COMPETITION AND THE BANK LENDING CHANNEL: EVIDENCE FROM BANK – LEVEL DATA IN THAILAND

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COMPETITION AND THE BANK LENDING CHANNEL: EVIDENCE FROM BANK – LEVEL DATA IN THAILAND

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ABSTRACT

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This paper attempts to assess the degree of competition in Thailand's banking system, and examine the evolutionary effect of bank regulations. Furthermore, this paper investigates how a change in competition can affect the monetary policy on bank lending channel in Thailand. This study employs panel data from ten commercial banks over quarterly time periods from 2001–2015. The competition variable is measured using the Lerner index. Bank regulations can be divided into four groups: (i) restrictions on banking activities, (ii) limitations on foreign bank entry, (iii) capital stringency, and (iv) deposit insurance. Firstly, the results suggest that the competition level reduced in the 2000s but has been stable over the last six years. Secondly, regulatory variables affect competition in the Thai banking industry. The findings also indicate that lower activity restrictions and greater capital stringency reduce competition. In addition, lower limitations on foreign bank entry and a reduction in deposit guarantees enhance the competitive market. Finally, intensive competition has a positive impact on monetary policy via bank lending channels.

Keywords: Bank competition, Bank regulation, Bank lending channel

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CHAPTER 1

INTRODUCTION

Theoretically, competition in the banking industry can contribute to the efficiency and maximisation of social welfare such as lower interest rates and better financial services. In addition, competition not only encourages the central bank to change the market interest rate on more quickly, but also improves the effectiveness of monetary policy transmission through the bank lending channel. However, the stability of the banking sector maintained through banking regulations is associated with policymakers. Unfortunately, there is not enough evidence to integrate the implication of these issues from 2001–2015 in Thailand. Therefore, this dissertation attempts to contribute to the link between the Bank of Thailand policy and the banking sector, particularly regarding competition and stability in banking. First, this study constructs a regulatory index to explain the evolution of bank competition for use alongside other relevant explanatory variables (such as a concentration ratio, inter-industry competition variables, and institutional factors). Second, this study rigorously examines the relationship between competition and the bank lending channel.

In the early 1990s, financial liberalisation in Thailand encouraged high economic growth via the supply of credit to firms and households by deregulating the banking industry. This deregulation created a more competitive environment in the banking sector, but unfortunately, such competition came with weak financial authority supervision. As a result, the banking system became unstable and caused the 1997 Thai financial crisis. This story implies that, theoretically, the competition (or market power) associated with high banking regulations can provide stability in the banking sector. On the other hand, deregulation has a positive effect on competition in the banking sector but can generate market failure if there is insufficient authorised monitoring.

After the crisis, the Bank of Thailand implemented the Financial Sector Master Plan (FSMP) through the FSMP 1 (2004–2008), FSMP 2 (2010–2014), and FSMP 3 (2016–2020), respectively. The purpose of this plan was to support competition among banks through consolidation, reducing restrictions on activities, deregulating foreign bank entry, etc. Furthermore, in the 2000s, progress in the financial environment led to increased inter-industry competition (banking market, financial market, and non-banks). Such developments presented challenges to the Bank of Thailand (BOT), especially in maintaining financial stability. The following questions arise: (i) How can the BOT determine banking competition behaviour? (ii) How can bank competition weaken or strengthen the transmission of monetary policy through the bank lending channel?

This paper draws on empirical evidence from 10 Thai commercial banks as a good proxy of the banking industry (as of 31 December 2015, the total average assets of these banks represented 81% of the total assets in the Thai banking industry). The study period covers the quarterly bank-level data on balance sheets and income statements from 2001–2015.

Theoretically, the degree of competition in a market cannot be directly observed, hence economists attempt to construct indices for its measurement. There are two main approaches for measuring a competitive market: the structural model and non-structural model.

The structural model develops from the structure-conduct-performance (SCP) paradigm. This describes the conduct and performance of firms through different market structures. For example, the relative size of a bank (or the degree of entry and exit in the banking industry) can affect profit via pricing strategies. Moreover, the SCP paradigm suggests that higher concentration in the banking industry is associated with less competition. A number of empirical studies concentrate on three indices to measure the competition via concentration: the number of firms, the concentration ratio (CR), and the Herfindahl-Hirschman Index (HHI).

Indexing the number of banks is the easiest way to achieve a competitive assessment, but does not capture the distribution. As a result, it is not a popular measure to employ in assessing the degree of bank competition. The concentration ratio (CR) improves the weak point of the number of firms by calculating the market

share of the top *k* firms in the industry. The existing empirical evidence in the banking sector commonly determines that the *k* value is equal to 4 or 5. However, the CR index does not take into account the size of the distribution in remaining firms. Therefore, the HHI seems to be the most appropriate, because it considers the total size of the firm's distribution, i.e. it represents the sum of the squares in the market share for all firms. The degree of concentration can be calculated using a simple method and little data, i.e. it employs the market share (assets or deposits) of each bank to assess the concentration. Hence, this paper uses HHI as a proxy for concentration in the Thai banking industry (see Chapter 2). However, recently, the level of concentration contradicts the concept of market contestability. In other words, a high entry or exit banking industry can also be associated with high concentration. Alternatively, the New Empirical Industrial Organization (NEIO) suggests that bank competition should be measured using three indices, requiring different data and assumptions, namely the non-structural model.

The non-structural model, including market power, the H-statistic, Lerner index, and Boone indicator, assesses the degree of competition through bank pricing behaviour.

Panzar and Rosse (1987) suggested the H-statistic by calculating the sum of elasticities in bank revenue to input price (fund, labour and capital). The H-statistic ranges from $-\infty$ to 1. It interprets whether the market is perfectly competitive ($H = 1$), monopoly ($H \leq 0$), or monopolistically competitive ($0 < H < 1$). For example, if the H-statistic is equal to one, any increase in input prices should fully pass through in total revenue, i.e. zero economic profit or perfectly competitive behaviour. The results of the H-statistic are shown in Chapter 2. The advantages of this index are: (i) it requires little data; and (ii) the estimation uses only one equation. Nonetheless, since the H-statistic relies on the long-run equilibrium of the banking industry, this is tested also. In addition, this index assesses the competition in the banking industry and may limit the capture of evolution in bank competition over time. Second, the Lerner index is interesting because it offers a bank-period specific measurement to the mark- up price over marginal cost, i.e. this index may investigate the pricing behaviour of a bank. However, it is possible that the increased average Lerner index relates positively to the intensity of competition due to the reallocation effect from inefficient

banks (low margin) to efficient (high margin). This shows that the average Lerner index may not be a good proxy for competition. Third, the Boone indicator (J. Boone, 2008) recommends that more efficient firms (lower marginal cost) will also benefit the market share (such as loans, deposits, etc.) and profits in a more competitive environment. Therefore, the Boone indicator may be a negative sign. In particular, if the Boone indicator shows a higher value in absolute terms, the market is more competitive. One advantage of this index is that it is able to assess the competition by product type, while the H-statistic and the Lerner index focus on all banking activities. This index measures the degree of bank competition via the negative relationship between market share and marginal cost. However, this link may be positive if banks compete in quality products.

These two approaches have both strengths and weaknesses in the context of technique, data availability, and the conception of competition. Some empirical studies seek to apply one indicator over another, but there is no general consensus because the different indices for assessing the degree of bank competition cannot provide the same result (Carbó, Humphrey, Maudos, & Molyneux, 2009).

Theoretically, in the case of Thailand, few studies relate to the measurement of the degree of competition in the Thai banking industry. They employ different indices, i.e. the H-statistic, the Boone indicator, and the Lerner index. In addition, the studies mostly cover the period from the 1990s to 2000s. The results of these papers highlight three issues. Firstly, based on the Boone indicator, Pisedtasalasai and Rujiratpichathorn (2017) and Roengpitya (2010) investigated competition in the Thai banking sector using the Boone indicator and found that the competition trend was unclear before the Asian financial crisis in 1997, but was less competitive in the 2000s. This result is consistent with that of Kubo (2006), who applied the Lerner index, and suggested that the evolution of Thai banking competition through market power decreased in the 2000s. Secondly, following the implementation of the Financial Sector Master Plan in 2004, Subhanij and Sawangngoenyuang (2011) showed that the degree of competition measured through the Boone indicator and the H-statistic was higher during the period 2005–2009. These empirical results are similar to those of Chiarapong (2009) who concluded that the Thai banking system had become more competitive due to FSMP 1. Conversely, at the same time,

Pisedtasalasai and Rujiratpichathorn (2017) applied the Boone indicator and found that the degree of competition had become rather stable. Thirdly, the value of the H-statistic indicated that the Thai banking industry was in monopolistic competition (Chiarapong, 2009; Subhanij & Sawangngoenyuang, 2011)

In terms of international evidence, a number of studies used the H-statistic, as shown in Table 1 (Bikker & Haaf, 2002; Bikker & Spierdijk, 2009; Claessens & Laeven, 2004; De Bandt & Davis, 2000; Gelos & Roldós, 2004; Nathan & Neave, 1989; Shin & Kim, 2013; Yuan, 2006) highlight the following three points. Firstly, the banking industry in many countries faces a monopolistic (or oligopolistic) market. Secondly, the banking sector in developed countries is less competitive than in developing countries. Thirdly, large banks are more competitive than small.

In addition, in terms of the Boone indicator, Van Leuvensteijn, Bikker, Van Rixtel, and Sørensen (2011) assessed the degree of bank competition in loan markets between five major EU countries and the UK, US and Japan. They suggested that the US was the most competitive, while Germany and Spain were the most competitive in the EU. Furthermore, the French, Japanese, and UK tended to experience a less competitive loan market. Recently, Roengpitya (2010) investigated the degree of competition between the loan market in the Thai banking industry and US banks. The results suggest that the Thai banking sector was slightly less competitive than the US from 1994–2004.

However, during the 2000s, few studies attempted to investigate the effect of relevant variables such as bank regulations, to explain the evolution of bank competition. Empirical literature suggests the application of potential explanatory variables, such as market structure, competitive inter-industry pressure, regulations and institutional factors. The first objective of this paper is to measure the degree of competition in Thai commercial banks and investigate how bank regulations determine such competition. This paper makes two contributions to the existing literature on this topic. Firstly, while previous works have focused on either cross-country competition or one competitive index, this study uses two indices: the H-statistic and Lerner index, to distinguish between large banks and medium and small banks. These bank groups are expected to be competitively different because of the variation in their business models. Secondly, this study constructs a unique regulatory

indicator in the context of the Thai banking sector from 2001–2015. The index may be a significant factor in explaining the pattern of competitive behaviour and can benefit regulators in the supervision of financial institutions.

Beyond its first objective, this study extends the important role of the banking system, i.e. credit supply. Theoretically, the central bank can control the supply of loans through monetary policy, given ceteris paribus, called "the bank lending channel". Existing literature argues that bank competition can also align with the transmission of monetary policy via this channel. However, there is no consensus on how bank competition affects bank lending. In other words, increased competition has a positive or negative impact on monetary policy through the bank lending channel. Surprisingly, there is no evidence to support investigation of this topic. Therefore, this study aims to examine the influence of competition on monetary policy transmission via the bank lending channel. However, according to (Gambacorta, 2005); Kashyap and Stein (1995) investigation of this topic would contribute to the existing literature by observing bank competition associated with the response of both deposits and liquid assets to monetary shock as well as the response of bank loans.

The rest of this study is organised as follows. Chapter 2 presents the structure of the banking industry in Thailand, including the relevant regulations and descriptive statistics. These stylised facts are then used to support the results in further chapters. The measurement results and important determinants of bank competition are presented in Chapter 3, and Chapter 4 provides the results of the competition associated with the bank lending channel. Finally, the main conclusions and implications of this task are summarised in Chapter 5.

CHAPTER 2

THE THAI BANKING INDUSTRY

2.1 An overview of the Thai financial system

Thailand's financial system can be mainly categorised into financial institutions (or financial intermediaries) and financial markets. It has performed an important role in financial resource allocation from saver to spender for 30 years. In the case of financial intermediaries, commercial banks, government-owned specialist financial institutions, and non-banks (such as finance companies, Credit Foncier companies, life insurance companies, and various co-operatives) have been major players in the loan market over the past 20 years. The Stock Exchange of Thailand (SET) and Thai Bond Market Association (Thai BMA) are the main equity and bond markets in Thailand, respectively.

The Thai financial system changed considerably after financial liberalisation at the beginning of the 1990s. Figure 2.1 shows the size of the Thai financial system during the period from 1993–2015, with Thai firms and households relying on bank loans as a source of funding between 1993 and 1997. At the same time, the bond market did not significantly increased for two important reasons. Firstly, the Thai government kept the budget in surplus, and secondly, firms financed their funds through Bangkok International Banking Facilities (BIBF). Furthermore, market capitalisation decreased rapidly before the 1997 financial crisis. However, the size of the country's financial structure altered significantly after the 1997 crisis, with bonds and capital markets becoming more important. Domestic firms changed their funding by issuing more debentures, while the SET was the main secondary market, supporting the issue of equities on corporate sites. Although such developments in the financial market have helped to increase the access to financial services, the banking sector is the most important financial institution for providing loans and taking deposits from households and SMEs in Thailand.

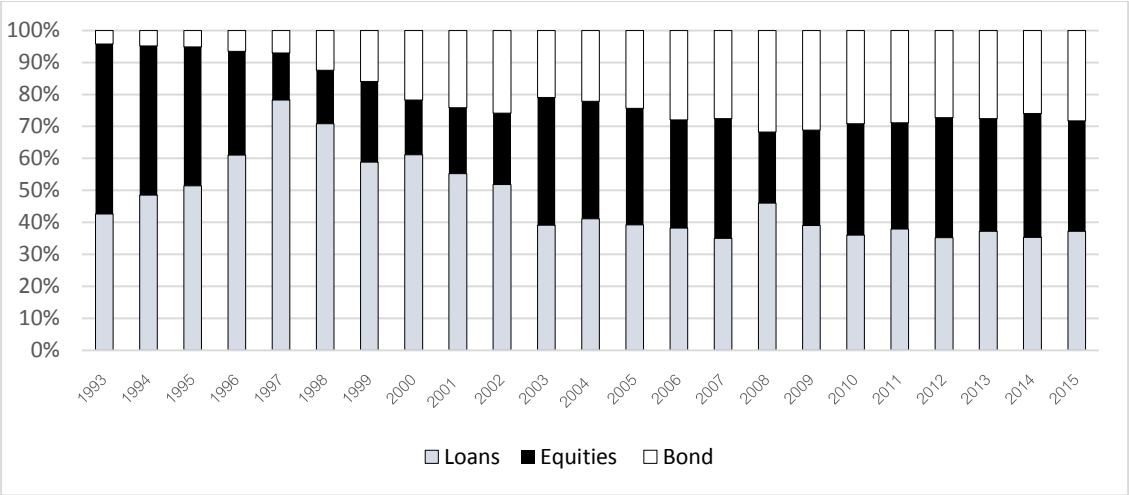

Figure 2.1 Major components of Thailand's financial system (31 December 2015)

Source: Thai BMA, Bank of Thailand (BOT), and Office of the National Economic and Social Development Board (NESDB)

After the crisis, the BOT and Ministry of Finance (MOF) changed the financial landscape to increase the financial stability of the banking sector by establishing a new development plan for financial institutions. This plan was called "The Financial Sector Master Plan (FSMP)" and was implemented through the FSMP 1 (20042008), FSMP 2 (20102014), and FSMP 3 (2016–2020), respectively. The Financial Sector Master Plan I, improved the structure of financial institutions through mergers and acquisitions (M&A), new banking licences, and extended bank activities. Consequently, the Thai banking industry can be divided into two groups: commercial banks registered in Thailand, such as Thai commercial banks, retail banks and subsidiaries; and foreign bank branches. FSMP 2 has enhanced competitiveness and access to financial institutions.

