t-1})*\ Unfunded\ ratio_{t-1}$	-0.010	-0.165**	8.374	0.800	0.411*	0.165***	0.395**	1.079*
	(0.154)	(0.068)	(11.51)	(2.520)	(0.253)	(0.049)	(0.141)	(0.559)
$Deposit\ insurance_{t-1}$	-0.005***	0.004**	-0.001*	0.032*	0.002**	0.026*	-0.004**	0.039**
	(0.002)	(0.002)	(0.001)	(0.017)	(0.001)	(0.015)	(0.002)	(0.019)
$Deposit\ insurance_{t-1}*$ $Unfunded\ ratio_{t-1}$	-0.004**	0.012*	-0.523	-0.133	0.162**	0.022**	-0.096*	0.155*
	(0.002)	(0.007)	(1.082)	(0.084)	(0.079)	(0.011)	(0.055)	(0.080)
$NPL\ ratio_{t-1}$	0.107*	0.006*	2.382	0.127	0.226	0.030	-0.517*	-0.320**
	(0.057)	(0.004)	(6.030)	(0.123)	(0.597)	(0.116)	(0.265)	(0.122)
ETA_{t-1}	0.012	-0.023*	-2.789	0.283**	0.366**	0.286*	0.347	0.138
	(0.026)	(0.012)	(3.663)	(0.115)	(0.179)	(0.170)	(0.364)	(0.245)

(*Continued*)

Table 14-*Continued*

	Time expense ratio		Deposit inflows		Lending decision		Liquid ratio	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Prior the crisis	After the crisis	Prior the crisis	After the crisis	Prior the crisis	After the crisis	Prior the crisis	After the crisis
$Total\ assets_{t-1}$	-0.003*	-0.001*	-0.563	-0.202**	-0.011	-0.066**	0.038	0.003
	(0.002)	(0.000)	(0.640)	(0.078)	(0.057)	(0.029)	(0.046)	(0.021)
$GDP\ growth_{t-1}$	-0.007**	-0.014**	8.097	-0.705	0.539**	0.267*	0.048**	0.368**
	(0.003)	(0.006)	(6.715)	(0.887)	(0.257)	(0.150)	(0.016)	(0.175)
$Inflation_{t-1}$	-0.079	-0.045	21.778	0.041	0.362	-0.249	0.005	0.477**
	(0.111)	(0.052)	(18.735)	(0.605)	(0.807)	(0.237)	(0.475)	(0.220)
_cons	0.196**	0.111**	7.919**	2.606**	0.426*	1.327**	0.615*	0.268*
	(0.084)	(0.056)	(3.332)	(1.158)	(0.231)	(0.523)	(0.384)	(0.143)
N	240	600	240	600	240	600	240	600
r2_a	0.101	0.142	0.128	0.113	0.112	0.171	0.096	0.099

Note: This table shows the results relating to the impact of a bank's unfunded loan commitments, deposit diversification, deposit insurance and interaction between them prior to and after the crisis. The dependent variables are interest expense, deposit inflows, lending decision and liquid ratios. The unfunded ratio is measured as the ratio of undrawn loan commitments to the sum of loans and unused commitments. It is an indicator of liquidity demand risk. Deposit (-HHI) is an indicator of diversification, which is a ratio that the ratio of deposit HHI times (-1). Deposit insurance is the log value of the insurance amount for each country. The period between 2005 to 2014 is divided into two groups. The first groups are the years before the crisis (2005 to 2007). The second groups are the years after the crisis (2010 to 2014). ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

4.5 Conclusions

Through analysing banks in 12 countries, it is clear that there exists liquidity demand risk during a crisis. Because of a synergy between deposit-taking and commitment needs, banks confronted the higher costs of funding and a shortage of capital during the period 2008-2009. We find that diversification may offer an additional channel for banks to access funding, which may decrease the pressure on funding demand and the cost of a deposit during a crisis; while lower diversification could bring an advantage for banks in obtaining deposits during normal periods. Furthermore, diversification could not only decrease the probability of liquidity demand risk, but could also help banks to maintain their lending decisions and even reduce liquidity risk.

However, we find that the "moral hazard" effect of deposit insurance dominates in the normal period while the "stabilization effect" dominates during a crisis. The "moral hazard" effect of an increase of liquidity risk may be greater than the "stabilization effect" during the crunch. Our results suggest that banks with deposit insurance may be more likely to suffer liquidity demand risk than those without a safety net. We can expect that although many countries increased the amount of deposit insurance in order to restore investors' confidence and decrease the probability of a run on the bank, this protection mechanism triggered potential liquidity demand risk. Additionally, the buffer function of diversification on liquidity demand risk is more effective in the countries with a safety net, than in those countries without deposit guarantees.

For the liquidity risk, the Basel III may provide a better liquidity regulation, such as a liquidity coverage ratio (LCR), but for individual strategies, banks should adjust to an appropriate structure of attracting capital. Diversification in deposits is an important strategy for banks to adjust their bearing capacity of liquidity (e.g., Disyatat, 2011; Kang 2013; García-Kuhnert *et al*., 2015). In addition, as discussed in various studies (e.g., Boyd

and De Nicolo, 2005; Gorton and Metrick, 2013; Anginer et al., 2014b; Shapiro and Skeie, 2015), we find that deposit insurance may operate in exactly the opposite direction, which causes banks to become risky during a crisis. Therefore, the strategy of diversification can be treated as an alternative scheme for banks to deal with liquidity risk, in case LCR follows the old path as the lender-of-last-resort and deposit insurance.

Chapter 5: Expected government support and bank risk-taking: Evidence from China

5.1 Introduction

Bank bailouts after the recent global financial crisis have brought to debates the issue of explicit government support (Anginer et al., 2014b), implicit guarantee (Schich and Lindh, 2012) and expected government support (Antzoulatos and Tsoumas, 2014). The effect of government support raises concern about the size of this support, the potential distortions in competition and the moral hazard problem. More importantly, it can influence banks' willingness to take on risk by detracting from market discipline (Peleg‐Lazar and Raviv, 2017) and increasing banks' charter value (Kaufman, 2014).

The explicit government support, such as troubled asset relief program and deposit insurance, are the cornerstone of the banking system, which protects the depositor and prevents bank runs during the crisis (Hoshi and Kashyap, 2010; Anginer et al., 2014b). However, these guarantees may weaken the market discipline carried out by depositors and creditors (Demirgüç-Kunt and Huizinga, 2004), and motivate banks to take excessive risks shifting the agent problem from the bank's creditors to the regulators (Cooper and Ross, 2002). While the implicit guarantee for banks considered by policymakers to be too important to be allowed to fail have been generally implemented in the region where policymakers do not have any explicit commitment to support (Schnabel, 2009; Schich and Lindh, 2012). This government support provides funding cost, which benefits banks triggering competitive distortions (Gropp et al., 2011). Thus, both explicit and implicit government support make it possible to exit the moral hazard problem.

However, the moral hazard problems arise from excessive risk-taking due to higher bailout expectations (Dam and Koetter, 2012). The safety net, such as explicit and implicit government support is neither a prerequisite nor a guarantee to be bailed out. If a bank is significantly essential in the financial market, it would be more likely to be rescued even though it is not a member of the safety net (Freixas and Rochet 2011). Thus, the moral hazard problem triggered by expected government support distorts competition (Schich and Lindh, 2012), weakens market discipline (Antzoulatos and Tsoumas, 2014), and induces banks to take excessive risk.

This problem attracts a number of researchers' attention. For example, Schich and Lindh (2012) used the evidence from OECD countries to show that the moral hazard problem of guarantee may distort banking competition. Antzoulatos and Tsoumas (2014) revealed the impact of the moral hazard and institutional environment on the willingness of government support. Dam and Koetter (2012) developed a model showing how the regional political factors affect bank bailouts. However, few research considers the impact of the willingness and capacity of government support on bank risk-taking behaviour by using rating information.

Implicit or expected government support is inherently difficult to measure. According to Schich and Lindh (2012) and Antzoulatos and Tsoumas (2014), the all-in rating is a bank’s long term deposit rating from Moody’s, which includes expected government support, while the stand-alone rating is financial strength rating, which reflects an ability to repay its financial obligation without any expected support. Thus, we employ the difference between these two ratings to represent the willingness and capacity of government support (expected government support).

