Essays on European Banks' Consolidation, Integration and Systemic Risk

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Abstract

This thesis consists of three essays about European banks and provides several useful policy implications for bank supervisors, regulators and managers.

In the first essay, firstly, we find some evidences that size, liquidity ratio, efficiency, leverage ratio, tier 1 ratio, concentration ratio, capital regulatory power and supervisory power are the main determinants of acquirers' performance changes after M&As. Secondly, we obtain that interest rate difference between distressed and non-distressed countries negatively granger-cause change of ROE and change of NII but not vice versa. Thirdly, we find some evidences that the financial crisis did have negative impacts on acquirers' performance changes after M&As.

In the second essay, first, we find that acquirers' systemic risk increased significantly after M&As. Second, we identify that acquirers from more integrated banking markets will have higher systemic risk after M&As. Third, we recognize that size, product diversification, asset quality, capital ratio, short-term debt, bailouts, deposit insurers' power and private monitoring index are the main determinants of acquirers' systemic risk of bank M&As in Europe. Fourth, we also find some evidences that those variables have significantly different effects on acquirers' systemic risks in post-crisis period, compared with those in pre-crisis period.

In the third essay, firstly, we find certain evidences that the expansionary monetary policy will contribute to the buildup of systemic risk in banking sector in euro area in the long-term. Secondly, we identify that banks that have more diversified income structure, poorer asset quality, more deposit funding, more equity capitals and larger sizes will have higher systemic risks. Thirdly, we find that riskier banks will benefit more from the expansionary monetary policy.

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List of Abbreviations

ABSPP: Asset-backed Securities Purchase Program

APP: Asset Purchase Program

BIS: Banking Stability Index

CBPP: Covered Bond Purchase Program

CCA: Contingent Claim Approach

CDO: Collateralized Debt Obligation

CDS: Credit Default Swap

CIMDO: Consistent Information Multivariate Density Optimizing

CoES: Conditional Expected Shortfall

CoVaR: Conditional Value at Risk

CR5: Concentration Ratio of 5 Largest Banks

CSPP: Corporate Sector Purchase Power

DBC: Degree of Bank Connectedness

DBI: Degree of Banking Integration

DBO: Degree of Banking Openness

DF: Deposit Facility

DIP: Distress Insurance Premium

DTBC: Degree of Total Bank Connectedness

EBA: European Banking Authority

ECB: European Central Bank

EEA: European Economic Area

EFSF: European Financial Stability Facility

EMI: European Monetary Institute

EMU: Economic and Monetary Union

ESM: European Stability Mechanism

EU: European Union

EVT: Extreme Value Theory

EWMA: Exponential Weighted Moving Average

GDP: Gross Domestic Product

GCA: General Contribution Approach

HHI: Herfindahl-Hirschman Index

IACFROA: Industry-adjusted Cash Flow Return on Asset

IACFROE: Industry-adjusted Cash Flow Return on Equity

IAROA: Industry-adjusted Return on Asset

IAROE: Industry-adjusted Return on Equity

IMF: International Monetary Funds

JPoD: Joint Probability of Default

LRMES: Long-run Marginal Expected Shortfall

LSAP: Large-scale Asset Purchase Program

LTD: Lower Tail Dependence

LTROs: Longer-term Refinancing Operations

M&A: Merger and Acquisition

MBS: Mortgage-backed Securities

MES: Marginal Expected Shortfall

MFI: Monetary Financial Institutions

MLF: Marginal Lending Facility

MRO: Marginal Refinancing Operations

OMT: Outright Monetary Transaction

OPCFROA: Operating Cash Flow Return on Asset

OPCFROE: Operating Cash Flow Return on Equity

PA: Participation Approach

PCA: Principal Component Analysis

PSPP: Public Sector Purchase Program

QE: Quantitative Easing

ROA: Return on Assets

ROE: Return on Equity

SCP: Structure-Conduct-Performance Paradigm

SES: Systemic Expected Shortfall

SIN: Systemic Risk Index Based on Number of Banks

SIV: Systemic Risk Index Based on Values

SMP: Securities Market Program

SMU: Single Monetary Union

TVP: Time-varying Parameter

VaR: Value at Risk

VAR: Vector Autoregressive

WDI: World Bank Development Indicator

Chapter 1

Introduction

1.1 Introduction to the Thesis

In the past decades, the banking sector has been subject to many changes, such as deregulation, technological innovation, change of business models and change of risk profiles. Deregulation and technological innovation affected the way banks operate and thus changed their business models and risk profiles.

A decade ago, the U.S. banking sector has been affected by the biggest global crisis since the Great Depression. Because the European economies were highly interconnected with the U.S. economy, the U.S. subprime crisis spread to the European continent. In May 2010, the European Sovereign Debt Crisis broke out in Greece. Both financial crises halted the process of financial integration and led to slowdown and recession that meant that central banks had to intervene with unconventional monetary policy tools (e.g. quantitative easing).

The main theme of this thesis is financial integration in banking market. All the other themes, including bank M&As, acquirers' operating performance, financial crises, acquirers' systemic risk, and monetary policy changes are relevant to financial integration in banking market. First, increase in value and number of cross-border bank M&As indicates higher level of financial integration in banking market. Second, one of the benefits of financial integration in banking market could be the increase of acquirers' operating performance; third, financial crises could have negatively impacts on the process of financial integration in banking market; fourth, one of the risks of financial integration in banking market could be the increase of acquirers' systemic risk and financial instability in banking market; finally, the ECB used more expansionary monetary policy in post-crisis period and resulted in recovery of financial integration in banking market after the European Sovereign Debt Crisis. Therefore, we highlight financial integration in banking market

as the key theme of this thesis.

1.2 Background

1.2.1 Recent Bank M&A Trend in Europe

The most recent bank merger and acquisition (M&A) wave around the developed world emerged in the mid-1980s and culminated in the late-1990s due to the financial deregulations, technological advance and increased competition in major banking sectors. DeYoung et al. (2009) identified that the transaction values of bank M&As in Intra-Europe increased dramatically: from less than $1bn in 1985 to $160bn in 1999. However, the total value of M&A transactions of EU bank M&As decreased significantly from €123bn in 2000 to €22bn in 2013 while the number of transactions decreased from 81 to 4 during the same time period (Casu et al. 2015).

Three reasons can be used to explain the significant decline of bank M&As in Europe after the financial crisis. Firstly, large banks had to re-evaluate their risk preference and reinforced their risk management so that they had lower willingness to engage in M&A deals. Secondly, banking authorities adopted stricter regulations to effectively monitor bank M&As (especially cross-border deals) to control systemic risk. Thirdly, European countries' governments increase takeover the failed banks rather than use private bank M&As.

1.2.2 The Establishment of Economic and Monetary Union

With the significant increase in the transaction value of $159bn in Europe between 1985 and 1999, the degree of financial integration also increased sharply. During the pre-Euro period, the establishment of the Economic and Monetary Union was the precondition and catalyst of financial integration in Europe. Several previous studies (Vardi 2011; Casu 2015; ECB 2015) described the

four stages before and after the EMU was established and the process of financial integration in Europe. The author reports that the First Stage towards the EMU increased freedom of capital movement and the level of member countries' monetary coordination while Stage Two established the European Monetary Institute (EMI) and strengthened the cooperation among member countries' central banks. He also outlines four convergence criteria formed in Stage Two. Actually, the four convergence criteria are very important preconditions for the first eleven member states in Stage Three after the European Central Bank (ECB) was established in 1998. In Stage Three, all the member states gradually replaced the local currencies with Euro. In Final Stage, the Euro was the only official currency for those euro area countries and more European countries joined in since 2002. It was mainly during Stage Three and the Final Stage towards EMU (1999-2007), the degree of financial integration in most markets (except retail banking market) in the euro area increased dramatically.

1.2.3 The Process, Benefits and Risks of Financial Integration

ECB's series of annual reports *Financial Integration in Europe* analyzed the process of financial integration in banking market and the impacts of financial crises on financial integration. ECB (2005-2009) reports summarized that the euro area banking market generally experienced increasing integration but the euro areas retail banking markets were still highly segmented whereas the euro area wholesale banking markets were highly integrated before the crisis in 2008. However, ECB (2010-2013) reports concluded that financial crisis had a negative impact on financial integration so that the degree of financial integration in banking market declines over 2009 and 2012. More recent ECB (2014, 2015) reports summarize that financial integration in banking market only has limited improvement because the degree of financial integration

increased faster in wholesale banking markets while the retail banking markets remained highly segmented. Finally, ECB (2016) report states that financial integration in European banking market moderately improved in 2015 due to monetary policy measures (e.g. asset purchase program and the targeted longer-term refinancing operations) and the establishment of the banking union. It also analyses that financial indicators of retail banking market demonstrate faster integration than previous years. Furthermore, there is one indispensable study (Coniglio and Prota, 2011) about the process of financial integration in Europe. As mentioned above, the process of financial integration was negatively affected by the financial crisis in 2008. Coniglio and Prota (2011) analyze how and why shocks affect regional convergence across countries. They argue that the less developed countries are more negatively affected by more developed countries. Moreover, they claim that the vulnerability of one country towards external financial shocks depend on this country's social, economic, geographic conditions and the country-specific institutional setting factors (e.g. the national authorities' responses to the crisis). Actually, these are the fundamental reasons why major distressed countries in euro area (Portugal, Ireland, Italy, Greece and Spain) perform much worse than those major non-distressed countries (Germany, France, Belgium, Netherlands and Austria) in the euro sovereign debt crisis in 2010. As a result, the financial integration indicators for distressed countries were much worse than those for non-distressed countries during 2008 and 2012 and the interest rate differentials between the two groups of countries were divergent. This decline of financial integration in euro area can be seen clearly in ECB (2013-2016)'s reports.

In his speech at the conference for the 20th anniversary of the establishment of the European Monetary Institute, President of the ECB Draghi (2014) claimed that financial integration could have both stabilizing (benefits) and destabilizing effects (risks). He pointed out two benefits of

financial integration. On the one hand, the first benefit can come from increased portfolio diversification, reduced exposure to domestic shocks and greater income; on the other hand, the second benefit is thought to come from the improved allocative efficiency and improved operating performance. In addition, Draghi (2014) also pointed out that one of the possible risks of financial integration is the destabilizing effects of bank integration. The destabilizing effects of financial integration come from increase of bank systemic risk and bank contagion.

1.2.4 The 2007-2009 Financial Crisis

The process towards greater financial integration started declining during the 2007- 2009 U.S. Financial Crisis, while European authorities became increasingly more concerned about banks' systemic risk. Bagliano and Morana (2011) explain the reason as follows: The deterioration of US economy and financial markets have significant effects on euro area financial convergence and financial stability - destabilizing US financial conditions may have contributed to destabilize euro area financial market. In fact, in July 2007, only six months after the first warning sign of US subprime crisis emerged, some European banks started to report their first losses in subprime mortgage markets and resulted in bank runs. Iceland, one of the member states of European Economic Area (EEA), experienced the collapse of its banking industry due to the failures of its largest three banks in 2008. According to European Free Trade Agreement (EFTA), EEA is the Agreement on the European Economic Area, which entered into force on 1 January 1994, which brings together the 28 EU member states and the three EEA EFTA states – Iceland, Liechtenstein and Norway – in a single internal market. All major economies in EEA were negatively affected by the subprime crisis. Moreover, the subprime crisis was followed by another crisis: the European Sovereign Debt Crisis over 2010 and 2012 (see Section 1.1.4). Teixeira (2011) analyzes the

fundamental reasons for the decreased financial integration and increased systemic risk. He claims that pursuing financial market integration and safeguarding financial market stability are mutually incompatible. In fact, financial integration implies large banks should be involved in more cross-border M&As and benefit from greater diversification. However, this may result in potentially more risks, and banks operating in areas where national legal and regulatory policies (e.g. fiscal policy) are unable to control the increasing risks.

1.2.5 The European Sovereign Debt Crisis

The subprime crisis was not even over in the US and Europe that several European economies fell into a sovereign debt crisis. Since the first International Monetary Fund-European Union (IMF-EU) support program for Greece in May 2010 (Cline, 2014), it is possible to identify three stages. In the first stage, Greece fell in debt crisis in the early 2010s and then the crisis spread quickly to other periphery countries, namely Ireland and Portugal in late 2010 and early 2011. In the second stage, the crisis reached larger economies, namely Italy and Spain in late of 2011 and early 2012. In the third stage, the ECB president Mario Draghi announced to implement the program of Outright Monetary Transaction (OMT) to purchase government bonds in the secondary market to resolve sovereign debt crisis in troubled countries. As reported in Cline (2014), the five troubled countries' sovereign risk spreads above 10-year German bonds (benchmark) soared in 2010, reached the peak in 2011 and 2012, and then plunged after 2012. The extremely high sovereign risk spreads indicate the extreme illiquidity in financial markets of five troubled countries while the lower spreads confirm the improved liquidity.

The main reasons of the European Sovereign Debt Crisis over 2010 and 2014 are extremely high public debt and fiscal deficits in Greece, Ireland, Portugal, Italy and Spain. Among the main

reasons behind the crisis are the inability of the government to repay the sovereign debts is due to the collapse of the housing bubble, its contagion to the banking market and other sectors and its contribution to the soared fiscal deficit. The ECB adopted the extremely expansionary monetary policies, especially for Quantitative Easing (QE), to inject liquidity to European financial markets to prevent the aggravated sovereign debt crisis. As a result, the sovereign risk spreads for troubled countries dropped sharply since 2012.

Cline (2014) points out that one of the policy implications is the pursuit of financial integration in the euro area has inherent limits. The reason is that each euro area country has its own fiscal policy and different interest rates for sovereign debt. This is a major obstacle to achieve high level of financial integration in Europe.

Both crises provide the evidence that pursuing financial integration (encouraging cross-border M&As) and maintaining financial stability are two conflicting objectives in euro area. This thesis aims to provide another evidence to support this idea by finding the relationship between financial integration in European banking market and acquirers' systemic risk changes. Furthermore, it will provide some recommendations how bank regulators can make trade-off between the two goals.

The rest of this chapter is organized as follows. Section 2 outlines each chapter's contributions to the literatures. Section 3 introduces main chapters' previews.

1.3 Contributions to the Literature and Research Questions

This thesis aims to discuss main contributions of each chapter and investigate several important research questions that are related to European banking sector. The empirical investigations are

carried out in Chapters 2-4 that are the three substantial chapters of this thesis.

This thesis contributes to fill gaps in the existing literatures about the European banking sector in several ways. Chapter 2 offers two major contributions. Firstly, the most important contribution of this chapter is that it fills a gap in the literature in that, to the best of my knowledge, there is no similar research so far examining specifically the relationship between acquirers' operating performance changes of cross-border bank M&As and banking market integration indicators. Secondly, this study adds more macroeconomic, industry-specific, bank regulatory, supervisory and deposit insurance variables into models. Therefore, it contributes to existing literatures by putting all five categories of variables into one model and trying to consider as many determinants of acquirers' performance as possible. This will give bank regulators and managers recommendations on what are the factors that influence acquirers' profitability after M&As are completed.

Specifically, the main research questions of chapter 2 are as follows:

1. What are the determinants of acquirers' performance changes of bank M&As in Europe?

2. Is there any positive or negative relationship between acquirers' performance changes of cross-border bank M&As and banking integration in Europe?

3. What are the impacts of the 2007-2009 U.S. Financial Crisis on acquirers' performance changes after M&As in Europe?

Chapter 3 contributes to the extant literatures in two ways. First, there are many researches focus on banks' systemic risk contributions since financial crisis. Nevertheless, there is only very few research (Weiss et al. 2014) focus on identifying determinants of systemic risk changes of bank M&As in Europe. This chapter adds more variables into the model and tries to identify more

determinants of acquirers' systemic risk changes. This provides bank regulators specific factors that contribute to the increase or decrease of systemic risk so that they can adopt practical policies to control systemic risk and maintain financial stability. Second, another important contribution of this chapter is that it fills the gap that there is no research so far on examining the relationship between acquirers' systemic risk changes of cross-border bank M&As and banking market integration indicators.

Therefore, chapter 3 aims to answer the following three research questions:

1. What are the determinants of acquirers' systemic risk changes of bank M&As in Europe?

2. Is there any positive or negative relationship between acquirers' systemic risk changes of cross-border bank M&As and banking integration in Europe?

3. What are the impacts of the 2007-2009 U.S. Financial Crisis and European Sovereign Debt Crisis on acquirers' systemic risk after M&As?

Chapter 4 contributes to the existing literature by filling the following three gaps. First, there are no studies that focuses on examining the impact of ECB's expansionary monetary policy on banks' systemic risk measures in both non-crisis and crisis years. This is the first paper that emphasizes on evaluating whether the impacts of monetary policies on banks' systemic risk in crisis and non-crisis years are different. Second, most previous works (Kuttner 2001; Bernanke and Kuttner 2005; Kontonikas and Kostakis 2013; Kontonikas et al. 2013; Yin and Yang 2013; Ricci 2015; Haitsma et al. 2016) focused on the impacts of Fed's and ECB's monetary policy changes on banks' stock returns rather than banks' systemic risk changes. Third, all previous studies focused on assessing heterogeneous responses of banks' stock returns towards monetary policy changes, but no previous study did research on investigating whether there were heterogeneous responses of banks' systemic

risks towards monetary policy changes. This is also the first paper that focuses on assessing heterogeneous responses of banks' systemic risks towards the expansionary monetary policy.

More specifically, chapter 4 mainly focuses on the following research questions:

1. What are the impacts of the ECB's expansionary monetary policies on banks' systemic risk?

2. Is there any heterogeneous response of banks towards monetary policy changes?

3. What are the key bank-specific variables that can affect banks' systemic risk if the ECB implements the expansionary monetary policies?

1.4 Overall Research Objectives, Academic Importance and Policy Implications

Based on above-mentioned research questions, this thesis has three main overall research objectives. Firstly, this thesis is aimed at investigating the benefits of financial integration in European banking market, that is, whether higher degree of financial integration in Europe leads to increase in acquirers' operating performance after cross-border M&As. Secondly, this thesis also seeks to examine the risks of financial integration in European banking market, that is, whether higher degree of financial integration in Europe results in increase in acquirers' systemic risk after cross-border M&As. Thirdly, this thesis aims to test whether the ECB's expansionary monetary policy increases banks' systemic risk.

The main overall research objectives have academic importance to scholars and policy implications to bank regulators and supervisors. On the one hand, this thesis is the first study that examines both stabilizing and destabilizing effects of financial integration in European banking market. The main findings recommend that bank regulators and supervisors should encourage higher degree of financial integration in European banking market to boost acquirers' operating

performance after cross-border M&As but they should pay more attention to the fact that higher degree of financial integration can increase acquirers' systemic risk after M&As; on the other hand, this thesis further contributes to the current literature in investigating the ECB's expansionary monetary policy increases banks' systemic risk in the long term. The main finding provides policy implication for bank regulators and supervisors that central banks could use the expansionary monetary policy to achieve financial stability in the short term but should gradually quit from the expansionary monetary policy in the long term once financial stability is achieved.

1.5 Chapter Preview and Main Methodological Issues

The remaining thesis is organized as follows. Chapter 2 first seeks to identify the determinants of acquirers' performance changes. In the first stage, it uses fixed-effect models that do not include banking integration indicators to find the determinants of acquirers' performance changes. In the second stage, it employs principal component analysis (PCA) to select three most important banking integration indicators and uses Granger-causality tests to examine the causal relationship between acquirers' performance changes in cross-border bank M&As and banking integration in Europe. Moreover, it uses t-tests to investigate whether financial crises have negative effects on acquirers' performance changes. Finally, it employs fixed-effect models that contain banking integration indicators to identify more determinants of acquirers' performance changes and check whether acquirers' performance changes have positive or negative significant relationships with banking integration indicators.

Chapter 3 first aims to find the determinants of acquirers' systemic risk changes in bank M&As in Europe. In the first stage, it employs t-tests to investigate whether acquirers' systemic risks

increase or decrease significantly. In the second stage, it uses PCA to select the three most important banking integration indicators and employs fixed-effect models to identify the determinant of acquirers' systemic risk changes for cross-border M&As in all years. In the third stage, it uses fixed-effect models again to find different determinants of acquirers' systemic risk changes in post-crisis and pre-crisis M&As. In the last stage, it employs p-score matching and fixed-effect models that include different banking integration indicators to conduct the robustness checks.

Chapter 4 first aims to investigate the impacts of the ECB's expansionary monetary policy on banks' systemic risks; In the first stage, it uses Taylor rule type model to compute the standard Taylor rule residuals, and employs the ECB shadow rate and calculate log difference of ECB monthly balance sheet to represent monetary policy shocks. It adopts monthly LRMES and SRISK of banks in euro area from V-lab website and calculates the standardized LRMES and standardized SRISK as systemic risk measures. In the second stage, this chapter seeks to examine the heterogeneity of banks response towards monetary policy changes. Therefore, it employs the yearly bank-specific variables from S&P market intelligence platform. In order to investigate these two research questions, this chapter will use fixed-effect model that contains systemic risk measure, monetary policy shock, bank-specific variables and interaction terms between bank-specific variables and monetary policy shock.

We will use the fixed–effect models in all chapters 2-4 as our mainline regressions and PCA in both chapter 2 and 3 to select most important banking integration indicators. Moreover, we will employ the Granger-causality test in both chapter 2 and 3 to test the causality between dependent and independent variables.

Chapter 5 summarizes the main findings in previous chapters and makes conclusions and implications for the whole thesis.

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Chapter 2

Operating Performance Changes of EU Bank M&As: Determinants and Relationships with Banking Market Integration

2.1 Introduction

The most recent bank merger and acquisition (M&A) wave around the developed world emerged in the mid-1980s and culminated in the late-1990s due to the financial deregulations, technological advance and increased competition in major banking sectors. DeYoung et al. (2009) identified the increase in the transaction value from $1bn to $160bn between 1985 and 1999 in Europe. However, the total value of M&A transactions of EU bank M&As decreased significantly from €123bn in 2000 to €22bn in 2013 while the number of transactions decreased from 81 to 4 during the same time period (Casu et al. 2015).

With the increase of bank M&A deals in 1980s and 1990s, there were an increasing number of studies about M&A effects over short-term and medium-long-term. According to Pilloff and Santomero (1997) and Fiordelisi (2009), one strand of such studies evaluated the bank M&A effects on the banks' operating performance in medium-long term and these studies measure the M&A effects by comparing profitability ratios (e.g, ROA and ROE) before and after M&As. They also outline many important studies since early 1980s (Rhodes 1993; Vander Vennet 1996; Focarelli et al. 2002; Diaz et al. 2004; Knapp et al. 2006; Cornett et al. 2006, Campa and Hernando et al.2006; Altunbas and Marques-Ibanez 2008; Becalli and Frantz 2009). However, according to DeYoung et al. (2009), the existing studies provide mixed results for the bank M&A effects on operating performances. Similarly, Casu et al. (2015) argue that some bank M&As may boost acquirers' operating performance while others may not, therefore, the bank M&As effects on operating performance should be discussed on a case-by-case basis.

Finding the determinants of acquirers' operating performance changes of bank M&As in Europe is critical to stakeholders, such as shareholders, bank managers, bank regulators, depositors,

financial market participants, competitors, credit-rating agencies. It is especially relevant to bank managers and regulators because they are interested in what the key characteristics of successful M&A deals are and what are the factors that can influence acquirers' operating performance. Based on these characteristics and factors, managers are able to find M&A deals that are more likely to boost operating performance while regulators can implement appropriate policies (e.g. capital regulatory policy and deposit insurance scheme) to ensure banks resulting from the consolidation process are safe and sound and customers deposits are protected in case of troubles.

Besides the M&A effects on bank operating performance, financial integration in banking markets has been one of the most important developments since the Euro area and European Monetary Union (EMU) were introduced in 1999. Many relevant literatures (Adam et al. 2002; Cabral et al. 2002; Baele et al. 2004; ECB 2005-2016) describe the process of financial integration in European banking market since the introduction of the single currency. Specifically, Adam et al. (2002) point out the European financial integration increased after 1999. More importantly, the ECB (2005-2016) reports pointed out that all financial markets, including money, bond, equity and banking market, had generally experienced increased integration. Concerning this latter, before the 2007-2009 Financial crisis (ECB 2005-2009), the euro area wholesale banking market activities show clear signs of increasing integration while the euro area retail banking market activities present highly fragmented. Then the financial crisis has negative impacts on financial integration and makes lower degree of integration in the euro area banking market between 2009 and 2012 (ECB 2010-2013). More recently the degree of integration in banking market improved slightly in 2013 and 2014 although it is still lower than the pre-crisis level (ECB 2014-2015). In this context, it is useful to note an important characteristic of integration in banking market: the wholesale banking

market is highly integrated while the retail banking market is still highly fragmented.

Mario Draghi (2014), the president of the European Central Bank (ECB), explained the importance of financial integration at a conference celebrating the 20th anniversary of the European Monetary Institute in Brussels in February 2014. Draghi pointed out that the banking market integration could have both stabilizing and destabilizing effects. One of the stabilizing effects is boosting performance and one of the destabilizing effects is increasing banks' risk-taking. Therefore, one of the motivations of this chapter is to examine whether there are positive or negative relationships between acquirers' performance changes in cross-border bank M&As and banking market integration in Europe.

This chapter aims to (1) identify the determinants of acquirers' operating performance changes of bank M&As in Europe; (2) examine the relationship between acquirers' operating performance changes and banking market integration in Europe and (3) investigate whether the financial crisis had a negative impact on the acquirers' performance changes. Therefore, the research questions for this chapter are:

1. What are the determinants of acquirers' performance changes of bank M&As in Europe?
2. What is the relationship between acquirers' performance changes of cross-border bank M&As and banking integration in Europe?
3. What is the impact of the 2007-2009 Financial Crisis on acquirers' performance changes after M&As?

In this chapter, to find answers of research question 1, we will focus on several bank-specific variables (e.g. insolvency risk, liquidity, and diversity), deal-specific variables (e.g. geographic

diversification, cross-border and listed/non-listed banks), structural and regulatory variables (e.g. CR5/HHI, regulatory, supervisory and deposit insurer powers) and treat all macroeconomic variables as country-specific controlled variables. To find the answer to research question 2, we will use a cross-border sample and include some selected banking integration indicators in our empirical analysis, then conduct some post-estimation robustness tests. To investigate the answer of research question 3, we will divide full sample into pre-crisis and post-crisis sub-samples and conduct some t-tests for different performance change measures.

The remaining Chapter 2 is organized as follows. Section2.2 provides the literature review for the (1) operating performance changes in bank M&As; (2) financial integration in European banking market; (3) bank operating performance changes and banking integration and (4) selected variables. Section2.3 states the key hypotheses, describes the selected samples' characteristics and limitations, the data sources, and main methodological issues. Section2.4 presents, discusses and interprets the key empirical results. Finally, section2.5 concludes.

2. 2 Literature Review

This section will review the relevant literature focusing in particular on four aspects: operating performance changes in bank M&As, financial integration in European banking market, banks' operating performance changes and banking integration, and, finally, literature about selected variables.

2.2.1 Operating Performance Changes in Bank M&As

Investigating M&As' medium-to-long term effects on banks' operating performance changes is

one important strand of M&As' value effects on banks since early 1980s (Fiordelisi 2009). Pilloff and Santomero (1997) describe one of the important traditional approaches to examine the M&As' medium-to-long tern effects on banks' operating performance changes, that is, employing accounting data (e.g. ROA and ROE) to compare acquirers' pre-merger and post-merger performances. More specifically, Beitel and Schiereck (2001) suggest that the time period can come from 1-3 years before the merger to 3-5 years after the merger. They argue that the most important strength of this approach is that it measures actual banks' actual performance changes, not just investors' expectations and responses to M&A announcements, so that it is more reliable. They also claim that accounting data are easily obtained and understood.

Nevertheless, both Pilloff and Santomero (1997) and Fiordelisi (2009) argue that this approach still has several shortcomings. First, accounting data are inaccurate to reflect a bank's economic profile and financial conditions because they can be manipulated by senior managers so they do not reflect the current market values. Second, the performance changes can be due to factors other than M&As. If the researchers do not account for these factors, they will not find the appropriate conclusions about merger-related performance changes.

Although the accounting method has these disadvantages, many studies in the U.S. and Europe still use it to evaluate the M&A effects on banks' operating performance （Berger and Humphrey 1992; Pilloff 1996; Vander Vennet 1996; Focarelli 2002; Altunbas and Marques-Ibanez 2004; Diaz et al. 2004; Cornett et al. 2006; Knapp et al. 2006; DeLong and DeYoung 2007; and Becalli and Frantz 2009). Some studies focus on the U.S. bank M&As. For instance, Knapp et al. (2006) employ ROA, cash flow ROA, ROE and cash flow ROE to evaluate 80 US mergers with values exceeding $25 million over 1987 and 1998. They find that these mergers create large profits five

years after the mergers. Cornett et al. (2006) use multiple regressions to identify factors that influence change of operating cash flow return on asset (ΔOPCFROA) for 134 mergers in the US between 1990 and 2000. They conclude that industry-adjusted operating performance of merged banks increases significantly after a merger; and that large bank mergers, activity focusing mergers, geographically focusing mergers produce greater performance gains.

Moreover, there are a great many studies in Europe since early 1980s. For example, Vander Vennet (1996) assesses 492 bank M&A deals in Europe between 1988 and 1992 by analyzing banks' changes in ROA, ROE and efficiency. He divided the full sample into domestic and cross-border subsamples and concludes that in domestic deals the combined entities have decreasing efficiency levels after the mergers while in cross-border deals the combined entities display increasing efficiency levels. Altunbas and Marques-Ibanez (2004) use 262 bank M&A deals (207 domestic and 55 cross-border) in EU between 1992 and 2001 and identify the improvements in performance after the merger has taken place particularly in the case of cross-border M&As and the important differences between domestic and cross-border M&As and across strategic dimensions. Campa and Hernando (2006) analyze 66 bank M&As in Europe between 1998 and 2002 and find the substantial ROE after the M&As are completed. Beccalli and Frantz (2009) use 714 bank M&A deals in EU between 1991 and 2005 and find the operating performance change is positively related to the levels of freedom from government in the target's country, the countries with better regulatory quality, and deals paid in equity, and is negatively related to higher concentration in the banking industry and deals paid in equity. ECB (2015b) uses dynamic panel data to identify the main determinants that influence banks' profitability, such as bank-specific factors, macroeconomic factors, and structural factors. The empirical results reveal that capital ratio, loan

growth ratio, retail ratio, real GDP growth rate, credit-to-GDP ratio and concentration ratio are positively related to banks' profitability while bank size, loan loss provisions over total loans, cost-to-income ratio are negatively related to banks' profitability.

2.2.2 Financial Integration in European Banking Market

This sub-section will outline the extant literature about financial integration in European banking market. A great number of studies (Adam et al. 2002; Cabral et al. 2002; ECB 2003; Baele et al. 2004; ECB 2005-2016; Groppe and Kashyap 2009; Casu and Girardone 2010) investigate financial integration in financial markets since the emergence of Euro and euro area and the establishment of Single Monetary Union (SMU). According to EU official website, SMU ensures free movement of goods, services, capital and persons across EU member countries by removing technical, legal and bureaucratic barriers. Therefore, the establishment of SMU is the premise of financial integration on EU markets. Based on these facts, most of these studies analyze the process of financial integration in different financial markets and develop categories of indicators to measure the degree of financial integration. Because the research topic of this study is banking market integration, we will focus on financial integration in banking market and review these literatures in three aspects: the definition of financial integration, the process of financial integration in banking market and financial integration indicators of banking market.

2.2.2.1 Definition of Financial Integration

ECB (2003) define financial integration as a situation that no discrimination exists between different economic agents whenever they access into or invest in capital on different locations. Baele et al. (2004) define financial integration and outline the three key characteristics that all potential market participants must have in order to qualify for a fully integrated market: (1) they

face a single set of rule when they decide to deal with those financial instruments and/or services; (2) they have equal access to the above-mentioned set of financial instruments and/or services; and (3) they are treated equally when they are active in the market. The basic theory for establishing a fully integrated market is "the law of one price". If the law of one price holds, then the two same assets with the same expected payoff will have the same price even if they are in the different markets. All three above-mentioned characteristics indicate that potential market participants in different markets can pay the same price for purchasing the same assets because they will have symmetric information regarding the assets, the same entry barriers to buy the assets and be treated equally. More importantly, these are the rationales behind the explanations of financial integration indicators in banking market. We will explain this in "Financial Integration Indicators of Banking Market" sub-section.

2.2.2.2 The Process of Financial Integration and the Financial Crisis

Most studies introduce the process of financial integration in banking market. For example, ECB (2005-2009) reports summarize that the euro area banking market generally experienced increasing integration but the euro areas retail banking markets were still highly segmented whereas the euro area wholesale banking markets were highly integrated before the crisis in 2008. However, ECB (2010-2013) reports conclude that financial crisis has a negative impact on financial integration so that the degree of financial integration in banking market declines over 2009 and 2012. More recent ECB (2014, 2015) reports summarize that financial integration in banking market only has limited improvement because the degree of financial integration increased faster in wholesale banking markets while the retail banking markets remained highly segmented. Finally, ECB (2016) report states that financial integration in European banking market

moderately improved in 2015 due to monetary policy measures (e.g. asset purchase program and the targeted longer-term refinancing operations) and the establishment of the banking union. It also analyses that financial indicators of retail banking market demonstrate faster integration than previous years. Furthermore, there is one indispensable study (Coniglio and Prota, 2011) about the process of financial integration in Europe. As mentioned above, the process of financial integration was negatively affected by the financial crisis in 2008. Coniglio and Prota (2011) analyze how and why shocks affect regional convergence across countries. They argue that the less developed countries are more negatively affected by more developed countries. Moreover, they claim that the vulnerability of one country towards external financial shocks depend on this country's social, economic, geographic conditions and the country-specific institutional setting factors (e.g. the national authorities' responses to the crisis). Actually, these are the fundamental reasons why major distressed countries in euro area (Portugal, Ireland, Italy, Greece and Spain) perform much worse than those major non-distressed countries (Germany, France, Belgium, Netherlands and Austria) in the euro sovereign debt crisis in 2010. As a result, the financial integration indicators for distressed countries were much worse than those for non-distressed countries during 2008 and 2012 and the interest rate differentials between the two groups of countries were divergent. This decline of financial integration in euro area can be seen clearly in ECB (2013-2016)'s reports.

Rughoo and Sarantis (2014) is another study that examines the effects of the global financial crisis on banking integration. They follow Phillips and Sul's (2007a) panel convergence methodology to evaluate the convergence process in the European retail banking industry by analyzing short-, intermediate- and long-term deposit rate, consumer credit rate and mortgage rate to the household sector between 2003 and 2011. They concluded that the global financial crisis had brought a halt

to the integration process in both the deposit and credit markets.

2.2.2.3 Financial Integration Indicators of Banking (Credit) Market

The extant literatures (Adam et al. 2002; Baele et al. 2004; Manna 2004; ECB 2005-2016; Casu and Girardone 2010) present three main categories of financial integration indicators of banking (credit) market: price-based, quantity/activity-based, and other indicators. The price-based indicators use some price data, such as interest rates, the standard deviation of interest rates to measure the degree of financial integration. Price-based indicators include interest rate differentials (margins) of new loans among different euro area countries (Adam et al. 2002; ECB 2005-2016), cross-country dispersion/standard deviation of interest rates on new loans (Baele et al. 2004; ECB 2005-2016) and on banks' CDS (ECB 2005-2016), β-convergence and σ-convergence (Adam et al. 2002; Baele et al. 2004; Casu and Girardone 2010). For interest rate differentials and cross-country dispersion, the lower values indicate the higher degree of financial integration because the lower the differentials and dispersion, the higher convergence across countries. Casu and Girardone (2006) explain that the negative β-convergence implies the convergence and the more negative the β, the greater convergence; they also point out that σ-convergence measures the speed of convergence and the more negative the σ, the faster of convergence.

The quantity/activity-based indicators use banks' different activities' quantity data, such as the amount of Monetary Financial Institutions (MFIs) loans: outstanding amounts by residency of counterparties, MFIs' securities holdings: outstanding amounts by residency of issuers, MFIs' deposits and cross-border loans, cross-border securities holdings to measure the degree of financial integration. For the quantity/activity based indicators, the higher values reveal more cross-border

activities across countries, the more free movement of capital thus higher degree of financial integration. Manna (2004) investigated the integration of the euro area banking systems with 14520 observations and mainly focused on quantity/activity based indicators and introduces eight indicators, including share of cross-border activity, home bias, concentration of cross-border trading, distribution of cross-border positions, distribution of cross-border positions (adjusted for land sharing), access to hub banking system, cross-border activity with UK residents (out of total activity) and cross-border activity with UK residents (out of cross-border activity). He claimed that most indicators show a clear increasing integration in European banking market since the introduction of Euro in 1999.

Other indicators include news-based indicators (Baele et al. 2004) and survey-based indicators (ECB 2005-2016). Baele et al. (2004) analyze that if the proportion of interest changes in one market can be explained by some common news (shocks), this market is highly integrated. Moreover, ECB (2005-2016) employ one survey-based indicator called changes in credit standard and summarize that persistent divergence of credit standards between non-distressed countries and distressed countries should indicate the lower degree of financial integration.

2.2.3 Bank Operating Performance Changes and Banking Integration

This is one specific previous study (Gropp and Kashyap 2009) that proposes a test of integration based on convergence in banks' profitability. Based on "the Law of One Price" theory, Gropp and Kashyap (2009) first use ROA as a measure of bank integration and employ the classic partial adjustment equation to seek for convergence in banks' ROA. Next, they put forward strong and weak definitions of integration. Finally, they analyze a sample of 36000 banks in France, Germany, Italy, Spain, US and UK and find that both US listed and non-listed banks' profits converge towards

the same target level of profitability while no evidence on non-listed banks' profits converge to a common equilibrium value in Europe. Their conclusions indicate that US banking market is highly integrated whereas the European banking markets are far from being integrated.

Another issue that cannot be ignored is that researchers should account for the mean reversion effects of post-merger bank performance so that they can measure the convergence of industry-adjusted returns and returns and the impact of the M&A deals on industry-adjusted returns and returns. One specific study (Knapp et al. 2006) investigates the mean reversion effects of profitability on post-merger performances of 80 bank holding companies with book values exceed $25 million during 1997-1998. They employed mean reversion equation and used industry-adjusted ROA (IAROA), industry-adjusted ROE (IAROE), industry-adjusted cash flow ROA (IACFROA) and industry-adjusted cash flow ROE (IACFROE) as variables. These new return measures have been adjusted by industry mean return measures and can be used to test whether the mean deviation tendency exists. They used the change in industry-adjusted returns from 1, 2, 3, 4, 5 and 6 year prior to the current year as dependent variables and the industry-adjusted returns of 1-6 years prior to the current year as explanatory variables. Their empirical results demonstrate that there are significant mean reversion trends for all industry-adjusted returns.

2.2.4 Literatures about Selected Variables

In this sub-section, some literatures about selected variables, the reasons why this study chooses these variables and the expected signs of coefficients will be discussed.

Firstly, this study uses a dependent variable similar to that adopted by Vander Vennet (1996), Cornett et al. (2006), Beccalli and Frantz (2009) and ECB (2015b) to describe performance

changes a dynamic setting that covers a medium-long term period starting 3 years before and 3 years after mergers are completed. In particular, the variable is proxied by the difference between average post-merger ROA (ROE) and average pre-merger ROA(ROE), ΔPERROA (ΔPERROE), can be used as performance changes. Similarly, ECB (2015b) uses the change of ROA (i.e., ΔROA_{it}) as the dependent variable. This chapter uses a dynamic analysis but still differs from Cornett et al. (2006) and Beccalli and Frantz (2009). Cornett et al. (2006) use both industry-adjusted operating pretax cash flow return on assets (OPCFROA) and ROA while Beccalli and Frantz (2009) uses the industry-adjusted performance ratios (e.g. industry-adjusted ROA) to calculate the performance changes. In this chapter, we will use standard measures of ROA and ROE without any adjustment. This study not only follows Vander Vennet (1996) to employ traditional performance measures of profitability (ROA and ROE), but also adds other performance measures, such as net interest margin (NIM) and net interest income (NII). Specifically, ROA is calculated by net income/total asset, ROE is calculated by net income/total shareholders' equity, NIM is calculated by (interest income – interest expense)/total earning assets and NII is calculated by (interest income- interest expense).

Secondly, for explanatory variables, Di Patti (2009) criticizes that there are very few bank-specific or deal-specific variables in Beccalli and Frantz (2009)'s analysis and suggests that more macroeconomic and regulatory variables should be added into the models. For the purpose of identifying more determinants, similar to Beltratti and Stulz (2012), this study additionally includes more macroeconomic, industry-specific, capital regulatory, bank supervisory and deposit insurance variables besides bank-specific and deal-specific variables. For bank-specific variables, acquirers' size, liquidity, capital adequacy, financial leverage, diversity, efficiency, growth, asset

quality and insolvency risk will be included. Ln (TA), the natural log of acquirers' total assets, representing acquirers' size. Similar to Cornett et al. (2006) and ECB (2015b), the sign of Ln(TA) can be positive may be due to traditional micro-economic theory. The traditional micro-economic theory states that larger banks have more market power to set prices (higher loan rates and lower deposit rates) thus exploit higher profits. LIQ represents liquid asset/total deposit and borrowing, measures acquirers' liquidity. The expected sign of LIQ should be positive because if a bank has higher proportion of liquid assets, it can sell liquid assets without much loss in market values, thus may incur fewer losses and increase its performance. However, the expected sign of LIQ can also be negative because the higher the liquidity ratio, the more liquid assets a bank has, the less high-yield assets the bank has, the lower profits banks will create. Moreover, there are two variables measure acquirers' capital ratios, TIER1 and CAP, representing tier1 capital ratio and capital funds/total assets. The expected sign of capital ratios in ROE models can be negative because the more capital a bank has, the higher equity, thus may result in lower ROE. On the contrary, the expected sign of capital ratios and ROA can be positive because the higher capital ratios may indicate lower risk-weighted assets, therefore may lead to higher ROA. Similarly, Cornett et al. (2006) also include ΔCAP to examine if the change in capital structure indicates lower operating performance. Next, D/E and D/A represent debt-to-equity ratio and debt-to-asset ratio, respectively, are used to measure acquirers' financial leverage. Specifically, total debt consists of short-term debt and long-term debt. D/E and D/A will have different and mixed effects on bank's ROA and ROE. First, higher D/A will increase bank's ROE but not necessarily increase bank's ROA because ROE = ROA * (1+D/A); second, higher D/E will increase bank's ROA but not necessarily increase ROE because ROA = ROE *(1+ D/E); third, higher financial leverage ratios indicate bank has

higher capital risk or insolvency risk, the less profits the bank may have (Casu et al. 2015). Consequently, the expected signs of financial leverage ratios are undetermined. ECB (2015b) employed equity-to-total-asset ratio to capture bank's solvency. C/I represents cost-to-income ratio, is calculated by [non-interest expense/ (net interest income + non-interest income)]. It reflects a bank's non-interest costs as a percentage of total income and measures a bank's efficiency. The higher the C/I ratio, the less efficient a bank is, the lower profitability a bank has. Therefore, C/I is expected to be negatively related to ΔROA and ΔROE. ADIVERSITY and IDIVERSITY are two variables that measure acquirers' diversity in business model or product diversification. ADIVERSITY represents acquirers' asset diversity, is calculated as 1-|(net loans – other earnings assets)/total earnings assets|. Its value ranges from 0 to 1 and the higher value indicates higher degree of asset diversification (Laeven and Levine 2005). IDIVERSITY stands for acquirers' income diversity, is calculated as 1-|(net interest income – other operating income)/total operating income|. Its value ranges from 0 to 1 (Laeven and Levine 2005). The expected sign of ADIVERSITY and IDIVERSITY can be either positive or negative because they have inconclusive relationship with acquirers' operating performance. Chiorazzo et al. (2008) found positive relationship between income diversification and risk-adjusted returns for Italian banks between 1993 and 2003. On the contrary, Stiroh (2004) found that risk-adjusted returns are negatively related to non-interest income for U.S. banks between 1984 and 2001. Furthermore, Stiroh and Rumble (2006) concluded that there is no relationship between performance and income diversification for U.S. bank holding companies over 1997-2002. Both two variables are used as proxies for the bank's business model. AGROWTH and LGROWTH are acquirers' asset growth rate and loan growth rate, demonstrates acquirers' growth. Both growth rates are expected to have

positive relationships with profitability because the higher asset or loan growth indicates that bank has more interest-generating assets and may result in greater profitability. Next, LLR, the abbreviation of loan loss ratio, reveals acquirers' asset quality. The expected sign of LLR should be negative because the higher the loan loss ratio, the lower asset quality, the lower bank's profits. Furthermore, ECB (2015b) analyzed that the negative relationship might be explained as worsening asset quality could result in higher costs of provisions and lower profitability. Finally, ZSCORE is the distance to default and is calculated as the sum of average ROA and average capital-to-asset ratio divided by standard deviation of ROA. The expected sign of ZSCORE is positive because the higher z-score shows that banks have lower insolvency risk, and this will result in higher operating performance for banks.

The deal-specific variables contain three dummy variables CROSSBORDER, GEO and LIST. Firstly, if the M&A deal is cross-border, CROSSBORDER will be 1 and otherwise 0. According to Beccalli and Frantz (2009), the cross border dummy variable is positively related to change in ROE. Secondly, GEO represents geographic diversification. If the acquirer and the target come from different continents, GEO will be 1 and otherwise 0. Both CROSSBORDER and GEO are expected to have positive signs due to product or geographic diversification. Casu et al. (2015) list many value-maximizing motives for cross-border bank M&As and point out that geographic or product diversification enable banks to (1) reduce costs and risks (2) increase customer base and revenues. Thirdly, if the acquirer is a listed bank, LIST will be 1 otherwise 0. The variable LIST is used to examine if listed banks have greater profits than non-listed banks.

The controlled country-specific macroeconomic variables include AGDP, AINF and AMONEY. AGDP is the annual real GDP growth rate (%) for acquirers' home country one year prior to M&A

announcement. The expected sign of AGDP should be positive because the higher the economic growth rate for acquirer's home country, the higher profits the acquirer will have. AINF is the inflation deflator (%) for acquirer's home country one year prior to M&A announcement. The inflation is expected to negatively correlated to banks' profits because the lower the inflation, the higher probability that monetary decision makers will implement expansionary monetary policy, and the higher expected profits for banks. AMONEY is the broad money supply (M2) growth rate (%) for acquirer's home country one year prior to M&A announcement. AMONEY is expected to have positive relationship with banks' profits because the higher the broad money supply growth rate, the more money the banks can borrow from central bank and interbank market, the more loans banks can lend, therefore, the more profits banks will have.

The industry-specific variables include CR5 and HHI. The former is the concentration ratio of 5 largest banks in the acquirer's banking market. HHI is the abbreviation of Herfindahl-Hirschman Index of the acquirer's banking market. Both CR5 and HHI are typical indicators that measure concentration of banking market. The expected sign of CR5 or HHI could be positive due to the traditional Structure-Conduct-Performance (SCP) paradigm. According to SCP paradigm, the higher the concentration of a banking market, the higher market power banks have to set higher loan rates and lower deposit rates, the higher banks' profitability (Heffernan 2005).

Finally, this chapter also follows Barth et al. (2013) to use another deposit insurance scheme variable DEPPOWER and two regulatory and supervisory variables REG and SUP. First, DEPPOWER stands for Deposit Insurer Power and measures whether the deposit insurance authority has the authority to make the decision to intervene in a bank. It ranges from 0 to 3 and the higher value indicates that the deposit insurance authority has higher authority and is more

powerful. Second, REG represents Capital Regulatory Index, which is the sum of Overall Capital Stringency and Initial Capital Stringency, measures whether the capital regulation is stringent or not. It ranges from 0 to 9 and the higher value indicates the greater stringency for capital regulation. Third, SUP stands for Official Supervisory Power and measures whether the supervisory authorities have the authority to take specific actions to prevent and correct problems. It ranges from 0 to 14 and the higher value indicates supervisory authority has greater supervisory power. The higher values for these three variables imply stricter regulation. Beltratti and Stulz (2012) argue that stricter regulation and supervision are more likely to be associated with better bank performance. Moreover, some previous authors (Molyneux et al.2014; Casu et al. 2015) note that the deposit insurance scheme may increase banks' moral hazard problems and contribute to greater systemic risk, and ultimately, decrease banks' performance. Therefore, both REG and SUP can be expected to have positive relationships with bank performance due to the regulation hypothesis for the performance of banks and DEPPOWER is expected to have negative sign. However, both REG and SUP can also have negative signs because the more stringent capital regulation and supervision can limit banks' willingness to take risk, leading to banks' lower profits.

2.3 Hypothesis

One important previous study (Ferguson et al. 2009) analyzed that benefits of financial integration come from reducing the cost of capital, enhancing competition, increasing productivity and growth, generating higher income and increasing consumption risk sharing. Another important previous literature (Draghi 2014) also analyzed benefits of financial integration in European banking market. In his speech at the conference for the 20th anniversary of the establishment of the European

Monetary Institute, President of the ECB Draghi (2014) claimed that financial integration could have both stabilizing (benefits) and destabilizing effects (risks). He pointed out two benefits of financial integration. On the one hand, the first benefit can come from increased portfolio diversification, reduced exposure to domestic shocks and greater income; on the other hand, the second benefit is thought to come from the improved allocative efficiency and improved operating performance. As level of financial integration increases, more productive capitals are allocated to most efficient banks and large cross-border banks can have higher overall operating performance. This principle can be applied into cross-border M&As as well. Acquirers, usually most efficient banks, can obtain capitals more easily and then engage in cross-border M&As to boost their operating performances in a more integrated banking market. It reveals that higher (lower) degree of banking market integration in Europe may cause higher (lower) operating performance for acquirers. Therefore, our hypothesis can be formulated as follows:

Hypothesis: The increased (decreased) banking integration in Europe can improve (deteriorate) acquirers' operating performances after cross-border bank M&A deals are completed.

In section 2.5 Discussion of results, this chapter will present all results of main regressions and whether all aforementioned hypotheses tested in this study.

2.4 Samples, Data Sources and Descriptive Statistics

In this subsection, samples descriptions, sample selection criteria, data sources and descriptive statistics for all variables will be presented and discussed.

2.4.1 Samples Descriptions, Selection Criteria

The full sample of this chapter consists of bank M&A deals between 1997 and 2011 whose acquirers come from EU 28 countries and whose targets can come from any country. The following are several requirements for selecting the full sample:

(1) the M&A deals are announced between 01/01/1997 and 31/12/2011;

(2) the acquirers must be commercial banks or savings banks from EU 28 countries;

(3) all the deals must be completed;

(4) the targets can be banks, bank units or banks' assets from any country;

(5) all money center banks, central banks and special purpose banks are excluded;

(6) all required data for accounting or financial data for acquirers must be available.

Please note that the samples between 2012 and 2014 are not included because acquirers' 1-year, 2-year and 3-year post-merger ROE, ROA, NIM and NII will be included in the main dataset. Originally, there are 560 deals, however, due to the data availability, some deals are excluded thus the final sample size is 471. This sample is important because most acquirers are large and systematically important banks in EU countries. Moreover, according to our calculation, the pre-merger total assets of acquirers in this sample have approximately 60% of total assets of the banking sector in European banking market. Then we divide the full sample into two subsamples: cross-border deals and domestic deals. More specifically, there are 277 cross-border deals and 194 domestic deals.

In order to find the relationships between change of acquirers' operating performance and banking integration indicators, the second subsample only contains cross-border bank M&A deals in the full sample. Moreover, the banking integration indicators are only available since 2003, therefore, the M&A deals between 1997 and 2002 in the full sample are excluded, and the sample size for

the second sample is 171. This subsample is significant because most acquirers are large and systematically important banks in euro area countries (and exclude acquirers in non-euro area countries). Moreover, according to our calculation, the pre-merger total assets of acquirers in this sample have approximately 70% of total assets of the banking sector in European banking market. The data sources come from the following multiple sources: (1) the original deal-specific data are downloaded from Bloomberg; (2) the acquirers' financial data are downloaded from Bankscope; (3) the macroeconomic data for acquirers' home countries are downloaded from World Bank Development Indicator (WDI) database; (4) the structural indicators for acquirers' banking markets are downloaded from ECB Statistics Data Warehouse; (5) the regulatory and deposit insurance data come from databases compiled by Barth et al. (2013) and Demirguc-Kunt et al. (2008); (6) the financial integration indicators come from ECB publications.

2.4.2 Descriptive Statistics

Table 2-1 shows descriptive statistics for the variables used in the model specifications. Most variables are presented in 4-digital decimals while a few variables are shown in percentages. Not surprisingly, the means of ΔROA (-0.0036, or -0.36%), ΔROE (-0.0589, or -5.89%.) and ΔNIM (-0.0234, or -2.34%) and the medians of ΔROA (-0.0016, or -0.16%), ΔROE (-0.0311, or -3.11%) and ΔNIM (-0.0020, or -0.2%) are negative, indicating that the M&As do not enhance acquirers' profitability ratios for most acquirers. On the contrary, the mean and the median of ΔNII are €1078.71 and €415.82, respectively. These statistics show that acquirers increased their absolute values of interest incomes after M&As due to increase of scales, but they did not genuinely increase their profitability ratios. Moreover, ΔROE (0.2047) has considerably higher standard deviation than ΔROA (0.0107) and ΔROE (0.0099), indicating ΔROE is much more volatile. The

natural log of total asset presents a high standard deviation and relatively large range, thus indicating that the acquirers' size varies dramatically. The range of total assets for all acquirers are extremely large (6567297 – 325.1), confirming that the acquirers' scales varied significantly. Surprisingly, the debt-to-equity ratio has extremely high standard deviation (7.2479) and high range (54.0316-0.032). This is because a few acquirers use very high leverage ratio before the financial crisis. The average Tier 1 capital ratio is 9%, that is much greater than Basel III requires. The ranges of asset growth rate and loan growth rate are quite wide, because the minimum are -0.2650 and -0.3284, and the maximum are 3.3841 and 9.1786, respectively.

The mean of cross-border is also greater than 0.5, showing that more than half of the deals are cross-border. On the contrary, the mean of geographic diversification is only 0.1486, revealing that both acquirers and targets of more than 85% of deals come from Europe. Not surprisingly,

all the means, standard deviations and ranges of macroeconomic and industry-specific variables are quite high because all variables except HHI are presented in percentages while HHI is presented at range of (0-10000). All these variables have very wide range, indicating these indicators in different countries vary significantly. Finally, capital regulatory index and official supervisory power have high mean values (6.2633 and 10.3949) while deposit insurer power has low mean value (0.7728). The high mean value of capital regulatory index indicates that most EU countries have stringent regulatory systems while the high mean value of official supervisory power demonstrates that banking supervisors in most EU countries have great authorities to supervise banks. On the contrary, the low mean value of deposit insurer power shows that deposit insurers in most EU countries have low authorities to make a decision to intervene in a bank.

On the other hand, table 2-2 presents descriptive statistics for data used in Granger-causality

Table 2-1 Descriptive Statistics for data used in model specifications

Variable	Obs.	Mean	Median	S.D.	Min.	Max.
Dependent variables						
Change of ROA	471	-0.0036	-0.0016	0.0107	-0.0806	0.0348
Change of ROE	471	-0.0589	-0.0311	0.2047	-1.4014	0.8066
Change of NIM	461	-0.0234	-0.0020	0.0099	-0.0344	0.0763
Change of NII (mil. Euro)	448	1078.71	415.82	2415	-5976	12377
Bank-specific variables						
Natural log of total assets	471	11.4266	11.6581	1.9201	5.7841	15.6976
Total assets (Mil. Euro)	471	334027	115629	541270	325.1	6567297
Liquid asset / total deposit and borrowing	471	0.2823	0.2402	0.1794	0.0082	0.8712
Tier 1 capital ratio	471	0.0900	0.0820	0.0292	0.0380	0.2300
Capital fund / total asset	471	0.0950	0.0848	0.0781	0.0199	0.9694
Debt-to-equity ratio	471	9.4043	7.5062	7.2479	0.0320	54.0316
Debt-to-asset ratio	471	0.4572	0.4251	0.2279	0.0032	0.9778
Cost-to-income ratio	471	0.6139	0.6034	0.1377	0.2630	1.4870
Asset diversity	471	0.6800	0.6900	0.2072	0.0975	0.9976
Income diversity	471	0.4782	0.4664	0.1737	0.0026	0.9877
Asset growth rate	471	0.1656	0.1092	0.2697	-0.2650	3.3841
Loan growth rate	471	0.1947	0.1332	0.4887	-0.3284	9.1786
Loan loss ratio	471	0.0301	0.0259	0.0241	0.0002	0.2222
Z-score	471	28.5558	20.8756	26.1821	-0.0032	195.7574
Deal-specific variables						
Listed banks	471	0.8641	1	0.3430	0	1
Geographic diversification	471	0.1486	0	0.3561	0	1
Cross-border	471	0.5860	1	0.4931	0	1
Macroeconomic variables						
Annual real GDP growth rate (%)	471	2.2468	2.3615	2.2775	-8.8637	10.2014
Inflation (%)	471	2.5615	2.4351	1.5058	-1.2593	14.7061
Money supply (M2) growth rate (%)	471	8.1799	8.1500	5.5762	-14.1900	42.3600
Industry-specific variables						
CR5 (%)	471	48.7669	45.04	17.5485	20.1611	99.3603
HHI (highest 10000)	471	754.1507	587	552.8324	158	4067
Regulatory and deposit insurance						
Capital regulatory index	471	6.2633	6	1.7390	3	9
Official supervisory power	471	10.3949	11	2.0130	5	14
Deposit insurer power	471	0.7728	0	0.8736	0	3

tests. There are 171 observations for all financial integration indicators due to the following: (1) all samples are cross-border M&As; (2) all acquirers should come from euro area countries (excluding deals whose acquirers come from UK, Sweden, Denmark, Poland, etc.); (3) data availability of all financial integration indicators. Not surprisingly, all the mean values of ΔROA, ΔROE and ΔNIM are negative show that the M&As do not boost acquirers' profitability on average. ΔROE (0.2702) has much greater standard deviation than ΔROA (0.0108) and ΔNIM (0.0091), indicating ΔROE is more volatile than ΔROA and ΔNIM. In contrast, the mean of ΔNII is 1607.97, which shows acquirers increased absolute values of net interest incomes via cross-border M&As. For all interest rates differences on new loans to euro area non-financial corporations, the average values, standard deviations and ranges are not very high. For interest rates difference on MFI deposits for households in the euro area, as expected, all these values for inter-quantile are much less than those for full range across countries. In all five indicators of cross-country standard deviation of MFI interest rates on loans to non-financial corporations and households, consumer credit indicator (DISPERSION3) has both highest mean and standard deviation, indicating that the interest rate for consumers is higher and more volatile than interest rates for house buyers and corporate clients across euro area countries. For interest rates difference on MFI deposits for households in the euro area, as expected, all these values for inter-quantile are much less than those for full range across countries.

Table 2-2 Descriptive Statistics for data used in Granger-causality tests

Variable	Obs.	Mean	S.D.	Min.	Max.
Dependent variables					
ΔROA	171	-0.0035	0.0108	-0.0723	0.0090
ΔROE	171	-0.1105	0.2702	-1.4014	0.1514
ΔNIM	171	-0.0020	0.0091	-0.0291	0.0672
ΔNII (mil. Euro)	169	1607.97	3401.76	-5976	12367.67
Banking market integration indicators					
Interest rates differences on new loans to euro area non-financial corporations (%)					
Distressed vs. non-distressed countries (IRDIFFERENCE1) (1)	171	0.7578	0.3170	0.4458	2.0896
Distressed vs. euro area average (IRDIFFERENCE4) (4)	171	0.4234	0.1396	0.2432	1.0546
Euro area average vs. non-distressed (IRDIFFERENCE5) (5)	171	0.3346	0.1854	0.2024	1.0350
Interest rates difference on MFI deposits for households in the euro area (%)					
Full range across countries (max. – min.) (IRDIFFERENCE2) (2)	171	1.8029	0.4752	1.2656	3.7115
Interquantile (3^{rd}.q- 1^{st}. q) (IRDIFFERENCE3) (3)	171	0.5291	0.1171	0.2408	1.0022
Cross-country standard deviation of MFI interest rates on loans to non-financial corporations and households (basis points)					
Floating rate and up to 1 year initial rate fixation (IRF), up to EUR 1 million (DISPERSION2) (6)	171	45.2942	8.9335	31.5104	89.9771
Floating rate and up to 1 year IRF, over EUR 1 million (DISPERSION5) (9)	171	28.5390	7.5867	21.8312	55.3254
Consumer credit, over 1 year and up to 5 Year IRF (DISPERSION3) (7)	171	113.6424	19.4797	85.1898	155.2568
House purchase, floating rate and up to 1 year (DISPERSION6) (10)	171	33.5792	8.5642	25.9672	60.7902
House purchase, over 5 years and up to 10 years (DISPERSION4) (8)	171	33.6712	6.8999	22.8838	55.0650

Table 2-3 shows the correlations coefficients among performance change measures and banking integration indicators. On the one hand, change of ROA and change of ROE have very high correlation with each other. So they will be separated as different dependent variables in different regressions. There is no high correlation among other performance change measures. We expect change of ROE to have similar results to change of ROA, but different results to change of NIM and change of NII. On the other hand, all banking integration indicators except DISPERSION3 have positive correlations with each other and negative correlations with change of ROA and change of ROE, but they have mixed signs for correlations with change of NII and change of NIM.

Table 2-3 the Correlation Coefficients among Performance Measures and Banking Integration Indicators

	ΔROA	ΔROE	ΔNIM	ΔNI1	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
ΔROA	1.0000													
ΔROE	0.6104***	1.0000												
ΔNIM	0.0356	0.1042	1.0000											
ΔNII	0.0164	0.1274*	0.0332	1.0000										
(1)	-0.2954***	-0.2303***	0.0782	-0.0366	1.0000									
(2)	-0.4678***	-0.2828***	0.0546	0.0889	0.6940***	1.0000								
(3)	0.2277***	0.2952***	-0.0670	-0.0692	-0.1457*	-0.3402***	1.0000							
(4)	-0.2776***	-0.1806**	0.0628	-0.0731	0.9670***	0.5847***	-0.0498	1.0000						
(5)	-0.2956***	-0.2573***	0.0859	-0.0079	0.9818***	0.7459***	-0.2110***	0.9010***	1.0000					
(6)	-0.0894	-0.1106	0.0479	-0.1209	0.8331***	0.3535***	0.1100	0.8280***	0.8013***	1.0000				
(7)	-0.3424***	-0.2054***	-0.0285	0.1009	0.2470***	0.6161***	-0.3672***	0.1834***	0.2835***	-0.0841	1.0000			
(8)	-0.1342*	-0.1005	0.1392*	-0.0003	0.7689***	0.4763***	-0.0509	0.7144***	0.7762***	0.8266***	0.1264*	1.0000		
(9)	-0.2808***	-0.2456***	0.0764	-0.0024	0.8741***	0.7021***	-0.3411***	0.7934***	0.8969***	0.8141***	0.2544***	0.8300***	1.0000	
(10)	-0.2850***	-0.2292***	-0.0259	-0.1373*	0.8469***	0.6596***	-0.0085	0.8203***	0.8310***	0.8163***	0.0983	0.6590***	0.8043***	1.0000

Note: *** ** * indicate the correlation coefficient is significant at 1%,5% and 10% significance level.