In addition, Thai commercial banks (excluding retail banks, subsidiaries, and foreign branches) dominate the total market share in the Thai banking industry. Figures 2.2 and 2.3 describe the structure of the market share in the Thai banking industry from 2001–2015. The data obtained highlights the following points. Firstly, the total assets of commercial banks registered in Thailand and foreign bank branches increased continuously, and their market share rose substantially during the period from 2010–2013. Secondly, the average market share of commercial banks in Thailand was about 88% of the total assets even though foreign bank branches had

increased their market share during this period also. Thirdly, the assets of 10 Thai commercial banks averaged 81% of the total assets in the Thai banking industry. These commercial banks are listed on SET.

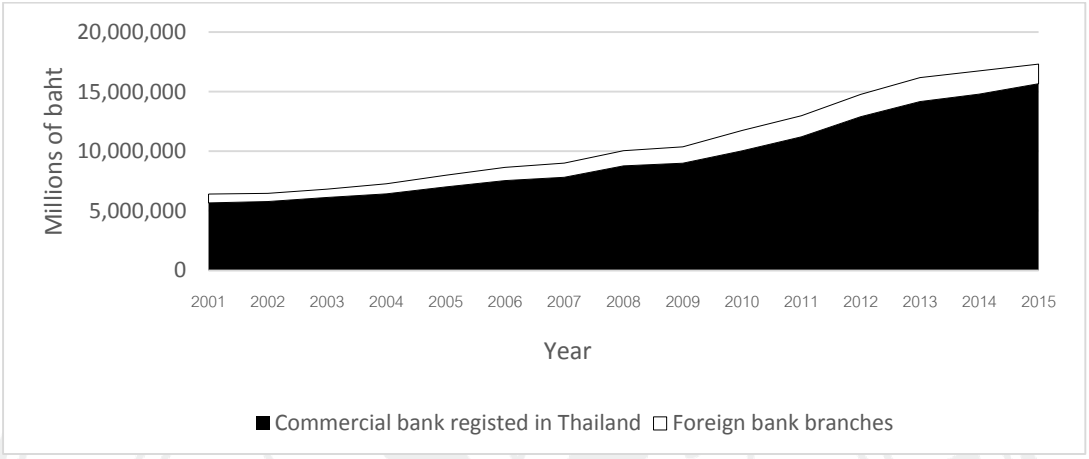

Figure 2.2 Size of assets in the Thai banking system

Source: Bank of Thailand

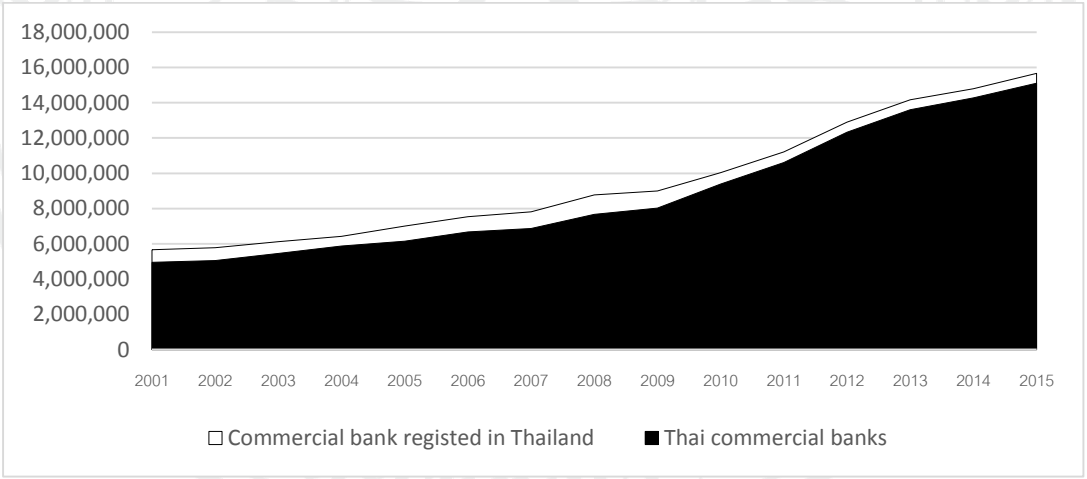

Figure 2.3 Thai Commercial Banks' Asset Market Share

Source: Bank of Thailand

2.2 Structure of the Thai banking industry

After the banking crisis in 1997, the main change in the landscape of the banking sector took place in 2004 when implementation of the FSMP began, transforming the structure of the banking system and numbers of players in the market. As of December 2003, the number of commercial banks registered in Thailand was 12, while there were 18 foreign bank branches. At the same time, there were four large banks: Bangkok Bank, Krung Thai Bank, Siam Commercial Bank, Thai Farmers Bank (KBank).

However, under the implementation of FSMP 1 (2004–2008), the number of players in the market changed significantly as a result of upgrades, mergers, and the entry of new players through licensing and the One Presence policy. In particular, the number of commercial banks registered in Thailand increased from 12 to 18, while the number of foreign bank branches decreased from 18 to 16 during the period from 2004–2008 (Table 2.1). In other words, during this period, the number of banks transformed through M&A, upgrades, and new licences to four, one, and eight, respectively (Table 2.2). For example, finance companies such as TISCO, Kiatnakin, and Asia Credit were permitted to become Thai commercial banks through new licences, while finance companies and Credit Foncier companies entered the market as retail banks, such as Land and Houses Retail Bank and Thai Credit Retail Bank.

Furthermore, the data on foreign bank branches shown in Table 2.3 indicates that the number of players decreased from 18 in 2004 to 12 in 2015, as a result of upgrades from foreign branches to subsidiaries and full commercial banks. In addition, in terms of new foreign branches, three new licences were given to Societe Generale Bank, UFJ Bank Ltd., and Indian Overseas Bank.

As mentioned above, although the number of commercial banks registered in Thailand increased during the FSMP, this does not explain how the bank concentration has evolved. Theoretically, two methods, namely CR and HHI help to assess the degree of bank concentration. These indices measure the competition through market structure.

Table 2.1 Number of Thai banks based on type

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
- Thai Commercial Bank	12	14	14	14	14	14	14	14	14	14	14	14
- Foreign bank branches	18	18	17	16	16	15	15	15	15	14	13	11
- Retail banks and Subsidiaries	0	2	3	4	4	3	3	2	2	2	3	5
- Total	30	34	34	34	34	32	32	31	31	30	30	31

Source: www.bot.or.th

Table 2.2 Number of commercial banks registered in Thailand

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
- Mergers & Acquisitions	1	2	0	1	0	2	1	1	0	0	0	0
- Upgraded	0	1	0	0	0	0	0	1	0	0	1	0
- New licences (new entries)	0	5	1	2	0	0	0	0	0	0	1	2
- Exit	1	1	0	1	0	1	0	1	0	0	0	0

Source: www.bot.or.th

Table 2.3 Number of foreign bank branches in Thailand

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
- Merger & Acquisitions	0	0	1	0	0	2	0	0	0	0	0	0
- Upgraded	0	0	0	0	0	0	0	0	0	0	0	0
- New licences (new entries)	0	2	0	1	0	0	0	0	0	0	0	0
- Exit	0	2	1	2	0	1	0	0	0	1	1	1

Source: www.bot.or.th

Focusing on 10 commercial banks registered in Thailand, the HHI of total assets is shown in Figure 2.4. The HHI suggests that the Thai banking sector has a moderate level of concentration. Moreover, it represents a decrease in market concentration during the period from 2001–2015. This is consistent with the increased number of new entries in the same period. Moreover, the period from 2004–2008 shows a dramatic decrease in the HHI, concurrent with the implementation of FSMP 1 and new entry players in the banking industry.

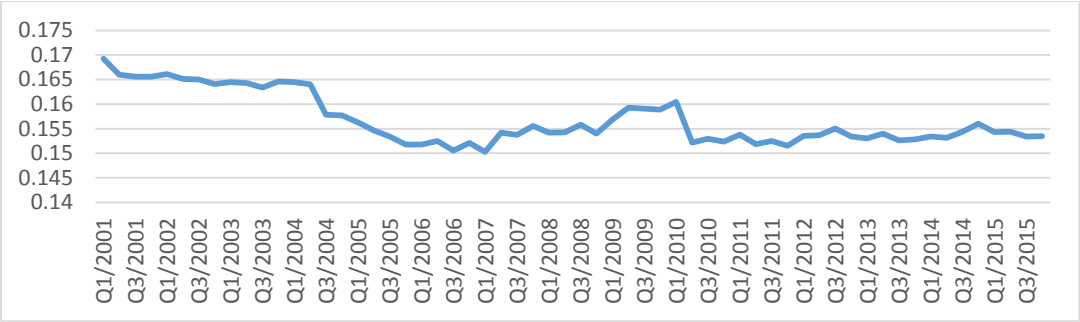

Figure 2.4 Market concentration of the Thai banking system (HHI)
Source: Thomson Reuters Datastream and author's calculations

2.3 Overview of the competitive environment of the Thai banking sector

The number of banks and market concentration alone cannot provide an exact measure of a competitive market. The exact measurement needs a sophisticated approach such as interest spread and the H-statistic. This section employs these indices to survey the perspective of bank competition in Thailand.

2.3.1 H-Statistic

Panzar and Rosse (1987) provides the H-statistic (Appendix A), representing the response of revenue to a set of input prices. This index ranges from $-\infty$ to 1. Under perfect competition, the H-value is equal to one, $H \leq 0$ indicates a monopoly, $0< H <1$ shows monopolistic competition, and $H = 1$ represents a perfect market.

Table 2.4 presents the values of the H-statistics for all banks and samples of various bank sizes. For all banks, the H-statistic is 0.588. The intermediate value (0.588) suggests that the bank industry is only partially sensitive to cost changes when setting prices. Both hypotheses $H = 1$ (perfect competition) and $H = 0$ (perfect cartel) are rejected at the 99% level of confidence. This result implies monopolistic competition.

Table 2.4 Empirical results for the H-value of various samples of bank size

	All Banks	Large Banks	Medium and Small Banks
Fund (w1)	0.211***	0.231***	0.200***
Labour (w2)	0.230***	0.388***	0.243***
Capital (w3)	0.148***	0.091***	0.150***
H-Value	0.588***	0.710***	0.593***
p-value(F-test)	0.00	0.00	0.00
Adj.R^2	0.79	0.79	0.77
Observations	600	240	360

Source: Thomson Reuters Datastream and author's calculations

Notes: *** Significance level of 1% or the null hypothesis H = 1 and H =0 can be rejected by F-test at the 1% level.

Furthermore, when the banking market is divided into segments, the results indicate that the large, medium, and small banks are likely to be monopolistic too. However, the competition among larger banks is higher than that among medium and small banks. This is consistent with the results of Bikker and Haaf (2002).

2.3.2 Net interest margin (NIM)

The NIM is defined as the ratio between the difference in interest income and interest expenses and average interest-earning assets. This represents the bank's gross margin but is not the net profit. The NIM variable excludes non-interest income and non-interest expenses. Generally, market demand and supply, monetary policy, and banking regulations can affect the banks' net interest margin. In addition, a comparison between the NIM of different banks should consider the differences in business model of each bank.

Figure 5 shows the trends in NIM from 2001–2015, categorised into two groups: commercial banks registered in Thailand (including Thai commercial banks, retail banks, and subsidiaries) and foreign banks. Overall, the NIM of commercial banks registered in Thailand is higher than that of foreign branches over time. The average NIM (commercial banks registered in Thailand) was 2.96. In particular, the NIM of the two groups increased in the first period, especially for commercial banks

registered in Thailand, but tended to decrease over time, especially for foreign bank branches.

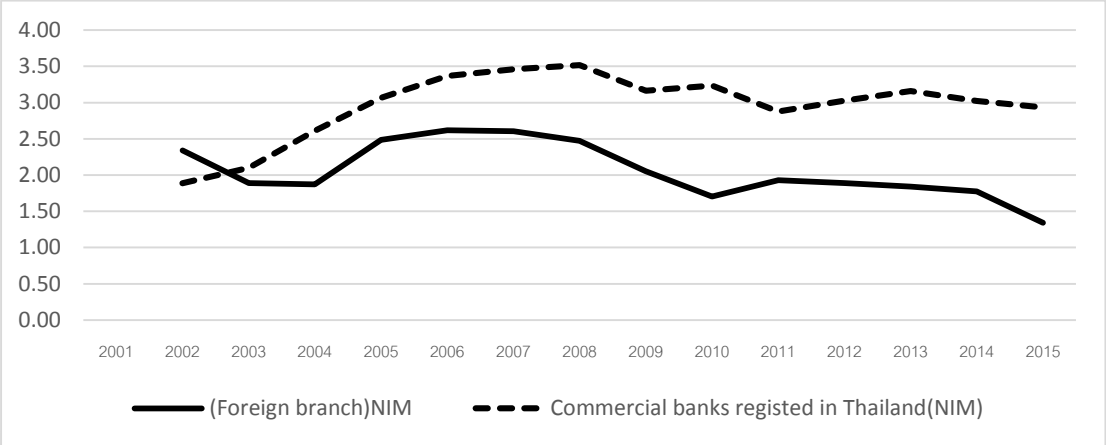

Figure 2.5 Net interest margin (NIM)

Source: Bank of Thailand and Author's calculations

The interest margins are different across banks. In other words, different bank characteristics, i.e. funding cost, credit provision (credit cost), and operational cost can influence the NIM. An increase in these variables is positively related to the NIM. The funding cost is lower if bank funding through current and savings accounts (CASA) increases. Credit provision (or NPL loan/total assets) is negatively correlated to the soundness of the domestic economy. Operational cost can indirectly affect the NIM through personnel and other expenses. In other words, these differences should be considered in distinct business models.

Table 2.5 shows the different business models in 10 Thai commercial banks and foreign bank branches. The business models are classified into seven indicators, based on the study by Roengpitya et al. (2014). Each indicator in the table represents its ratio to the total asset share. These indicators imply that Thai commercial banks are retail-funded because the main sources of funds are deposits and gross loans. These indicators further suggest that foreign bank branches seem to perform as wholesale-funded institutions since they finance a greater funding mix compared to retail banks. In other words, foreign bank branches have less reliance on deposit accounts but are funded by other borrowing.