China is now the second biggest economy after overtaking Japan in 2010, and its banking sector is its main important financial intermediary. Hence, the stability of the banking system for Chinese economic growth is crucial. However, it is interesting that there is no any significant financial crash in the Chinese banking sector over the last two decades. Even though the 2007 global financial crisis had a huge impact on the banking system throughout the world, the Chinese banking industry did not suffer obvious damage and even maintained its growth rate with net profits rising to RMB 668.4 billion in 2009, a 30.6% increase from the previous year (Fenech et al., 2014). This is because the Chinese government provides support to the banking sector, and because of this support the risk of a run on a bank is minimal (Bailey et al., 2011). As the explicit government support is not implemented in China's banking system before 2016, the support from the Chinese government was implicit guarantees (Gropp et al., 2011)[55]. Although this type of government support could provide liquidity (Acharya and Mora, 2015) and restrict the bank run (Pennacchi, 2006) during the crisis, this bailout expectation of implicit support will inspire the bank to take an excessive risk during the normal times (Dam and Koetter, 2012). In addition, Chinese banks with implicit support may be pressured to issue loans to support some state-owned companies with underperformance, in order to serve the political goals of governments (Bailey et al., 2011).

We contribute to government support in a few important ways. First, the majority of previous papers focuses on the role of expected government support in different instruments such as competition (Schich and Lindh, 2012), political factors (Dam and Koetter, 2012) and sovereign credit risk (Correa et al., 2014), and even on how to determine the expected government support (Antzoulatos and Tsoumas, 2014). We

[55] By implicit guarantees we mean the market expectation that a bank is saved even if there is no explicit government commitment to do so (Gropp et al/. 2011).

employ the difference between the ratings to reflect expected government support and extend previous the literature by focusing the impact of the support on bank risk-taking. This is the first paper to suggest that the bailout expectation of implicit support increases bank risk-taking in China. The expected government support not only exists with the moral hazard problem in normal times, but also reduces banking stability. Second, we find that expected government support and bank risk-taking is stronger in state-owned banks. Third, we find that expected government support and bank risk-taking is stronger in large banks.

The rest of this paper is structured along the following lines. Section 2 provides our paper hypotheses. Section 3 presents the data description and the methods used to estimate expected government support and the relationship between expected government support and bank risk-taking. Section 4 analyses the empirical results. Section 5 contains the conclusions.

5.2 Literature review and hypotheses development

5.2.1 Expected Government support and bank risk-taking

Government support plays an important role in the banking sector during the 2007 to 2009 crisis. The government interventions provided backup liquidity to the banking industry in the financial crash, when banks suffered a funding shortage (Acharya and Mora, 2015). The explicit government support on deposits reduced banks' liquidity and credit risk. It also restricted the bank run and restored investor confidence (Pennacchi, 2006). For example, the Troubled Asset Relief Program (TARP) was one of the important ways implemented by government to support the banking sector during the crisis. This measure was employed to ensure the safety and soundness of the banking system, and impose

restrictions on excessive risk-taking (Hoshi and Kashyap, 2010). Therefore, banks with government support may be more stable, since the government could internalize the benefits of a more stable macroeconomic environment (Micco and Panizza, 2006).

However, there is a perception about "too big to fail" and the moral hazard problem associated with the willingness of government support. This willingness may send a wrong signal to banks to take excessive risk, as banks believe that they are important in the financial market and will be bailed out in the future (Wilson and Wu, 2010; Elyasiani et al., 2014). Hence, banks may still choose to increase lending and invest in risk portfolios, even though their financial condition was stressed (Black and Hazelwood, 2013). In addition, because of expected government support, managers may be more concerned about compensation incentives rather than risk, and then make more risk decisions (Chakraborty et al., 2007; Kempf et al., 2009). More importantly, Acharya and Yorulmazer (2007) point out an implicit "too many to fail" theory that banks have incentives to herd and increase the risk, in order to increase the likelihood of being bailed out, if the government is willing to bail out failed banks. Although government guarantee aims at ensuring the stability of the banking sector and reducing the "excessive risk-taking", it provides incentives for banks to take excessive risk.

The "moral hazard" effect of government support, such as deposit insurance, dominates in normal times, even though this guarantee may reduce the fragility of the banking system during the crisis (Anginer et al., 2014b). Actually, this moral hazard problem is induced by expected support from the government (Antzoulatos and Tsoumas, 2014), since the support tempts banks to reduce their capital requirements. It provides incentives for banks to take excessive risk by using spare funding (Ioannidou and Penas, 2010). Furthermore, based on the market discipline theory, expected government support decreases bank depositors' incentives to monitor bank risk-taking, particularly in normal

times (Demirgüç-Kunt and Huizinga, 2004). As the incentives of investors to limit bank risk-taking decreases, they may release the "punishment" in interest rates and then the funding cost of banks declines. As a result, the bank would enjoy the benefit of lower cost to take excessive risk. Therefore, our first hypothesis is as follows:

Hypothesis 1*: The expected government support would increase bank risk-taking.*

5.2.2 Stated-owned banks

A large percentage of Chinese commercial banks is owned or controlled by the state, either directly or indirectly through central or local government agencies. Chinese government will hardly ever allow a bank in which they hold a greater ownership stake, to fail. In this situation, state-owned banks may have a lower cost of debt as well as higher leverage (Borisova and Megginson, 2011), and even experience a less pronounced impact of audit quality (Akins et al., 2017). As the government ownership reduces the probability of banks' failure, it would increase incentives for bad behaviour, such as corruption and over risk-taking (Dam and Koetter, 2012).

When the government controls a bank, the board of directors and senior officers would generally be approved by the government. Their main responsibility is to effectively carry out the instructions of the government, and then not to bear the consequences of any inappropriate decisions they made (Chen et al., 2009). It increases the probability that officers experience less employment risk and exert corrupt behaviour for private benefit, which increases the bad loans (Akins et al., 2017). Thus, the officers have less incentive to monitor the banks and even make more risky decisions. More importantly, state-owned banks generally enjoy the benefit of either implicit or explicit support from government

(Okazaki, 2007; Dong et al., 2014)[56]. This protection provides incentives for banks to take excessive risks, since the losses and costs are covered-up by government. Therefore, our second hypothesis is as follows:

Hypothesis 2*: The positive relationship between expected government support and bank risk-taking is stronger in banks where the government holds a significant stake.*

5.2.3 Large banks

Larger bank size tends to raise the potential systemic risk (Ioannidou and Penas, 2010), such as liquidity and credit risk, as large banks tend to have lower capital ratios, less stable funding, and more exposure to potentially risky market-based activities (Laeven et al., 2014). According to the "too big to fail" theory, governments are reluctant to allow large banks to fail, since they adhere to protect the depositors and reduce the probability of contagion of failure in the financial market. As a result, it creates moral hazard behaviour that larger banks would like to take excessive risks in the expectation of government bailouts (Farhi and Tirole, 2012). For the investors and depositors, they are uncertain ex-ante about which banks will be bailed out in the future. In their inertial thinking, larger banks are more likely to be covered by the government, as they are too cost to fail. Hence, the incentive of outside investors to monitor bank risk-taking is decreased. According to the agency cost theory, large banks experience increased agency problems through activities diversification, which can translate into systemic risk (Bolton et al., 2007). It means that they have a natural tendency to take excessive risks to retain their size, and share these risks in the system (Laeven et al., 2016). However, government guarantees

[56] The State Council transferred around 1245 billion Yuan in non-performing loans from the Big Five banks to asset management companies set up by the government during 2003–2005.

like deposit insurance, are designed for all banks, regardless of bank size. It will amplify the risk-taking behaviour of large banks and the "stabilization effect" of deposit insurance will be gradually eliminated (Anginer et al., 2014b). Therefore, our third hypothesis is as follows:

Hypothesis 3*: The positive relationship between expected government support and bank risk-taking is stronger in large banks.*

5.3 Data description and Methodology

5.3.1 Dependent variables

We use data on the bank-level variables from BankScope. All of them are reported in $US from the period of 2010 to 2016 and shown in Panel A, Table 1. The dependent variables, we use four types of indicators as our measures of bank risk. First, we use the ratio of loan loss provisions to total assets (NPL_t) as bank insolvency risk, and this ratio reflects the aggressiveness of the bank's lending decisions (Akins et al., 2017). Second, we use the ($zscore_t$) to estimate the distance to insolvency (Laeven and Levine 2009). This indicator is equal to the return on asset (ROA) plus leverage (equity to total asset) of each bank divided by the bank's standard deviation of return on asset (σROA). A higher z-score means that the bank has a greater degree of stability. Third, we use the ratio of liquid asset to total asset ($Liquid_t$) as a measure of liquidity risk (Acharya and Mora, 2015). This ratio reflects whether a bank is exposed to a financial intermediation risk and whether a bank has a sufficient liquidity to match sudden funding demand. Finally, we use the ratio of doubtful loan to total loans (DL_t) as a proxy to measure bank risk-taking (Dermine and De Carvalho, 2006). Doubtful loan represents the loss of bank in a lending.