2.4.3 Empirical Methodology

For research question 1, in order to find acquirers' performance changes of bank M&As, the difference between post-merger and pre-merger profitability of acquirers will be calculated. First of all, 3-year, 2-year and 1-year post-merger and pre-merger ROA,ROE,NIM and NII for acquirers are collected from Bankscope and the average post-merger ROA, ROE, NIM and NII and the average pre-merger ROA,ROE, NIM and NII are calculated, respectively. Secondly, the difference between the average post-merger ROA and pre-merger ROA, the difference between the average post-merger ROE and pre-merger ROE, the difference between the average post-merger NIM and pre-merger NIM and the difference between the average post-merger NII and pre-merger NII are computed, respectively. Thirdly, the four differences computed in the second step are used as dependent variables and the acquirers' financial ratios, deal-specific variables, industry-specific variables, macroeconomic variables and regulatory variables are used as independent variables.

On the one hand, for research question 1, the full samples (including both cross-border and domestic bank M&As) are used and the linear panel data models are employed. First, both fixed-effect model and random-effect model can be used in this study. On the one hand, according to Greene (1990), the fixed-effect model can be written as follows:

$$y_{it} = \alpha + \beta x_{it} + \mu_i + v_{it} \tag{2.1}$$

where μ_i is the time-invariant component of the error (e.g. cross-sectional) and v_{it} is the time-variant component of the error (e.g. time-series). Cameron and Trivedi (2010) specified that μ_i is permitted to be correlated with any of the regressors x_{it} and v_{it} is assumed to be uncorrelated with x_{it} in the fixed-effect model. Therefore, it is possible that one or more regressors have correlations with the time-variant component of the error and they cannot be estimated by using the fixed-effect

model.

On the other hand, Greene (1990) described the random-effect model as follows:

$$y_{it} = \alpha + \beta X_{it} + \varepsilon_i + v_{it} \tag{2.2}$$

where ε_i is the time-invariant component of the error (e.g. cross-sectional) and v_{it} is the time-variant component of the error (e.g. time-series). Cameron and Trivedi (2010) stated that ε_i is purely random and is uncorrelated with any of the regressors x_{it} in the random-effect model. Consequently, all the explanatory variables, including the time-invariant variables, can be estimated by using the random-effect model.

Second, either the fixed-effect model or the random-effect model can be selected by conducting the Hausman test (Brooks 2008; Cameron and Trivedi 2010). They stated that the Hausman test can be used to test to know if the time-invariant component of error is correlated with the regressors. Wooldridge (2010) described that the Hausman test as follows: the null hypothesis and alternative hypothesis are:

$$\mathrm{H}_0 : E[\mu_i x_{it}] = 0; H_1 : E[\mu_i x_{it}] \neq 0 \tag{2.3}$$

and the test statistics of the Hausman test is:

$$\mathrm{H} = (\hat{\beta}_{FE} - \hat{\beta}_{RE})^T [Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}) \tag{2.4}$$

If *H* is greater than the critical value, the null hypothesis is rejected, this means the time-invariant component of error is correlated with the regressors, then the estimators in fixed-effect models are consistent and the fixed-effect models are preferred; if *H* is less than the critical value, the null hypothesis cannot be rejected, this means the time-invariant component of error is uncorrelated with the regressors, then the estimators in both fixed-effect and random-effect models are consistent but random-effect estimators are more efficient, then the random-effect models are

preferred.

In this study, the test statistic of the Hausman test is 61.87, which is much greater than the critical value and the p-value is 0.0000, therefore, the null hypothesis is rejected and the fixed-effect model is preferred.

For research question 1 and 2, the following fixed-effect models will be used:

$$\Delta Per_{it} = \alpha + \beta_1 FI_{it} + \beta_2 BC_{it} + \beta_3 DS_{it} + \beta_4 IS_{it} + \beta_5 Macro_{it} + \beta_6 \mathrm{Re}\, gulat_i + (\mu_i + \nu_{it}) \quad (2.5)$$

where ΔPer_{it} is change of performance measures (i.e. ROA, ROE, NIM and NII) for acquirer *i* at time *t* (*i* = 1,2,3…*N*; *t* = 1,2,3,…*T*); FI_{it} is a financial integration indicator in European banking market; BC_{it} is a vector of bank-specific variables (including size, liquidity, capitalization, solvency, efficiency, asset/income diversification, growth, asset quality and insolvency risk); DS_{it} is a vector of deal-specific variables (listed, geographic diversification and cross-border); IS_{it} stands for a vector of industry-specific/structural variables (CR5, HHI); $Macro_{it}$ is a vector of macroeconomic variables (GDP growth rate, inflation and broad money supply M2 growth rate); and $Regulat_i$ is a vector of regulatory variables (capital regulatory index, overall supervisory index and deposit insurer power, etc.) for country *i*. Of all these variables, the main variables are financial integration indicator in European banking market, z-score, geographic diversification, cross border, CR5 and capital regulatory index while the other variables are treated as control variables.

With regard to the banking integration indicators, some indicators from ECB report *Financial Integration in Europe* and the corresponding data from ECB website will be used. Specifically, the activity-based and price-based indicators, including interest rates on new loans to euro area non-financial corporations, interest rates on MFI deposits for households in the euro area, cross-country

standard deviation of MFI interest rates on new loans to non-financial corporations and households, will be employed. The first two indicators are activity-based and the last two indicators are price-based. The lower the interest rates with the significant level of convergence across countries (lower interest rates difference across countries) indicate higher degree of integration. Therefore, for the first two indicators, the difference between average interest rates for distressed countries and for non-distressed countries and the full range difference across countries (max minus min) will be calculated. In addition, the lower cross-country standard deviations of interest rates indicate higher degree of integration. Consequently, for the last two indicators, the original time series are kept as the integration indicators. Although there are at least two time-series for each indicator, only one or two time-series are selected. According to the announcement date of M&A, the monthly data of all selected banking integration indicators for all eligible deals (those deals whose acquirers come from 10 euro areas countries in distressed and non-distressed countries) will be input.

Additionally, to select some most important financial integration indicators, principal component analysis (PCA) will be employed in this chapter. According to Jollife (1986) and Rabe-Hesketh and Everitt (2007), Principal Component Analysis, originally introduced by Pearson (1901) and Hotelling (1933), has the central idea to reduce the dimentionality of a dataset which consists of a large number of inter-correlated, while retaining as much as possible of the variation in the data set. Van Belle et al. (2004) define the first, second, third… and the kth principal components and point out that for each k, the first k principal components explain as much of the variability in a sample as may be explained by any *k* directions or *k* variables. Based on these ideas, this chapter now will use PCA to select several principal components that can explain most amount of variability in the dataset thus to reduce the number of banking integration indicators from 10 to a

smaller number. This chapter will follow Jolliffe's (1986) rule to determine the number of principal components. In his book *Principal Component Analysis*, he listed four types of rules to select the number of principal components and pointed out that the most obvious criterion is to select a cumulative percentage (i.e. 80% or 90%) of total variation it is desired that the principal components should contribute. Specifically, formula to calculate the percentage of variation contributed by the first k PCs is

$$t_k = 100\sum_{j=1}^{k} l_j \Big/ \sum_{j=1}^{p} s_{jj} = 100\sum_{j=1}^{k} l_j \Big/ \sum_{j=1}^{p} l_j \tag{2.6}$$

Then we need to choose a cut-off, t^*, between 70% and 90% of total variation and keep the smallest number for k, that is m, for which $t_k > t^*$. The first m PCs can provide most information in a vector of variables. This chapter will also follow Rabe-Hesketh and Everitt (2007) to present the process of PCA by using Stata. All the results will be presented and discussed in the following section of Discussion of Results.

Next, this chapter will also use mean-comparison t-tests to evaluate whether the 2007-2009 financial crisis and European sovereign debt crisis have negative impacts on acquirers' performances after M&As. First, the full sample will be divided into two sub-samples: pre-crisis sample (1997-2006) and post-crisis sample (2007-2011); second, both post-crisis and pre-crisis averages of ΔROA, ΔROE, ΔNIM and ΔNII will be calculated; third, for each post-crisis and pre-crisis average performance change, one-sample t-test will be used to test whether the average post-crisis and pre-crisis performance changes are significantly negative, significantly positive or insignificant; fourth, the differences between the average post-crisis performance change and the average pre-crisis performance change will be computed, and finally, two-sample mean-comparison t-tests using variables will be employed to further test whether the average post-crisis

performance changes are significantly lower than the average pre-crisis performance changes.

The null and alternative hypotheses of one-sample t-test for average performance changes are:

H_0: mean (performance change) = 0 , H_1: mean (performance change) < 0 (2.7)

H_0: mean (performance change) = 0 , H_1: mean (performance change) > 0 (2.8)

If the t-statistics is greater than the critical value or p-value is less than the critical value, the null hypothesis should be rejected, thus the average post-crisis and/or pre-crisis performance change is significantly different from 0. Furthermore, if the null hypothesis in (2.7) is rejected, the average post-crisis and/or pre-crisis performance change is significantly lower than 0, indicating acquirers' lower performances after M&As; if the null hypothesis in (2.8) is rejected, the average post-crisis and/or pre-crisis performance change is significant higher than 0, indicating acquirers' higher performances after M&As. If neither null hypothesis in (2.9) and (2.10) is rejected, the acquirers' average post–crisis and pre-crisis performance changes do not change significantly.

The null and alternative hypotheses of two-sample mean-comparison t-test for average performance changes are:

H_0: mean (post-crisis performance change) – mean (pre-crisis performance change) = 0

H_1: mean (post-crisis performance change) – mean(pre-crisis performance change) < 0 (2.9)

H_0: mean (post-crisis performance change) – mean (pre-crisis performance change) = 0

H_1: mean (post-crisis performance change) – mean(pre-crisis performance change) > 0 (2.10)

If the t-statistics is greater than the critical value or p-value is less than the critical value, the null hypothesis should be rejected, thus the average post-crisis and pre-crisis performance change are significantly different. If the null hypothesis in (2.9) is rejected, the average post-crisis performance change is significantly lower than the average pre-crisis performance change,

indicating financial crises have negative impacts on acquirers' performances after M&As; if the null hypothesis in (2.10) is rejected, the average post-crisis performance change is significantly higher than the average pre-crisis performance change, indicating financial crises have positive impacts on acquirers' performances after M&As. If neither null hypothesis in (2.9) and (2.10) is rejected, the financial crises do not have significant impacts on acquirers' performances after M&As.

On the other hand, this chapter will focus on cross-border bank M&As only and investigate whether acquirers' performance changes and banking integration indicators have mutual relationships. To achieve this aim, in addition to including banking integration indicators in the main regressions, this chapter will use the Granger-causality tests. Brooks (2008) defines that he Granger-causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. He also describes that Granger-causality tests seek to answer questions such as "Do changes in the first variable cause changes in the second variable?" If the first variable causes the second variable, then lags of the first variable should be significant in the equation for the second variable. If this is the case, we say that the first variable "Granger-causes" the second variable. If the second variable causes the first variable, lags of the second variable should be significant in the equation for the first variable. If both sets of lags are significant, there is "bi-directional causality". If neither the second variable causes the first variable, nor the first variable causes the second variable, then they are independent. More specifically, in this chapter, the Granger-causality tests between acquirers' performances (the first variable) and banking integration indicators (the second variable) will be used.

2.5 Discussions of Results

In this section, we first use fixed-effect regressions as main models to investigate the determinants of acquirers' performance changes after M&As. Secondly, the principal component analysis (PCA) will be employed to select several most important banking integration indicators. Thirdly, these selected indicators will be included in other fixed-effect models in cross-border sample to find whether they are significant with acquirers' performance changes. Fourthly, some t-tests will be employed to investigate whether the 2007-2009 Financial Crisis had negative effects on acquirers' performance changes after M&As. Finally, several robustness checks, including more fixed-effect models with different explanatory variables and Granger-causality tests will be used to provide further evidences for previous findings.

2.5.1 Determinants of Acquirers' Performance Changes for All M&A Deals

Table 2-4 reports the results for different specifications for change of ROE in full sample. It is found that Z-score is positively and significantly associated with changed in ROE in all specifications, which indicates that acquirers with lower risks may have higher profitability. However, several authors (e.g. Casu et al. 2015) argue that the Z-score depends positively on bank's profitability the higher ROE may not necessarily lead to higher ROE or ROA after M&As. In order to investigate the relationship between acquirers' performance changes and Z-score, more robustness checks will be conducted later in this section.

Geographic diversification is found to be positively and significantly related to changes in ROE, suggesting that acquires whose targets come from other continents have on average been more

Table 2-4 Determinants of Acquirers' change of ROE for bank M&As

Variable	(1) ΔROE/full	(2) ΔROE bank-specific	(3) ΔROE bank-specific macroeconomic	(4) ΔROE bank-specific deal-specific and macro	(5) ΔROE bank-specific and regulatory
Z-score	0.0009**	0.0008**	0.0009***	0.0008**	0.0010**
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Asset diversity	-0.0303	-0.0376	-0.0372	-0.0364	-0.0320
	(0.0299)	(0.0250)	(0.0252)	(0.0258)	(0.0327)
Geographic diversification	0.0290*	0.0503**	0.0479**	0.0471**	0.0274**
	(0.0141)	(0.0188)	(0.0184)	(0.0190)	(0.0116)
Cross border	-0.0382*	-0.0503**	-0.0583**	-0.0563**	-0.0294
	(0.0215)	(0.0204)	(0.0212)	(0.0205)	(0.0210)
Ln(TA)	0.0040	0.0055	0.0049	0.0066	0.0022
	(0.0064)	(0.0071)	(0.0070)	(0.0073)	(0.0066)
Liquid ratio	0.2382**	0.2617**	0.2639**	0.2612**	0.2386**
	(0.0817)	(0.0980)	(0.0947)	(0.0936)	(0.0853)
Capital ratio	-0.0986	-0.0608	-0.0370	-0.0382	-0.1077
	(0.0792)	(0.0740)	(0.0561)	(0.0608)	(0.0896)
Debt-to-equity	-0.0052	-0.0065	-0.0066	-0.0069	-0.0050
	(0.0043)	(0.0049)	(0.0052)	(0.0052)	(0.0040)
Loan growth	0.0033	0.0016	0.0025	0.0040	0.0013
	(0.0108)	(0.0116)	(0.0105)	(0.0112)	(0.0114)
Loan loss ratio	0.3928	0.1806	0.2632	0.2594	0.3697
	(0.3233)	(0.5169)	(0.4603)	(0.4561)	(0.3779)
Cost-to-income	0.0706	0.0396	0.0569	0.0468	0.0685
	(0.0798)	(0.0744)	(0.0848)	(0.0858)	(0.0678)
Listed banks	-0.0231			-0.0331	
	(0.0265)			(0.0284)	
Real GDP growth	0.0172**		0.0146**	0.0147**	
	(0.0069)		(0.0057)	(0.0058)	
Inflation	-0.0184**		-0.0252**	-0.0254**	
	(0.0070)		(0.0096)	(0.0098)	
Money supply growth	0.0055**		0.0068**	0.0067**	
	(0.0024)		(0.0027)	(0.0027)	
CR5	-0.0030***				-0.0031***
	(0.0009)				(0.0010)_
Capital regulatory index	0.0028				0.0061
	(0.0127)				(0.0129)
Official supervisory index	-0.0180				-0.0238**
	(0.0109)				(0.0102)
Deposit insurer power	-0.0381				-0.0432
	(0.0250)				(0.0271)
Obs.	471	471	471	471	471
R^2	0.2257	0.0941	0.1374	0.1355	0.1811

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

Numbers in parentheses are heteroscedasticity-robust standard errors

profitable. These results also show that acquirers involve in M&As outside Europe can have at least 2.9% higher ROE than peers only involved in M&As in Europe. This is expected and can be explained by acquirers that engage in M&As outside Europe can benefit more from geographic diversification and can have lower cost per unit and thus higher profitability.

In contrast, surprisingly, the estimated coefficients of CROSSBORDER in all models are negative and significant, showing that acquirers engage in cross-border M&A deals have been less profitable. This result is unexpected, but it has economic significance. On average, the acquirers involve in cross-border M&As have at least 3.82% lower ROE. This result, to some extent, is contrast with the result of geographic diversification, can be explained by the fact that acquirers engage in cross-border M&As in EU28 countries rather than outside Europe do not benefit from geographic diversification. This makes sense because most EU countries have identical monetary policy and same currency and they have highly positive correlations in macroeconomic conditions and performance in banking markets.

Moreover, liquidity ratio has positive and significant estimated coefficients in all models, indicating that if acquirers increase the liquidity ratios by 1%, their ROE will increase at least 0.21%. This result is consistent with previous studies and can be interpreted as banks with higher liquidity can sell their assets more easily without loss. Additionally, both CR5 and HHI are found to have negative and significant estimated coefficients in all models, showing that acquirers in less concentrated banking markets have been more profitable. This result is consistent with the results in some previous studies on European banks (Kosmidou 2008, Petria et al. 2015) but contrast with results in other studies (ECB 2015b). For example, Kosmidou (2008) examined the determinants of performance of Greek banks during 1990 and 2002 and found ROAA is significantly negative

with concentration ratio. Similarly, Petria et al. (2015) assessed the main determinants of banks' profitability in EU 27 countries over the period 2004-2011 and concluded that were negatively significant with HHI. These results challenge the traditional Structure-Conduct-Performance (SCP) paradigm of increased banking industry concentration lowering the cost of collusion thus result in excess profits. One possible explanation is the competition-stability view, which argues that less concentration may indicate higher competition and may encourage bank managers to carry out better screening and monitoring activities to avoid moral hazard and adverse selection, leading to a better asset quality and lower non-performing loans, thus result in less loan losses and higher profits. In contrast, ECB (2015b) analyze the determinants of EU banks' profitability based on sample of 98 banks between 1994 and 2004 and found that ROA is positively significant with both HHI and CR5, which supports the traditional SCP view.

Next, asset diversity has negative but insignificant estimated coefficients in all models, suggesting that asset diversity is only weakly negatively related to acquirers' performance changes. Finally, as expected, all coefficients of the three controlled country-specific macroeconomic variables have positive signs. Both real GDP growth rate and money supply growth rate in acquirers' home countries are positively and significantly associated with change of ROE, indicating both economic growth and money supply can contribute to higher acquirers' performance after M&As. The coefficient for inflation rate in the acquirers' home countries is negatively and significant, demonstrating that higher inflation will result in lower acquirers' profitability after M&As.

Table 2-5 Determinants of Acquirers' change of NII for bank M&As

Variable	(1) ΔNII/full	(2) ΔNII bank-specific	(3) ΔNII bank-specific macroeconomic	(4) ΔNII bank-specific deal-specific and macro	(5) ΔNII bank-specific and regulatory
Z-score	-0.7826	1.8259	1.0172	0.5862	-0.2189
	(6.8261)	(4.4336)	(4.4159)	(4.7012)	(6.9308)
Asset diversity	-1278.97	-1471.86	-1455.72	-1458.65	-1302.2
	(1210.95)	(1157.35)	(1156.92)	(1162.58)	(1210.37)
Geographic diversification	-119.51	452.67	372.44	370.99	-32.98
	(308.02)	(312.78)	(328.58)	(325.88)	(302.67)
Cross border	124.39	42.69	116.17	122.86	55.66
	(187.75)	(180.20)	(243.20)	(226.93)	(132.11)
Ln(TA)	268.54***	333.99***	327.31***	334.85***	276.78***
	(74.77)	(77.43)	(74.87)	(81.69)	(71.11)
Liquid ratio	3993.54***	4482.95***	4300.98***	4292.76***	4144.27***
	(1262.22)	(1334.57)	(1215.72)	(1210.6)	(1369.73)
Capital ratio	-1060.38	-1910.81	-1815.34	-1812.06	-1235.47
	(3162.26)	(3526.23)	(3255.44)	(3252.25)	(3329.36)
Debt-to-equity	-39.06*	-31.43	-29.08	-30.07	-39.85*
	(21.81)	(23.61)	(25.98)	(26.70)	(20.58)
Loan growth	73.44	90.60	53.66	59.54	104.83
	(257.07)	(237.67)	(228.89)	(232.67)	(267.23)
Loan loss ratio	-2124.51	-375.04	428.03	625.27	-3105.21
	(5571.99)	(6049.94)	(6360.29)	(6505.65)	(4816.57)
Cost-to-income	-1051.5	-2256.92*	-2017.74	-2044.60	-1291.40
	(1069.05)	(1214.02)	(1199.96)	(1222.26)	(1051.61)
Listed banks	-29.29			-136.71	
	(398.99)			(523.17)	
Real GDP growth	-127.92		-122.91	-123.40	
	(161.31)		(145.77)	(144.58)	
Inflation	21.67		42.28	43.09	
	(89.17)		(67.43)	(66.69)	
Money supply growth	33.11		35.15	35.10	
	(56.38)		(61.30)	(61.39)	
CR5	-13.48				-14.42*
	(7.84)				(7.57)
Capital regulatory index	-238.55**				-256.60**
	(96.34)				(87.24)
Official supervisory index	-0.9452				23.16
	(73.45)				(66.51)
Deposit insurer power	817.317***				827.71***
	(234.71)				(236.22)
Obs.	448	448	448	448	448
R^2	0.3065	0.2528	0.2464	0.2467	0.3093

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

Numbers in parentheses are heteroskedasitity-robust standard errors

Regressions in table 2-5 replace change of ROE with change of NII, with the same sample and explanatory variables in table 2-4. These results provide further evidence for acquirers with higher liquidity ratios and challenges for acquirers come from more concentrated markets may have higher performance. Moreover, more determinants have been identified from these results. For example, the natural log of total asset has extremely positive significant coefficients in all models, showing larger acquirers may have greater net interest incomes after M&As, which provides evidence for economies of scale. Furthermore, all coefficients on capital regulatory index are negative and significant, revealing that acquirers whose home countries have less stringent capital regulations may have greater profits. These results are partly consistent with our previous findings. One possible explanation can be: if a bank regulator in one country has less regulatory power, it will require that banks hold less regulatory capital. Consequently, banks will be more willing to have risky assets and increase their profitability. Finally, all coefficients on deposit insurer power are large in magnitude and show very positive significance, indicating acquirers that based on countries whose deposit insurers have more authorities will have much higher net interest incomes. Specifically, after M&As are completed, acquirers that are based on countries whose deposit insurers have more authorities will have about €800 more in change of net interest income than acquirers that are based on countries whose deposit insurers have less authorities. Possible explanation can be: deposit insurers will have additional authorities to intervene to support banks in difficulties in the resolution facilitator model; it can facilitate a corporate restructuring or even a merger to increase banks' performance. (Casu et al. 2015). Moreover, regressions in table 2-6 replace change of ROE and change of NII with change of NIM. All coefficients have small magnitudes, indicating that acquirers' change of net interest

Table 2-6 Determinants of Acquirers' change of NIM for bank M&As

Variable	(1) ΔNIM/full	(2) ΔNIM bank-specific	(3) ΔNIM bank-specific macroeconomic	(4) ΔNIM bank-specific deal-specific and macro	(5) ΔNIM bank-specific and regulatory
Z-score	0.00003*	0.00002	0.00002*	0.00002*	0.00002*
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
Asset diversity	-0.0021	-0.0019	-0.0020	-0.0021	-0.0026
	(0.0023)	(0.0021)	(0.0022)	(0.0021)	(0.0025)
Geographic diversification	-0.0027*	-0.0020	-0.0026*	-0.0025*	-0.0024
	(0.0015)	(0.0013)	(0.0014)	(0.0013)	(0.0018)
Cross border	0.0018	0.0013	0.0019	0.0018	0.0011
	(0.0015)	(0.0015)	(0.0015)	(0.0015)	(0.0013)
Ln(TA)	-0.0003	-0.0001	-0.0002	-0.0003	-0.00004
	(0.0002)	(0.0003)	(0.0002)	(0.0002)	(0.0003)
Liquid ratio	-0.0026	-0.0018	-0.0029	-0.0027	-0.0010
	(0.0027)	(0.0029)	(0.0026)	(0.0026)	(0.0034)
Capital ratio	0.0050	0.0033	0.0041	0.0042	0.0022
	(0.0047)	(0.0046)	(0.0049)	(0.0048)	(0.0038)
Debt-to-equity	0.0001	0.00004	0.00004	0.00006	0.0001
	(0.00007)	(0.00006)	(0.0001)	(0.00007)	(0.0001)
Loan growth	0.00001	0.0004	0.0001	-0.00003	-0.00002
	(0.0006)	(0.0004)	(0.0006)	(0.0006)	(0.0006)
Loan loss ratio	-0.0102	-0.0210	-0.0165	-0.0165	-0.0193
	(0.0146)	(0.0168)	(0.0158)	(0.0164)	(0.0172)
Cost-to-income	0.0067*	0.0038	0.0056	0.0065*	0.0028
	(0.0037)	(0.0032)	(0.0037)	(0.0036)	(0.0036)
Listed banks	0.0028*			0.0029**	
	(0.0013)			(0.0012)	
Real GDP growth	-0.0009**		-0.0008**	-0.0008**	
	(0.0003)		(0.0003)	(0.0003)	
Inflation	-0.0003		-0.0003	-0.0003	
	(0.0004)		(0.0004)	(0.0004)	
Money supply growth	0.0003**		0.0003**	0.0003***	
	(0.0001)		(0.0001)	(0.0001)	
CR5	-0.00001				-0.000005
	(0.00002)				(0.00002)
Capital regulatory index	0.0003				-0.0001
	(0.0002)				(0.0003)
Official supervisory index	-0.0005				-0.0004
	(0.0004)				(0.0004)
Deposit insurer power	-0.0007				-0.0008
	(0.0008)				(0.0011)
Obs.	461	461	461	461	461
R^2	0.0266	0.0173	0.0232	0.0257	0.0272

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

Numbers in parentheses are heteroscedasticity-robust standard errors

margin does not respond significantly to all independent variables. This may be explained by the relative small numbers of change of NIM (the mean is -0.0020 or -0.2%). In most specifications, z-score found to be positively related to change in NIM, providing further evidence that acquirers with lower insolvency risks may have higher profitability. Nevertheless, geographic diversification has negative and significant estimated coefficients in most models. These results are surprising and contrary to the previous results in specifications of change of ROE. One possible explanation can be: acquirers that engage in M&As outside Europe may be confronted with more intensive competitions from local banks, leading to decreased NIM, that is, the difference between the interest rate that banks earn on loans and the interest rate that banks pay on deposits declined. Additionally, in some models, ΔNII is negatively significant with Tier1 capital ratio, debt-to-equity ratio and cost-to-income ratio. These results provide some evidences for (1) acquirers with lower capital ratio can have higher net interest income; (2) acquirers with lower leverage ratio can have higher net interest income; and (3) acquirers with higher efficiency ratio can have higher net interest income. All these results are reasonable and consistent with the results of previous studies (ECB 2015b). With regard to controlled country-specific macroeconomic variables, unexpectedly, real GDP growth rate has negative sign, revealing that greater home countries' macroeconomic growth leads to lower NIM after M&As. Finally, table 2-7 shows the results for change of ROA. These results provide further challenges for acquirers in more concentrated banking markets have been more profitable and further supports for the effects of macroeconomic variables on acquirers' performance after M&As.

Table 2-7 Determinants of Acquirers' change of ROA for bank M&As

Variable	(1) ΔROA/full	(2) ΔROA bank-specific	(3) ΔROA bank-specific macroeconomic	(4) ΔROA bank-specific deal-specific and macro	(5) ΔROA bank-specific and regulatory
Z-score	0.00002	0.00002	0.00002	0.00002	0.00002
	(0.00003)	(0.00002)	(0.00002)	(0.00003)	(0.00003)
Asset diversity	-0.0020	-0.0018	-0.0017	-0.0017	-0.0021
	(0.0020)	(0.0022)	(0.0018)	(0.0017)	(0.0026)
Geographic diversification	0.0007	0.0017	0.0016	0.0015	0.0006
	(0.0009)	(0.0012)	(0.0011)	(0.0012)	(0.0008)
Cross border	0.0003	0.0003	-0.0001	0.00001	0.0007
	(0.0014)	(0.0013)	(0.0013)	(0.0012)	(0.0014)
Ln(TA)	0.0008	0.0007	0.0007	0.0008	0.0007
	(0.0006)	(0.0005)	(0.0005)	(0.0006)	(0.0006)
Liquid ratio	0.0063	0.0074	0.0075	0.0074	0.0064
	(0.0045)	(0.0052)	(0.0050)	(0.0051)	(0.0047)
Capital ratio	-0.0018	-0.0016	-0.0005	-0.0006	-0.0022
	(0.0034)	(0.0034)	(0.0030)	(0.0031)	(0.0034)
Debt-to-equity	0.00007	0.00002	0.00002	0.00003	0.0001*
	(0.00005)	(0.00007)	(0.00001)	(0.0001)	(0.00004)
Loan growth	-0.0006	-0.0008	-0.0008	-0.0007	-0.0007
	(0.0006)	(0.0006)	(0.0006)	(0.0007)	(0.0005)
Loan loss ratio	0.0073	-0.0043	-0.0006	-0.0008	0.0061
	(0.0300)	(0.0402)	(0.0356)	(0.0350)	(0.0344)
Cost-to-income	0.0086	0.0074	0.0081	0.0076	0.0087*
	(0.0051)	(0.0048)	(0.0052)	(0.0052)	(0.0047)
Listed banks	-0.0014			-0.0015	
	(0.0019)			(0.0020)	
Real GDP growth	0.0008**		0.0006*	0.0006**	
	(0.0003)		(0.0003)	(0.0003)	
Inflation	-0.0008		-0.0010	-0.0010	
	(0.0005)		(0.0006)	(0.0006)	
Money supply growth	0.0002		0.0003	0.0003	
	(0.0001)		(0.0002)	(0.0002)	
CR5	-0.00001*				-0.00008*
	(0.00004)				(0.00004)
Capital regulatory index	-0.0004				- 0.0003
	(0.0010)				(0.0010)
Official supervisory index	-0.0005				-0.0008
	(0.0006)				(0.0006)
Deposit insurer power	-0.0008				-0.0010
	(0.0018)				(0.0019)
Obs.	471	471	471	471	471
R^2	0.1460	0.0581	0.0980	0.0936	0.1025

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

Numbers in parentheses are heteroscedasticity-robust standard errors

Lastly, we will employ the Granger-causality tests to examine whether the lower insolvency risk (higher z-score) has positive relationship with each other. Table 2-8 presents the results of causality tests, indicating that only change of NIM granger-causes z-score and vice versa. This result shows that change of ROE (also change of ROA and change of NII) does not have positive relationship with z-score.

Table 2-8 Results of granger-causality tests between performance changes and Z-score

Null Hypothesis	F-statistics	p-value
(1) Z-score does not Granger-cause ΔROA	0.3981	0.6723
ΔROA does not Granger cause Z-score	0.3161	0.7295
(2) Z-score does not Granger-cause ΔROE	0.1403	0.8692
ΔROE does not Granger cause Z-score	0.7033	0.4955
(3) Z-score does not Granger-cause ΔNIM	2.3685*	0.0948
ΔNIM does not Granger cause Z-score	2.6003*	0.0753
(4) Z-score does not Granger-cause ΔNII	0.7725	0.4625
ΔNII does not Granger cause Z-score	0.5660	0.5682

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

2.5.2 Selecting Banking Integration Indicators

In this subsection, we use principal component analysis (PCA) to select several most important banking integration indicators.

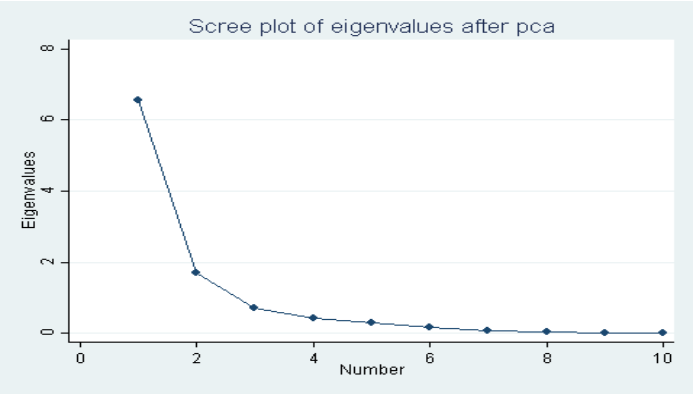
Table 2-9 shows the first three principal components can explain approximately 90% of the total variance. In addition, figure 2-1, the scree plot of eigenvalues after PCA also reveals that the first three principal components have largest eigenvalues. Therefore, we select the first three principal components.

Table 2-9 Results of Principal Component Analysis (PCA) Variance explained

Components	Eigenvalue	Proportion	Cumulative
Component 1	6.5288	0.6529	0.6529
Component 2	1.7168	0.1717	0.8246
Component 3	0.7248	0.0725	0.8970
Component 4	0.4217	0.0422	0.9392
Component 5	0.2952	0.0295	0.9687
Component 6	0.1648	0.0165	0.9852
Component 7	0.0743	0.0074	0.9926
Component 8	0.0502	0.0050	0.9977
Component 9	0.0234	0.0023	1.0000

Next, in table 2-10, we further report the loadings for the first three components and identify that the first principal component has largest absolute values for loadings for IRDIFFERENCE1, IRDIFFERENCE5 and DISPERSION5 while the second and the third principal components have largest absolute values for loadings for IRDIFFERENCE2, IRDIFFERENCE3 and DISPERSION3. These results indicate that PC1 can be mostly interpreted by IRDIFFERENCE1, IRDIFFERENCE5 and DISPERSION5 and PC2 and PC3 can be mostly explained by IRDIFFERENCE2, IRDIFFERENCE5 and DISPERSION5.

Figure 2-1 Scree plot of eigenvalues after PCA



Therefore, we select IRDIFFERENCE1, IRDIFFERENCE5 and DISPERSION5 as the most important banking integration indicators in the main regressions and use IRDIFFERENCE2, IRDIFFERENCE3 and DISPERSION3 as less important indicators in robustness checks.

Table 2-10 the Loadings of Principal Component Analysis (PCA)

Variable	Comp1	Comp2	Comp3
IRDIFFERENCE1	0.3813	0.0306	0.0379
IRDIFFERENCE5	0.3807	-0.0284	-0.0021
DISPERSION5	0.3689	-0.0585	-0.2466
IRDIFFERENCE2	0.2906	-0.3878	0.2858
IRDIFFERENCE3	-0.0715	0.5606	0.7536
DISPERSION3	0.1114	-0.6088	0.4918
IRDIFFERENCE4	0.3603	0.1078	0.0892
DISPERSION2	0.3365	0.3355	-0.0976
DISPERSION4	0.3279	0.1391	-0.1318
DISPERSION6	0.3480	0.1265	0.1070

2.5.3 Determinants of Acquirers' Performance Changes for Cross-border M&A Deals

In the previous section, the results of PCA show that IRDIFFERNCE1, IRDIFFERENCE5 and DISPERSION5 are the three most important banking integration indicators. In this subsection, the

sub-sample with cross-border deals will be used, moreover, these indicators will be included in all main regressions. However, the dummy variable CROSSBORDER will not be included in main regressions due to the multicollinearity (this is because all deals in this sub-sample are cross-border per se).

Regressions (1) - (3) of table 2-11 estimate the relationships between change of ROE and banking integration indicators and the determinants of change of ROE. The sample includes only cross-border deals between 2003 and 2011 because the data for banking integration indicators are available since 2003. On the one hand, there are several same results as those in main regressions in full sample. Z-score and liquidity ratio have positive and significant estimated coefficients while CR5 has negative significant coefficients. Moreover, the coefficients of asset diversity are still insignificant. In contrast, geographic diversification has positive but insignificant coefficients in regression (1) and (2) and significant coefficient in regression (3), providing some support for previous findings. On the other hand, there are some new significant explanatory variables. For instance, in all three regressions, both listed banks and official supervisory index have negative and significant coefficients, indicating that listed acquirers and acquirers operating in countries with less stringent supervision may be more profitable. These results provide evidences for previous findings. The former can be explained by listed banks generally larger equities thus may have lower ROE. The latter can be interpreted as follows: if bank supervisors have more powers to intervene bank managers' decision-making, they are very probably to limit banks' risk taking, therefore, banks are more likely to take lower risks and may incur fewer losses for risky assets, leading to greater profitability. Furthermore, IRDIFFERENCE1 has negatively economic significance with change of NIM, indicating that if interest rate difference

Table 2-11 Determinants of Acquirers' change of ROE and change of NII for cross-border M&As

Variable	(1) ΔROE IR DIFFERENCE1	(2) ΔROE IR DIFFERENCE5	(3) ΔROE DISPERSION5	(4) ΔNII IR DIFFERENCE1	(5) ΔNII IR DIFFERENCE5	(6) ΔNII DISPERSION5
IRDIFFERENCE1	-0.4066*			-4101.07*		
	(0.2154)			(2100.78)		
IRDIFFERENCE5		-0.7523			-7070.76	
		(0.4555)			(4324.41)	
DISPERSION5			-0.0117			-112.99
			(0.0066)			(113.25)
Z-score	0.0015**	0.0014**	0.0010**	20.93*	20.18*	16.67
	(0.0005)	(0.0006)	(0.0004)	(10.69)	(10.21)	(11.70)
Asset diversity	-0.0292	-0.0251	-0.0308	-160.51	-116.26	-155.71
	(0.1049)	(0.1039)	(0.1087)	(1746.47)	(1756.06)	(1917.86)
Geographic diversification	0.0485	0.0476	0.0518*	-326.42	-331.83	-289.14
	(0.0310)	(0.0298)	(0.0253)	(388.02)	(387.28)	(327.19)
Ln(TA)	0.0187	0.0201	0.0225	396.51	411.84	435.66
	(0.0214)	(0.0217)	(0.0203)	(243.43)	(254.04)	(236.35)
Liquid ratio	0.3042**	0.3021**	0.2916**	5653.24***	5610.90***	5514.21***
	(0.1174)	(0.1143)	(0.0956)	(1583.96)	(1610.12)	(1688.20)
Capital ratio	-0.0967	-0.1046	-0.0713	-3524.49*	-3608.69*	-3290.16*
	(0.1020)	(0.1009)	(0.1102)	(1550.94)	(1593.36)	(1433.04)
Debt-to-equity	-0.0164	-0.0161	-0.0171	-17.32	-15.50	-24.98
	(0.0103)	(0.0102)	(0.0106)	(29.56)	(27.91)	(35.44)
Loan growth	-0.0639	-0.0726	-0.0695	4197.22**	4106.49*	4150.23*
	(0.1764)	(0.1748)_	(0.1733)	(1811.20)	(1798.16)	(1831.09)
Loan loss ratio	-0.2403	-0.2315	-0.3097	17803.55***	17895.91***	17161***
	(0.2464)	(0.2417)	(0.2259)	(1618.66)	(1604.76)	(2010.85)
Cost-to-income	0.1522	0.1525	0.1328	-1337.73	-1304.16	-1483.54
	(0.1731)	(0.1734)	(0.1882)	(1337.71)	(1382.06)	(1668.67)
Listed banks	-0.1799*	-0.1830*	-0.1823*	38.28	98.08	110.40
	(0.0864)	(0.0858)	(0.0840)	(610.90)	(590.92)	(649.29)
Real GDP growth	0.0118	0.0107	0.0128	-148.68	-161.23	-142.80
	(0.0174)	(0.0175)	(0.0179)	(342.12)	(337.21)	(351.18)
Inflation	-0.0043	-0.0032	-0.0122	96.10	107.69	23.10
	(0.0233)	(0.0232)	(0.0216)	(248.86)	(247.26)	(293.05)
Money supply growth	0.0061	0.0063	0.0064	81.01	84.33	85.49
	(0.0077)	(0.0077)	(0.0079)	(89.76)	(87.27)	(92.00)
CR5	-0.0049***	-0.0048***	-0.0049***	-8.23	-7.42	-7.60
	(0.0012)	(0.0012)	(0.0012)	(9.49)	(8.77)	(9.13)
Capital regulatory index	0.0195	0.0198	0.0244	-745.24***	-742.04***	-698.25**
	(0.0173)	(0.0173)	(0.0152)	(205.54)	(200.75)	(224.06)
Official supervisory index	-0.0298**	-0.0298*	-0.0260*	-354.74*	-353.33*	-318.33*
	(0.0128)	(0.0132)	(0.0114)	(155.93)	(158.44)	(166.15)
Deposit insurer power	-0.0480	-0.0511	-0.0493	1432.15***	1400.79***	1421.34***
	(0.0305)	(0.0303)	(0.0310)	(313.91)	(313.71)	(285.40)
Obs.	171	171	171	169	169	169
R^2	0.4136	0.4212	0.4561	0.3422	0.3238	0.3906

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

Numbers in parentheses are heteroscedasticity-robust standard errors

between distressed countries and non-distressed countries decreases by 1%, acquirers' net interest incomes after M&A will increase by 0.41%. This result supports our hypothesis of the higher level of banking market integration may contribute to greater profits for acquirers after M&As. However, this result does not necessarily indicate banking integration and change of NIM have unidirectional or bidirectional relationship. To investigate whether they have negative relationships with each other, we will conduct Granger-causality tests in the next subsection.

Regressions (4) – (6) replace change of ROE with NII and employ the same models and explanatory variables. On the one hand, these results show that z-score, liquidity ratio and official supervisory index have identical results as regressions (1) – (3); on the other hand, there are more explanatory variables are economically significant in these results. For example, IRDIFFERENCE1 has negatively economic significance with change of NII, indicating that if interest rate difference between distressed countries and non-distressed countries decreases by 1%, acquirers' net interest incomes after M&A will increase by €4101.07 mil. This result further supports our hypothesis of the increased banking integration in Europe can improve acquirers' operating performances after cross-border M&As.

Furthermore, most results are expected and reasonable except loan loss ratio. ΔNII is positively significant with loan growth ratio and deposit insurer power while it is negatively significant with capital ratio and capital regulatory index. These results provide further evidences for (1) acquirers in banking markets with less stringent capital regulation may have greater profits; (2) acquirers in banking markets with less powerful deposit insurers may have greater profits and new evidences for (1) acquirers with lower capital ratio may have higher profits; (2) acquirers with higher growth rates may have higher profits. However, loan loss ratio has unexpected

Table 2-12 Determinants of Acquirers' change of NIM and change of ROA for cross-border M&As

Variable	(1) ΔNIM IR DIFFERENCE1	(2) ΔNIM IR DIFFERENCE5	(3) ΔNIM DISPERSION5	(4) ΔROA IR DIFFERENCE1	(5) ΔROA IR DIFFERENCE5	(6) ΔROA DISPERSION5
IRDIFFERENCE1	0.0114			-0.4059		
	(0.0082)			(0.0103)		
IRDIFFERENCE5		0.0143			0.0093	
		(0.0143)			(0.0128)	
DISPERSION5			0.0001			0.0002
			(0.0002)			(0.0002)
Z-score	-0.000004	0.000004	0.000009	0.00006	0.00006	0.0001
	(0.00004)	(0.00004)	(0.00003)	(0.00004)	(0.00004)	(0.00004)
Asset diversity	0.0022	0.0022	0.0025	0.0014	0.0011	0.0011
	(0.0017)	(0.0017)	(0.0018)	(0.0048)	(0.0047)	(0.0049)
Geographic diversification	-0.0040	-0.0040	-0.0040	0.0024	0.0024	0.0024
	(0.0023)	(0.0024)	(0.0026)	(0.0019)	(0.0017)	(0.0017)
Ln(TA)	0.0009*	0.0009**	0.0008**	0.0022	0.0023	0.0023
	(0.0004)	(0.0003)	(0.0003)	(0.0014)	(0.0014)	(0.0014)
Liquid ratio	-0.0063	-0.0053	-0.0049	0.0018	0.0012	0.0013
	(0.0029)	(0.0036)	(0.0036)	(0.0023)	(0.0026)	(0.0026)
Capital ratio	0.0036	0.0037	0.0034	-0.0004	-0.0002	-0.0006
	(0.0026)	(0.0027)	(0.0030)	(0.0047)	(0.0051)	(0.0049)
Debt-to-equity	-0.00003	-0.00003	-0.00003	0.00004	0.00004	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Loan growth	-0.0008	-0.0006	-0.0007	0.0088	0.0088	0.0088
	(0.0027)	(0.0027)_	(0.0027)	(0.0078)	(0.0079)	(0.0079)
Loan loss ratio	-0.0035	-0.0038	-0.0034	-0.0049	-0.0048	-0.0036
	(0.0023)	(0.0023)	(0.0025)	(0.0059)	(0.0059)	(0.0061)
Cost-to-income	0.0077	0.0077	0.0077	0.0067	0.0069	0.0072
	(0.0053)	(0.0053)	(0.0056)	(0.0048)	(0.0048)	(0.0050)
Listed banks	0.0063*	0.0063*	0.0062*	-0.0061	-0.0060	-0.0060
	(0.0029)	(0.0030)	(0.0030)	(0.0045)	(0.0043)	(0.0043)
Real GDP growth	-0.0010	-0.0010**	-0.0011**	0.0016	0.0017	0.0017
	(0.0003)	(0.0003)	(0.0004)	(0.0013)	(0.0013)	(0.0013)
Inflation	0.0008	0.0008	0.0008	0.0004	0.0003	0.0005
	(0.0005)	(0.0005)	(0.0006)	(0.0016)	(0.0016)	(0.0017)
Money supply growth	0.0002*	0.0002	0.0002	-0.0001	-0.00002	-0.00002
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
CR5	-0.00002	-0.00002	-0.00002	-0.0002***	-0.0002***	-0.0002***
	(0.00003)	(0.00003)	(0.00003)	(0.00004)	(0.00004)	(0.00004)
Capital regulatory index	-0.0003	-0.0003	-0.0003	-0.0006	-0.0006	-0.0007
	(0.0002)	(0.0002)	(0.0002)	(0.0013)	(0.0014)	(0.0014)
Official supervisory index	-0.0012**	-0.0012**	-0.0012**	-0.0013	-0.0013	-0.0014
	(0.0004)	(0.0004)	(0.0004)	(0.0013)	(0.0012)	(0.0013)
Deposit insurer power	-0.0021*	-0.0020*	-0.0020*	-0.0021	-0.0021	-0.0022
	(0.0010)	(0.0009)	(0.0009)	(0.0031)	(0.0029)	(0.0029)
Obs.	171	171	171	171	171	171
R^2	0.0742	0.0833	0.0704	0.3070	0.2394	0.2639

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

Numbers in parentheses are heteroscedasticity-robust standard errors

results that it has positively significant estimated coefficients in regressions (4) – (6). One possible explanation can be: after some large acquirers completed their M&As, they significantly increase their deposits and loans, thus may increase their net interest incomes. Although the proportion of non-performing loans had been increasing (loan loss ratio is higher), they could still receive full interest payments from borrowers and thus increase net interest income. However, increase in net interest income does not necessarily increase the profitability ratio. If net interest income increases smaller percentage than total assets, total equity and total revenue, ROA, ROE and NIM should be lowered. All these analyses may interpret why loan loss ratio has positive coefficients for change of NII while has negative coefficients for all other three profitability ratios.

Regressions (1) – (3) and regressions (4) – (6) of table 2-12 report results of change of NIM and change of ROA. This table has many small and a few significant coefficients and small R^2, indicating that change of NIM and change of ROA do not respond significantly to most independent variables (especially Z-score and DISPERSION5). This may be explained by the relatively small numbers of change of NIM (the mean is -0.0020 or -0.20%) and change of ROA (-0.0035 or -0.35%). Regarding the results of change of NIM, official supervisory index has same results as it has in results of change of ROE and further supports our previous findings. Nevertheless, there are still contrary results. For instance, the variable listed bank has positively and significant when the dependent variable is the change of NIM while it has negatively significant coefficients for the change in ROE. One possible explanation can be that although listed banks generally are larger and have more market powers to price loans and deposits than non-listed banks to earn higher net interest incomes, they still have lower profitability ratios.

Results of change of ROA reveal that CR5 has negatively significant coefficients, providing further

challenges for acquirers whose countries have more concentration ratios can have higher performance after M&As.

2.5.4 Relationships between Acquirers' Performance Changes and Banking Integration Indicators

As discussed in the previous subsection, even the coefficients of banking integration indicators are significant does not necessarily indicate the causal relationships between acquirers' performance changes and banking integration indicators. To investigate such causal relationships between them, in this subsection, we will use Granger-causality tests.

Table 2-13 presents results of pairwise Granger-causality tests for four performance change measures. On the one hand, regarding the results of change of ROE and change of ROA, most F-statistics and p-values are significant for null hypotheses "banking integration indicator does not granger-cause performance change" while most results are insignificant for null hypotheses "performance change does not granger-cause banking integration indicators". Therefore, the former null hypotheses can be rejected and latter ones cannot be rejected. Therefore, combined with the results in the previous subsections, we conclude that banking integration generally has negative causal relationship with change of ROE and change of ROA but change of ROE and change of ROA do not have negative causal relationship with banking integration. Specifically, combined with the result in previous subsection, results of (2) provide strong evidence that lower interest rate difference between distressed and non-distressed countries in the euro area, which indicate higher level of banking integration in Europe, can contribute to higher profitability for acquirers after M&As.

Table 2-13 Results of Pairwise Granger-Causality Tests

Null Hypothesis	F-statistics	p-value
(1) Interest rate difference on new loans to euro area non-financial Corporations between distressed and non-distressed countries does not granger Cause ΔROA (IRDIFFERENCE1)	18.6429***	0.0000
ΔROA does not granger cause interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries	0.5944	0.4418
(2) Interest rate difference on new loans to euro area non-financial Corporations between distressed and non-distressed countries does not granger Cause ΔROE	8.3520***	0.0044
ΔROE does not granger cause interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries	1.3399	0.2487
(3) Interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries does not granger cause ΔNIM	0.9005	0.4084
ΔNIM does not granger cause interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries	3.2106 **	0.0429
(4) Interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries does not granger cause ΔNII	2.9632 *	0.0545
ΔNII does not granger cause interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries	0.3494	0.7057
(5) Interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries does not granger cause ΔROA (IRDIFFERENCE5)	18.3987***	0.0000
ΔROA does not granger cause interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries	12.8709***	0.0004
(6) Interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries does not granger cause ΔROE	7.6676***	0.0063
ΔROE does not granger cause interest rate difference on new loans to euro area non-financial corporations between euro area average and distressed countries	1.1662	0.2817

(7) Interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries does not granger cause ΔNIM	2.6499*	0.0737
ΔNIM does not granger cause interest rate difference on new loans to euro area non-financial corporations between euro area average and distressed countries	2.7841*	0.0647
(8) Interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries does not granger cause ΔNII	1.8295	0.1639
ΔNII does not granger cause interest rate difference on new loans to euro area non-financial corporations between euro area average and distressed countries	1.3613	0.2593
(9) Full range of interest rate difference on MFI deposits for household across euro area countries (max – min) does not granger cause ΔROA (IRDIFFERENCE2)	31.8704***	0.0000
ΔROA does not granger cause full range of interest rate difference on MFI deposits for household across euro area countries (max – min)	0.8624	0.3544
(10) Full range of interest rate difference on MFI deposits for household across euro area countries (max – min) does not granger cause ΔROE	11.1554***	0.0010
ΔROE does not granger cause full range of interest rate difference on MFI deposits for household across euro area countries (max – min)	0.1058	0.7453
(11) Full range of interest rate difference on MFI deposits for household across euro area countries (max – min) does not granger cause ΔNIM	0.9433	0.3915
ΔNIM does not granger cause full range of interest rate difference on MFI deposits for household across euro area countries (max – min)	0.0729	0.9297
(12) Full range of interest rate difference on MFI deposits for household across euro area countries (max – min) does not granger cause ΔNII	3.3890**	0.0362
ΔNII does not granger cause full range of interest rate difference on MFI deposits for household across euro area countries (max – min)	0.0370	0.9637
(13) Inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$) does not granger cause ΔROA (IRDIFFERENCE3)	15.0062***	0.0002
ΔROA does not granger cause inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$)	7.5010***	0.0068

(14) Inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} - 1^{st}$) does not granger cause ΔROE	12.7637***	0.0005
ΔROE does not granger cause inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} - 1^{st}$)	0.0880	0.7671
(15) Inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} - 1^{st}$) does not granger cause ΔNIM	0.2289	0.7957
ΔNIM does not granger cause inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} - 1^{st}$)	0.5477	0.5793
(16) Inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} - 1^{st}$) does not granger cause ΔNIM	0.6686	0.5139
ΔNIM does not granger cause inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} - 1^{st}$)	2.3009	0.1035
(17) Cross-country standard deviation of MFI interest rates on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million) does not granger cause ΔROA (DISPERSION5)	19.1798***	0.0000
ΔROA does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)	0.0019	0.9657
(18) Cross-country standard deviation of MFI interest rates on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million) does not granger cause ΔROE	10.5570	0.0014
ΔROE does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)	0.1529	0.6963
(19) Cross-country standard deviation of MFI interest rates on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million) does not granger cause ΔNIM	3.1632**	0.0449
ΔNIM does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)	0.4627	0.6304
(20) Cross-country standard deviation of MFI interest rates on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million) does not granger cause ΔNII	0.2036	0.8160
ΔNII does not granger cause cross-country standard deviation of MFI interest rate on loans	0.4586	0.6330

to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)		
(21) Cross-country standard deviation of MFI interest rates on loans to household (consumer credit, over 1 year and up to 5 years IRF) does not granger cause ΔROA (DISPERSION3)	15.1536***	0.0001
ΔROA does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (consumer credit, over 1 year and up to 5 years IRF)	0.6047	0.4379
(22) Cross-country standard deviation of MFI interest rates on loans to household (consumer credit, over 1 year and up to 5 years IRF) does not granger cause ΔROE	4.7548**	0.0306
ΔROE does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (consumer credit, over 1 year and up to 5 years IRF)	2.2797	0.1330
(23) Cross-country standard deviation of MFI interest rates on loans to household (consumer credit, over 1 year and up to 5 years IRF) does not granger cause ΔNIM	0.0899	0.9140
ΔNIM does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (consumer credit, over 1 year and up to 5 years IRF)	0.7323	0.4823
(24) Cross-country standard deviation of MFI interest rates on loans to household (consumer credit, over 1 year and up to 5 years IRF) does not granger cause ΔNII	1.2325	0.2944
ΔNII does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (consumer credit, over 1 year and up to 5 years IRF)	0.2219	0.8012

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

In contrast, most F-statistics and p-values for those null hypotheses are insignificant, showing that there is no evidence of a strong relationship between change of NII/change of NIM and banking integration indicators. These results imply that level of banking integration cannot contribute to acquirers' performance changes after M&As and vice versa. In a word, all above-mentioned results

provide solutions for research question 2 and strong supports to hypothesis of the increased banking integration in Europe can improve acquirers' operating performances after cross-border M&As.

2.5.5 Effects of Financial Crisis on Acquirers' Performance Changes after M&As

In the previous subsections, we have identified several key determinants of acquirers' performance changes after M&As and found that to some extent, higher level of banking integration can contribute to the increase of acquirers' performance after M&As. In this subsection, we will use some t-tests to investigate whether 2007-2009 Financial Crisis had negative impacts on acquirers' performance after M&As.

Panel A of table 2-14 shows that the average change of NIM is the only variable that is significantly negative in our pre-crisis sample. This indicates that acquirers generally could boost their profitability through M&As in pre-crisis period. The significant decrease in net interest margin for the acquirers may mainly due to ECB's interest rate cut between 2000 and 2005. In contrast, panel B indicates that the average change in NII is the only variable that is significantly positive in post-crisis sample, demonstrating that acquirer' profitability decline dramatically after M&As in post-crisis period. The significant increase in the average net interest income can be explained by the economies of scale, that is, through M&As, acquirers could make more deposits and loans and have more market powers to price the loans and deposits thus could increase interest income and/or reduce interest expenses. However, the average increase in net interest income still dropped significantly from €2490.74million in pre-crisis period to €1594.25

Table 2- 14 Average changes of performance measures for pre-crisis and post-crisis samples

Variable	(1)		(2)		(3)		(4)	
	N	ΔROE	N	ΔROA	N	ΔNIM	N	ΔNII (mil. Euro)
Panel A: pre-crisis sample								
	309	0.1217*** (0.0000)	309	0.0151** (0.0420)	299	-0.0027*** (0.0000)	297	2490.74*** (0.0000)
Panel B: post-crisis sample								
	162	-0.1430*** (0.0000)	162	-0.0087*** (0.0000)	162	-0.0023*** (0.0007)	151	1594.25*** (0.0000)
Panel C: mean comparison (post-crisis – pre-crisis)								
		-0.2646*** (0.0000)		-0.0078*** (0.0000)		0.0004 (0.7159)		-896.49*** (0.0048)

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

milion.in the post-crisis period. The results in panel C further support this finding. The difference between the average net interest income in pre-crisis period and the average net interest income in post-crisis period is -€896.40 million, which is also quite significant. Furthermore, both differences in average change of ROE (-0.2646) and average change in ROA (-0.0078) are negative and significant, while the difference in average change of NIM is slightly positive. All these results reveal that both acquirers' profitability ratios and profits after M&As declined significantly in the post-crisis period.

2.5.6 Robustness Checks

In addition to the main results in previous subsections, we examine the robustness of the results using same model but alternative dependent and explanatory variables. On the one hand, in models with full sample, we replace income diversity, tier1, debt-to-asset ratio, asset growth ratio, and HHI with asset diversity, capital ratio, debt-to-equity ratio, loan growth ratio, and CR5, and keep

all dependent variables unchanged. On the other hand, in models with cross-border sample, we not only change the above-mentioned explanatory variables but also replace IRDIFFERENCE1, IRDIFFERENCE5 and DISPERSION5 with IRDIFFERENCE2,

IRDIFFERENCE3 and DISPERSION3. Therefore, we expect to have more alternative specifications for cross-border sample. All results in robustness check are presented in table 2A-1 to table 2A-10 in Appendix.

First, table 2A-1 shows that change of ROE has the same results in alternative specifications as it has in main regressions, providing robustness for our results in table 2-4 and confirming our previous findings. Second, regressions in table 2A-2 reveal the similar results with regressions in table 2-5 for change of NII, but still have two more explanatory variables significant. In most alternative specifications, both tier1 and cost-to-income ratio are found to be negative and significant. Both results are expected and reasonable because (1) if acquirers have higher tier1 capital ratio, they will have lower risky assets and will have lower profits; (2) if acquirers have higher cost-to-income ratio, they are less efficient and will have lower profits.

Third, table 2A-3 and table 2A-4 report results of alternative specifications for change of NIM and change of ROA, providing quite similar findings except that cost-to-income ratio is not significant with change of NIM and income diversity is negatively significant with change of ROA in some alternative specifications. The latter results confirm the previous finding of acquirers cannot benefit from asset and income diversity to raise their profitability ratios. Generally speaking, the results of alternative specifications confirm our findings in main regressions.

Regarding the results in alternative specifications in cross-border sample, we report them in different tables (table 2A-5 to table 2A-10). First, although the overall results in alternative

specifications are similar to those in the main regressions, there are still several different results for change of ROE. For instance, in table 2A-5, the estimated coefficient of IRDIFFERNECE1 is negative and has economic significance, indicating that if the interest rate difference between distressed and non-distressed countries in euro area decrease by 1%, acquirers' ROE will increase by 0.4794%. This result confirms that our hypothesis holds. Moreover, all estimated coefficients of liquidity ratio, listed banks and official supervisory index are not significant, providing no further support the corresponding findings. However, deposit insurer power is found to be negative and significant, showing that acquirers come from countries with less powerful deposit insurers may have greater profitability ratio. Then z-score has identical results as those in main regressions and HHI has the same results as CR5 has in main regressions. Again, these results confirm our previous findings. If we change the banking integration indicators and estimate the same model again (as results presented in table 2A-7 and table 2A-9), we can find the same results for z-score, geographic diversification, liquidity ratio, HHI, official supervisory index and deposit insurer power and confirm our previous findings again.

Second, regressions (4) – (6) of table 2A-5 demonstrate that alternative specifications of change of NII, providing the same results as those in main regressions. If we change the banking integration indicators (as results shown in table 2A-7 and table 2A-9), we find no more support for the negative relationship between banking integration indicators and acquirers' performance changes. But we can still confirm other previous findings for bank-specific, structural and regulatory variables in main regressions because all other results are identical.

Third, regressions (1) – (3) of table 2A-6 report robustness check results for change of NIM. These results are similar to those in main regressions, except that loan loss ratio has negatively significant

coefficients. If we change the banking integration indicators (as results shown in table 2-22), the results are even more robust. All coefficients of loan loss ratio are negative and economically significant, showing that if an acquirer's loan loss ratio decreases by 1%, its NIM will increase by at least 0.3%. The results of alternative specifications also confirm our previous findings of bank-specific and regulatory variables in main regressions. Finally, regressions (4) – (6) in table 2A-6 report the results of robustness checks of change of ROA. HHI has negatively significant coefficients for all models, confirming our previous findings. In some regressions, the estimated coefficients of z-score and natural log of total assets are positively significant, and those of loan loss ratio are negatively significant. These results provide some further supports for the findings of (1) acquirers with lower insolvency risks may have greater profitability; (2) larger acquirers may have greater profitability; and (3) acquirers with higher asset quality may have higher profitability. If we change the banking integration indicators and estimate the same models again (as results reported in table 2A-8 and table 2A-10), we will find the similar results and can confirm some previous findings for change of ROA and change of NIM.

2.6 Conclusions and Policy Implications

In this chapter, we first use different operating performance measures to investigate the determinants of acquirers' performance changes after M&As between 1997 and 2011. We find the robust evidences that acquirers with lower insolvency risks which operate in less concentrated banking markets are associated with greater profitability ratios. The latter challenges the traditional Structure-Conduct-Performance (SCP) view that acquirers that are based in countries with more concentrated banking markets can have higher performance after M&As. Moreover, we can

provide supports for acquirers that can benefit from geographic diversification to raise ROE after M&As. We can also find some evidences that size, liquidity ratio, efficiency, leverage ratio, tier 1 ratio, concentration ratio, capital regulatory power and supervisory power are the main determinants of acquirers' operating performance changes after M&As. All these results give banks managers and regulators implications about what types of acquirers can have higher profitability after M&As. We recommend that acquirers (1) with lower insolvency risks, (2) operate in less concentrated markets; (3) that merge targets from other continents; (4) with higher liquidity ratio; (5) with larger size; (6) operate in markets with less stringent regulation; (7) operate in markets with less stringent official supervision; (8) operate in markets with less deposit insurer power engage in more cross-border M&A deals outside Europe to boost operating performance.