Table 2.5 Overall business model (average from 2001–2015)

Variables	Thai commercial banks	Foreign bank branches
Assets		
1. Gross loans	70.2	43.2
2. Investments	14.1	25.1
3. Repurchase market	0.9	0.9
4.Interbank and money market (lending)	10.4	19.5
Liabilities		
1. Deposits	74.1	37.0
2. Debts and borrowing	7.6	9.3
3. Interbank and money market (borrowing)	5.2	8.2
Number of bank/years	16	16

Source: Bank of Thailand and Author's calculations

Furthermore, Table 2.6 and 2.7 indicate the structure of loans and deposits in 10 Thai commercial banks as of December 2015. This data suggests the following points. Firstly, on the loan side, the types are separated into corporate, SME, and retail loans. Each bank has its own credit market. Bangkok Bank (BBL) focuses on corporate loans, while Kiatnakin Bank (KKP), Thanachart Bank (TCAP), Tisco Bank (TISCO) offer loans mainly through leasing. The Land and Houses Bank (LHBANK) lends to corporate and housing businesses. Large banks, including Krung Thai Bank (KTB), Siam Commercial Bank (SCB), and Kasikornbank

Table 2.6 Loan structure of 10 Thai commercial banks (as of 31 December 2015)

Banks	Corporate loans	SME loans	Retail loans		
			Leasing	Mortgages	Others
BAY	42%	15%	21%	12%	10%
BBL	40%	31%	0%	11%	18%
KBANK	29%	38%	0%	15%	18%
KTB	35%	22%	0%	18%	25%
SCB	35%	22%	9%	27%	9%
TMB	43%	37%	0%	11%	9%
LHBANK	56%	20%	0%	22%	2%
KKP	5%	12%	65%	1%	17%
TCAP	21%	10%	53%	13%	3%
TISCO	18%	8%	64%	1%	9%
Average	32%	22%	21%	13%	12%

Source: The Stock Exchange of Thailand

Table 2.7 Deposit structure of 10 Thai banks (as of 31 December 2015)

Banks	Demand deposits	Savings deposits	Time deposits
BAY	3%	49%	48%
BBL	4%	41%	55%
KBANK	6%	67%	28%
KTB	6%	54%	40%
SCB	3%	58%	38%
TMB	10%	63%	26%
LHBANK	4%	38%	58%
KKP	0%	50%	48%
TCAP	1%	39%	60%
TISCO	2%	30%	68%
Total	5%	53%	43%

Source: Financial Statement

(KBANK), have diversified into the credit market. The TMB Bank (TMB) disregards retail credit, while the Bank of Ayudhya (BAY) is interested in both corporate and retail.

Secondly, on the deposits side, SCB, KBANK, and TMB attract customers through the demand deposits and saving deposits, while LH Bank, TCAP, and TISCO focus on time deposits.

2.4 Conclusions

This section attempts to investigate the overall structure and competitiveness of the Thai banking industry. After the Thai financial crisis, the structure and number of both commercial banks registered in Thailand and foreign bank branches have changed considerably with the implementation of the Financial Sector Master Plan (FSMP), specifically regarding the One Presence policy. In particular, the number of commercial banks registered in Thailand increased through upgrades, mergers, and new licenses.

Bank competition in Thailand, measured by the HHI and H-statistic indicates moderate concentration and monopolistic competition. However, in term of H-statistic, large banks exhibit more competition than medium and small banks. In addition, the NIM of commercial banks registered in Thailand increased prior to 2005 while subsequently dropping slightly. Overall, the NIM of commercial banks registered in Thailand is higher than for foreign branches over time. Such differences may occur due to variations in the bank business models.

CHAPTER 3

BANK COMPETITION AND REGULATION: EVIDENCE FROM THE THAI BANKING INDUSTRY

3.1 Introduction

This paper aims to investigate the effect of financial regulations on bank competition in Thailand from 2001–2015. Competition is measured using the Lerner index, while regulation indices are constructed to explain the degree of regulatory restriction in the Thai banking industry.

The banking sector is important to the country's economy. It is essentially an intermediary between lenders (savers) and borrowers (spenders), especially in developing countries with emerging economies. Theoretically, banks aim to solve the problem of asymmetric information in the financial system (Mishkin, 1996). In addition, competitive banking is essential for accessing finance and the effective allocation of funds (Cetorelli & Strahan, 2006). In other words, competition may lead to lower prices, improve the quality of products and services, and stimulate innovation. Therefore, it can contribute to market efficiency and the maximisation of social welfare.

However, from the financial stability perspective, the banking industry is relatively vulnerable compared to other industries. For instance, banks make profits by selling liabilities and short-term deposits and using the proceeds to buy long-term assets that can be difficult to liquidate quickly. This leads to the bank being vulnerable to runs in the absence of deposit insurance or maturity-matching technologies, and so a shock to one bank can lead to shocks in others (contagion). Consequently, this can increase the losses incurred during a financial crisis (Northcott, 2004).

Since the 1997 financial crisis in Thailand and recent global financial crisis from 2008–2009, the relationship between competition and financial stability in the

banking system has aligned with the arguments concerning financial regulation. In addition, over the last 20 years, the BOT has adopted many regulatory frameworks through the Financial Master Plan (FSMP) and the Basel Accord. The FSMP implementation involved two phases: FSMP I (20042008) and FSMP II (2010–2014) aimed to enhance efficiency, strength, and access to the domestic banking sector. The main intentions of the FSMP are banking consolidation and promoting competition, such as with the One Presence policy, widening bank business scope, and new licences for foreign bank entry. The Basel Accord is a global, voluntary regulatory framework on bank capital adequacy, stress testing, and risk. The Thai banking industry has operated under Basel III since 2013. These regulatory frameworks contribute to financial stability in the Thai banking industry. However, there have only been a few empirical research studies to explain how regulation can affect competition in the Thai banking industry.

Initial empirical evidence suggests that some economists have attempted to employ a variable such as the concentration ratio or HHI to explain the evolution of bank competition. For example, the pioneers Bikker and Haaf (2002) found that increased concentration weakens competition. However, Claessens and Laeven (2004) showed that bank concentration related positively to the degree of competition rather than negatively according to the conventional hypothesis. Recently, Shin and Kim (2013) also confirmed that the competitiveness of the Korean banking industry, evidenced by a monopolistic market, is associated with intensified bank concentration, leading to inconclusive results. In addition, these authors argued that the concept of market contestability exists in a concentrated market if banks are free to enter and exit. In other words, despite high market concentration, banks can still perform competitively because the market operates with low barriers to entry (for new banks) and easy exit conditions (for unprofitable banks).

Turk-Ariss (2009) suggested that more market contestability, foreign bank penetration, and less bank activity restrictions were important drivers for enhancing competition in the Middle East and North Africa. Empirical evidence from 101 countries (emerging, developing and advanced economies) provided by Bikker and Spierdijk (2009) indicated that greater contestability and cross-sector financial substitution increased competitiveness in many countries. Jeon, Olivero, and Wu

(2011) indicated that increased foreign bank penetration supported competitive behaviour.

According to the New Industrial Organization theory, a structural contestability approach (such as the theory of entry or activity restriction) can effectively explain the degree of competition, particularly, the role of market regulations in relation to market contestability. Unfortunately, the number of existing studies is insufficient for confirming the relationship between competition and regulation in the Thai banking industry from 2001–2015. Hence, this paper contributes to the limited empirical literature of the Thai banking industry by focusing on the importance of financial regulation in determining the evolution of competition besides other explanatory variables.

The remainder of this study is organised as follows. Section 2 briefly presents the literature review, while section 3 describes the data and research methodology. Section 4 shows the preliminary results of the study. Finally, section 5 presents the conclusions and limitations.

3.2 Literature review

This subsection provides a brief literature review relating to bank regulation and competition including empirical research on the Lerner index. Subsequently, regulatory variables and other variables are reviewed together with their contribution to competition.

3.2.1 Measuring of banking competition: Lerner index

Lerner (1934) suggested that competition be assessed via market power and this is now known as the Lerner index (L): $L_i = \frac{p - mc_i}{p}$ where p is the price in the market and mc_i is the marginal cost of firm i. This index is derived from the profit maximisation issue (Appendix B). The degree of competition is determined according to range, where $0 \leq$ Lerner index ≤ 1. An index equal to zero is perfectly competitive, and equal to one if a pure monopoly. The Lerner index is a popular tool in recent studies for investigating bank competition (Beck, De Jonghe, & Schepens, 2013; Carbó et al., 2009; Fernandez de Guevara, Maudos, & Perez, 2005). One important

advantage of the index is that it compares the market competition among banks and/or over a certain period. Recent works measure banking competition by averaging the individual Lerner indices (Maudos & Solís, 2011; Weill, 2013). According to empirical reviews, a number of studies also attempt to account for the trend in competitive behaviour over time. However, the Lerner index has a weakness (market power ≠ competition) in that an increase in the average Lerner index over time is related to an increase in competition intensity of competition. This result makes the index less reliable (J. Boone, van Ours, & van der Wiel, 2013; Leon, 2015).

3.2.2 Background to the determinants of banking competition

In initial empirical studies, the structural approach is used to investigate the evolution of bank competition. The concentration indices (CR ratio and HHI) are most appropriate for comparing the number of banks, NIM, and product differentiation. However, ambiguous predictions about the relationship between industry competition and concentration, i.e. competitive pricing behaviour, may be associated with a concentrated market. Consequently, a number of studies (Claessens & Klingebiel, 2001; Claessens & Laeven, 2004) propose that other, more important determinants of competition evolution should apply, not only to the market concentration indices but also to market entry and exit barriers. Under the theory of contestability, firms are more competitive in reducing entry barriers, i.e. the limit on bank activity is one of the main restrictions to free entry into the banking industry. Specifically, two regulatory restrictions are purported to influence to the degree of competition. Firstly, the degree of restriction on banking activities, i.e. securities, insurance, and real estate, and secondly, the regulatory conditions applying to bank entry or the degree of ownership and control of nonfinancial firms on banks. The bank entry of variables comprise three conditions: (i) limitation on foreign bank entry/ownership, (ii) bank entry requirements, and (iii) percentage of entry applications denied. In addition, capital requirements and the deposit insurance system are other important components of bank regulation (Mishkin, 1996). Soedarmono, Machrouh, and Tarazi (2013) and Shy, Stenbacka, and Yankov (2016) insist that the high level of bank capital and limited deposit insurance coverage weaken competition. It is plausible that the institutional and financial substitution

variables of direct and indirect finance should also be considered in order to explain the evolution of competition in the banking sector.

Overall, there is little evidence to explain the relationship between bank regulation and the evolution of competition. Claessens and Laeven (2004) employed bank-level data from 1994–2001. Their findings showed that a contestable market with increased foreign bank entry and fewer bank activity restrictions is more competitive. Bikker and Spierdijk (2009) produced the same results, suggesting that if there are no barriers to foreign bank entry, competition is stronger. Mirzaei and Moore (2014) studied the source of competition across different income groups in various countries during the period from 1999–2011. Their results indicated that market contestability and the number of institutions improved the competition in emerging and developing countries, while inter-industry factor strengthened a competitive market.

3.2.3 Regulatory restrictions in the banking sector

The banking sector is subject to a tight set of financial regulations. Theoretically, exiting asymmetric information in the banking industry leads to adverse selection and moral hazard problems. In other words, the interested parties (savers and borrowers) do not have the same information in a financial contract and hence, the government imposes regulations to address the issue. Empirically, there are many financial regulations, but the most relevant (in the case of Thailand) fall into the following four categories.

3.2.3.1 Banking activities

Generally, the main activity in traditional banking is the lending of funds. Alternatively, banks also hold other assets (securities, insurance, and real estate), providing the bank with higher earnings, but at greater risk. Consequently, if these risky assets do not pay off, it could lead to bankruptcy and the loss of depositors. To reduce the risk involved in taking on these activities, financial supervisors need to regulate the holding of risky assets by the bank.

Economic theory suggests that the restriction on bank activities can be viewed from different perspectives. For instance, Boyd, Chang, and Smith (1998) proposed that banks with a wider range of activities may undertake riskier behaviour

by investing in others (moral hazard). Whereas large financial conglomerates may reduce both competition and efficiency in the banking industry, i.e. it may become "too big to fail" (Barth, Caprio Jr, & Levine, 2002). This implies that the regulator can enhance a sound banking system by restricting bank activities. However, Casu and Girardone (2006) provided conflicting views on this point, showing that with the deregulation of banking activities in the EU in 1993, banks operated various activities. Specifically, this more competitive environment, especially for non-interest bearing products, increases efficiency and consolidation. Furthermore, all banks benefitted from the restrictions by the economies of scale and diversifying income, including those with greater stability (Claessens & Klingebiel, 2001).

Empirically, (Barth, Caprio Jr, & Levine, 2001a) indicated that higher limitations on bank activities were associated with negative results, such as a banking crisis and lower bank performance efficiency. In addition, they suggested that stricter regulations on bank activities were unrelated to less concentration or more competition. However, Turk-Ariss (2009) examined the effect of restricting bank activities on competition in the highly concentrated Middle East and North Africa banking systems. The results suggested that fewer restrictions on bank activities (securities, insurance, and real estate) could improve competition. This conforms to the results presented by Claessens and Laeven (2004), i.e. that the evolution of competitiveness was not determined by bank concentration, but varied negatively according to the limitations on bank activities.

3.2.3.2 Foreign bank entry

Following Thailand's reform of the financial system through the FSMP in 2004, foreign bank penetration in Thailand has significantly influenced the Thai banking sector. Foreign banks have moved into the Thai banking industry through M&A. The influence of foreign bank penetration in the banking industry can be measured by the ratio of foreign banks to domestic (or in terms of assets, loans, and deposits). In addition, if foreign banks operate a different business model to domestic banks, foreign bank entry affects domestic banks in the context of competition, market structure, and bank performance. Firstly, the effect of deregulation on foreign entry into the banking market can increase competition. In particular, foreign entrants

with different characteristics from the existing domestic banks tend to introduce new products, advanced management skills, and advanced technologies into the market. Hence, domestic banks may react to the new foreign banks by imitating these new concepts, i.e. banking in the host country is more competitive in a new market environment (Levine, 1996; Okuda & Rungsomboon, 2007). Similarly, Jeon et al. (2011) showed that foreign bank penetration improved competition in the emerging economies of Asia and Latin America. Specifically, these authors indicated that the positive relationship between foreign bank entry and the competition was stronger when considering the spillover effect from foreign banks (high efficiency and low risk) to domestic banks with low concentrations in host countries. On the other hand, Yeyati and Micco (2007) examined how foreign penetration influenced bank competition among Latin American countries. They indicated that foreign banks weaken the competition due to the differences in business models between local and foreign banks (imperfect substitution). Secondly, in terms of increased foreign ownership in domestic banks, Okuda and Rungsomboon (2007) argued that the change in ownership structure might improve domestic bank performance, such as modernising operations and enhancing bank efficiency, although foreigners are not majority owners of domestic banks. In terms of the negative impact of foreign entry on domestic bank performance, these authors suggested that according to the structure-conduct-performance (SCP) paradigm, foreign entrants affect the performance of domestic banks via the change in market concentration associated with competitiveness. For example, when a new foreign player enters the market, the domestic banks respond to higher competition by reducing their operational costs and profit (Claessens, Demirgüç-Kunt, & Huizinga, 2001) Furthermore, Unite and Sullivan (2003) and Barajas, Steiner, and Salazar (2000) proposed that financial reform should be controlled to distinguish between foreign entry and other financial regulations. Conversely, if entry is stressful, domestic banks with monopolistic characteristics tend to increase market value.