Higher value implies more risk-taking. According to Rajan and Zingales (1995), we adjust the differences in accounting standards across countries.

Table 1

Variables	
Panel A – Dependent variables	
Non-performance loan ratio	This ratio is measured as loan loss provisions to total assets (NPL_t) as bank insolvency risk. Expressed as % annual rate and collected from the Bankscope.
Z-score	This indicator equals to the return on asset (ROA) plus leverage (equity to total asset) of each bank divided by the banks' standard deviation of return on asset (σROA).
Liquidity ratio	Liquidity ratio is measured as liquid assets to total assets ($Liquid_t$). Collected from the Bankscope.
Doubtful loan ratio	This ratio is measured as doubtful loans to total loans (DL_t). Collected from the Bankscope.
Panel B Independent variables	
Expected Government support	This indicator is the difference between the bank long-term deposit ratings and financial strength ratings. Collected from the Bloomberg and Thomson Reuters Eikon.
Stated-owned	This is the dummy variable. Indicator with one for bank owned by government, and zero otherwise.
Large	This is the dummy variable with one for the biggest quartile banks and zero otherwise, based on total asset.
Deposit	This ratio is measured as total deposits to total assets ($deposit_{t-1}$). Collected from the Bankscope.
Interest income	This indicator equals to interest operating income divided by total loans ($Iincome_{t-1}$). Collected from the Bankscope.
Liability	This equals to total liability to total asset ($liability_{t-1}$). Collected from the Bankscope.
Loan	This is the ratio of total loan to total asset ($loan_{t-1}$). Collected from the Bankscope.
Equity	Equity is the natural logarithm of total equity ($equity_{t-1}$). Collected from the Bankscope.
GDP	The GDP growth rate (GDP_{t-1}) is expressed as annual rate collected from World Bank.

5.3.2 Explanatory variable

We measure expected government support using bank-specific ratings information from Moody's. According to the studies (e.g. Gropp et al., 2011; Antzoulatos and Tsoumas, 2014; Correa et al., 2014), we employ the proxy $Expected\ governement\ support$, which is the difference between the bank all-in rating and stand-alone rating, to reflect the capacity and willingness of government support.

For the all-in rating, Moody's takes into account the expected support from regional government and national government (Moody's, 2007b). This rating reflects the government capacity as well as willingness to provide support, and the probability that the government will bail out when banks fail (Schich and Lindh, 2012). This Moody's assessment relies on the importance of the banking sector for the national economy and the importance of an individual bank in the economy. Hence, the standard credit rating (long-term deposit rating in local currency) is the all-in rating collected from Bloomberg and Thomson Reuters Eikon, which is used to reflect bank credit quality with government support.

The stand-alone rating, the financial strength ratings (BFSR) reflects a bank's ability to repay its financial obligation without expected government support (Moody's, 2007a). BFSB is the local currency deposit rating without any expected external support, collected from Bloomberg and Thomson Reuters. Therefore, the proxy $governement\ support$ is measured as follows:

$$Expected\ government\ support = (Long\ term\ deposit\ rating\ ) - (Financial\ strength\ rating)$$

Although, the standard credit rating may consider the expected support from cooperative group and regional government, their capacity and willingness are boosted by the national government (Antzoulatos and Tsoumas, 2014).

As Table 2 shows, long-term deposit rating like all other measures of the all-in ratings, are ranking from Aaa to C, while the BFSR is on the scale A to E. In order to calculate the difference, we assign numerical values for the ratings. We code these ranking grades using 20 as the highest and 0 as the lowest accordingly, by following the study of Antzoulatos and Tsoumas (2014)

Table 2

Bank's long-term credit rating grades and bank financial strength ratings

Moody's ratings		Assigned numerical values
LTDR	BFSR	
Aaa	A	20
Aa1	A-	19
Aa2	B+	18
Aa3	B	17
A1	B-	16
A2	C+	15
A3	C	14
Baa1	C-	13
Baa2	C-	12
Baa3	D+	11
Ba1	D+	10
Ba2	D	9
Ba3	D-	8
B1	E+	7
B2	E+	6
B3	E+	5
Caa1	E	4
Caa2	E	3
Caa3	E	2
Ca	E	1
C	E	0

Note: The numerical values is based on the measurement of Antzoulatos and Tsoumas (2014)

5.3.3 Control variable

We control bank specific characteristics and macro economy characteristics, which are found to affect bank risk-taking. All of them are shown in Panel B, Table 1. We use the ratio of total deposits to total assets ($Deposit_{t-1}$) to control bank funding liquidity. Acharya and Mora (2015) suggest that if banks have more deposits, they have less "run" risk. We control the interest income ($Iincome_{t-1}$), which equals interest operating income divided by total loans because it represents the price of loan products. We control the liability ($Liability_{t-1}$), which is the ratio of total liability to total asset. Liability is an indicator of potential risk, and the greater value may reflect the lower risk-prevention incentives (Biais et al., 2016). Consistent with (Khan et al., 2016), we control the ratio of total loan to total asset ($Loan_{t-1}$) and the natural logarithm of total equity ($Equity_{t-1}$) to represent bank characteristics as potential determinants of bank risk. Finally, we control GDP growth (GDP_{t-1}) to reflect the economic condition.

Table 3 reports the correlation matrix of variables. All of the variables used in the regression have a correlation co-efficiencies lower than 0.65, indicating no serious multicollinearity issues. . Tables 4 provides descriptive statistics for our variables

Table 3

Correlation matrix

	1	2	3	4	5	6	7	8	9	10	11	12	13
NPL	1												
Z-score	-0.007	1											
Liquid	-0.279	0.050	1										
DL	0.183	-0.185	-0.274	1									
EGS	0.545	-0.112	-0.239	0.078	1								
SO	-0.411	0.178	0.417	-0.067	-0.327	1							
Large	0.189	0.086	0.275	-0.352	0.117	-0.055	1						
Deposit	0.068	0.444	0.099	-0.230	-0.193	0.321	0.208	1					
Iincome	-0.261	-0.220	-0.188	0.328	-0.150	0.169	-0.455	-0.362	1				
Liability	-0.107	0.103	-0.302	0.232	-0.129	0.079	-0.542	0.088	0.520	1			
Loan	-0.475	0.048	0.295	-0.182	-0.380	0.453	-0.182	0.166	0.269	0.072	1		
Equity	-0.088	0.086	-0.198	0.220	-0.105	0.304	-0.451	0.223	0.397	0.502	0.050	1	
GDP	-0.041	0.039	-0.187	0.186	-0.053	0.104	-0.515	0.118	0.507	0.460	0.126	0.517	1

Notes: EGS is the expected government support. SO is the state-owned. Other variable definitions refer to Table 1.

Table 4

Summary statistics

Variable	N	mean	p25	p50	p75	min	max	Std
NPL	255	0.201	0.006	0.009	0.015	0.000	0.589	2.421
Z-score	255	4.073	3.425	4.349	4.982	-1.652	7.975	1.397
Liquid	255	0.242	0.129	0.205	0.309	0.002	0.882	0.157
DL	255	0.178	0.004	0.006	0.007	0.000	0.403	0.611
Expected government support	213	2.494	1.000	2.000	3.000	0.000	7.000	1.477
State-owned	225	0.462	0.000	0.000	1.000	0.000	1.000	0.500
Large	255	0.101	0.000	0.000	0.000	0.000	1.000	0.301
Deposit	255	0.837	0.836	0.869	0.896	0.086	0.954	0.123
Iincome	255	0.149	0.086	0.103	0.130	0.000	5.893	0.360
Liability	255	0.836	0.892	0.921	0.936	0.016	0.987	0.222
Loan	255	0.420	0.333	0.434	0.508	0.001	0.971	0.148
Equity	255	14.485	13.543	14.204	15.057	6.757	19.468	1.593
GDP	255	7.308	6.918	7.298	7.758	6.756	9.536	0.567

Notes: This table reports summary statistics (number, mean, P25, median, P75, minimum, maximum and standard deviation) for the variables used in this paper. BRI-PCA is a national regulation index. Other variable definitions refer to Table 1.