Second, to investigate whether acquirers' operating performance changes have relationships with banking integration indicators, we first use principal component analysis to select several most important indicators and then include all of them in regressions. We identify that interest rate difference between distressed and non-distressed countries in euro area (the indicator that can explain most variability) is the only indicator that is negatively significant with several performance change measures. However, it could be argued that this result is not the sufficient evidence for the negative relationship between acquirers' performance changes after M&As and banking integration indicators. Therefore, we employ Granger-causality tests for these operating performance change measures. We identify that interest rate difference between distressed and non-distressed countries Granger-causes change of ROE and change of NII but not vice versa. Therefore, we can conclude that higher level of banking market integration contributes to acquirers' greater performance after M&As (hypothesis). This significant finding provides implications for

bank regulators and managers that banking integration can boost acquirers' performance changes after M&As. Therefore, we recommend that European banking regulators and supervisors should strengthen the Banking Union to increase level of financial integration in European banking market to improve acquirers' operating performance after M&As.

Lastly, we employ some t-tests to examine whether 2007-2009 U.S. Financial Crisis had negative impacts on acquirers' performance after M&As. We further conduct mean-comparison t-test to assess whether the difference between the average performance change in post-crisis period and the average performance change in pre-crisis period is negatively significant. We identify that it is negatively significant and we conclude that the financial crisis did have negative impacts on acquirers' performance changes after M&As.

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Appendix

Table A2-1 Determinants of Acquirers' change of ROE for bank M&As

Variable	(1) ΔROE/full	(2) ΔROE bank- specific	(3) ΔROE banks-specific macroeconomic	(4) ΔROE bank-specific deal-specific and macro	(5) ΔROE bank-specific and regulatory
Z-score	0.0011**	0.0008**	0.0008**	0.0007**	0.0010**
	(0.0004)	(0.0003)	(0.0003)	(0.0003)	(0.0004)
Income diversity	-0.0091	-0.0077	-0.0168	-0.0120	0.0019
	(0.0505)	(0.0649)	(0.0567)	(0.0591)	(0.0601)
Geographic diversification	0.0461***	0.0618**	0.0607***	0.0593***	0.0450**
	(0.0137)	(0.0212)	(0.0186)	(0.0185)	(0.0151)
Cross border	-0.0450**	-0.0571**	-0.0656***	-0.0639***	-0.0366*
	(0.0203)	(0.0203)	(0.0211)	(0.0206)	(0.0207)
Ln(TA)	-0.0007	-0.0016	-0.0026	-0.0012	-0.0024
	(0.0084)	(0.0098)	(0.0098)	(0.0094)	(0.0088)
Liquid ratio	0.2111**	0.2270**	0.2308**	0.2296**	0.2098**
	(0.0800)	(0.0874)	(0.0861)	(0.0859)	(0.0838)
Tier 1	-0.2852	-0.3803	-0.4720	-0.5038	-0.2601
	(0.5841)	(0.6418)	(0.6263)	(0.6339)	(0.6093)
Debt-to-asset	-0.0267	-0.0859	-0.0695	-0.0847	-0.0333
	(0.0824)	(0.0998)	(0.1140)	(0.1271)	(0.0652)
Asset growth	0.0185	0.0293	0.0168	0.0186	0.0288
	(0.0349)	(0.0424)	(0.0388)	(0.0408)	(0.0369)
Loan loss ratio	0.7224*	0.5202	0.6350	0.6323	0.7022
	(0.3949)	(0.5764)	(0.5195)	(0.5153)	(0.4585)
Cost-to-income	0.0300	-0.0095	0.0110	0.0008	0.0188
	(0.0788)	(0.0679)	(0.0743)	(0.0785)	(0.0715)
Listed banks	-0.0196			-0.0318	
	(0.0301)			(0.0370)	
Real GDP growth	0.0182**		0.0139**	0.0138**	
	(0.0068)		(0.0062)	(0.0063)	
Inflation	-0.0136**		-0.0194**	-0.0195**	
	(0.0061)		(0.0078)	(0.0081)	
Money supply growth	0.0064**		0.0072**	0.0072**	
	(0.0028)		(0.0025)	(0.0024)	
HHI	-0.0001**				-0.0001**
	(0.00003)				(0.00003)
Capital regulatory index	0.0046				0.0072
	(0.0110)				(0.0107)
Official supervisory index	-0.0174				-0.0230**
	(0.0109)				(0.0104)
Deposit insurer power	-0.0478				-0.0504
	(0.0300)				(0.0305)
Obs.	471	471	471	471	471
R^2	0.2105	0.0733	0.1141	0.1128	0.1618

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table A2-2 Determinants of Acquirers' change of NII for bank M&As

Variable	(1) ΔNII/full	(2) ΔNII bank-specific	(3) ΔNII bank-specific macroeconomic	(4) ΔNII bank-specific deal-specific and macro	(5) ΔNII bank-specific and regulatory
Z-score	-0.2309	2.0364	1.4641	0.7894	0.3424
	(5.6640)	(3.7550)	(3.8336)	(4.0052)	(5.6540)
Income diversity	-1347.68	-1424.14	-1491.46	-1470.20	-1308.96
	(1491.45)	(1637.74)	(1580.79)	(1571.88)	(1547.30)
Geographic diversification	-77.83	437.62	358.21	352.08	2.3649
	(276.71)	(276.76)	(301.21)	(290.05)	(267.73)
Cross border	84.29	11.44	71.67	80.31	24.61
	(237.78)	(224.59)	(290.13)	(278.46)	(179.54)
Ln(TA)	225.22***	279.62***	281.01***	291.14***	224.54***
	(62.59)	(66.09)	(63.23)	(66.28)	(59.88)
Liquid ratio	3928.27***	4521.19***	4378.95***	4371.18***	4047.39***
	(1360.04)	(1504.58)	(1418.29)	(1421.63)	(1430.28)
Tier 1	-7535.86	-11209.55*	-11120.69*	-11342*	-7086.93
	(5391.27)	(6155.02)	(6127.20)	(6211.74)	(5365.06)
Debt-to-asset	-756.43	-656.36	-583.11	-674.63	-800.81*
	(526.53)	(517.78)	(579.93)	(580.21)	(408.46)
Asset growth	913.24	929.94	802.84	815.56	1028.94
	(799.99)	(684.58)	(797.46)	(806.01)	(736.50)
Loan loss ratio	-706.51	1982.69	2778.45	3026.92	-1948.18
	(5520.73)	(6061.81)	(6704.14)	(6685.70)	(4665.57)
Cost-to-income	-1180.98	-2327.69**	-2060.53**	-2113.55*	-1413.67
	(871.84)	(1027.81)	(947.29)	(998.40)	(825.24)
Listed banks	-92.34			-229.39	
	(397.62)			(494.67)	
Real GDP growth	-124.40		-118.21	-120.17	
	(165.11)		(143.68)	(140.74)	
Inflation	68.65		83.94	85.42	
	(100.73)		(90.81)	(90.87)	
Money supply growth	32.21		34.15	33.78	
	(59.39)		(67.47)	(67.55)	
HHI	-0.4681*				-0.4936**
	(0.2392)				(0.2116)
Capital regulatory index	-199.70**				-217.34***
	(75.08)				(64.85)
Official supervisory index	8.66				33.61
	(80.32)				(74.80)
Deposit insurer power	778.83***				803.76***
	(224.16)				(238.96)
Obs.	448	448	448	448	448
R^2	0.3054	0.2523	0.2458	0.2471	0.3096

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table A2-3 Determinants of Acquirers' change of NIM for bank M&As

Variable	(1) ΔNIM/full	(2) ΔNIM bank-specific	(3) ΔNIM bank-specific macroeconomic	(4) ΔNIM bank-specific deal-specific and macro	(5) ΔNIM bank-specific and regulatory
Z-score	0.00003*	0.00003	0.00002	0.00003	0.00002
	(0.00002)	(0.00002)	(0.00002)	(0.00002)	(0.00001)
Income diversity	0.0013	0.0018	0.0016	0.0011	0.0014
	(0.0034)	(0.0036)	(0.0033)	(0.0034)	(0.00375)
Geographic diversification	-0.0029*	-0.0023	-0.0029	-0.0028*	-0.0027
	(0.0015)	(0.0014)	(0.0014)	(0.0014)	(0.0018)
Cross border	0.0018	0.0012	0.0018	0.0017	0.0012
	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0013)
Ln(TA)	-0.0004	-0.0001	-0.0002	-0.0003	-0.0001
	(0.0002)	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Liquid ratio	-0.0021	-0.0015	-0.0024	-0.0023	-0.0005
	(0.0026)	(0.0028)	(0.0026)	(0.0026)	(0.0032)
Tier 1	0.0018	0.0042	0.0047	0.0071	-0.00004
	(0.0151)	(0.0133)	(0.0136)	(0.0138)	(0.0136)
Debt-to-asset	0.0010	-0.0007	-0.0012	0.0001	0.0015
	(0.0016)	(0.0016)	(0.0018)	(0.0018)	(0.0024)
Asset growth	-0.0005	0.0007	-0.0002	-0.0004	-0.0004
	(0.0012)	(0.0013)	(0.0011)	(0.0012)	(0.0011)
Loan loss ratio	-0.0128	-0.0226	-0.0189	-0.0189	-0.0220
	(0.0147)	(0.0164)	(0.0158)	(0.0158)	(0.0181)
Cost-to-income	0.0067	0.0040	0.0056	0.0065	0.0032
	(0.0039)	(0.0034)	(0.0039)	(0.0039)	(0.0037)
Listed banks	0.0028*			0.0027*	
	(0.0014)			(0.0013)	
Real GDP growth	-0.0009**		-0.0008**	-0.0008**	
	(0.0003)		(0.0003)	(0.0003)	
Inflation	-0.0003		-0.0003	-0.0003	
	(0.0004)		(0.0004)	(0.0004)	
Money supply growth	0.0003***		0.0003***	0.0003***	
	(0.0001)		(0.0001)	(0.0001)	
HHI	-0.0000004				-0.0000005
	(0.0000005)				(0.0000005)
Capital regulatory index	0.0003				-0.00002
	(0.0003)				(0.0003)
Official supervisory index	-0.0005				-0.0004
	(0.0003)				(0.0004)
Deposit insurer power	-0.0007				-0.0007
	(0.0008)				(0.0011)
Obs.	461	461	461	461	461
R^2	0.0241	0.0148	0.0209	0.0227	0.0209

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors

Table A2-4 Determinants of Acquirers' change of ROA for bank M&As

Variable	(1) ΔROA/full	(2) ΔROA bank-specific	(3) ΔROA bank-specific macroeconomic	(4) ΔROA bank-specific deal-specific and macro	(5) ΔROA bank-specific and regulatory
Z-score	0.00002	0.00002	0.00002	0.00002	0.00002
	(0.00003)	(0.00002)	(0.00002)	(0.00003)	(0.00003)
Income diversity	-0.0055	-0.0055	-0.0059*	-0.0057*	-0.0050
	(0.0031)	(0.0031)	(0.0031)	(0.0031)	(0.0032)
Geographic diversification	0.0009	0.0018	0.0017	0.0017	0.0008
	(0.0007)	(0.0012)	(0.0011)	(0.0011)	(0.0007)
Cross border	0.0003	0.0002	-0.0001	-0.0001	0.0006
	(0.0014)	(0.0013)	(0.0013)	(0.0013)	(0.0015)
Ln(TA)	0.0008	0.0007	0.0007	0.0007	0.0008
	(0.0006)	(0.0006)	(0.0006)	(0.0006)	(0.0006)
Liquid ratio	0.0070	0.0078	0.0080	0.0080	0.0069
	(0.0053)	(0.0057)	(0.0057)	(0.0057)	(0.0054)
Tier 1	0.0152	0.0088	0.0048	0.0038	0.0160
	(0.0349)	(0.0388)	(0.0382)	(0.0382)	(0.0357)
Debt-to-asset	0.0032	0.0015	0.0022	0.0017	0.0031*
	(0.0021)	(0.0022)	(0.0032)	(0.0031)	(0.0015)
Asset growth	-0.0024	-0.0019	-0.0025	-0.0024	-0.0020
	(0.0020)	(0.0017)	(0.0020)	(0.0020)	(0.0017)
Loan loss ratio	0.0017	-0.0048	0.0002	0.0001	0.0011
	(0.0335)	(0.0424)	(0.0383)	(0.0381)	(0.0369)
Cost-to-income	0.0092*	0.0072	0.0081	0.0078	0.0087*
	(0.0051)	(0.0046)	(0.0049)	(0.0052)	(0.0044)
Listed banks	-0.0008			-0.0011	
	(0.0020)			(0.0020)	
Real GDP growth	0.0008**		0.0006*	0.0006	
	(0.0004)		(0.0003)	(0.0003)	
Inflation	-0.0008		-0.0009	-0.0009	
	(0.0005)		(0.0006)	(0.0006)	
Money supply growth	0.0003*		0.0003*	0.0003	
	(0.0002)		(0.0002)	(0.0002)	
HHI	-0.000003*				-0.000003*
	(0.000001)				(0.000001)
Capital regulatory index	-0.0004				-0.0003
	(0.0009)				(0.0010)
Official supervisory index	-0.0004				-0.0006
	(0.0005)				(0.0005)
Deposit insurer power	-0.0007				-0.0009
	(0.0017)				(0.0018)
Obs.	471	471	471	471	471
R^2	0.1627	0.0643	0.1114	0.1078	0.1054

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors

Table A2-5 Determinants of Acquirers' change of ROE for cross-border M&As

Variable	(1) ΔROE IR DIFFERENCE1	(2) ΔROE IR DIFFERENCE5	(3) ΔROE DISPERSION5	(4) ΔNII IR DIFFERENCE1	(5) ΔNII IR DIFFERENCE5	(6) ΔNII DISPERSION5
IRDIFFERENCE1	-0.4794*			-3593.50*		
	(0.2276)			(1815.60)		
IRDIFFERENCE5		-0.8945			-6333.59	
		(0.4961)			(3699.05)	
DISPERSION5			-0.0102			-95.58
			(0.0065)			(99.49)
Z-score	0.0023**	0.0022**	0.0019**	20.30*	19.42*	16.50
	(0.0008)	(0.0008)	(0.0007)	(9.43)	(9.35)	(9.99)
Income diversity	0.0929	0.0833	0.0723	-871.63	-945.41	-1043.43
	(0.0792)	(0.0704)	(0.0856)	(2376.67)	(2235.93)	(2333.91)
Geographic diversification	0.0781	0.0763	0.0835*	-317.84	-326.02	-268.61
	(0.0422)	(0.0410)	(0.0397)	(437.62)	(429.23)	(343.32)
Ln(TA)	0.0110	0.0133	0.0152	460.18	477.95	491.94
	(0.0194)	(0.0198)	(0.0175)	(285.68)	(292.67)	(280.41)
Liquid ratio	0.2043*	0.2027*	0.1861*	5609.16***	5579.23***	5458.19***
	(0.1310)	(0.1270)	(0.1075)	(1623.56)	(1618.48)	(1664.07)
Tier 1	0.6947	0.6682	0.6120	-25640.59**	-26054.82**	-25819.82**
	(0.8685)	(0.8795)	(0.8958)	(9203.85)	(8870.3)	(9871.57)
Debt-to-asset	-0.1838	-0.1856	-0.1841	-1006.55	-1030.31	-1092.59
	(0.2362)	(0.2386)	(0.2285)	(1249.59)	(1239.32)	(1296.32)
Asset growth	0.1590	0.1469	0.1530	4691.95**	4608.36**	4622.07**
	(0.1174)	(0.1132)_	(0.1032)	(1691.93)	(1676.16)	(1585.49)
Loan loss ratio	0.0449	0.0443	0.0120	14177.76***	14177.77***	13815.22***
	(0.0578)	(0.0488)	(0.0417)	(485.77)	(490.58)	(974.92)
Cost-to-income	-0.0222	-0.0185	-0.0418	-2205.41	-2161.41	-2366.04
	(0.1421)	(0.1420)	(0.1575)	(1576.17)	(1563.49)	(1835.10)
Listed banks	-0.1305	-0.1373	-0.1301	-724.93	-805.76	-774.61
	(0.0799)	(0.0821)	(0.0789)	(940.16)	(905.80)	(943.00)
Real GDP growth	0.0161	0.0146	0.0171	-50.07	-63.23	-47.15
	(0.0194)	(0.0195)	(0.0200)	(325.64)	(318.64)	(330.44)
Inflation	0.0019	0.0029	-0.0045	-22.12	-14.45	-77.08
	(0.0212)	(0.0212)	(0.0212)	(211.23)	(213.74)	(253.62)
Money supply growth	0.0050	0.0053	0.0057	98.80	102.23	102.55
	(0.0065)	(0.0066)	(0.0068)	(81.25)	(79.91)	(83.52)
HHI	-0.0002***	-0.0001***	-0.0001***	-0.4167	-0.3846	-0.3953
	(0.00003)	(0.00003)	(0.00004)	(0.3338)	(0.3139)	(0.3308)
Capital regulatory index	-0.0031	-0.0024	0.0011	-693.12***	-687.60***	-652.81***
	(0.0164)	(0.0163)	(0.0144)	(178.01)	(177.36)	(189.99)
Official supervisory index	-0.0346	-0.0338	-0.0313	-247.84*	-241.21	-214.66
	(0.0189)	(0.0192)	(0.0182)	(130.00)	(134.79)	(124.29)
Deposit insurer power	-0.0649*	-0.0674*	-0.0701*	1566.77***	1548.1***	1538.87***
	(0.0320)	(0.0344)	(0.0350)	(324.35)	(331.59)	(309.44)
Obs.	171	171	171	169	169	169
R^2	0.2940	0.2954	0.3575	0.3664	0.3496	0.4141

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors

Table A2-6 Determinants of Acquirers' change of NIM for cross-border M&As

Variable	(1) ΔNIM IR DIFFERENCE1	(2) ΔNIM IR DIFFERENCE5	(3) ΔNIM DISPERSION5	(4) ΔROA IR DIFFERENCE1	(5) ΔROA IR DIFFERENCE5	(6) ΔROA DISPERSION5
IRDIFFERENCE1	0.0112			-0.0050		
	(0.0080)			(0.0099)		
IRDIFFERENCE5		0.0138			0.0083	
		(0.0143)			(0.0126)	
DISPERSION5			0.00005			0.0001
			(0.0001)			(0.0002)
Z-score	-0.000002	0.000002	0.00001	0.00008*	0.00007*	0.00008
	(0.00004)	(0.00004)	(0.00003)	(0.00004)	(0.00004)	(0.00004)
Income diversity	0.0023	0.0025	0.0026	-0.0021	-0.0022	-0.0020
	(0.0032)	(0.0031)	(0.0033)	(0.0040)	(0.0038)	(0.0037)
Geographic diversification	-0.0040	-0.0040	-0.0041	0.0025	0.0025	0.0025
	(0.0023)	(0.0024)	(0.0026)	(0.0020)	(0.0019)	(0.0019)
Ln(TA)	0.0009*	0.0008*	0.0008*	0.0024	0.0025*	0.0025*
	(0.0004)	(0.0004)	(0.0004)	(0.0014)	(0.0013)	(0.0013)
Liquid ratio	-0.0062	-0.0060	-0.0058	0.0010	0.0006	0.0008
	(0.0035)	(0.0036)	(0.0035)	(0.0033)	(0.0033)	(0.0032)
Tier 1	-0.0115	-0.0083	-0.0047	0.0570	0.0502	0.0493
	(0.0234)	(0.0215)	(0.0234)	(0.0538)	(0.0552)	(0.0580)
Debt-to-asset	-0.0028	-0.0030	-0.0033	0.0043	0.0048	0.0050
	(0.0033)	(0.0034)	(0.0034)	(0.0047)	(0.0045)	(0.0044)
Asset growth	-0.0024	-0.0022	-0.0025	0.0130	0.0132	0.0132
	(0.0032)	(0.0032)_	(0.0036)	(0.0087)	(0.0085)	(0.0085)
Loan loss ratio	-0.0030*	-0.0032**	-0.0033*	-0.0078**	-0.0073**	-0.0067
	(0.0013)	(0.0013)	(0.0016)	(0.0024)	(0.0024)	(0.0026)
Cost-to-income	0.0071	0.0071	0.0072	0.0080	0.0080	0.0083
	(0.0055)	(0.0056)	(0.0058)	(0.0055)	(0.0054)	(0.0057)
Listed banks	0.0060*	0.0060*	0.0059*	-0.0046	-0.0044	-0.0045
	(0.0029)	(0.0030)	(0.0030)	(0.0034)	(0.0032)	(0.0033)
Real GDP growth	-0.0010***	-0.0010**	-0.0010**	0.0019	0.0020	0.0019
	(0.0003)	(0.0003)	(0.0003)	(0.0012)	(0.0013)	(0.0013)
Inflation	0.0006	0.0006	0.0007	0.0001	0.00007	0.0002
	(0.0004)	(0.0005)	(0.0006)	(0.0015)	(0.0014)	(0.0015)
Money supply growth	0.0002**	0.0002*	0.0002	0.00001	0.00004	0.00004
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0003)
HHI	-0.0000004	-0.0000005	-0.0000005	-0.000005*	-0.000004*	-0.000004*
	(0.0000008)	(0.0000007)	(0.0000007)	(0.000002)	(0.000002)	(0.000002)
Capital regulatory index	-0.0002	-0.0002	-0.0002	-0.0011	-0.0011	-0.0011
	(0.0004)	(0.0003)	(0.0003)	(0.0013)	(0.0013)	(0.0014)
Official supervisory index	-0.0011***	-0.0011***	-0.0011***	-0.0010	-0.0010	-0.0011
	(0.0003)	(0.0003)	(0.0003)	(0.0013)	(0.0012)	(0.0013)
Deposit insurer power	-0.0021**	-0.0020*	-0.0019**	-0.0014	-0.0015	-0.0015
	(0.0009)	(0.0009)	(0.0008)	(0.0029)	(0.0027)	(0.0027)
Obs.	171	171	171	171	171	171
R^2	0.0797	0.0900	0.0819	0.3314	0.2826	0.3041

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors

Table A2-7 Determinants of Acquirers' change of ROE for cross-border M&As

Variable	(1) ΔROE IR DIFFERENCE2	(2) ΔROE IR DIFFERENCE3	(3) ΔROE DISPERSION3	(4) ΔNII IR DIFFERENCE2	(5) ΔNII IR DIFFERENCE3	(6) ΔNII DISPERSION3
IRDIFFERENCE2	-0.0208			-147.77		
	(0.1001)			(917.45)		
IRDIFFERENCE3		0.4228			3146.17	
		(0.2572)			(1916.51)	
DISPERSION3			0.0002			8.72
			(0.0021)			(20.27)
Z-score	0.0011*	0.0011**	0.0011*	17.55	17.79	17.68
	(0.0005)	(0.0005)	(0.0005)	(10.96)	(10.65)	(10.97)
Asset diversity	-0.0396	-0.0316	-0.0412	-255.86	-216.46	-245.16
	(0.0973)	(0.0979)	(0.1070)	(1830.74)	(1779.92)	(1837.70)
Geographic diversification	0.0478*	0.0600*	0.0482*	-329.61	-243.61	-319.08
	(0.0215)	(0.0297)	(0.0223)	(394.33)	(296.22)	(395.47)
Ln(TA)	0.0234	0.0252	0.0238	443.39	457.54	454.23
	(0.0223)	(0.0225)	(0.0222)	(251.20)	(259.20)	(264.10)
Liquid ratio	0.2785**	0.2806**	0.2794**	5388.44**	5410.09**	5446.31**
	(0.1002)	(0.1029)	(0.0987)	(1723.60)	(1732.56)	(1762.26)
Capital ratio	-0.0938	-0.1194	-0.0922	-3504.65**	-3680.87**	-3492.65**
	(0.1027)	(0.0955)	(0.1033)	(1450.98)	(1472.59)	(1468.91)
Debt-to-equity	-0.0163	-0.0163	-0.0163	-17.26	-16.58	-17.95
	(0.0105)	(0.0106)	(0.0104)	(28.51)	(29.53)	(28.31)
Loan growth	-0.0693	-0.0389	-0.0669	4139.33*	4367.82*	4213.83*
	(0.1847)	(0.1822)_	(0.1863)	(1878.50)	(1965.14)	(1904.68)
Loan loss ratio	-0.2285	-0.2392	-0.2291	17919***	17832***	17982***
	(0.2467)	(0.2348)	(0.2601)	(1803.81)	(1851.52)	(1840.39)
Cost-to-income	0.1587	0.1091	0.1578	-1244.10	-1648.44	-1279.41
	(0.1792)	(0.1856)	(0.1845)	(1429.63)	(1749.06)	(1482.27)
Listed banks	-0.1770*	-0.1830*	-0.1762*	-42.24	-43.19	-35.82
	(0.0838)	(0.0793)	(0.0832)	(667.58)	(627.98)	(649.70)
Real GDP growth	0.0120	0.0204	0.0129	-147.83	-80.99	-130.67
	(0.0176)	(0.0214)	(0.0188)	(357.43)	(395.60)	(366.18)
Inflation	-0.0047	-0.0150	-0.0062	90.60	11.68	68.75
	(0.0211)	(0.0218)	(0.0221)	(259.51)	(272.14)	(258.13)
Money supply growth	0.0076	0.0061	0.0076	96.78	85.14	94.67
	(0.0078)	(0.0077)	(0.0081)	(80.46)	(91.88)	(81.15)
CR5	-0.0049***	-0.0048***	-0.0049***	-7.88	-7.35	-7.54
	(0.0012)	(0.0012)	(0.0012)	(9.74)	(9.72)	(9.49)
Capital regulatory index	0.0178	0.0220	0.0179	-759.85***	-730.55***	-760.67***
	(0.0193)	(0.0170)	(0.0193)	(168.34)	(179.18)	(167.01)
Official supervisory index	-0.0299**	-0.0237*	-0.0292**	-353.59**	-307.48*	-345.19**
	(0.0110)	(0.0111)	(0.0107)	(132.30)	(152.83)	(134.47)
Deposit insurer power	-0.0529*	-0.0514	-0.0522*	1385.97***	1395.26***	1394.63***
	(0.0250)	(0.0283)	(0.0244)	(295.59)	(292.82)	(296.99)
Obs.	171	171	171	169	169	169
R^2	0.4378	0.5036	0.4169	0.4664	0.4510	0.4926

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors

Table A2-8 Determinants of Acquirers' performance changes for cross-border M&As

Variable	(1) ΔNIM IR DIFFERENCE2	(2) ΔNIM IR DIFFERENCE3	(3) ΔNIM DISPERSION3	(4) ΔROA IR DIFFERENCE2	(5) ΔROA IR DIFFERENCE3	(6) ΔROA DISPERSION3
IRDIFFERENCE2	0.0022			-0.0099		
	(0.0039)			(0.0089)		
IRDIFFERENCE3		-0.0143			-0.0039	
		(0.0105)			(0.0167)	
DISPERSION3			-0.0001			-0.00002
			(0.0001)			(0.0001)
Z-score	0.00001	0.00001	0.00001	0.00006	0.00006	0.00007
	(0.000003)	(0.00004)	(0.00003)	(0.00004)	(0.00004)	(0.00004)
Asset diversity	0.0024	0.0022	0.0024	0.0022	0.0012	0.0012
	(0.0018)	(0.0018)	(0.0018)	(0.0047)	(0.0050)	(0.0050)
Geographic diversification	-0.0040	-0.0044	-0.0040	0.0023	0.0023	0.0024
	(0.0026)	(0.0029)	(0.0026)	(0.0017)	(0.0017)	(0.0018)
Ln(TA)	0.0008**	0.0007**	0.0008*	0.0021	0.0022	0.0022
	(0.0003)	(0.0003)	(0.0003)	(0.0012)	(0.0014)	(0.0013)
Liquid ratio	-0.0049	-0.0050	-0.0053	0.0016	0.0015	0.0014
	(0.0035)	(0.0034)	(0.0039)	(0.0028)	(0.0025)	(0.0024)
Capital ratio	0.0036	0.0044	0.0035	-0.0011	-0.0001	-0.0003
	(0.0031)	(0.0034)	(0.0028)	(0.0057)	(0.0052)	(0.0049)
Debt-to-equity	-0.00003	-0.00003	-0.00002	0.00005	0.00004	0.00005
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Loan growth	-0.0005	-0.0017	-0.0010	0.0080	0.0085	0.0087
	(0.0027)	(0.0024)_	(0.0026)	(0.0078)	(0.0077)	(0.0080)
Loan loss ratio	-0.0039	-0.0035	-0.0042*	-0.0041	-0.0047	-0.0049
	(0.0023)	(0.0024)	(0.0022)	(0.0052)	(0.0062)	(0.0064)
Cost-to-income	0.0075	0.0092	0.0078	0.0070	0.0072	0.0069
	(0.0055)	(0.0064)	(0.0056)	(0.0052)	(0.0066)	(0.0051)
Listed banks	0.0062*	0.0064*	0.0061*	-0.0064	-0.0060	-0.0061
	(0.0029)	(0.0028)	(0.0030)	(0.0043)	(0.0045)	(0.0045)
Real GDP growth	-0.0010**	-0.0013*	-0.0012**	0.0013	0.0016	0.0016
	(0.0004)	(0.0005)	(0.0004)	(0.0012)	(0.0013)	(0.0013)
Inflation	0.0007	0.0011	0.0009	0.0009	0.0005	0.0004
	(0.0006)	(0.0007)	(0.0006)	(0.0017)	(0.0017)	(0.0016)
Money supply growth	0.0002	0.0002	0.0002	-0.00005	-0.00003	-0.00004
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0003)	(0.0002)
CR5	-0.00002	-0.00002	-0.00002	-0.0002**	-0.0002***	-0.0002***
	(0.00003)	(0.00003)	(0.00003)	(0.00005)	(0.00004)	(0.00004)
Capital regulatory index	-0.0002	-0.0004*	-0.0002	-0.0006	-0.0006	-0.0006
	(0.0002)	(0.0002)	(0.0002)	(0.0014)	(0.0015)	(0.0013)
Official supervisory index	-0.0011**	-0.0014**	-0.0012**	-0.0016	-0.0014	-0.0013
	(0.0004)	(0.0005)	(0.0004)	(0.0013)	(0.0013)	(0.0013)
Deposit insurer power	-0.0019*	-0.0020*	-0.0020*	-0.0024	-0.0021	-0.0021
	(0.0009)	(0.0010)	(0.0009)	(0.0027)	(0.0029)	(0.0029)
Obs.	171	171	171	171	171	171
R^2	0.0710	0.0663	0.0658	0.3834	0.2734	0.3118

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors

Table A2-9 Determinants of Acquirers' performance changes for cross-border M&As

Variable	(1) ΔROE IR DIFFERENCE2	(2) ΔROE IR DIFFERENCE3	(3) ΔROE DISPERSION3	(4) ΔNII IR DIFFERENCE2	(5) ΔNII IR DIFFERENCE3	(6) ΔNII DISPERSION3
IRDIFFERENCE2	-0.0115			174.36		
	(0.0961)			(723.41)		
IRDIFFERENCE3		0.5542			2610.83	
		(0.3396)			(1869.78)	
DISPERSION3			-0.0004			9.25
			(0.0015)			(18.00)
Z-score	0.0020**	0.0019**	0.0020**	17.64	17.35*	17.65
	(0.0008)	(0.0007)	(0.0008)	(9.65)	(9.11)	(9.71)
Income diversity	0.0828	0.0584	0.0829	-963.83	-1066.05	-968.96
	(0.0853)	(0.0927)	(0.0887)	(2390.36)	(2390.00)	(2365.62)
Geographic diversification	0.0813**	0.0923*	0.0811*	-285.91	-242.22	-280.93
	(0.0337)	(0.0455)	(0.0340)	(392.00)	(360.99)	(394.89)
Ln(TA)	0.0153	0.0183	0.0151	496.99	506.31	505.74
	(0.0179)	(0.0180)	(0.0175)	(284.31)	(286.76)	(290.55)
Liquid ratio	0.1865	0.1819	0.1844	5463.45***	5455.48**	5516.62**
	(0.1091)	(0.1088)	(0.1080)	(1674.45)	(1690.36)	(1686.95)
Tier 1	0.3420	0.4590	0.3359	-28391.63**	-27739.46**	-28220**
	(1.0842)	(1.0557)	(1.0922)	(10460.63)	(10742.68)	(10401.36)
Debt-to-asset	-0.1551	-0.1851	-0.1542	-826.98	-929.87	-850.00
	(0.2287)	(0.2276)	(0.2272)	(1118.65)	(1063.02)	(1087.54)
Asset growth	0.1656	0.1520	0.1635	4763.70**	4678.76**	4827.17**
	(0.1356)	(0.1056)_	(0.1352)	(1864.43)	(1719.92)	(1880.39)
Loan loss ratio	0.0717	0.0034	0.0702	14372***	14054***	14415***
	(0.0587)	(0.0406)	(0.0584)	(484.34)	(752.63)	(474.14)
Cost-to-income	-0.0219	-0.0863	-0.0209	-2188.32	-2510.99	-2217.66
	(0.1577)	(0.1491)	(0.1576)	(1704.56)	(1960.27)	(1737.94)
Listed banks	-0.1264	-0.1421	-0.1264	-727.40	-761.31	-721.45
	(0.0782)	(0.0770)	(0.0782)	(925.46)	(919.00)	(922.35)
Real GDP growth	0.0173	0.0276	0.0172	-35.57	8.49	-28.73
	(0.0195)	(0.0225)	(0.0208)	(351.12)	(381.47)	(922.35)
Inflation	0.0006	-0.0124	0.0006	-44.08	-94.87	-50.11
	(0.0205)	(0.0234)	(0.0215)	(220.23)	(233.72)	(226.70)
Money supply growth	0.0067	0.0052	0.0068	111.92	104.26	109.52
	(0.0068)	(0.0062)	(0.0069)	(73.23)	(81.07)	(74.78)
HHI	-0.0001***	-0.0002***	-0.0001***	-0.3855	-0.4067	-0.3658
	(0.00004)	(0.00003)	(0.00003)	(0.3399)	(0.3503)	(0.3228)
Capital regulatory index	-0.0038	0.0035	-0.0036	-695.97***	-663.08***	-701.40***
	(0.0186)	(0.0140)	(0.0186)	(155.87)	(161.61)	(153.61)
Official supervisory index	-0.0355*	-0.0257	-0.0355*	-245.72*	-207.01	-243.42*
	(0.0174)	(0.0168)	(0.0184)	(109.86)	(113.54)	(109.04)
Deposit insurer power	-0.0742*	-0.0697*	-0.0741**	1508.57***	1517.92***	-1512.14***
	(0.0287)	(0.0329)	(0.0294)	(325.10)	(317.56)	(318.84)
Obs.	171	171	171	169	169	169
R^2	0.3717	0.4430	0.3740	0.5001	0.4701	0.5064

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors

Table A2-10 Determinants of Acquirers' performance changes for cross-border M&As

Variable	(1) ΔNIM IR DIFFERENCE2	(2) ΔNIM IR DIFFERENCE3	(3) ΔNIM DISPERSION3	(4) ΔROA IR DIFFERENCE2	(5) ΔROA IR DIFFERENCE3	(6) ΔROA DISPERSION3
IRDIFFERENCE2	0.0023			-0.0088		
	(0.0041)			(0.0083)		
IRDIFFERENCE3		-0.0138			-0.0023	
		(0.0102)			(0.0173)	
DISPERSION3			-0.0001			-0.00001
			(0.0001)			(0.00008)
Z-score	0.00001	0.00001	0.000005	0.00007*	0.00008	0.00008*
	(0.00003)	(0.00004)	(0.00003)	(0.00004)	(0.00004)	(0.00004)
Income diversity	0.0024	0.0031	0.0027	-0.0016	-0.0021	-0.0022
	(0.0034)	(0.0031)	(0.0031)	(0.0034)	(0.0033)	(0.0038)
Geographic diversification	-0.0040	-0.0043	-0.0041	0.0024	0.0024	0.0025
	(0.0026)	(0.0028)	(0.0026)	(0.0018)	(0.0018)	(0.0019)
Ln(TA)	0.0008	0.0007	0.0007	0.0008	0.0025*	0.0025*
	(0.0005)	(0.0004)	(0.0004)	(0.0036)	(0.0013)	(0.0013)
Liquid ratio	-0.0058	-0.0057	-0.0062	0.0541	0.0008	0.0007
	(0.0035)	(0.0034)	(0.0038)	(0.0581)	(0.0033)	(0.0030)
Tier 1	-0.0035	-0.0062	-0.0042	0.0049	0.0527	0.0530
	(0.0219)	(0.0253)	(0.0231)	(0.0042)	(0.0598)	(0.0592)
Debt-to-asset	-0.0035	-0.0027	-0.0032	0.0123	0.0047	0.0046
	(0.0034)	(0.0032)	(0.0038)	(0.0088)	(0.0041)	(0.0042)
Asset growth	-0.0023	-0.0022	-0.0031	-0.0075**	0.0131	0.0129
	(0.0037)	(0.0034)_	(0.0037)	(0.0028)	(0.0086)	(0.0088)
Loan loss ratio	-0.0036**	-0.0019	-0.0038**	0.0082	-0.0073	-0.0076**
	(0.0015)	(0.0013)	(0.0015)	(0.0057)	(0.0041)	(0.0029)
Cost-to-income	0.0071	0.0087	0.0074	-0.0047	0.0083	0.0081
	(0.0057)	(0.0063)	(0.0057)	(0.0033)	(0.0071)	(0.0056)
Listed banks	0.0059*	0.0063*	0.0058*	-0.0047	-0.0045	-0.0046
	(0.0029)	(0.0028)	(0.0030)	(0.0033)	(0.0034)	(0.0034)
Real GDP growth	-0.0010***	-0.0013*	-0.0011**	0.0016	0.0019	0.0019
	(0.0003)	(0.0005)	(0.0004)	(0.0012)	(0.0012)	(0.0012)
Inflation	0.0005	0.0010	0.0008	0.0006	0.0001	0.0001
	(0.0005)	(0.0006)	(0.0006)	(0.0015)	(0.0015)	(0.0015)
Money supply growth	0.0002	0.0002*	0.0002*	0.00002	0.00003	0.00003
	(0.0001)	(0.0001)	(0.0001)	(0.0003)	(0.0003)	(0.0003)
HHI	-0.0000005	-0.0000003	-0.0000006	-0.000004*	-0.000004*	-0.000004*
	(0.0000007)	(0.0000008)	(0.0000007)	(0.000002)	(0.000002)	(0.000002)
Capital regulatory index	-0.0002	-0.0004	-0.0002	-0.0011	-0.0011	-0.0011
	(0.0004)	(0.0003)	(0.0003)	(0.0014)	(0.0015)	(0.0013)
Official supervisory index	-0.0010**	-0.0013***	-0.0011***	-0.0013	-0.0011	-0.0010
	(0.0003)	(0.0003)	(0.0003)	(0.0013)	(0.0013)	(0.0013)
Deposit insurer power	-0.0018**	-0.0020**	-0.0019**	-0.0017	-0.0015	-0.0015
	(0.0007)	(0.0010)	(0.0008)	(0.0026)	(0.0027)	(0.0027)
Obs.	171	171	171	171	171	171
R^2	0.0795	0.0749	0.0782	0.3927	0.3132	0.3353

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroskedasitity-robust standard errors.

Chapter 3

Systemic Risk and Bank M&As in Europe: Determinants and Relationships with Banking Markets Integration

3.1 Introduction

In recent years, European banking regulators have been considering the adoption of stricter policies to effectively monitor cross-border bank M&A deals. A systematically important bank (SIB) is a bank that is interconnected to many other financial institutions and whose failure may result in a financial crisis. Molyneux et al. (2014) quote Petrovic and Tutschu's (2009) argument that many conglomerates like the SIBs in operating major EU economies were rescued during the crisis and were naturally recognized as "too-big-to-fail" (TBTF) institutions because their failures would have resulted in increased systemic risk and financial instability.

The Financial Crisis of 2007-2009 and the European Sovereign Debt Crisis that followed significantly affected the bank M&As trend in the EU. Casu et al. (2015) illustrate that both the number and the value of EU banks' M&As increased over 2004 and 2007 but generally declined over 2008 and 2013. The number of transactions rose dramatically from 45 in 2004 to the peak of 180 in 2007 and plunged to 5 in 2013. Meanwhile, the transaction value increased steadily from approximately €57bil in 2004 to €81bil in 2007 and then declined to €22bil in 2013.

Based on the aforementioned trends for bank M&As in Europe, the effects of bank consolidation on banking stability is one of the most important and controversial topics since the financial crises broke out. Several recent studies (Heffernan 2005; Weiss et al. 2014; Casu et al. 2015) analyze the banks' M&As' effects on systemic risk and point out that the existing literature provides no consistent evidence. On the one hand, all bank M&As and particularly cross-border operations, can increase the diversification benefits thus reducing banks' individual risk including systemic risk. On the other hand, Molyneux et al. (2014), Weiss et al. (2014) and Casu et al. (2015) note that M&As will increase banks' size thus enabling banks to exploit safety net subsidies because of their TBTF status. Moreover, these TBTF banks are more likely to increase their systemic risk contributions if they default in financial crisis. This

will potentially increase the instability of whole financial/banking system. Casu et al. (2015) provide evidence that large banks that follow more aggressive diversification strategies by M&As may increase in risk taking.

A related issue is financial and banking integration (see chapter 2 for more details on how to measure it). In theory there are many benefits deriving from integrated markets and in practice one way to boost integration is to via cross-border merger operations. Several ECB publications describe the process of banking integration in Europe over the past decade. Since 2005, each year the ECB (2005-2015) has been publishing detailed reports on Financial Integration in Europe. It appears that the euro area retail banking markets remain highly fragmented whereas the wholesale banking markets show clear signs of increasing integration since the establishment of Monetary Union with a single currency of the euro in 1999. Furthermore, these reports also summarize that the Financial Crisis of 2007-2009 had a very significant and negatively effect on the process of banking market integration. Specifically, the figures reported in ECB (2005-2009) show that the euro area banking market generally experienced increasing integration before the crisis in 2008. In the next period, the ECB (2010-2013) reports conclude that the degree of financial integration in banking market declined sharply over 2009 and 2012. Finally, the two most recent ECB reports (2014, 2015) summarize that financial integration in banking market shows only limited improvement after 2012 and does not reach the pre-crisis level.

Based on the above-mentioned background, this chapter seeks to (i) investigate whether acquirers' systemic risks increased after bank M&As are completed; (ii) explore the impact of the U.S. Subprime Crisis and Euro Sovereign Debt Crisis on acquirers' systemic risk after M&As are completed; (iii) identify the determinants of acquirers' systemic risk changes after bank M&As are completed; and (iv) examine the relationships between acquirers' systemic risk changes in cross-border bank M&As and banking market integration in Europe.

The rest of Chapter 3 is organized as follows. Section3.2 provides a literature review for the (1) systemic risk changes in bank M&As; (2) systemic risk changes and banking integration; (3) systemic risk measures; and (4) selected variables. Section3.3 reports the key hypotheses and describes the data samples' characteristics and limitations, data sources and methodology used for the empirical analysis. Section3.4 presents, discusses and interprets key empirical results. Finally, Section3.5 provides the main conclusions.

3.2 Literature Review

This section offers a selected review of relevant literatures from four interrelated topics that are important for our analysis, in particular: systemic risk in bank M&As (subsection 3.2.1), systemic risk and banking integration (subsection3.2.2), systemic risk measures and selected variables (subsection 3.2.3).

3.2.1 Systemic Risk Changes in Bank M&As

This sub-section will outline current literatures about systemic risk changes in bank M&As from two aspects: definition of systemic risk (subsubsection 3.2.1.1) and systemic risk changes in bank M&As (subsubsection 3.3.1.2).

3.2.1.1 Definition of Systemic Risk

Exsiting literature provides a variety of definitions of systemic risk. One strand of literature (Billio et al. 2012; Hull 2015) mainly focuses on the interconnectedness among financial institutions. For example, Billio et al. (2012, p.536) state that: " Systemic risk involves the financial system, a collection of interconnected institutions that have mutually beneficial business relationships through which illiquidity, insolvency, and losses can quickly propagate during periods of financial crisis." Therefore, systemic risk can be defined as the risk that the failure of one or more financial institutions will cause the failure of other interconnected financial institutions. Similarly, Hull (2015) defines systemic risk as the risk that default by

one financial institution will lead to default by other financial institutions and threat financial stability. Unlike idiosyncratic risk, systemic risk relates risk to a great many of connected financial institutions or the entire financial system rather than an individual institution. The buildup of high systemic risk in the banking system resulted in bank runs in the 2007-2009 U.S. Subprime Crisis. Another strand of literature (De Nicolo et al. 2002; ECB 2009; Forque and Langsam 2013) mainly emphasizes its negative effects on real economy. For instance, De Nicolo et al. (2002) point out that systemic risk is "the risk that an event (shock) will trigger a loss of economic value or confidence in, and attendant increases in uncertainty about, a substantial portion of the financial system that is large enough to, in all probability, have significant adverse effects on the real economy. Moreover, ECB (2009) combines the systemic risk with its negative effects on economy and defines systemic risk as "the risk of threats to financial stability that impair the functioning of a large part of the financial system with significant adverse effects on the broader economy". Similarly, Fouque and Langsam (2013) define systemic risk as the risk of a disruption of the market's ability to facilitate the flows of capital that results in the reduction in the global GDP growth.

Overall, the negative effects of increasing systemic risk on the real economy can be very serious. From increasing financial instability in the banking system, to decreasing aggregate demand and capital flows in financial markets, hence affecting real GDP growth rate, with potential negative effects on the labor market if unemployment also soars and income growth rate declines.

3.2.1.2 Systemic Risk and Bank M&As

Several studies (Amihud et al. 2002; Weiss et al. 2013; Weiss et al. 2014) focus on systemic risk changes in bank M&As**.** However, evidence is mixed about whether bank M&As significantly affect systemic risk changes. For example, Amihud et al. (2002) analyze a sample of 214 mergers where the acquirers' stock are publicly traded between 1985 and 1998 in the

U.S. and conclude there is no evidence that cross-border merging banks add to the risk exposure of either domestic or host country regulators. Nevertheless, Weiss et al. (2013) study 440 bank mergers with bidders predominantly located in the US, Canada, EU, Norway, Switzerland, Turkey, Some Asian and Latin American countries and find that bank mergers significantly increase in the contribution of acquirers, targets and their competitors to financial instability. Similarly, Weiss et al. (2014) evaluate different samples of banks in four different continents during the Mexico Peso crisis, Asian crisis, LTCM crisis (the more-than-one-billion-dollar fund of Long-Term Capital Management nearly collapsed the global financial system in late 1998 due to its highly leveraged trading strategies), Dotcom, 9/11, subprime and Lehman and find that bank-specific characteristics, regulatory variables and deposit insurance schemes can explain large portions of banks' systemic risk changes. The latter two studies focus on the destabilizing effects of bank consolidations in financial crises and confirm the destabilizing effects of banking consolidation exist.

3.2.2 Systemic Risk Changes and Banking Integration

Another important relationship is the one between systemic risk and banking integration. Lim et al. (2015) use a sample of 36 country-pair large banks in Asia-Pacific region between Q4 1997 and Q1 2010 to identify whether bank integration in Asia-Pacific region reduces cross-border systemic risk and investigate the long-term effect of bank integration on systemic risk. They find strong evidences that increasing banking integration raises cross-border systemic risk between a country-pair and banking integration has a long-term effect on the increasing cross-border systemic risk over time. Their findings strongly support the cost side of banking integration. Fecht et al. (2012) analyze three cases (banks with an undiversified portfolio, banks with a safe portfolio and banks with a diversified portfolio) and find evidence of both benefits and costs of financial integration. On the one hand, the benefits of financial integration are (i) integration weakly decreases the probability of individual banking crises and (ii) it improves

welfare due to greater specialization in banking markets. On the other hand, the cost of financial integration is that it may increase the systemic risk of the banking sector and thus it is more likely to result in a banking contagion. In this chapter, we will examine whether any cost of financial integration exists in pre-crisis and post-crisis periods in section 3.4.2.

Regarding banking integration indicators, apart from those described in chapter 2, a recent study (Fernandez and Ausina 2015) construct different indicators based on the structure of current relations between banking markets. The authors define and calculate distance-corrected and distance uncorrected degree of banking openness (DBO), degree of bank connectedness (DBC), degree of total bank connectedness (DTBC) and degree of banking integration (DBI), respectively. Based on these component indicators, they finally calculate weighted global indicators. They analyze the level of banking integration of 22 countries between 2003 and 2011 and find that banking markets in most countries experience increasing banking integration between 2003 and 2007 and then a drop between 2007 and 2011. They also conclude that the Financial Crisis 2007-2009 had negative impacts on global banking integration and increased systemic risk in banking markets.

3.2.3 Systemic Risk Measures

Another strand of literature about systemic risk changes is using different systemic risk measures based on different types of data. With regard to the types of data used for measurement, Freixas et al. (2015) divide systemic risk measures into measures based on fundamentals and measures based on market data. We will discuss both categories of systemic risk measures in more detail in the next two subsections.

3.2.3.1 Measures Based on Fundamentals

One type of systemic risk measure based on fundamental is the systemic risk measure calculated via contingent claim approach (CCA), a method based on banks' assets, liabilities and equity price. Lehar (2005) follows Merton's (1973) model and interprets equity as a call

option on a bank's asset. He first uses Merton's (1973) model (Maximum Likelihood Estimate) to derive bank's asset values and employ Exponential Weighted Moving Average (EWMA) model to obtain asset correlations. Second, he employs Monte Carlo simulations (based on Geometric Brownian Motion (GBM, is a continuous-time stochastic process in which the logarithm of the randomly varying quantity follows a Brownian motion with drift) to predict future bank asset values and compare them with their liabilities according to different criteria to construct the systemic risk indexes: Systemic Risk Index based on Values (SIV) and Systemic Risk Index based on Number of Banks (SIN). Moreover, Freixas et al. (2015) discuss other measures based on fundamentals, such as sectoral measures (e.g. excessive credit growth and leverage, asset price booms) and interbank liquidity networks. The authors argue that although these measures are easily obtained, and to some extent, can provide early warning signals in banking sector and the economic condition, they may not measure systemic risk buildup appropriately and therefore may provide incorrect signals for economic downturn. In order to address this limitation, in recent years, scholars have created several most commonly used measures based on market data. We will discuss these measures in next subsection.

3.2.3.2 Measures Based on Market Data

Depending on the different types of market data used, systemic risk measures based on market data can be further divided into several categories. They include measures about (i) extreme equity returns, for instance, ①lower tail dependence (LTD, Nelson 2006; Schmidt and Stadtmuller 2006; Ruenzi and Weigert 2011; Weiss et al. 2013; Weiss et al. 2014), ②using copula functions to estimate several systemic risk measures (Joint Probability of Distress, JPoD and Banking Stability Index, BSI, Segoviano and Goodhart 2009; Probability of Default, PD, Kleinow and Moreira 2016), ③systemic/marginal expected shortfall (SES/MES, Acharya et al. 2010; Weiss et al. 2013; Weiss et al. 2014), and ④sharpley value (Drehmann and Tarashev 2013);(ii) co-risk management, for example, conditional value at risk conditional expected

shortfall (CoVaR and CoES, Adrian and Brunnermeier 2011); (iii) conditional capital shortfall (SRISK, Brownless and Engle 2016); (iv) variance decomposition and interconnectedness, for instance, ①Principal Component Analysis (PCA) and ②Granger-causality (Billio et.al. 2012) and (v) CDS or CDO spreads, indexes and tranches, for example, ①Distress Insurance Premium (DIP, Huang, Zhou and Zhu 2009, Huang et.al. 2010, Black et.al. 2016) and ②using a linearized three-jump model to estimate systemic risk spreads (Bhansali at.al. 2008; Rodrigez-Moreno and Pena 2010). Other systemic risk measures include the Joint Probability of Distress (JPoD) and Banking Stability Index (BSI) (Segoviano and Goodhart 2009) and CATFIN based on three different VaR and ES measures (Allen et.al. 2012). Allen et al. (2012) forecasted macroeconomic downturns six months into future using out-of-sample tests conducted with U.S., European, and Asian bank data derived a brand new measure of aggregate systemic risk called CATFIN. We will discuss these systemic risk measures and the relevant literature in more details in the following paragraphs in this subsection.

Specifically on market-based systemic risk measures, there are two measures about "co-risk management". Adrian and Brunnermeier (2011) propose CoVaR and CoES, the VaR and the ES of a bank (or the whole system) conditional on some credit events (e.g. default or bank contagion) of the whole system (or another bank). They analyze a sample of 1226 institutions at least 260 weeks of asset return data (an average length of 645 weeks) between 1986Q1 and 2010Q4 and use quantile regression and time variation associated with systemic state variables to estimate ΔCoVaR and Forward-ΔCoVaR to capture a bank's systemic risk change or systemic risk contribution to the whole system. They find that Forward-ΔCoVaR can predict systemic risk buildups in advance but ΔCoVaR cannot. Moreover, they also recognize two merits for ΔCoVaR. First, it focuses on the contribution of each bank to overall systemic risk. Second, it captures the risk spillovers from institution to institution across the whole financial network. Both of them can provide useful information for bank regulators and senior managers.

Nevertheless, other scholars argue that ΔCoVaR still has several drawbacks. For example, Billio et al. (2012) claims that ΔCoVaR implies lower estimates of systemic risk until after a volatility spike occurs. Second, Huang et al. (2010) point out that ΔCoVaR cannot appropriately aggregate the systemic risk contributions of individual banks because VaR is not additive. Therefore, individual banks' systemic risk contributions cannot be simply added up to obtain the aggregated systemic risk. This is consistent with Acharya et al.'s (2010) analysis that VaR is not a coherent risk measure. Third, Adrian and Brunnermeier (2011) claim that the weekly contemporaneous CoVaR is pro-cyclical and cannot identify systemic risk build-up and thus cannot predict the systemic crisis in advance. They propose a remedy to address this drawback: constructing Forward-ΔCoVaR to replace ΔCoVaR. They point out that Forward ΔCoVaR can capture systemic risk buildup thus can predict systemic crisis in advance.

In order to provide a remedy for the second drawback of ΔCoVaR, many studies also propose several other systemic risk measures based on extreme value theory (EVT). For instance, Acharya et al. (2010) use SES/MES, OLS regression and probit regression analysis to study 102 financial institutions between July 2007 and December 2008. According to Acharya et al (2010), SES evaluates the amount a bank's equity falls below its target level if aggregate banking capital is less than target level while MES measures the individual bank's marginal risk contribution to the overall banking system if the overall market experiences moderately tail risk. They conclude that MES appear to be able to predict the financial firms with the worst contributions in the systemic crisis. MES has two advantages over other systemic risk measures. First, MES is simple to compute and easy for regulators to consider. Second, ES is a coherent risk measure and is more robust than VaR. However, Weiss et al. (2013) claim two disadvantages of MES. First, it is only based on the left tail of the market's marginal distribution but ignores the right tail of the market's distribution. This means MES cannot be used to predict the extreme good results (e.g. when overall market experiences significant

increase). Second, it does not capture the true tails of the return distribution because it only measures the moderate tail risk. If the overall market or the specific bank experiences extremely negative return, ES is more likely to underestimate the bank's true systemic risk.

Some studies (Nelson 2006; Schmidt and Stadtmuller 2006; Ruenzi and Weigert 2011) propose Lower Tail Dependence (LTD) to correct the second drawback of MES. Nelson (2006) defines LTD as the probability that an observation of the random variables joint distribution will lie in the distribution's extreme lower tail. Therefore, compared to MES, LTD is more likely to accurately estimate the bank's true systemic risk. On the one hand, Schmidt and Stadtmuller (2006) propose non-parametric method (tail copulae without parameter to estimate the lower dependence coefficient. On the other hand, Ruenzi and Weigert (2011) employ a parametric method (asymptotically lower tail, upper tail dependent and independent copula functions with other basic copula parameters) to estimate lower and upper tail dependence coefficients. Weiss et al. (2013) compare the two methods and claim that using parametric method (e.g. different copula) to calculate LTD may suffer from the model risk due to misuse of copula function. Two studies (Acharya et al. 2010; Weiss et al. 2013) summarize three advantages of LTD. First, it measures the left tail of the respective joint distribution. Second, it allows for easy averaging over the different financial sectors and market regimes. Third, it exactly captures tail probability in the extreme tail of the market's and individual bank's joint distribution which has systemic risk. Due to these advantages, using LTD to measure systemic risk, to some extent, can alleviate the problem of underestimating real systemic risk contribution of a particular bank or banking system.

Besides these measures, one specific study employs more advanced copula function, the Consistent Information Multivariate Density Optimizing (CIMDO)-copula method, to recover the banking system's multivariate density (BSMD) and then estimate two new systemic risk measures in banking system, the Joint Probability of Distress (JPoD) and Bank Stability Index

(BSI). They argue that the non-parametric method (CIMDO-copula) has a key advantage over other standard risk models: it captures adequate default (distress) dependence (both linear and non-linear) and can change at different points of the economic cycle. This is a desirable property for systemic risk measures because it enables bank regulators and managers to accurately quantify and timely monitor the actual systemic risk buildup in a particular banking system and banks in different time periods. Furthermore, they claim that CIMDO-copula maintains all the benefits of the copula approach but avoids drawbacks for standard parametric copula functions: it addresses the copula choice problem, avoids the imposition of constant correlation parameter assumptions and appears to be more robust in the tail of the density. Lastly, they point out the economic interpretations for JPoD and BSI: the JPoD represents the probability of the banks in the system becoming distressed and captures changes in the (linear and non-linear) distress dependence among the banks while the BSI reflects the expected number of banks becoming distressed given that at least one bank has become distressed. Both measures can provide significant economic meanings for systemic risk changes in banking systems.

Unlike the systemic risk measures that focus on tail risk or extreme loss, SRISK measures the expected capital shortfall conditional on s systemic risk event. Brownless and Engle (2016) use SRISK to measure a bank's contribution to the undercapitalization of the financial system in case of a crisis. They compare SRISK with other market-based measures and find SRISK considers joint dependence among banks and their size and leverage. They point out that the sum of SRISK across all banks measures the overall systemic risk in the entire financial system and can also be thought as the total amount if capital that government would have to provide to bailout the financial system. They further identify that SRISK improves predicting the Fed capital injections during the crisis and it provides early warning signals of distress in indicators of real activity. However, they also propose that this measure does not use off-balance sheet

information and may not appropriately capture the true asset structure of a firm. Generally, from bank regulators' and researchers' perspectives, SRISK has much more advantages than disadvantages, therefore, it has been widely employed in recent studies to quantify and monitor the systemic risk contribution of an individual SIFI and systemic risk change of a banking system over time.

Apart from the aforementioned systemic risk measures, other studies (Bhansali et al. 2008; Huang et al. 2009; Huang et al. 2010; Allen et al. 2012; Billio et al. 2012; Drehmann and Tarashev 2013; Black et al. 2016; Kleinow and Moreira 2016) propose several other systemic risk measures to complement them after financial crisis in 2008. Most of these measures are calculated based on market data that can be obtained relatively easily. For example, Huang et al. (2009) and Huang et al. (2010) use single-name CDS spreads to calculate Distress Insurance Premium (DIP) and marginal DIP to identify systematically important banks and find that the elevated systemic risk in the banking sector is initially driven by the rising /insolvency risk premium and later by heightened liquidity risk premium. They define DIP is a risk-neutral based measure that captures the insurance premium to cover distressed losses in a banking market and marginal DIP is banks' marginal contribution to the hypothetical distress insurance premium of the banking market. In addition, they also find that the marginal contribution of individual banks to the systemic risk is mostly determined by its size, although correlation and default probability also matters. They further point out that, similar to MES, DIP is additive and can appropriately aggregate the systemic risk contributions of individual institutions. However, Billio et al. (2012) claim that DIP implies lower estimates of systemic risk after a volatility spike occurs. Moreover, Bhansali et al. (2008) and Roidrigez-Moreno and Pena (2010) use CDO indexes and their tranches and employ a linearized three-jump model to estimate the intensities and jump sizes to each Poisson counter. They further decompose the CDO indexes into three different spreads, idiosyncratic, systematic and systemic spreads and argue that the

systemic spread represents the systemic risk in the whole banking system. Billio et al. (2012) propose two more systemic risk measures, principal component analysis (PCA) and Granger-causality networks. They state that PCA measures both the contribution and the exposure of an institution to the overall risk of the system given a strong common component across the returns of all institutions while Granger-causality tests can significantly identify the networks of Granger-causal relationships among all financial institutions. They find that both PCA and Granger-causality networks can measure correlation directly and unconditionally and can be used to gauge the degree of connectedness of financial system. However, only Granger-causality can capture higher-order causal relationships.

Drehmann and Tarashev (2013) use another commonly used method Sharpley Value and define two specific applications of the Sharpley Value: participation approaches (PA) and generalized contribution approach (GCA). They recognize that Sharpley value measures a bank's systemic risk change when it joins any subsystem. As two applications of Sharpley Value, PA measures a bank's systemic importance by the expected losses the bank generates in systemic events while GCA captures the risk that a bank generates on its own as well as the bank's systemic risk contribution to each subsystem. Moreover, they point out that Sharpley Value has several desirable properties thus it can attribute individual systematically important banks' systemic importance to the banking systems or subsystems with different systemic risk measures (e.g. VaR and ES). Nevertheless, they conclude that the measured systemic importance of individual banks can differ materially across approaches (PA and CGA) so that researchers should choose appropriate methods to address the question at hand.

Finally, these systemic risk measures based on market data also have some disadvantages. Freixas et al. (2015) emphasize two limitations: first, most systemic risk measures based on market data require detailed data that are not readily available (e.g. the equity prices for some private-owned and unlisted banks). Second, these measures can underestimate real systemic

risk as they also incorporate the potential bailouts from taxpayers and the liquidity assistance from central banks. In some periods of time, especially after governments announce some important bailouts or expansionary monetary policy measures, the SIFIs' equity prices can surge dramatically to distort the real systemic risk buildup. To alleviate these limitations, they further propose that researchers should use a combination of measures to track different aspects of systemic risk over time and across institutions and markets. Many recent studies (Segoviano and Goodhart 2009; Rodrigez-Moreno and Pena 2010; Allen et al. 2012; Weiss et al. 2013; Bostandzic et al. 2014; Weiss et al. 2014; Black et al. 2016; Berger et al. 2016) have employed different systemic risk measures to follow their suggestion. In this chapter, we will also employ a combination of different systemic risk measures as dependent variables in main regressions and robustness checks.