3.2.3.3 Capital adequacy

The purpose of regulatory capital adequacy for banks is to serve as a buffer against risk. Practically, capital adequacy is measured in terms of the ratio of

capital to the total risky assets of the bank. A formal definition of capital adequacy is linked to the Basel Accord, although there are many rules determining the precise amount and nature of capital holding. Bolt and Tieman (2004) indicated that a higher capital ratio in the banking sector could decrease risk-taking behaviour through the adoption of more stringent conditions for new lending. In addition, the capital requirements associated with the deposit insurance system decreases risk-taking, if banks compete in the deposit market instead of the loan market (Niinimaki, 2004). In terms of the relationship between capital requirements and competitive behaviour among banks, Agoraki, Delis, and Pasiouras (2011) mentioned that higher capital stringency increased market power among existing banks via the higher fixed costs involved in new bank entry.

Recently, on its new dataset, the World Bank has provided information on bank regulation and supervision. The fourth survey in 2011 includes 270 questions, divided into 14 groups. Empirical studies focus on only four groups: limited bank entry, scope of bank activities, bank ownership, and bank capital. Furthermore, Barth, Caprio Jr, and Levine (2013) adjusted the latest information of the World Bank to construct a range of indices to provide crucial information on key banking policies. They constructed a capital regulatory index, measuring capital stringency calculated from specific survey questions based on the Basel Accord in 180 countries from 1999–2011.

3.2.3.4 Deposit insurance

The United States first implemented a deposit insurance scheme in 1934. At the present time, many countries have adopted different deposit insurance systems with the objective of protecting depositors from contagious bank runs (Barth et al., 2002). In Thailand, a national deposit insurance scheme has been in operation since 2008. Theoretically, deposit insurance creates both positive and negative effects. In other words, it stabilises the banking system against systemic risk, in compensation for the associated costs (Diamond & Dybvig, 1983).

In particular, deposit insurance is a government safety net to promote banking stability during bad periods. It directly benefits the depositor by protecting against bank failure or bank panic (bank run). However, the negative effect is that it reduces depositor incentive to monitor banks, leading to excessive risk-taking, i.e. the

moral hazard effect (Kim, Kim, & Han, 2014). As empirical evidence, Anginer, Demirguc-Kunt, and Zhu (2014) studied the impact of deposit insurance on bank risk and found that it positively affected bank stability in times of panic, while generating the "moral hazard" effect in normal times. However, banks with good supervision tend to reduce risk-taking behaviour due to the unintended consequences of deposit insurance during good times.

Kusairi, Sanusi, and Ismail (2018) investigated the impact of deposit insurance on bank stability in the ASEAN, and found that it led to the banking sector taking higher risks to increase returns instead of improving total bank deposits (or the confidence of depositors). In terms of a positive relationship between deposit insurance and bank stability, Cull, Senbet, and Sorge (2005) suggested that under the implementation of deposit insurance, the strength of financial regulations contributes to the stability of the banking system.

Furthermore, Mishkin (2004) suggested that the moral hazard problem associated with deposit insurance may be minimised via restrictions on bank asset holdings, such as securities, insurance, and real estate (or on the extent of capital regulations). As important empirical evidence, Barth et al. (2002) indicated a positive relationship between restrictions and banking crises, suggesting that it may represent another omitted variable, i.e. deposit insurance. In particular, countries with weak supervision adopt greater restrictions on bank activities to offset the high cost of deposit insurance.

As to the relationship between the degree of deposit insurance and bank competition, it can be argued that cheaper deposit insurance encourages bank competition through new products, such as different deposit account options. Recently, Shy et al. (2016) investigated the relationship between limited deposit insurance coverage and bank competition, and mention that the deposit insurance system imposes no limit on the number of accounts held with different banks. This implies an impact from deposit insurance coverage on bank profit via deposit market competition. One important result of this study indicates that limited deposit insurance coverage creates less competition among banks in relation to unlimited or no deposit protection regimes. Therefore, to detect the evolution of bank competition, this paper applies bank insurance as a variable in determining competition.

3.3 Methodology

3.3.1 Data

Overall, the quarterly bank-level data used in this paper has been obtained from Thomson Reuters Datastream and CEIC Data. The dataset covers 10 commercial banks registered in Thailand (Bangkok Bank (BBL), Krung Thai Bank (KTB), Siam commercial Bank (SCB), Kasikornbank (KBANK), Bank of Ayudhya (BAY), TMB Bank (TMB), Thanachart Bank (TCAP), CIMB Thai Bank (CIMB), Tisco Bank (TISCO), and Kiatnakin Bank (KKP) for the period from 2001–2015, compared according to bank size. The sample is divided into two groups; large and small and medium-sized banks, respectively. The grouping criteria (based on definitions according to the Bank of Thailand) is "market share" or the percentage of one Thai commercial bank's total assets against the total assets of all Thai commercial banks. Large banks include Thai commercial banks with a market share of 10% or above. Medium banks include those with a market share of 3% and less than 10%. Small banks consist of Thai commercial banks with a market share of less than 3%.

Table 3.1 shows 600 total bank observations from 2001–2015, 240 observations for the four largest banks, and 360 observations for six medium and small-sized banks. Table 3.2 presents a statistical summary of the variables used to estimate the Lerner index from 2001–2015.

Table 3.1 Mean total asset market share of each bank from 2001–2015 (%)

	Large banks				**Medium banks**				**Small banks**	
	BBL	KTB	SCB	KBANK	BAY	TMB	TCAP	CIMB	TISCO	KKP
Mean	0.22	0.19	0.16	0.16	0.10	0.08	0.05	0.03	0.02	0.01
Maximum	0.25	0.21	0.19	0.18	0.11	0.12	0.10	0.06	0.03	0.02
Minimum	0.19	0.17	0.13	0.13	0.08	0.05	0.02	0.01	0.01	0.01
Std. Dev.	0.02	0.01	0.02	0.01	0.01	0.02	0.02	0.01	0.01	0.00
Observations	60	60	60	60	60	60	60	60	60	60

Source: Thomson Reuters Datastream and author's calculation

Table 3.2 Summary of the statistics used in the Lerner index

Variables	Observations	Mean	Max	Min	Std.Dev.
- total income/total assets (P)	600	1.72	4.31	0.66	0.01
- total costs/total assets (c/q)	600	1.20	3.09	0.26	0.07
- interest expenses/total deposits (w_1)	600	0.73	3.58	0.21	0.00
- personnel expenses/total assets (w_2)	600	0.26	0.78	0.10	0.00
- other expenses/fixed assets (w_3)	600	31.79	203.42	4.37	0.29
- total equity/total assets	600	9.47	30.88	0.32	0.05
- total non-performing loan/total loans	600	8.68	32.54	1.00	0.06

Source: Thomson Reuters Datastream and author's calculation
Notes: Each variable is shown as a percentage or share of the factor used to normalise it.

3.3.2 Econometric model

The empirical study follows the literature (Fernandez de Guevara et al., 2005) with the Lerner index used as the proxy of bank competition. Moreover, the Lerner index can capture the dynamics of market competition, which is important for estimating the panel data model. Therefore, this paper employs the Lerner index as a competitive measure. The Lerner index measures the mark-up price over marginal cost as follows.

$$L_{i,t} = \frac{p_{i,t} - mc_{i,t}}{p_{i,t}} \quad (2.1)$$

One important disadvantage of this measure is that the information on prices and costs cannot be directly observed. According to the conventional approach, the price can be estimated using the ratio of total income to total assets, and the marginal cost estimated from a translog cost function with one output (total assets) and three inputs: fund price, labour price, and physical price (Fungacova, Solanko, & Weill, 2014). The cost function is formed as

$$\ln(C_i) = \alpha + \beta_1 \ln(q_i) + \frac{\beta_2}{2}(\ln(q_i))^2 + \sum_{k=1}^{3} \Phi_k \ln(w_{ki}) + \sum_{k=1}^{3} \gamma_k \ln(q_i) \ln(w_{ki}) + \frac{1}{2}\sum_{k=1}^{3} \delta_{kk} (\ln(w_{ki}))^2 + \delta_{12} \ln(w_{1i}) \ln(w_{2i}) + \delta_{13} \ln(w_{1i}) \ln(w_{3i}) + \delta_{23} \ln(w_{2i}) \ln(w_{3i}) \quad (2.2)$$

where C represents the total costs (the sum of interest, personnel, and other non-interest expenses), q output (total assets), w_1 the fund price (ratio of interest expenses to total deposits), w_2 the price of labour (ratio of personnel expenses to total assets), and w_3 the price of fixed capital (ratio of other non-interest expenses to fixed assets).

Marginal costs are directly obtained from the estimated coefficients of equation (2.2) by calculating the derivative with respect to q

$$mc_i = \frac{c_i}{q_i} [\beta_1 + \beta_2 \ln(q_i) + \sum_{k=1}^{3} \gamma_k \ln(w_{ki})] \quad (2.3)$$

Table 3.3 shows a statistical summary of the variables used to examine the impact of bank regulations on competition (equation 2.4). Firstly, the Lerner index is 0.33 on average, implying that the Thai banking industry is potentially a monopolistic competition market. Next, the HHI average is 0.16, suggesting that the market structure is moderately concentrated. In addition, the largest four banks have an average market share of about 70% of the total assets in the industry. As for the regulatory indices, restrictions on bank activities and limits on foreign entry have moderate values. Insurance penetration is measured using the ratio of life and non-life insurance premium volume to GDP, suggesting that this insurance growth is 5.05% on average. Market capitalisation to GDP is 264% on average. Finally, institutional factors including financial freedom (FF) and property rights (PR) score 58 and 51 of 100, respectively, indicating that the degree of financial openness and protection of property are moderate.

The Lerner index is computed at bank-level for each period. Higher index values indicate greater market power. To detect the effect of the regulatory index (banking regulations) on competition behaviour in the Thai banking industry, four

sub-groups are employed: bank activities, limited entry, bank capital, and deposit insurance. However, to avoid model specification error, this study includes other relevant variables: market structure, inter-industry competition, institution, and bank characteristics. The meanings of explanatory variables, including their hypotheses in equation 2.4, are described as follows.

Firstly, the market structure can be measured by the concentration ratio or the HHI. However, this paper employs the concentration ratio of the largest four banks (CR4), i.e. BBL, KTB, SCB, and KBANK to investigate their influence on the competition in the Thai banking industry. According to the SCP paradigm and efficiency hypothesis, it is presumed that the four-bank concentration positively relates to the degree of competition. Secondly, in the context of bank regulation and supervision in the Thai banking sector, the BOT implemented the FSMP and Basel Accords (I, II, III). Essentially, there are four basic categories: restrictions on bank activities (security, insurance, and real estate), limit on foreign bank entry, deposit insurance coverage, and capital requirement (see details in Appendix C). Regarding the limit on bank activities and foreign bank entry, there are two data sources: the bank regulation and supervision survey of the World Bank (Barth et al., 2013) and newly constructed indices namely the dataset as a unique source in the Thai banking industry.

In terms of bank activities, the restrictions are measured according to conditions for engaging in the business of securities, insurance, and real estate. The restrictions indicate whether banks can earn non-interest income from these activities. The definition of regulatory restrictions on bank activities can be separated into two approaches. Firstly, an index based on the restrictions for bank activities ranging from 0 to 12, i.e. higher values indicate fewer restrictions (dataset from the World Bank). Secondly, an index calculated by the number of relaxed restrictions on securities, insurance, and real estate activities (newly constructed dataset). A higher index indicates that the banking sector has fewer activity restrictions.

Table 3.3 Summary statistics. Variables are defined in Appendix C

	Mean	Max.	Min.	Std. Dev.	Obs.
Bank competition					
- Lerner index	0.33	0.71	-0.35	0.12	600
Market structure					
- CR4	0.73	0.77	0.69	0.02	60
- HHI	0.16	0.17	0.15	0.01	60
Regulation indices on bank activity and entry (World Bank)					
- Restrictions on bank activities	6.33	7.00	5.00	0.94	60
- Limit for foreign bank entry in Thailand	2.07	3.00	0.00	1.34	60
New regulation indices on bank activity and entry					
- Number of new restrictions on bank activities	2.83	5.0	0.00	1.49	60
- Number of new commercial banks registered in Thailand	6.72	12.00	0.00	3.85	60
- Number of new foreign branches	2.10	3.00	0.00	1.29	60
- Ratio of the number of foreign branches to the total number of banks in Thailand	0.50	0.60	0.35	0.064	60
Regulations on deposit insurance and capital					
- Deposit insurance coverage	0.83	3.00	0.00	0.93	60
- Capital adequacy (actual capital ratio)	0.15	0.32	0.06	0.04	600
Inter-industry competition					
- Insurance penetration volume to GDP (%)	5.05	6.58	3.88	0.82	60
- Stock market capitalisation to GDP (%)	264.22	447.38	102.56	90.04	60
Institution					
- Financial freedom	58.00	70.00	50.00	9.10	60
- Protection of property rights	51.67	70.00	40.00	9.61	60
Control variables					
NPL to loans	0.09	0.33	0.01	0.06	600

Source: Thomson Reuters Datastream, World Bank, Heritage Foundation Database, Worldwide Governance indicator, and author's calculation

Notes: The unit root test is employed to investigate whether or not these variables are stationary. The results show that the panel data (the Lerner index, actual capital ratio, and NPL to loans) are stationary at level, but time series data (regulatory indices, insurance penetration volume to GDP, stock market capltalisation to GDP, financial freedom, and protection of property rights) are stationary at first difference. In addition, the time series data is adjusted in a different form, associated with panel data for regression estimation in equation 4. The results seem poor, especially since regulation indices in different forms cannot significantly explain the evolution of competition. Therefore, this paper uses time series data at level in the equation.

In terms of foreign bank entry, the definition of limited entry in this study can be divided into two groups. Firstly, it relates to whether foreign banks enter the Thai banking industry through A&M, a subsidiary, branch, or joint venture, based on the World Bank dataset. Secondly, to measure the effect of foreign bank penetration on the domestic banking system, there are three newly constructed indices: (i) the number of new entries through commercial banks registered in Thailand, including Thai commercial banks, retail banks, and subsidiaries, (ii) the number of new foreign bank branches, and (iii) the ratio of foreign banks to the total number of banks in the domestic banking system.