5.3.4 Methodology

Fixed Effect

In order to estimate the impact of government support on the risk-taking behaviour of banks, we use a panel regression with heteroskedasticity robust standard errors. The model includes a number of control variables, such as bank-specific and macroeconomic variables, which may influence a bank's risk-taking behaviour. We also consider the time effect in the model. Therefore, the model is as follows:

$$Risk_{i,t} = \beta_0 + \beta_1 Expected\ government\ support_{i,t-1} +$$
$$\beta_2 Expected\ government\ support_{i,t-1} * State - owned_{i,t-1} +$$
$$\beta_3 Expected\ government\ support_{i,t-1} * Banksize_{i,t-1} + \beta_4 State - owned_{i,t-1} +$$
$$\beta_5 Large_{i,t-1} + \beta_6 Deposit_{t-1} + \beta_7 Iincome_{t-1} + \beta_8 Liability_{t-1} + \beta_9 Loan_{t-1} +$$
$$\beta_{10} Equity_{t-1} + \beta_{11} GDP_{t-1} + \sigma_{i,t} \qquad (1)$$

The dependent variable, $Risk_{i,t}$ is the vector of alternative bank risk variables for bank i in year t. Bank risk has been estimated by the ratios of loan loss provisions to total assets (NPL_t), the natural logarithm of the Z-score ($zscore_t$), the ratio of liquid asset to total asset ($Liquid_t$), and the ratio of doubtful loans to total asset (DL_t).

The main independent variable, $Expected\ government\ support_{i,t-1}$ is the capacity and willingness of government support for bank i in year $t-1$. This proxy is the difference between long-term deposit ratings and financial strength ratings, and reflects the expected support from the government (Antzoulatos and Tsoumas, 2014). If government has a greater willingness to support a bank, it will induce bank managers to take excessive risk (Ioannidou and Penas, 2010). $State - owned_{i,t-1}$ is the dummy variable for measuring whether state-owned bank takes more risk with government

support. $Large_{i,t-1}$ is the dummy variable with one for the biggest quartile banks and zero otherwise.

The control variables, $Deposit_{t-1}$ is the ratio of total deposits to total assets. $Iincome_{t-1}$ is the ratio of interest operating income divided by total loans. $Liability_{t-1}$ is the ratio of total liability to total asset. $loan_{t-1}$ is the ratio of total loan to total asset. $Equity_{t-1}$ is the natural logarithm of total equity. GDP_{t-1} is the GDP growth ratio.

Dynamic Panel Model

A common problem in using empirical data is autocorrelation and heteroscedasticity, and we eliminate their impact using fixed effect with robust check. Another important feature of this analysis is that we account for the potential endogeneity of inefficiency. In order to correct for possible endogeneity (Arellano & Bond 1991; Aslan & Kumar, 2014), we estimate the Generalized Method of Moment (GMM) panel regression (2) as below:

$$Risk_{i,t} = \beta_0 + \beta_1 Risk_{i,t-1} + \beta_2 Expected\ government\ support_{i,t-1} +$$
$$\beta_3 Expected\ government\ support_{i,t-1} * State - owned_{i,t-1} +$$
$$\beta_4 Expected\ government\ support_{i,t-1} * Large_{i,t-1} + \beta_5 State - owned_{i,t-1} +$$
$$\beta_6 Large_{i,t-1} + \beta_7 Deposit_{t-1} + \beta_8 Iincome_{t-1} + \beta_9 Liability_{t-1} + \beta_{10} Loan_{t-1} +$$
$$\beta_{11} Equity_{t-1} + \beta_{12} GDP_{t-1} + \sigma_{i,t} \qquad (2)$$

In this equation, $Risk_{i,t-1}$ is the lag value of the risk of bank i at time $t-1$.

5.4 Empirical results

5.4.1 The effect of expected government support on bank risk-taking

The regression results are summarized in Table 5. Panel A, Table 5 shows the results using fixed effect panel estimations while Panel B shows the results using dynamic panel

models (GMM). These two approaches generate similar results. Thus, we focus on Panel A to discuss our empirical results.

As model 1, Table 5 shows, expected government support is positively related to the ratio non-performance loan (NPL) and the co-efficiency is highly significant (β=0.002, ρ<0.01), and indicates that one standard deviation increase in expected government support is associated with a 0.002 increase on non-performance loan. It means that previous expected government support will increase bank risk-taking behaviour as evidenced by rising non-performance loan. Model 2, Table 5 shows that there is a significantly negative relationship between expected government support and the Z-score (β=-0.005, ρ<0.01). It means that expected government support reduces bank stability and increases bank's insolvency risk. Similarly, there is a significantly negative relationship between expected government support and liquid ratio. It suggests that the willingness and capacity of government support may increase the possibility of liquidity risk. Finally, model 4 further shows that expected government support may increase bank's risk-taking behaviour as evidenced by rising doubtful loan ratio.

The results in Panel A, Table 5 support the hypothesis1 that the expected government support would increase bank risk-taking, which contrasts with previous studies ((Micco and Panizza, 2006; Pennacchi, 2006; Hoshi and Kashyap, 2010; Acharya and Mora, 2015). Our findings suggest that the willingness of government support may send a wrong signal to banks to take excessive risk, as banks believe that they are important in the financial market and will be bailed out in the future (Wilson and Wu, 2010; Elyasiani et al., 2014). Comparing this with the study of Anginer et al. (2014b), we find that expected government support could create the "moral hazard" problem.

Our results also show that deposit ratio has a positive impact on the ratio of non-performance loan and doubtful loan, while it has a negative impact on Z-score and liquidity ratio. These findings support the idea that banks with greater funding inflow (lower funding liquidity risk) will have incentives to take more risk (Acharya and Naqvi, 2012; Khan et al., 2016). Furthermore, our findings show that liability has a negative relationship with risk-taking behaviour while equity has a positive association with this behaviour. These results suggest that debtholders threaten to liquidate a bank that has not monitored its loans, which may restrict bank risk-taking behaviour (Acharya et al., 2016), while shareholders have incentives to take excessive risk, as this risk-shifting increases equity value at the expense of debtholders (Lambert et al., 2015; Peleg‐Lazar and Raviv, 2017).

Panel B, Table 5 shows the regression models using the GMM approach, which is employed to address possible endogeneity issues. Following Arellano & Bond (1991), we adopt the AB-GMM approach by using the lagged values of the dependent variables, such as NPL, Z-score, Liquid and DL, as instrumental variables. The results in Panel B also support the hypothesis 1, and suggest that if banks receive a sign from the willingness of government support, they would be more likely to take excessive risk.