3.2.3.3 Systemic Risk Sensitivity and Systemic Risk Contribution

There is another method to classify most existing systemic risk measures. All above-mentioned systemic risk measures can be used to evaluate (1) each individual bank's systemic risk changes conditional on systemic events occur in the whole banking system and (2) each individual bank's systemic risk contribution to the whole banking system conditional on individual shock. Kleinow and Moreira (2016) distinguish the first one from the second one and define the first one as systemic risk *sensitivity* and second one as systemic risk *contribution*. They also categorize several most commonly used measures, such as MES, SRISK, LTD and CCA, into systemic risk sensitivity and other measures, including ΔCoVaR, Co-risk and Granger causality into systemic risk contribution. Actually, some specific systemic risk measures, such as ΔCoVaR, can be interpreted as either systemic risk sensitivity or systemic risk contribution. According to Adrian and Brunnermeier (2011), $\Delta CoVaR^{system|i}$ denotes the VaR of the whole banking system conditional on the distress of a particular bank *i* while $\Delta CoVaR^{i|system}$ denotes the VaR of a particular bank *i* conditional on a specific systemic event occurs in the banking

system. According to Kleinow and Moreira (2016), the former should be included as systemic risk contribution and the latter as systemic risk sensitivity. Based on definitions, systemic risk sensitivity measures the negative effects of system-level events on individual banks while systemic risk contribution measures the negative effects of bank-level events on the whole banking system. In this chapter, we will investigate both systemic risk sensitivity (MES, LTD) and systemic risk contribution (ΔCoVaR) and calculate both bank-level and system-level systemic risk changes after M&As.

3.2.4 Literatures about Selected Variables

In this sub-section, we review the main literature relating to the variables that will be included in our empirical models and we will discuss the reasons why we select these variables as well as the expected signs of the estimated coefficients.

This study follows Weiss et al. (2014) to compute the dependent variable: *systemic risk change*, that is calculated the difference between acquirers' post-merger systemic risk during 11 days and 180 days after deal completion and pre-merger systemic risk during 180 days and 11 days prior to deal announcements. In addition to the methodology of Weiss et al. (2014), for the purposes of our empirical analysis, we will not only calculate change of MES and change of LTD but also compute change of ΔCoVaR.

Most recently, Kleinow et al. (2017) compute and compare four alternative measures: MES, Co-Risk, ΔCoVaR and LTD of U.S. banks, non-depository institutions and insurance companies between 2005 and 2014. They conclude that the results vary significantly within and between banks, non-depository financial institutions and insurance companies. They also find that MES, LTD and ΔCoVaR increased considerably during two crises and decreased significantly after crises for all three segments. Therefore, in this study we expect acquirers' MES, LTD and ΔCoVaR to increase significantly after M&As in both US Subprime Crisis and European Debt Crisis and rise much more significantly in two financial crises than in the non-

crisis period.

In terms of explanatory variables, this study employs bank-specific variables, deal-specific variables and macroeconomic, industry-specific and regulatory variables. Bank-specific variables include the following: acquirers' size, liquidity, capital adequacy, financial leverage, profitability, asset diversity, asset quality, insolvency risk and valuation. Ln (TA), the natural log of acquirers' total assets, represents acquirers' size. Previous papers had mixed results for the relationship between systemic risk and bank size. Laeven et al. (2016) find that systemic risk is positively associated with bank size in a sample consists of 412 deposit-taking institutions whose assets in excess of US$ 10bil. at the end of 2006 from 56 countries. They find that this result is consistent with the view that large banks can acquire or merge with other banks to become "too-big-to-fail" or "too-systematically important-to-fail" banks, thus enabling them to exploit the safety net subsidies and create moral hazard problems. These large banks are found to pay less attention to the risks they take and increase their systemic risk to the whole banking system. On the contrary, Weiss et al. (2014) obtain the different results that larger acquirers have lower systemic risk after M&As are completed. They find that larger acquirers can use M&As to increase their contributions to financial instability and confirm the "concentration-fragility" hypothesis. In this chapter, we will test the "too-big-to-fail" and "concentration-fragility" hypotheses and expect acquirers' size to be positively associated with acquirers' systemic risk changes after M&As.

LIQ is measured as liquid asset/total deposit and borrowing and represents the acquirers' liquidity. The expected sign of the variable LIQ is negative because banks with a higher proportion of liquid assets, in case of trouble they can sell them to meet the liquidity requirements set by banking regulators. Therefore, they will have lower probability to experience liquidity problems and have lower systemic risk contribution to the banking system. TIER1 is acquirers' core capital ratio, indicating their capital adequacy. It is reasonable to

expect a negative sign for TIER1 because if acquirers have a higher capital ratio, they will have more capital to cover the expected and unexpected losses, thus leading to decreased systemic risk contribution to the banking system. Bostandzic et al. (2014) analyze the effect of capital on the global systemic risk of international banks between 1999 and 2012 and find that banks with higher Tier1 capital ratio have lower systemic risk contributions to global banking markets. Similarly, Laeven et al. (2016) calculate systemic risk measures for more than 1000 financial institutions across 32 countries between July 2007 and December 2008 and find that systemic risk is inversely related to Tier1 capital ratio alone. These results are consistent with the traditional view that more well-capitalized banks have lower systemic risk. E/A represents equity-to-asset ratio, and it is used to measure financial leverage. Higher E/A indicates lower financial leverage and higher equity to cover the risk asset exposures. Banks with lower leverage ratio have lower insolvency risk and lower systemic risk contribution to banking system. Therefore, the expected sign of E/A should be negative. ROA measures acquirers' profitability and has an expected negative sign. If acquirers have higher profitability ratio, they will have higher earnings relative to their size and may have higher retained earnings to cover incurred and potential losses, consequently, they will have lower systemic risk contributions to banking system. ADIVERSITY is the variable that measure acquirers' diversity in business model (product diversification). ADIVERSITY represents acquirers' asset diversity, is calculated as 1-|(net loans – other earnings assets)/total earnings assets|. Its value ranges from 0 to 1 and the higher value indicates higher degree of asset diversification (Laeven and Levine 2005). The expected sign of ADIVERSITY is negative because acquirers with higher diversity in their business models are more likely to benefit from diversification and thus lower their systemic risk contributions to banking system. SHORTTERM is short-term debt/total liability, is a measure of banks' reliance on short-term funding. Brunnermeier and Pedersen (2009) argue that banks' greater dependence on short-term funding expose themselves more to liquidity risk

thus lead to higher systemic risk contributions to banking system if they make more deposits. Consequently, we expect SHORTTERM to be positively related to acquirers' systemic risk. Next, NPL, the abbreviation of non-performing loan ratio, reveals acquirers' asset quality. The expected sign of NPL is positive as acquirers with better asset quality are less likely to experience losses and have lower systemic risk contributions to banking system. Furthermore, NONINTEREST represents non-interest income/total income, is a measure of income diversity. The expected sign of NONINTEREST can be negative or positive. On the one hand, if acquirers have higher proportion of non-interest income, they are more likely to benefit from diversification and may have lower systemic risk contributions to the banking system. Bostandzic et al. (2014) find some evidence to support this view. However, on the other hand, higher proportion of non-interest income can indicate that acquirers may take more risk to increase non-interest income and may result in higher systemic risk to banking system. Brunnermeier et al. (2012) identify the evidence to support this viewpoint. ZSCORE is the distance to default and is calculated as the sum of average ROA and average capital-to-asset ratio divided by standard deviation of ROA. The expected sign of ZSCORE is negative because the higher z-score indicates that banks have lower insolvency risk and that should be associated with lower systemic risk contributions to the banking system. Finally, PB represents the price-to-book ratio, another form of market value-to-book value ratio, is a measure of acquirers' valuation. Keeley (1990) analyzed that banks with greater charter value (Acharya (1996) defined the charter value of a bank as the value that would be foregone due to a bank closure) can have more incentives to increase capital ratio and limit their risk taking thus will have more capital to cover losses and have lower systemic risk. Therefore, we expect acquirers' PB to be negatively related to systemic risk.

The deal-specific variables contain three dummy variables CROSSBORDER, GEO and SYSTEMATIC. Firstly, CROSSBORDER will be 1 if the M&A deal is cross-border and

otherwise 0. Secondly, GEO represents geographic diversification. GEO is 1 if the acquirer and the target come from different continents and otherwise 0. GEO differs from CROSSBORDER because cross-border deals are deals whose acquirers and targets can come from different EU countries while GEO contains deals whose acquirers must come from EU countries and targets must come from other continents. Both CROSSBORDER and GEO are expected to have negative signs due to product or geographic diversification. Casu et al. (2015) list many value-maximizing motives for cross-border bank M&As and point out that geographic or product diversification enable banks to diversify their idiosyncratic risk thus lower their systemic risk contributions to banking system. SYSTEMATIC is another dummy variable that equals to 1 if the acquirer is a systematically important bank and 0 otherwise. We obtain information from the European Banking Authority (EBA) website to determine whether the acquirer is a systematically important bank or not. We expect SYSTEMATIC to be positively related to acquirers' systemic risk because the failure of one or more systematically important banks may cause the failure of one or more other interconnected financial institutions and increase systemic risk to banking system.

The controlled country-specific macroeconomic variables include AGDP, AINF and AMONEY. AGDP is the annual real GDP growth rate (%) for acquirers' home country one year prior to M&A announcement. The expected sign of AGDP should be negative because the higher economic growth rate for the acquirer's home country results in the acquirers' higher profits and lower idiosyncratic risks, thus reducing their contribution to the systemic risk of the banking system. AINF is the inflation deflator (%) for the acquirer's home country one year prior to the M&A announcement. The inflation is expected to positively correlated to banks' profits because the lower the inflation, the higher probability that monetary decision makers will implement expansionary monetary policy and the higher expected profits and lower idiosyncratic risk for banks, and lower systemic risk to banking system. Weiss et al. (2014)

found that inflation is positive and significantly related to systemic risk in LTCM, Dotcom, Subprime and Lehman Brother crises. AMONEY is the broad money supply (M2) growth rate (%) for the acquirer's home country one year prior to the M&A announcement. AMONEY is expected to have a positive relationship with banks' systemic risk because the higher the broad money supply growth rate, the more money the banks can borrow from central bank and interbank market, the more loans banks can lend, therefore, banks can take more risks and increase their systemic risk to banking system.

The industry-specific variable is CR5/HHI. CR5 is the concentration ratio of the 5 largest banks in acquirer's banking market. It is computed as sum of total assets of the 5 largest banks divided by sum of total assets of all banks in the same banking market and ranges from 0 to 1. HHI is the Herfindahl-Hirschman Index, is calculated as the sum of squared market shares of a country's domestic and foreign banks, ranging from 0 to 10000. Both variables are used for measuring degree of concentration in banking market, and higher values indicate higher concentration. CR5 and HHI are two different measures of concentration because the former calculates the market share of the largest five banks while the latter calculates the squared market share of all banks. We employ HHI as an alternative measure to CR5 to examine whether higher concentration is positively or negatively related to acquirers' systemic risk changes after the M&As. If higher concentration is positively related to acquirers' systemic risk changes after M&As, then "concentration-fragility" hypothesis will hold; on the contrary, if higher concentration is negatively related to acquirers' systemic risk changes after M&As, then "concentration-stability" hypothesis will hold (Berger et al. 2004;Boyd et al.2006).

This chapter also follows Barth et al. (2013) to use another deposit insurance scheme variable DEPPOWER and two regulatory and supervisory variables REG and SUP. First, DEPPOWER stands for Deposit Insurer Power and measures whether the deposit insurers have the authorities to make the decision to intervene in banks. It ranges from 0 to 3 and the higher value indicates

that the deposit insurance authority has higher authority and is more powerful. Second, REG represents Capital Regulatory Index, which is the sum of Overall Capital Stringency and Initial Capital Stringency, measures whether the capital regulation is stringent or not. It ranges from 0 to 9 and the higher value indicates the greater stringency for capital regulation. Third, SUP stands for Official Supervisory Power and measures whether the supervisory authorities have the authority to take specific actions to prevent and correct problems. It ranges from 0 to 14 and the higher value indicates supervisory authority has greater supervisory power. The higher value for DEPPOWER indicates that deposit insurers are more likely to implement deposit insurance scheme well and the higher values for REG and SUP show stricter regulation. Some previous studies (Molyneux et.al.2014; Casu et.al. 2015) observe that the presence of a deposit insurance scheme may increase banks' moral hazard problems and contribute to greater systemic risk while stricter regulation may require banks to limit risk taking and thus lower systemic risk. On the one hand, both REG and SUP can also have negative signs because the more stringent capital regulation and supervision can limit banks' willingness to take risk, leading to banks' lower idiosyncratic risk and lower systemic risk in the banking system. On the other hand, DEPPOWER has a positive sign because deposit insurers from acquirers' home countries are more powerful, these countries are more likely to have better deposit insurance implementation, then moral hazard problems are more likely to rise, banks may take higher risks and finally contribute to higher systemic risk that could affect entire banking system. Therefore, both REG and SUP can be expected to be negatively associated with acquirers' systemic risk changes after M&As due to the regulation hypothesis for the banks' risk-taking while DEPPOWER is expected to have a positive relationship with the acquirers' systemic risk changes after M&As.

More regulatory variables are added into baseline model. Firstly, BAILOUT is another dummy variable that equals to 1 if an acquirer is bailout recipient in the US Subprime Crisis or the

European Sovereign Debt Crisis and otherwise equals to 0. Berger et al. (2016) use difference-in-difference analysis and find that US Troubled Assets Relief Program (TARP) reduces the systemic risk significantly. Therefore, we expect BAILOUT to be negatively related to the acquirers' systemic risk to banking system. Secondly, Private Monitoring represents the private monitoring index, which measures the incentives and capabilities provided by regulators or supervisors to encourage private investors to monitor banks, ranging from 0 to 12. If the regulatory and supervisory authorities have more incentives and capabilities to encourage private investors to monitor banks, these latter will be less willing to take on more risk and thus will be less likely to transmit systemic risk to banking system. Therefore, the private monitoring index should have negative relationship with acquirers' systemic risk. Bostandzic et al. (2014) find that systemic risk is inversely related to private monitoring index. Finally, Moral Hazard represents the moral hazard index, which captures the degree to which moral hazard exists, ranging from 0 to 3. Higher values indicate greater mitigation of moral hazard. The moral hazard index can be either positive or negative related to acquirers' systemic risk. If deposit insurance schemes reduce depositors' incentives to monitor banks, moral hazard problem increases, then the index is low, and banks will have higher systemic risk after M&As. In this case, the moral hazard index is negative related to banks' systemic risk. Bostandzic et al. (2014) identify that the Moral Hazard Index is positively associated with systemic risk. On the contrary, if deposit insurance can significantly reduce banks' systemic risk to banking system, then the moral hazard index is positively related to banks' systemic risk after M&As.

3.3 Hypotheses

The ECB Financial Integration reports (2005-2017) describe that level of banking integration in Europe increased prior to financial crises, then decreased during financial crises and recovered after financial crises. This historical trend indicates negative impact of financial

crises on banking integration in Europe. ECB reports also found that as level of banking integration increases, systemic risk in banking sector increased gradually after M&A deals are completed in pre-crisis period and contributed to buildup of financial instability and finally resulted in financial crises. In addition, Draghi (2014) also points out that one of the possible risks of financial integration is the destabilizing effects of bank integration. The destabilizing effects of financial integration come from increase of bank systemic risk and bank contagion. This may be interpreted as follows: acquirers from more integrated markets become even larger and more interconnected after M&As thus may have higher systemic risk. It indicates that acquirers from more integrated banking markets may have higher systemic risk after mergers thus contribute to financial instability. Therefore, the hypothesis of this chapter can be formulated as follows:

Hypothesis: Acquirers from more (less) integrated banking markets will have higher (lower) systemic risk after M&As.

3.4 Samples, Data Sources and Descriptive Statistics

3.4.1 Sample and Data Source

The full sample used in this study consists of bank M&A deals carried out between 1997 and 2015 whose acquirers are headquartered in EU 28 countries and whose targets can come from any country. Specifically, the following are the steps used for selecting the full sample for this empirical analysis:

(1) the M&A deals are announced between 01/01/1997 and 31/12/2015;

(2) the acquirers must be commercial banks or savings banks from EU 28 countries;

(3) all the deals must be completed;

(4) acquirers must be listed banks;

(5) the targets must be banks from any country;

(6) all money center banks, central banks and special purpose banks are excluded;

(7) all required data for accounting or financial data for acquirers must be available.

Originally, we identified 657 deals, however, due to data availability, around half of the deals had to be excluded from the final sample that is 322 deals. Moreover, to investigate whether the U.S. Subprime Crisis and the European Sovereign Debt Crisis have positive or negative impacts on acquirers' systemic risk after M&As are completed, in this study we will further create three subsamples: 202 deals in the non-crisis subsample (1997-2006 and 2014-2015), 71 deals in the US Subprime Crisis subsample (2007-2009) and 49 deals in the European Sovereign Debt Crisis subsample (2010-2013). We find the second and third subsamples have relatively small sample sizes. According to Brooks (2008), a sample size that is too small reduces the statistical power of the empirical models, that is, a sample size that is too small increases the likelihood of a Type II error that skews the results, which reduces the reliability of results of empirical models.

In order to investigate the relationships between acquirers' systemic risk changes and banking integration indicators, we use a smaller sample that only contains cross-border bank M&A deals in the full sample. Moreover, the banking integration indicators are only available since 2003, therefore, the M&A deals between 1997 and 2002 in the full sample are excluded, and the sample size for the second sample is 113.

The data are drawn from the following multiple sources: (1) the original deal-specific data are downloaded from Bloomberg; (2) the acquirers' stock price data are obtained from DataStream; (3) the required data in calculating ΔCoVaR are obtained from Bloomberg and DataStream; (4) the acquirers' financial data are downloaded from FitchConnect; (5) the macroeconomic data for acquirers' home countries are downloaded from World Bank Development Indicator (WDI) database and DataStream; (6) the structural indicators for acquirers' banking markets are

downloaded from ECB Statistics Data Warehouse; (7) the regulatory and deposit insurance data come from databases compiled by Barth et al. (2013) and Demirguc-Kunt et al. (2008); (8) the financial integration indicators come from ECB publications.

3.4.2 Descriptive Statistics

Table 3-1 demonstrates descriptive statistics for the variables used in the fixed-effect models. As expected, the average values for the change of MES (0.0024), change of ΔCoVaR (4.0609) and change of LTD (0.0026) and the medians of change of MES (0.0017), and change of LTD (0.0067) are positive, indicating that the acquirers' systemic risk increase after M&As are completed. On the contrary, the median value for the change of ΔCoVaR is negative (-0.0892). Moreover, change of ΔCoVaR (20.5379) has considerably higher the standard deviation than change in MES (0.0101) and change of LTD (0.0329), indicating that change of ΔCoVaR is much more volatile than the other two systemic risk measures. The natural log of total asset has a relatively high standard deviation and large range, showing that the acquirers' size varies dramatically in our sample. The range of total assets for all acquirers is extremely large ($1.47*10^7$ – 370.8). Surprisingly, the minimum values of equity-to-asset ratio and return on asset are negative. The average Tier 1 capital ratio is 9.15%, is much greater than that Basel Ⅲ requires (i.e. how much). The minimum value of non-interest income/total income is negative (-0.2286), indicating a hefty non-interest loss; on the contrary, another acquire has 86% of its total income from non-interest income. Similarly, all acquirers have varied asset diversity (minimum 0.0976 and maximum 0.9943) and Z-score (minimum -1.2872 and maximum 341.15). With regard to deal-specific variables, the mean of cross-border is approximately equal to 0.6, showing that more than half of the deals are cross-border. On the contrary, the mean of geographic diversification is only 0.1304, revealing that both acquirers and targets of about 87% of deals come from Europe. Not surprisingly, the mean of systemic important is 0.5723, demonstrating that more than half of the acquirers are recognized as systematic

Table 3-1 Descriptive Statistics for data used in model specifications

Variable	Obs.	Mean	Median	S.D.	Min.	Max.
Dependent variables						
Change of MES	320	0.0024	0.0017	0.0101	-0.0472	0.0429
Change of ΔCoVaR	315	4.0609	-0.0892	20.5379	-52.2836	168.43
Change of LTD	306	0.0026	0.0067	0.0329	-0.1713	0.0813
Bank-specific variables						
Price-to-book ratio	305	1.8747	1.6600	1.2280	-1.9800	9.4600
Total assets (Mil .Euro)	322	447987	129010	1251223	370.8	$1.47*10^7$
Natural log of total assets	322	5.0466	5.1106	0.8127	2.5691	7.1683
Liquid asset/total deposit and borrowing	322	0.2487	0.2150	0.1611	0.0309	0.8428
Equity-to-asset ratio	322	0.0642	0.0604	0.0329	-0.033	0.1946
Return on asset	322	0.0088	0.0079	0.0133	-0.0467	0.1092
Non-interest income/total income	314	0.4184	0.3985	0.1789	-0.2286	0.8602
Non-performing loan ratio	306	0.0538	0.0348	0.0675	0.0018	0.5100
Short-term debt/total liability	321	0.6514	0.6621	0.1878	0.0089	0.9900
Tier 1 capital ratio	308	0.0915	0.0830	0.0321	0.0200	0.2898
Asset diversity	301	0.6600	0.6740	0.2004	0.0976	0.9943
Z-score	302	23.9729	19.4250	28.1947	-1.2872	341.151
Deal-specific variables						
Cross-border	322	0.6025	1	0.4901	0	1
Geographic diversification	322	0.1304	0	0.3373	0	1
Systemic important	322	0.7733	1	0.4194	0	1
Macroeconomic variables						
Annual real GDP growth rate (%)	317	2.0443	2.3615	2.6484	-8.8637	10.2014
Inflation (%)	317	2.3851	2.3495	1.8755	-2.539	14.7061
Money supply (M2) growth rate (%)	276	7.9354	8.1820	5.5962	-14.1900	48.4212
Industry-specific variables						
CR5(%)	316	52.2347	51.84	17.1714	18.946	98.880
Regulatory and deposit insurance						
Capital regulatory index	322	6.3509	7	1.7377	3	9
Official supervisory power	322	9.9627	10	2.0352	5	13
Deposit insurer power	322	0.8478	1	0.8602	0	3
Moral hazard index	297	1.4781	2	0.5816	0	2
Private monitoring index	295	8.4271	8	0.9797	6	11
Bailout	322	0.6770	1	0.4683	0	1

important banks. Next, all the means, standard deviations and ranges of macroeconomic and industry-specific variables are high because all variables except HHI are presented in percentages while HHI is presented at range of (0-10000). All these variables have very wide range, suggesting that these indicators in different countries vary significantly. For regulatory and deposit insurance variables, capital regulatory index and official supervisory power have high mean values (6.4321 and 10.3102) while deposit insurer power has low mean value (0.8148). The high mean value of capital regulatory index indicates that most EU countries have stringent regulatory systems while the high mean value of official supervisory power demonstrates that banking supervisors in most EU countries have great authorities to supervise banks. Most EU countries have low authorities to decide to intervene in a bank. Finally, the dummy variable BAILOUT has mean value of 0.5892, revealing that most acquirers are bailout recipients in two financial crises. On the other hand, table 3-2 shows the descriptive statistics for data used in Granger-causality tests (see subsection 3.4.4 for more methodological details). There are 113 observations for all financial integration indicators due to (1) all samples are cross-border M&As; (2) all acquirers should come from euro area countries (excluding deals whose acquirers come from UK, Sweden, Denmark, Poland, etc.); (3) data availability of all financial integration indicators. Not surprisingly, all the mean values of change of MES, change of ΔCoVaR and change of LTD are positive, showing that acquirers' systemic risk generally increase after M&As are completed. Change of ΔCoVaR (30.6149) has much greater standard deviation than change of MES (0.0079) and table 3-2 shows the descriptive statistics for data used in Granger-causality tests (see subsection 3.4.4 for more methodological details). There are 113 observations for all financial integration indicators due to (1) all samples are cross-border M&As; (2) all acquirers should come from euro area countries (excluding deals whose acquirers come from UK, Sweden, Denmark, Poland, etc.); (3) data availability of all financial integration indicators. Not surprisingly, all the mean values of change of MES, change of

Table 3-2 Descriptive Statistics for data used in Granger-causality tests

Variable	Obs.	Mean	M.d.	S.D.	Min.	Max.
Dependent variables						
Change of MES	113	0.0037	0.0028	0.0079	-0.0169	0.0351
Change of ΔCoVaR	113	6.3147	0.2036	30.6149	-214.47	168.43
Change of LTD	113	0.0116	0.0125	0.0344	-0.1713	0.1866
Banking market integration indicators						
Interest rates differences on new loans to euro area non-financial corporations (%)						
Distressed vs. non-distressed countries (IRDIFFERENCE1) (1)	113	0.8173	0.6774	0.4333	0.4458	2.552
Distressed vs. euro area average (IRDIFFERENCE4) (4)	113	0.4568	0.4043	0.2053	0.2432	1.3120
Euro area average vs. non-distressed (IRDIFFERENCE5) (5)	113	0.3607	0.2710	0.2325	0.2024	1.24
Interest rates difference on MFI deposits for households in the euro area (%)						
Full range across countries (max. – min.) (IRDIFFERENCE2) (2)	113	1.8133	1.6729	0.5048	1.2656	3.3525
Interquantile (3^{rd}.q- 1^{st}. q) (IRDIFFERENCE3) (3)	113	0.5403	0.5528	0.1143	0.2408	0.8277
Cross-country standard deviation of MFI interest rates on loans to non-financial corporations and households (basis points)						
Floating rate and up to 1 year initial rate fixation (IRF), up to EUR 1 million (DISPERSION2) (6)	113	48.62	44.64	18.4179	31.5104	132.6137
Floating rate and up to 1 year IRF, over EUR 1 million (DISPERSION5) (9)	113	30.39	26.49	11.6811	22.0213	75.9859
Consumer credit, over 1 year and up to 5 Year IRF (DISPERSION3) (7)	113	117.62	116.02	22.7752	86.8699	178.974
House purchase, floating rate and up to 1 year (DISPERSION6) (10)	113	33.57	29.65	8.8866	25.9672	62.3227
House purchase, over 5 years and up to 10 years (DISPERSION4) (8)	113	34.88	32.94	8.7507	25.2518	67.4132

ΔCoVaR (30.6149) has much greater standard deviation than change of MES (0.0079) and change of LTD (0.0344), revealing that change of ΔCoVaR is much more volatile than change of MES and change of LTD. For all interest rates differences on new loans to euro area non-financial corporations, the mean values, standard deviations and ranges are not extremely high. For interest rates difference on Monetary Financial Institution (MFI, is defined as financial institution whose major businesses are to take deposits from and to grant loans to other financial institutions) deposits for households in the euro area, as expected, all these values for inter-quantile are much less than those for full range across countries. In all five indicators of cross-country standard deviation of MFI interest rates on loans to non-financial corporations and households, consumer credit indicator (DISPERSION3) has both highest mean and standard deviation, indicating that the interest rate for consumers is higher and more volatile than interest rates for house buyers and corporate clients across euro area countries. For interest rates difference on MFI deposits for households in the euro area, as expected, all these values for inter-quantile are much less than those for full range across countries.

Table 3-3 presents correlation coefficients among systemic risk measures and independent variables. First, all three changes of systemic risk measures have weak correlations with all independent variables, indicating that endogeneity problem is less likely to exist in the baseline models. Second, all three changes of systemic risk measures have weak correlations with each other, showing that they are to some extent heterogeneous. Third, ROA has high correlations with other balance sheet-related (such as price-to-book ratio, natural log of total asset, equity-to-asset ratio and short-term debt ratio) and macroeconomic (such as GDP, inflation rate and money supply growth rate) variables. This is because ROA is correlated to bank's assets, liabilities and equities and can be affected by macroeconomic conditions. Fourth, natural log of total asset has high correlation with some bank-specific variables (such as liquidity ratio, equity-to-asset ratio, return on asset, short-term debt ratio) and regulatory

variables (such as deposit insurer power, private monitoring index, capital regulatory index and bailout). This is because large banks may have different accounting ratios from medium and small banks and are more likely to be subject to more banking regulations. These results may indicate multicollinearity problem in the baseline models. In order to test if the multicollinearity problem exists in baseline models, we calculate Variance Inflation Factor (VIF) for all variables. We find the VIFs for all variables are less than 10, and the average VIF of the baseline model is 1.78. These results indicate no multicollinearity exists in the baseline models.

Table 3-3 Correlation Coefficients among Systemic Risk Measures and Independent Variables

	ΔMES	ΔLTD	Δ (ΔCoVaR)	PB	lnTA	LIQ	EA	ROA	NPL	Short-term debt	TIER1	Non-interest	Cross-border	GEO
ΔMES	1.0000													
ΔLTD	0.1148***	1.0000												
Δ(ΔCOVaR)	0.2699***	-0.0064**	1.0000											
PB	0.0689	-0.0433	0.1182	1.0000										
lnTA	0.1580***	0.1865**	-0.0478**	-0.5565***	1.0000									
LIQ	0.0128	0.0701*	-0.0498	-0.2521	0.4737***	1.0000								
EA	-0.0788**	-0.0186*	0.0671	0.2096***	-0.4454***	-0.3346	1.0000	**ROA**						
-0.0937	0.0519	0.0461	0.5389***	-0.6000***	-0.3130	0.5692***		1.0000						
NPL	-0.0402	0.0307	-0.0739	-0.1857***	0.0205***	0.0013	0.3562***	-0.1800***	1.0000					
Short-term	0.0196	-0.1221	0.1029	0.3749*	0.5444***	0.4789***	0.4597***	0.5728*	0.0602***	1.0000				
TIER1	0.0418	0.1063	-0.0070	-0.0546***	-0.0297***	0.0389	0.6291***	0.0836	0.4894***	0.1578***	1.0000			
Non-interest	-0.1283	0.0686**	-0.0210	-0.0112	0.1832***	0.3922***	-0.2793*	-0.1456***	-0.0962***	-0.2979**	-0.2841***	1.0000		
Cross-border	0.0375*	-0.0029***	0.0405**	0.0292	0.1241***	0.0310***	-0.0182**	0.0467	0.0880***	-0.0177	0.0724***	-0.0873***	1.0000	
GEO	0.0891	0.0743	-0.0501	-0.0823	0.1269***	-0.2050	-0.0780	-0.0900	-0.0497	0.0072	0.0599	-0.0574**	0.0481***	1.0000

Note: *** ** * indicate the correlation coefficient is significant at 1%,5% and 10% significance level.

Table 3-3 Correlation Coefficients among Systemic Risk Measures and Independent Variables (Continued)

	ΔMES	ΔLTD	Δ (ΔCoVaR)	PB	lnTA	LIQ	EA	ROA	NPL	Short-term debt	TIER1	Non-interest	Cross-border	GEO
Zscore	-0.0099	0.0681	-0.0670	-0.1422	-0.0449	-0.0968	-0.0498	-0.0222	-0.0855**	-0.1020	-0.1160	0.0015	-0.1799	0.0145
Systematic	0.1455	0.0660	0.0959**	-0.0125*	0.2708***	0.1351*	0.0099****	0.0640	0.0927**	0.2174*	0.0932***	0.0050	0.4373***	0.1100*
GDP	0.0732	-0.1130	0.0414	0.5476***	-0.2205	0.0785***	0.0795***	0.5183***	0.2473***	0.2700	-0.0667***	0.0257***	0.0818***	-0.0820
Inflation	0.0610	0.0625	0.0994	0.4415***	-0.3322***	-0.0239***	0.1412***	0.5329***	-0.1860***	0.2342	-0.0850	0.0411**	-0.0577	-0.0860
Moneysupply	0.2314	-0.1808	0.1747	0.4143	-0.1814	0.2641	0.0292	0.2421	-0.0320	0.0642	-0.0344	0.1330	0.0127	-0.0912**
CR5	-0.0723	-0.1021	0.1668**	0.2729	-0.3092***	0.0577*	-0.0530	0.1236	-0.2439***	0.2822***	-0.0440***	0.0751***	-0.1139	-0.1541***
Deppower	0.0026	0.1547*	0.0057	-0.1782	0.4099***	0.3737*	-0.3824***	-0.2378	-0.1437	-0.1392	0.0398	0.1320	0.1336***	0.2557***
REG	0.1386	0.2404	0.0704	-0.1552*	0.4240*	0.4028	-0.3286	-0.2670	-0.0489***	-0.1489	0.0308	-0.0408	0.1951*	0.0609**
SUP	0.1752	0.1161	-0.0116	-0.2583*	0.2149	0.0641*	-0.0014	-0.1358**	0.0977	-0.2454***	-0.1484***	0.1864**	-0.0968*	-0.2566***
Moralhazard	0.0696	0.0381	0.1250	0.0844***	0.1794	0.2983***	-0.0767	-0.2054	0.0909*	-0.3791***	0.0469	0.1408	-0.0768	-0.0934***
Monitoring	0.0617	-0.0045	-0.0925	-0.2021**	0.5409***	0.5511***	-0.4082*	-0.3363	0.0236	-0.2540	-0.0240	0.2703**	0.2560***	0.1465***
Diversity	-0.0529*	-0.1306	-0.1314	-0.0194*	0.1405**	-0.1032	-0.2592***	-0.1381	-0.2968**	-0.0309**	-0.1631	0.0383	-0.0239	-0.0524
Bailout	-0.0954	0.1835	0.0874	-0.0820*	0.3882***	0.1121	-0.1503***	-0.3669	0.0968	-0.1173***	-0.0383***	0.2183	-0.0301	-0.0846
IRDIFF1	-0.1052	0.0673	-0.1884**	-0.4542***	-0.0872	-0.2632***	0.1452	-0.1654**	0.3172*	0.1281	0.2912***	-0.2967***	-0.0057	0.1212

Note: *** ** * indicate the correlation coefficient is significant at 1%,5% and 10% significance level.

Table 3-3 Correlation Coefficients among Systemic Risk Measures and Independent Variables (Continued)

	Zscore	Systemic	GDP	Inflation	Moneysupply	CR5	Deppower	REG	SUP	Moralhazard	Monitoring	Diversity	Bailout	IRDIFF1
Zscore	1.0000													
Systematic	-0.2861*	1.0000												
GDP	-0.1118	0.1218	1.0000											
Inflation	-0.0093	-0.0139	0.5186***	1.0000										
Moneysupply	-0.1124	0.1328	0.5125	0.5186	1.0000									
CR5	-0.1792***	-0.0426	0.2022*	0.1511	-0.0424	1.0000								
Deppower	-0.2715*	0.3054***	-0.0270	-0.0493	-0.1663	0.2709*	1.0000							
REG	-0.3237	0.2588**	-0.0161	-0.0051*	-0.0783	0.2458*	0.7318***	1.0000						
SUP	0.3119**	-0.0891***	-0.1179**	0.0389	0.0403	-0.4500***	-0.5131***	-0.3035**	1.0000					
Moralhazard	-0.4477***	-0.1757	-0.0097	0.0121	0.0333	-0.0039	0.1628	0.2824	-0.1916*	1.0000				
Monitoring	-0.2268	0.3601***	-0.0472*	-0.1755	0.1501	-0.1481***	0.6428***	0.4973***	-0.2589***	0.1057***	1.0000			
Diversity	-0.1642**	-0.0574	0.0525**	-0.2160	-0.1014	0.0499	0.1544	0.0214**	0.0035	-0.2344**	0.1474	1.0000		
Bailout	-0.0755**	0.1120***	-0.1883**	-0.2898***	-0.2018	0.0611	0.1346***	0.2938***	0.1421***	0.1582***	0.1998	0.0799	1.0000	
IRDIFF1	0.1123	0.0100	-0.5139***	-0.3548***	-0.5871***	-0.0579	0.1691**	0.0821*	-0.1784	-0.2787***	0.0600	-0.0523*	0.0100***	1.0000

Note: *** ** * indicate the correlation coefficient is significant at 1%,5% and 10% significance level.

3.5 Empirical Methods

3.5.1 Systemic Risk

For answering research question 1, the acquirers' systemic risk changes of bank M&As will be calculated as, the difference between acquirers' post-merger (as in Acharya et al. (2010), Adrian and Brunnermeier (2011) and Weiss et al. (2014)) and pre-merger systemic risk measures. Specifically, first, calculate marginal expected shortfall (MES) by following Acharya et al. (2010) and Weiss et al. (2014) define marginal expected shortfall as how an individual bank's risk taking contributes to banking system's overall risk. They realize

bank *i*'s MES as the mean net equity loss of the bank during the worst 5% banking index's returns as described in equation (1):

$$MES_i^{5\%} = -\,E\left[\frac{W1}{W0} \mid I5\%\right] \tag{3.1}$$

where W1 and W0 are market values at end and beginning of period, respectively.

Specifically, Acharya et al. (2010) and Weiss et al. (2014) estimate bank *i*'s MES by calculating the average log returns on the bank's stocks conditional on those days that the market experienced downward movements in $[T_1,T_2]$ in equation (2):

$$MES^{5\%}_{i:[T1,T2]} = \frac{1}{\#days\ in\ [T1,T2]} * \Sigma_{t:\ \text{system is in its 5\% tail}} R^i_t \tag{3.2}$$

where R^i_t is the return on bank *i*''s stock return at time t. In this study we will adopt Weiss et.al. (2014) to calculate acquirers' change of MES in equation (3):

$$\Delta MES_i^{5\%} = MES^{5\%}_{i:[+11,+180]} - MES^{5\%}_{i:[-180,-11]} \tag{3.3}$$

where $\Delta MES_i^{5\%}$ is acquirer *i*'s systemic risk change in 5% significance level, $MES^{5\%}_{i:\,[+11,\,+180]}$ is acquirer *i*'s MES between 11 days and 180 days after deal completion in 5% significance level, $MES^{5\%}_{i:\,[-180,\,-11]}$ is acquirer *i*'s MES between 180 days and 11 days prior to deal announcements in 5% significance level.

Second, we follow Schmidt and Stadtmuller (2006) and Weiss et al. (2014) to compute lower

tail dependence (LTD). Nelsen (2006) defines lower dependence tail coefficient as the probability that both bank's stock return and banking index's return lie in the extreme tail jointly: $LTD_{1,2:} = (X_1,X_2) = \lim_{n\to\infty} P(X_2 \leq F^{-1}{}_2(u) | X_1 \leq F^{-1}{}_1(u))$ (3.4)

Schmidt and Stadtmuller (2006) use non-parametric method to calculate the tail copula function in equation (3.5):

$$\Lambda_L(x,y): = \lim_{t\to\infty} tC(x/t, y/t) \quad (3.5)$$

They also define lower tail dependence coefficient as follows:

$$LTD_{1,2} = \Lambda_L(1,1) \quad (3.6)$$

They first employ GARCH (1,1) model and Maximum-likelihood Estimation with t-distribution to compute the residuals for acquirers' and banking index's log returns ($X^{(1)}; Y^{(1)}$), ($X^{(2)}; Y^{(2)}$) …($X^{(m)}; Y^{(m)}$). They also suppose the two time-series are independent and identically distributed (i.i.d.) random vectors with distribution function F having marginal distribution functions G, H and Copula C. Then they let C_m denote the empirical copula by equation (7):

$$C_m(u,v) = F_m(G^{-1}{}_m(u), H^{-1}{}_m(v)), (u,v)' 0[0,1]^2 \quad (3.7)$$

where F_m, G_m and H_m are empirical distributions corresponding to F, G, H.

Moreover, let $R_{m1}^{(j)}$ and $R_{m2}^{(j)}$ $(j = 1,2,...m)$ denote the rank of the observations $X^{(j)}$ and $Y^{(j)}$ in the sample. They finally define a non-parametric estimator for the lower tail copula in equation (8):

$$\widehat{\lambda}_L(x,y) := \frac{m}{k} C_m\left(\frac{kx}{m}, \frac{ky}{m}\right) \approx \frac{1}{k} \sum_{j=1}^{m} 1 \quad (3.8)$$

with some parameter k 0{$1,2,...m$} to be chosen by the use of plateau-finding algorithm. Frahm et al. (2005) describe the plateau-finding algorithm in two steps. First, the map $k \to \hat{\lambda}_k$ is smoothed by a simple box kernel with bandwidth b 0N, the means of $2b + 1$ successive points of $\hat{\lambda}_1, \ldots \hat{\lambda}_n$ lead to the new smoothed map $\bar{\lambda}_1 \ldots \bar{\lambda}_{n-2b}$, b = $\lfloor 0.005n \rfloor$ such that each moving average consists of approximately 1% of the data. In the second step, a plateau of length m =

$\lfloor\sqrt{n-2b}\rfloor$ is defined as a vector $p_k = (\bar{\lambda}_k \ldots, \bar{\lambda}_{k+m-1})$, $k = 1, \ldots, n-2b-m+1$. The algorithm stops at the first plateau p_k which elements fulfil the condition

$$\sum_{i=k+1}^{k+m-1} \left|\bar{\lambda}k - \bar{\lambda}1\right| \leq 2\sigma \tag{3.9}$$

where σ represents the standard deviation of $\bar{\lambda}_1 \ldots \bar{\lambda}_{n-2b}$. Then the LTD estimate is set to

$$LTD_{1,2} = \hat{\lambda}_L(k) = \frac{1}{m}\sum_{i=1}^{m} \bar{\lambda}k + i - 1 \tag{3.10}$$

Therefore, this chapter will follow Weiss et.al. (2014) to calculate acquirers' change of LTD as follows:

$$\Delta LTD_i^{5\%} = LTD^{5\%}_{i:[+11,+180]} - LTD^{5\%}_{i:[-180,-11]} \tag{3.11}$$

where $\Delta LTD_i^{5\%}$ is acquirer *i*'s systemic risk change in 5% significance level, $LTD^{5\%}_{i:[+11,+180]}$ is acquirer *i*'s LTD between 11 days and 180 days after deal completion in 5% significance level, $LTD^{5\%}_{i:[-180,-11]}$ is acquirer *i*'s MES between 180 days and 11 days prior to deal announcements in 5% significance level.

Similar to chapter 2, the linear panel data models will be used in this chapter. The results of Hausman test show that test statistic is 131.38, which is much greater than the critical value, and the p-value is 0.0000. Therefore, the null hypothesis is rejected and fixed-effect model is preferred.

Third, in this study we will follow Adrian and Brunnermeier (2011) to compute Conditional Value at Risk (CoVaR) and ΔCoVaR. They define $CoVaR^{j|i}_q$ the of institution j (or financial system) conditional on some event $C(X^i)$ of institution *i*. $CoVaR^{j|i}_q$ is defined by the q-quantile of the conditional probability distribution:

$$\Pr(X^j \leq CoVaR_q^{j|C(Xi)} \mid C(X^i)) = q \tag{3.12}$$

They denote institution *i*'s systemic risk contribution institution *j* (or financial system) by

$$\Delta CoVaR^{j|i}_q = CoVaR_q^{j|Xi=VaR\ i(q)} - CoVaR_q^{j|Xi=\text{Median } i(q)} \tag{3.13}$$

$$\Delta CoVaR^{j|system}_q = CoVaR_q^{j|system=VaR(q)} - CoVaR_q^{j|system=Median(q)} \tag{3.14}$$

$\Delta CoVaR^{j|system}_q$ denotes the difference between the VaR of institution *i* conditional on the

distress of the financial system and the VaR of institution *i* conditional on the median state of the financial system on qth-quantile. $\Delta CoVaR^{j|system}_{q}$ indicates institution *j*'s increase in value-at-risk in the case of financial crisis and measures the extent to which an individual institution is affected by systemic financial events.

Next, in order to analyze the risk effects on acquirers, after we have calculated the acquirers' systemic risk changes after M&As, we divide the full sample into several different sub-samples based on different bank-specific and deal-specific characteristics (e.g. crisis, geographic diversification and bank size) and conduct t-tests to statistically verify whether acquirers' systemic risk increase significantly after M&As. We conduct one-sample t-tests to examine (1) whether financial crises have negative impacts on acquirers' systemic risk after M&As; (2) whether acquirers in cross-border and domestic deals increase systemic risk significantly after M&As; and (3) whether large acquirers (total asset > €500 billion), medium acquirers (€50 billion < total asset < €500 billion) and small acquirers (total asset < €50 billion) increase systemic risk significantly after M&As. We also conduct two-sample t-tests to investigate whether (1) the U.S. Subprime Crisis and the European Sovereign Debt Crisis have more significant negative impact on acquirers (i.e. increase acquirers' systemic risk more significantly); and (2) acquirers in cross-border deals have more significant systemic risk.

Firstly, the full sample will be divided into three sub-samples as described in subsection 3.3.2; secondly, the acquirers' average of change of MES, ΔCoVaR and LTD will be calculated; thirdly, for each average systemic risk change, one-sample t-test will be used to test whether acquirers' average change of each systemic risk measure in each subsample significantly negative, significantly positive or insignificant; fourthly, (1) the difference between the average change of each systemic risk measure in the U.S. Subprime Crisis and the average change of each systemic risk measure in non-crisis subsample and (2) the difference between the average of each systemic risk measure in European Sovereign Debt Crisis and the average change of

each systemic risk measure in non-crisis subsample, will be computed, and finally, two-sample mean-comparison t-tests using variables will be employed to further test whether the average systemic risk changes in the U.S. Subprime Crisis and the European Sovereign Debt Crisis are significantly lower than the average systemic risk changes in the non-crisis subsample.

The null and alternative hypotheses of one-sample t-test for average systemic risk changes are:

H_0: mean (systemic risk change) = 0 , H_1: mean (systemic risk change) < 0 (3.15)

H_0: mean (systemic risk change) = 0 , H_1: mean (systemic risk change) > 0 (3.16)

If the t-statistics is greater than the critical value or p-value is less than the critical value, the null hypothesis should be rejected, thus the average systemic risk change in each subsample is significantly different from 0. Furthermore, if the null hypothesis in (3.15) is rejected, the systemic risk change in each subsample is significantly lower than 0, indicating acquirers' lower systemic risks after M&As; if the null hypothesis in (3.16) is rejected, the average systemic risk change in each subsample is significant higher than 0, indicating acquirers' higher systemic risks after M&As. If neither null hypothesis in (3.17) and (3.18) is rejected, the acquirers' average systemic risk changes in each subsample do not change significantly.

The null and alternative hypotheses of two-sample mean-comparison t-test for average systemic risk changes are:

H_0: mean (US Subprime Crisis systemic risk change) – mean (non-crisis systemic risk change) = 0

H_1: mean (US Subprime Crisis systemic risk change) – mean (non-crisis systemic risk change) < 0 (3.17)

H_0: mean (US Subprime Crisis systemic risk change) – mean (non-crisis systemic risk change) = 0

H_1: mean (US Subprime Crisis systemic risk change) – mean (non-crisis systemic risk

change) > 0 (3.18)

H_0: mean (European Sovereign Debt Crisis systemic risk change) – mean (non-crisis systemic risk change) = 0

H_1: mean (European Sovereign Debt Crisis systemic risk change) – mean (non-crisis systemic risk change) < 0 (3.19)

H_0: mean (European Sovereign Debt Crisis systemic risk change) – mean (non-crisis systemic risk change) = 0

H_1: mean (European Sovereign Debt Crisis systemic risk change) – mean (non-crisis systemic risk change) > 0 (3.20)

If the t-statistics is greater than the critical value or p-value is less than the critical value, the null hypothesis should be rejected, thus the average systemic risk changes in the U.S. Subprime Crisis and non-crisis periods are significantly different. If the null hypothesis in (3.17) is rejected, the average systemic risk change in the U.S. Subprime Crisis is significantly lower than the average systemic risk change in non-crisis period, indicating the U.S. Subprime Crisis has positive impacts on acquirers' systemic risks after M&As; if the null hypothesis in (3.18) is rejected, the average systemic risk change in the U.S. Subprime Crisis is significantly higher than the average systemic risk change in non-crisis period, indicating the U.S. Subprime Crisis has negative impacts on acquirers' systemic risks after M&As. If neither null hypothesis in (3.17) and (3.18) is rejected, the U.S. Subprime Crisis does not have significant impacts on acquirers' systemic risks after M&As.

Similarly, if the t-statistics is greater than the critical value or p-value is less than the critical value, the null hypothesis should be rejected, thus the average systemic risk changes in the European Sovereign Debt Crisis and non-crisis periods are significantly different. If the null

hypothesis in (3.19) is rejected, the average systemic risk change in the European Sovereign Debt Crisis is significantly lower than the average systemic risk change in non-crisis period, indicating the European Sovereign Debt Crisis has positive impacts on acquirers' systemic risks after M&As; if the null hypothesis in (3.20) is rejected, the average systemic risk change in the European Sovereign Debt Crisis is significantly higher than the average systemic risk change in non-crisis period, indicating the European Sovereign Debt Crisis has negative impacts on acquirers' systemic risks after M&As. If neither null hypothesis in (3.19) and (3.20) is rejected, the European Sovereign Debt Crisis does not have significant impacts on acquirers' systemic risks after M&As. The similar t-test procedures will be conducted for cross-border/domestic subsamples and large/medium/small subsamples.

To conduct research question 3, that is, to identify the main determinants of acquirers' systemic risk changes after M&A operations, the following fixed-effect models will be used: $\Delta SYS_{it} = \alpha + \beta 1 * lnTA_{it} + \beta 2 * Bailout_{it} + \beta 3 * BS_{it} + \beta 4 * DS_{it} + \beta 5 * IS_{it} + \beta 6 * Macro_{it} + \beta 7 * Regulat_i + (\mu_i + v_{it})$ (3.21)

where ΔSYS_{it} is change of systemic risk measures (i.e. MES, ΔCoVaR, LTD) for acquirer i at time t (i = 1,2,3…N; t = 1,2,3,…T); $lnTA_{it}$ is acquirers' natural log of total asset, $Bailout_{it}$ is a dummy variable that is 1 if acquirers are bailout recipients and 0 if acquirers are not bailout recipients; BS_{it} is a vector of bank-specific variables (including liquidity ratio, leverage ratio, performance, asset quality, debt ratio, capital ratio, income diversity, asset diversity, insolvency risk and valuation); DS_{it} is a vector of deal-specific variables (geographic diversification, cross-border, systematic importance); IS_{it} stands for a vector of industry-specific/structural variables (CR5, HHI); $Macro_{it}$ is a vector of macroeconomic variables (GDP growth rate, inflation and broad money supply M2 growth rate); and $Regulat_i$ is a vector of regulatory variables (capital regulatory index, overall supervisory index and deposit insurer power, moral hazard index, private monitoring index) for country i. Of all variables, the main variables are natural log of

total assets, bailout, asset diversity and non-performing loan/total loan while other variables are treated as control variables.

3.5.2 Principal Component Analysis

Additionally, as we did in the previous chapter, to select some most important financial integration indicators, we will also use principal component analysis (PCA) in this chapter . According to Jollife (1986) and Rabe-Hesketh and Everitt (2007), Principal Component Analysis, originally introduced by Pearson (1901) and Hotelling (1933), has the central idea to reduce the dimentionality of a dataset which consists of a large number of inter-correlated, while retaining as much as possible of the variation in the data set. Van Belle et al. (2004) define the first, second, third… and the kth principal components and point out that for each k, the first k principal components explain as much of the variability in a sample as may be explained by any *k* directions or *k* variables. Based on these ideas, we will use PCA to select several principal components that can explain most amount of variability in the dataset thus to reduce the number of banking integration indicators from 10 to a smaller number e will follow Jolliffe's (1986) rule to determine the number of principal components. In his book *Principal Component Analysis*, he listed four types of rules to select the number of principal components and pointed out that the most obvious criterion is to select a cumulative percentage (i.e. 80% or 90%) of total variation it is desired that the principal components should contribute. Specifically, formula to calculate the percentage of variation contributed by the first *k* PCs is

$$t_k = 100\sum_{j=1}^{k} l_j \Big/ \sum_{j=1}^{p} s_{jj} = 100\sum_{j=1}^{k} l_j \Big/ \sum_{j=1}^{p} l_j \qquad (3.22)$$

Then we need to choose a cut-off, t^*, between 70% and 90% of total variation and keep the smallest number for *k*, that is *m*, for which $t_k > t^*$. The first *m* PCs can provide most information in a vector of variables. This chapter will also follow Rabe-Hesketh and Everitt (2007) to present the process of PCA by using Stata. All the results will be presented and discussed in the following section of Discussion of Results (section 3.5).

3.5.3 Systemic Risk and Financial Integration

Furthermore, to examine the relationship between acquirers' systemic risk changes and banking integration indicators, this chapter will employ the following fixed-effect model

$$\Delta SYS_{it} = \alpha + \beta 1 * lnTA_{it} + \beta 2 * Bailout_{it} + \beta 3 * FI_{it} + \beta 4 * BS_{it} + \beta 5 * DS_{it} + \beta 6 * IS_{it} + \beta 7 * Macro_{it} + \beta 8 * Regulat_{i} + (\mu_i + v_{it}) \quad (3.23)$$

where FI_{it} is a financial integration indicator in European banking market. Of all variables, main variables are financial integration indicator in banking market, natural log of total assets, bailout, asset diversity and non-performing loan/total loan while other variables are treated as control variables.

With regard to the banking integration indicators, some indicators from ECB report *Financial Integration in Europe* and the corresponding data from ECB website will be used. Specifically, the activity-based and price-based indicators, including interest rates on new loans to euro area non-financial corporations, interest rates on MFI deposits for households in the euro area, cross-country standard deviation of MFI interest rates on new loans to non-financial corporations and households, will be employed. The first two indicators are activity-based and the last two indicators are price-based. The lower the interest rates with the significant level of convergence across countries (lower interest rates difference across countries) indicate higher degree of integration. Therefore, for the first two indicators, the difference between average interest rates for distressed countries and for non-distressed countries and the full range difference across countries (max minus min) will be calculated. In addition, the lower cross-country standard deviations of interest rates indicate higher degree of integration. Consequently, for the last two indicators, the original time series are kept as the integration indicators. Although there are at least two time-series for each indicator, only one or two time-series are selected. According to the announcement date of M&A, the monthly data of all selected banking integration indicators for all eligible deals (those deals whose acquirers come from 10

euro areas countries in distressed and non-distressed countries) will be employed.

3.5.4 Granger-causality Test

The significance of coefficients of banking integration indicators does not necessarily indicate the causal relationships between change of systemic risk and financial integration indicators. In order to investigate whether they have causal relationships, we will also employ the Granger-causality tests in this chapter. Brooks (2008) defines that the Granger-causality test is a statistical hypothesis test for determining whether one time series is useful in forecasting another. He also describes that Granger-causality tests seek to answer questions such as "Do changes in the first variable cause changes in the second variable?" If the first variable causes the second variable, then lags of the first variable should be significant in the equation for the second variable. If this is the case, we say that the first variable "Granger-causes" the second variable. If the second variable causes the first variable, lags of the second variable should be significant in the equation for the first variable. If both sets of lags are significant, there is "bi-directional causality". If neither the second variable causes the first variable, nor the first variable causes the second variable, then they are independent. We will adopt these rules to determine whether the systemic risk has causal relationship with banking integration indicator.

3.5.5 Propensity Score Matching

We follow Weiss et.al (2014) to use propensity score matching as robustness check to provide further evidence to support the hypothesis that acquirers' systemic risk increase significant after M&As. We examine the hypothesis by building a control group of non-merging banks and estimate the changes in the non-merging banks' MES, LTD and ΔCoVaR around mergers. We first match the combined banks with non-merging banks based on the merging banks' pre-merger total assets and market-to-book ratio; secondly, we match each acquiring bank in the post-merger to a non-merging bank based on post-merger total assets and market-to-book ratio; thirdly, the propensity score on total assets and market-to-book ratio via probit model and

retrieve the predicted probability; and fourthly, we use nearest-neighbor matching: treated merging bank is matched to non-treated non-merging bank such that

$$| p_{merging} - p_{non\text{-}merging} | = min \{ | p_{merging} - p_k | \} \quad (3.24)$$

and finally we calculate MES, LTD, and ΔCoVaR of $acquirer_{pre\text{-}merger}$, $combined_{pre\text{-}merger,}$ $combined_{post\text{-}merger}$ for merging banks and non-merging banks.

3.6 Discussion of Results

3.6.1 Acquirers' Systemic Risk Changes after M&As

To investigate whether systemic risk increased or decreased significantly after the bank M&As, we first compute the acquirers' average changes of all three systemic risk measures after bank M&As. The results in table 3-4 demonstrate that all three systemic risk measures increase significantly after M&As for all acquirers. Evidence shows that the average change of acquirers' MES is statistically significant at 1% significance level and on average, acquirers increase MES by approximately by 0.24% after M&As. Similarly, on average, acquirers increase LTD by about 0.26% after M&As. Finally, the average change of acquirers' ΔCoVaR is 4.0609 and is statistically significant at 1% significance level. It shows that on average, acquirers increase ΔCoVaR by more than 4 after M&As.

We then additionally calculate the average systemic risk changes for the acquirers' competitors. To do so we select all peer banks in EU 28 countries that do not engage in M&As as competitors. We find that both MES and LTD of competitors increase significantly while change of ΔCoVaR increases insignificantly. Furthermore, we conduct t-tests of mean difference between acquirers and their competitors for all three systemic risk measures and all results are acquirers and their competitors for all three systemic risk measures and all results are insignificant. These results demonstrate that both acquirers and their competitors suffer the same extent from the increase in systemic risk.

Table 3-4 Systemic Risk Changes after M&As

	Change of MES	Change of LTD	Change of ΔCoVaR
Acquirers	0.0024*** (0.0000)	0.0026* (0.0837)	4.0609*** (0.0003)
Acquirers' competitors	0.0032*** (0.0021)	0.0051* (0.0879)	3.7662 (0.8537)
Acquirers vs. competitors	-0.0008 (0.7334)	-0.0025 (0.7268)	4.0048 (0.4687)
M&A deals in crisis period vs. deals in non-crisis period	0.0040*** (0.0009)	0.0033 (0.2043)	7.8591*** (0.0024)
M&A deals in the US crisis vs. deals in non-crisis period	0.0061*** (0.0000)	0.0069* (0.0846)	15.6881*** (0.0001)
M&A deals in the European crisis vs. non-crisis period	0.0007 (0.3632)	-0.0226 (0.6590)	4.1134*** (0.0095)

3.6.2 Acquirers' Systemic Risk Changes after M&As Based on Different Characteristics

In order to find whether the U.S. Financial Crisis and the European Sovereign Debt Crisis have significantly negative impacts on acquirers' systemic risks, we then use t-tests of average differences of three systemic risk measures between (1) M&A deals in crisis period and M&A deals in non-crisis period; (2) M&A deals in the U.S. Financial Crisis and M&A deals in non-crisis period; and (3) M&A deals in the European Sovereign Debt Crisis and M&A deals in non-crisis period. These results show that (1) acquirers in crisis period have more significant increase in MES and ΔCoVaR than acquirers in non-crisis period; (2) the U.S. Financial Crisis has much more significantly negative impact on acquirers' systemic risks than the European Sovereign Debt Crisis. Results in table 3-5 provide further evidences for the financial crises have much more significantly negative impacts on acquirers' systemic risks. Acquirers' average MES, LTD and ΔCoVaR increased by 0.49%, 0.39% and 9.0508 in crisis period while they only rose by 0.09%, 0.17% and 1.1917 in non-crisis period. These results demonstrate that

acquirers in crisis period have much higher systemic risk increases

than acquirers in non-crisis period. Therefore, both financial crises have a significant negative impact on banks, but the U.S. financial crisis appears more detrimental than the European Sovereign Debt Crisis. This finding is reasonable because the U.S. Financial Crisis is a global

Table 3-5 Systemic Risk Changes after M&As in Crisis and Non-Crisis Periods

	mean(change of MES)	mean(change of LTD)	Mean(change of ΔCoVaR)
Crisis	0.0049*** (0.0000)	0.0039* (0.0852)	9.0508*** (0.0003)
Non-crisis	0.0009* (0.0598)	0.0017 (0.2226)	1.1917 (0.1271)

crisis while the European Debt Crisis is a regional crisis. The former is more contagious than the later.

We then divide the full sample into several sub-samples and calculate the changes of systemic risk measures after bank M&As to identify some determinants of acquirers' systemic risk changes. Firstly, we calculate the systemic risk changes for acquirers with different sizes.

We divide the full sample into three sub-samples: large banks (assets > €500bn), medium banks (€50bn<assets<€500bn) and small banks (assets< €50bn).

Table 3-6 shows that large acquirers are characterized by significantly greater increases in systemic risk than medium and small acquirers. Large acquirers increased MES, LTD and ΔCoVaR by 0.47%, 0.61% and 6.2338, while medium and small acquirers increased three systemic risk measures by much smaller percentages (small acquirers' LTD even decreased by 0.22%). These results can provide first evidences for larger acquirers will have higher systemic risks after M&As. One possible explanation can be: larger acquirers can merge other banks and become even larger and "too-big-to-fail" (TBTF). This enables them to exploit safety-net subsidies and creates moral hazard problem. Therefore, our evidence seems

Table 3-6 Systemic Risk Changes for Banks with Different Sizes

	mean(change of MES)	mean(change of LTD)	Mean(change of ΔCoVaR)
Large banks (Assets > €500bn)	0.0047*** (0.0001)	0.0061** (0.0447)	6.2338*** (0.0058)
Medium banks (€50bn - €500bn)	0.0028*** (0.0010)	0.0039* (0.0812)	3.0982** (0.0127)
Small banks (Assets < €50bn)	0.00001 (0.4939)	-0.0022 (0.7244)	3.8546* (0.0772)

to suggest that larger acquirers will take more risks and contribute higher systemic risks to the banking system.

Next, we compute the average changes of acquirers' systemic risks in cross-border and domestic M&A deals and the average differences of acquirers' systemic risk changes between cross-border and domestic deals. Table 3-7 reports acquirers' changes of all three systemic risk measures in cross-border and domestic M&As. We find that acquirers in cross-border

Table 3-7 Systemic Risk Changes for Cross-border and Domestic M&As

	mean(change of MES)	mean(change of LTD)	Mean(change of ΔCoVaR)
Cross-border	0.0032*** (0.0000)	0.0065*** (0.0047)	6.1858*** (0.0001)
Domestic	0.0011* (0.0994)	-0.0036 (0.1071)	0.7205 (0.2932)
Cross-border Vs. domestic	0.0021** (0.0312)	0.0101*** (0.0035)	5.4653*** (0.0054)

deals have much more significant systemic risk increases than acquirers in domestic deals. For cross-border M&As, diversification benefits can be partly offset by shifts to higher-risk portfolio and/or greater operational risks, then acquirers in cross-border M&As may have more significant systemic risk increases than acquirers in domestic M&As. On the contrary, Weiss

et. al. (2014) finds that acquirers in domestic M&As more significant systemic risk increases than acquirers in cross-border M&As. Our findings are different from those in Weiss et.al. (2014) and we believe that this could be possibly due to the fact that: (1) there are more cross-border M&As in EU countries while more domestic M&As in North America; (2) acquirer's bank size in EU countries is generally much larger than acquirer's bank size in North America. Finally, we investigate whether acquirers in periphery countries have higher systemic risk increases than acquirers in core countries. Table 3-8 presents acquirers' changes of all three systemic risk measures for M&As in periphery countries and core countries. Surprisingly, we find that acquirers in core countries have much higher systemic risk increases than acquirers in periphery countries. One possible explanation can be that acquirers in core countries may be more interconnected with other banks than acquirers in periphery countries.