There are two main hypotheses for assessing the impact of restrictions on bank activities and foreign bank penetration on the evolution of competition. Fewer restrictions on bank activities can improve competition among banks. According to the contestable market hypothesis, foreign bank entry improves the degree of competition, when they find it easier to enter the domestic bank market until normal profit among banks is equal to zero.

For other bank regulations, deposit insurance is measured by the degree of limited deposit insurance, and the actual capital ratio in each bank is a proxy for capital stringency in the Thai banking sector. Deposit insurance in Thailand is assessed through the degree of limited deposit guarantee. Value is added to the index if the deposit guarantee is 100, 50, or 25%, when it scores 1, 2, and 3, respectively. However, if the deposit insurance system is not implemented, the score would be 0. Bank capital regulation in Thailand is based on the Basel standard, measured by the ratio of bank capital to risk-weighted assets. The actual capital ratio represents the evolution of bank capital requirements. Assuming that (i) the higher capital requirement weakens the competition (market power) and a lower level of deposit insurance encourages the competition (market power).

In addition, this study employs two additional indices to capture the institutional environment: financial freedom and property rights. The two institutional indices constructed by the Heritage Foundation can negatively relate to the degree of competition (Delis, 2012). The financial freedom index ranges from 0 to 100, and a higher index implies an increase in a country's financial freedom. The index for the protection of property rights ranges from 0 to 100. The greater the protection of

property rights, the better. According to Mirzaei and Moore (2014), the protection of property rights also enhances the competition. For inter-industry competition in the Thai financial system, the capital market and insurance companies provide competition for the Thai banking industry. Therefore, stock market capitalisation to GDP and insurance premium volume to GDP are proxy rivals for the banking sector. Both the capital market and insurance market are likely to weaken competition among banks. After the Thai financial crisis in 1997, bank regulators were concerned with non-performing loans (NPLs) affecting bank profits. The ratio of NPLs to total loans can be taken as a proxy for bank risk. The percentage of NPLs to total loans on listed banks in Thailand have a negative impact on market power. All explanatory variables for the evolution of bank competition can be shown as follows.

$$competition\ index_{it} = \beta_0 + \beta_1 \cdot Market\ structure_t + \beta_2 \cdot Regulation_t + \beta_3 \cdot Inter - industry_t + \beta_4 \cdot Institution_t + \beta_5 \cdot Bank\ characteristics_{it} + \varepsilon_{it} \quad (2.4)$$

where i is the bank index and t is time.

3.4 Empirical results

This section focuses on the effect of financial regulations on bank competition in Thailand from 2001–2015. The estimation of the Lerner index is compared to the results of market competition among banks and/or over the period. Equation 2.4 is then estimated by regressing the evolution of competition on the potential determinants, especially the regulatory variables. The results can be considered as follows.

3.4.1 Measuring the degree of competition: Lerner index

The estimated coefficients in Table 3.4 are used to calculate the marginal cost for each bank from 2001-2015. This is the marginal cost of total output (total assets) computed from the translog cost function in equation (2.2) using panel data (a fixed-effects model is estimated).

Table 3.4 Estimated coefficients from the TCF used for the marginal cost calculation

Coefficients	β_1	β_1	γ_1	γ_2	γ_3
Values	0.608**	0.001	0.041	-0.032	0.039***
(S.E.)	(0.305)	(0.009)	(0.033)	(0.034)	(0.014)

Notes: Standard errors exist below the coefficients in parentheses. ** and * indicate the statistical significance at 5 and 10%, respectively.

Figure 3.1 presents the average Lerner indices among banks, changing over time and calculated in both equally weighted and weighted form using asset market share. Overall, these Lerner indices imply monopolistic competition in the Thai banking industry. Furthermore, they imply that the evolution of competition continues to decrease. In particular, the degree of competition in the Thai banking industry clearly decreased from 2001–2003. However, the degree of competition was higher after the implementation of FSMP1 during the period from 2004–2006. It has subsequently become more competitive and stable over the last six years. This result is consistent with that of Pisedtasalasai and Rujiratpichathorn (2017) and Kubo (2006), who indicated that the degree of bank competition decreased in the 2000s and then became more stable due to the adoption of the FSMP, especially FSMP phase1 (2004–2008) which contributed to a stable baking system through M&A.

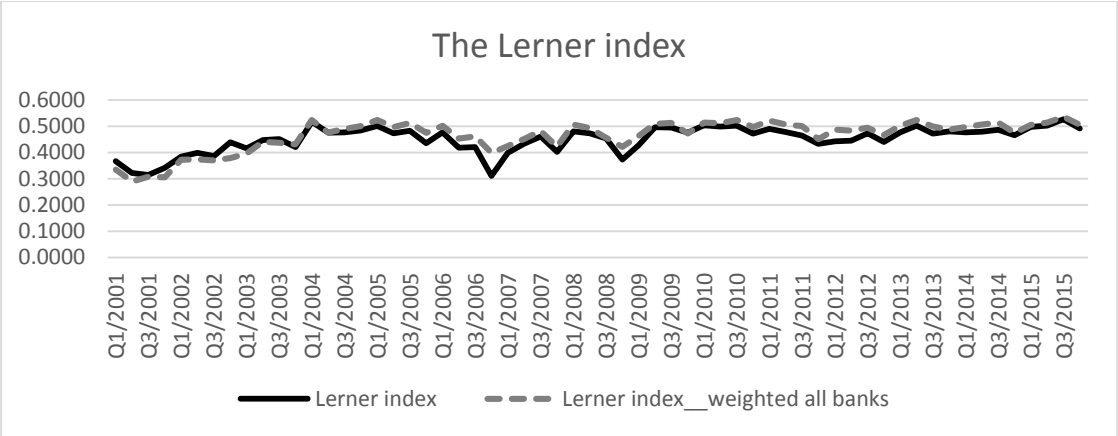

Figure 3.1 The Lerner index
Source: Author's calculations

Furthermore, according to Table 3.5, the results indicate that both large and small and medium banks are significantly different in terms of their degree of competition (or market power). Specifically, with testing (T-test) the difference in means (Lerner indices) between the large and medium and small banks, it can be interpreted that medium and small-sized banks are significantly more competitive than large banks due to their lower market power.

Table 3.5 Estimated Lerner index for various bank types

	All banks	Large banks	Medium and Small banks	T-test
Lerner index (Equally weighted)	0.451	0.488	0.426	5.771***
Lerner index (Weighted by market share)	0.465	0.485	0.412	6.423***
Observations	600	240	360	

Source: Author's calculations

Notes: This table displays the average Lerner index, divided into three groups: all banks, large banks, and medium and small banks. In addition, the t-statistics (for testing differences between means) also reported whether there is a difference in the means of Lerner indices between large and medium and small banks.

3.4.2 The impact of bank regulation on competition in the Thai banking industry

The role of regulation in bank competition is investigated through a two-step procedure. Firstly, regulatory variables are separated from other groups (structure, inter-industry, and institutional) and regressed using the Lerner index. Secondly, other independent variables are added to the model to correct specification errors during regression. This is also a robustness test.

Table 3.6 shows the preliminary regression results in the context of the relationship between regulations and competition in Thai banking, reported in four models. These models are different in activity restriction and limited entry. In other words, model 1 is based on the World Bank dataset, while models 2, 3, and 4 rely on Thailand's unique dataset.

Overall, the results reveal that lower activity restriction and higher capital regulation are significantly related to decreased competition (higher market power) in the Thai banking sector, while limits on bank entry cannot obviously explain the evolution of bank competition. Specifically, lower limits for foreign bank entry through M&A, subsidiaries, and branches significantly improve competition. Whereas new entries into the Thai banking sector (in the context of the number of new commercial banks registered in Thailand, the entry of new foreign bank branches, and the ratio of foreign bank branches to the total number of banks in Thailand) are not significantly correlated to competition. Furthermore, lower deposit insurance coverage strengthens the competitive environment in the Thai banking sector. However, it is plausible that the results are unreliable due to the omission of some relevant variables from the model (specification errors in the regression model). Consequently, other independent variables should be included in the model.

For the next step, structure, inter-industry competition, and institutional groups are included in the models as independent variables. However, the estimation of various models by separating one group of independent variables from another and combining them with the regulation indices is preferred. Consequently, the institutional quality variables, i.e. the degree of financial freedom and protection of

Table 3.6 Relationship between bank regulation and competition

	Model 1 (World Bank)	Model 2 (New indices)	Model 3 (New indices)	Model 4 (New indices)
- Constant term	- 0.702***	0.131***	0.137***	0.150 **
	(0.202)	(0.039)	(0.027)	(0.071)
- Relaxed restrictions on bank activities	0.188***			
	(0.042)			
- Limit for foreign bank entry into Thailand	- 0.134***			
	(0.029)			
- Number of relaxed restrictions on bank activities		0.039***	0.040***	0.041 ***
		(0.008)	(0.008)	(0.008)
- Number of new commercial banks registered in Thailand		0.001		
		(0.003)		
- Number of new foreign bank branches			0.002	
			(0.008)	
- Ratio of foreign branches to the total number of banks in Thailand				- 0.019 (0.125)
- Deposit insurance coverage	0.012*	- 0.042***	- 0.042***	- 0.042 ***
	(0.006)	(0.013)	(0.012)	(0.012)
- Capital adequacy (actual capital ratio)	0.953***	0.889***	0.889***	0.889 ***
	(0.116)	(0.181)	(0.176)	(0.173)
- Ratio of NPL to total loans	- 0.273	-0.154	-0.172	- 0.183
	(0.167)	(0.127)	(0.134)	(0.136)
- Number of observations	600	600	600	600

Note: This estimation is based on panel data regression with a fixed effect. Cluster-robust standard errors in parentheses are calculated using the White period method.
* Significant at 10%; ** Significant at 5%; *** Significant at 1%. Descriptions of each variable can be found in Appendix C.

property rights significantly relate to competition, while inter-industry competition and structure variables do not. Therefore, institutional factors are included in the second group. Subsequently, the four-bank concentration (CR4), insurance penetration, and market capitalisation are included as explanatory variables in the model.

Table 3.7 reports the impact of bank regulations and institutional quality on competition. The additional regression results are presented in models 4–7 as follows. Firstly, the overall results indicated that all independent variables significantly affect the competitiveness of the banking system. Secondly, in terms of bank activities, fewer restrictions increase market power among Thai banks. Thirdly, the limits on foreign entry and number new banks enhance competition. However, the ratio of foreign bank branches to the number of total banks positively relates to competition, i.e. this contradicts the hypothesis. Fourthly, banks with higher capital strengthen the competitive market, but the deposit insurance scheme does not directly affect competition. Finally, better property rights protection can improve a competitive market, while the financial freedom factor cannot exactly predict changes in the competitive environment. Table 3.8 shows the main models, including all groups as independent variables. Overall, bank regulation and institutional quality used to explain the evolution of competition provide similar results to models 5–8.

There are five important results in the context of bank regulation. In measuring the relaxation of bank activity restrictions (World Bank dataset) and the number of relaxed restrictions on bank activities (newly constructed dataset), the findings indicate that fewer limits on bank activities weaken competition in the Thai banking industry via market power, contradicting economic theory. There are two reasons for supporting this result. Each bank has its own business model. For example, large banks tend to focus on corporate credits, while smaller banks prefer to lend mainly to households. Therefore, fewer limits on bank activities encourage higher market power. In addition, there is a large concentration of four to five banks in the Thai banking industry, limiting the competition from other banks. In terms of new bank or foreign bank entry through M&A, subsidiaries, and branches, the result reveal that these improve the degree of competition. However, using the ratio of foreign branches to the total number of banks in Thailand as a proxy of foreign branch

Table 3.7 The impact of bank regulation and institutional quality on competition

	Model 5 (World Bank)	**Model 6 (New indices)**	**Model 7 (New indices)**	**Model 8 (New indices)**
- Constant term	- 0.172 (0.164)	0.464*** (0.107)	0.434*** (0.107)	0.27 *** (0.082)
- Relaxed restrictions on bank activities	0.118*** (0.034)			
- Limit for foreign bank entry into Thailand	- 0.100*** (0.025)			
- Number of relaxed restrictions on bank activities		0.034 *** (0.009)	0.031 *** (0.008)	0.037 *** (0.011)
- Number of new commercial banks registered in Thailand		- 0.005* (0.003)		
- Number of new foreign branches			- 0.014* (0.008)	
- Ratio of foreign branches to the total number of banks in Thailand				0.328** (0.159)
- Deposit insurance coverage	- 0.004 (0.007)	- 0.027*** (0.010)	- 0.030*** (0.010)	- 0.02 *** (0.007)
- Capital adequacy (actual capital ratio)	0.970*** (0.119)	0.941*** (0.146)	0.935*** (0.148)	0.956 *** (0.138)
- Financial freedom	0.001* (0.0005)	- 0.002* (0.001)	- 0.001 (0.001)	- 0.002 ** (0.001)
- Protection of property rights	- 0.004*** (0.001)	- 0.004*** (0.001)	- 0.004*** (0.001)	-0.003 ** (0.001)
- Number of observations	600	600	600	600

Note: This estimation is based on panel data regression with a fixed effect. Cluster-robust standard errors in parentheses are calculated using the White period method. * Significant at 10%; ** Significant at 5%;*** Significant at 1%. Descriptions of each variable can be found in Appendix C.

Table 3.8 Determinants of bank competition

	Model 9 (World Bank)	**Model 10 (New indices)**	**Model 11 (New indices)**	**Model 12 (New indices)**
- Constant term	- 0.741** (0.360)	0.031 (0.357)	- 0.015 (0.354)	-0.287 (0.354)
- CR4	0.847** (0.420)	0.495 (0.474)	0.534 (0.471)	0.513 (0.475)
- Relaxed restrictions on bank activities	0.106*** (0.034)			
- Limit for foreign bank entry into Thailand	- 0.092*** (0.024)			
- Number of relaxed restrictions on bank activities		0.024** (0.010)	0.023** (0.010)	0.024 ** (0.01)
- Number of new commercial banks registered in Thailand		- 0.006* (0.013)		
- Number of new foreign branches			- 0.014* (0.008)	
- Ratio of foreign bank branches to the total number of banks in Thailand				0.477 ** (0.192)
- Deposit insurance coverage	- 0.038*** (0.012)	- 0.060*** (0.013)	- 0.061*** (0.013)	- 0.056 *** (0.012)
- Capital adequacy (actual capital ratio)	0.958*** (0.127)	0.933*** (0.153)	0.927*** (0.159)	0.956 *** (0.135)
- Insurance penetration volume to GDP (%)	0.041 ** (0.020)	0.067*** (0.024)	0.057*** (0.20)	0.092 *** (0.03)
- Stock market capitalisation to GDP (%)	- 0.0004 (0.0001)	- 0.0002 (0.0001)	- 0.0001 (0.0001)	- 0.0002 * (0.0001)
- Financial freedom	0.0004 (0.0005)	- 0.002** (0.001)	- 0.001 (0.001)	- 0.003 *** (0.001)
- Protection of property rights	- 0.006*** (0.001)	- 0.005*** (0.001)	- 0.005*** (0.001)	-0.005 *** (0.001)
- Number of observations	600	600	600	600

Note: This estimation is based on panel data regression with a fixed effect. Cluster-robust standard errors in parentheses are calculated using the White period method. A constant term was added but not reported. * Significant at 10%; ** Significant at 5%; ***Significant at 1%. Descriptions of each variable can be found in Appendix C.

penetration indicates that foreign bank branches negatively relate to competition in the Thai banking industry, conflicting with the empirical literature review. However, according to Thai financial reform through FSMP, a number of existing foreign bank branches (such as Standard Chartered Bank, Industrial and Commercial Bank of China, and Bank of China) have upgraded to Thai commercial banks (commercial banks registered in Thailand) during the period from 2004–2015. This phenomenon indicates that a lower foreign bank ratio may contribute to an increase in competition or a decrease in market power for Thai commercial banks.