Table 5

The relationship between $Expected\ government\ support_{i,t-1}$ and bank risk-taking

	Panel A – Fixed Effect				Panel B – GMM model			
	(1) NPL	(2) Z-score	(3) Liquid	(4) DL	(5) NPL	(6) Z-score	(7) Liquid	(8) DL
$Expected\ government\ support_{i,t-1}$	0.003***	-0.005***	-0.009*	0.028**	0.011***	-0.042***	-0.008**	0.084***
	(0.001)	(0.002)	(0.005)	(0.014)	(0.003)	(0.015)	(0.003)	(0.030)
$Deposit_{t-1}$	0.023*	-0.183*	-0.450**	0.673*	0.019*	-1.049***	0.041	1.929*
	(0.013)	(0.111)	(0.208)	(0.374)	(0.011)	(0.306)	(0.053)	(1.065)
$Iincome_{t-1}$	0.009	-0.967***	0.598	-0.759	0.071*	-2.651**	-0.466*	-0.180
	(0.032)	(0.319)	(0.436)	(1.320)	(0.037)	(1.296)	(0.246)	(1.524)
$Liability_{t-1}$	-0.184**	11.505***	-1.440	-1.501	-0.181**	7.281***	1.977***	6.473
	(0.077)	(0.584)	(0.905)	(3.595)	(0.082)	(1.669)	(0.600)	(4.286)
$Loan_{t-1}$	-0.001	-0.187*	-0.115	0.029	0.027*	-0.354	-0.091	2.496***
	(0.017)	(0.111)	(0.179)	(0.607)	(0.014)	(0.547)	(0.129)	(0.554)
$Equity_{t-1}$	0.006	-0.101***	-0.105*	0.170**	-0.001	-0.035	-0.009*	0.049*
	(0.004)	(0.037)	(0.059)	(0.066)	(0.001)	(0.044)	(0.006)	(0.029)
GDP_{t-1}	-0.001*	-0.010	0.023*	-0.032*	-0.004***	-0.155***	0.031*	-0.003
	(0.001)	(0.007)	(0.013)	(0.018)	(0.001)	(0.058)	(0.017)	(0.076)
L. NPL					0.521***			
					(0.117)			
L. Z-score						0.891***		
						(0.077)		
L. Liquid							0.665***	
							(0.087)	
L. DL								0.571**
								(0.222)
_cons	-0.241*	-4.000***	2.963*	3.487	-0.135*	-4.930***	1.893***	-5.548
	(0.141)	(1.069)	(1.709)	(4.357)	(0.072)	(1.316)	(0.564)	(4.096)
N	188	195	195	173	151	154	154	133

(*Continued*)

Table 5

The relationship between $Expected\ government\ support_{i,t-1}$ and bank risk-taking

	Panel A – Fixed Effect				Panel B – GMM model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	NPL	Z-score	Liquid	DL	NPL	Z-score	Liquid	DL
r2_a	0.661	0.907	0.400	0.263				
F	25.821	148.995	9.446	6.152				
AR(1)					0.100	0.006	0.005	0.099
AR(2)					0.306	0.637	0.530	0.592
Hansen(p-value)					1.000	0.625	1.000	0.679

Notes: This table presents coefficients for the relationship between expected government support (EGS) and bank risk-taking. The dependent variables are the NPL, Z-score, Liquid and DL in used to reflect individual bank's risk-taking behaviour. The main dependent variable is $Expected\ government\ support_{i,t-1}$, which is the difference between bank's long-term credit rating grades and financial strength ratings. The control variables include bank specific variables and macroeconomic variables. The models (1) to (3) are panel regressions with fixed effects during the period 2010 – 2016. The models (4) to (6) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

5.4.2 The relationship between expected government support and bank risk-taking in state-owned banks

The results from model 1 to 4 in Panel A, Table 6 show that expected government support increase bank risk-taking behaviour through increasing the non-performance loan (NPL) as well as the doubtful loan, and decreasing the Z-score as well as the liquid ratio, which is in line with the findings in Table 5. As Models 3 and 4 show, the dummy variable, state-owned, has a negative impact on liquid ratio (β=-0.078, ρ<0.05) and has a positive impact on the doubtful loan (DL) (β=0.084, ρ<0.10). It means that state-owned banks may take more risk than other banks (Dam and Koetter, 2012). Furthermore, we find that deposit and equity provide incentives for banks to take excessive risk while liability may restrict the risk-taking behaviour, which is consistent with our previous findings.

Model 1, Table 6 further shows that there is a significant positive interaction between expected government support and a state-owned dummy in affecting the ratio of the non-performance loan (β=0.003, ρ<0.01). While model 2, shows that there is a negative interaction between expected government support and state-owned in affecting the Z-score (β=-0.006, ρ<0.05). These results imply that since the board of directors in state-owned bank has less responsibility to bear the consequences of any inappropriate decisions (Chen et al., 2009), the "moral hazard" effect of expected government support provides officers with incentives to exert corrupt behaviour for private benefit, which increases the bank's risk (Akins et al., 2017).

Models using the GMM approach in Panel B, Table 6 further show that there is a positive interaction between expected government support and state-owned in affecting the non-performance loan (β=0.011, ρ<0.01) and is a negative interaction in impacting the Z-score (β=-0.028, ρ<0.05). This indicates that the risk-taking behaviour induced by expected government support will be exacerbated in state-owned banks, which generally take

advantage of either implicit or explicit support from government to increase risk-taking (Dong et al., 2014). These findings support the hypothesis 2, and suggest that the positive relationship between expected government support and risk-taking behaviour is stronger in state-owned banks.

Table 6

The relationship between $Expected\ government\ support_{i,t-1}$ and bank risk-taking in state-owned banks

	Panel A – Fixed Effect				Panel B – GMM model			
	(1) NPL	(2) Z-score	(3) Liquid	(4) DL	(5) NPL	(6) Z-score	(7) Liquid	(8) DL
$Expected\ government\ support_{i,t-1}$								
$* State - owned_{t-1}$	0.002**	-0.006**	0.004	-0.056	0.003*	-0.028***	-0.031*	0.031**
	(0.001)	(0.003)	(0.010)	(0.072)	(0.002)	(0.011)	(0.018)	(0.015)
$Expected\ government\ support_{i,t-1}$	0.001*	-0.006**	-0.013*	0.028*	-0.001	0.006	-0.035**	0.011*
	(0.001)	(0.002)	(0.008)	(0.016)	(0.001)	(0.008)	(0.018)	(0.006)
$State - owned_{t-1}$	-0.001	0.019	-0.078**	0.084*	-0.005	0.049	-0.152**	-0.031
	(0.003)	(0.012)	(0.038)	(0.050)	(0.004)	(0.037)	(0.075)	(0.021)
$Deposit_{t-1}$	0.037**	-0.307**	-0.520**	-0.631	0.064**	-1.201***	-0.020	0.344*
	(0.016)	(0.125)	(0.218)	(0.396)	(0.028)	(0.253)	(0.427)	(0.183)
$Iincome_{t-1}$	0.022	1.097***	0.608	-0.870	0.146***	-0.176	-0.114	-1.712***
	(0.031)	(0.320)	(0.467)	(1.470)	(0.045)	(0.207)	(0.525)	(0.187)
$Liability_{t-1}$	-0.180**	11.558***	-1.460	-5.737*	-0.308**	3.601***	1.725*	-4.056***
	(0.068)	(0.570)	(0.909)	(3.785)	(0.146)	(0.765)	(1.119)	(0.988)
$Loan_{t-1}$	-0.004	-0.145	-0.100	-0.071	0.057**	0.470**	0.288	-0.279
	(0.015)	(0.104)	(0.198)	(0.718)	(0.024)	(0.212)	(0.330)	(0.223)
$Equity_{t-1}$	0.004	-0.109***	-0.105*	-0.092	-0.000	-0.021***	0.011	0.002
	(0.004)	(0.039)	(0.060)	(0.065)	(0.001)	(0.008)	(0.012)	(0.008)
GDP_{t-1}	-0.002*	-0.010	-0.023*	-0.035*	-0.004**	-0.017***	-0.047*	-0.015
	(0.001)	(0.007)	(0.013)	(0.019)	(0.002)	(0.006)	(0.026)	(0.020)
L. NPL					0.463***			
					(0.167)			
L. Z-score						0.996***		
						(0.006)		
L. Liquid							1.280***	
							(0.180)	

(*Continued*)

Table 6

The relationship between $Expected\ government\ support_{i,t-1}$ and bank risk-taking in state-owned banks

	Panel A – Fixed Effect				Panel B – GMM model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	NPL	Z-score	Liquid	DL	NPL	Z-score	Liquid	DL
L. DL								0.316***
								(0.063)
_cons	-0.195	-3.866***	2.908*	4.177	-0.229*	-2.039***	-1.020	4.166***
	(0.122)	(1.107)	(1.725)	(4.426)	(0.124)	(0.544)	(0.956)	(0.830)
N	182	185	185	169	143	146	146	130
r2_a	0.701	0.911	0.417	0.214				
F	16.173	129.189	9.682	4.882				
AR(1)					0.073	0.001	0.008	0.082
AR(2)					0.194	0.452	0.665	0.632
Hansen(p-value)					1.000	0.794	0.888	0.654