Table 3-8 Systemic Risk Changes for M&As in Periphery and Core Countries

	mean(change of MES)	mean(change of LTD)	Mean(change of ΔCoVaR)
Periphery countries	0.0013** (0.0489)	0.0010 (0.3557)	1.9536* (0.0820)
Core countries	0.0033** (0.0104)	0.0041 (0.1903)	9.4248*** (0.0033)
Periphery Vs. core	-0.0020 (0.8995)	-0.0031 (0.7195)	-7.4712*** (0.0217)

3.6.3 Selecting Banking Integration Indicators

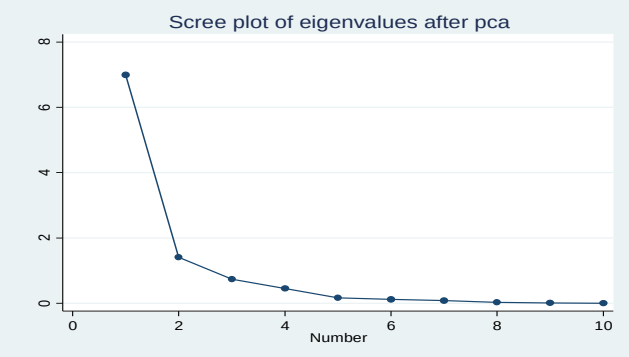
In this subsection, we will employ principal component analysis (PCA) （as described in subsection 3.4.2）to select several banking integration indicators that can explain most variability in the models. Table 3-9 shows that the first three principal components can explain more than 91% of the total variance. In addition, figure 3-1 illustrates the scree plot of eigenvalues after PCA also reveals that the first three principal components have largest

eigenvalues. Therefore, we select the first three principal components.

Table 3-9 Results of Principal Component Analysis (PCA) Variance explained

Components	Eigenvalue	Proportion	Cumulative
Component 1	7.0002	0.7000	0.7000
Component 2	1.4052	0.1405	0.8405
Component 3	0.7378	0.0738	0.9143
Component 4	0.4514	0.0451	0.9595
Component 5	0.1680	0.0168	0.9763
Component 6	0.1149	0.0115	0.9878
Component 7	0.0856	0.0086	0.9963
Component 8	0.0250	0.0025	0.9988
Component 9	0.0117	0.0012	1.0000

Figure 3-1 Scree plot of eigenvalues after PCA



Next, in table 3-10, we further report the loadings for the first three components and identify that the first principal component has largest absolute values for loadings for IRDIFFERENCE1 (interest rate difference on new loans to non-financial corporations between distressed and non-distressed countries), IRDIFFERENCE5 (interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries) and DISPERSION5 (cross-country standard deviation of MFI interest rates on loans to non-financial corporations and households), while the second principal component has

largest absolute values for loadings for IRDIFFERENCE3 (interquantile of interest rate difference on MFI deposits for households in the euro area) , IRDIFFERENCE2 (full range of interest rate difference on MFI deposits for households in the euro area) and DISPERSION3(cross-country standard deviation of MFI interest rates on loans to non-financial corporations and households). These results indicate that PC1 can be mostly

Table 3-10 the Loadings of Principal Component Analysis (PCA)

Variable	Comp1	Comp2	Comp3
IRDIFFERENCE1	0.3724	0.0431	-0.0370
IRDIFFERENCE5	0.3721	-0.0237	-0.0513
DISPERSION5	0.3619	-0.0131	-0.0249
IRDIFFERENCE2	0.2523	-0.5013	-0.0073
IRDIFFERENCE3	0.0769	0.7183	0.3488
DISPERSION3	0.2061	-0.3559	0.8293
IRDIFFERENCE4	0.3609	0.1181	-0.0204
DISPERSION2	0.3484	0.2605	0.0429
DISPERSION4	0.3472	0.1126	-0.0711
DISPERSION6	0.3230	-0.0954	-0.4227

interpreted by IRDIFFERENCE1, IRDIFFERENCE5 and DISPERSION5 while PC2 can be mostly explained by IRDIFFERENCE3, IRDIFFERENCE2 and DISPERSION3.

Therefore, we select IRDIFFERENCE1, IRDIFFERENCE5 and DISPERSION5 as the most important banking integration indicators in the main regressions and use IRDIFFERENCE2, IRDIFFERENCE3 and DISPERSION3 as less important indicators in robustness checks.

3.6.4 Determinants of Acquirers' Systemic Risk Changes for Cross-border M&As

To identify more determinants of acquirers' systemic risk changes after M&As, we employ the panel data model. As we discussed in subsection 3.4.1, we use Hausman test to determine that fixed-effect model is preferred to random-effect model.

Table 3-11 presents the results of fixed-effect models that examine the determinants of acquirers' changes of MES. Regressions (1) – (3) report the results of full models with banking integration indicators. IRDIFFERENCE1 has significantly negative relationships with ΔMES while DISPERSION5 does not have significant relationship with ΔMES. Lower interest rate differentials and higher cross-country standard deviation of MFI interest rates on loans indicate higher level of banking integration and more cross-border flows for banks. Acquirers can take more risks via bank M&As, therefore, acquirers have higher systemic risk contributions to banking sector after M&As. These results provide partial support for the destabilizing effects of banking integration (hypothesis). Asset diversity is statistically significant at the 5% significance level and is negatively related to ΔMES in regressions (1) and (2). If acquirers' asset diversity increases by 1%, their MES will decrease by more than 1%. These results offer support to our previous finding and indicate that product diversification tends to reduce individual bank risk and hence indirectly decreasing the systemic risk contributions to the banking system. Price-to-book ratio (or market value-to-book value ratio) is positively related to ΔMES, demonstrating that the directors' hubris (higher price-to-book ratio indicates that banks' directors assume excessive risks to increase banks values) may result in banks to take higher risky M&As and thus increases acquirers' systemic risk contributions to banking sector. These results are consistent with those results of Vallascas and Hagendorff (2011). They found that low-risk banks increase their risk after a merger.

Surprisingly, non-performing loan ratio is statistically significant at 1% significance level and is negatively related to ΔMES. One possible explanation could be that banks that are less focused on traditional deposit taking and lending business are more likely to take exposures that carry systemic risks.

Table 3-11 Determinants of Acquirers' changes of MES for Cross-border M&As

Variable	(1) ΔMES IR DIFFERENCE1 Full	(2) ΔMES IR DIFFERENCE5 Full	(3) ΔMES DISPERSION5 Full	(4) ΔMES IR DIFF1 Bank-specific	(5) ΔMES IR DIFF3 Bank-specific	(6) ΔMES DISPERSION5 Bank-specific
Banking integration	-0.0151*	-0.0097*	0.0001	-0.0212**	-0.0431***	0.0001
	(0.0083)	(0.0055)	(0.0003)	(0.0003)	(0.0125)	(0.0003)
Asset diversity	-0.0110**	-0.0104**	-0.0118***	-0.0070*	-0.0072**	-0.0065*
	(0.0055)	(0.0051)	(0.0045)	(0.0037)	(0.0035)	(0.0151)
Non-performing loan	-0.0182***	-0.0167***	-0.0732**	-0.0533*	-0.0580**	-0.0339
	(0.0057)	(0.0065)	(0.0334)	(0.0286)	(0.0278)	(0.0297)
Tier 1 Capital	0.0924**	0.0889	0.0855**	0.0658*	0.0711**	0.0655*
	(0.0412)	(0.0520)	(0.0367)	(0.0348)	(0.0343)	(0.0365)
Ln(TA)	0.0061**	0.0059	0.0049*	0.0028*	0.0027*	0.0038**
	(0.0030)	(0.0039)	(0.0203)	(0.0015)	(0.0015)	(0.0016)
PB	0.0031*	0.0036*	0.0018	0.0001	0.0001	0.0008
	(0.0018)	(0.0020)	(0.0016)	(0.0014)	(0.0013)	(0.0014)
Moral hazard index	0.0035	0.0045*	0.0028			
	(0.0023)	(0.0023)	(0.0018)			
Liquid ratio	-0.0133	-0.0145	-0.0093	-0.0040	-0.0043	-0.0048
	(0.0082)	(0.0124)	(0.0066)	(0.0047)	(0.0046)	(0.0050)
Equity-to-asset	-0.0384	-0.0349	-0.0640	-0.0727	-0.0755	-0.0841
	(0.0634)	(0.0932)	(0.0585)	(0.0514)	(0.0507)	(0.0538)
ROA	-0.1887	-0.1758	0.1326	0.0269	0.0156	0.0676
	(0.2609)	(0.2153)	(0.2236)	(0.1898)	(0.1876)	(0.1986)
Short-term debt	0.0178**	0.0179*	0.0163**	0.0078	0.0066	0.0079
	(0.0086)	(0.0101)	(0.0077)	(0.0062)	(0.0061)	(0.0066)
Non-interest income	-0.0062	-0.0071	-0.0019	-0.0054	-0.0057	-0.0058
	(0.0060)	(0.0042)	(0.0052)	(0.0046)	(0.0045)	(0.0048)
Z-score	0.0001	0.0001	-0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cross-border	-0.0041	-0.0026	-0.0007			
	(0.0047)	(0.0044)	(0.0037)			
Geographic diversification	0.0015	0.0025	0.0012			
	(0.0025)	(0.0032)	(0.0021)			
Systemic importance	0.0008	0.0023	-0.0034			
	(0.0046)	(0.0036)	(0.0036)			
Bailout	-0.0144***	-0.0143***	-0.0061**			
	(0.0041)	(0.0035)	(0.0030)			
Real GDP growth	0.0009	0.0009	0.0018			
	(0.0010)	(0.0009)	(0.0008)			
Inflation	-0.0013	-0.0016***	-0.0026***			
	(0.0009)	(0.0004)	(0.0008)			
Money supply growth	0.0001	0.0001	0.0001			
	(0.0001)	(0.0001)	(0.0001)			
CR5	0.0001	0.0011	0.0001			
	(0.0001)	(0.0001)	(0.0001)			
Capital regulatory index	0.0012	0.0011	0.0006			
	(0.0010)	(0.0008)	(0.0001)			
Official supervisory index	0.0023**	0.0026***	0.0020***			
	(0.0009)	(0.0007)	(0.0008)			
Deposit insurer power	-0.0021	-0.0014	0.0028			
	(0.0021)	(0.0020)	(0.0018)			
Private monitoring index	0.0025*	0.0024	0.0007			
	(0.0015)	(0.0020)	(0.0012)			
Obs.	100	100	100	100	100	100
R^2	0.1457	0.2814	0.1256	0.1014	0.2076	0.1016

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Another unexpected result is Tier1 capital ratio is negatively related to ΔMES. This indicates that acquirers with higher Tier1 capital ratio will have higher systemic risks after M&As. Our results are different from results in previous studies (Bostandzic et.al. 2014; Laeven et.al. 2016). One possible explanation for our unexpected results is that banks that have high capital ratios are more exposed in unregulated parts of the banking business (e.g. off-balance sheet and derivatives). In addition, the BIS report (2013) argues that despite adequate capital ratio, many banks still experienced difficulties because they did not manage their liquidity risks in a prudent manner in crisis years. Therefore, they increased their individual risks and increased their systemic risk contributions to banking system. We have quite interesting findings in regression models (1) - (3). The dummy for Bailout is statistically significant at 1% significance level and is negatively related to ΔMES. These results are consistent with results in Berger et.al (2016), indicating that acquirers that receive bailouts will have lower MES after bank M&As. Berger et.al.(2016) claim that government rescue troubled banks for the purpose of maintaining financial stability and reducing the costs associated with bank failures.

Moreover, short-term debt ratio is positively related to ΔMES, showing that acquirers that rely more on short-term debts will have higher MES after M&As. These results are expected because banks that use more short-term debts (more traditional banks) as their sources of funds will have higher solvency risk, thus will have higher systemic risk contributions to banking system.

In regressions (1) and (3), the natural log of total asset is positively related to ΔMES. This result supports the previous finding that larger acquirers have higher systemic risks after M&As. Larger banks are able to become even larger and "too-big-to-fail" (TBTF) after M&As. This enables them to exploit safety-net subsidies and creates moral hazard problem, indicating that larger banks are more likely to take more risk and will contribute higher systemic risk to banking sector. However, our result differs from that in Weiss et al. (2014). Weiss et al. (2014)

find that total asset is negatively significant with ΔMES for international banks. The difference can be explained by the different samples for the two studies: Weiss et al. (2014) has international banks while we have European banks. Models (4) - (6) in table 3-11 constitute baseline regressions that only contain banking integration indicators and bank-specific variables. They have similar results as regressions (1) - (3), except that short-term debt ratio and price-to-book ratio are not significant related with ΔMES. These results provide more evidences for previous findings that (1) acquirers with higher asset diversity, (2) smaller acquirers and (3) acquirers from less integrated markets will have lower systemic risk after M&As.

Regressions (1) – (3) in table 3-12 are regressions which exclude macroeconomic, structural and regulatory variables. They have similar results as the full models, except that non- interest income/total income is negative significant with ΔMES and short-term debt/total liabilities is not significant with ΔMES. These results do not change our previous conclusions and provide more evidences for acquirers with higher product diversification will have lower systemic risk contributions after M&As.

Regressions (4) – (6) in table 3-12 constitute regressions that only include bank-specific, deal-specific and regulatory variables. These regressions have two differences from the regressions above. First, in regressions (4) and (6), capital regulatory index is positively significant with ΔMES. This indicates that acquirers from countries with more stringent capital requirements will have higher systemic risk contributions to banking system. These results are unexpected, but can be explained as follows: if a country requires banks to have higher capital ratio, banks will comply with capital regulations and will hold extra capital, but they may manage liquidity risks in a less prudent manner, thus leading to higher systemic risk contributions to banking system. Second, in regression (5), equity-to-asset ratio is negatively

Table 3-12 Determinants of Acquirers' changes of MES for Cross-border M&As

Variable	(1) ΔMES IR DIFFERENCE1 Bank-specific Deal-specific	(2) ΔMES IR DIFFERENCE5 Bank-specific Deal-specific	(3) ΔMES DISPERSION5 Bank-specific Deal-specific	(4) ΔMES IR DIFF1 Deal-specific Regulatory	(5) ΔMES IR DIFF3 Deal-specific Regulatory	(6) ΔMES DISPERSION5 Deal-specific
Banking integration	-0.0145**	-0.0346***	0.0001	-0.0139*	-0.0340**	0.0001
	(0.0064)	(0.0103)	(0.0004)	(0.0066)	(0.0161)	(0.0004)
Asset diversity	-0.0086*	-0.0102*	-0.0097**	-0.0065	-0.0066	-0.0065*
	(0.0041)	(0.0046)	(0.0048)	(0.0058)	(0.0047)	(0.0061)
Non-performing loan	-0.0492	-0.0582*	-0.0478	-0.0614*	-0.0651*	-0.0529
	(0.0322)	(0.0316)	(0.0310)	(0.0323)	(0.0337)	(0.0311)
Tier 1 Capital	0.0661	0.0619	0.0615	0.0913*	0.0927**	0.0888*
	(0.0484)	(0.0498)	(0.0506)	(0.0416)	(0.0423)	(0.0431)
Ln(TA)	0.0057**	0.0082**	0.0091***	0.0032*	0.0030	0.0041**
	(0.0025)	(0.0030)	(0.0026)	(0.0015)	(0.0025)	(0.0013)
PB	0.0013	0.0026*	0.0033**	0.0011	0.0010	0.0020
	(0.0010)	(0.0012)	(0.0040)	(0.0014)	(0.0018)	(0.0019)
Moral hazard index				0.0017	0.0017	0.0018
				(0.0020)	(0.0019)	(0.0024)
Liquid ratio	-0.0064	-0.0086	-0.0103	-0.0075	-0.0071	-0.0092
	(0.0071)	(0.0080)	(0.0079)	(0.0090)	(0.0070)	(0.0097)
Equity-to-asset	-0.0643	-0.0434	-0.0398	-0.1075	-0.1081*	-0.1022
	(0.0620)	(0.0677)	(0.0686)	(0.0691)	(0.0639)	(0.0720)
ROA	0.0034	-0.1639	-0.1663	0.0521	0.0346	0.0383
	(0.2008)	(0.2068)	(0.1976)	(0.2766)	(0.2286)	(0.3006)
Short-term debt	0.0115	0.0151	0.0154	0.0124	0.0121	0.0131
	(0.0126)	(0.0105)	(0.0097)	(0.0146)	(0.0082)	(0.0145)
Non-interest income	-0.0071**	-0.0074***	-0.0068*	-0.0056	-0.0058	-0.0059
	(0.0020)	(0.0023)	(0.0032)	(0.0036)	(0.0056)	(0.0311)
Z-score	0.0001	0.0001	-0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cross-border	-0.0058	-0.0046	-0.0037			
	(0.0035)	(0.0029)	(0.0032)			
Geographic diversification	0.0008	-0.0006	0.0001			
	(0.0021)	(0.0020)	(0.0001)			
Systemic importance	-0.0023	-0.0034	-0.0023			
	(0.0026)	(0.0026)	(0.0029)			
Bailout	-0.0066**	-0.0066*	-0.0069**			
	(0.0029)	(0.0029)	(0.0025)			
Real GDP growth						
Inflation						
Money supply growth						
CR5						
Capital regulatory index				0.0006**	0.0006	0.0007*
				(0.0002)	(0.0009)	(0.0003)
Official supervisory index				0.0009	0.0008	0.0011
				(0.0007)	(0.0008)	(0.0008)
Deposit insurer power				-0.0016	-0.0018	-0/0011
				(0.0013)	(0.0019)	(0.0011)
Private monitoring index				0.0010	0.0010	0.0008
				(0.0017)	(0.0012)	(0.0019)
Obs.	105	105	105	101	101	101
R^2	0.2674	0.2834	0.2356	0.2373	0.2539	0.2087

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

and significantly related to ΔMES. This is an expected result and one possible explanation is banks with lower leverage ratios are able to limit their risk takings and therefore reduce their systemic risk contributions to banking system. Overall, most results in these regressions confirm previous findings and presented in table 3-12.

Regressions (1) - (3) in table 3-13 are baseline models only constitute bank–specific and macroeconomic variables. In these regressions, only interest rate differences, asset diversity and the natural log of total assets are significant related to ΔMES. These results further support our three hypotheses.

Regressions (4) – (6) in table 3-13 exclude all regulatory variables. These results are very similar to the results in models with bank-specific and deal-specific variables, except that macroeconomic variables, such as money supply growth rate and inflation, have some explanatory powers to acquirers' systemic risks changes after M&As. These results show that acquirers from countries with higher money supply growth rate and lower inflation rate will have higher systemic risks after M&As. One possible explanation is both higher money supply growth rate and lower inflation rate indicate expansionary monetary policy, which may result in financial instability in banking system. All other significant results mainly confirm our previous findings.

Table 3A-1 presents the results of fixed-effect models that examine the determinants of acquirers' changes of LTD (see in the Appendix). Regressions (1) – (3) report the results of full models with banking integration indicators. Only IRDIFFERENCE5 is negatively related to ΔLTD, indicating that if interest rate differences on new loans to euro area non-financial corporations between euro area average and non-distressed countries narrows, acquirers' systemic risk will increase after M&As. Asset diversity is negatively related to ΔLTD only in regression (1), revealing that acquirers with higher product diversification will have lower systemic risks after M&As. In addition, one interesting result is that results in regressions (1)

Table 3-13 Determinants of Acquirers' changes of MES for Cross-border M&As

Variable	(1) ΔMES IR DIFFERENCE1 Bank-specific Macroeconomic	(2) ΔMES IR DIFFERENCE5 Bank-specific Macro	(3) ΔMES DISPERSION5 Bank-specific Macro	(4) ΔMES IR DIFF1 Bank-specific Deal-specific Macroeconomic	(5) ΔMES IR DIFF3 Bank-specific Deal-specific Macro	(6) ΔMES DISPERSION5 Bank-specific Deal-specific
Banking integration	-0.0137*	-0.0324**	0.0001	-0.0161*	-0.0374***	0.0001
	(0.0080)	(0.0155)	(0.0005)	(0.0076)	(0.0106)	(0.0004)
Asset diversity	-0.0083*	-0.0083**	-0.0087**	-0.0107**	-0.0109**	-0.0106**
	(0.0042)	(0.0042)	(0.0038)	(0.0047)	(0.0046)	(0.0047)
Non-performing loan	-0.0466	-0.0492	-0.0407	-0.0777**	-0.0814**	-0.0678**
	(0.0314)	(0.0312)	(0.0294)	(0.0327)	(0.0322)	(0.0305)
Tier 1 Capital	0.0560	0.0563	0.0577	0.0603	0.0617	0.0605
	(0.0408)	(0.0404)	(0.0576)	(0.0555)	(0.0550)	(0.0558)
Ln(TA)	0.0051***	0.0049**	0.0061***	0.0072*	0.0071*	0.0081**
	(0.0019)	(0.0019)	(0.0017)	(0.0034)	(0.0035)	(0.0030)
PB	0.0013	0.0012	0.0019	0.0029**	0.0028*	0.0035*
	(0.0016)	(0.0015)	(0.0016)	(0.0013)	(0.0013)	(0.0016)
Moral hazard index						
Liquid ratio	-0.0073	-0.0072	-0.0092	-0.0061	-0.0063	-0.0081
	(0.0061)	(0.0060)	(0.0079)	(0.0090)	(0.0091)	(0.0084)
Equity-to-asset	-0.0452	-0.0443	-0.0426	-0.0374	-0.0370	-0.0335
	(0.0556)	(0.0551)	(0.0739)	(0.0798)	(0.0789)	(0.0817)
ROA	0.0286	0.0027	0.0268	-0.1064	-0.1356	-0.1071
	(0.2347)	(0.2333)	(0.2037)	(0.2083)	(0.1980)	(0.1992)
Short-term debt	0.0069	0.0065	0.0072	0.0144	0.0141	0.0137
	(0.0072)	(0.0072)	(0.0126)	(0.0115)	(0.0120)	(0.0113)
Non-interest income	-0.0043	-0.0048	-0.0035	-0.0052**	-0.0056**	-0.0047*
	(0.0055)	(0.0055)	(0.0044)	(0.0021)	(0.0021)	(0.0026)
Z-score	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cross-border				-0.0056	-0.0056	-0.0048
				(0.0034)	(0.0031)	(0.0037)
Geographic diversification				-0.0014	-0.0017	-0.0008
				(0.0022)	(0.0021)	(0.0023)
Systemic importance				-0.0021	-0.0023	-0.0014
				(0.0033)	(0.0033)	(0.0036)
Bailout				-0.0060*	-0.0060*	-0.0059*
				(0.0032)	(0.0032)	(0.0030)
Real GDP growth	0.0007	0.0006	0.0009*	0.0004	0.0004	0.0006
	(0.0008)	(0.0007)	(0.0005)	(0.0006)	(0.0006)	(0.0004)
Inflation	-0.0009	-0.0008	-0.0011	-0.0008	-0.0007	-0.0010**
	(0.0008)	(0.0008)	(0.0006)	(0.0005)	(0.0005)	(0.0004)
Money supply growth	0.0001	0.0001	0.0001	0.0001***	0.0001***	0.0001**
	(0.0001)	(0.0001)	(0.0001)	(0.00001)	(0.00001)	(0.00005)
CR5				-0.0001	-0.0001	-0.0001
				(0.0001)	(0.0001)	(0.0001)
Capital regulatory index						
Official supervisory index						
Deposit insurer power						
Private monitoring index						
Obs.	104	104	104	104	104	104
R^2	0.2278	0.2410	0.1995	0.3069	0.3221	0.2684

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

and (2) are different from results in regression (3). In contrast, results in regressions (1) and (2) provide further evidence for previous findings. This indicates that regressions that include interest rate differences provide more robust evidence than that rely on the cross-country standard deviations of MFI interest rates on loans. This may be interpreted as follows: compared to the cross-country standard deviations of MFI interest rates on loans, interest rate differences on different loans are better indicators to quantify the degree of banking integration and are more sensitive to systemic risk measures. Generally, these results partly confirm our previous findings. Price-to-book ratio is positively related to ΔLTD, providing more confirming evidence for directors' hubris may lead banks to take higher-risky M&As and make greater systemic risk contributions to banking sector. Finally, the natural log of total assets is positively related to ΔLTD. It offers further supports to the conjecture that larger acquirers have higher systemic risks after M&As.

Regressions (4) - (6) in table 3A-1 report results of regressions that only contain bank-specific variables (see in the Appedix). In all these regressions, banking integration indicators are not significant with ΔLTD, thereby not providing support to our previous finding that acquirers from more integrated banking markets may have higher systemic risk after M&As. Asset diversity is significantly negative related to ΔLTD in all three regressions, showing that acquirers having higher product diversification will have lower systemic risk after M&As. The natural log of total assets is significantly positive related to ΔLTD, providing further evidences for larger acquirers will have higher systemic risk contributions to banking sector. Surprisingly, ROA is positively significant with ΔLTD. On possible explanation can be: banks that had high profitability in previous year may manage risk in a less prudent manner and thus increase systemic risks.

Regressions (1) - (3) in table 3A-2 constitute regressions with bank-specific and deal-specific variables (see in the Appendix). These regressions have similar results as regressions in

previous table, except that equity-to-asset ratio is negatively related to ΔLTD. This result can be explained by acquirers with higher capital ratio and lower leverage ratio will limit their risk takings and thus reduce their systemic risk contributions to banking sector.

In regressions (4) – (6) in table 3A-2, we only use bank-specific and regulatory variables (see in the Appendix). These regressions have similar results as previous one, except that private monitoring index is significantly negative related to ΔLTD. These results are expected and indicate that acquirers from countries that require more banks' private monitoring will have lower systemic risks after M&As.

Models (1) – (3) in table 3A-3 report the results from including bank-specific and macroeconomic variables (see in the Appendix). One different result is that systematic importance is negative significantly related to ΔLTD, indicating that systematic important acquirers will have lower systemic risk after M&As. Systematic important acquirers are more interconnected to other financial institutions, thus, they have higher systemic risk contributions to banking system.

Regressions (4) – (6) in table 3A-3 constitute regressions with bank-specific, deal-specific and macroeconomic variables (see in the Appendix). These regressions also have similar results as previous regressions and provide important evidences for our previous findings. However, banking integration indicators are not significant related to ΔLTD in these regressions while they are significantly negative related to ΔMES in most regressions. This shows that ΔMES regressions provide more robust evidences to support our previous finbdings than ΔLTD regressions.

Table 3A-4 presents the results of fixed-effect models that investigate the determinants of acquirers' changes of ΔCoVaR (see in the Appendix). Regressions (1) – (3) report results of full models with banking integration indicators. Banking integration indicator is significantly negatively related to changes of ΔCoVaR in regression (2) but not in regression (1). This result

indicates that lower interest rate differences on new loans to euro area non-financial corporations between distressed and non-distressed countries, higher level of banking integration, acquirers will have higher systemic risks after M&As. Asset diversity is significantly negative related to changes of ΔCoVaR in regressions (1) and (3) but not in regression (2). These results partly support our previous findings that acquirers from more integrated banking markets (hypothesis) and acquirers with less diversified assets will have higher systemic risk contributions after M&As. However, natural log of total assets are not significant with change of ΔCoVaR. Moral hazard index is negatively related to change of ΔCoVaR, partly confirming our previous findings that acquirers from countries having more severe moral hazard problem will have higher systemic risks after M&As. Short-term debt ratios have significantly positive relationship with change of ΔCoVaR. Acquirers that rely more on short-term debt financing will have higher systemic risks after M&As. In regression (1), cross-border is positively significant with change of ΔCoVaR. This result is expected and partly supports our previous finding that acquirers that engage in cross-border M&As will have higher systemic risk contributions after M&As. One possible explanation can be: if acquirers engage in more cross-border M&As, they will have more cross-border inflows and outflows and are more interconnected with financial institutions in other countries, therefore, they will have more systemic risk contributions to banking system after the cross-border M&As. Similar to previous regressions, surprisingly, non-performing loan ratio is negatively significant related to change of ΔCoVaR in regressions (1) and (2). This can be explained by banks having high proportion of non-performing loans will manage liquidity risk in a more prudent manner. Bailout is negatively significant with change of ΔCoVaR in regressions (1) and (2), indicating that acquirers receive bailouts will have lower systemic risk after M&As. In regression (3), official supervisory index is significantly negative related to change of ΔCoVaR. This result is expected and one possible explanation can be: if the banking supervisor authorities have more

powers to take actions against banks to correct problems, banks will limit risk takings and thus will reduce systemic risks contributions to banking system. Deposit insurance power index is also positively significant related to change of ΔCoVaR, partly confirming our previous findings that acquirers from countries which deposit insurers are more powerful will have higher systemic risks after M&As.

Regressions (4) – (6) in table 3A-4 constitute regressions with bank-specific variables (see in the Appendix). Asset diversity is negatively significant related to change of ΔCoVaR, providing more robust evidences for our previous findings. Similar to the results in previous regressions, non-performing loan ratio is negatively significant related to change of ΔCoVaR. In regression (4), another unexpected result is that ROA is positively significant related to change of ΔCoVaR, implying that acquirers that had higher profitability in previous year may not manage risks in a more prudent manner and may have higher systemic risks after M&As.

Regressions (1) – (3) in table 3A-5 demonstrate the results of regressions with bank-specific and deal-specific variables (see in the Appendix). Asset diversity, non-performing loan ratio and short-term debt ratios are significant in all three regressions while banking integration indicators are not significant in all three regressions, providing more robust evidences for our previous findings. Bailout is negatively significant related to change of ΔCoVaR in regressions (1) and (2), revealing that acquirers that receive bailouts will have lower systemic risks after M&As.

In regressions (4) – (6) of table 3A-5, we use deal-specific and regulatory variables (see in the Appendix). Non-performing loan ratio is negatively related to change of ΔCoVaR in regression (2), partly support our previous findings. Moral hazard index is negatively significant related to change of ΔCoVaR, partly confirming our previous findings that acquirers from countries having more severe moral hazard problem will have higher systemic risks after M&As. Short-term debt ratios have significantly positive relationship with change of ΔCoVaR in all three

regressions, implying that acquirers that rely more on short-term debt financing will have higher systemic risks after M&As.

Regressions (1) – (3) of table 3A-6 present results of the regressions with bank-specific and macroeconomic variables (see in the Appendix). Asset diversity is negatively significant with change of ΔCoVaR in all three regressions. These results are consistent with our previous findings and provide more robust evidences for acquirers with more asset diversity will have lower systemic risks after M&As. In addition, non-performing loan ratio is negatively significant with change of ΔCoVaR, implying that acquirers that had high non-performing loan ratio may manage risk in a prudent manner in upcoming years, therefore, reducing their systemic risks after M&As. However, banking integration indicators and natural log of total assets are not significant with change of ΔCoVaR in all three regressions.

Regressions (4) – (6) of table 3A-6 use bank-specific, deal-specific and macroeconomic variables (see in the Appendix). Asset diversity has weakly negative significant coefficients (at 10% significance level) in all three regressions, further confirming our previous findings. Non-performing loan ratio is only negatively significant with change of ΔCoVaR in regression (5), partly supporting our previous findings that acquirers that had lower asset quality in the past year will have lower systemic risks after M&As. Furthermore, short-term debt ratio is weakly positive related to change of ΔCoVaR in regressions (4) and (5), providing further evidences for acquirers rely more on short-term debt will have lower systemic risks after M&As.

Finally, bailout is significantly positive related to change of ΔCoVaR in regressions (4) and (5). These results imply that acquirers that receive bailouts will have lower systemic risk contributions to banking system and further confirm our previous findings. In order to examine whether acquirers of post-crisis M&A deals have different significant variables from acquirers of pre-crisis M&A deals, we then use the fixed-effect models for post-crisis and

Table 3-14 Determinants of Acquirers' Changes of MES for M&As in Post-crisis and Pre-crisis Periods

Variable	(1) Post-crisis ΔMES No integration	(2) Pre-crisis ΔMES No integration	(3) Post-crisis ΔMES IR DIFFERENCE1	(4) Pre-crisis ΔMES IR DIFFERENCE1	(5) Post-crisis ΔMES IR DIFFERENCE5	(6) Pre-crisis ΔMES IR DIFFERENCE5
Banking integration			-0.0259	-0.0187	-0.0452	-0.0643
			(0.0189)	(0.0232)	(0.0517)	(0.0524)
Asset diversity	-0.0114	-0.0051**	-0.0127	0.0039	-0.0116	-0.0044
	(0.0120)	(0.0022)	(0.0186)	(0.0072)	(0.0233)	(0.0066)
Non-performing loan	0.0242	-0.0186	-0.3166	-0.0567	-0.3125*	-0.0570
	(0.0417)	(0.0124)	(0.2128)	(0.0693)	(0.1514)	(0.0277)
Tier 1 Capital	-0.0098	0.0992***	0.1128	0.0450	0.0873**	0.0218
	(0.0229)	(0.0277)	(0.0908)	(0.0693)	(0.0341)	(0.0756)
Ln(TA)	0.0038	0.0030	-0.0020	0.0029	0.0002	0.0012
	(0.0034)	(0.0039)	(0.0076)	(0.0087)	(0.0100)	(0.0095)
PB	-0.0050	0.0029	0.0014	0.0024*	0.0020	0.0020
	(0.0055)	(0.0017)	(0.0062)	(0.0007)	(0.0050)	(0.0010)
Moral hazard index	-0.0006	-0.0004	-0.0021	0.0021	-0.0028	0.0019
	(0.0049)	(0.0013)	(0.0055)	(0.0016)	(0.0036)	(0.0015)
Liquid ratio	-0.0145*	0.0051	-0.0099	0.0011	-0.0086	0.0027
	(0.0065)	(0.0070)	(0.0189)	(0.0133)	(0.0112)	(0.0127)
Equity-to-asset	-0.0823*	-0.0734	-0.0785	-0.0430	-0.0291	-0.0172
	(0.0362)	(0.0381)	(0.2977)	(0.0664)	(0.2923)	(0.0718)
ROA	0.2588*	-0.0165	0.3195	-0.3201	0.2136	-0.4115
	(0.1238)	(0.1320)	(0.8342)	(0.1770)	(0.9079)	(0.2067)
Short-term debt	-0.0082	0.0173***	-0.0190	0.0311**	-0.0171	0.0311**
	(0.0140)	(0.0047)	(0.0300)	(0.0054)	(0.0241)	(0.0061)
Non-interest income	0.0081	-0.0152**	0.0232	-0.0006	0.0205	0.0025
	(0.0073)	(0.0062)	(0.0163)	(0.0054)	(0.0074)	(0.0058)
Z-score	0.00001	-0.0001	-0.00007	0.00003	-0.0001	0.00003
	(0.00001)	(0.00006)	(0.0003)	(0.00009)	(0.0004)	(0.0001)
Cross-border	0.0080**	-0.0027*	0.0077	-0.0009	0.0081	-0.0016
	(0.0024)	(0.0014)	(0.0057)	(0.0033)	(0.0051)	(0.0035)
Geographic diversification	0.0044	0.0011	-0.0036	-0.0008	0.0040	-0.0006
	(0.0029)	(0.0015)	(0.0039)	(0.0017)	(0.0073)	(0.0012)
Systemic importance	-0.0025	-0.0027	-0.0132	-0.0004	-0.0172	-0.0004
	(0.0044)	(0.0024)	(0.0185)	(0.0042)	(0.0133)	(0.0035)
Bailout	0.0031	-0.0019	-0.0019	-0.0134***	-0.0026	-0.0132**
	(0.0027)	(0.0018)	(0.0124)	(0.0021)	(0.0134)	(0.0025)
Real GDP growth	0.0006	-0.0005	-0.0047	0.0005	-0.0045**	0.0007
	(0.0007)	(0.0004)	(0.0040)	(0.0012)	(0.0017)	(0.0015)
Inflation	0.0005	0.0004	-0.0007	0.0002	-0.0006	0.0005
	(0.0010)	(0.0006)	(0.0026)	(0.0012)	(0.0015)	(0.0011)
Money supply growth	-0.0002	0.00001*	0.0012	0.00001	0.0012	0.0001**
	(0.0003)	(0.000005)	(0.0008)	(0.00001)	(0.0008)	(0.00003)
CR5	0.00004	-0.00002	0.00003	0.00003	0.00004	0.00002
	(0.0001)	(0.00006)	(0.0002)	(0.00007)	(0.0001)	(0.00007)
Capital regulatory index	-0.0019	0.0032	0.0023	0.0013***	0.0023	0.0014**
	(0.0013)	(0.0006)	(0.0041)	(0.0002)	(0.0025)	(0.0003)
Official supervisory index	0.0013	0.0015	0.0044*	0.0018	0.0042	0.0020
	(0.0015)	(0.0010)	(0.0023)	(0.0011)	(0.0034)	(0.0013)
Deposit insurer power	-0.0037	0.0023	-0.0031	0.0005	-0.0029	0.0006
	(0.0031)	(0.0021)	(0.0057)	(0.0011)	(0.0070)	(0.0013)
Private monitoring index	-0.0002	-0.0008	-0.0039	0.0004	-0.0040***	0.0010
	(0.0018)	(0.0007)	(0.0038)	(0.0016)	(0.0010)	(0.0019)
Obs.	47	53	47	53	47	53
R^2	0.3285	0.2083	0.1580	0.5864	0.1797	0.6036

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

pre-crisis periods. Table 3-14 and table 3-15 report the results of fixed-effect models for acquirers' changes of MES for M&As in post-crisis and pre-crisis periods. Regressions (1) - (2) present results of ΔMES models that exclude banking integration indicators. We find several different results between two models. For instance, cross-border is positively significant with ΔMES in pre-crisis model while it is negatively significant with ΔMES in post-crisis model. These results indicate that acquirers that engage in cross-border M&As have higher MES than acquirers that engage in domestic M&As in post-crisis period, while acquirers that engage in cross-border M&As have lower MES than acquirers that engage in domestic M&As in pre-crisis period. This implies that acquirers cannot reduce MES via cross-border M&As in crisis period while they can achieve this objective via cross- border M&As in pre-crisis period. Moreover, non-performing loan ratio, tier 1 capital ratio, price-to-book ratio, liquidity ratio, return on asset, short-term debt ratio, non-interest income ratio, z-score, money supply growth rate, capital regulatory index and deposit insurer power have opposite signs in post-crisis and pre-crisis models. These are expected results and can be explained by the fact that (1) acquirers in post-crisis period had different bank-specific accounting ratios from acquirers in pre-crisis period; (2) many EU countries changed their monetary policies; and (3) the banking regulators and supervisors change the regulatory and supervisory policies. As we expected, both asset diversity and natural log of total asset have same and expected signs in two models. These results partly provide further evidences for our previous findings.

Regressions (3) - (6) in table 3-14 and (1) - (6) in table 3-15 report results of MES models that contain different banking integration indicators. Although all banking integration indicators have identical negative signs with ΔMES, only two of them are significant with ΔMES. These results only show limited evidences for our hypothesis . Many independent variables have different signs with ΔMES between post-crisis and pre-crisis models that

Table 3-15 Determinants of Acquirers' Changes of MES for M&As in Post-crisis and Pre-crisis Periods

Variable	(1) Post-crisis ΔMES DISPERSION5	(2) Pre-crisis ΔMES DISPERSION5	(3) Post-crisis ΔMES IR DIFFERENCE2	(4) Pre-crisis ΔMES IR DIFFERENCE2	(5) Post-crisis ΔMES DISPERSION3	(6) Pre-crisis ΔMES DISPERSION3
Banking integration	0.0010	0.0007	-0.0003	-0.0090***	-0.00002	-0.0001*
	(0.0011)	(0.0005)	(0.0057)	(0.0008)	(0.0003)	(0.00004)
Asset diversity	0.0071	-0.0039	0.0041	-0.0005	0.0043	-0.0009
	(0.0109)	(0.0072)	(0.0172)	(0.0058)	(0.0139)	(0.0057)
Non-performing loan	-0.1564	-0.0567	-0.1567	-0.0731	-0.1616	-0.0691
	(0.1354)	(0.0272)	(0.1230)	(0.0355)	(0.1351)	(0.0339)
Tier 1 Capital	0.1300	0.0450	0.0815	0.0949	0.0824**	0.1112
	(0.0936)	(0.0693)	(0.0358)	(0.0621)	(0.0327)	(0.0721)
Ln(TA)	-0.0084	0.0029	-0.0046	0.0074	-0.0048	0.0081
	(0.0098)	(0.0087)	(0.0096)	(0.0077)	(0.0073)	(0.0083)
PB	0.0076	0.0024*	0.0071***	0.0028***	0.0070	0.0031
	(0.0006)	(0.0007)	(0.0018)	(0.0003)	(0.0051)	(0.0004)
Moral hazard index	-0.0022	0.0021	-0.0021	0.0041	-0.0019	0.0036***
	(0.0034)	(0.0016)	(0.0037)	(0.0005)	(0.0016)	(0.0006)
Liquid ratio	-0.0070	0.0011	-0.0062	-0.0046	-0.0065	-0.0058
	(0.0113)	(0.0133)	(0.0109)	(0.0157)	(0.0163)	(0.0167)
Equity-to-asset	-0.3361	-0.0430	-0.2230	-0.1104*	-0.2183	-0.0931*
	(0.3996)	(0.0664)	(0.2859)	(0.0351)	(0.2974)	(0.0298)
ROA	1.1748	-0.3200	0.9045	-0.2264***	0.9072	-0.2593
	(0.9001)	(0.1700)	(0.7867)	(0.0138)	(0.7033)	(0.0597)
Short-term debt	-0.1564	0.0311**	-0.0359	0.0334***	-0.0349	0.0321***
	(0.1354)	(0.0054)	(0.0232)	(0.0029)	(0.0290)	(0.0038)
Non-interest income	0.0157	-0.0006	0.0102	-0.0109*	0.0109	-0.0112**
	(0.0103)	(0.0054)	(0.0094)	(0.0038)	(0.0078)	(0.0020)
Z-score	0.0003	0.00003	0.0002	0.00009	0.0002	0.00008
	(0.0003)	(0.00007)	(0.0003)	(0.00004)	(0.0002)	(0.00004)
Cross-border	0.0075	-0.0009	0.0072	0.0009	0.0081	0.0006
	(0.0053)	(0.0033)	(0.0055)	(0.0011)	(0.0056)	(0.0008)
Geographic diversification	0.0055	-0.0008	0.0057	-0.0001	0.0058	0.0001
	(0.0063)	(0.0017)	(0.0065)	(0.0039)	(0.0057)	(0.0034)
Systemic importance	-0.0038	-0.0004	-0.0099	0.0019	-0.0105	0.0010
	(0.0200)	(0.0042)	(0.0119)	(0.0031)	(0.0172)	(0.0034)
Bailout	0.0073	-0.0134***	0.0055	-0.0127***	0.0050	-0.0127***
	(0.0109)	(0.0021)	(0.0110)	(0.0015)	(0.0173)	(0.0012)
Real GDP growth	-0.0060**	0.0005	-0.0052*	-0.0003	-0.0053**	-0.0003
	(0.0025)	(0.0012)	(0.0023)	(0.0006)	(0.0019)	(0.0006)
Inflation	-0.0023***	0.0002	-0.0020	-0.0008	-0.0020*	-0.0010
	(0.0007)	(0.0012)	(0.0009)	(0.0015)	(0.0009)	(0.0018)
Money supply growth	0.0023	0.00001*	0.0019	0.00001**	0.0019	0.00006**
	(0.0007)	(0.000004)	(0.0008)	(0.000002)	(0.0003)	(0.00002)
CR5	0.0001	0.00003	0.0001	0.00004	0.0001	0.00007
	(0.00007)	(0.00007)	(0.00006)	(0.00004)	(0.00008)	(0.00004)
Capital regulatory index	0.00007	0.0013	0.0001	0.0013***	0.0003	0.0012***
	(0.0017)	(0.0002)	(0.0016)	(0.0002)	(0.0038)	(0.00008)
Official supervisory index	0.0075	0.0018	0.0064*	0.0010	0.0065***	0.0011
	(0.0021)	(0.0011)	(0.0027)	(0.0013)	(0.0009)	(0.0013)
Deposit insurer power	0.0038	0.0005	0.0024	-0.0006	0.0025	-0.0002
	(0.0019)	(0.0011)	(0.0041)	(0.0008)	(0.0031)	(0.0009)
Private monitoring index	-0.0042*	0.0004	-0.0036	-0.0014	-0.0037*	-0.0013
	(0.0022)	(0.0016)	(0.0024)	(0.0011)	(0.0019)	(0.0010)
Obs.	47	53	47	53	47	53
R^2	0.1743	0.5864	0.3413	0.4878	0.3256	0.4273

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

include different banking integration indicators, but they have same signs with ΔMES in post-crisis models (or pre-crisis models) that contain different banking integration indicators. These are reasonable results because many variables are heterogeneous in post-crisis and pre-crisis periods.

Tables 3A-7 and 3A-8 present the results of acquirers' changes of LTD for M&As in post- crisis and pre-crisis periods (see in the Appendix). Similar to the results of MES models, the results of LTD models show that many independent variables have different signs with ΔLTD in post-crisis and pre-crisis models. For example, different banking integration indicators have opposite signs with LTD. For example, IRDIFFERENCE1 and IRDIFFERENCE5 are negatively significant related to ΔLTD while DISPERSION5 is positively related to ΔLTD in post-crisis models. These results indicate that the higher interest rate differences on loans and deposits of euro area banking market and lower cross-country standard deviation of MFI interest rates on loans to non-financial corporations and households lead to lower LTD after M&As. The first result is consistent with our previous findings while the second result is not. This can be explained by the fact the interest rate difference and cross-country standard deviation of MFI interest rates on loans are two heterogeneous banking integration indicators. Moreover, price-to-book ratio, liquidity ratio, short-term debt ratio, non-interest income ratio, z-score cross-border, geographic diversification, systematic importance, bailout, inflation, money supply growth rate and concentration ratio have opposite signs with ΔLTD in post-crisis and pre-crisis models. This can be interpreted by the fact that bank-specific accounting ratios, bank-specific variables and regulatory variables are different in post-crisis and pre-crisis periods.

However, there are still some independent variables that have same signs with ΔLTD. For instance, asset diversity and non-performing loan ratio are negatively significant related to ΔLTD, indicating that acquirers with higher product diversification and lower asset quality will have lower LTD. These results provide further evidences for our previous findings. ROA is also

negatively significant related to ΔLTD, showing that acquirers having higher profitability will have lower LTD. In addition, capital regulatory index is positively significant related to ΔLTD while official supervisory index is negatively significant related to ΔLTD. These results reveal that acquirers from countries with less stringent capital regulation and more stringent supervision will have lower LTD. If acquirers are required to hold higher level of capital, they may manage liquidity risk in a less prudent manner, acquirers will have higher systemic risk contributions to banking system. If acquirers are subject to more stringent supervision, acquirers will have lower systemic risk contributions to banking system.

Tables 3A-9 and 3A-10 report the results of acquirers' changes of ΔCoVaR for M&As in post-crisis and pre-crisis periods (see in the Appendix). First, we find that interest rate differences are positively significant related to change of ΔCoVaR in post-crisis models. These results are different from previous finding and indicate that the higher interest rate differences on loans in the euro area banking market (or the lower level of banking integration), the higher acquirers'ΔCoVaR after M&As. Nevertheless, on the contrary, the cross-country standard deviation of MFI interest rates on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million) is negatively significant related to change of ΔCoVaR in pre-crisis model (regression (2) in table 3A-10). This is consistent with our previous finding of the destabilizing effect of banking integration (hypothesis). Moreover, asset diversity is negatively significant related to change of ΔCoVaR in regression (1) in tables 3A-9 and 3A-10. These results partly provide further evidences for acquirers with higher asset diversity will have lower systemic risk after M&As. Moral hazard index is positively significant related to change of ΔCoVaR in all models with banking integration indicators. These results demonstrate that the deposit insurance scheme creates higher moral hazard problem but reduce acquirers' systemic risks after M&As. This result is consistent with Bostandzic et al. (2014).

Similar to the results in ΔMES and ΔLTD models, many other variables have opposite signs in

post-crisis and pre-crisis models. For example, capital regulatory index is negatively significant related to change of ΔCoVaR in some post-crisis models while it is positively significant related to change of ΔCoVaR in some pre-crisis models. These results show that acquirers from countries with more stringent capital regulation have lower systemic risk in pre-crisis period while acquirers from countries with less stringent capital regulation have lower systemic risk in post-crisis period. This is a surprising result because it implies that the more stringent capital regulation works better in M&A deals in pre-crisis years than in M&As in post-crisis years. In pre-crisis years, more stringent capital regulation is more likely to result in lower systemic risk; however, in post-crisis years, more stringent capital regulation does not necessarily lead to lower systemic risk. This can be interpreted as follows: if banks Are required to comply with more stringent capital requirement in the phase of systemic risk buildup in non-crisis years, SIFIs will have more capitals to cover expected and unexpected losses and thus will have lower individual risks and lower systemic risk contributions to banking system; however, after the financial crisis breaks out, if banks are required to raise more capitals, their profitability ratios (e.g. ROE and ROA) may be lowered; moreover, some banks may conduct less prudent manner in liquidity risk management after they raise more capitals from financial markets. Under these circumstances, banks may have higher systemic risks even if they comply with more stringent capital regulations and have higher capital ratios. Interestingly, these interpretations can also be used to explain the contradictory results of tier 1 capital ratio in post-crisis and pre-crisis models. In summary, for all three systemic risk measures, there are a number of explanatory variables that have opposite signs in post-crisis and pre-crisis models. This is because these variables, including some bank-specific variables, deal-specific variables, macroeconomic variables and regulatory variables, change significantly and have very different effects on acquirers' systemic risk changes. This indicates that it is really necessary for us to compare the results of post-crisis models with the results of pre-crisis models.

3.6.5 Relationships between Acquirers' Systemic Risk Changes and Banking Integration Indicators

As discussed in the subsection 3.4.4, the significant coefficients of banking integration indicators do not necessarily indicate the causal relationships between acquirers' systemic risk changes and banking integration indicators. In this subsection, we will use the Granger-causality tests to investigate such causal relationships between acquirers' systemic risk banking integration indicators, they will have causal relationships with banking integration indicators; if banking integration indicators granger-cause acquirers' systemic risk changes, they will have causal relationships with acquirers' systemic risk changes as well. However, if neither one granger-causes the other, they will not have causal relationships with each other. Table 3-16 presents results of pairwise Granger-causality tests for changes of three systemic risk measures. Most results are not significant, indicating that most systemic risk measures do not have causal relationships with most banking integration indicators. We only have a few significant results for the Granger-causality tests. For example, interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries granger causes change of ΔCoVaR, indicating that lower interest rate difference causes higher ΔCoVaR. Change of MES granger causes interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries, showing that higher MES causes lower interest rate difference. The similar result is that higher MES causes lower interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries. Moreover, change of LTD granger causes the full range of interest rate difference on MFI deposits for household across euro area countries (max.- min.), revealing that higher LTD causes lower interest rate difference on

Table 3-16 Results of Pairwise Granger-Causality Tests

Null Hypothesis	F-statistics	p-value
(1) Interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries does not granger cause ΔMES (IRDIFFERENCE1)	2.3195	0.1033
ΔMES does not granger cause interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries	1.4433	0.2408
(2) Interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries does not granger cause ΔLTD	0.0022	0.9978
ΔLTD does not granger cause interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries	0.3211	0.7261
(3) Interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries does not granger cause change of ΔCoVaR	2.9302*	0.0578
Change of ΔCoVaR does not granger cause interest rate difference on new loans to euro area non-financial corporations between distressed and non-distressed countries	0.9619	0.3855
(4) Interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries does not granger cause ΔMES (IRDIFFERENCE5)	1.9677	0.1448
ΔMES does not granger cause interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries	2.5093*	0.0861
(5)Interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries does not granger cause ΔLTD	0.0282	0.9722
ΔLTD does not granger cause interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries	0.7448	0.4774
(6)Interest rate difference on new loans to euro area non-financial corporations between euro area average and non-distressed countries does not granger cause Change of ΔCoVaR	2.1073	0.1267
Change of ΔCoVaR does not granger cause interest rate difference on new loans to euro area non-financial corporations between euro area average and distressed countries	0.6605	0.5188
(7)Full range of interest rate difference on MFI deposits for household across euro area		

countries (max – min) does not granger cause ΔMES (IRDIFFERENCE2)	0.9595	0.3864
ΔMES does not granger cause full range of interest rate difference on MFI deposits for household across euro area countries (max – min)	3.3451**	0.0390
(8)Full range of interest rate difference on MFI deposits for household across euro area countries (max – min) does not granger cause ΔLTD	0.1895	0.8277
ΔLTD does not granger cause full range of interest rate difference on MFI deposits for household across euro area countries (max – min)	2.7008*	0.0720
(9) Full range of interest rate difference on MFI deposits for household across euro area countries (max – min) does not granger cause Change of ΔCoVaR	1.7579	0.1774
Change of ΔCoVaR does not granger cause full range of interest rate difference on MFI deposits for household across euro area countries (max – min)	0.7081	0.4949
(10) Inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$) does not granger cause ΔMES (IRDIFFERENCE3)	4.2921**	0.0161
ΔMES does not granger cause inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$)	0.0421	0.9588
(11) Inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$) does not granger cause ΔLTD	1.5756	0.2241
ΔLTD does not granger cause inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$)	0.3066	0.7383
(12) Inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$) does not granger cause Change of ΔCoVaR	1.7579	0.1774
Change of ΔCoVaR does not granger cause inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} – 1^{st}$)	0.7081	0.4949
(13) Cross-country standard deviation of MFI interest rates on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million) does not granger cause ΔMES (DISPERSION5)	1.2405	0.2934
ΔMES does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)	0.9917	0.3743
(14) Cross-country standard deviation of MFI interest rates on loans to non-financial		

institution (floating rate and up to 1 year IRF, over EUR 1 million) does not granger cause ΔLTD	0.6818	0.5080
ΔLTD does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)	0.7166	0.4909
(15) Cross-country standard deviation of MFI interest rates on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million) does not granger cause Change of ΔCoVaR	2.3197	0.1033
Change of ΔCoVaR does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)	0.2374	0.7891
(16) Cross-country standard deviation of MFI interest rates on loans to household (consumer credit, over 1 year and up to 5 years IRF) does not granger cause ΔMES (DISPERSION3)	0.2333	0.7923
ΔMES does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (consumer credit, over 1 year and up to 5 years IRF)	1.1640	0.3162
(17) Cross-country standard deviation of MFI interest rates on loans to household (consumer credit, over 1 year and up to 5 years IRF) does not granger cause ΔLTD	0.3450	0.7090
ΔLTD does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (consumer credit, over 1 year and up to 5 years IRF)	0.2936	0.7462
(18) Cross-country standard deviation of MFI interest rates on loans to household (consumer credit, over 1 year and up to 5 years IRF) does not granger cause Change of ΔCoVaR	0.1012	0.9039
Change of ΔCoVaR does not granger cause cross-country standard deviation of MFI interest rate on loans to non-financial institution (floating rate and up to 1 year IRF, over EUR 1 million)	1.2042	0.3040

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively

deposits. Finally, inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd.} - 1^{st.}$) granger causes change of MES, showing that lower interest rate difference causes higher MES.

3.6.6 Robustness Checks

One may argue that the previous finding that "acquirers' systemic risks increase significantly after M&As" is not sufficient to conclude that "acquirers increase their systemic risks due to M&As". One can argue that acquirers' systemic risks increase due to the destabilizing effects of financial crises. To find more robust evidences to support our previous finding, we conduct p-score matching method to match merging group with non-merging group and examine whether merging group increases systemic risk after M&As while non-merging group does not increase systemic risk.

In p-score matching, the average differences in p-scores are relatively small, indicating a good matching between merging banks and non-merging banks. Table 3-17 presents the systemic risk changes for merging and non-merging banks. Panel A shows that all three systemic risk measures increase significantly after M&As for acquirers and combined banks. On the contrary, panel B indicates that all three systemic risk measures decreased significantly for matched non-merging banks in the same time periods. These results provide robust evidences for systemic risk increases due to bank M&As.

Additionally, we investigate the robustness of the main results by using the same fixed-effect models and the same dependent variables but with different explanatory variables. On the one hand, we employ different banking integration indicators, that is, we replace IRDIFFERENCE1, IRDIFFERENCE5 and DISPERSION5 with IRDIFFERENCE2, IRDIFFERENCE3 and DISPERSION3; on the other hand, we use different bank-specific, deal-specific, macroeconomic, structural and regulatory variables in different regressions.

Table 3-18, table 3-19 and table 3-20 report the results of fixed-effect models with MES as dependent variable and different explanatory variables. The estimated coefficients of banking integration indicators and asset diversity are negative while the estimated coefficients of natural log of total asset are positive. If acquirers have 1% higher asset diversity, their

Table 3-17 Systemic Risk Changes for Merging and Non-merging banks

	N	$Acquirer_{pre-merger}$	$Combined_{pre-merger}$	$Combined_{post-merger}$	ΔAcquirer	ΔCombined
PanelA: Acquirer+ Target						
MES	321	0.022	0.018	0.025	0.003*** (0.012)	0.007*** (0.003)
LTD	307	0.823	0.804	0.853	0.003*** (0.005)	0.0049*** (0.002)
ΔCoVaR	315	15.3238	19.5644	20.0832	4.2406** (0.015)	4.5188*** (0.008)
PanelB: Matched non-merging banks						
MES	640		0.016	0.008		-0.008*** (0.008)
LTD	640		0.752	0.648		-0.104*** (0.006)
ΔCoVaR	640		18.3248	17.0815		-1.2433*** (0.005)

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

marginal expected shortfall will decrease by approximate 0.75%-1%. Moreover, if acquirers' sizes increase by 1%, their marginal expected shortfall will decrease by about 0.55%.

In addition, table 3A-11, table 3A-12 and table 3A-13 present results of fixed-effect models with ΔLTD as dependent variables and different explanatory variables (see in the Appendix). These results provide more robust evidences for smaller and more asset-diversified acquirers will have lower systemic risks after M&As. If acquirers' asset diversity increases by 1%, their lower tail dependences will decrease by more than 2%; moreover, if acquirers' natural log of total assets increase by 1%, their systemic risks will increase by about 2% - 4%.

Next, table 3A-14, table 3A-15 and table 3A-16 demonstrate results of fixed-effect models with change of ΔCoVaR as dependent variables and different explanatory variables (see in the Appendix). These results partly confirm our previous findings that (1) acquirers from more integrated banking markets (2) acquirers having less asset diversity will have higher systemic

Table 3-18 Determinants of Acquirers' Changes of MES for Cross-border M&As

Variable	(1) ΔMES IR DIFFERENCE3 Full	(2) ΔMES IR DIFFERENCE2 Full	(3) ΔMES DISPERSION3 Full	(4) ΔMES IR DIFF3 Bank-specific	(5) ΔMES IR DIFF2 Bank-specific	(6) ΔMES DISPERSION3
Banking integration	-0.0097	-0.0048	-0.0001	-0.0119	-0.0071**	-0.0001
	(0.0099)	(0.0031)	(0.0001)	(0.0100)	(0.0030)	(0.0001)
Asset diversity	-0.0104*	-0.0103*	-0.0093	-0.0084*	-0.0079**	-0.0075*
	(0.0056)	(0.0055)	(0.0056)	(0.0042)	(0.0040)	(0.0041)
Non-performing loan	-0.0967***	-0.1004***	-0.0919**	-0.0374	-0.0425	-0.0350
	(0.0360)	(0.0356)	(0.0365)	(0.0305)	(0.0298)	(0.0306)
Tier 1 Capital	0.0889**	0.0904**	0.0881	0.0675*	0.0638	0.0651
	(0.0420)	(0.0415)	(0.0420)	(0.0397)	(0.0387)	(0.0398)
Ln(TA)	0.0059*	0.0060*	0.0057*	0.0054***	0.0048***	0.0054***
	(0.0031)	(0.0031)	(0.0031)	(0.0018)	(0.0018)	(0.0018)
PB	0.0036*	0.0037**	0.0040**	0.0014	0.0016	0.0019
	(0.0018)	(0.0018)	(0.0018)	(0.0015)	(0.0015)	(0.0015)
Moral hazard index	0.0045*	0.0038	0.0046*			
	(0.0023)	(0.0023)	(0.0024)			
Liquid ratio	-0.0145*	-0.0135	-0.0145*	-0.0097	-0.0093	-0.0093
	(0.0084)	(0.0082)	(0.0084)	(0.0059)	(0.0266)	(0.0059)
Equity-to-asset	-0.0349	-0.0538	-0.0371	-0.0606	-0.0713	-0.0614
	(0.0648)	(0.0644)	(0.0646)	(0.0528)	(0.0516)	(0.0529)
ROA	-0.1758	-0.1464	-0.1772	-0.0420	-0.0186	-0.0411
	(0.2660)	(0.2620)	(0.2657)	(0.2097)	(0.2034)	(0.2104)
Short-term debt	0.0179**	0.0173**	0.0178**	0.0086	0.0073	0.0083
	(0.0087)	(0.0086)_	(0.0087)	(0.0070)	(0.0069)	(0.0070)
Non-interest income	-0.0071	-0.0071	-0.0070	-0.0059	-0.0070	-0.0056
	(0.0061)	(0.0060)	(0.0061)	(0.0051)	(0.0050)	(0.0052)
Z-score	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Cross-border	-0.0026	-0.0032	-0.0028			
	(0.0048)	(0.0047)	(0.0047)			
Geographic diversification	0.0025	0.0017	0.0027			
	(0.0025)	(0.0025)	(0.0025)			
Systemic importance	0.0023	0.0012	0.0023			
	(0.0046)	(0.0046)	(0.0046)			
Bailout	-0.0143***	-0.0132***	-0.0141***			
	(0.0042)	(0.0042)	(0.0042)			
Real GDP growth	0.0009	0.0008	0.0008			
	(0.0011)	(0.0010)	(0.0011)			
Inflation	-0.0016	-0.0013	-0.0015			
	(0.0009)	(0.0009)	(0.0010)			
Money supply growth	-0.0001	0.0001	0.0001			
	(0.0001)	(0.0001)	(0.0001)			
CR5	0.0001	0.0001	0.0001			
	(0.0001)	(0.0001)	(0.0001)			
Capital regulatory index	0.0011	0.0012	0.0013			
	(0.0010)	(0.0010)	(0.0010)			
Official supervisory index	0.0026	0.0023**	0.0027***			
	(0.0009)	(0.0009)	(0.0009)			
Deposit insurer power	-0.0014	-0.0019	-0.0016			
	(0.0021)	(0.0021)	(0.0021)			
Private monitoring index	0.0024	0.0022	0.0027*			
	(0.0015)	(0.0015)	(0.0015)			
Obs.	100	100	100	105	105	105
R^2	0.2814	0.2729	0.2647	0.1829	0.2217	0.1798

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively.
Numbers in parentheses are heteroscedasticity-robust standard errors.