Lower deposit insurance coverage tends to increase the degree of competition. This result is consistent with that obtained by Shy et al. (2016). If the degree of deposit insurance is lower, then the deposit market among banks is more competitive. As for capital stringency, the result suggests that a higher capital requirement leads to a less competitive market. This implies that banks with higher levels of capitalisation may reduce the competition associated with a higher degree of market power because capital stringency obstructs new players through the higher fixed cost of entry. In addition, banks with higher capital exhibit less risky behaviour in a less competitive market (Soedarmono et al., 2013).

Apart from these bank regulations, in terms of the market structure according to assets, the market share of the largest four banks in the industry does not explicitly change the bank concentration (Figure 3.2). Therefore, the resulting effect of concentration on the degree of competition is inconclusive. In terms of institutional quality, property rights positively relate to the degree of competition, but financial freedom seems to enhance the competitive environment. However, even if financial freedom is excluded from the models, the results are still robust.

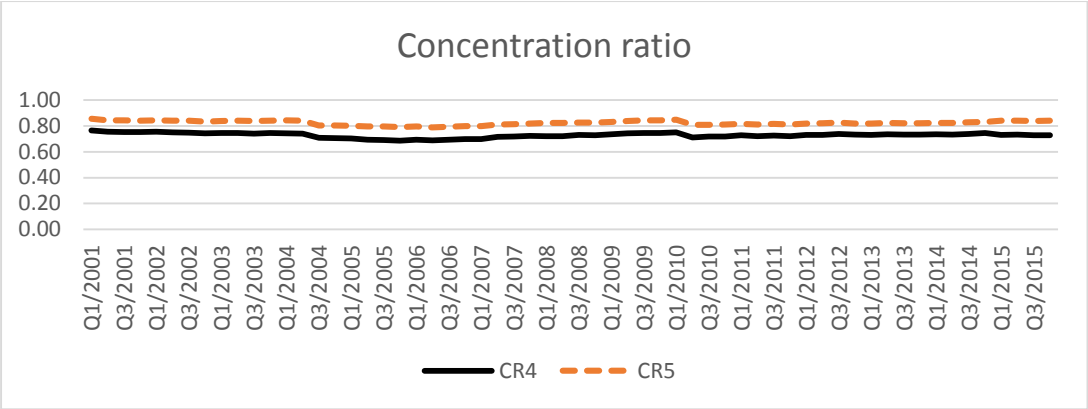

Figure 3.2 Concentration ratio (CR) in ten commercial banks registered in Thailand

Source: Bank of Thailand, Author's calculations

In terms of inter-industry competition, higher insurance penetration in the Thai financial system (the ratio of insurance premium volume to GDP) significantly weakens the degree of market power. Stock market capitalisation shows no statistical significance with the Lerner index, although the coefficient gives the right sign according to the hypothesis (capital market competing with the bank sector).

3.5 Conclusions

A competitive banking industry is subject to the most stringent regulations. The Thai government has attempted to implement different forms of banking regulations. Therefore, this study aims to investigate the effect of such regulations on competition. Competition is measured using the Lerner index, while regulation indices are constructed to explain the degree of stringency. Bank regulations are divided into four groups: (i) restrictions on banking activities, (ii) limitations on foreign banks entry, (iii) capital stringency, and (iv) deposit insurance. To detect the relationship between other independent variables and the competition, market structure, inter-industry, and institutional quality are also included. The bank-level data in this study covers ten commercial banks for the period from 2001–2015.

The results reveal the distinctive characteristics driving competition in Thailand. The main findings suggest that: (i) the degree of competition among Thai banks decreased over 15 years ago, (ii) higher limits on entry, greater capital restriction, and weaker property protection rights reduce competitiveness, (iii) bank

concentration (market structure) cannot explain the evolution of the Thai banking system, and (iv) fewer activity restrictions relate to a less competitive environment. This is not in line with economic theory, for two reasons. Firstly, each bank has its own business model. Large banks tend to target corporate clients, while smaller banks prefer to focus on consumer loans. Other banks operate leasing or concentrate on SMEs. Hence, the overlap in the clientele base could limit competition. Secondly, there is a large concentration of four or five banks in the Thai banking industry, limiting the competition from other banks.

CHAPTER 4

BANK COMPETITION AND THE BANK LENDING CHANNEL OF MONETARY POLICY IN THAILAND

4.1 Introduction

The objective of this chapter is to investigate how competition affects the bank lending channel of monetary policy in Thailand. In addition, the impact of foreign bank entry on the bank lending channel is also investigated. The banking sector is an important financial intermediary and the main source of finance for firms and households in developing countries. Theoretically, bank loans can help to solve the problem of asymmetric information in financial markets. In addition, this role can affect the effectiveness of the monetary policy transmission mechanism through the bank lending channel (Bernanke & Blinder, 1988; Bernanke & Gertler, 1995). The bank lending channel is usually referred to as the impact of monetary policy change on bank loans which subsequently affect economic activities, such as consumption and investment. For example, a contractionary monetary policy will decrease bank reserves and bank deposits, subsequently decreasing the number of loans available. This result then leads to a decrease in consumption and investment. However, if bank deposits can perfectly substitute other sources of funds, then this mechanism need not exist (Mishkin, 1996).

There are many studies regarding the influence of the bank lending channel. Early analysis used only aggregate data. For example, Bernanke and Blinder (1992) tested the relationship between bank balance sheet variables (loans, deposits, and securities) and the rate of federal funds. The results show that monetary policy is significantly related to bank loans. However, with aggregate data, it is difficult to separate loan supply and demand. To correct this problem, disaggregated data on banks (balance sheet and income statement) has been used instead Kashyap and Stein (1995) as seminal pioneers employed bank-level data to investigate the bank lending

channel. Subsequent studies have also found that typical bank characteristics (size, liquidity, and capitalisation) may influence the bank lending channel in different ways (Altunbaş, Fazylov, & Molyneux, 2002; Ehrmann, Gambacorta, Martínez-Pagés, Sevestre, & Worms, 2001; Kashyap & Stein, 2000).

Furthermore, it can be argued that bank competition can align with the transmission of monetary policy via this channel. However, this issue has been explored in a number of research studies but there is no consensus on how bank competition affects the bank lending channel. In particular, intensive competition has a positive impact on monetary policy via the bank lending channel (Fungacova et al., 2014; Leroy, 2014). The idea is that stronger bank competition may reduce access to alternative fund sources (certificates of deposit and interbank loans), potentially cutting bank lending. This strengthens the monetary policy transmission mechanism. Conversely, there is some evidence to support that increased competition weakens this channel (Gunji, Miura, & Yuan, 2009; Olivero, Li, & Jeon, 2011b). One plausible reason is that higher bank competition relates to an increase in the market share of large banks, giving them easier access to other sources of funds than smaller banks. Therefore, this tends to weaken the bank lending channel through monetary policy transmission.

In addition, there are a few empirical research studies that only focus on the bank lending channel in Thailand. Disyatat and Vongsinsirikul (2003) examine the role of the bank lending channel using aggregate data with a VAR model, showing that bank lending was an important channel in the transmission of monetary policy. Charoenseang and Manakit (2007) provided consistent evidence in the Thai financial system to support that the bank lending channel is stronger than the interest rate channel. More recently, Mahathanaseth and Tauer (2019) suggested that small banks are more responsive than large banks to the monetary policy of the bank lending channel, reflecting that large banks can easily access other funding sources.

Unfortunately, despite a number of studies exploring the lending channel in individual countries, there is no empirical research concerning the effect of bank competition on monetary policy transmission via the bank lending channel in Thailand from 2001–2015 employing disaggregated data from bank balance sheets. In addition, after the Thai financial crisis in 1997, the BOT implemented the FSMP to

support competition and stability among banks, such as bank consolidation, reducing activity restrictions, deregulation of foreign banks entry, etc., so the bank lending channel may have been undermined. Therefore, this study examines how competition influences monetary policy transmission via the bank lending channel.

4.2 Literature Review

Early studies on the transmission mechanism of monetary policy have started with interest rate channel (the money view). However, this channel cannot fully explain monetary transmission, and Bernanke and Gertler (1995) proposed the credit view. The credit channel view is amplified by the interest channel through the external finance premium (cost of funding minus retained earnings). This additional effect then influences the cost and availability of credit, thereby aggregating demand (firms and households). The credit channel can be separated into two groups: the balance sheet and bank lending channel.

Theoretically, the effectiveness of bank lending relies on the degree of substitution between deposit and alternative sources of funds (Mishkin, 1996). In addition, empirical research suggests that the decline in traditional banks, financial deregulation, and financial innovation may also reduce bank lending channel performance (Bernanke & Gertler, 1995).

During the 1990s, many monetary economists attempted to investigate the existence of the bank lending channel. Bernanke and Blinder (1992) made an early contribution to this task by attempting to identify how the monetary policy stance (federal fund rate) affects the bank lending channel through monetary transmission. Their analysis is based on a VAR model with aggregated US data and found evidence to support the existence of the bank lending channel. Specifically, the expansion of monetary policy i.e. a decrease in the interest rate can increase the amount of bank lending to the private sector. However, the study confronted a significant problem of omitting aggregate loan data from loan demand. Consequently, studies have used disaggregate data from the balance sheet and income statement (bank-level data) to correct this problem. This comparative data has led to a new contribution on how banks with varying characteristics (size, liquidity, capitalisation, ownership) react

differently to monetary policy shock through the credit channel. In other words, if greater financial constraints also reflect a higher external finance premium, then this weakens the bank lending channel of monetary policy.

Many empirical articles attempt to identify how bank characteristics influence this channel. The literature shows that the bank lending channel may be strongly transmitted through small banks rather than large (Kashyap & Stein, 1995, 2000). It is suggested that the response of bank loans to monetary policy might be different across bank size since larger banks offer relatively more commercial and industrial (C&I) loans which are relatively less reactive to monetary policy shock. Furthermore, studies have found illiquid (or undercapitalised) banks strengthen the monetary transmission mechanism (Altunbaş et al., 2002; Gambacorta, 2005; Kishan & Opiela, 2000). They indicated that banks with higher liquid assets (cash and securities) can maintain their lending position against changes in monetary policy. In addition, If well-capitalised banks undertake less credit risk (or have a greater ability to increase uninsured deposits), lending for these banks is lower following implementation of a tight monetary policy. However, some studies have no evidence of a bank lending channel with bank-specific characteristics (Favero, Giavazzi, & Flabbi, 1999; Oliner & Rudebusch, 1995).

Apart from these bank characteristics, Ananchotikul and Seneviratne (2016) added new variables such as the degree of foreign bank penetration in the domestic banking industry and globalisation. They mentioned that higher foreign bank penetration and relaxed global financial conditions tend to weaken the bank lending channel. Global financial easing increases capital flow and affects domestic liquidity. Hence, monetary policy tends to have a smaller impact on the restrictions of bank lending. Moreover, a higher degree of foreign bank penetration in the domestic banking sector provides greater access to external fund sources, lowering the degree of responsiveness of bank loans to monetary policy. Wu, Luca, and Jeon (2011) examine the effect of foreign bank entry on the bank lending channel in emerging economies, finding that foreign bank penetration softens competition among banks. Jeon and Wu (2014) found consistent evidence from Asian countries, including Thailand, to affirm that bank lending effectiveness was undermined by greater foreign bank entry during the 2008–2009 crisis. Li and Lee (2015) compared the effectiveness

of the bank lending channel between Chinese and foreign banks in China, finding that monetary policy affected foreign banks' lending less than those of the domestic banks.

In addition, a few studies argue that a competitive banking environment may be key to the transmission of monetary policy, either weakening or strengthening the mechanism via the bank lending channel. Assessing the degree of competition also presents a challenge.

There are two main approaches to measuring the degree of banking competition: structural and non-structural. Initially, the structural approach using concentration indices and the HHI is used to measure competition. However, Claessens and Laeven (2004) suggested that these measurements may be not good predictors of competition. A high level of concentration can occur in either the monopolistic competition market with a high degree of competition or the oligopolistic market with a lower degree of competition. Hence, the degree of concentration cannot be a good indicator for competitiveness. Alternatively, the non-structural approach directly measures market power by observing bank pricing behaviour, such as with the Panzar-Rose model and the Lerner index.

During the last two decades, a number of studies have examined whether bank competition influences the bank lending channel. Cecchetti (1999) investigated the varying effects of the ECB monetary policy across countries using bank characteristics (such as size and concentration). The results suggest that an increase in the number of banks does not lead to a decrease in banking industry concentration. In addition, the impact of monetary policy shock was different among countries in size and concentration.

To measure bank concentration and the bank lending channel, Adams and Amel (2005) applied the HHI, indicating that less concentrated banks enhanced the bank lending channel of monetary policy. Furthermore, the effectiveness of the bank lending channel among banks in rural areas is greater than in urban areas, because clients in urban markets have better access to external financing and do not need to rely on bank credit as the main source of funding. On the other hand, Olivero, Li, and Jeon (2011a) employed the five-firm concentration ratio and HHI to assess the degree of concentration in Asian and Latin American countries during the period from 1996–

2006. Their study indicated that increased consolidation in the banking system negatively affected monetary policy effectiveness via the bank lending channel. However, Olivero et al. (2011b) provided a different result when applying the H-statistic as a potential and broader measurement of bank competition, i.e. stronger competition undermines the bank lending channel. Gunji et al. (2009), who applied the H-statistic, showed consistent evidence to support that the more competitive banks make the bank lending channel less effective. Yang and Shao (2016) investigated whether the impact of monetary policy on the bank lending channel depends on the degree of bank competition, measured using the Lerner index. They confirm that stronger competition weakens the transmission of monetary policy through the bank lending channel.

Conversely, Leroy (2014) uses both the Lerner index and market structure index to prove how these indices, as proxies of the degree of competition, relate to the monetary policy transmission in Eurozone countries for the period from 1999–2011. His research revealed that the effect of bank competition on the bank lending channel was significant i.e. a more competitive banking industry supports this channel. In addition, Fungacova et al. (2014) presented a similar outcome, suggesting that banks with greater market power soften the monetary policy of the bank lending channel. Khan, Ahmad, and Gee (2016) employed different competition indicators (CR5, HHI, Lerner index, and Boone) showing that the effect of monetary policy on bank lending was weakened by a less competitive banking environment in five ASEAN countries.