Notes: This table presents coefficients for the relationship between expected government support (EGS) and bank risk-taking in state-owned banks. The dependent variables are the NPL, Z-score, Liquid and DL in used to reflect individual bank's risk-taking behaviour. $Expected\ government\ support_{i,t-1}$ is the difference between bank's long-term credit rating grades and financial strength ratings. $State - owned_{i,t-1}$ is the dummy variable. This indicator with one for bank owned by government, and 0 otherwise. The control variables include bank specific variables and macroeconomic variables. The models (1) to (3) are panel regressions with fixed effects during the period 2010 – 2016. The models (4) to (6) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

5.4.3 The relationship between expected government support and bank risk-taking in large banks

The regression results using fixed effect panel estimations are shown in Panel A Table 7. The models 1 and 3 show that expected government support has a positive impact on non-performance loan (β=0.002, ρ<0.01) and has a negative effect on liquid ratio (β=-0.017, ρ<0.01), which is consistent with the previous finding that expected government support would increase bank risk-taking behaviour. As Models 1 and 4 show, the dummy variable, large, has a positive impact on non-performance loan (β=0.03, ρ<0.01) and doubtful loan (β=0.031, ρ<0.05). This finding suggests that large banks tend to have lower capital ratios, less stable funding, and more exposure to potentially risky activities (Laeven et al., 2014). Additionally, we also support the view that bank with greater deposit inflow will take more risk in the future (Khan et al., 2016), and debtholders will monitor the bank risk-taking behaviour as evidenced by liability (Acharya et al., 2016), and shareholders would like to shift the risk to debtholders by taking excessive risk (Peleg‐Lazar and Raviv, 2017).

Model 1, Table 7 further indicates that there is a significant positive interaction between the expected government support and the large dummy in affecting the ratio of the non-performance loan (β=0.003, ρ<0.01). While model 3, shows that there is a negative interaction between the expected government support and the large dummy in affecting liquid ratio (β=-0.017, ρ<0.10). These results imply that governments are reluctant to allow large bank to fail, in order to reduce the probability of contagion of failure in the financial market (Elyasiani et al., 2014), and expected government support triggers the moral hazard behaviour that larger banks would like to take excessive risks in the expectation of government bailouts (Farhi and Tirole, 2012).

The models in Panel B using GMM measurement further show that there is a negative interaction between the expected government support and the large dummy in affecting the Z-score (β=-0.030, ρ<0.05) and there is a positive interaction in impacting the doubtful loan (β=0.082, ρ<0.42). Combining the results in Panel A and Panel B, it suggests that banks have a natural tendency to take excessive risk (Laeven et al., 2016), and the government guarantee provides more incentives for them to take risk (Anginer et al., 2014b) and decreases depositors' incentives to monitor bank's risk-taking (Demirgüç-Kunt and Huizinga, 2004). The findings support the hypothesis 3, and suggest that the positive relationship between expected government support and risk-taking behaviour is stronger in large banks.

Table 7

The relationship between $Expected\ government\ support_{i,t-1}$ and bank risk-taking in large banks

	Panel A – Fixed Effect				Panel B – GMM model			
	(1) NPL	(2) Z-score	(3) Liquid	(4) DL	(5) NPL	(6) Z-score	(7) Liquid	(8) DL
$Expected\ government\ support_{i,t-1} * Large_{i,t-1}$	0.003***	0.002	-0.017*	-0.008	0.002**	-0.030**	-0.037*	0.082**
	(0.001)	(0.003)	(0.010)	(0.010)	(0.001)	(0.014)	(0.021)	(0.042)
$Expected\ government\ support_{i,t-1}$	0.001*	-0.006**	-0.015**	0.026*	0.001*	0.019	0.011	0.041**
	(0.001)	(0.002)	(0.007)	(0.016)	(0.001)	(0.012)	(0.012)	(0.019)
$Large_{i,t-1}$	0.003*	0.004	0.043	0.062*	-0.004	-0.154*	-0.142**	0.637**
	(0.002)	(0.010)	(0.040)	(0.036)	(0.003)	(0.083)	(0.067)	(0.322)
$Deposit_{t-1}$	-0.031**	-0.192	-0.480**	0.557*	-0.028*	-0.094	-0.285**	1.938*
	(0.014)	(0.135)	(0.212)	(0.297)	(0.014)	(0.158)	(0.133)	(1.039)
$Iincome_{t-1}$	0.017	0.977***	0.546	-0.771	0.071**	-0.905***	0.115	0.418
	(0.029)	(0.324)	(0.453)	(1.329)	(0.033)	(0.288)	(0.535)	(1.630)
$Liability_{t-1}$	0.143**	-11.464***	-1.307	-1.437	0.177***	-2.645***	-2.487*	14.956**
	(0.063)	(0.581)	(0.869)	(3.682)	(0.068)	(0.523)	(1.496)	(6.581)
$Loan_{t-1}$	-0.013	-0.201*	-0.089	0.049	0.021	-0.070	0.337	1.677*
	(0.014)	(0.116)	(0.184)	(0.627)	(0.015)	(0.150)	(0.326)	(0.892)
$Equity_{t-1}$	0.004	-0.103***	-0.111*	-0.067	0.000	0.003	-0.024	0.118
	(0.004)	(0.038)	(0.060)	(0.064)	(0.001)	(0.011)	(0.018)	(0.074)
GDP_{t-1}	0.001	-0.019**	-0.017*	-0.032*	-0.004**	-0.027***	-0.069*	-0.148*
	(0.001)	(0.007)	(0.012)	(0.019)	(0.002)	(0.004)	(0.035)	(0.082)
L. NPL					0.378***			
					(0.114)			
L. Z-score						0.977***		
						(0.007)		

(*Continued*)

Table 7-*Continued*

	Panel A – Fixed Effect				Panel B – GMM model			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	NPL	Z-score	Liquid	DL	NPL	Z-score	Liquid	DL
L. Liquid							0.217**	
							(0.109)	
L. DL								0.586***
								(0.119)
_cons	-0.169	-3.926***	2.720	3.373	-0.131**	-2.088***	2.319*	-16.363**
	(0.118)	(1.076)	(1.819)	(4.427)	(0.062)	(0.639)	(1.257)	(7.268)
N	188	195	195	173	147	154	144	133
r2_a	0.605	0.906	0.404	0.154				
F	39.763	484.568	8.405	5.515				
AR(1)					0.029	0.001	0.017	0.062
AR(2)					0.222	0.445	0.413	0.783
Hansen(p-value)					0.999	1.000	0.769	0.932

Notes: This table presents coefficients for the relationship between expected government support (EGS) and bank risk-taking in big banks. The dependent variables are the NPL, Z-score, Liquid and DL in used to reflect individual bank's risk-taking behaviour. $Expected\ government\ support_{i,t-1}$ is the difference between bank's long-term credit rating grades and financial strength ratings. $large_{i,t-1}$ is the dummy variable with one for the biggest quartile banks and zero otherwise. This indicator with one for bank owned by government, and 0 otherwise. The control variables include bank specific variables and macroeconomic variables. The models (1) to (3) are panel regressions with fixed effects during the period 2010 – 2016. The models (4) to (6) are dynamic panel models (GMM) with robust standard errors during the same period. The Arellano-Bond test for autocorrelation has a null hypothesis of no autocorrelation. The Hansen's J statistic tests the validity of the instruments used, and rejection implies that the instruments are not valid. ***Statistical significance at the 1% level. **Statistical significance at the 5% level. *Statistical significance at the 10% level.

5.5 Conclusions

This research analyses the impact of expected government support on bank risk-taking, and in particular how their impacts can be stronger in state-owned banks and large banks. Using 255 observations from 45 banks in China during the period 2010-2016, we find the willingness and capacity of government support enhance the bank's risk-taking behaviour through increasing the non-performance loan as well as the doubtful loan, and decreasing the Z-score as well as the liquid ratio. This moral hazard problem is further enhanced in state-owned banks and large banks.

Our analysis has important policy implications. From a wider government support perspective, we reveal that the implicit guarantee for banks considered by policymakers may send a signal of higher bailout expectation to banks, which raises moral hazard problems giving banks incentives to take excessive risk (Gropp et al., 2011; Dam and Koetter, 2012). Policymakers should reduce the size of expected support, and strengthen regulations on state-owned as well as large banks, in order to restrict the risk-taking behaviour. Moreover, the government should enhance the power of market discipline and improve banks' stand-alone ratings to tackle the problems of "Too big to fail" and excessive risk-taking. More importantly, policymakers should implement explicit guarantee rather than implicit safety net, as implicit support may provide higher bailout expectations, which reduce the incentives of market discipline and increase the likelihood of moral hazard.