Table 3-19 Determinants of Acquirers' Changes of MES for Cross-border M&As

Variable	(1) ΔMES IR DIFFERENCE3 Bank-specific Deal-specific	(2) ΔMES IR DIFFERENCE2 Bank-specific Deal-specific	(3) ΔMES DISPERSION3 Bank-specific Deal-specific	(4) ΔMES IR DIFF3 Bank-specific Regulatory	(5) ΔMES IR DIFF2 Bank-specific Regulatory	(6) ΔMES DISPERSION3 Bank-specific
Banking integration	-0.0141*	-0.0072**	-0.0001	-0.0086	-0.0076**	-0.0001
	(0.0074)	(0.0026)	(0.0001)	(0.0069)	(0.0031)	(0.0001)
Asset diversity	-0.0110**	-0.0106**	-0.0098**	-0.0073	-0.0067	-0.0062
	(0.0044)	(0.0043)	(0.0043)	(0.0057)	(0.0047)	(0.0048)
Non-performing loan	-0.0494	-0.0560	-0.0467	-0.0502	-0.0605*	-0.0503
	(0.0287)	(0.0312)	(0.0259)	(0.0286)	(0.0330)	(0.0341)
Tier 1 Capital	0.0613	0.0603	0.0590	0.0821*	0.0886**	0.0851*
	(0.0504)	(0.0473)	(0.0491)	(0.0429)	(0.0419)	(0.0432)
Ln(TA)	0.0088**	0.0084**	0.0088**	0.0036**	0.0035	0.0036
	(0.0029)	(0.0029)	(0.0028)	(0.0013)	(0.0025)	(0.0026)
PB	0.0030**	0.0032**	0.0035**	0.0018	0.0018	0.0022
	(0.0013)	(0.0010)	(0.0014)	(0.0016)	(0.0017)	(0.0017)
Moral hazard index				0.0020	0.0019	0.0020
				(0.0023)	(0.0019)	(0.0020)
Liquid ratio	-0.0108	-0.0105	-0.0100	-0.0095	-0.0080	-0.0092
	(0.0080)	(0.0077)	(0.0078)	(0.0091)	(0.0069)	(0.0071)
Equity-to-asset	-0.0375	-0.0527	-0.0399	-0.0900	-0.1223*	-0.0970
	(0.0728)	(0.0627)	(0.0703)	(0.0719)	(0.0638)	(0.0654)
ROA	-0.2004	-0.1448	-0.1857	0.0014	0.0659	0.0061
	(0.2199)	(0.1624)	(0.2014)	(0.2950)	(0.2268)	(0.2354)
Short-term debt	0.0151	0.0142	0.0149	0.0125	0.0122	0.0128
	(0.0101)	(0.0102)_	(0.0096)	(0.0144)	(0.0081)	(0.0083)
Non-interest income	-0.0072**	-0.0081**	-0.0068**	-0.0071	-0.0069	-0.0058
	(0.0026)	(0.0027)	(0.0023)	(0.0033)	(0.0056)	(0.0057)
Z-score	0.00001	0.00001	0.00001	0.00004	0.00003	0.00005
	(0.00005)	(0.00004)	(0.00005)	(0.00008)	(0.00009)	(0.00009)
Cross-border	-0.0037	-0.0041	-0.0039			
	(0.0032)	(0.0029)	(0.0033)			
Geographic diversification	-0.0001	-0.0008	-0.00002			
	(0.0021)	(0.0023)	(0.0022)			
Systemic importance	-0.0023	-0.0033	-0.0025			
	(0.0032)	(0.0027)	(0.0028)			
Bailout	-0.0072**	-0.0065*	-0.0068**			
	(0.0027)	(0.0025)	(0.0028)			
Real GDP growth						
Inflation						
Money supply growth						
CR5						
Capital regulatory index				0.0004	0.0006	0.0007
				(0.0004)	(0.0009)	(0.0009)
Official supervisory index				0.0012	0.0009	0.0011
				(0.0008)	(0.0007)	(0.0008)
Deposit insurer power				-0.0016	-0.0018	-0/0011
				(0.0013)	(0.0019)	(0.0019)
Private monitoring index				0.0008	0.0008	0.0010
				(0.0018)	(0.0012)	(0.0013)
Obs.	105	105	105	101	101	101
R^2	0.2540	0.2870	0.2473	0.2112	0.2672	0.2228

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3-20 Determinants of Acquirers' Changes of MES for Cross-border M&As

Variable	(1) ΔMES IR DIFFERENCE3 Bank-specific Macroeconomic	(2) ΔMES IR DIFFERENCE2 Bank-specific Macro	(3) ΔMES DISPERSION3 Bank-specific Macro	(4) ΔMES IR DIFF3 Bank-specific Deal-specific Macroeconomic	(5) ΔMES IR DIFF2 Bank-specific Deal-specific Macro	(6) ΔMES DISPERSION3 Bank-specific Deal-specific
Banking integration	-0.0120	-0.0065**	-0.00006	-0.0134	-0.0070**	-0.00006
	(0.0077)	(0.0025)	(0.00008)	(0.0100)	(0.0031)	(0.00007)
Asset diversity	-0.0098**	-0.0089**	-0.0087**	-0.0115**	-0.0109**	-0.0107**
	(0.0037)	(0.0036)	(0.0036)	(0.0044)	(0.0046)	(0.0045)
Non-performing loan	-0.0423	-0.0464	-0.0392	-0.0759**	-0.0814**	-0.0648**
	(0.0257)	(0.0300)	(0.0237)	(0.0346)	(0.0322)	(0.0358)
Tier 1 Capital	0.0588	0.0564	0.0561	0.0614	0.0617	0.0586
	(0.0584)	(0.0546)	(0.0566)	(0.0404)	(0.0550)	(0.0417)
Ln(TA)	0.0057**	0.0051**	0.0058**	0.0080***	0.0074***	0.0081***
	(0.0019)	(0.0021)	(0.0020)	(0.0028)	(0.0028)	(0.0028)
PB	0.0016	0.0017	0.0020	0.0038**	0.0033**	0.0037**
	(0.0014)	(0.0012)	(0.0015)	(0.0016)	(0.0016)	(0.0017)
Moral hazard index						
Liquid ratio	-0.0093	-0.0089	-0.0090	-0.0082	-0.0063	-0.0082
	(0.0078)	(0.0072)	(0.0074)	(0.0065)	(0.0091)	(0.0067)
Equity-to-asset	-0.0436	-0.0555	-0.0438	-0.0502	-0.0370	-0.0340
	(0.0821)	(0.0748)	(0.0791)	(0.0557)	(0.0789)	(0.0570)
ROA	0.0184	0.0246	0.0066	-0.0987	-0.1356	-0.1227
	(0.1949)	(0.1647)	(0.1846)	(0.2411)	(0.1980)	(0.2500)
Short-term debt	0.0069	0.0061	0.0068	0.0136	0.0141	0.0136
	(0.0127)	(0.0127)_	(0.0121)	(0.0081)	(0.0120)	(0.0084)
Non-interest income	-0.0039	-0.0055	-0.0036	-0.0061	-0.0061	-0.0049*
	(0.0034)	(0.0036)	(0.0032)	(0.0053)	(0.0057)	(0.0059)
Z-score	0.00004	0.00003	0.00004	0.00006	0.00004	0.00002
	(0.00004)	(0.00003)	(0.00004)	(0.00007)	(0.00007)	(0.00007)
Cross-border				-0.0049	-0.0056	-0.0048
				(0.0045)	(0.0031)	(0.0046)
Geographic diversification				-0.0017	-0.0017	-0.0008
				(0.0022)	(0.0021)	(0.0022)
Systemic importance				-0.0026	-0.0023	-0.0017
				(0.0038)	(0.0033)	(0.0039)
Bailout				-0.0057*	-0.0060*	-0.0060*
				(0.0034)	(0.0032)	(0.0035)
Real GDP growth	0.0008	0.0006	0.0008	0.0004	0.0004	0.0005
	(0.0007)	(0.0006)	(0.0007)	(0.0008)	(0.0006)	(0.0008)
Inflation	-0.0011	-0.0008	-0.0010	-0.0008	-0.0007	-0.0009
	(0.0006)	(0.0006)	(0.0006)	(0.0008)	(0.0005)	(0.0009)
Money supply growth	0.00004*	0.00005***	0.00004**	0.00009	0.00009	0.00008
	(0.00002)	(0.00001)	(0.00002)	(0.00009)	(0.00009)	(0.00009)
CR5				-0.00006	-0.00006	-0.00004
				(0.00006)	(0.00001)	(0.00007)
Capital regulatory index						
Official supervisory index						
Deposit insurer power						
Private monitoring index						
Obs.	104	104	104	104	104	104
R^2	0.2130	0.2423	0.2072	0.3156	0.3221	0.2757

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

risks after M&As but no further evidence for larger acquirers will have higher systemic risks after M&As. For example, if acquirers increase asset diversity by 1%, their ΔCoVaR will decrease by more than 0.24. In addition, if the inter-quantile of interest rate difference on MFI deposits for household across euro area countries ($3^{rd} - 1^{st}$) increase by 0.01% (1 bp), acquirers' change of ΔCoVaR will decrease by approximate 0.5. However, we conduct granger-causality tests again and find no causal relationships between acquirers' systemic risk measures and the three alternative banking integration indicators.

Finally, other results in robustness checks partly provide evidences for our previous findings that acquirers (1) with lower asset quality in previous year; (2) with lower capital ratio in previous year; (3) with lower price-to-book ratio; (4) that not rely much on short-term debt; (5) that receive bailouts; (6) from countries whose deposit insurers are more powerful and (7) from countries that encourage investors to engage in more private monitoring will have lower systemic risks after M&As.

3.7 Conclusions and Policy Implications

In this chapter, we first calculate the average changes of acquirers' MES, LTD and ΔCoVaR and use t-tests to investigate whether systemic risk increased or decreased significantly after M&As. We find that acquirers' MES, LTD and ΔCoVaR increased significantly after M&As, thereby providing support to our first research question. This result can be explained as follows: acquirers' increase their size via M&As and become TBTF banks, therefore, they are more likely to be bailout. Once bank managers have this expectation, they are more likely to take riskier activities and increase banks' systemic risk.

We then compute the average changes of peer banks' MES, LTD and ΔCoVaR. We find that both MES and LTD of competitors increase significantly while change of ΔCoVaR increases insignificantly. We employ t-test again to demonstrate that merging banks and their competitors

suffer the same extent from the increase in systemic risks. Our findings provide implications for bank supervisors and regulators that M&As are not the only factor that affect significantly acquirers' systemic risks. We use more t-tests to find that the two financial crises had a significantly negative impact on acquirers' systemic risks, and the U.S. Financial Crisis had more negative impacts on acquirers' systemic risks than the European Sovereign Debt Crisis (research question 2). This result is expected as the former is the global financial crisis while the latter is the regional financial crisis. It is reasonable that the former had more pronounced effects than the latter.

In addition, to find more robust evidences for acquirers' increases in systemic risks due to bank M&As, we conduct an important robustness check by using propensity score matching. Specifically, we match merging banks with non-merging banks based on total assets and market-to-book ratio and compute the average changes of three systemic risk measures for acquirers, combined banks and non-merging banks. We find that all three systemic risk measures increase significantly for acquirers and combined banks while they decreased significantly for non-merging banks. These results provide robust evidences for acquirers and policy implications for bank regulators and supervisors that increase systemic risks due to bank M&As. We recommend that bank regulators and supervisors should scrutinize bank M&A deals in order to achieve financial stability in European banking market.

To test whether banks with different characteristics will have different systemic risks after M&As, we divide the full sample into different sub-samples based on different characteristics. We also find that (1) large acquirers have higher systemic risks after M&As than small and medium-sized acquirers; (2) acquirers that engage in cross-border M&As have higher systemic risks after M&As than acquirers that engage in domestic M&As; (3) acquirers from core countries have higher systemic risks after M&As than acquirers from periphery countries (research question 3). All these findings give bank regulators, supervisors and managers the

implications about which characteristics can significantly affect acquirers' systemic risks after M&As. We recommend that regulators and supervisors should approve domestic M&As whose acquirers are large banks headquartered in periphery countries.

We next turn to employ fixed-effect models to identify more determinants of acquirers' systemic risk changes after M&As (research question 3). First, we find strong evidences for the hypothesis that acquirers with higher asset diversity will have lower systemic risks after M&As. This important finding implies that product diversification can contribute to lower bank-specific risk and achieve financial stability. Second, we also find some evidences for the hypothesis that larger acquirers will have higher systemic risks after M&As. This implies that exploitation of safety-net subsidies hypothesis holds. Large acquirers can engage in M&As to become even larger and are eligible for "too-big-to-fail" banks, then they are able to receive safety-net subsidies. This worsens moral hazard problem and enables banks to take more risks, and finally, leads to banks' higher systemic risk contributions to banking system. Third, we identify some evidences for acquirers from more integrated banking markets may have higher systemic risk after M&As. This implies that the destabilizing effect of banking integration to some extent exists. This may be explained as follows: acquirers from more integrated markets become even larger and more interconnected after M&As thus may have higher systemic risk. Besides these findings, we further identify that systemic risk measures are significant with several variables, indicating that acquirers with different characteristics in the previous year will have different systemic risk after M&As this year. We find evidences for acquirers (1) with lower asset quality in previous year; (2) with lower capital ratio in previous year; (3) with lower price-to-book ratio; (4) that not rely much on short-term debt; (5) that receive bailouts; (6) from countries whose deposit insurers are more powerful and (7) from countries that more encourage investors to engage in private monitoring will have lower risks after M&As this year. These findings provide implications for European banking regulators what types of bank mergers in

this year are more likely to contribute to financial stability next year. Bank regulators may ask banks that engage in large cross-border M&As to hold relatively higher capital and liquidity than other banks.

Finally, we use both post-crisis and pre-crisis sub-samples to conduct fixed-effect models for all three systemic risk measures. We include and exclude banking integration indicators in the models. First, we find that a number of explanatory variables have opposite signs with three systemic risk measures. These results imply that those variables have significantly different effects on acquirers' systemic risks in post-crisis period, compared with those in pre-crisis period. Therefore, banking regulators, supervisors and managers should scrutinize changes of those variables and take different actions to reduce acquirers' systemic risks before crisis and after crisis.

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Appendix

Table 3A-1 Determinants of Acquirers' changes of LTD for Cross-border M&As

Variable	(1) ΔLTD IR DIFFERENCE1 Full	(2) ΔLTD IR DIFFERENCE5 Full	(3) ΔLTD DISPERSION5 Full	(4) ΔLTD IR DIFF1 Bank-specific	(5) ΔLTD IR DIFF Bank-specific	(6) ΔLTD DISPERSION5
Banking integration	-0.0503	-0.0778*	-0.0009	-0.0842	-0.0716	0.0005
	(0.0355)	(0.0377)	(0.0009)	(0.0356)	(0.0686)	(0.0016)
Asset diversity	-0.0301**	-0.0328	-0.0262	-0.0337*	-0.0344*	-0.0346*
	(0.0140)	(0.0289)	(0.0151)	(0.0187)	(0.0187)	(0.0190)
Non-performing loan	-0.1233*	-0.0758	-0.0659	-0.0706	-0.0736	-0.0532
	(0.0591)	(0.0560)	(0.0824)	(0.1362)	(0.1366)	(0.1366)
Tier 1 Capital	0.3470*	0.3264*	0.1184	0.3684**	0.3707**	0.3711*
	(0.1556)	(0.1525)	(0.1120)	(0.1770)	(0.1771)	(0.1782)
Ln(TA)	0.0404**	0.0397**	0.0181	0.0240***	0.0240***	0.0269***
	(0.0154)	(0.0168)	(0.0133)	(0.0084)	(0.0084)	(0.0081)
PB	0.0121**	0.0122**	0.0080	0.0035	0.0036	0.0052
	(0.0047)	(0.0051)	(0.0055)	(0.0068)	(0.0068)	(0.0067)
Moral hazard index	-0.0115*	-0.0084	0.0027			
	(0.0096)	(0.0101)	(0.0076)			
Liquid ratio	0.0157	0.0063	0.0346	-0.0295	-0.0306	-0.0355
	(0.0743)	(0.0748)	(0.0339)	(0.0267)	(0.0266)	(0.0266)
Equity-to-asset	-0.3903	-0.3424	-0.2026	-0.3563	-0.3572	-0.3455
	(0.2200)	(0.1959)	(0.1886)	(0.2401)	(0.2402)	(0.2440)
ROA	2.1159	2.0492	1.4011	2.1341**	2.0996**	2.1469**
	(2.0372)	(1.9247)	(1.4867)	(0.9571)	(0.9597)	(0.9689)
Short-term debt	0.0191	0.0179	0.0295	-0.0122	-0.0132	-0.0109
	(0.0612)	(0.0621)_	(0.0285)	(0.0314)	(0.0314)	(0.0322)
Non-interest income	0.0053	0.0014	-0.0129	0.0101	0.0095	0.0115
	(0.0251)	(0.0254)	(0.0401)	(0.0231)	(0.0231)	(0.0235)
Z-score	-0.0005	-0.0003	0.0002	-0.0002	-0.0002	-0.0002
	(0.0002)	(0.0002)	(0.0004)	(0.0003)	(0.0003)	(0.0003)
Cross-border	0.0052	0.0099	0.0016			
	(0.0333)	(0.0345)	(0.0171)			
Geographic diversification	-0.0002	0.0022	0.0063			
	(0.0091)	(0.0082)	(0.0085)			
Systemic importance	-0.0296	-0.0247	-0.0203			
	(0.0229)	(0.0269)	(0.0220)			
Bailout	0.0044	0.0031	0.0173			
	(0.0198)	(0.0176)	(0.0128)			
Real GDP growth	-0.0062	-0.0063	-0.0023			
	(0.0040)	(0.0043)	(0.0043)			
Inflation	0.0049	0.0040	0.0028			
	(0.0030)	(0.0031)	(0.0020)			
Money supply growth	0.0001	0.0001	0.0001			
	(0.0001)	(0.0001)	(0.0001)			
CR5	-0.0003	-0.0003	-0.0003			
	(0.0005)	(0.0005)	(0.0003)			
Capital regulatory index	0.0067	0.0063	0.0044*			
	(0.0059)	(0.0043)	(0.0023)			
Official supervisory index	-0.0028	-0.0020	0.0012			
	(0.0041)	(0.0033)	(0.0016)			
Deposit insurer power	-0.0008	0.0023	0.0073*			
	(0.0068)	(0.0070)	(0.0040)			
Private monitoring index	-0.0177*	-0.0174	-0.0122			
	(0.1550)	(0.0102)	(0.0062)			
Obs.	95	95	95	100	100	100
R^2	0.0916	0.2076	0.1016	0.3001	0.2915	0.1244

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively.
Numbers in parentheses are heteroscedasticity-robust standard errors.

Table 3A-2 Determinants of Acquirers' changes of LTD for Cross-border M&As

Variable	(1) ΔLTD IR DIFFERENCE1 Bank-specific Deal-specific	(2) ΔLTD IR DIFFERENCE5 Bank-specific Deal-specific	(3) ΔLTD DISPERSION5 Bank-specific Deal-specific	(4) ΔLTD IR DIFF1 Deal-specific Regulatory	(5) ΔLTD IR DIFF5 Deal-specific Regulatory	(6) ΔLTD DISPERSION5 Deal-specific
Banking integration	0.0030	-0.0992	-0.0006	-0.0536	-0.0312	0.0003
	(0.0072)	(0.0679)	(0.0016)	(0.0692)	(0.0361)	(0.0016)
Asset diversity	-0.0428**	-0.0437**	-0.0411**	-0.0292	-0.0289	-0.0292
	(0.0187)	(0.0187)	(0.0191)	(0.0207)	(0.0206)	(0.0211)
Non-performing loan	-0.0781	0.0005	-0.0602	-0.1115	-0.1113	-0.0871
	(0.1383)	(0.1389)	(0.1402)	(0.1453)	(0.1446)	(0.1443)
Tier 1 Capital	0.3540**	0.3591**	0.3581**	0.4148**	0.4144**	0.4047**
	(0.1740)	(0.1742)	(0.1767)	(0.1809)	(0.1806)	(0.1816)
Ln(TA)	0.0335***	0.0333***	0.0356***	0.0310***	0.0309***	0.0330***
	(0.0110)	(0.0110)	(0.0111)	(0.0113)	(0.0113)	(0.0111)
PB	0.0030	0.0030	0.0051	0.0075	0.0073	0.0091
	(0.0072)	(0.0072)	(0.0071)	(0.0075)	(0.0074)	(0.0072)
Moral hazard index				0.0008	0.0009	0.0009
				(0.0083)	(0.0083)	(0.0084)
Liquid ratio	-0.0208	-0.0228	-0.0259	-0.0100	-0.0086	-0.0148
	(0.0269)	(0.0268)	(0.0272)	(0.0311)	(0.0312)	(0.0310)
Equity-to-asset	-0.4121*	-0.4148*	-0.4197*	-0.4325	-0.4359	-0.4129
	(0.2393)	(0.2396)	(0.2455)	(0.2778)	(0.2776)	(0.2799)
ROA	2.9727***	2.9216***	3.0691***	2.0697**	2.0996**	2.0815**
	(0.9966)	(0.9990)	(1.0290)	(1.0153)	(1.0134)	(1.0239)
Short-term debt	0.0131	0.0112	0.0074	0.0101	0.0111	0.0110
	(0.0338)	(0.0338)_	(0.0348)	(0.0355)	(0.0355)	(0.0361)
Non-interest income	0.0010	0.0005	0.0003	0.0151	0.0152	0.0156
	(0.0229)	(0.0230)	(0.0236)	(0.0245)	(0.0244)	(0.0246)
Z-score	-0.0004	-0.0004	-0.0003	-0.0002	-0.0002	-0.0002
	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0004)
Cross-border	-0.0154	-0.0149	-0.0179			
	(0.0249)	(0.0249)	(0.0257)			
Geographic diversification	0.0008	0.0002	0.0021			
	(0.0092)	(0.0093)	(0.0093)			
Systemic importance	-0.0406**	-0.0403**	-0.0377**			
	(0.0158)	(0.0158)	(0.0159)			
Bailout	0.0139	0.0141	0.0150			
	(0.0132)	(0.0132)	(0.0136)			
Real GDP growth						
Inflation						
Money supply growth						
CR5						
Capital regulatory index				0.0057	0.0055	0.0059
				(0.0038)	(0.0038)	(0.0038)
Official supervisory index				0.0010	0.0010	0.0014
				(0.0034)	(0.0033)	(0.0034)
Deposit insurer power				-0.0001	0.00002	0.0010
				(0.0083)	(0.0082)	(0.0083)
Private monitoring index				-0.0129**	-0.0130**	-0.0130**
				(0.0054)	(0.0054)	(0.0054)
Obs.	100	100	100	96	96	96
R^2	0.3770	0.3684	0.5251	0.4693	0.4605	0.4607

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-3 Determinants of Acquirers' changes of LTD for cross-border M&As

Variable	(1) ΔLTD IR DIFFERENCE1 Bank-specific Macroeconomic	(2) ΔLTD IR DIFFERENCE5 Bank-specific Macro	(3) ΔLTD DISPERSION5 Bank-specific Macro	(4) ΔLTD IR DIFF1 Bank-specific Deal-specific Macroeconomic	(5) ΔLTD IR DIFF5 Bank-specific Deal-specific Macro	(6) ΔLTD DISPERSION5 Bank-specific Deal-specific
Banking integration	-0.0558	-0.1046	0.0001	-0.0613	-0.1129	-0.0006
	(0.0362)	(0.0695)	(0.0017)	(0.0372)	(0.0717)	(0.0017)
Asset diversity	-0.0261	-0.0271	-0.0278	-0.0357*	-0.0367*	-0.0106**
	(0.0189)	(0.0189)	(0.0194)	(0.0200)	(0.0046)	(0.0353)
Non-performing loan	-0.1335	-0.1376	-0.1074	-0.0145	-0.0879	-0.0588
	(0.1383)	(0.1388)	(0.1403)	(0.0265)	(0.1615)	(0.1638)
Tier 1 Capital	0.3535*	0.3568*	0.3577*	0.3349*	0.3406*	0.3397*
	(0.1799)	(0.1800)	(0.1831)	(0.1836)	(0.1839)	(0.1874)
Ln(TA)	0.0235***	0.0235***	0.0277***	0.0357***	0.0352***	0.0381***
	(0.0085)	(0.0085)	(0.0083)	(0.0129)	(0.0130)	(0.0131)
PB	0.0050	0.0051	0.0074	0.0043	0.0043	0.0066
	(0.0068)	(0.0068)	(0.0067)	(0.0075)	(0.0075)	(0.0075)
Moral hazard index						
Liquid ratio	-0.0204	-0.0221	-0.0286	-0.0249	-0.0268	-0.0301
	(0.0267)	(0.0265)	(0.0269)	(0.0294)	(0.0294)	(0.0300)
Equity-to-asset	-0.3182	-0.3195	-0.3149	-0.3311	-0.3351	-0.0345
	(0.2496)	(0.2498)	(0.2584)	(0.2646)	(0.2651)	(0.2743)
ROA	1.8958*	1.8399	2.0341*	2.4891**	2.4286*	2.7653**
	(1.1018)	(1.1068)	(1.1333)	(1.1918)	(1.1986)	(1.2410)
Short-term debt	-0.0170	-0.0187	-0.0192	0.0058	0.0032	-0.0026
	(0.0319)	(0.0318)_	(0.0328)	(0.0374)	(0.0373)	(0.0382)
Non-interest income	-0.0116	-0.0125	-0.0076	-0.0145	-0.0148	-0.0127
	(0.0247)	(0.0248)	(0.0254)	(0.0265)	(0.0265)	(0.0273)
Z-score	-0.0002	-0.0002	-0.0002	-0.0003	-0.0003	-0.0003
	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)	(0.0003)
Cross-border				-0.0152	-0.0148	-0.0186
				(0.0263)	(0.0263)	(0.0272)
Geographic diversification				0.0011	0.0007	0.0035
				(0.0101)	(0.0102)	(0.0101)
Systemic importance				-0.0315	-0.0310	-0.0289
				(0.0188)	(0.0188)	(0.0192)
Bailout				0.0045	0.0051	0.0071
				(0.0158)	(0.0158)	(0.0161)
Real GDP growth	-0.0049	-0.0049	-0.0040	-0.0035	-0.0035	-0.0028
	(0.0034)	(0.0034)	(0.0035)	(0.0039)	(0.0039)	(0.0039)
Inflation	0.0058	0.0059	0.0047	0.0042	0.0042	0.0030
	(0.0037)	(0.0037)	(0.0037)	(0.0040)	(0.0040)	(0.0040)
Money supply growth	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.00001)	(0.00001)	(0.00001)
CR5				0.0002	0.0002	0.0002
				(0.0001)	(0.0003)	(0.0003)
Capital regulatory index						
Official supervisory index						
Deposit insurer power						
Private monitoring index						
Obs.	99	99	99	99	99	99
R^2	0.1929	0.1869	0.2248	0.3258	0.3341	0.3110

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-4 Determinants of Acquirers' changes of ΔCoVaR for Cross-border M&As

Variable	(1) Diff(ΔCoVaR) IR DIFFERENCE1 Full	(2) Diff(ΔCoVaR) IR DIFFERENCE5 Full	(3) Diff(ΔCoVaR) DISPERSION5 Full	(4) Diff(ΔCoVaR) IR DIFF1 Bank-specific	(5) Diff(ΔCoVaR) IR DIFF5 Bank-specific	(6) Diff(ΔCoVaR) DISPERSION5
Banking integration	-20.0013	-59.5039**	-1.5805	-48.8444*	-75.7230	-1.6373
	(18.5995)	(20.4261)	(1.0661)	(26.8549)	(48.8987)	(1.3418)
Asset diversity	-27.2760**	-24.1939	-34.0036*	-23.9963*	-23.8126**	-25.2492*
	(13.0355)	(16.5158)	(17.5652)	(10.8507)	(10.3884)	(12.2512)
Non-performing loan	-140.0882***	-164.4337*	-151.732	-196.089*	-194.359**	-132.029
	(69.2805)	(86.1474)	(135.967)	(93.6400)	(87.2982)	(92.9432)
Tier 1 Capital	25.1907	41.0434	-17.8233	1.7535	-7.3599	-4.1213
	(173.8788)	(148.895)	(106.682)	(81.0663)	(84.64)	(85.8880)
Ln(TA)	-5.8790	-5.0092	-4.1907	1.1216	0.7663	-2.3319
	(18.2606)	(16.5231)	(17.1025)	(5.8565)	(5.9379)	(7.7034)
PB	-4.8659*	-4.0154	-0.8815	5.2607	4.7304	3.9864
	(2.2675)	(3.2063)	(3.9387)	(6.2066)	(5.9199)	(6.0026)
Moral hazard index	-15.1504*	-13.1048*	-3.4348			
	(7.7581)	(6.3537)	(2.7457)			
Liquid ratio	-20.2325	-16.5120	-19.3097	14.8752	15.7876	19.6150
	(33.1348)	(33.5009)	(29.0108)	(19.6314)	(18.9019)	(19.8346)
Equity-to-asset	-97.4989	-133.4948	256.0179	-230.8216	-219.8644	-197.7029
	(471.9956)	(457.5966)	(222.581)	(148.8481)	(149.9227)	(167.4737)
ROA	1084.034	1196.876	-808.248	1172.68**	1170.611	1058.792
	(2080.723)	(1994.146)	(626.922)	(431.142)	(431.62)	(499.9187)
Short-term debt	30.8960**	29.1375*	30.3784	-20.359	-18.2028	-27.6905
	(11.5360)	(10.7079)_	(17.9548)	(12.2499)	(12.3233)	(17.0250)
Non-interest income	-1.8389	1.3384	-17.8233	-17.0563	-16.3019	-18.2190
	(22.2368)	(19.1519)	(106.682)	(12.5697)	(12.6253)	(12.3920)
Z-score	-0.1023	-0.2048	-0.1805	0.1400	0.1318	0.1437
	(0.3043)	(0.3433)	(0.2830)	(0.2672)	(0.2708)	(0.2893)
Cross-border	8.4765*	5.3764	9.5343			
	(4.5268)	(4.8644)	(5.9341)			
Geographic diversification	-2.8511	-4.4097	-0.2294			
	(4.2394)	(5.8397)	(2.3904)			
Systemic importance	1.5864	-0.2923	-0.1805			
	(13.9897)	(11.8135)	(0.2830)			
Bailout	-24.4425**	-25.7700**	-0.9116			
	(8,3277)	(8.9643)	(5.6239)			
Real GDP growth	2.7351	2.7406	3.0176			
	(7.1043)	(6.4379)	(3.1724)			
Inflation	-9.0294*	-8.7635*	-5.6312**			
	(4.8558)	(4.4920)	(2.0826)			
Money supply growth	1.6306	1.7545	-0.0001**			
	(1.3169)	(1.2089)	(0.0001)			
CR5	0.1564	0.1334	0.0440			
	(0.4727)	(0.3839)	(0.3002)			
Capital regulatory index	-5.1344	-4.5294	-1.2340			
	(4.0662)	(3.2397)	(1.7461)			
Official supervisory index	-5.4461	-5.2083	-6.5507*			
	(4.3648)	(4.3680)	(2.0053)			
Deposit insurer power	16.3561	14.9017	13.9055*			
	(13.8919)	(13.6718)	(6.4047)			
Private monitoring index	-5.7097	-6.1164	-1.7002			
	(4.3648)	(4.4714)	(2.1879)			
Obs.	99	99	99	124	124	124
R^2	0.0531	0.0829	0.1032	0.3298	0.3491	0.2797

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-5 Determinants of Acquirers' changes of ΔCoVaR for Cross-border M&As

Variable	(1) Diff(ΔCoVaR) IR DIFFERENCE1 Bank-specific Deal-specific	(2) Diff(ΔCoVaR) IR DIFFERENCE5 Bank-specific Deal-specific	(3) Diff(ΔCoVaR) DISPERSION5 Bank-specific Deal-specific	(4) Diff(ΔCoVaR) IR DIFF1 Deal-specific Regulatory	(5) Diff(ΔCoVaR) IR DIFF5 Deal-specific Regulatory	(6) Diff(ΔCoVaR) DISPERSION5 Deal-specific
Banking integration	-12.8651	-31.9604	-0.0992	-9.6609	-24.702	-0.0849
	(11.8055)	(23.3591)	(0.6136)	(30.7465)	(60.1150)	(1.4241)
Asset diversity	-27.7484*	-28.0174*	-27.2702*	-20.9005	-23.6141	-23.1874
	(13.227)	(13.2080)	(12.7711)	(16.0638)	(17.5516)	(17.8898)
Non-performing loan	-163.0712**	-166.5224***	-158.6101**	-198.3343	-210.2001*	-203.2654
	(52.7359)	(51.1559)	(50.3205)	(121.2041)	(124.5583)	(124.419)
Tier 1 Capital	35.3728	36.6559	37.0667	-6.3480	-6.1706	-7.9824
	(50.8820)	(51.1049)	(50.5573)	(155.7565)	(156.6581)	(156.8213)
Ln(TA)	-3.9089	-4.0317	-3.4269	2.5792	2.7788	3.4768
	(9.8880)	(9.7670)	(9.6670)	(9.3552)	(9.4269)	(9.2802)
PB	-4.0211	-4.1321	-3.4661	-2.4665	-2.3389	-1.6148
	(3.4209)	(3.3814)	(3.0606)	(6.4648)	(6.5033)	(6.2620)
Moral hazard index				-11.5014*	10.1522	10.2903
				(6.2068)	(7.1102)	(7.1140)
Liquid ratio	-23.1545	-23.2340	-24.1534	-8.9235	-8.2191	-9.3843
	(21.3107)	(26.9868)	(26.2853)	(25.8363)	(25.9874)	(26.2289)
Equity-to-asset	69.549	69.9229	67.6040	97.0622	94.8216	96.7447
	(133.3202)	(131.0572)	(145.1636)	(235.1745)	(236.4666)	(237.5305)
ROA	-301.6257	-318.7771	-293.784	-485.5305	-518.1896	-506.1029
	(1050.022)	(1051.081)	(1109.613)	(840.61)	(846.8331)	(850.4683)
Short-term debt	15.4895***	15.2851***	14.4657**	55.7858*	56.5612*	50.7009*
	(3.5657)	(3.6361)_	(4.7637)	(29.3172)	(30.4707)	(30.6911)
Non-interest income	-0.8514	-1.1068	-1.1564	-9.5163	-9.5562	-9.8469
	(11.1494)	(10.8524)	(13.0425)	(20.7565)	(20.8562)	(20.9118)
Z-score	-0.2154	-0.2173	-0.2163	-0.2168	-0.1316	-0.1251
	(0.3551)	(0.3549)	(0.3484)	(0.3554)	(0.3341)	(0.3358)
Cross-border	-2.2424	-2.2766	-2.0126			
	(6.1543)	(5.9213)	(6.3752)			
Geographic diversification	-5.8263	-6.1156	-5.4428			
	(5.4096)	(5.4335)	(5.3572)			
Systemic importance	3.5696	3.2828	4.2235			
	(13.3163)	(13.3270)	(14.4715)			
Bailout	-18.3092*	-18.2874**	-18.5165			
	(6.3014)	(6.1853)	(6.4098)			
Real GDP growth						
Inflation						
Money supply growth						
CR5						
Capital regulatory index				-2.0533	-2.2360	-2.1823
				(3.1288)	(3.1794)	(3.1826)
Official supervisory index				1.0709	1.0276	1.1678
				(2.8050)	(2.8236)	(2.8372)
Deposit insurer power				4.7367	4.4668	4.8943
				(7.0276)	(7.0978)	(7.0856)
Private monitoring index				-3.8153	-4.0542	-4.1700
				(4.5912)	(4.6468)	(4.6785)
Obs.	104	104	104	100	100	100
R^2	0.1910	0.2446	0.1431	0.3002	0.3186	0.1827

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-6 Determinants of Acquirers' changes of ΔCoVaR for Cross-border M&As

Variable	(1) Diff(ΔCoVaR) IR DIFFERENCE1 Bank-specific Macroeconomic	(2) Diff(ΔCoVaR) IR DIFFERENCE5 Bank-specific Macro	(3) Diff(ΔCoVaR) DISPERSION5 Bank-specific Macro	(4) Diff(ΔCoVaR) IR DIFF1 Bank-specific Deal-specific Macroeconomic	(5) Diff(ΔCoVaR) IR DIFF5 Bank-specific Deal-specific Macro	(6) Diff(ΔCoVaR) DISPERSION5 Bank-specific Deal-specific
Banking integration	-12.5263	-27.2012	-0.2192	-10.6058	-25.6634	-0.4514
	(25.9589)	(51.3988)	(0.6238)	(22.8666)	(46.6979)	(1.4475)
Asset diversity	-33.1959**	-33.2767**	-32.8775**	-32.0317*	-32.1911*	-31.2829*
	(14.1304)	(14.0762)	(14.4132)	(15.0225)	(19.0716)	(16.9463)
Non-performing loan	-188.203**	-190.0046**	-186.3897**	-164.4068	-168.3878*	-164.1509
	(70.0634)	(67.9447)	(72.4281)	(91.5883)	(91.2651)	(133.9209)
Tier 1 Capital	35.2323	35.5536	38.7465	67.0010	67.6245	71.2415
	(124.0992)	(124.5881)	(126.0179)	(113.9478)	(113.4784)	(155.7166)
Ln(TA)	1.3009	1.2056	1.9683	-2.2579	-2.3966	-1.9126
	(9.6662)	(9.4989)	(9.8875)	(15.1439)	(15.1201)	(10.6067)
PB	0.2326	0.2030	0.8561	-3.6176	-3.6776	-3.1374
	(3.7038)	(3.6968)	(2.9117)	(3.3008)	(3.3537)	(6.2744)
Moral hazard index						
Liquid ratio	-12.3871	-12.3922	-13.5265	-22.0884	-21.9864	-22.3819
	(27.4286)	(26.9487)	(24.3611)	(42.2645)	(41.8719)	(27.0715)
Equity-to-asset	84.7601	86.1828	77.4114	12.6685	13.8146	0.3779
	(254.5881)	(256.1492)	(264.5865)	(274.4223)	(274.22)	(220.887)
ROA	-124.1365	-146.6594	-87.8974	323.6224	299.8667	394.7264
	(1180.966)	(1213.877)	(1220.44)	(1523.828)	(1554.618)	(958.7018)
Short-term debt	35.9371	35.6509	35.0374	22.3167*	22.2389*	20.4059
	(22.9528)	(22.4473)_	(23.2340)	(12.1275)	(11.9520)	(31.7051)
Non-interest income	-7.5007	-7.9223	-7.8181	0.2742	-0.0223	-1.0117
	(20.3667)	(19.7683)	(23.3277)	(20.4048)	(19.8527)	(22.4266)
Z-score	-0.2347	-0.2360	-0.2371	-0.2220	-0.2239	-0.2175
	(0.3356)	(0.3344)	(0.3182)	(0.3700)	(0.3681)	(0.2685)
Cross-border				-1.1885	-1.1706	-1.9497
				(3.6595)	(3.4449)	(17.6592)
Geographic diversification				-5.8033	-6.0116	-5.6425
				(4.9283)	(4.8524)	(8.3446)
Systemic importance				-1.3783	-1.5044	-1.3981
				(19.4357)	(19.3659)	(14.6767)
Bailout				16.3554***	16.3056***	16.8345
				(2.4531)	(2.4801)	(13.1158)
Real GDP growth	-1.4624	-1.4696	-1.5034	-0.7879	-0.7887	-0.9151
	(6.4887)	(6.4793)	(6.7223)	(7.0143)	(7.0092)	(3.4639)
Inflation	-2.2405	-2.1803	-2.3758*	-3.3428**	-3.2833*	-3.4441
	(1.2682)	(1.2699)	(1.3030)	(1.4756)	(1.4991)	(3.1782)
Money supply growth	-0.6747	-0.6884	-0.6359	-0.0663	-0.0841	-0.0434
	(1.1726)	(1.1938)	(0.9804)	(1.7887)	(1.8051)	(1.0070)
CR5				0.0691	0.0664	0.0773
				(0.3446)	(0.3455)	(0.2594)
Capital regulatory index						
Official supervisory index						
Deposit insurer power						
Private monitoring index						
Obs.	103	103	103	103	103	103
R^2	0.1377	0.1381	0.1360	0.1740	0.1747	0.1738

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-7 Determinants of Acquirers' Changes of LTD for M&As in Post-crisis and Pre-crisis Periods

Variable	(1) Post-crisis ΔLTD No integration	(2) Pre-crisis ΔLTD No integration	(3) Post-crisis ΔLTD IR DIFFERENCE1	(4) Pre-crisis ΔLTD IR DIFFERENCE1	(5) Post-crisis ΔLTD IR DIFFERENCE5	(6) Pre-crisis ΔLTD IR DIFFERENCE5
Banking integration			-0.0210***	-0.0947	-0.1672**	-0.2925
			(0.0029)	(0.0798)	(0.0673)	(0.2091)
Asset diversity	-0.0110	-0.0258*	-0.1099**	-0.0362	-0.1166**	-0.0377
	(0.0178)	(0.0134)	(0.0431)	(0.0427)	(0.0436)	(0.0383)
Non-performing loan	0.0175	-0.1103**	-0.8985***	-0.0978**	-0.9706***	-0.1021*
	(0.0798)	(0.0400)	(0.1698)	(0.0305)	(0.2110)	(0.0385)
Tier 1 Capital	0.1250	0.1520	0.3075	0.3932 0.2416	(0.2739)	0.3055
	(0.1721)	(0.1303)	(0.2327)	(0.1743)		(0.3245)
Ln(TA)	0.0199	0.0104	0.0605*	0.0199	0.0675*	0.0124
	(0.0200)	(0.0101)	(0.0308)	(0.0270)	(0.0215)	(0.0288)
PB	0.0067	0.0049	-0.0210***	0.0102	-0.0223***	0.0084
	(0.0069)	(0.0049)	(0.0029)	(0.0044)	(0.0043)	(0.0053)
Moral hazard index	-0.0059	-0.0082	-0.0337**	-0.0178	-0.0356**	-0.0182
	(0.0086)	(0.0072)	(0.0138)	(0.0085)	(0.0116)	(0.0082)
Liquid ratio	-0.0121	0.0242	-0.1021***	0.0626**	-0.1025***	0.0694**
	(0.0346)	(0.0136)	(0.0254)	(0.0181)	(0.0215)	(0.0199)
Equity-to-asset	-0.0697	0.3013	1.1683	0.8798	1.4095	0.9666*
	(0.2558)	(0.2845)	(0.8216)	(0.4080)	(0.7809)	(0.3771)
ROA	-0.4868	-1.4665	-6.8438***	-3.3285**	-7.5702***	-3.7058**
	(0.5419)	(1.0293)	(1.7851)	(0.8584)	(1.6342)	(0.8806)
Short-term debt	0.0215	0.0124	-0.0684	0.0333	-0.0596	0.0337
	(0.0358)	(0.0425)	(0.1140)	(0.0460)	(0.1092)	(0.0437)
Non-interest income	-0.0371	0.0103	-0.0128	0.0272	-0.0165	0.0387
	(0.0312)	(0.0266)	(0.0348)	(0.0626)	(0.0184)	(0.0698)
Z-score	0.0002**	-0.0002	-0.0011	0.00009	-0.0013	0.00009
	(0.00007)	(0.0005)	(0.0010)	(0.0005)	(0.0010)	(0.00005)
Cross-border	-0.0046	-0.0169	-0.0056	0.0474	-0.0081	0.0460
	(0.0136)	(0.0150)	(0.0057)	(0.0576)	(0.0055)	(0.0549)
Geographic diversification	0.0274**	-0.0127	0.0029	-0.0068	0.0031	-0.0058
	(0.0107)	(0.0107)	(0.0087)	(0.0136)	(0.0075)	(0.0140)
Systemic importance	-0.0102	-0.0101	0.0830	-0.0328	0.0730	-0.0323
	(0.0207)	(0.0210)	(0.0620)	(0.0282)	(0.0613)	(0.0297)
Bailout	0.0130	-0.0088	0.0018	-0.0290	-0.0034	-0.0277
	(0.0141)	(0.0185)	(0.0472)	(0.0349)	(0.0458)	(0.0341)
Real GDP growth	-0.0013	-0.0047	-0.0051	-0.0049	-0.0039	-0.0042
	(0.0040)	(0.0041)	(0.0102)	(0.0099)	(0.0091)	(0.0093)
Inflation	0.0130**	0.0030	0.0353***	-0.0066*	0.0363***	-0.0054*
	(0.0049)	(0.0033)	(0.0038)	(0.0024)	(0.0027)	(0.0019)
Money supply growth	-0.0016	0.00004*	-0.0036	0.00001	-0.0038	0.00001
	(0.0027)	(0.00002)	(0.0023)	(0.00001)	(0.0021)	(0.00003)
CR5	-0.0002	-0.0003**	0.0004	-0.0006	0.0004*	-0.0007
	(0.0003)	(0.0001)	(0.0003)	(0.0004)	(0.0002)	(0.0004)
Capital regulatory index	0.0015	0.0010	0.0374***	0.00004	0.0385***	0.0003
	(0.0041)	(0.0033)	(0.0021)	(0.0075)	(0.0013)	(0.0073)
Official supervisory index	-0.0027	-0.0009	-0.0237***	-0.0019	-0.0255***	-0.0011
	(0.0053)	(0.0022)	(0.0025)	(0.0104)	(0.0029)	(0.0095)
Deposit insurer power	0.0023	0.0050	-0.0545***	0.0257*	-0.0566***	0.0263*
	(0.0156)	(0.0115)	(0.0065)	(0.0095)	(0.0044)	(0.0084)
Private monitoring index	-0.0062	-0.0061	-0.0145	-0.0227	-0.0147	-0.0204
	(0.0073)	(0.0051)	(0.0093)	(0.0139)	(0.0084)	(0.0131)
Obs.	106	101	45	50	45	50
R^2	0.2278	0.2138	0.1237	0.3790	0.1133	0.432

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-8 Determinants of Acquirers' Changes of LTD for M&As in Post-crisis and Pre-crisis Periods

Variable	(1) Post-crisis ΔLTD DISPERSION5	(2) Pre-crisis ΔLTD DISPERSION5	(3) Post-crisis ΔLTD IR DIFFERENCE2	(4) Pre-crisis ΔLTD IR DIFFERENCE2	(5) Post-crisis ΔLTD IR DISPERSION3	(6) Pre-crisis ΔLTD IR DISPERSION3
Banking integration	0.0020***	-0.0006	-0.0055	0.0341	0.0002	0.0001
	(0.0005)	(0.0034)	(0.0148)	(0.0119)	(0.0005)	(0.0002)
Asset diversity	-0.0538	-0.0322	-0.0315	-0.0092	-0.0565	-0.0347
	(0.0333)	(0.0475)	(0.0451)	(0.0336)	(0.0436)	(0.0464)
Non-performing loan	-0.3790	-0.1396	-0.1358	0.0054	-0.2647	-0.1219
	(0.0798)	(0.1105)	(0.0581)	(0.3899)	(0.3821)	(0.0518)
Tier 1 Capital	0.3183	0.5394	0.5531	0.1127 0.1958	(0.1420)	0.5138
	(0.2118)	(0.2654)	(0.2105)	(0.1994)		(0.2500)
Ln(TA)	0.0405	0.0315	0.0328	0.0459	0.0491	0.0279
	(0.0266)	(0.0227)	(0.0230)	(0.0141)	(0.0256)	(0.0269)
PB	-0.0029	0.0120*	0.0115*	0.0086	-0.0004	0.0107
	(0.0078)	(0.0044)	(0.0041)	(0.0081)	(0.0132)	(0.0053)
Moral hazard index	-0.0323*	-0.0146	-0.0137	-0.0297***	-0.0342**	-0.0146
	(0.0135)	(0.0115)	(0.0088)	(0.0042)	(0.0105)	(0.0102)
Liquid ratio	-0.0101***	0.0462	0.0400**	-0.1219***	-0.0997***	0.0479***
	(0.0229)	(0.0255)	(0.0098)	(0.0205)	(0.0223)	(0.0057)
Equity-to-asset	0.4680	0.6545	0.6774*	0.5518	0.6182	0.6781*
	(0.2558)	(0.4056)	(0.2777)	(0.6868)	(0.9430)	(0.2684)
ROA	-4.6519*	-2.6114	-2.8378	-4.7368**	-5.2129*	-2.7044
	(2.3088)	(1.1375)	(1.3211)	(1.6412)	(2.3296)	(1.5674)
Short-term debt	-0.1468	0.0269	0.0304	-0.1843	-0.1600	0.0280
	(0.0962)	(0.0601)	(0.0614)	(0.0574)	(0.0877)	(0.0634)
Non-interest income	-0.0481**	0.0476	0.0086	-0.1002	-0.0746	0.0176
	(0.0149)	(0.0522)	(0.0503)	(0.0186)	(0.0229)	(0.0570)
Z-score	-0.0001	0.0002	0.0003	0.0005	-0.0001	0.0002
	(0.0011)	(0.0004)	(0.0005)	(0.0012)	(0.0010)	(0.0005)
Cross-border	-0.0046	0.0476	-0.0053	0.0513	-0.0081	0.0510
	(0.0136)	(0.0522)	(0.0118)	(0.0618)	(0.0055)	(0.0634)
Geographic diversification	0.0092**	-0.0109	-0.0101	0.0125	0.0095	-0.0116
	(0.0028)	(0.0123)	(0.0084)	(0.0035)	(0.0037)	(0.0115)
Systemic importance	0.1204	-0.0295	-0.0277	0.1129	0.1191	-0.0290
	(0.0581)	(0.0332)	(0.0312)	(0.0480)	(0.0482)	(0.0297)
Bailout	0.0312	-0.0224	-0.0241	0.0348	0.0353	-0.0233
	(0.0437)	(0.0359)	(0.0400)	(0.0258)	(0.0395)	(0.0405)
Real GDP growth	-0.0086	-0.0059	-0.0061	-0.0083	-0.0037	-0.0051
	(0.0081)	(0.0117)	(0.0114)	(0.0037)	(0.0104)	(0.0119)
Inflation	0.0307***	-0.0089	-0.0098	0.0291	0.0313***	-0.0085
	(0.0062)	(0.0073)	(0.0064)	(0.0050)	(0.0058)	(0.0054)
Money supply growth	-0.0004	0.00004	0.00004	0.0024	-0.0013	0.00004
	(0.0012)	(0.00004)	(0.00004)	(0.0014)	(0.0012)	(0.00003)
CR5	0.0008	-0.0007	-0.0007	0.0014***	0.0009*	-0.0008
	(0.0001)	(0.0008)	(0.0005)	(0.0003)	(0.0002)	(0.0006)
Capital regulatory index	0.0300	0.0003	0.00007	0.0266***	0.0275**	0.0001
	(0.0047)	(0.0087)	(0.0070)	(0.0049)	(0.0093)	(0.0072)
Official supervisory index	-0.0149***	-0.0049	-0.0048	-0.0102**	-0.0179***	-0.0042
	(0.0032)	(0.0113)	(0.0091)	(0.0037)	(0.0289)	(0.0095)
Deposit insurer power	-0.0340***	0.0220	0.0230	-0.0168*	-0.0355***	0.0235*
	(0.0066)	(0.0154)	(0.0088)	(0.0071)	(0.0076)	(0.0078)
Private monitoring index	-0.0139	-0.0268	-0.0274	-0.0130***	-0.0121	-0.0263
	(0.0073)	(0.0142)	(0.0142)	(0.0030)	(0.0078)	(0.0151)
Obs.	45	50	45	50	45	50
R^2	0.2587	0.2561	0.2593	0.2320	0.2941	0.2828

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-9 Determinants of Acquirers' Changes of ΔCoVaR for M&As in Post-crisis and Pre-crisis Periods

Variable	(1) Post-crisis ΔCoVaR No integration	(2) Pre-crisis ΔCoVaR No integration	(3) Post-crisis ΔCoVaR IR DIFFERENCE1	(4) Pre-crisis ΔCoVaR IR DIFFERENCE1	(5) Post-crisis ΔCoVaR IR DIFFERENCE5	(6) Pre-crisis ΔCoVaR IR DIFFERENCE5
Banking integration			106.3122*	23.23182	176.9831**	51.1900
			(53.0057)	(24.1263)	(79.7377)	(66.4694)
Asset diversity	-25.3159**	-6.4685	-32.3246	-1.8633	-39.6380	-1.8540
	(10.2654)	(5.1648)	(43.6610)	(5.0064)	(34.8505)	(5.3505)
Non-performing loan	-25.6569	-130.9929***	2867.684***	-144.3412	2820.729***	-140.8287
	(119.8766)	(36.8054)	(740.748)	(83.6337)	(617.0371)	(82.8497)
Tier 1 Capital	-142.7711**	261.3825	-515.5343**	538.4478**	-409.669**	536.3667**
	(49.7973)	(111.0577)	(148.6457)	(166.1659)	(142.3072)	(150.487)
Ln(TA)	2.7329	8.1377	8.3538	-25.9426	0.2037	-25.4261
	(4.5220)	(7.3692)	(15.6712)	(29.6812)	(13.8676)	(28.4931)
PB	5.9145	4.3662	64.6736**	-3.5146	61.1369**	-3.2805
	(8.8914)	(2.4499)	(22.0260)	(2.5088)	(18.4703)	(2.1311)
Moral hazard index	4.6515	3.3454	62.7103***	24.7313***	64.8425***	24.2646***
	(9.1283)	(2.3539)	(7.1722)	(1.1397)	(5.7599)	(0.7582)
Liquid ratio	7.3635	-2.8381	-70.4592*	-31.4125	-76.0288*	-30.7119
	(14.0395)	(8.4895)	(33.8662)	(25.5757)	(31.6429)	(24.4061)
Equity-to-asset	44.3167	-63.2267	-2764.996**	87.0802	-2930.18**	84.1014
	(62.9364)	(125.9195)	(994.0552)	(202.3463)	(845.7958)	(189.5358)
ROA	120.7145	-289.7285	9406.045**	-705.394	9706.163**	-666.6198
	(237.1389)	(624.9752)	(2979.646)	(871.3821)	(2889.446)	(818.6078)
Short-term debt	16.1237	30.2927	-228.3484	22.4192*	-232.6215*	22.5623*
	(11.7280)	(18.4794)	(148.6457)	(9.1660)	(103.1799)	(8.9904)
Non-interest income	-2.6497	-28.5826	-106.059	-51.8469***	-93.1066*	-52.2130***
	(9.3758)	(22.9905)	(56.9144)	(6.0096)	(46.7413)	(3.5366)
Z-score	0.0661**	-0.1014	2.1933*	0.1721	2.1790**	0.1615
	(0.0214)	(0.0954)	(1.0634)	(0.1746)	(0.8897)	(0.1690)
Cross-border	12.1773***	-7.6631	10.0832**	24.6615	11.5334**	24.3784
	(3.0942)	(4.1666)	(4.1983)	(23.0708)	(5.0204)	(23.3794)
Geographic diversification	-2.8315	4.2426	15.2078	5.7232*	13.3394	5.6793*
	(4.0464)	(3.2906)	(9.3540)	(2.2498)	(8.2870)	(2.3288)
Systemic importance	-6.5218	9.3970	98.6684	17.6375*	113.514	17.1847*
	(4.4742)	(9.5110)	(73.1868)	(5.8246)	(67.1977)	(5.7045)
Bailout	19.4142*	3.6186	162.6528***	-6.7365	164.0718***	-7.2123
	(9.0631)	(3.4804)	(32.0384)	(8.7710)	(24.8864)	(8.8583)
Real GDP growth	0.8787	-5.0857	68.5731***	-13.0115***	-82.3664***	-12.9626***
	(2.4757)	(3.2148)	(6.8876)	(1.3779)	(10.4186)	(1.4414)
Inflation	-4.8793*	0.5840	-53.6945***	-7.4326	-53.7977***	-7.3233
	(2.2189)	(0.0033)	(5.9966)	(3.6629)	(5.1269)	(3.4644)
Money supply growth	-0.1922	0.4312	4.2150*	8.6207***	3.8967**	8.4903***
	(0.9095)	(0.2355)	(2.0018)	(0.8048)	(1.5669)	(0.8485)
CR5	0.3391	0.1644	3.2553***	0.4819	3.1890***	0.4907
	(0.2409)	(0.1096)	(0.8063)	(0.2247)	(0.7112)	(0.2254)
Capital regulatory index	-9.2594**	2.2514	-82.7304***	7.5099**	-82.3664***	7.4300**
	(3.0248)	(1.0335)	(12.5390)	(2.0390)	(10.4186)	(1.9898)
Official supervisory index	5.0710***	-2.8375**	18.7742**	9.9731	19.2868***	9.8456
	(0.5965)	(1.1474)	(5.6569)	(4.5975)	(5.1093)	(4.4676)
Deposit insurer power	10.7104**	-6.1028*	63.8843**	0.6588	62.1839**	0.5793
	(3.1308)	(2.8031)	(22.1978)	(3.5344)	(22.1766)	(3.4723)
Private monitoring index	-8.3499	-5.1833*	-4.4405	-1.3656	-3.9200	-1.3525
	(6.2559)	(2.2602)	(9.3651)	(4.8026)	(8.1800)	(4.4402)
Obs.	107	105	47	52	47	52
R^2	0.2587	0.2385	0.1118	0.3712	0.1239	0.3707

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-10 Determinants of Acquirers' Changes of ΔCoVaR for M&As in Post-crisis and Pre-crisis Periods

Variable	(1) Post-crisis ΔCoVaR DISPERSION5	(2) Pre-crisis ΔCoVaR DISPERSION5	(3) Post-crisis ΔCoVaR IR DIFFERENCE2	(4) Pre-crisis ΔCoVaR IR DIFFERENCE2	(5) Post-crisis ΔCoVaR DISPERSION3	(6) Pre-crisis ΔCoVaR DISPERSION3
Banking integration	0.1738	-1.4708***	-16.0475	11.6757**	-0.2315	0.1448
	(2.5301)	(0.2352)	(14.5787)	(2.8027)	(0.7000)	(0.1234)
Asset diversity	-102.3215**	-3.2683	-123.9404***	-5.2039	-105.7945***	-5.0337
	(32.6570)	(7.1436)	(28.3936)	(6.4667)	(25.7747)	(5.8770)
Non-performing loan	2203.078***	166.4583	2107.573***	-119.4039	2110.262**	-125.2383
	(500.52)	(88.9268)	(474.3855)	(89.6010)	(666.2249)	(92.9915)
Tier 1 Capital	-380.078	483.4405**	-412.4303*	441.2334**	-383.0560*	426.4409
	(199.2634)	(121.3248)	(189.5607)	(154.0361)	(192.445)	(190.3864)
Ln(TA)	19.0938	-30.8053	27.2966	-31.3784	19.7463	-32.4818
	(19.0781)	(24.4818)	(25.2003)	(28.1683)	(16.056)	(31.1320)
PB	40.8151**	-2.1630	36.1886**	-3.9981	37.3493*	-4.4545
	(15.5761)	(1.4070)	(13.7596)	(1.8350)	(19.1210)	(2.5528)
Moral hazard index	62.4401***	22.7755***	62.3115***	20.8223***	65.1936***	21.7542
	(6.7505)	(1.2453)	(4.8326)	(1.3487)	(7.3088)	(1.4156)
Liquid ratio	-85.3394**	-15.4015	-81.0718**	-18.6197	-88.3550***	-18.1150
	(26.0942)	(23.2340)	(29.9444)	(30.5616)	(22.5187)	(35.2056)
Equity-to-asset	-2177.656*	74.6724	-1980.746*	137.9324	-2047.509	122.8432
	(987.9492)	(180.5839)	(849.8798)	(225.9248)	(1088.164)	(221.9797)
ROA	6990.516**	-556.4743	6186.852*	-661.7572	6785.543*	-650.8082
	(2764.264)	(702.9052)	(2921.593)	(853.8000)	(2930.386)	(750.0212)
Short-term debt	-157.958	17.7330**	-135.929	19.9810*	-138.0276	21.5156*
	(84.8660)	(5.1826)	(103.3738)	(7.4299)	(136.0731)	(7.3918)
Non-interest income	-51.2761*	-44.8228***	-48.8292	-37.2810*	-41.789	-37.7908**
	(25.4328)	(3.3038)	(31.9136)	(5.7437)	(51.2678)	(8.7970)
Z-score	1.0740	0.0517	0.7577	0.0813	0.9875	0.0912
	(0.9575)	(0.1732)	(0.8200)	(0.1545)	(0.8270)	(0.1868)
Cross-border	-15.3247	18.4777	-17.2354	20.7013	-16.3502	21.4279
	(18.3384)	(20.6690)	(16.4783)	(19.6811)	(17.4558)	(19.7200)
Geographic diversification	6.2516	3.6674	5.5624	5.1401	6.6983	4.6969
	(7.4081)	(4.7353)	(7.9785)	(5.1245)	(9.0092)	(4.2419)
Systemic importance	85.7208	14.0922*	81.0002	14.4872	74.9806	15.7569*
	(63.5462)	(4.9888)	(60.5140)	(6.2704)	(89.0382)	(5.8659)
Bailout	132.4413***	-5.2754	127.3856***	-6.4714	124.2486**	-6.6673
	(24.5406)	(11.5780)	(20.0230)	(9.4548)	(39.9390)	(9.4456)
Real GDP growth	70.4226***	-13.1711***	74.3027***	-11.2995***	69.2402***	-11.5052***
	(6.6893)	(1.7868)	(3.4004)	(1.1835)	(8.4987)	(1.3913)
Inflation	-48.3078***	-5.3887	-46.5488***	-5.2010	-47.9066***	-5.0676
	(4.8359)	(3.9176)	(5.2189)	(4.6771)	(5.0258)	(5.5569)
Money supply growth	1.3699	9.0282***	-0.2947	7.6829***	1.3115	7.8858***
	(1.8767)	(1.1489)	(2.1480)	(0.9095)	(0.7262)	(0.8228)
CR5	2.8793***	0.3660*	2.8289***	0.4253	2.8396***	0.3913
	(0.6143)	(0.1335)	(0.5136)	(0.1947)	(0.6732)	(0.2663)
Capital regulatory index	-73.9515***	8.1158**	-73.8548***	7.2236**	-71.6698***	7.4061**
	(10.6319)	(2.0983)	(9.7108)	(1.9802)	(13.8906)	(1.9532)
Official supervisory index	10.6294	10.3774*	6.5857	9.9989*	11.0239**	10.0842*
	(6.3010)	(4.3542)	(4.4534)	(4.0890)	(4.1069)	(4.1944)
Deposit insurer power	41.1878	-0.2491	32.2187	0.7271	40.0134*	0.5371
	(23.7521)	(1.8530)	(18.5433)	(2.0961)	(20.3251)	(2.2851)
Private monitoring index	-5.4036	-0.4039	-3.9983	1.3227	-5.3790	1.1432
	(5.4827)	(4.5059)	(2.9431)	(4.7143)	(5.0100)	(5.4366)
Obs.	47	52	47	52	47	52
R^2	0.1822	0.3064	0.1808	0.3223	0.1896	0.2956

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-11 Determinants of Acquirers' Changes of LTD for Cross-border M&As

Variable	(1) ΔLTD IR DIFFERENCE3 Full	(2) ΔLTD IR DIFFERENCE2 Full	(3) ΔLTD DISPERSION3 Full	(4) ΔLTD IR DIFF3 Bank-specific	(5) ΔLTD IR DIFF2 Bank-specific	(6) ΔLTD DISPERSION3
Banking integration	-0.0778*	-0.0022	-0.0003	-0.1048**	0.0006	-0.0004
	(0.0451)	(0.0188)	(0.0003)	(0.0433)	(0.0138)	(0.0003)
Asset diversity	-0.0328	-0.0266	-0.0258	-0.0431**	-0.0338*	-0.0350*
	(0.0252)	(0.0264)	(0.0258)	(0.0185)	(0.0189)	(0.0186)
Non-performing loan	-0.0758	-0.0940	-0.0706	-0.0590	-0.0550	-0.0459
	(0.1622)	(0.0772)	(0.0556)	(0.1316)	(0.1369)	(0.1351)
Tier 1 Capital	0.3264*	0.3432**	0.3335**	0.3694**	0.3718**	0.3591**
	(0.1866)	(0.1339)	(0.1369)	(0.1694)	(0.1784)	(0.1766)
Ln(TA)	0.0397***	0.0397**	0.0382**	0.0246***	0.0267***	0.0254***
	(0.0145)	(0.0154)	(0.0153)	(0.0078)	(0.0083)	(0.0080)
PB	0.0122	0.0147**	0.0148**	0.0026	0.0054	0.0062
	(0.0082)	(0.0050)	(0.0047)	(0.0065)	(0.0067)	(0.0066)
Moral hazard index	-0.0084	-0.0092	-0.0084			
	(0.0108)	(0.0109)	(0.0106)			
Liquid ratio	0.0068	0.0114	0.0087	-0.0366	-0.0346	-0.0337
	(0.0383)	(0.0705)	(0.0742)	(0.0256)	(0.0266)	(0.0262)
Equity-to-asset	-0.3424	-0.3895	-0.3817*	-0.3229	-0.3545	-0.3443
	(0.2981)	(0.1622)	(0.1918)	(0.2336)	(0.2427)	(0.2394)
ROA	2.0493	2.3542	2.2228	1.8868**	2.1795**	2.0145**
	(1.2658)	(1.9741)	(1.8626)	(0.9366)	(0.9635)	(0.9611)
Short-term debt	0.0179	0.0151	0.0155	-0.0113	-0.0128	-0.0131
	(0.0410)	(0.0661)_	(0.0641)	(0.0305)	(0.0317)	(0.0312)
Non-interest income	0.0014	0.0054	0.0038	0.0079	0.0106	0.0112
	(0.0279)	(0.0121)	(0.0240)	(0.0224)	(0.0234)	(0.0230)
Z-score	-0.0003	-0.0003	-0.0003	-0.0001	-0.0002	-0.0001
	(0.0005)	(0.0002)	(0.0001)	(0.0003)	(0.0003)	(0.0003)
Cross-border	0.0099	0.0059	0.0073			
	(0.0283)	(0.0348)	(0.0331)			
Geographic diversification	0.0022	0.0033	0.0037			
	(0.0117)	(0.0097)	(0.0066)			
Systemic importance	-0.0247	-0.0239	-0.0241			
	(0.0222)	(0.0232)	(0.0243)			
Bailout	0.0031	0.0066	0.0061			
	(0.0191)	(0.0175)	(0.0190)			
Real GDP growth	-0.0063	-0.0062	-0.0064			
	(0.0047)	(0.0043)	(0.0042)			
Inflation	0.0040	0.0037	0.0041			
	(0.0043)	(0.0034)	(0.0035)			
Money supply growth	0.00002	0.00002	0.00002			
	(0.00004)	(0.00002)	(0.00003)			
CR5	-0.0003	-0.0003	-0.0003			
	(0.0004)	(0.0005)	(0.0006)			
Capital regulatory index	0.0063	0.0074	0.0074			
	(0.0045)	(0.0057)	(0.0054)			
Official supervisory index	-0.0020	-0.0014	-0.0012			
	(0.0042)	(0.0037)	(0.0040)			
Deposit insurer power	0.0023	0.0014	0.0009			
	(0.0094)	(0.0059)	(0.0075)			
Private monitoring index	-0.0174**	-0.0177	-0.0168			
	(0.0070)	(0.0103)	(0.0112)			
Obs.	95	95	95	100	100	100
R^2	0.2076	0.2022	0.2094	0.2809	0.3352	0.4290

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively.
Numbers in parentheses are heteroscedasticity-robust standard errors.