4.3 Methodology

4.3.1 Data

This study employs a balanced panel dataset. The data comprises quarterly bank-level data and macroeconomic data for the period from 2001–2015 obtained from Thomson Reuters Datastream, CEIC Data, and BOT. The dataset covers ten commercial banks registered in Thailand: Bangkok Bank (BBL), Krung Thai Bank (KTB), Siam Commercial Bank (SCB), Bank of Ayudhya (BAY), TMB Bank (TMB), Thanachart Bank (TCAP), CIMB Thai Bank (CIMB), Tisco Bank (TISCO), and Kiatnakin Bank (KKP). There are 600 observations in the panel dataset. The bank

sample includes 240 observations for the group of four largest banks, 240 observations for the four medium banks, and 120 observations for the two small banks. The grouping criteria is based on the Bank of Thailand definition. Table 4.1 provides a statistical summary of the variables used in equation 1.

Table 4.1 Summary of statistics

Variables	Mean	Max.	Min.	Std. Dev.	Obs.
Loan growth	0.026	0.662	-0.44	0.063	590
Policy rate (%)	2.446	5	1.25	1.028	60
LERNER	0.335	0.709	-0.353	0.122	600
SIZE	-3.33E-12	1.478	-2.161	1.037	600
LIQ	-0.004458	0.320	-0.182	0.086	600
CAP	-4.80E-06	0.214	-0.091	0.047	600
GDP (%)	4.06	15.33	-4.31	3.307	60

Source: Thomson Reuters Datastream, Bank of Thailand, and author's calculation

Notes: The unit root test is employed to ascertain whether these variables are stationary. The results show that these variables are stationary at level.

4.3.2 Econometric model

In this subsection, the following three equations are employed to investigate how the degree of competition in Thai commercial banks affects the bank lending channel. Equation (4.1) regresses the loan growth ($\Delta \text{loans}_{i,t}$) on the stance of the monetary policy indicator (mp_t), bank characteristics ($\text{BC}_{i,t}$), competition index ($\text{Compet}_{i,t}$), GDP growth (ΔGDP_t), and interaction term between a change in the monetary policy indicator and the competition index (or bank characteristics).

$$\Delta \ln \text{loans}_{i,t} = \theta_i + \alpha \text{mp}_t + \omega \text{BC}_{i,t-1} + \eta \text{BC}_{i,t-1} \text{mp}_t + \gamma \text{Compet}_{i,t} + \beta \text{Compet}_{i,t} * \text{mp}_t + \psi \Delta \text{GDP}_t + \varepsilon_{it} \quad (4.1)$$

with i = 1,…,N and t = 1,…,T represent bank i and the time period (quarterly), respectively. According to Ehrmann et al. (2001), the significant coefficient β implies that bank competition can affect the bank lending channel and GDP growth is included to control the demand effect (changes in the demand for loans). In addition, the Lerner index is used to assess the degree of competition (Fungacova et al., 2014)

and bank characteristics comprise bank size, liquidity, and capitalisation. The potential endogeneity between loan growth and bank characteristics is reduced by using one-quarter lag values for the bank characteristics, defined as follows: Size is calculated by the log of total asset (A). Liquidity is assessed as the ratio of liquid assets to total assets ($\frac{L}{A}$). Capitalisation is given by the ratio of capital to total assets ($\frac{C}{A}$). These bank characteristics are normalised with respect to the sample mean. The variables can be defined as (Gambacorta, 2005):

$$Size_{i,t} = logA_{i,t} - \frac{1}{N_t}\sum_i logA_{i,t} \quad (4.2)$$

$$Liquidity_{i,t} = \frac{L_{i,t}}{A_{i,t}} - \frac{1}{T}\sum_t\left(\frac{1}{N_t}\sum_i \frac{L_{i,t}}{A_{i,t}}\right) \quad (4.3)$$

$$Capitalisation_{i,t} = \frac{C_{i,t}}{A_{i,t}} - \frac{1}{T}\sum_t\left(\frac{1}{N_t}\sum_i \frac{C_{i,t}}{A_{i,t}}\right) \quad (4.4)$$

4.4 Empirical results

This subsection shows the results for the effect of bank competition on the bank lending channel of monetary policy in Thailand. To examine this objective, three different models are generated based on equation 4.1. Model 1 is formed to detect the standard of bank lending channel with bank characteristics (size, liquidity, capital) and their interaction with the monetary policy interest rate without bank competition indicators. Model 2 substitutes the interaction between bank characteristics and monetary policy rate with the bank competition variables. Finally, model 3 combines models 1 and 2 with competition variables and interaction terms. In other words, model 3 is the optimal model for detecting the impact of competition on the bank lending channel and examining the effect of different bank characteristics on the bank lending channel. The three main results are as follows (Table 4.2).

Firstly, in terms of the standard of bank lending channel, the baseline result in model 1 suggests that the effect of monetary policy rates on loan growth is a negative sign, as expected, but not significant (only significant at the 85% level). In other words, this implies that there is no evidence on the bank lending channel in Thailand from 2001–2015. However, when the stance of monetary policy is associated with the degree of competition and bank characteristics in models 2 and 3 respectively,

Table 4.2 Effects of bank competition on the bank lending channel

Independent variables	Bank lending channel (Model 1)	Bank lending channel with competition (Model 2)	Bank lending channel with competition and all interactions (Model 3)
MP (Policy rate)	- 0.003	- 0.014*	- 0.017**
	(0.002)	(0.008)	(0.008)
Size (-1)	- 0.035*	- 0.029	- 0.025
	(0.019)	(0.019)	(0.016)
Liquidity (-1)	0.117	0.102	0.109
	(0.138)	(0.078)	(0.127)
Capitalisation (-1)	0.220	0.258*	0.412**
	(0.191)	(0.155)	(0.165)
MP x Size (-1)	0.001		- 0.002
	(0.002)		(0.002)
MP x Liquidity (-1)	- 0.012		- 0.006
	(0.029)		(0.025)
MP x Capitalisation (-1)	0.002		- 0.067
	(0.076)		(0.060)
Lerner index		- 0.078	- 0.105
		(0.087)	(0.083)
MP x Lerner index		0.035	0.046*
		(0.023)	(0.024)
GDP	0.002***	0.002***	0.002***
	(0.001)	(0.001)	(0.001)
Constant	0.023***	- 0.048	0.056*
	(0.004)	(0.033)	(0.032)
Observations	590	590	590
R-squared	0.144	0.150	

Notes: This estimation is based on panel data regression with a fixed effect. Cluster-robust standard errors in parentheses are calculated using the White period method. * Significant level at 10%; ** Significant level at 5%; ***Significant level at 1%.

the impact of the monetary policy rate on loan growth shows a significantly negative sign. This confirms that an increase (decrease) in the interest rate leads to a decrease (increase) in the loan growth rate, i.e. the standard bank lending channel exists in the Thai financial system.

Secondly, the interaction in terms of the monetary policy rate and bank-specific characteristics (size, liquidity, and capitalisation) is not significant. This implies that the difference in bank characteristics does not affect the bank lending channel. In addition, highly capitalised banks enhance loan growth. In terms of changes in the economy, GDP growth is positively related to loan growth.

Thirdly, in terms of competition and the bank lending channel, the results show the significant effect of competition on the bank lending channel in model 3. Specifically, the coefficient of interaction in terms of monetary policy rate and the Lerner index (MP × Lerner index) is positive and statistically significant. This suggests that increased market power weakens the bank lending channel. In other words, a decrease in the level of bank competition weakens transmission, for two reasons: (i) Banks with higher market power should have relatively easy access to alternative sources of funding, hence they are less responsive to monetary policy shock than banks with lower market power. (ii) Market power and potential profitability can influence the effectiveness of the bank lending channel (Gunji & Yuan, 2010). Specifically, profitable banks are less responsive to monetary policy shock. For example, if tight monetary policy results in fewer deposits, banks with low market power tend to decrease lending instead of increasing capital, i.e. these banks have greater capital costs. Moreover, this finding affirms many previous studies such as Fungacova et al. (2014) or Leroy (2014), indicating that a banking sector with higher market power (or less competition) reduces the transmission of the European Central Bank (ECB) monetary policy via the bank lending channel. In addition, this result confirms the recent work of Khan et al. (2016) on five ASEAN countries (Malaysia, Indonesia, Singapore, the Philippines, and Thailand), who apply four indicators to measure the competition (CR5, HHI, Lerner index, and Boone indicator). In particular, the results from the Lerner index show that increased market power weakens the bank lending channel.

In term of policy implications, this result confirms the findings of Fungacova et al. (2014), who suggest separating banking supervision from the conduct of monetary policy. This implies that stronger competition enhances the monetary policy of the bank lending channel, but competitive banking may lead to financial instability among banks, raising the question of conflict between price stability and financial stability. However, in this case, the BOT should provide reasons to support the FSMP which aims to increase competition in the banking industry of Thailand to maintain price stability.

In addition, over the past ten years, the impact of increased foreign bank entry on the monetary policy transmission mechanism through the bank lending channel has been of considerable importance. In Thailand, the entry of foreign banks into the country's banking industry underwent deregulation through A&M, subsidiaries, and foreign bank branches according to the FSMP from 2004–2015. On the other hand, as illustrated in Figures 4.1 and 4.2, the degree of foreign bank branch penetration, measured by the share of bank assets and ratio of foreign bank branches to the total number of banks, decreased from 2001–2015. This was due to some foreign bank branches upgrading to subsidiaries and full commercial banks through mergers. However, at the same time, new foreign bank branches also entered the Thai banking sector. Previous empirical studies tend to focus on measuring foreign bank penetration in the host country through an ownership dummy (the dummy is equal to 1 if the bank is foreign-owned during the study period, and 0 otherwise).

According to the results presented in Chapter 2, lower entry limits enhance Thai banking competitiveness. Consequently, this study investigates the extent to which new foreign bank entries influence the bank lending channel. Therefore, this paper employs two approaches for measuring foreign bank entry. The first variable is the number of new foreign branch entries, i.e. a higher index indicates greater foreign bank penetration. The second index is the limitation on foreign bank entry through mergers, subsidiaries, branches, and joint ventures. Value is added to the index if foreign banks can enter through mergers, subsidiaries, branches, and joint ventures, scoring 1, 2, 3, and 4, respectively. The indicator ranges from 0–4. To detect the variable of new foreign bank branches, the new player index (foreign bank branches)

is substituted for the competition index. The regression model from equation 1 is applied for estimation. As reported in Table 4.3, the main findings are as follows.

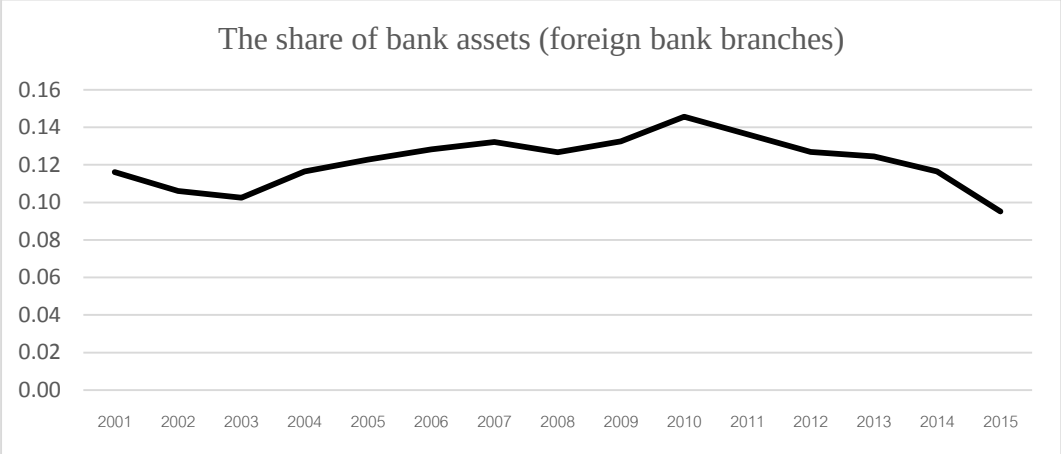

Figure 4.1 The share of bank assets (foreign bank branches)

Source: Bank of Thailand

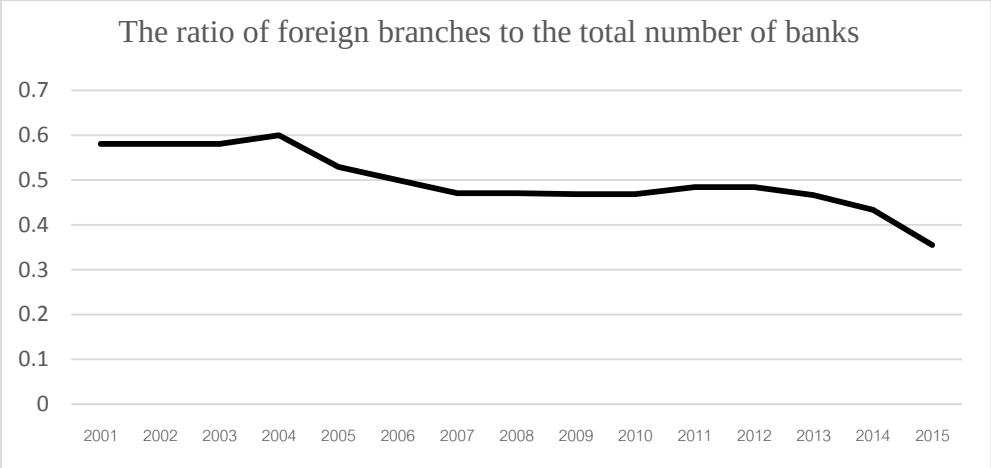

Figure 4.2 The ratio of foreign branches to the total number of banks

Source: Bank of Thailand

Table 4.3 Effect of new foreign bank branch entry on the bank lending channel

Independent variables	**Bank lending channel with new player index (foreign branches)**	**Bank lending channel with new foreign bank index and all interactions**
MP (Policy rate)	- 0.018***	- 0.019***
	(0.006)	(0.008)
Size (-1)	- 0.032	- 0.035*
	(0.020)	(0.019)
Liquidity (-1)	0.094	0.146
	(0.085)	(0.136)
Capitalisation (-1)	0.232	0.207**
	(0.129)	(0.170)
MP x Size (-1)		0.001
		(0.002)
MP x Liquidity (-1)		- 0.017
		(0.024)
MP x Capitalisation (-1)		0.011
		(0.067)
New entry foreign branches	- 0.014**	- 0.014**
	(0.007)	(0.007)
MP x New entry foreign branches	0.007**	0.007***
	(0.003)	(0.003)
GDP	- 0.002**	0.002**
	(0.001)	(0.001)
Constant	0.053***	0.055***
	(0.016)	(0.017)
Observations	590	590
R-squared	0.151	0.152

Note: This estimation is based on panel data regression with fixed effects. Cluster-robust standard errors in parentheses are calculated using the White period method. ***, ** and * indicate that each coefficient is significant at 1, 5, and 10%, respectively.