Chapter 6: Conclusion

This thesis provides a comprehensive analysis of the impact of macro-level and bank-specific variables on banking performance in the emerging market (11 Asian countries) during the period 2000-2012. Furthermore, we look at the bank liquidity risk by focusing on banks' undrawn loan commitment, and investigate whether deposit diversification and insurance could mitigate this risk, particularly during the financial crisis. Finally, we analyse whether expected government support could enhance bank risk-taking. This thesis is a novel contribution to the banking literature that analyses the determinant of bank performance, stability as well as risk-taking, and has substantial policy implications. The contribution initiated by investigating the impact of credit rating, bank regulation, supervision as well as investor protection on the performance, as estimated by cost inefficiency scores, in the emerging market (11 Asian countries) (chapter 2). Over last two decades, banks in emerging markets have developed dramatically, and encounter numerous challenges and opportunities, because of economic integration, internationalization and globalization. Although they are trying to improve their performance aiming to catch up with the banks in developed countries, their nature weakness that banks in emerging markets usually face large shocks is a stumbling block. The regime shifts, speculative bank runs, "hot money" flows and exchange rate volatility are a more likely influence their overall credit worthiness. (Khwaja and Mian, 2008). Therefore, it is important to analyse whether CRAs' can monitor banks by addressing the issues related to high complexity and serious credit problems in the industry, when cooperating with Basel II regulations and investor protection.

In more detail, we have estimated bank cost inefficiency scores by employing a parametric methodology (SFA) in the emerging market during the period 2000-2012. In the nest stage, we have regressed these inefficiency scores by using fixed effect, dynamic panel model and a two-stage least squares instrumental variable model for the main three variables, such as credit rating, bank regulation and supervision, and investor protection. The first contribution is that we focus on the credit ratings assigned to an individual bank and extend the previous literature by focusing the monitoring impact of CRAs on bank performance, comparing this with the majority of previous papers[57]. The important result that credit rating has a negative impact on bank cost inefficiency, and suggests that credit ratings issued by credit rating agencies improve bank performance. Secondly, through investigating the interaction between CRAs and investor protection embodied in different institutional environments, as well as between CRAs and bank regulation, we not only enhance our understanding of the specific transmission mechanism related to CRAs, which helps to realize the impact of bank regulations and investor protection on bank performance. Our results suggest that credit ratings improve bank cost efficiency more when there is a higher investor protection embedded in the institutional environment in an emerging market, while strict bank regulation, as a relatively less flexible approach to monitor bank activities, can offset the benefits of credit in monitoring banks. Finally, we find an important result that credit ratings downgrade is consistent with the result of CRA that credit rating agencies can play a role as market discipline to improve bank performance, while credit ratings upgrade may show a "credit shopping" behaviour on the part of banks. The public policy implications that arise from this chapter are clear.

[57] The previous literatures focus on the role of external credit ratings in different financial instruments such as corporate bonds (Güntay and Hackbarth, 2010; White, 2010), sovereign bonds (Hilscher and Nosbusch, 2010; Acharya et al., 2014), debt (Asquith, 2005) and loans (Hasan et al., 2014) and stock markets (Dichev and Piotroski, 2001).

From a wider governance perspective, we reveal that optimal public policy may not be achieved by too much bank regulation and discipline (Barakat and Hussainey, 2013; Bruno and Claessens, 2010). It is clear that the banking sector could benefit from the monitoring of credit rating agencies with less strict bank regulation and supervision. Policy makers can enhance their overall investor protection quality for the purpose of further enhancing the benefits of CRAs in the banking sectors, if their economies are in weak institutional environments.

In Chapter 3, we have analysed the impact of micro-level and bank-specific variables on the bank performance in the emerging market over the 2000-2012 period. The micro-level variables include two strategies such as market power and revenue diversification. The market power is measured by Lerner methodology, while revenue diversification is an accounting ratio. We place particular attention on these two strategies since there is no clear evidence or conclusion of whether these strategies have contributed to the underperformance of the banking industry. Recent studies on the causes of the credit crunch have highlighted deregulation and excessive competition as factors that led to a financial sector meltdowns in the US and the UK (Llewellyn, 2007; Brunnermeier, 2009; Milne, 2009; OECD, 2011). It is interesting to investigate whether the relationship between banking market power, performance and stability has been affected after the outbreak of the recent financial crisis. Moreover, financial liberalisation also allows commercial banks to compete on a wider range of market segments (investment banking and market trading). While some previous papers suggest that combining traditional service with other earning activities could benefit from diversification and risk reduction, other literature put another forward that revenue diversification could increase the earning volatility. Thus, it is important to assess whether this strategy has a different impact on bank performance and stability.

In more detail, we have also estimated bank cost inefficiency scores by employing a parametric methodology (SFA) in the emerging market during the period 2000-2012. In the nest stage, we have regressed these inefficiency scores by using fixed effect, dynamic panel model, a two-stage least squares instrumental variable model and dynamic panel threshold model for the two main strategies. First, the important finding is that market power reduce bank cost inefficiency and has a negative relationship with Z-score. In other words, market power may attract managers pursue the maximization of profit and reduction of labor conflict at the expense of efficiency, but it provides incentives for managers to take excessive risk. Second, we find that revenue diversification reduces bank efficiency while it improves individual stability. When a bank expands a service in a new industry, it may use resources from its traditional activity and increase cost inefficiency, but the bank could be involved in non-profits activities to reduce its revenue volatility at the same time (Stiroh, 2006a; Stiroh, 2006b; Mercieca et al., 2007; Lepetit et al., 2008; Sanya and Wolfe, 2011; Nguyen et al., 2012). Furthermore, our findings further suggest that market power and revenue diversification should be simultaneously employed as a bundle to improve bank efficiency and stability. Both regulatory and institutional environmental factors are considered in our models. An important result threshold analysis reveals is that the positive impact of market power, measured by the Lerner index, on bank performance is more pronounced for banks in a high regime, while the negative impact of revenue diversification on bank efficiency is more pronounced for banks in a high regime. Regarding the stability, the negative effect of market power is more pronounced for banks that fall below a threshold market power value, while the positive impact of revenue diversification is more pronounced for banks that rise above a threshold value. These findings provide some important implications for bank managers and regulators in emerging markets. First, bank managers can expand their market power

to improve performance while enhancing bank's ability for risk-tolerance through diversifying non-interest activities. As financial liberalisation increases in an emerging market, to prevent the competition from foreign banks, managers consolidate market power through merger and acquisition. Simultaneously, managers should expand services in not-profit activity in order to offset portfolio risk caused by market power. First, to protect the domestic small bank with lower market power, regulators adopt a more cautious approach to put in place a certain level of entry restriction for foreign bank entrants. Second, regulators should adjust an appropriate capital requirement and encourage banks to diversify their non-interest activities instead of only focusing on traditional lending services. However, regulators still need to issue some regulations to restrict larger banks' activities, since the institutional environment in an emerging market is little far from complete, which may provider a wrong incentive to take excessive risk. Finally, policymakers should encourage financial innovation among banks, based on prudential regulation to allow resource allocation within an economy effectively, in order to expand their services, reduce non-performance loan and economies of scale.

In Chapter 4, we find that the negative impact of unfunded loan commitments on bank liquidity is significant when banks are in a stressed financial condition. Evidence from G7 and BRICS countries suggests that this impact can be mitigated by deposit diversification while exacerbated by deposit insurance, over the period 2005-2014. We put emphasis on the four main dependent variables such as the interest rate, deposit inflow, lending amount and liquid ratio as proxies for bank liquidity, and investigate whether these indicators are affected by undrawn loan commitments as well as how these effects are mitigated by deposit diversification or insurance. Unfunded loan commitment is that a bank provides the firm with loan funds when the firm faces a liquidity shortfall, and a bank charges a commitment fee as compensation for the firm in exchange. A firm can

reduce the cost of holding cash by employing this credit commitment (Sufi, 2009), while a bank may use this to enhance liquidity and reduce the cost of finding a borrower (Ivashina and Scharfstein 2010; Acharya et al., 2013a). However, the period 2007-2009 was a crisis of banks as liquidity providers, and banks suffered huge withdrawals from deposit accounts as well as tightened lending (Brunnermeier, 2009; Covitz et al., 2013). Consequently, under great pressure of the liquidity demand from firms that had pre-existing credit commitments with banks, banks had to increase their deposit rates, faced low deposit inflow, reduced lending and liquid asset (Acharya and Mora, 2015). This liquidity risk of commitments-exposed banks are simply transformed to insolvency problem. Hence, the investigation of unfunded loan commitments on the liquidity of banks becomes predominantly relevant in the context of this thesis.