Table 3A-12 Determinants of Acquirers' Changes of LTD for Cross-border M&As

Variable	(1) ΔLTD IR DIFFERENCE3 Bank-specific Deal-specific	(2) ΔLTD IR DIFFERENCE2 Bank-specific Deal-specific	(3) ΔLTD DISPERSION2 Bank-specific Deal-specific	(4) ΔLTD IR DIFF3 Deal-specific Regulatory	(5) ΔLTD IR DIFF2 Deal-specific Regulatory	(6) ΔLTD DISPERSION2 Deal-specific
Banking integration	-0.0933**	-0.0036	-0.0003	-0.0836*	0.0048	-0.0022*
	(0.0433)	(0.0128)	(0.0003)	(0.0435)	(0.0132)	(0.0013)
Asset diversity	-0.0504***	-0.0419**	-0.0418**	-0.0331*	-0.0280	-0.0326
	(0.0188)	(0.0190)	(0.0188)	(0.0190)	(0.0208)	(0.0204)
Non-performing loan	-0.0591	-0.0101	0.0625	-0.0684	-0.0863	-0.1409
	(0.1355)	(0.1395)	(0.1145)	(0.1355)	(0.1437)	(0.1429)
Tier 1 Capital	0.3540**	0.1747	0.1298	0.3837**	0.4064**	0.4676**
	(0.1714)	(0.1698)	(0.1567)	(0.1760)	(0.1812)	(0.1805)
Ln(TA)	0.0349***	0.0218**	0.0227**	0.0321***	0.0333***	0.0311***
	(0.0107)	(0.0104)	(0.0102)	(0.0107)	(0.0111)	(0.0109)
PB	0.0035	0.0038	0.0072	0.0063	0.0092	0.0065
	(0.0070)	(0.0069)	(0.0063)	(0.0070)	(0.0072)	(0.0072)
Moral hazard index				0.0021	0.0009	0.0003
				(0.0073)	(0.0084)	(0.0082)
Liquid ratio	-0.0309	0.0073	0.0075	-0.0155	-0.0145	-0.0109
	(0.0262)	(0.0250)	(0.0248)	(0.0296)	(0.0308)	(0.0301)
Equity-to-asset	-0.3682	-0.3301	-0.3040	-0.3669	-0.4060	-0.4632*
	(0.2363)	(0.2440)	(0.2397)	(0.2709)	(0.2804)	(0.2732)
ROA	2.6100	1.9655**	1.6982*	1.9022*	2.0880**	1.9525**
	(0.9978)	(0.9866)	(0.9672)	(0.9871)	(1.0187)	(0.9993)
Short-term debt	0.0123	0.0205	0.0235	0.0127	0.0104	0.0046
	(0.0332)	(0.0334)_	(0.0332)	(0.0338)	(0.0356)	(0.0350)
Non-interest income	0.0002	-0.0065	-0.0081	0.0120	0.0160	0.0166
	(0.0226)	(0.0227)	(0.0221)	(0.0238)	(0.0246)	(0.0240)
Z-score	-0.0003	-0.0001	0.00001	-0.0002	-0.0001	-0.0002
	(0.0003)	(0.0003)	(0.0003)	(0.0004)	(0.0004)	(0.0004)
Cross-border	-0.0119	-0.0044	-0.0015			
	(0.0246)	(0.0194)	(0.0192)			
Geographic diversification	0.0009	0.0056	0.0065			
	(0.0091)	(0.0089)	(0.0086)			
Systemic importance	-0.0360**	-0.0311**	-0.0306**			
	(0.0154)	(0.0149)	(0.0148)			
Bailout	0.0095	0.0151	0.0135			
	(0.0132)	(0.0114)	(0.0113)			
Real GDP growth						
Inflation						
Money supply growth						
CR5						
Capital regulatory index				0.0048	0.0060	0.0048
				(0.0037)	(0.0038)	(0.0038)
Official supervisory index				0.0005	0.0014	0.0003
				(0.0033)	(0.0034)	(0.0033)
Deposit insurer power				0.0021	0.0011	-0/0021
				(0.0080)	(0.0083)	(0.0082)
Private monitoring index				-0.0131**	-0.0131**	-0.0131**
				(0.0052)	(0.0054)	(0.0053)
Obs.	100	100	100	96	96	96
R^2	0.2833	0.2601	0.2561	0.3713	0.5082	0.3686

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-13 Determinants of Acquirers' changes of LTD for Cross-border M&As

Variable	(1) ΔLTD IR DIFFERENCE3 Bank-specific Macroeconomic	(2) ΔLTD IR DIFFERENCE2 Bank-specific Macro	(3) ΔLTD DISPERSION3 Bank-specific Macro	(4) ΔLTD IR DIFF3 Bank-specific Deal-specific Macroeconomic	(5) ΔLTD IR DIFF2 Bank-specific Deal-specific Macro	(6) ΔLTD DISPERSION3 Bank-specific Deal-specific
Banking integration	-0.1014**	-0.0015	-0.0004	-0.1008**	-0.0015	-0.0004
	(0.0431)	(0.0249)	(0.0004)	(0.0447)	(0.0249)	(0.0003)
Asset diversity	-0.0369*	-0.0362*	-0.0368*	-0.0444**	-0.0362*	-0.0368*
	(0.0187)	(0.0173)	(0.0183)	(0.0200)	(0.0172)	(0.0202)
Non-performing loan	-0.1104	-0.0536	-0.0257	-0.0384	-0.0536	-0.0257
	(0.1345)	(0.0825)	(0.0728)	(0.1571)	(0.0824)	(0.1626)
Tier 1 Capital	0.3582**	0.3359**	0.3207*	0.3311*	0.3359**	0.3207*
	(0.1762)	(0.1495)	(0.1537)	(0.1806)	(0.1495)	(0.1857)
Ln(TA)	0.0255***	0.0382*	0.0385**	0.0392***	0.0382*	0.0385***
	(0.0080)	(0.0174)	(0.0151)	(0.0127)	(0.0174)	(0.0130)
PB	0.0048	0.0065	0.0074	0.0049	0.0065	0.0074
	(0.0066)	(0.0054)	(0.0055)	(0.0073)	(0.0055)	(0.0075)
Moral hazard index						
Liquid ratio	-0.0304	-0.0316	-0.0333	-0.0380	-0.0316	-0.0333
	(0.0257)	(0.0357)	(0.0370)	(0.0288)	(0.0357)	(0.0295)
Equity-to-asset	-0.2900	-0.3310*	-0.3133	-0.2799	-0.3310*	-0.3133
	(0.2448)	(0.1513)	(0.1834)	(0.2611)	(0.1513)	(0.2673)
ROA	1.7935	2.6659	2.4317	2.2694*	2.6659	2.4317**
	(1.0805)	(1.9515)	(1.7914)	(1.1807)	(1.9515)	(1.2140)
Short-term debt	-0.0184	-0.0009	0.0005	0.0016	-0.0009	0.0005
	(0.0312)	(0.0404)_	(0.0380)	(0.0366)	(0.0404)	(0.0375)
Non-interest income	-0.0095	-0.0114	-0.0112	-0.0159	-0.0114	-0.0112
	(0.0241)	(0.0200)	(0.0194)	(0.0260)	(0.0200)	(0.0266)
Z-score	-0.0001	-0.0003	-0.0002	-0.0002	-0.0003	-0.0002
	(0.0003)	(0.0002)	(0.0002)	(0.0003)	(0.0002)	(0.0003)
Cross-border				-0.0115	-0.0168	-0.0142
				(0.0259)	(0.0203)	(0.0266)
Geographic diversification				0.0033	0.0035	0.0036
				(0.0098)	(0.0112)	(0.0100)
Systemic importance				-0.0272	-0.0283	-0.0292
				(0.0184)	(0.0196)	(0.0189)
Bailout				-0.0007	0.0065	0.0047
				(0.0158)	(0.0172)	(0.0159)
Real GDP growth	-0.0039	-0.0027	-0.0027	-0.0033	-0.0027	-0.0027
	(0.0033)	(0.0031)	(0.0030)	(0.0038)	(0.0031)	(0.0039)
Inflation	0.0044	0.0031	0.0035	0.0035	0.0031	0.0035
	(0.0035)	(0.0048)	(0.0045)	(0.0039)	(0.0048)	(0.0040)
Money supply growth	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)
CR5				0.0003	0.0002	0.0002
				(0.0003)	(0.0002)	(0.0003)
Capital regulatory index						
Official supervisory index						
Deposit insurer power						
Private monitoring index						
Obs.	99	99	99	99	99	99
R^2	0.1651	0.1386	0.1358	0.1535	0.1386	0.1358

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-14 Determinants of Acquirers' changes of ΔCoVaR for Cross-border M&As

Variable	(1) Diff(ΔCoVaR) IR DIFFERENCE3 Full	(2) Diff(ΔCoVaR) IR DIFFERENCE2 Full	(3) Diff(ΔCoVaR) DISPERSION3 Full	(4) Diff(ΔCoVaR) IR DIFF3 Bank-specific	(5) Diff(ΔCoVaR) IR DIFF2 Bank-specific	(6) Diff(ΔCoVaR) DISPERSION3
Banking integration	-59.5039***	1.4252	-0.1202	-48.3081**	-6.7817**	-0.1245
	(20.4261)	(3.5951)	(0.1864)	(16.7708)	(2.8748)	(0.1608)
Asset diversity	-24.1939	-28.8975	-28.5909	-25.9490**	-31.4965**	-31.1944**
	(16.5158)	(20.5827)	(19.6758)	(9.4554)	(11.5497)	(11.6879)
Non-performing loan	-164.4337*	-150.8862	-140.4985	-158.00***	-164.705***	-155.925***
	(86.1474)	(100.1693)	(110.1975)	(46.7210)	(48.9562)	(41.4260)
Tier 1 Capital	41.0434	25.4569	20.4151	-6.9668	-9.8085	-10.3745
	(148.895)	(168.8248)	(171.0785)	(61.1530)	(64.3022)	(62.3407)
Ln(TA)	-5.0092	-5.7832	-6.3149	5.2104	3.2612	3.7063
	(16.5231)	(18.5501)	(18.2928)	(9.0213)	(7.4138)	(7.5943)
PB	4.0154	5.8162**	5.7740**	1.6990	0.2390	0.6758
	(3.2063)	(2.5158)	(2.4087)	(2.0919)	(2.7795)	(2.3717)
Moral hazard index	-13.1048*	-14.2081*	-14.5477*			
	(6.3537)	(6.9696)	(7.6256)			
Liquid ratio	-16.5120	-18.1759	-19.1656	-21.4112	-23.0252	-22.9635
	(33.5009)	(32.3794)	(35.1744)	(25.2657)	(24.0839)	(22.3879)
Equity-to-asset	-133.4948	-85.8737	-83.1382	-128.7379	-130.7129	-141.3745
	(457.5966)	(467.6245)	(459.093)	(1138.157)	(124.2224)	(128.2669)
ROA	1196.876	1012.712	970.3391	-593.092	-705.95	-747.6984
	(1994.146)	(2025.257)	(1978.345)	(931.912)	(873.5872)	(878.4103)
Short-term debt	29.1375*	31.6902**	31.9044**	29.8040	28.7219	29.5305
	(10.7079)	(11.8411)_	(11.6517)	(23.3830)	(20.2579)	(20.3839)
Non-interest income	1.3384	-1.3940	-1.9941	-4.6730	-6.3853	-4.8415
	(19.1519)	(20.7438)	(20.8827)	(13.1957)	(12.1451)	(12.2400)
Z-score	-0.2048	-0.1285	-0.1001	-0.2698	-0.2502	-0.2419
	(0.3433)	(0.3294)	(0.3491)	(0.2889)	(0.3190)	(0.3212)
Cross-border	5.3764	6.7150	6.8809			
	(4.8644)	(5.3976)	(5.6196)			
Geographic diversification	-4.4097	-3.6641	-3.3699			
	(5.8397)	(5.0705)	(4.5154)			
Systemic importance	-0.2923	0.2474	-0.0993			
	(11.8135)	(15.0854)	(15.6199)			
Bailout	-25.7700**	-23.7069**	-23.6848***			
	(8.9643)	(8.1230)	(7.2948)			
Real GDP growth	2.7406	2.8866	2.7897			
	(6.4379)	(7.1506)	(7.0730)			
Inflation	-8.7635*	-8.5986*	-8.3912*			
	(4.4920)	(4.3327)	(4.3745)			
Money supply growth	1.7545	1.4475	1.4306			
	(1.2089)	(1.1601)	(1.3290)			
CR5	0.1334	0.1482	0.1687			
	(0.3839)	(0.4527)	(0.4794)			
Capital regulatory index	-4.5294	-5.2509	-5.2281			
	(3.2397)	(4.1904)	(4.0619)			
Official supervisory index	-5.2083	-4.8871	-4.9436			
	(4.3680)	(3.9640)	(4.1143)			
Deposit insurer power	14.9017	15.2312	14.9081			
	(13.6718)	(13.3692)	(13.1854)			
Private monitoring index	-5.1164	-5.2164	-4.7450			
	(4.4714)	(4.3831)	(4.2724)			
Obs.	99	99	99	104	104	104
R^2	0.2848	0.2588	0.2609	0.1170	0.1015	0.1002

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-15 Determinants of Acquirers' Changes of ΔCoVaR for Cross-border M&As

Variable	(1) Diff(ΔCoVaR) IR DIFFERENCE3 Bank-specific Deal-specific	(2) Diff(ΔCoVaR) IR DIFFERENCE2 Bank-specific Deal-specific	(3) Diff(ΔCoVaR) DISPERSION3 Bank-specific Deal-specific	(4) Diff(ΔCoVaR) IR DIFF3 Deal-specific Regulatory	(5) Diff(ΔCoVaR) IR DIFF2 Deal-specific Regulatory	(6) Diff(ΔCoVaR) DISPERSION3 Deal-specific
Banking integration	-56.7726**	-9.3667*	-0.1016	-45.3206***	-6.4892	-0.0946
	(18.5652)	(4.9461)	(0.1672)	(13.9335)	(11.7536)	(0.2185)
Asset diversity	-21.6984*	-28.7802*	-27.7038*	-13.7667	-20.8833	-20.2944**
	(11.0520)	(13.7977)	(13.3983)	(11.5525)	(18.1425)	(8.7991)
Non-performing loan	-156.8147**	-166.8325**	-154.3871***	-181.3229***	-190.4527	-180.0934***
	(53.1540)	(53.8130)	(45.3912)	(48.7794)	(126.6472)	(41.0249)
Tier 1 Capital	39.0420	34.4358	32.8641	-8.4969	-20.0417	-24.2626
	(49.5517)	(49.7954)	(51.3942)	(96.0741)	(157.9510)	(111.9469)
Ln(TA)	-2.4549	-4.1118	-3.6160	-3.5103	-2.5168	-2.3979
	(9.5110)	(9.5883)	(9.8164)	(12.4036)	(9.3606)	(13.4845)
PB	-2.2300	-3.6379	-3.1965	-0.6320	-2.1010	-1.7510
	(2.2579)	(3.7037)	(3.0310)	(1.1028)	(6.2960)	(1.9595)
Moral hazard index				12.0835	11.2841	11.4689**
				(8.3847)	(7.2656)	(5.0106)
Liquid ratio	-21.9002	-25.0000	-24.3183	-7.3133	-7.9427	-9.0844
	(27.2195)	(25.8223)	(26.2488)	(26.2579)	(25.8968)	(25.8838)
Equity-to-asset	-51.2348	-56.8037	72.7306	74.9104	81.7582	104.8406
	(147.3661)	(121.7495)	(133.2628)	(372.7551)	(238.7865)	(384.7411)
ROA	-123.7043	-293.5339	-343.6922	-365.3083	-471.0617	-529.4548
	(1100.543)	(1008.306)	(1039.67)	(1775.898)	(850.2559)	(1752.82)
Short-term debt	14.4293**	13.9577***	14.6660***	59.3956**	52.9300*	53.3549**
	(6.0218)	(3.3012)_	(3.5195)	(22.3865)	(30.5680)	(19.0964)
Non-interest income	-0.5372	-2.2692	-0.6166	-6.6509	-9.0642	-8.0935
	(12.0103)	(12.0601)	(11.8419)	(13.7060)	(21.0934)	(14.9009)
Z-score	-0.2412	-0.2194	-0.2091	-0.2168	-0.0998	-0.0747
	(0.3368)	(0.3593)	(0.3587)	(0.3554)	(0.3380)	(0.3726)
Cross-border	-3.3282	-1.8413	-1.5179			
	(7.2576)	(6.1582)	(6.3312)			
Geographic diversification	-5.3893	-6.4345	-5.3698			
	(5.7725)	(5.6700)	(5.3555)			
Systemic importance	3.7137	3.1061	4.2256			
	(13.1310)	(13.7395)	(13.6995)			
Bailout	-20.3151**	-18.5272**	-18.2027**			
	(6.8842)	(6.3008)	(6.2402)			
Real GDP growth						
Inflation						
Money supply growth						
CR5						
Capital regulatory index				-1.3157	-2.2476	-2.1238
				(1.3064)	(3.1913)	(1.2508)
Official supervisory index				1.5636	1.1743	1.3962
				(3.7019)	(2.8155)	(3.6736)
Deposit insurer power				4.4268	4.5832	5.2176
				(9.2853)	(7.0938)	(9.3596)
Private monitoring index				-4.6614	-4.6819	-4.4805
				(4.6238)	(4.7320)	(5.3751)
Obs.	104	104	104	100	100	100
R^2	0.1694	0.1504	0.1448	0.1834	0.2143	0.1741

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Table 3A-16 Determinants of Acquirers' Changes of ΔCoVaR for Cross-border M&As

Variable	(1) Diff(ΔCoVaR) IR DIFFERENCE3 Bank-specific Macroeconomic	(2) Diff(ΔCoVaR) IR DIFFERENCE2 Bank-specific Macro	(3) Diff(ΔCoVaR) DISPERSION3 Bank-specific Macro	(4) Diff(ΔCoVaR) IR DIFF3 Bank-specific Deal-specific Macroeconomic	(5) Diff(ΔCoVaR) IR DIFF2 Bank-specific Deal-specific Macro	(6) Diff(ΔCoVaR) DISPERSION3 Bank-specific Deal-specific
Banking integration	43.2049**	-9.4733	-0.0835	-53.4079**	-9.7832	-0.1036
	(16.4775)	(5.7048)	(0.1732)	(19.5721)	(7.7011)	(0.1992)
Asset diversity	-28.5037**	-34.1871**	-33.4080**	-26.1977**	-33.4296*	-32.0621*
	(11.7341)	(14.7862)	(14.0220)	(11.6746)	(16.3517)	(15.2232)
Non-performing loan	-183.1273**	-189.8236**	-180.9251**	-160.4366*	-169.8654*	-150.4983
	(67.4869)	(73.0163)	(70.7299)	(79.3650)	(88.5356)	(88.9593)
Tier 1 Capital	36.9809	33.1293	35.6457	71.5448	65.7296	64.7625
	(114.6209)	(127.8219)	(125.5143)	(100.6406)	(116.1546)	(120.3234)
Ln(TA)	-3.1821	-0.9012	1.8589	-1.2449	-2.8301	-1.5830
	(10.6667)	(8.8116)	(9.2664)	(13.2367)	(14.5568)	(14.5568)
PB	1.9744	0.6001	0.9500	-2.2476	-3.2951	-3.0615
	(2.4877)	(3.4231)	(2.7150)	(2.4760)	(3.3365)	(2.7548)
Moral hazard index						
Liquid ratio	-13.4488	-13.0916	-14.5561	-22.1940	-22.2544	-24.8700
	(25.6194)	(23.1697)	(24.5420)	(39.1181)	(35.7555)	(40.3969)
Equity-to-asset	-70.6804	76.6524	81.5010	-14.0249	-1.6375	-10.5068
	(255.5038)	(246.2924)	(251.4015)	(287.6095)	(253.8935)	(270.0053)
ROA	-26.2063	-149.5992	-145.869	499.7028	296.7189	308.0298
	(1203.826)	(1150.19)	(1171.253)	(1579.718)	(1455.225)	(1447.401)
Short-term debt	35.0984	35.3324	35.4590	20.0836	22.7288*	21.3404*
	(24.3961)	(32.0293)_	(22.4125)	(12.2976)	(11.2902)	(11.1682)
Non-interest income	-6.8306	-9.5315	-6.6823	1.8529	-1.2383	0.7223
	(22.4947)	(20.166)	(21.6539)	(20.9268)	(20.0905)	(21.0460)
Z-score	-0.2578	-0.2370	-0.2352	-0.2530	-0.2323	-0.2154
	(0.3089)	(0.3367)	(0.3326)	(0.3581)	(0.3675)	(0.3715)
Cross-border				-2.6291	-0.5228	-0.5840
				(4.9200)	(3.1273)	(3.1516)
Geographic diversification				-5.9050	-6.4556	-5.4616
				(5.7321)	(5.1708)	(5.0347)
Systemic importance				-1.5858	-2.2276	-1.5629
				(19.2369)	(19.2535)	(20.3082)
Bailout				-19.3857***	-16.4881***	-16.3304***
				(3.2351)	(2.8867)	(2.4847)
Real GDP growth	-1.5882	-1.4028	-1.4484	-0.7126	-0.6378	-0.8795
	(6.5160)	(6.4827)	(6.5241)	(6.7888)	(7.0470)	(7.0448)
Inflation	-2.2095	-2.0714	-2.3709*	-3.4471**	-3.2194**	-3.4031**
	(1.2287)	(1.1815)	(1.1839)	(1.3425)	(1.3490)	(1.2775)
Money supply growth	-0.5175	-0.8066	-0.5761	0.1502	-0.2199	-0.0568
	(0.9953)	(1.1499)	(1.0175)	(1.6225)	(1.7458)	(1.6858)
CR5				0.0577	0.0510	0.0926
				(0.3072)	(0.3340)	(0.3484)
Capital regulatory index						
Official supervisory index						
Deposit insurer power						
Private monitoring index						
Obs.	103	103	103	103	103	103
R^2	0.1603	0.1429	0.1369	0.2830	0.2167	0.2626

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Chapter 4

The Impact of the ECB's Monetary Policy on Banks' Systemic Risk in Euro Area

4.1 Introduction

Since the 2007-2009 U.S. Global Financial Crisis (GFC) and the European Sovereign Debt Crisis (SDC), major central banks utilized both expansionary conventional (e.g. interest rate changes and required reserve ratio changes) and unconventional (e.g. quantitative easing, (QE)) monetary policy instruments to lower the systemic risk and restore the financial stability of banking systems. The response to the 2007-2009 U.S. GFC and the European SDC led to historically low policy rates in most advanced economies. In the U.S., the Federal Funds target rate reached the zero lower bound in December 2008 and the Fed subsequently adopted unconventional monetary policy instruments by using three rounds of QEs. In the Euro Area, on 16 March 2016, the European Central Bank (ECB) announced that it would lower the main refinancing operations (MRO) rate to 0 and the marginal lending facility (MLF) to 0.25%. Meanwhile, the ECB increased its monthly bond purchases from €60 billion per month to €80 billion per month and included more eligible assets into the program. Indeed, the conventional and unconventional monetary policy instruments of major central banks had played a key role in reducing systemic risk and maintaining financial stability of banking systems. Deev and Hodula (2015) illustrated that both SRISK and Systemic Risk Stress Index for Eurozone reached two peaks in 2009 and 2012 but declined significantly immediate (i.e. very short-term) after the ECB adopted both expansionary conventional and unconventional monetary policy instruments.

Meanwhile, this topic attracts attention in the academic research as well. First, some previous studies (Fratzsher et al. 2014; Chodorow-Reich et al. 2014; Di Maggio et al. 2016; Faia and Karau 2018) assessed only the impacts of monetary policy changes on banks' credit risk and systemic risk measures in short-run while others (Delis et al. 2010; Borio and Zhu 2012; Jimenez et al. 2014) examined the effects of monetary policy changes on banks' credit and systemic risk-taking behaviors in long-term. In addition, only two studies (Deev and Hodula

2015; Lamers et al. 2016) investigated both research questions.

Second, a large quantity of past literature (Gambocorta 2009; Delis 2010; De Nicolo 2010; Fratzscher et al. 2014; Brissmis and Delis 2010; Chodorow-Reich et al. 2014; Di Maggio et al. 2016; Lamers et al. 2016; Faia and Karau 2018) investigated the channels through which monetary policy is expected to affect banks' risk-taking behaviors. For example, Chodorow-Reich et al. (2014) discussed the real spending channel, reaching for yield channel, general equilibrium channel and leverage channel while Fratzscher et al. (2014) analyzed confidence channel, bank credit risk channel, sovereign credit risk channel and international portfolio channel.

Third, two recent studies (Brissimis and Delis 2010; Lamers et al. 2016) examined the heterogeneous response of EU banks' risk-taking behaviors towards monetary policy changes. Brissmis and Delis (2010) concluded that the impact of a monetary policy change on banks' risk-taking behaviors will decrease (increase) with higher (lower) levels of bank liquidity, capital and market power. Lamers et al. (2019) found that the expansionary monetary policy shock reduces systemic risk more for banks with higher asset risk.

This study contributes to existing literature in several ways. First, most previous studies (Kuttner 2001; Bernanke and Kuttner 2005; Kontonikas and Kostakis 2013; Kontonikas et al. 2013; Yin and Yang 2013; Ricci 2015; Haitsma et al. 2016) emphasized on the impacts of Fed's and the ECB's monetary policy changes on banks' stock returns rather than banks' systemic risk measures. There are only a few past literature (Deev and Hodula 2015; Lamers et al. 2016; Faia and Karau 2018) that focus on the impacts of monetary policy changes on banks' systemic risk. Therefore, this study contributes to existing literature by providing a new study using new updated data. Second, Kontonikas et al. (2013) argued that the responses towards conventional monetary policy changes were asymmetric and state dependent. They indicated that the impacts of monetary policy changes on stock returns are different in crisis and non-crisis periods.

However, there is no previous study that examines whether there are different impacts of monetary policy changes on banks' systemic risk in crisis and non-crisis periods. This study extends the current literature to assess whether the ECB's monetary policies have different impacts on banks' systemic risk changes in crisis and non-crisis periods.

This chapter aims to (1) investigate the impact of ECB's expansionary monetary policy on banks' systemic risk in euro area countries; (2) examine the heterogeneity of banks response towards monetary policy changes. Therefore, the research questions for this chapter are:

What are the impacts of the ECB's monetary policies on banks' systemic risk?

Is there any heterogeneous response of banks towards monetary policy changes?

What are key bank-specific variables that can affect banks' systemic risk if the ECB implements the expansionary monetary policies?

In this chapter, to find the solution of research question 1, we will first collect monthly systemic risk data (LRMES and SRISK) of 54 banks in euro area countries between September 2004 and March 2017. Second, we will focus on calculating monthly monetary policy shocks. We first use Taylor-rule type model to calculate standard Taylor rule residuals, and then collect the ECB shadow rate. Thirdly, we collect the ECB monthly total asset data and calculate the log difference of the ECB monthly total asset. We will investigate whether systemic risk measures of euro area banks increase or decrease when ECB implements the expansionary monetary policy. To find the answer of research question 2, we include the interaction terms between several bank-specific variable and corresponding monetary policy shock in the main regression to examine whether banks that have specific characteristics will benefit more from the expansionary monetary policy. To find the solution of research question 3, we will focus on the main bank-specific variables that can significantly influence banks' systemic risk.

The remaining Chapter 4 is organized as follows. Section 4.2 provides literature review from four aspects. Section 4.3 states hypotheses. Section 4.4 selected samples' characteristics and

limitations, the data sources, and econometric approach. Section 4.5 presents, discusses and interprets key empirical results. Finally, section 4.6 provides conclusions.

4.2 Literature Review

In this section, this chapter will review relevant literatures from five aspects: (1) the conventional and unconventional monetary policy instruments in Euro Area; (2) monetary policy shocks; (3) systemic risk measures; (4) banks' systemic risk-takings, bank heterogeneity and monetary policy channels

4.2.1 Conventional and Unconventional Monetary Policy Instruments in Euro Area

Before the financial crisis, the ECB mainly adopted the conventional monetary policy to achieve its major macroeconomic objectives. Since the 2007-2009 U.S. Financial Crisis, a number of studies by ECB's researchers (ECB 2010; ECB 2011; Cour-Thimann and Winkler 2013; Pattipeilohy et al. 2013) described how the ECB adopted the conventional and unconventional monetary policy instruments to respond the financial crises. For conventional monetary policy instruments, the ECB provides two standing facilities, including marginal lending facility (MLF) and the deposit facility (DF), and reduces (increases) the interest rates of the two standing facilities to provide more (less) overnight liquidity to financial institutions. In addition, the ECB uses the main refinancing operation (MRO) rate and longer-term refinancing operations (LTROs) as two main open market operations. Finally, the ECB changes the minimum reserve requirements to stabilize the market interest rates. The ECB cut MRO by a total of 325 basis points between October 2008 and March 2009, to a historic low of 1%. Meanwhile, the ECB also cut DF rate from 3.25% to 0.25%, the MLF rate from 5.25% to 1.75%. Since all interest rates were at historic low at that time, in October 2008, the ECB decided to implement the unconventional monetary policy to complement the conventional monetary policy to restore an appropriate monetary policy transmission. Cour-Thimann and Winkler

(2013) illustrated five unconventional monetary policies that the ECB adopted to resolve the U.S. Financial Crisis of 2007-2009: fixed-rate allotment, extension of the maturity of liquidity provision, extension of collateral eligibility, currency swap arrangements and covered bond purchase program (CBPP). They temporarily provided unlimited liquidity for more eligible financial institutions. For instance, fixed-rate full allotment enabled euro area financial institutions to have unlimited access to ECB's liquidity at a fixed interest rate (i.e. MRO); both maturity and eligibility of the collateral have been extended; currency swap agreements enabled the Eurosystem to provide more liquidity provision in foreign currencies; CBPP was the first asset purchase program that enabled the Eurosystem to purchase covered bonds (mortgaged-backed securities, MBS) between June 2009 and 2010. ECB (2011) illustrated that all above-mentioned measures except CBPP were extended after the Sovereign Debt Crisis started in May 2010 and CBPP was replaced by the Securities Markets Program (SMP). SMP enabled the Eurosystem to purchase debt securities and was intended to maintain depth and liquidity in malfunctioning segments of debt securities markets and to restore an appropriate functioning of the monetary policy transmission mechanism (ECB 2010). However, the Sovereign Debt Crisis and European banking sector strains still intensified in the summer of 2011, the ECB announced four more monetary policy changes (three unconventional and one conventional) to respond the crisis on 8 December 2011: two 3-year LTROs, extending eligible collaterals; encouraging the development of alternative credit assessment sources for use in the selection of eligible collateral and reducing the required reserve ratio from 2% to 1%. They were intended to provide sufficient liquidity for euro area banks. Nevertheless, on 6 September 2012, as the Sovereign Debt Crisis continuously intensified and the liquidity conditions on financial markets deteriorated, the ECB announced that it would implement the Outright Monetary Transactions (OMT) program to restore an appropriate monetary policy transmission and the singleness of the monetary policy. The OMT program involves purchases of short-term

sovereign bonds under some strict conditions (Pattipeilohy et al. 2013). A necessary condition for OMT is strict and effective conditionality attached to an appropriate European Financial Stability Facility/European Stability Mechanism (EFSF/ESM) program. Meanwhile, the ECB gradually decreased the interest rates to historic low: it decreased Deposit Facility rate to 0 in July 2012, further to -0.4% in March 2016 and lowered MRO rate to 0 and MLF rate to 0.25% in March 2016. Since November 2014, the ECB mainly adopted the unconventional monetary policy measures. On 21 November 2014, the ECB started the third round of asset-backed securities purchase program (ABSPP3); on 9 March 2015, the ECB began buying public sector securities under the public sector purchase program (PSPP); on 10 March 2016, the ECB decided to expand the monthly purchase under the asset purchase program (APP) to €80billion per month from April 2016 to March 2017; on 2 June 2016, the ECB announced to start corporate sector purchase program (CSPP) on 8 June; on 8 December 2016, the ECB decided to reduce monthly APP to €60 billion from April 2017 to December 2017; on 26 October 2017, the ECB announced to further reduce monthly APP to €30 billion from January 2018 to September 2018. Pattipeilohy et al. (2013) summarized that the ECB's unconventional monetary policy frameworks might consist of three key elements: (1) providing large-scale liquidity support to banks; (2) extending the historic low interest rates into longer term; (3) large scale asset purchases. In next subsection, we will discuss literature about monetary policy shocks.

4.2.2 Monetary Policy Shocks

Two previous papers (Clarida et al. 1998, 2000) used residuals from a Taylor-rule type models to calculate long-run (monthly) unexpected monetary policy changes (shocks). Clarida et al. (1998) illustrated the specification and estimation of the monetary policy function based on Taylor rule and estimated monetary policy reaction functions for two sets of countries: Germany, Japan and the U.S., and the U.K., France and Italy. Similarly, Clarida et al. (2000)

also employed Taylor rule to demonstrate the Federal Reserve's monetary policy reaction function. Both papers are the early papers that demonstrate how to use Taylor rule to compute monetary policy reaction function for researchers in next two decades. They also provide empirical evidences for the relationships between monetary policy rules and macroeconomic stability in the U.S., Japan and some European countries. We will calculate standard Taylor rule residuals to represent one measure of monetary policy shock.

The most recent papers (Wu and Xia 2016; Faia and Karan 2018) propose new indicators to represent the unconventional monetary policy shocks. Wu and Xia (2016) first propose the shadow rate and employ term structure model to calculate the shadow rate mainly in times when the main interest rates are close to zero bound. The shadow rate can be negative when the central banks conduct the unconventional monetary policy instruments. The shadow rate has an advantage over central banks' policy rates. Compared to the effective central banks' policy rates, the shadow rate is not subject to zero interest rate bound and can account for real effects of the unconventional monetary policy tools on borrowing costs of financial intermediaries and firms. Faia and Karau (2018) not only use Wu-Xia and Krippner shadow rates but also employ log difference of central banks' balance sheets between 2007 and 2016. They find that the size of ECB's balance sheet increases in most time periods since the U.S. Financial Crisis and implies that the ECB conducts the expansionary monetary policy. We will follow Faia and Karau (2018) to use both Wu-Xia shadow rate and log difference of the ECB monthly total asset to represent the other measures of monetary policy shock.

4.2.3 Systemic Risk Measures

Since the U.S. 2007-2009 Financial Crisis, a few studies (Acharya et al. 2010; Adrian and Brunnermeier 2011; Brownless and Engle 2016) focused on systemic risk measures and mostly utilised marketed-based measures. The most commonly used systemic risk measures are marginal expected shortfall (MES), Conditional Value-at-Risk (ΔCoVaR), and SRISK. Acharya

et al. (2010) defined MES and used OLS regression and probit regression analysis to study 102 financial institutions between July 2007 and December 2008. They defined MES as a measure of the individual bank's marginal risk contribution to the overall banking system if the overall market experiences moderately tail risk and concluded that MES appear to be able to predict the financial firms with the worst contributions in the systemic crisis. Furthermore, they claimed that MES had two advantages over the other systemic risk measures: (1) MES is simple to compute and is easy for regulators to consider; and (2) ES is a coherent risk measure and is more robust than VaR. However, Weiss et al. (2013) claimed two disadvantages of MES: (1) it is only based on the left tail of the market's marginal distribution but ignores the right tail of the market's distribution; and (2) it does not capture the true tails of the return distribution because it only measures the moderate tail risk. Adrian and Brunnermeier (2011) utilized CoVaR to analyze a sample of 1226 institutions at least 260 weeks of asset return data (an average length of 645 weeks) between 1986Q1 and 2010Q4 and used quantile regression and time variation associated with systemic state variables to estimate ΔCoVaR. Moreover, they also pointed out two advantages of ΔCoVaR: (1) it focuses on the contribution of each bank to overall systemic risk; (2) it captures the risk spillovers from institution to institution across the whole financial network. Nevertheless, other scholars argue that ΔCoVaR also has several drawbacks. For example, Billio et al. (2012) claimed that ΔCoVaR implies lower estimates of systemic risk after a volatility spike occurs. Moreover, Huang et al. (2010) pointed out that ΔCoVaR cannot appropriately aggregate the systemic risk contributions of individual banks because VaR is not additive. These advantages indicate that VaR is not a coherent risk measure and cannot predict systemic risk timely when it is building up. Brownless and Engle (2016) adopted SRISK to measure a bank's contribution to the undercapitalization of the financial system in case of a crisis. They pointed out three advantages of SRISK. First, the sum of SRISK across all banks measures the overall systemic risk in the entire financial system. Second,

SRISK can also be thought as the total amount if capital that government would have to provide to bailout the financial system. Third, SRISK improves predicting the Fed capital injections during the crisis and provides early warning signals of distress in indicators of real activity. However, they also proposed that this measure does not use off-balance sheet information and may not appropriately capture the true asset structure of a firm. Some of these systemic risk measures have been adopted as dependent variables in the most recent studies that examine the relationships between systemic risk measures and monetary policy changes (shocks). We will discuss this in more details in the following subsection.

4.2.4 Banks' Systemic Risk-takings, Bank Heterogeneity and Monetary Policy Channels

Many previous studies (Gambacorta 2009; Brissimis and Delis 2010; Delis et al. 2010; De Nicolo et al. 2010; Brissmis and Delis 2010; Chodorow-Reich et al. 2014; Di Maggio et al. 2016; Lamers et al. 2016; Faia and Karau 2018). Brissimis and Delis (2010) analyzed the heterogeneous response of the U.S. and Euro Area banks in terms of their lending and risk-taking decisions when monetary policy changes during 1994 and 2007. They illustrated three channels of transmission of monetary policy through banks: bank lending, bank risk-taking and bank profitability. Firstly, the bank lending channel indicates that the expansionary (restrictive) monetary policy increases (decreases) bank loan supply and thus increases (decreases) aggregate economic activity and aggregate demand. Secondly, the bank risk-taking channel shows that the expansionary monetary policy encourages banks to take riskier assets and boosts asset prices, resulting in increased aggregate economic activity and aggregate demand. Thirdly, the bank profitability channel shows that the expansionary monetary policy lowers short-term borrowing costs relative to long-term lending incomes for banks that borrow short and lend long and this increases banks' net interest margins. As a result, this further increases the aggregate economic activity and aggregate demand. In order to investigate the heterogeneous impacts of monetary policy changes on bank lending, risk-taking and profitability, they

formulated three different hypotheses based on bank liquidity, equity capital, and market power. They employed the Local GMM method and set three equations with regard to bank lending, bank risk-taking and bank profitability to examine whether the three hypotheses are correct. They found that all three hypotheses are correct and concluded that the impacts of monetary policy changes on bank lending, bank risk-taking and bank profitability are lower for banks with healthier balance sheets and higher market power. These results indicate two implications. On the one hand, that bank activities are less sensitive to monetary policy changes for banks with high liquidity, equity capitals and market power. On the other hand, banks with less healthy balance sheets (e.g. more risky assets, fewer equity capital, and lower profitability) have more benefits from the expansionary monetary policy (e.g. low interest rate).

Lamers et al. (2019) summarized five heterogeneous transmission of monetary policy channels to bank systemic risk. First, when the ECB implements the expansionary monetary policy, short-term risk-free interest rates decrease and bank's net interest margin increases, therefore, bank's profitability increases and will have higher incentives for excessive risk, and finally decreases bank's systemic risk. Second, when the ECB implements the expansionary monetary policy, long-term risk-free interest rates decrease and bank's net interest margin decreases, thus bank's profitability decreases and will have lower incentives for excessive risk, and finally increases systemic risk. Third, when the ECB adopts the expansionary monetary policy, risk premia will decrease and asset prices will increase, therefore, banks' capital and profitability will increase, and banks' systemic risk will decrease. Fourth, when the ECB adopts the expansionary monetary policy shock, bank liquidity will improve, then banks will delay writing off bad loans, and finally bank's systemic risk will increase. Fifth, when the ECB uses the expansionary monetary policy, funding risk will decrease and finally bank's systemic risk will decrease. They conclude that the expansionary monetary policy actions reduce banks' systemic risks in the short-run but increase banks' risk-taking incentives in the long-run. These

conclusions can be interpreted by the first and second heterogeneous transmission of monetary policy channels, respectively.

Fratzscher et al. (2014) proposed four monetary policy channels: confidence channel, bank credit risk channel, sovereign credit risk channel and international portfolio balance channel. Confidence channel indicates that central banks use the expansionary monetary policies to restore confidence in the financial markets and reduce risk premia thus increase asset prices. Bank credit risk channel shows that the expansionary monetary policies can lower credit risk therefore increase asset prices. Similarly, the expansionary monetary policies can also reduce sovereign credit risk and thus increase asset prices. International portfolio balance channel indicates that the expansionary monetary policies can rebalance portfolio across assets therefore change asset prices. In their paper, Fratzscher et al. (2014) found that monetary policy changes in the euro area influenced global markets mainly through a rise in confidence, a reduction of sovereign risk and a decrease in bank credit risk and confirmed that confidence channel, bank credit risk channel and sovereign credit risk channel hold while international portfolio balance channel does not hold.

Di Maggio et al. (2016) put forward three more monetary policy channels: the portfolio-balancing channel, the segmentation channel and the capital-constraints channel. The portfolio-balancing channel indicates that the central bank affects the return of different assets by affecting their relative supply; the segmentation channel posits that LSAPs are effective when capital-constrained intermediaries in the secondary market are unable to arbitrage in the short run across different segments; The capital-constraints channel highlights how LSAPs can offset the decline in private lending from disruptions in financial intermediation. They conclude that Quantitative Easing works through a refinancing channel via reducing interest rates for mortgage borrowers and increasing credit availability, which lead to increase in investment and consumption and finally increase the aggregate demand of the real economy. They finally

concluded that the central banks' purchases of large quantity of long-term assets in QE programs usually have spill-over effects on different sectors of the real economy when capitals are reallocated across different sectors (i.e. from the least efficient sectors to the most efficient sectors). Their conclusion supports the portfolio-rebalancing channel.

In addition, Chodorow-Reich (2014) defined the leverage channel as low interest rates result in lower cost of capital and cost of holding collaterals and therefore leads to higher leverage for banks and increase banks' risk-taking behaviors. Borio and Zhu (2010) defined bank risk-taking channel as lower interest rates will result in higher liquidity and lower external constraints, thus further lead to higher risk tolerance for banks and finally increase banks' risk-takings.

4.3 Hypothesis

Since the 2007-2009 U.S. Subprime Crisis and the 2010-2012 European Sovereign Debt Crisis, major central banks implemented several rounds of expansionary monetary policies. One of the most important aims of central banks to adopt the expansionary monetary policy tools is to reduce credit risks and systemic risks in banking sectors. Therefore, there is an increasing number of studies that examine whether central banks' expansionary policies will increase or decrease banks' systemic risks in the long-term. A few previous studies (Delis et al. 2010; Borio and Zhu 2012; Jimenez et al. 2014; Deev and Hodula 2015; Lamers et al. 2016) investigate the impacts of monetary policy on banks' risk-taking behaviors in the long-term. All these researches hold the same conclusion that maintaining low interest rate for too long will increase banks' systemic risk-taking behavior and contribute to the buildup of systemic risk of banking sector in the long term. This can be explained by the "search for yield" channel. If the interest rates are kept low in longer time, banks will have declining net interest margins. In order to maintain the stable net interest margins, banks have to increase their risk-taking activities. This

conclusion can also be interpreted by "leverage channel". Chodorow-Reich (2014) analyzed the "leverage channel" as low interest rates result in lower cost of capital and cost of holding collaterals and therefore leads to higher leverage for banks and increase banks' risk-taking behaviors. Borio and Zhu (2010) illustrated another bank risk-taking channel: lower interest rates will result in higher liquidity and lower external constraints, thus further lead to higher risk tolerance for banks and finally increase banks' risk-takings. Therefore, the hypothesis of this chapter can be formulated as follows:

Hypothesis: The expansionary monetary policies will contribute to the buildup of systemic risks of euro area banks in the long term.

4.4 Sample, Data Sources and Descriptive Statistics

4.4.1 Sample and Data Sources

We will select banks in euro area countries in our full sample in this chapter. Since the ECB was established in June 1998, and the euro was introduced in 1999, we will select banks from countries that were EU member countries before 1999. Because we will use market-based systemic risk measures, all banks must be public listed. Due to the data availability on V-lab website (https://vlab.stern.nyu.edu/) and S&P market intelligence platform, the full sample of this chapter consists of 54 banks (6532 observations) from 11 countries (Austria, Belgium, Finland, France, Germany, Greece, Italy, Ireland, Netherlands, Portugal, Spain) between September 2004 and March 2017. Next, in order to examine whether banks in core countries and periphery countries have different responses to the expansionary monetary policy, we will follow Alfonso et al. (2018) to divide the full sample into banks in core countries (Austria, Belgium, Finland, France, Germany and Netherlands) and banks in periphery countries (Greece, Italy, Ireland, Portugal and Spain). Finally, to investigate whether banks in crisis period and non-crisis period have different responses towards the expansionary monetary policy, we will follow Alfonso et

al. (2018) to divide the full sample into banks in crisis period (August 2007 – July 2012) and banks in non-crisis period (September 2004 – July 2007 and August 2012 – March 2017). Alfonso et al. (2018) explain that the estimated Time-varying parameter (TVP) coefficients of all risk sources are zero and near-zero in the non-crisis period while the coefficients increase rapidly to positive and significant values in the crisis period. They also propose that the non-crisis period covers the two pricing regimes that have low/reduced absolute values of coefficients of risk factors while crisis period covers the one pricing regime that have relatively high absolute values of coefficients of risk factors. Therefore, we combine the two crises into the "crisis period" and the remaining years in "non-crisis period".

The data are drawn from the following multiple sources: (1) the data of systemic risk measures LRMES and SRISK are downloaded from V-lab; (2) the bank-specific data are obtained from S&P market intelligence platform and Bloomberg; (3) the macroeconomic data in calculating monetary policy shocks (Taylor-rule type residuals) are collected from ECB Statistics Data Warehouse; (4) the ECB policy rate (Main Refinancing Operation rate, MRO) and annual total assets are obtained from ECB website; (5) the ECB's Shadow rate is collected from Quandl website. Additionally, in order to evaluate the economic significance of the variables, we follow Bostandzic and Weiss (2018) to standardize all variables to have zero mean and unit standard deviation.

4.4.2 Monetary Policy Shocks

We will use Taylor-rule type models to calculate monetary policy shocks as follows: first, take the difference between the log of the current month CPI and the log of the 12^{th} lag of the monthly CPI, that is,

$$INF = \log(CPI(t)) - \log(CPI(t-12)) \tag{4.1}$$

to generate annual inflation (INF); second, take the logarithm and generate deviations of potential output (GAP) from a Hodrick Prescott trend, that is,

$$GAP = \log(IP) - \log(IPTrend) \quad (4.2)$$

and third, follow Clarida et.al. (1998, 2000) to use the standard Taylor-rule model, that is,

$$MRO(t) = a + b*MRO(t-1) + c*INF(t) + d*GAP(t) + error(t) \quad (4.3)$$

to estimate the error terms to represent the monetary policy shocks.

Next, we will follow Faia and Karau (2018) to employ two more measures, the shadow rate and the log difference of central banks' balance sheets as proxies for monetary policy shocks. Wu and Xia (2016) proposed the shadow rate to account for conventional monetary policy rates as well as unconventional monetary policy shocks. They used the term structure model to calculate the shadow rate and mainly considered the monetary policy tools in times when the main interest rates are close to zero bound. Wu-Xia shadow rate differs from the effective central banks' policy rates as it can be very negative in times of unconventional monetary policy tools (e.g. Quantitative Easing, QEs and large-scale asset purchase programs, LSAPs). Compared to the effective central banks' policy rates, the shadow rate is not subject to zero interest rate bound and can account for real effects of unconventional monetary policy tools on borrowing costs of financial intermediaries and firms. This paper will use ECB's level of shadow rate. In addition, Faia and Karau (2018) also proposed the change in central banks' balance sheets for the post-2007 period when unconventional monetary policy tools are used more frequently.

4.4.3 Systemic Risk Measures

We follow Brownless and Engle (2016) to compute both LRMES and SRISK. On the one hand, they calculated LRMES based on the Marginal Expected Shortfall (MES) proposed by Acharya et.al. (2010). They defined MES by using net equity returns of firm *i* during worst 5% markets outcomes at daily frequency:

$$MES_i^{5\%} := -E\left[\frac{Wi,1}{Wi,0} | I5\%\right] \quad (4.4)$$

Then Brownless and Engle (2016) expanded MES into longer-term and defined Long-run

Marginal Expected Shortfall (LRMES) as the expectation of the firm equity over a longer period of time arithmetic return conditional on the systemic event, that is

$$LRMES_{i,t} = -E_t(R_{i,t+1:t+h} | R_{m,t+1:t+h} < C) \quad (4.5)$$

where $R_{i,t+1:t+h}$ is the h-period arithmetic firm equity return between period *t+1* and *t+h*. In this paper, *h* is 6 month (6M) and *C* is -40%. That means we will estimate the valuation loss a bank would generate conditional on a stock market decreases by 40% over a period of six months. On the other hand, they also defined SRISK as the expected shortfall conditional on a systemic event as follows:

$$\begin{aligned} SRISK_{i,t} &= E_t(CS_{i,t+h} | R_{m,t+1:t+h} < C) \\ &= k*E_t(D_{i,t+h} | R_{m,t+1:t+h} < C) - (1 - k)*E_t(W_{i,t+h} | R_{m,t+1:t+h} < C) \end{aligned} \quad (4.6)$$

They further assume that $E_t(D_{i,t+h} | R_{m,t+1:t+h} < C) = D_{i,t}$, then

$$\begin{aligned} SRISK_{i,t} &= k*D_{i,t} - (1- k)*W_{i,t}*(1 - LRMES_{i,t}) \\ &= W_{i,t}*[k*LVG_{i,t} + (1 - k)*LRMES_{i,t} - 1] \end{aligned} \quad (4.7)$$

where $LVG_{i,t}$ is the quasi-leverage ratio $(D_{i,t}+W_{i,t})=W_{i,t}$ and LRMES is the Long-run Marginal Expected Shortfall.

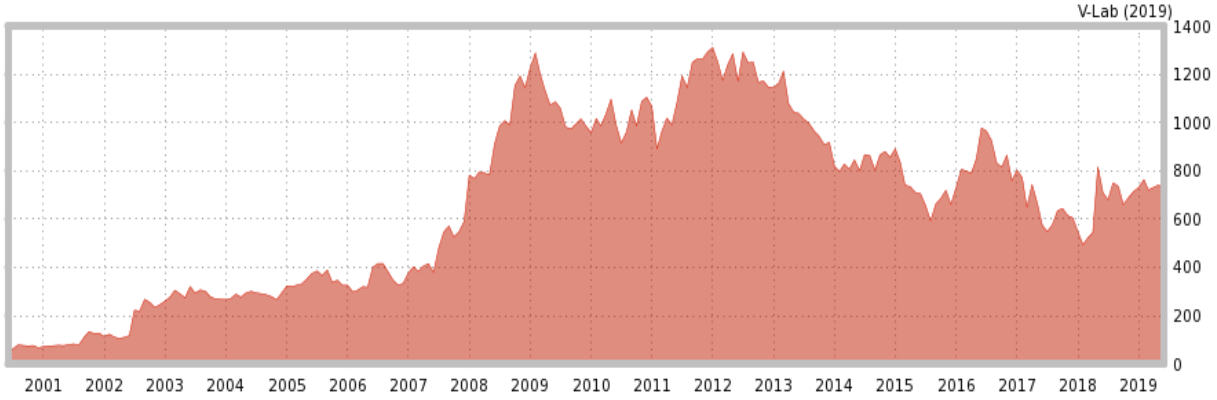
In chapter 4, we employ different systemic risk measures from chapter 3 because (1) we aim at examining the short-term impact of M&As on acquirers' systemic risk while we seek to investigate the long-term effect of ECB's monetary policy changes on banks' systemic risk taking behaviours; (2) we use daily data in chapter 3 and monthly data in chapter 4; (3) LRMES and SRISK are long-term systemic risk measures while MES, LTD and ΔCoVaR are short-term.

4.4.4 Descriptive Statistics

Graph 4-1 illustrates SRISK of 11 euro area countries (Austria, Belgium, Finland, French, Germany, Greece, Ireland, Italy, Netherlands, Portugal and Spain). SRISK rose significantly during the Global Financial Crisis and European sovereign debt crisis and arrived at the top in

early 2009 and early 2012. After the ECB President Mario Draghi's "Whatever it takes" speech, SRISK dropped significantly.

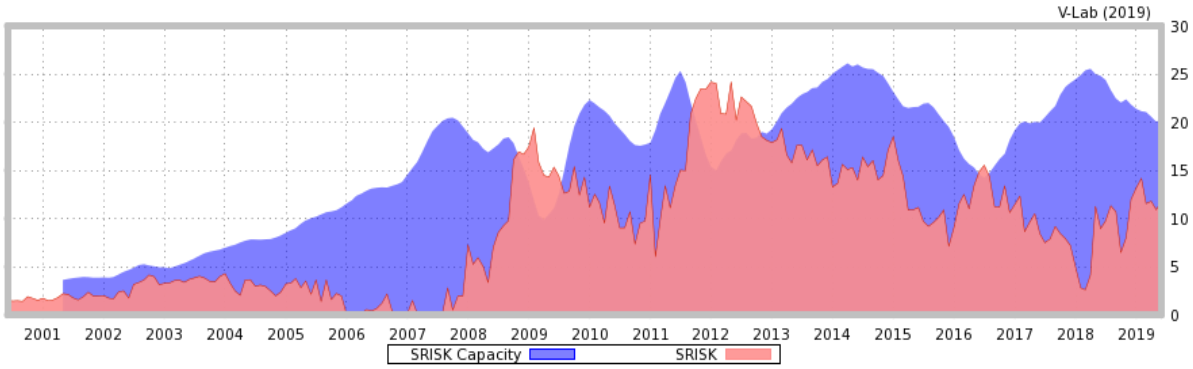
Graph 4-1 Graph of SRISK of 11 Euro Area Countries ($Billion)



Source: v-lab (2019)

Graph 4-2 shows that SRISK for Austria increased quickly during the Global Financial Crisis then decreased in 2010, however, it reached at the highest systemic risk during the European sovereign debt crisis and finally decreased thereafter.

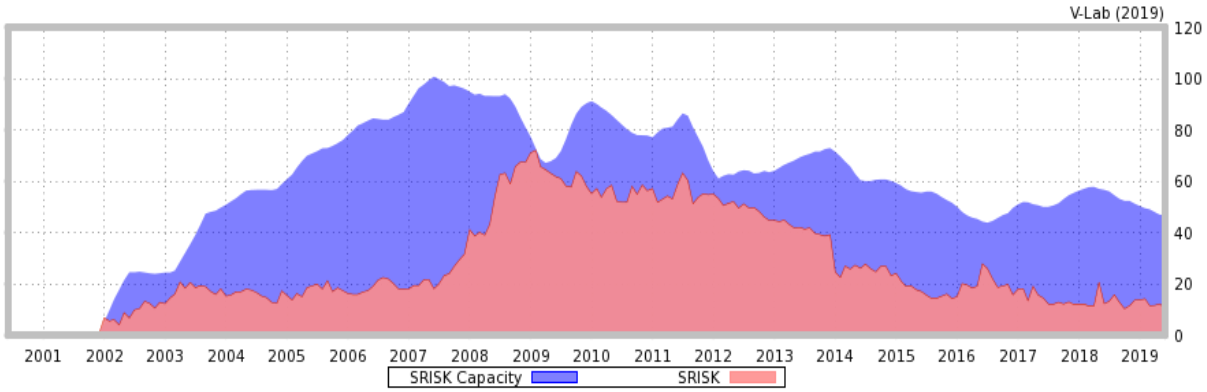
Graph 4-2 Graph of SRISK of Austria ($Billion)



Source: v-lab (2019)

SRISK of Finland (graph 4-4) and Portugal (4-11) have similar trends. They reached at the highest level during the European sovereign debt crisis and decreased thereafter. These trends are reasonable because banks in these countries were most adversely affected by the European sovereign debt crisis.

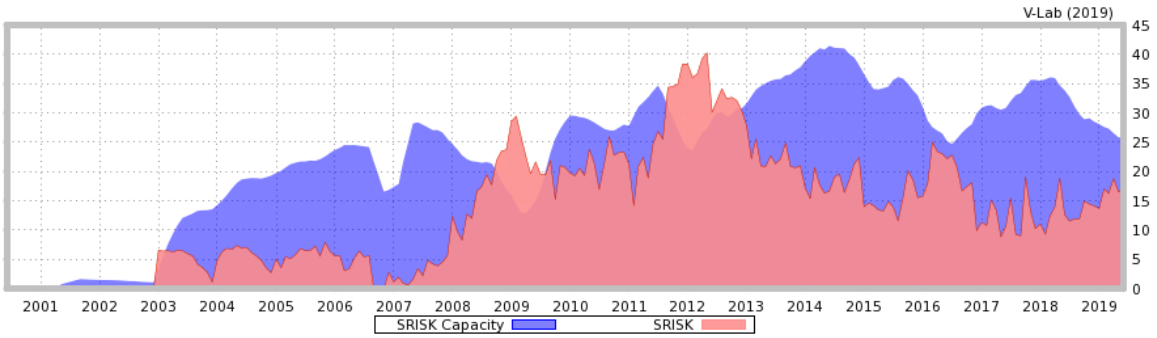
Graph 4-3 Graph of SRISK of Belgium ($Billion)



Source: v-lab (2019)

SRISK of Belgium (Graph 4-3) arrived at the highest level during the Global Financial Crisis and then decreased gradually. This is because one of the largest Belgian bank, Dexia bank, failed in 2009. SRISK of Ireland (graph 4-8) has similar trend as one of largest Irish bank, Allied Irish bank was in trouble in the second half of 2008.