Table 4.4 Effects of foreign entry limitations on the bank lending channel

Independent variables	Limited entry index included	Bank lending channel with limited entry index and all interactions
MP (Policy rate)	- 0.009**	- 0.009**
	(0.004)	(0.003)
Size (-1)	- 0.033	- 0.035*
	(0.021)	(0.020)
Liquidity (-1)	0.089	0.127
	(0.083)	(0.133)
Capitalisation (-1)	0.230*	0.220
	(0.133)	(0.178)
MP x Size (-1)		0.001
		(0.002)
MP x Liquidity (-1)		- 0.014
		(0.025)
MP x Capitalisation (-1)		- 0.004
		(0.071)
Limited entry for foreign banks	- 0.006	- 0.006
	(0.006)	(0.006)
MP x Limited entry for foreign banks	0.003	0.003
	(0.002)	(0.002)
GDP	-0.002**	0.002**
	(0.001)	(0.001)
Constant	0.037**	0.038**
	(0.015)	(0.015)
Observations	590	590
R-squared	0.146	0.146

Note: This estimation is based on panel data regression with fixed effects. Cluster-robust standard errors in parentheses are calculated using the White period method. * Significant at the 10% level; ** Significant at the 5% level

Firstly, the coefficients on the stance of monetary policy (MP) are negative and statistically significant. This shows that the bank lending channel exists, i.e. there is a negative correlation between loan growth and monetary policy rate. Secondly, the significantly negative sign in the coefficients on the new entry of foreign bank branches suggests that if new players in the foreign bank sector increase, loan growth

decreases. Finally, the coefficient on the interaction term between monetary policy rate and the new entry of foreign bank branches (MP x New entry of foreign branches) is statistically significant in both models, implying that an increase in foreign bank branches weakened the effectiveness of the bank lending channel in Thailand during the period from 2001–2015.

The index constructed by the World Bank is used to measure the limitations on foreign bank entry through mergers, subsidiaries, branches, and joint ventures. Two regression models are estimated by applying equation 2. Table 18 reports the following empirical results.

Loan growth is significantly associated with the monetary policy rate in both models. In particular, an interest rate policy can reduce the growth rate of loans, and vice versa. The two coefficients of MP x Limited entry for foreign banks show only positive signs, but they are not significant. Therefore, it cannot be concluded that the limitation on foreign bank entry reduces the ability of the bank lending channel.

4.5 Conclusions and Recommendations

This paper investigates the degree of Thai banking competitiveness using panel data on 10 domestic commercial banks during the period from 2001–2015 to detect how the evolution of bank competition affects the banking system and monetary policy mechanism through the bank lending channel. The main results of the study are as follows.

Firstly, the degree of competition in the Thai banking sector, measured by the Lerner index (market power or the markup price over marginal cost), declined considerably before 2004 and has become more stable over the last six years.

Secondly, there are three important pieces of evidence to support the relationship between competition and the bank lending channel in the Thai credit market. Greater market power or less competition in the Thai banking industry seems to reduce the effectiveness of the monetary policy mechanism via the bank lending channel. Banks with higher capitalisation tend to enhance loan growth. In addition, evidence was found that foreign bank penetration, measured by the number of new foreign bank branch entries, weakens the bank lending channel.

Our findings suggest two issues. Firstly, decreased bank competition weakens monetary policy transmission through the bank lending channel, supporting the implementation of the SFMP to increase competition in the banking industry in Thailand. Secondly, the findings indicate that foreign bank branches may respond differently to domestic banks regarding loan growth. This suggests that the BOT should monitor the increase of foreign bank branches in the Thai banking industry, especially when implementing monetary policy via the bank lending channel. For example, if an international bank experiences a liquidity problem in its home country, it can reallocate financial resources from the foreign bank branch in the host country. This may present a challenge to monetary policy transmission via the bank lending channel in the host country.

CHAPTER 5

CONCLUSIONS

This paper investigates the degree of Thai bank competition using panel data on 10 domestic commercial banks during the period from 2001–2015, and detect how the evolution of bank regulations affects the banking system. Furthermore, this paper examines the impact of competition on the monetary policy mechanism through the bank lending channel.

After the Thai financial crisis from 1997–1998, the overall structure of the Thai banking industry significantly changed in the context of the market share of total assets and number of banks. In particular, the financial system has been equally diversified into the banking sector, bond market, and capital market, while the number of commercial banks registered in Thailand associated with new banking licences and One Presence (financial consolidation) policy increased from 2001–2015. In addition, three competition indices are employed, namely the HHI, H-statistic, and NIM, to preliminary outline the competitive environment of the banking industry in Thailand.

The HHI suggests that Thai banking concentration tends to decrease, although the level of market concentration is moderate. Large banking groups (Bangkok Bank, Krung Thai Bank, Siam Commercial Bank, and Kasikorn Bank) have a total asset market share of 80% on average. The degree of competition, measured through the H-statistic (non-structural model) manifests a moderate monopolistic competition, while large banks are more competitive than small and medium banks. Finally, the NIM of registered commercial banks explicitly increased from 2001–2008 but subsequently decreased, while the NIM of foreign bank branches sharply declined after the global crisis in 2008. The NIM of both Thai and foreign banks decreased during the same period but the NIM of Thai commercial banks was in a better position. The gap between them expanded during this period.

To achieve the objectives of this study requires the completion of two important tasks: finding proxies for the competition and financial regulation in the Thai banking system. This paper assesses the evolution of competition through the Lerner index. Banking regulations are divided into four groups: (i) activity restrictions, (ii) limitations on foreign bank entry/ownership in Thailand's banking industry, (iii) deposit insurance scheme, and (iv) capital requirement (capital adequacy). These regulations are based on the construction of a regulatory index.

The variables for bank activity regulation consist of securities, insurance, and real estate with higher values indicating fewer restrictions. Two approaches are used to measure the limited entry variable: (i) foreign banks are prohibited from entering through M&A, subsidiaries, branches, and joint ventures, and (ii) the number of new players (accumulation) in the Thai banking industry through commercial banks registered in Thailand, and the ratio of foreign bank branches to the total number of banks in Thailand. If the indices are higher, the regulations are less stringent. However, these regulatory indices are employed from the World Bank dataset (the bank regulation and supervision survey) and the researcher's own indices construction to test the robustness. The deposit insurance scheme is then measured in the form of an index. The degree of deposit insurance will decrease, if and only if, this index is higher. Finally, the capital adequacy of Thai banks, based on the voluntary regulatory framework of the Basel Accord is defined as the actual bank capital ratio.

The main results of the study are as follows. Firstly, evidence was found to support that the degree of competition in the Thai banking sector, measured by the Lerner index (market power or the markup price over marginal cost), declined considerably before 2004 and has become more stable over the last six years. Secondly, bank regulations, especially deposit insurance and capital adequacy, significantly relate to the evolution of competition. In particular, fewer securities and insurance restrictions in the banking sector strengthen market power (Thai banks are permitted to participate in insurance activities). In addition, lower entry limits and bank insurance can enhance competition. In fact, according to the FSMP, foreign banks can enter the Thai banking industry through M&A, subsidiaries, and branches. Greater capital stringency reduces competitiveness. However, inter-industry competition and institutional factors also significantly affect the degree of market

power. Increased insurance penetration enhances market power (or reduces competition), while better property protection rights support a competitive environment. Thirdly, there are three important pieces of evidence to support competition and the existence of a bank lending channel in the Thai credit market. Higher market power or less competition in the Thai banking industry may reduce the effectiveness of the monetary policy mechanism via the bank lending channel. Banks with higher capitalisation may enhance loan growth.

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APPENDICES

Appendix A. The Panzar and Rosse approach (H-statistic)

Bank i maximizes its profit where marginal revenue equals marginal cost:

$$R'_i(y_i, Z_i) - C'_i(y_i, W_i, T_i) = 0. \quad (1\text{-A})$$

R_i refers to revenues and C_i to costs of bank i , Y_i is the output of bank i, w_i is a vector of k input prices of bank i, Z_i is a vector of exogenous variable that shift the bank's revenue function ,and T_i is a vector of exogenous variable that shift the bank's cost function.

At the bank equilibrium, the zero profit condition can hold:

$$R^*_i(y^*_i, Z_i) = C_i(y^*_i, W_i, T_i) \quad (2\text{-A})$$

where * represents equilibrium variables.

The H-statistic that is the sum of the elasticity to total revenues with respect to changes in input prices is used for measure degree of competition as follow

$$H = \sum_{k=1}^{K} \frac{\partial R \cdot w_{ki}}{\partial w_{ki} R_i} \quad (3\text{-A})$$

where $H \leq 0$ (monopoly)

$0 < H < 1$ (monopolistic competition)

$H = 1$ (perfect competition).

The empirical application of the Panzar-Rose approach assumes a log-linear marginal revenue and marginal cost function form as shown in equation (4-A) and (5-A) respectively.

$$\ln(R'_i) = \alpha_0 + \alpha_1 \ln(y_i) + \alpha_2 + \sum_{j=1}^{J} \beta_j \ln(Z_{ji}) \quad (4\text{-A})$$

$$\ln(C'_i) = \delta_0 + \delta_1 \ln(y_i) + \alpha_2 + \sum_{k=1}^{K} \phi_k \ln(W_{ki}) + \sum_{l=1}^{L} \beta_l \ln(T_{li}) \quad (5\text{-A})$$

At equilibrium, marginal revenue equals marginal cost:

$$\ln(y'_i) = \frac{1}{\alpha_1 - \delta_1} \cdot \{ \delta_0 - \alpha_0 + \sum_{k=1}^{K} \phi_k \ln(W_{ki}) + \sum_{l=1}^{L} \beta_l \ln(T_{li}) - \sum_{j=1}^{J} \beta_j \ln(Z_{ji}) \} \quad (6\text{-A})$$

The reduced - form equation for revenues is shown as the product of the equilibrium output and the common price level:

$$\ln(R^*_i) = \ln(y^*_i, P^*). \quad (7\text{-A})$$

The common price level is determined by the inverse demand equation as $\ln(p) = \eta + \Upsilon \ln(Y)$. Y is output of the industry ($\sum_{i=1}^{I} y_i$).

Then in the empirical research, equation (7-A) can be written as reduced-form equation:

$$\ln(R^*_{it}) = \mu + \sum_{k=1}^{3} \omega_k \ln(W_{kit}) + \sum_{q=1}^{Q} \Psi_q \ln(B_{qii}) \quad (8\text{-A})$$

where R_{it} is the ratio of total revenues (interest revenue plus non-interest revenue) to the total assets of bank i

W_{1it} is the ratio of interest expenses to total deposit of bank i at time t, or the (approximated) borrowed capital's price

W_{2it} is the ratio of personnel expenses to total assets of bank i at time t, or the (approximated) labor's price

W_{3it} is the ratio of other non-interest expenses to fixed assets of bank i at time t, or the (approximated) Physical capital's price

B_{qii} are bank specific exogenous factors (without explicit reference to their origin from the cost or revenue function)

Appendix B. Lerner index Approach

$$\text{Max } \pi_i = p(Q,z)\cdot q_i - C(q_i,w_i) \quad (1\text{-B})$$

where p (price), q (firm' output), Q (industry' output), c (cost), z (exogenous variables), and w (inputs price)

The first order condition is

$$\frac{\partial \pi_i}{\partial q_i} = p + \{q_i \cdot \frac{\partial p}{\partial Q} \cdot \frac{\partial Q}{\partial q_i}\} - \frac{\partial C_i}{\partial q_i} = 0 \quad (2\text{-B})$$

Rearranging (2) yields

$$p - mc_i = \{-Q \cdot \frac{\partial p}{\partial Q}\} \cdot \{\frac{\partial Q}{\partial q_i} \cdot \frac{q_i}{Q}\} = \frac{\theta_i}{\eta} \quad (3\text{-B})$$

Dividing both sides of equation (3) by p, we obtain a Lerner index (L_i),

$$L_i = \frac{p - mc_i}{p} \quad (4\text{-B})$$

Marginal costs are directly obtained from the estimated parameters of the translog function by calculating the derivative with respect to q

$$mc_i = \frac{c_i}{q_i}[\beta_1 + \beta_2 \ln(q_i) + \sum_{k=1}^{3} \gamma_k \ln(w_{ki})] \quad (5\text{-B})$$

Appendix C. Definition of independence variable

Table 1-C

Variables	Definition	Quantification		Source
CR4	Assets of four largest banks as a share of total Thai commercial banking asset	The indicator ranges from 0 to 100 percent (higher values indicate higher concentration)		1. Thomson Reuters Datastream
Activity restriction	The activity restrictions include restriction on securities, insurance, real estate activities	1.World bank dataset A value is added to index if an activity is prohibited, restricted, permitted, and unrestricted, then it scores 1, 2, 3, and 4, respectively. The indicator ranges from 0 to 12 (higher values indicate lower restriction)	2. Newly constructed dataset (unique) The number of the activity restriction on securities, insurance, real estate activities relax.	1. World Bank surveys on bank regulation. (2003, 2007, 2012) 2. Bank of Thailand
Limit entry	Whether foreign banks may own domestic banks and whether foreign banks may enter a country's banking industry	1. World bank dataset Are foreign entities prohibited from entering through the following? a. Acquisition b. Subsidiary c. Branch d. Joint Venture Yes = 0, No = 1 The indicator ranges from 0 to 4 (lower values indicate greater stringency)	2. Newly constructed dataset (unique) (1) The number of new player enter the commercial banks registered in Thailand. (2) The number of new player enter foreign branch in Thailand.	1. World Bank surveys on bank regulation. (2003, 2007, 2012) 2. Bank of Thailand

Variables	Definition	Quantification		Source
Deposit insurance	The degree of limited deposit guarantee.	The index is equal to a. 1 if deposit guarantee is 100 %. b. 2 if deposit guarantee is 50 million baht. c. 3 if deposit guarantee is 25 million baht. If this program does not implement, the index is 0.		www.dpa.or.th
Capital regulation	Overall capital adequacy (Basel I, II, and III)	Actual capital ratio		Bank of Thailand (www.bot.or.th)
Insurance (life and non-life)	Ratio of life and non-life insurance premium volume to GDP	Higher ratio may enhances competition.		World Bank: The Global Finance Development Database
Capitalization (SET)	Stock market capitalization of listed companies to GDP	Higher ratio may enhances competition.		www.set.or.th
Financial freedom	Financial freedom is a measure of banking efficiency as well as a measure of independence from government control and interference in the financial sector.	An overall score of 0 to 100 is given to an economy's financial freedom through deductions from the ideal score of 100.		Heritage Foundation Data base
Property right	The protection of property right	It ranges from 0 to 100. A higher score indicates better protection of property right.		Heritage Foundation Data base
KKZ index	An aggregate indicator of the quality of institutional development in the country	Average indicators of information on six issues: voice accountability, political stability, government's effectiveness, regulatory quality, rule of law, and control of corruption. Higher value indicates higher institutional quality.		Worldwide Governance Indicator

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