In more detail, we have regressed the unfunded loan commitment ratio by employing fixed effect and dynamic panel model with interest rate, deposit inflow, lending amount and liquid ratio. We find that there is great potential liquidity risk for banks with the pre-exiting commitment during the recent financial crisis, since they suffer from higher interest rate, lower deposit inflow, decreasing lending and lower liquid ratio. In the next stage, an important finding is that deposit diversification can mitigate the negative impact of undrawn loan commitment on the four main variables (interest rate, deposit inflow, lending amount and liquid ratio). It means that diversification may offer an additional channel for banks to access funding (Laeven and Levine, 2007; Ellul and Yerramilli, 2013), and to reduce the impact of liquidity demand risk during the crisis by decreasing the cost of funding, increasing the funding inflow, maintaining the total amount of loan lending and enhancing the liquid ratio. However, another important result is that banks with deposit insurance may be more likely to suffer liquidity demand risk than those without this safety net, and the “moral hazard” effect of deposit insurance on liquidity

risk may be greater than the "stabilization effect" during the crunch. Although deposit insurance could restore depositor confidence and avert panic in the banking sector (Demirguc-Kunt and Huizinga, 2004; Karas et al., 2013; Anginer et al., 2014b), this safety net can exacerbate moral hazard problems in the banking sector by incentivizing banks to take on excessive risk (Ioannidou and Penas, 2010; Gorton and Metrick, 2013; Shapiro and Skeie, 2015). These results have some important implications for regulators and policy makers. As the deposit diversification plays an important role in mitigating the liquidity risk caused by credit commitments during the crisis, it seems imperative that regulators should put emphasis on this strategy that allows banks to adjust their bearing capacity of liquidity and reduces an authority's pressure on government borrowing (Disyatat, 2011; Kang 2013; García-Kuhnert et al., 2015). Comparing with previous papers (e.g., Boyd and De Nicolo, 2005; Gorton and Metrick, 2013; Anginer et al., 2014b; Shapiro and Skeie, 2015), we find that deposit insurance may operate in exactly the opposite direction and loses its benefit, which causes banks to become risky during a crisis. Although Basel III may provide a better liquidity regulation such as a liquidity coverage ratio (LCR) to handle liquidity risk, regulators should encourage banks to set up an "internal monitoring standard" (deposit diversification standard) to increase funding sources. This "internal monitoring standard" can be treated as an alternative scheme for banks to deal with liquidity risk, in case LCR follows the old path as the lender-of-last-resort, and deposit insurance.

In chapter 5, we analyse whether expected government support could enhance bank risk-taking. In chapter 4, we find that the 'moral hazard' effect of explicit government support is significant in the banking sector. Thus, we want to investigate whether an implicit guarantee could trigger a 'moral hazard' problem, particularly in normal times. We put emphasis on the four main dependent variables such as the non-performance loan, Z-score,

doubtful loan and liquid ratio as proxies for bank risk-taking behaviour, and investigate whether these indicators are affected by expected government support as well as how these effects are enhanced in state-owned and large banks. The explicit and implicit government support are the cornerstone of financial market and protect the investors and creditors (Hoshi and Kashyap, 2010; Schich and Lindh, 2012; Anginer et al., 2014). However, these guarantees may weaken the market discipline carried out by depositors and creditors (Demirgüç-Kunt and Huizinga, 2004), and motivate banks to take excessive risks shifting the agent problem from the bank's creditors to the regulators (Cooper and Ross, 2002), and lead banks to trigger competitive distortions (Gropp et al., 2011). More importantly, the implicit guarantee may send a wrong signal of higher bailout expectation to banks, and this expectation would possibly provide incentives for banks to take excessive risk (Dam and Koetter, 2012). Over risk-taking increases bank fragility and may reduce financial market stability. Thus, it is important to analyse the impact of expected government support on bank risk-taking.

In more detail, following the studies (e.g. Gropp et al., 2011; Antzoulatos and Tsoumas, 2014; Correa et al., 2014), we employ the difference between the bank all-in rating and stand-alone rating, to reflect the capacity and willingness of government support. For the all-in rating, Moody's takes into account the expected support from regional government and national government (Moody's, 2007b). The stand-alone rating, the financial strength ratings (BFSR) reflects a bank's ability to repay its financial obligation without government expected support (Moody's, 2007a). We have regressed the expected government support by employing fixed effect and dynamic panel model with the non-performance loan, Z-score, doubtful loan and liquid ratio. We find that the willingness and capacity of government support enhances bank's risk-taking behaviour through increasing the non-performance loan as well as the doubtful loan, and decreasing the Z-

score as well as the liquid ratio. This moral hazard problem is further enhanced in state-owned banks and large banks. These results have some important implications for regulators and policy makers. From a wider government support perspective, we reveal that the implicit guarantee for banks considered by policymakers may send a signal of higher bailout expectation to banks, which may trigger moral hazard problems giving banks the incentives to take excessive risk (Gropp et al., 2011; Dam and Koetter, 2012). Policymakers should reduce the size of expected support, and strengthen regulations on state-owned as well as large banks, in order to restrict the risk-taking behaviour. Moreover, the government should enhance the power of market discipline and improve banks' stand-alone ratings to tackle the problems of "Too big to fail" and excessive risk-taking. More importantly, policymakers should implement explicit guarantee rather than the implicit safety net, as implicit support may provide higher bailout expectations, which reduce the incentives for market discipline and increase the likelihood of moral hazard.

This thesis has showed a comprehensive research on the macro-level and bank-specific determinants of the bank performance and stability including the crisis, but there are remain some limitations and challenges for future research. Previous papers have discussed in detail, which methodology is most appropriate for estimating bank performance. In this thesis, we use cost inefficiency as bank performance measured by a structural method (SFA). We also consider the Battese and Coelli (1995) model, which allows measurement of inefficiency from the best-practice frontier in a single-step estimation to run the robustness test. However, in this thesis, we do not employ a non-parametric method, such as DEA, to measure bank performance and further test the impact of the macro-level as well as bank-specific variables on bank performance. The main strength of DEA is that this methodology does not require priori information on functional forms (cost functions). In addition, there is low likelihood of estimation bias

on inefficiency scores. However, the main disadvantage of DEA is that it cannot distinguish between inefficiency and other stochastic shocks in the estimation of efficiency scores. In future research, it would be an interesting point to measure efficiency scores and further tests for robustness.

Additionally, because of data limitations, we have only looked in Chapter 2 at the four main regulatory variables on bank performance in an emerging market. Therefore, a further investigation would enable the examination of the impact of all regulatory variables on the performance of banks in a global market. This is interesting research because regulators have implemented Basel III regulation on banking activity, and capital and liquid requirements, after the latest global crisis. In future research, we will not only analyse the external monitoring standard (CRA), but also consider the internal monitoring standard, such as bank corporate governance and ownership control. In Chapter 3, we have only used the non-interest income as diversification because of data limitations in BankScope and Compustar. Hence, further research would analyse in which country non-interest income has been generated, and consider the country's regulatory and institutional environment at the same time. Then, we can consider financial integration and international business in the banking sector. In Chapter 4, we focus on the liquidity risk in G7 and BRICS countries (1200 observations), since a lot of annual reports of banks do not show this part of the off balance sheet and have language limitations. Therefore, since the recent financial crisis has had a huge impact on the European economy, further research will focus on the liquidity risk of banks in European countries, in order to analyse whether this liquidity risk is a contagion in an economic union. In chapter 5, because of data limitations, we focus on the period from 2010 to 2016. In future research, we will consider the impact of implicit government support on bank stability during the crisis. Furthermore, as China implement explicit government support (deposit insurance) in

2016, we will investigate whether the explicit government support could be more effective than the implicit guarantee.

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