Graph 4-4 Graph of SRISK of Finland ($Billion)

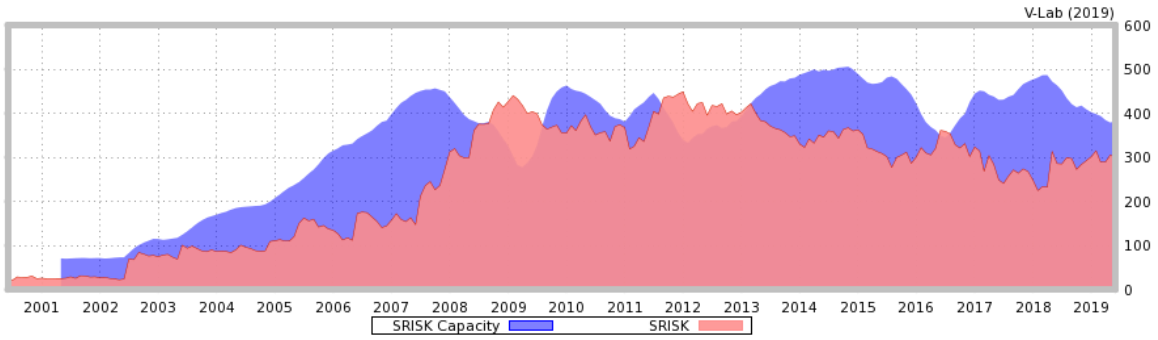


Source: v-lab (2019)

Graph 4-5 shows SRISK of France. It is possible to note that it reached the top levels during two financial crises, indicating that the two financial crises affected French banks in similar

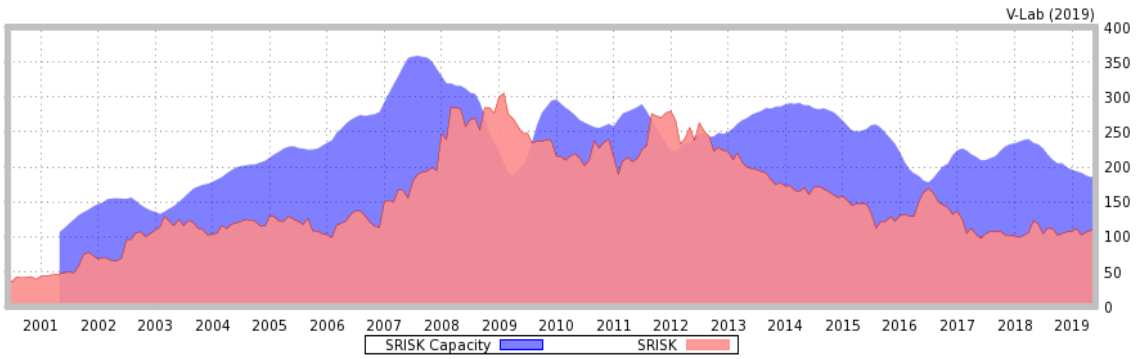
extents. SRISK of Germany (graph 4-6) and SRISK of Netherlands (graph 4-10) have similar trends as they are major core countries in the euro area.

Graph 4-5 Graph of SRISK of France ($Billion)



Source: v-lab (2019)

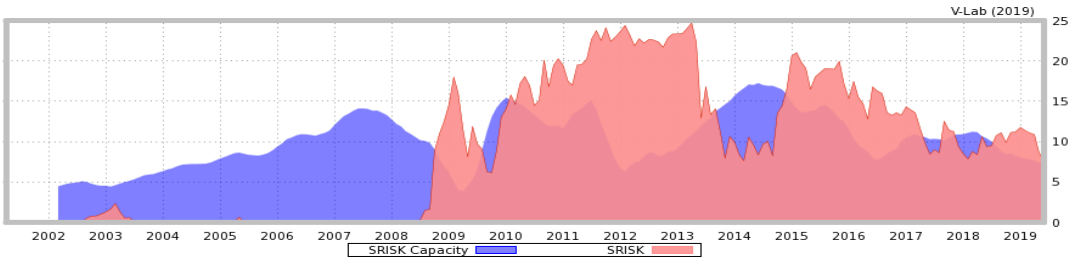
Graph 4-6 Graph of SRISK of Germany ($Billion)



Source: v-lab (2019)

Graph 4-7 presents SRISK of Greece. Compared to the core countries, SRISK of Greece has relatively unique trend. SRISK of Greece rose significantly in the first half of 2010 (the beginning of European sovereign debt crisis and reached at the highest level in 2012 and 2013, then decreased in 2014 under the bailout programs and surged again in 2015 as the

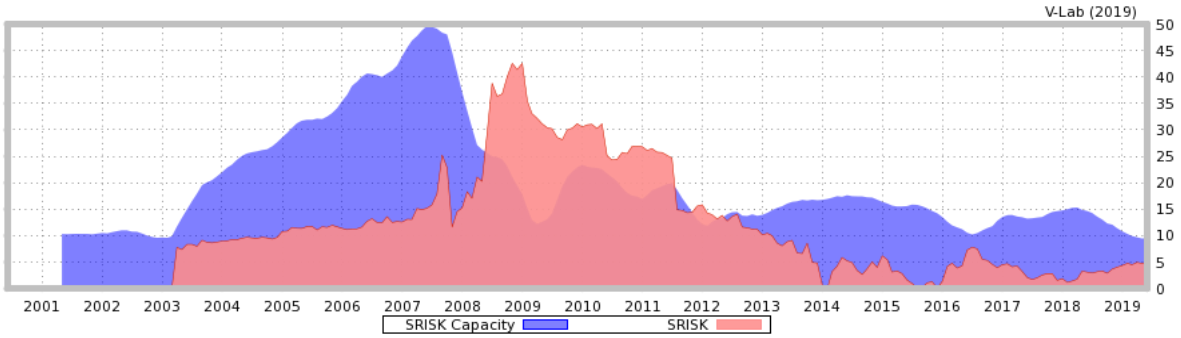
Graph 4-7 Graph of SRISK of Greece ($Billion)



Source: v-lab (2019)

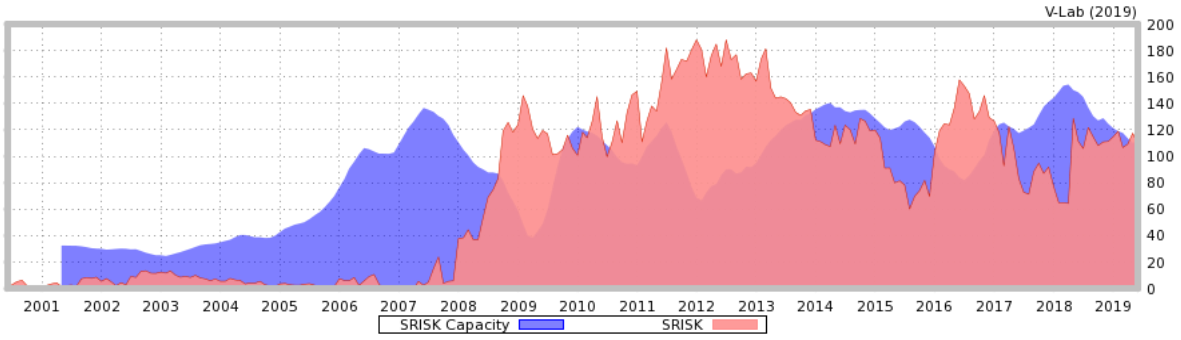
Greek economy deteriorated again in 2015 and 2016. SRISK of Italy (graph 4-9) and SRISK of Spain (graph 4-12) have similar trends as they are major periphery countries that are adversely affected by high level of sovereign debts during 2011-2013 and 2015-2017.

Graph 4-8 Graph of SRISK of Ireland ($Billion)



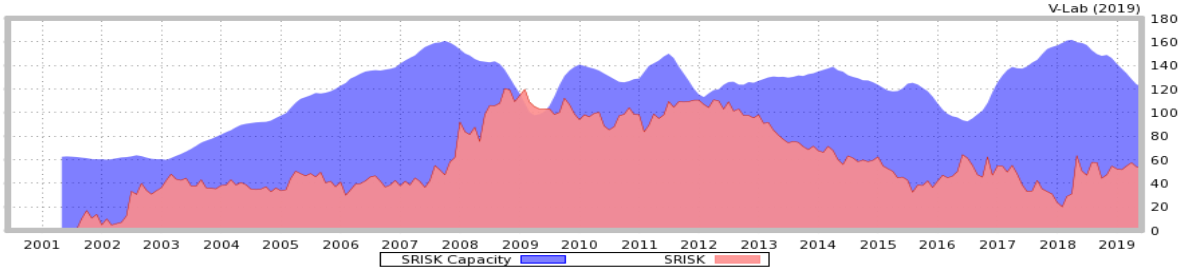
Source: v-lab (2019)

Graph 4-9 Graph of SRISK of Italy ($Billion)



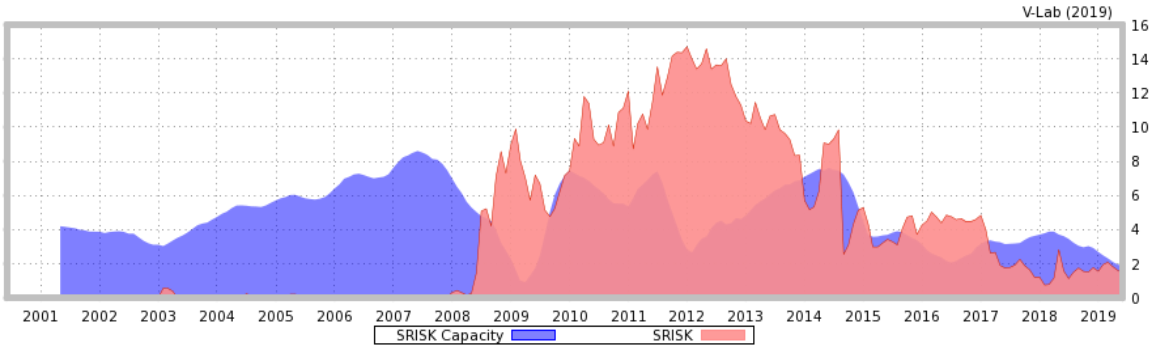
Source: v-lab (2019)

Graph 4-10 Graph of SRISK of Netherlands ($Billion)



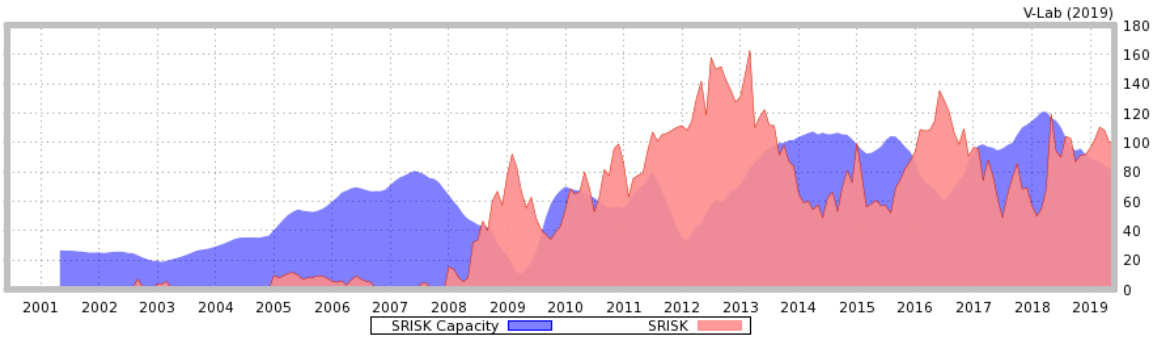
Source: v-lab (2019)

Graph 4-11 Graph of SRISK of Portugal ($Billion)



Source: v-lab (2019)

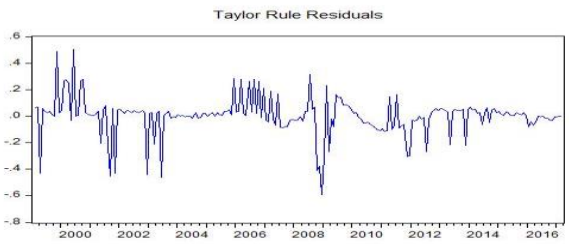
Graph 4-12 Graph of SRISK of Spain ($Billion)



Source: v-lab (2019)

Next, we present the graphs of the trend of three monetary policy shocks and offer some discussions. Then, we report the descriptive statistics of all variables included in our models and present the descriptive statistics. Finally, we present the correlation coefficients among all variables and discuss the correlation coefficients.

Graph 4-13 Graph of Taylor Rule Residuals

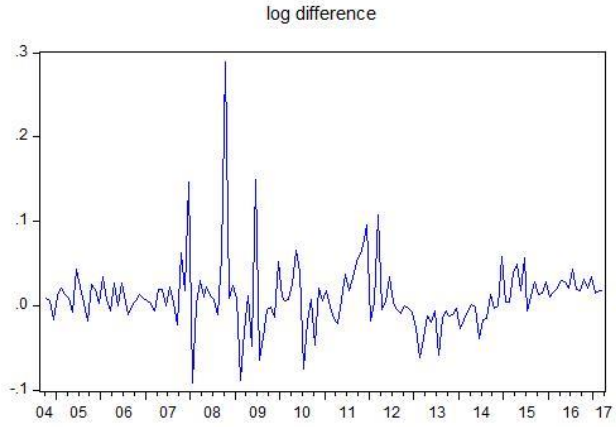


Source: author's own calculation

Graph 4-13 shows the trend of Taylor rule residuals between 1999 and 2017. More negative Taylor rule residuals indicate more expansionary monetary policy. This graph shows that Taylor rule residuals are about -0.4 in 1999, 2001 and 2003, about -0.6 in late 2008 and between -0.2 and -0.3 over 2011 and 2014. All these residuals are more negative because the ECB implements expansionary monetary policy to stimulate economic growth when euro area economy is negatively affected by some external shocks (e.g. the Russian Financial Crisis in 1998, 9/11 terrorist attack in New York in 2001, Dot-com bubble between 2000 and 2002, the 2007-2009 U.S. Financial Crisis and the European Sovereign Debt Crisis between 2010 and 2013). The residuals are positive in 2000 and 2006 because the ECB implements restrictive monetary policy to curb Dot-com bubble and the overheated economy.

Graph 4-14 indicates the trend of log difference of the ECB monthly total asset between 2004 and 2017. More positive number represents that the ECB is increasing its balance sheet thus is implementing more expansionary monetary policy. The numbers are more than 0.1 and less than 0.3 between 2007 and 2009 and bout 0.1 in 2011 and 2012, indicating that the ECB implements the expansionary monetary policy in the 2007-2009 U.S. Financial Crisis and the European Sovereign Debt Crisis.

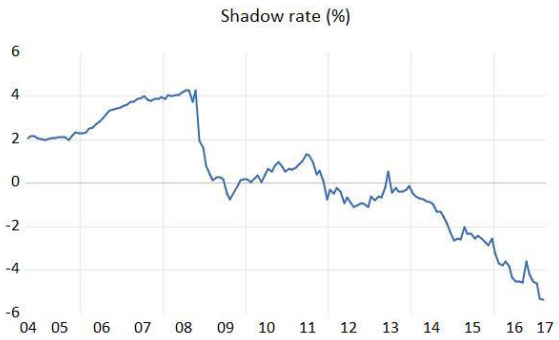
Graph 4-14 Graph of Log Difference of the ECB Monthly Total Asset



Source: ECB website

Graph 4-15 shows the graph of trend of the ECB shadow rate in percentage. The ECB shadow rate in percentage turns into negative in late 2008 for the first time and in late 2011 for the second time and them becomes more negative thereafter. This trend can be explained as follows: the ECB adopts the expansionary monetary policy to make the shadow rate more negative to stimulate economic growth in the U.S. Financial Crisis and the European Sovereign Debt Crisis. After 2013, the ECB cuts key interest rates for several times and implements several asset purchase programs to make the shadow rate further negative. Therefore, the trend is consistent with the fact that the ECB maintains the expansionary monetary policy in the long term since the U.S. 2007-2009 Financial Crisis.

Graph 4-15 Graph of the ECB shadow rate (%)



Source: Quandl

Table 4-1 reports the descriptive statistics of variables are used in the fixed-effect model. As expected, the means and medians of level of LRMES (42.7461, 44.71) and level of SRISK (13704.61, 1332.55) are positive, indicating that European banks have positive systemic risks in most periods of time between September 2004 and March 2017. In addition, level of SRISK has much greater standard deviation (28515.04) than level of LRMES (44.71), indicating that SRISK is much more volatile than LRMES. This is consistent with the fact that level of SRISK had much greater range (170166.9 – (48604.2)) than level of LRMES had (96.08 – (-23.79)).

The negative values of level of systemic risk measures show that some banks have lower systemic risk in some periods of time.

With regard to proxies for monetary policy shocks, the ECB's shadow rate has negative mean (-0.0915) and median (-0.2230), indicating that the ECB's shadow rate was negative in most periods of time between September 2004 and March 2017. This complies with the fact that the real effects of ECB unconventional monetary policy tools are reducing banks' actual

Table 4-1 Descriptive Statistics for data used in model specifications

Variable	Obs.	Mean	Median	S.D.	Min.	Max.
Systemic risk measures						
Level of LRMES	6532	42.7461	44.71	17.1891	-23.79	96.08
Level of SRISK	6532	13704.61	1332.55	28515.04	-48604.2	176166.90
Monetary policy shocks						
Standard Taylor Rule residuals	6532	-0.0069	0.0040	0.1157	-0.5920	0.3124
Shadow rate (%)	6532	-0.0915	-0.2230	2.4449	-5.3753	4.2785
Log difference of ECB balance sheet	6532	0.0018	0.0030	0.0382	-0.6373	0.1104
Bank-specific variables						
Total loan/earning assets	6532	0.6413	0.6974	0.1922	0.0961	0.9697
Non-interest income/total income	6532	0.2639	0.2564	0.1379	0.0019	0.7232
Non-performing loans/total loans	6532	0.0772	0.0442	0.0950	0.0013	0.6104
Total deposits/total liabilities	6532	0.4615	0.4642	0.1785	0.0291	0.8421
Equity/total assets	6532	0.0560	0.0604	0.0536	-0.3646	0.2755
Total assets (Mil.Euro)	6532	$3.06*10^{11}$	$6.16*10^{10}$	$4.85*10^{11}$	$5.38*10^{7}$	$2.2*10^{12}$

ECB monthly total assets has positive mean (0.0018) and median (0.0030), revealing that ECB expanded its balance sheet in most months between September 2004 and March 2017. This is consistent with the fact that ECB implemented non-standard expansionary monetary policy since the U.S. Financial Crisis. The other proxies for monetary policy shocks, including standard Taylor rule residuals, have different means and medians. Standard Taylor rule residuals have negative mean but positive median, indicating more positive residuals but greater negative residuals. Because the negative residuals indicate the expansionary monetary policy during financial crises, monetary policy shocks estimated by standard Taylor rule model

show that the ECB implemented the expansionary monetary policy between 2007 and 2017. With regard to bank-specific variables, total loan/earning assets has large range (0.9697 – 0.0961), indicating that some banks have loans as their main source of earning assets while other banks only have more earning assets other than loans. Non-interest income/total income varies greatly from bank to bank (from 0.0019 to 0.7232), revealing that some have higher reliance on non-interest incomes than other banks do. Non-performing loans/total loans also has great range (0.6104 – 0.0013), showing that some banks (e.g. Greek banks) have much worse asset quality than other banks (0.0013). Total deposits/total liabilities has maximum value of 0.8421, indicating that one particular bank relies heavily on volatile liabilities as its main source of funds. Equity/asset ratio (capital ratio) has minimum value of -0.3636, indicating that a specific bank has very negative capital ratio and thus has high insolvency risk. Finally, bank size varies greatly (total assets range from $5.38*10^7$ million Euro to $2.2*10^{12}$ million Euro). These great ranges show that all these bank-specific variables have outliers, therefore, we conduct 1% winsorize to remove these outliers. In order to interpret the economic meaning of the coefficients of variables, we standardize all variables to zero mean and unit standard risk and use standardized variables in the fixed-effect models.

Table 4-2 reports the correlation coefficients among systemic risk measures, monetary policy shocks and bank-specific variables. Most variables have low correlation coefficients with other variables, but there are a few exceptions. First, SRISK and LRMES have high positive correlation (0.5634). This is reasonable because both SRISK and LRMES are systemic risk measures. Second, log difference of ECB monthly balance sheet has high negative correlation coefficient (-0.5634) with shadow rate and standard Taylor rule (-0.5271) while shadow rate has positive correlation coefficient (0.6235) with standard Taylor rule residuals. These are also expected because lower shadow rate and standard Taylor rule residuals and higher log difference of ECB monthly balance sheet indicate the expansionary monetary policy. Third, the

high negative correlation coefficient between size and loan/earning assets is unexpected. Generally speaking, the correlation coefficient table demonstrates there is no multicollinearity.

Table 4-2 Correlation Coefficients among Systemic Risk Measures, Monetary Policy Shocks and Bank-Specific Variables

	LRMES	SRISK	Shadow rate	Log difference	Standard Taylor rule	Loan/EA	NII/TI	NPL/TL	Dep/Lia	Equity/asset	Size
LRMES	1.0000										
SRISK	0.5326	1.0000									
Shadow rate	0.0249*	-0.0024*	1.0000								
Log difference	0.0249*	0.0254*	-0.5634*	1.0000							
Standard Taylor rule	-0.0236*	-0.0632*	0.6235*	-0.5271*	1.0000						
Loan/EA	0.0438***	0.0414***	0.0310**	-0.0169**	0.0114**	1.0000					
NII/TI	0.1234***	-0.1112***	0.0267**	-0.0150**	0.0275**	-0.1073***	1.0000				
NPL/TL	0.1868***	0.1941***	0.0483***	0.0085***	0.0153***	0.1796***	-0.1994***	1.0000			
Dep/Lia	0.1171***	0.1276***	0.0245**	0.0055***	0.0004***	0.2204***	-0.0561***	0.3117***	1.0000		
Equity/asset	0.1638***	0.1342***	0.1534***	-0.0127***	0.0033***	0.1540***	-0.0592***	0.1483***	-0.1512***	1.0000	
Size	-0.0364**	-0.0393***	-0.0402***	0.0114***	-0.0397***	-0.5226***	-0.1475***	-0.1405***	-0.2508***	-0.1470***	1

Note: *** ** * indicate the correlation coefficient is significant at 1%,5% and 10% significance level.

4.5 Econometric Approach

In order to examine the impact of monetary policy shocks on the banks' systemic risk, this paper follows Lamers.et.al. (2016) to employ a panel data model that accounts for banks' heterogeneity. This paper estimates the following panel data model with using variables of monthly data:

$$Y_{i,t} = \alpha + (\beta_0 + \sum_{k=1}^{K} \beta_k BM_{k,i,t}) \times Shock_t + \sum_{k=1}^{K} \gamma_k BM_{k,i,t} + \epsilon_{i,t} \quad (4.8)$$

where $Y_{i,t}$ is systemic risk, BM is a vector of bank-specific variables and $shock_t$ is the monetary policy shock in month t. This paper uses LRMES and SRISK as dependent variables, and bank-specific variables contain loan-to-earning assets, non-interest income/total income, non-

performing loans/total loans, total deposits/total liabilities, equity/assets and total assets as independent variables. $\sum^{K}_{k=1}\beta_k BM_{k,i,t} \times Shock_t$ represent interaction terms of bank-specific variables and corresponding monetary policy shock. In order to interpret the economic meaning of all coefficients, we standardize all variables to zero mean and unit standard deviation.

Finally, either the fixed-effect model or the random-effect model can be selected by conducting the Hausman test (Brooks 2008; Cameron and Trivedi 2010). They stated that the Hausman test can be used to test to know if the time-invariant component of error is correlated with the regressors. Wooldridge (2010) described that the Hausman test as follows: the null hypothesis and alternative hypothesis are:

$$\mathrm{H}_0 : E[\mu_i x_{it}] = 0; H_1 : E[\mu_i x_{it}] \neq 0 \tag{4.9}$$

and the test statistics of the Hausman test is:

$$\mathrm{H} = (\hat{\beta}_{FE} - \hat{\beta}_{RE})^T [Var(\hat{\beta}_{FE}) - Var(\hat{\beta}_{RE})]^{-1} (\hat{\beta}_{FE} - \hat{\beta}_{RE}) \tag{4.10}$$

If ***H*** is greater than the critical value, the null hypothesis is rejected, this means the time-invariant component of error is correlated with the regressors, then the estimators in fixed-effect models are consistent and the fixed-effect models are preferred; if ***H*** is less than the critical value, the null hypothesis cannot be rejected, this means the time-invariant component of error is uncorrelated with the regressors, then the estimators in both fixed-effect and random-effect models are consistent but random-effect estimators are more efficient, then the random-effect models are preferred.

In this analysis, the test statistic of Hausman test is -888.05, which is much greater than the critical value and the p-value is 0.0000, therefore, the null hypothesis is rejected and the fixed –effect model is preferred.

4.6 Discussion of Results

4.6.1 Results of the Full Sample and the Sample Excludes Greek Banks

To examine whether banks' systemic risk measures increased or decreased significantly after the ECB implemented the expansionary monetary policy, we first calculate standard Taylor Rule residuals, shadow rate and log difference of the ECB monthly total assets as monetary policy shocks. Secondly, we compute six bank-specific variables, including loan/earning asset, non-interest income/total income, non-performing loans/total loans, deposit/total liabilities, equity/assets and total assets, to represent banks' asset structure, income structure, asset quality, funding structure, capital structure and size. Thirdly, we calculate the interaction terms by timing bank-specific variables and corresponding monetary policy shocks.

First, our main results in table 4-3 show that both Taylor rule residuals and shadow rate are negative and significant with SRISK while log difference of the ECB monthly assets is positive and significant. These results indicate that banks' systemic risk increases if the ECB implements the expansionary monetary policy and are consistent with our hypothesis that posits that the ECB's expansionary monetary policy contributes to buildup of systemic risk in European banking sector. In addition, these findings are also consistent with those in Lamers et al. (2019). Second, results from all models indicate that, with the only exception of the loan/earning asset ratio, SRISK is statistically significant and positively related with all bank-specific variables, namely: (1) banks with more diversified income structure, (2) banks that have poorer asset quality, (3) banks that rely more on deposits funding, (4) banks that have more equity capital, and (5) banks that have larger size (in line with Varotto and Zhao (2018)). Third, only a few interaction terms have significant coefficients, revealing that they have weak explanatory powers and only provide limited evidence for our previous finding.

In regression (1), the coefficient of Taylor rule residuals is -0.0677 and has economic significance as follows: if the Taylor rule residuals decrease by 1%, SRISK will increase by approximately 0.07%. The coefficient in regressions (2) has similar economic significance. These negative coefficients imply that the lower the standard Taylor rule residuals, the more

expansionary the monetary policy, the higher systemic risk for euro area banks. These results can be explained by the 'search-for-yield channel': if the central bank keeps the interest rate for too long and uses unconventional monetary policy tools, bank managers will have to shift from safer assets into riskier assets to increase rate of return on assets.

In regression (3), the coefficient of shadow rate is -0.0243 and has economic significance as follows: if the shadow rate decreases by 1%, SRISK will increase by approximately 0.024%. The coefficient in regression (4) has a similar economic significance. These negative coefficients imply that the lower the shadow rate, the more expansionary monetary policy, the higher systemic risk for euro area banks. Similar to the previous case, these results can be explained by search-for-yield channel as well.

In regression (5), the coefficient of log difference of the ECB monthly asset is 0.0246 and has economic significance as follows: if log difference of the ECB monthly asset increases by 1%, SRISK will increase by approximately 0.025%. The coefficient in regressions (6) has similar economic significance. These positive coefficients imply that the higher log difference of the ECB monthly asset, the more expansionary monetary policy, the higher systemic risk for euro area banks. These results further support our hypothesis and can be explained as follows: higher log difference of the ECB monthly asset reveals that the ECB implements more expansionary monetary policy by purchasing asset (securities) programs and injecting more liquidity into financial markets. Banks will receive more credits and make more new loans to increase their risk-taking activities. This accumulates the buildup of systemic risk in the European banking sector.

With regard to bank-specific variables, results in all regressions are as expected. In particular, they can be interpreted as follows: banks with more diversified income structures will have higher systemic risks because banks rely more on non-traditional activities (e.g. fee income, commissions and trading income) are riskier than banks that rely more on loan-deposits

businesses. For instance, some types of non-interest income, including gain/losses from trading in securities, foreign exchange transactions and derivative securities, are more volatile when the global financial markets are unstable. Banks that have higher non-performing loans/total loans (i.e. a poorer asset quality) make greater contributions to systemic risks in the banking sector because (1) their stock prices are more likely to decline significantly during financial crises; and (2) their loan defaults are more likely to result in greater shocks on other financial institutions. Banks that rely more on deposit funding will have higher systemic risk. This can be interpreted as follows: these banks will have higher cost of funding and lower profitability thus will have higher systemic risks. This result is similar to that of Lamers et al. (2019) that deposits/total liabilities is positively and significantly associated with changes in LRMES. Banks that have higher capital ratios will have higher systemic risks because of moral hazard problems, if, they become less prudent in the risk management process. For example, banks that have more capital will have more risk-taking activities and fewer incentives to monitor borrowers because they know they have more capital to absorb unanticipated losses. This will make greater contributions to systemic risks. This result is also similar to Varotto and Zhao (2018)'s findings that tier1 ratio is positive and significant with expected shortfall. The authors also show that a higher tier 1 capital ratio may be related to higher systemic risk because regulators can exercise discretion to increase minimum capital requirements when they are concerned about the safety of a bank or its exposure to systemic risk of a bank. Larger banks will have higher systemic risks because they are usually systematically important financial institutions and are more connected with other financial institutions around the world. This finding is consistent with several previous studies including e.g. Laeven et al. (2016) who find strong evidence that systemic risk increases with bank size. In particular, they indicated that a 1% increase in total assets increases the banks' contribution to systemic risk by about 0.5% when measured by SRISK. Therefore, they tend to be more negatively affected by financial

market turmoil.

Table 4-3 Results of Banks' SRISK in Full Sample

Variable	(1) SRISK Full sample	(2) SRISK Full sample	(3) SRISK Full sample	(4) SRISK Full sample	(5) SRISK Full sample	(6) SRISK Full sample
Taylor Rule Residuals	-0.0677***	-0.0651***				
	(0.0144)	(0.0145)				
Shadow rate			-0.0243*	-0.0224		
			(0.0148)	(0.0146)		
Log difference of ECB balance sheet					0.0246***	0.0258***
					(0.0070)	(0.0080)
Loan/earning assets	0.0110	0.0095	0.0123	0.0103	0.0117	0.0118
	(0.0138)	(0.0139)	(0.0139)	(0.0139)	(0.0139)	(0.0139)
Non-interest income/total income	0.0946***	0.0950***	0.0944***	0.0932***	0.0936***	0.0930***
	(0.0117)	(0.0118)	(0.0118)	(0.0118)	(0.0118)	(0.0116)
Non-performing loan/total loan	0.1930***	0.1945***	0.1933***	0.1959***	0.1921***	0.1928***
	(0.0145)	(0.0144)	(0.0144)	(0.0143)	(0.0146)	(0.0146)
Deposits/total liabilities	0.1201***	0.1205***	0.1209***	0.1209***	0.1207***	0.1206***
	(0.0142)	(0.0141)	(0.0142)	(0.0142)	(0.0142)	(0.0142)
Equity/assets	0.0971***	0.0986***	0.0973***	0.1000***	0.0978***	0.0982***
	(0.0132)	(0.0133)	(0.0133)	(0.0136)	(0.0132)	(0.0132)
Total assets	0.0735***	0.0735***	0.0761***	0.0754***	0.0755***	0.0758***
	(0.0124)	(0.0122)	(0.0124)	(0.0123)	(0.0124)	(0.0122)
Loan/EA*MPS		0.0033		-0.0177		-0.0034
		(0.0177)		(0.0133)		(0.0120)
Income structure*MPS		-0.0176		-0.0149		-0.0259***
		(0.0134)		(0.0110)		(0.0097)
NPL/Loan*MPS		-0.0206		-0.0478***		-0.0059
		(0.0150)		(0.0142)		(0.0130)
Deposits/Liabilities*MPS		-0.0163		0.0048		0.0109
		(0.0174)		(0.0110)		(0.0084)
Equity/assets*MPS		-0.0188		-0.0192		-0.0073
		(0.0197)		(0.0126)		(0.0219)
Total assets*MPS		-0.0073		-0.0182*		0.0077
		(0.0157)		(0.0098)		(0.0154)
Obs.	6532	6532	6532	6532	6532	6532
R^2	0.0737	0.0749	0.0695	0.0726	0.0699	0.0706

Note: ***, **, * means statistically significant at the 1%, 5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

With regard to the interaction terms, in regression (2), we obtain no significant coefficients. Conversely, in regression (4), we obtain several interesting findings. Firstly, the interaction term between non-performing loans/total loans and shadow rate is negative and significant with

SRISK, indicating that banks with poorer asset quality will have lower systemic risks than banks with better asset quality when the ECB adopts more negative shadow rate. Therefore, riskier banks appear to benefit more from the expansionary monetary policy.

This finding can be explained by the confidence channel. Banks with poorer asset quality will receive new credits to replace the bad loans. This should improve banks' asset quality in the future as well as investors' expectations and confidence about banks' strength. In such scenario, stock prices will rise, and systemic risks will be reduced. Secondly, the interaction term between total assets and shadow rate is also negative and significant with SRISK at 10% significance level, indicating that larger banks will benefit more from the more negative shadow rate. This is consistent with the result in Lamers et al. (2019) and can be explained as follows: on the one hand, larger banks are more likely to receive more credits when a central bank implements more accommodative monetary policy and will have more loanable funds to make loans, therefore, they increase their profitability and reduce systemic risks. On the other hand, once larger banks receive more credits, investors will have more optimistic expectations about banks' fundamentals in the future and boost stock prices of larger banks, resulting in lower systemic risk. Thirdly, regression (6) shows that the interaction term between non-interest income/total income and log difference of the ECB monthly asset is negative and significant with SRISK, indicating that banks with more diversified income structure will have lower systemic risks than banks with less diversified income structure when the ECB expands its balance sheet. This finding can be interpreted as follows: if the ECB purchases more assets and expands its balance sheets, more liquidity is injected into financial markets, more loanable funds will be supplied and the effective interest rates will be reduced, then banks' net interest margins will decline. Therefore, banks that rely more on non-interest incomes will be less vulnerable to the decrease in net interest margins and will have higher profitability and lower systemic risk.

Our main results in table 4-4 indicate that only the shadow rate is negative and significant with LRMES, while the log difference of the ECB monthly asset is positive and significant. These results indicate that banks' systemic risk increases if the ECB adopts the expansionary monetary policy and provide further support for our hypothesis that the ECB's expansionary monetary policy contributes to buildup of systemic risk in European banking sector. Moreover, these findings are also consistent with those in Lamers et al. (2019). Second, all regressions present that LRMES is positive and significant with loan/earning asset, non-interest income/total income, non-performing loans/total loans and deposits/total liabilities. These results indicate that (1) banks with riskier asset composition, (2) banks with more diversified income structure, (3) banks that have poorer asset quality, and (4) banks that rely more on deposit financing will have higher systemic risk. Third, there are four interaction terms that have negative and significant coefficients, providing some support for our previous findings.

In regressions (1) and (2), the coefficient of the Taylor rule residuals is negative but not significant with LRMES. These results indicate that Taylor rule residuals provide weak explanatory powers in predicting LRMES.

In regression (3), the coefficient of shadow rate is -0.1351 and has economic significance as follows: if the shadow rate decreases by 1%, LRMES will increase by approximately 0.135%. The coefficient in regressions (4) has similar economic significance. These negative coefficients imply that the lower shadow rate, the more expansionary the monetary policy, the higher systemic risk for euro area banks. These results can be explained by the 'search-for-yield' channel as well.

In regression (5), the coefficient of log difference of the ECB monthly asset is 0.0261 and has economic significance as follows: if log difference of the ECB monthly asset increases by 1%, LRMES will increase by approximately 0.026%. The coefficient in regressions (6) has similar economic significance. These positive coefficients imply that the higher log difference of the

ECB monthly asset, the more expansionary the monetary policy, the higher the systemic risk for euro area banks. These results are consistent with our hypothesis and can have the same explanations as the results in SRISK regressions.

With regard to bank-specific variables, results in all regressions are as expected. However, compared to the results in SRISK regressions, there are three notable differences in the results of the LRMES regressions. First, loans/earning assets is positive and significant with LRMES but not significant with SRISK. This result can be interpreted as follows: banks that have more loans in their balance sheets are more likely to have more default loans, therefore, they may have greater contributions to systemic risk in European banking sector. Second, the equity/assets ratio is positive and significant with SRISK but loses significance when LRMES is dependent variable. Third, the variable total assets is positive and significant with SRISK but again insignificantly associated with LRMES. These results show that both capital ratio and size have weak explanatory powers in predicting LRMES. The can be possibly explained by the different measures and meanings between SRISK and LRMES. On the one hand, LRMES, or Long-run Marginal Expected Shortfall, is defined as the expectation of the firm equity over a longer period of time arithmetic return conditional on the systemic event. Therefore, LRMES reflects the market expectation of bank's stock return on a specific systemic event. On the other hand, SRISK is defined as capital shortfall conditional on the systemic event. Consequently, LRMES and SRISK measure banks' systemic risk from different aspects. The possible explanation of the different results between LRMES and SRISK can be: SRISK, which reflects the bank's capital shortfall of a systemic event, is more sensitive to the bank-specific variable because bank capital is more relevant to its financial ratios. All the other bank-specific variables, including non-performing loan/total loan, non-interest income/total income and deposits/total liabilities, have same results and explanations as SRISK regressions.

Table 4-4 Results of Banks' LRMES in Full Sample

Variable	(1) LRMES Full sample	(2) LRMES Full sample	(3) LRMES Full sample	(4) LRMES Full sample	(5) LRMES Full sample	(6) LRMES Full sample
Standard Taylor Rule Residuals	-0.2556	-0.2556				
	(0.1847)	(0.1821)				
Shadow rate			-0.1351***	-0.1340***		
			(0.0197)	(0.0198)		
Log difference of ECB balance sheet					0.0261**	0.0217*
					(0.0122)	(0.0116)
Loan/earning assets	0.0228*	0.0229*	0.0242*	0.0231*	0.0228*	0.0226*
	(0.0132)	(0.0132)	(0.0132)	(0.0130)	(0.0132)	(0.0132)
Non-interest income/total income	0.0550***	0.0550***	0.0563***	0.0541***	0.0547***	0.0548***
	(0.0115)	(0.0114)	(0.0114)	(0.0112)	(0.0115)	(0.0115)
Non-performing loan/total loan	0.1888***	0.1901***	0.1904***	0.1926***	0.1883***	0.1878***
	(0.0111)	(0.0111)	(0.0111)	(0.0106)	(0.0111)	(0.0111)
Deposits/total liabilities	0.0612***	0.0609***	0.0617***	0.0619***	0.0614***	0.0615***
	(0.0123)	(0.0123)	(0.0123)	(0.0123)	(0.0124)	(0.0124)
Equity/assets	-0.0127	-0.0125	-0.0131	-0.0129	-0.0123	-0.0122
	(0.0113)	(0.0113)	(0.0113)	(0.0117)	(0.0113)	(0.0113)
Total assets	0.0185	0.0183	0.0200	0.0187	0.0188	0.0189
	(0.0123)	(0.0124)	(0.0122)	(0.0118)	(0.0123)	(0.0122)
Loan/EA*MPS		0.0128		-0.0396***		0.0002
		(0.0136)		(0.0131)		(0.0116)
Income structure*MPS		0.0154		-0.0200*		0.0017
		(0.0112)		(0.0104)		(0.0092)
NPL/Loan*MPS		-0.0116		-0.0573***		-0.0014
		(0.0090)		(0.0118)		(0.0100)
Deposits/Liabilities*MPS		-0.0030		0.0179		0.0032
		(0.0094)		(0.0114)		(0.0104)
Equity/assets*MPS		0.0009		0.0108		0.0229
		(0.0105)		(0.0122)		(0.0182)
Total assets*MPS		0.0068		-0.0347***		-0.0034
		(0.0144)		(0.0120)		(0.0150)
Obs.	6532	6532	6532	6532	6532	6532
R^2	0.0416	0.0421	0.0553	0.0595	0.0755	0.0418

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

With regard to the interaction terms, only a few coefficients are significant. In regressions (2) and (6), there are no significant coefficients. However, regression (4) reports four significant coefficients for interaction terms. Firstly, the interaction term between loan/earning assets and shadow rate is negative and significant with LRMES, revealing that banks with riskier asset composition will have a more reductions in systemic risk when the ECB has more negative

shadow rate. Secondly, the interaction term between non-performing loans/total loans and shadow rate is negative and significant with LRMES, indicating that banks with poorer asset quality will have less high systemic risk when the ECB has more negative shadow rate. Both findings provide evidences for our previous finding that conjectures that riskier banks will have greater sensitivities towards the expansionary monetary policy and indicate that riskier banks can benefit more from the expansionary monetary policy. Thirdly, the interaction term between non-interest income/total income and shadow rate is negative and significant with LRMES, demonstrating that banks with more diversified income structures will have a lower systemic risk when the ECB has a more negative shadow rate. Finally, the interaction term between total assets and shadow rate is negative and significant with LRMES, showing that larger banks can benefit more from the more negative shadow rate than smaller banks.

We also carry out some robustness checks. It is well known that Greece was the first European country that claimed its government was unable to repay the government debt in 2010. In addition, Greek banks have been more negatively affected by the financial crises and have much greater systemic risks. This generates several outliers that make our statistics more volatile. Therefore, we removed all Greek banks from our full sample (about 406 observations on average per year).

Table 4-5 presents the results of SRISK in the sample excludes Greek banks. Our main results in this table demonstrate similar results as regressions in table 4-3 and provide further evidences for our hypothesis. However, there are also some differences between results in table 4-3 and table 4-5. First, in regression (4), the shadow rate is negative and significant with SRISK in table 4-5 while it is insignificant with SRISK in table 4-3. We identify evidences that a more negative shadow rate will contribute to the build-up of systemic risk if we exclude Greek banks (and no evidence if these latter are included). Second, in regressions (1), (5) and (6), the loans/earning assets ratio is weakly positive and significant with SRISK in the sample

that excludes the Greek banks while it is insignificant with SRISK in the full sample. We find evidences that banks with riskier asset composition may have higher systemic risk if we do not include Greek banks while no evidence if we include Greek banks. Third, in regressions (3) and (4), both equity/assets and total assets are positive and significant with SRISK in table 4-3 while they are insignificant in table 4-5.

Table 4-5 Results of Banks' SRISK (Excluding Greek Banks)

Variable	(1) SRISK Without Greek banks	(2) SRISK Without Greek banks	(3) SRISK Without Greek banks	(4) SRISK Without Greek banks	(5) SRISK Without Greek banks	(6) SRISK Without Greek banks
Standard Taylor Rule Residuals	-0.0682***	-0.0654***				
	(0.0196)	(0.0192)				
Shadow rate			-0.0910***	-0.0901***		
			(0.0200)	(0.0201)		
Log difference of ECB balance sheet					0.0230***	0.0242***
					(0.0050)	(0.0059)
Loan/earning assets	0.0275*	0.0257	0.0139	0.0125	0.0290*	0.0289*
	(0.0159)	(0.0159)	(0.0138)	(0.0136)	(0.0160)	(0.0160)
Non-interest income/total income	0.1137***	0.1138***	0.0554***	0.0533***	0.1131***	0.1134***
	(0.0138)	(0.0139)	(0.0123)	(0.0122)	(0.0139)	(0.0139)
Non-performing loan/total loan	0.2045***	0.2055***	0.1838***	0.1863***	0.2038***	0.2039***
	(0.0160)	(0.0160)	(0.0111)	(0.0109)	(0.0161)	(0.0162)
Deposits/total liabilities	0.1298***	0.0130***	0.0757***	0.0756***	0.1304***	0.1308***
	(0.0155)	(0.0154)	(0.0133)	(0.0132)	(0.0156)	(0.0156)
Equity/assets	0.0982***	0.0992***	0.0029	0.0043	0.0987***	0.0985***
	(0.0173)	(0.0172)	(0.0134)	(0.0135)	(0.0174)	(0.0174)
Total assets	0.0895***	0.0887***	0.0174	0.0163	0.0918***	0.0923***
	(0.0145)	(0.0143)	(0.0128)	(0.0125)	(0.0146)	(0.0145)
Loan/EA*MPS		0.0044		-0.0334**		-0.0123
		(0.0198)		(0.0136)		(0.0111)
Income structure*MPS		-0.0191		-0.0136		0.0138**
		(0.0147)		(0.0112)		(0.0067)
NPL/Loan*MPS		-0.0154		-0.0526***		0.0044
		(0.0173)		(0.0120)		(0.0105)
Deposits/Liabilities*MPS		-0.0209		0.0171		0.0122**
		(0.0181)		(0.0128)		(0.0062)
Equity/assets*MPS		-0.0217		-0.0044		-0.0051
		(0.0251)		(0.0143)		(0.0100)
Total assets*MPS		-0.0109		-0.0296**		0.0019
		(0.0177)		(0.0129)		(0.0105)
Obs.	5687	5687	5687	5687	5687	5687
R^2	0.0788	0.0799	0.0507	0.0543	0.0753	0.1149

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Therefore, we identify strong evidences that well-capitalized and larger banks will have higher systemic risk if we include Greek banks while no evidence if we exclude Greek banks. Fourth, in regression (4), the interaction term between loans/earning assets and shadow rate is negative and significant with SRISK in table 4-5 while it is insignificant with SRISK in table 4-3. We find evidence for banks with riskier asset composition will benefit more from the expansionary monetary policy if we exclude Greek banks while no evidence if we include Greek banks. Fifth, in regressions (5) and (6), both interaction terms between non-interest income/total income and log difference of the ECB monthly assets, deposits/liabilities and log difference of the ECB monthly assets are negative and significant with SRISK in table 4-5 while they are insignificant with SRISK in table 4-3. We identify strong evidences for banks with more diversified income structure and rely more on deposit financing benefit more from the expansionary monetary policy if we exclude Greek banks while no evidence if we include Greek banks.

Table 4-6 shows the results of LRMES with the sample exclude Greek banks. Our main results in this table present similar results as regressions in table 4-4 and confirm our hypothesis. Nevertheless, there are several differences between results in table 4-4 and table 4-6. First, in regressions (3) and (4), the shadow rate is negative and significant with LRMES in table 4-4 while it is insignificant with LRMES in table 4-6. We find evidences for more negative shadow rate will contribute the build-up of systemic risk if we include Greek banks while no evidence if we exclude Greek banks. Second, in regressions (1), (2), (5) and (6), the loan/earning assets ratio is positive and significant with LRMES in table 4-4 while it is insignificant with SRISK in table 4-6. We find weak evidences for banks with riskier asset composition may have higher systemic risk if we include Greek banks while no evidence if we exclude Greek banks. Third, in regressions (2), the interaction term between non-interest income/total income is positive and significant with LRMES in table 4-6 while it is

Table 4-6 Results of Banks' LRMES (Excluding Greek Banks)

Variable	(1) LRMES Without Greek banks	(2) LRMES Without Greek banks	(3) LRMES Without Greek banks	(4) LRMES Without Greek banks	(5) LRMES Without Greek banks	(6) LRMES Without Greek banks
Standard Taylor Rule Residuals	-0.1832	-0.1812				
	(0.1924)	(0.1899)				
Shadow rate			-0.0159	-0.0132		
			(0.0157)	(0.0155)		
Log difference of ECB balance sheet					0.0233**	0.0241**
					(0.0103)	(0.0098)
Loan/earning assets	0.0128	0.0136	0.0290*	0.0268*	0.0131	0.0130
	(0.0138)	(0.0139)	(0.0160)	(0.0159)	(0.0138)	(0.0139)
Non-interest income/total income	0.0543***	0.0546***	0.1133***	0.1118***	0.0543***	0.0546***
	(0.0123)	(0.0123)	(0.0139)	(0.0139)	(0.0123)	(0.0122)
Non-performing loan/total loan	0.1824***	0.1832***	0.2047***	0.2078***	0.1821***	0.1821***
	(0.0112)	(0.0111)	(0.0159)	(0.0158)	(0.0112)	(0.0111)
Deposits/total liabilities	0.0753***	0.0740***	0.1306***	0.1303***	0.0754***	0.0755***
	(0.0133)	(0.0133)	(0.0156)	(0.0155)	(0.0133)	(0.0133)
Equity/assets	0.0029	0.0032	0.0984***	0.1006***	0.0031	0.0028
	(0.0133)	(0.0133)	(0.0174)	(0.0175)	(0.0133)	(0.0134)
Total assets	0.0163	0.0166	0.0920***	0.0912***	0.0166	0.0169
	(0.0129)	(0.0130)	(0.0146)	(0.0146)	(0.0129)	(0.0128)
Loan/EA*MPS		0.0097		-0.0180		-0.0028
		(0.0132)		(0.0147)		(0.0099)
Income structure*MPS		0.0293**		-0.0136		0.0084*
		(0.0126)		(0.0132)		(0.0050)
NPL/Loan*MPS		0.0032		-0.0490***		0.0087
		(0.0114)		(0.0160)		(0.0109)
Deposits/Liabilities*MPS		-0.0090		0.0023		0.0020
		(0.0097)		(0.0119)		(0.0102)
Equity/assets*MPS		-0.0001		-0.0256		-0.0078
		(0.0117)		(0.0161)		(0.0151)
Total assets*MPS		0.0082		-0.0160		0.0021
		(0.0141)		(0.0126)		(0.0093)
Obs.	5687	5687	5687	5687	5687	5687
R^2	0.0452	0.0463	0.0745	0.0778	0.0451	0.0761

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

insignificant with LRMES in table 4-4. Therefore, if we exclude Greek banks we identify strong evidence for banks with more diversified income structure will benefit more from the expansionary monetary policy while no evidence. Fourth, in regressions (3) and (4), both equity/assets and total assets are positive and significant with LRMES in table 4-6 while they

are insignificant with LRMES in table 4-4. We find strong evidences for well-capitalized and larger banks will have higher systemic risk if we exclude Greek banks while no evidence if we include Greek banks. Fifth, in regression (4), all interaction terms between loan/earning assets and shadow rate, non-interest income/total income and shadow rate, total assets and shadow rate are negative and significant with LRMES in table 4-4 while they are insignificant with LRMES in table 4-6. We identify strong evidences for banks with riskier asset composition, more diversified income structure and larger size will benefit more from the expansionary monetary policy if we contain Greek banks while no evidence if we exclude Greek banks. Finally, in regression (6), the interaction term between non-interest income/total income and log difference of the ECB monthly asset is positive and significant with LRMES in table 4-6 while it is insignificant with LRMES in table 4-4. We identify weak evidence for banks with more diversified income structure will benefit more from the expansionary monetary policy if we exclude Greek banks while no evidence if we include Greek banks.

Furthermore, the expansionary monetary policy may have different impacts on banks in core and periphery countries in the Euro Area. This issue is investigated in the next section.

4.6.2 Results of Core Countries and Periphery Countries

Previous studies have explored whether the ECB's accommodative monetary policy has different effects on systemic risks of banks operating in core and periphery countries (see e.g. Lamers et al. (2019) who recently found that the effects are more pronounced for banks headquartered in the periphery countries). Here we follow Afonso et al. (2018) and divide the full sample into two subsamples: banks headquartered in core countries and banks headquartered in periphery countries. Core countries include Austria, Belgium, Finland, France, Germany, and Netherlands while periphery countries include Greece, Italy, Ireland, Portugal and Spain.

Tables 4-7 and 4-8 present the results of SRISK of banks headquartered in core countries and

periphery countries, respectively. Most coefficients in the two tables have the same signs and significance. First, in regressions (1) - (4) in both tables, Taylor rule residuals and shadow rates are negative and significant with SRISK of banks headquartered in core and periphery

Table 4-7 Results of Banks' SRISK in Core Countries

Variable	(1) SRISK Core countries	(2) SRISK Core countries	(3) SRISK Core countries	(4) SRISK Core countries	(5) SRISK Core countries	(6) SRISK Core countries
Standard Taylor Rule Residuals	-0.1091***	-0.0868***				
	(0.0347)	(0.0365)				
Shadow rate			-0.1175***	-0.1060***		
			(0.0254)	(0.0245)		
Log difference of ECB balance sheet					0.0347***	0.1737
					(0.0128)	(0.1275)
Loan/earning assets	0.0648**	0.0558**	0.0662**	0.0632**	0.0691**	0.0703***
	(0.0270)	(0.0259)	(0.0271)	(0.0276)	(0.0272)	(0.0271)
Non-interest income/total income	0.1856***	0.1990***	0.1817***	0.1934***	0.1819***	0.1800***
	(0.0275)	(0.0274)	(0.0276)	(0.0289)	(0.0275)	(0.0272)
Non-performing loan/total loan	0.2580***	0.2549***	0.2524***	0.2573***	0.2561***	0.2557***
	(0.0240)	(0.0232)	(0.0241)	(0.0236)	(0.0240)	(0.0241)
Deposits/total liabilities	0.2124***	0.2205***	0.2095***	0.2058***	0.2119***	0.2123***
	(0.0284)	(0.0283)	(0.0284)	(0.0284)	(0.0285)	(0.0286)
Equity/assets	0.1421***	0.1485***	0.1419***	0.1413***	0.1424***	0.1424***
	(0.0289)	(0.0283)	(0.0289)	(0.0287)	(0.0290)	(0.0290)
Total assets	0.1152***	0.1196***	0.1222***	0.1314***	0.1216***	0.1213***
	(0.0301)	(0.0299)	(0.0299)	(0.0331)	(0.0300)	(0.0300)
Loan/EA*MPS		1.4040		-0.0029		-0.3179
		(0.9645)		(0.0320)		(0.2035)
Income structure*MPS		-1.3016**		0.0242		0.1203
		(0.5818)		(0.0252)		(0.1607)
NPL/Loan*MPS		0.0241		-0.0688*		0.0293
		(0.8177)		(0.0358)		(0.1622)
Deposits/Liabilities*MPS		-1.6137**		-0.0263		0.1750
		(0.7355)		(0.0285)		(0.1662)
Equity/assets*MPS		-1.1463		-0.0734*		-0.1977
		(0.8321)		(0.0412)		(0.4086)
Total assets*MPS		1.3668		0.0213		-0.0002
		(0.8879)		(0.0406)		(0.0005)
Obs.	2709	2709	2709	2709	2709	2709
R^2	0.1149	0.1223	0.1181	0.1227	0.1084	0.1106

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

countries. These results are consistent with our previous findings and provide further support

for our hypothesis that the expansionary monetary policies will contribute to the buildup of systemic risks of euro area banks in the long term. Second, with the only exception of loan/earning asset ratio, in all models in both tables, coefficients of bank-specific variables are positive and significant with SRISK of banks headquartered in core and periphery countries. These results confirm our previous findings that banks with more diversified income structure, poorer asset quality, more reliant on deposit funding, more capitalized and larger in asset size are associated with higher systemic risk. Third, in regression (4) in both tables, the interaction terms between non-performing loan/total loan and shadow rate, equity/assets and shadow rate are negative and significantly correlated with SRISK of banks headquartered in core and periphery countries. The first result provides further evidence for our previous finding that conjectures that riskier banks will be more sensitive towards the expansionary monetary policy. However, there are also several important differences among the coefficients in the two tables. First, in regressions (1) and (2), the absolute values of coefficients of Taylor rule residuals are considerably bigger for banks headquartered in periphery countries than for banks headquartered in core countries. The economic significance is that SRISK of banks headquartered in periphery countries will increase by about 0.36%-0.38% while SRISK of banks headquartered in core countries will increase by only about 0.09%-0.11% if the Taylor rule residuals decrease by 1%. These results support the conclusion proposed by Lamers et al. (2019) that effects of the expansionary monetary policy are more pronounced for banks in headquartered in periphery countries and our previous finding. Second, in regression (2), the interaction term between non-interest income/total income and Taylor rule residuals, deposits/liabilities and Taylor rule residuals are negative and significantly associated with the SRISK of banks headquartered in core countries. Conversely, the interaction term between non-performing loans/total loans and Taylor rule residuals is negative and significant with SRISK of banks headquartered in periphery countries. Third, in regression (4), the interaction terms

between non-interest income/total income and shadow rate, total assets and shadow rate are negative and significant with SRISK of banks headquartered in periphery countries while they are insignificant with SRISK of banks headquartered in core countries.

Table 4-8 Results of Banks' SRISK in Periphery Countries

Variable	(1) SRISK Periphery Countries	(2) SRISK Periphery Countries	(3) SRISK Periphery Countries	(4) SRISK Periphery Countries	(5) SRISK Periphery Countries	(6) SRISK Periphery Countries
Standard Taylor Rule Residuals	-0.3666***	-0.3821***				
	(0.0742)	(0.0730)				
Shadow rate			-0.0835***	-0.0833***		
			(0.0092)	(0.0090)		
Log difference of ECB balance sheet					0.0049	0.0073
					(0.0043)	(0.0058)
Loan/earning assets	0.0075	0.0073	0.0087	0.0071	0.0074	0.0072
	(0.0075)	(0.0075)	(0.0075)	(0.0076)	(0.0075)	(0.0076)
Non-interest income/total income	0.0307***	0.0313***	0.0322***	0.0318***	0.0307***	0.0311***
	(0.0058)	(0.0058)	(0.0057)	(0.0058)	(0.0058)	(0.0058)
Non-performing loan/total loan	0.0980***	0.0997***	0.0976***	0.1018***	0.0976***	0.0971***
	(0.0118)	(0.0116)	(0.0118)	(0.0111)	(0.0118)	(0.0118)
Deposits/total liabilities	0.0236**	0.0237**	0.0239***	0.0242***	0.0240***	0.0244***
	(0.0092)	(0.0092)	(0.0091)	(0.0091)	(0.0091)	(0.0091)
Equity/assets	0.0262***	0.0272***	0.0256***	0.0284***	0.0264***	0.0266***
	(0.0061)	(0.0061)	(0.0061)	(0.0063)	(0.0061)	(0.0060)
Total assets	0.0259***	0.0256***	0.0280***	0.0270***	0.0263***	0.0263***
	(0.0088)	(0.0088)	(0.0087)	(0.0085)	(0.0087)	(0.0088)
Loan/EA*MPS		0.0120		-0.0100		0.0013
		(0.0080)		(0.0065)		(0.0071)
Income structure*MPS		0.0062		-0.0155***		-0.0052
		(0.0060)		(0.0052)		(0.0060)
NPL/Loan*MPS		-0.0310***		-0.0643***		0.0079
		(0.0117)		(0.0098)		(0.0071)
Deposits/Liabilities*MPS		0.0003		0.0020		0.0035
		(0.0115)		(0.0079)		(0.0037)
Equity/assets*MPS		-0.0098		-0.0094**		0.0109
		(0.0086)		(0.0043)		(0.0070)
Total assets*MPS		-0.0034		-0.0125**		0.0032
		(0.0110)		(0.0063)		(0.0109)
Obs.	3728	3728	3728	3728	3728	3728
R^2	0.0578	0.0642	0.0821	0.1024	0.0489	0.0502

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Tables 4-9 and 4-10 report the results for banks headquartered in core and periphery countries

when the dependent variable is LRMES. As for the case of SRISK, most coefficients in the

Table 4-9 Results of Banks' LRMES in Core Countries

Variable	(1) LRMES Core Countries	(2) LRMES Core Countries	(3) LRMES Core Countries	(4) LRMES Core Countries	(5) LRMES Core Countries	(6) LRMES Core Countries
Standard Taylor Rule Residuals	-0.0090	-0.0141				
	(0.0213)	(0.0227)				
Shadow rate			0.0240	0.0277		
			(0.0209)	(0.0210)		
Log difference of ECB balance sheet					0.0390***	0.0488***
					(0.0100)	(0.0174)
Loan/earning assets	0.0208	0.0203	0.0202	0.0140	0.0214	0.0225
	(0.0201)	(0.0199)	(0.0201)	(0.0187)	(0.0202)	(0.0197)
Non-interest income/total income	0.0262	0.0264	0.0258	0.0264	0.0257	0.0256
	(0.0215)	(0.0215)	(0.0214)	(0.0213)	(0.0214)	(0.0214)
Non-performing loan/total loan	0.1147***	0.1149***	0.1140***	0.1185***	0.1141***	0.1142***
	(0.0138)	(0.0138)	(0.0136)	(0.0141)	(0.0138)	(0.0138)
Deposits/total liabilities	0.0785***	0.0775***	0.0779***	0.0773***	0.0775***	0.0772**
	(0.0177)	(0.0177)	(0.0177)	(0.0177)	(0.0177)	(0.0177)
Equity/assets	0.0382**	0.0377**	0.0381**	0.0392**	0.0382**	0.0388**
	(0.0188)	(0.0187)	(0.0188)	(0.0191)	(0.0187)	(0.0187)
Total assets	0.0112	0.0133	0.0113	0.0142	0.0115	0.0124
	(0.0206)	(0.0203)	(0.0299)	(0.0199)	(0.0206)	(0.0203)
Loan/EA*MPS		0.0135		-0.0640***		-0.0105
		(0.0249)		(0.0169)		(0.0349)
Income structure*MPS		0.0287		0.0280		0.0201***
		(0.0202)		(0.0186)		(0.0140)
NPL/Loan*MPS		0.0216*		-0.0359**		0.0056
		(0.0123)		(0.0167)		(0.0145)
Deposits/Liabilities*MPS		0.0219		0.0129		0.0043
		(0.0166)		(0.0159)		(0.0248)
Equity/assets*MPS		-0.0155		-0.0252		-0.0027
		(0.0169)		(0.0209)		(0.0270)
Total assets*MPS		0.0784***		-0.0103		-0.0063
		(0.0247)		(0.0218)		(0.0324)
Obs.	2709	2709	2709	2709	2709	2709
R^2	0.0379	0.0445	0.0389	0.0489	0.0387	0.0390

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

two tables have the same signs and significance. First, in regressions (1) and (2) in both tables, Taylor rule residuals are negative and insignificant with LRMES of banks headquartered in

core and periphery countries. These results are slightly different from our previous findings. Second, in all regressions in both tables, non-performance loan/total loan, deposits/total liabilities and equity/assets are positive and significant. These results confirm our previous findings that banks with poorer asset quality, more rely on deposit funding, more capital will have higher systemic risk. Third, in regression (4) in both tables, the interaction terms between non-performing loan/total loan and shadow rate is negative and significant with LRMES of banks headquartered in core and periphery countries. This result provides further evidence for our previous finding of riskier banks will have greater sensitivities towards the expansionary monetary policy.

There are however, several key differences among the coefficients in the two tables. First, in regressions (3) and (4), the log difference of the ECB monthly asset is positive and insignificant with LRMES of banks headquartered in periphery countries while it is negative and significant with LRMES of banks headquartered in core countries. These results are similar to previous findings in SRISK regressions and have similar explanations. Second, in all regressions, the interaction term between non-interest income/total income and monetary policy shocks is positive and significant with LRMES of banks headquartered in periphery countries while it is negative and insignificant with LRMES of banks headquartered in core countries. Third, in regressions (3) and (4), the interaction term between total assets and shadow rate is positive and significant with LRMES of banks headquartered in periphery countries while it is insignificant with LRMES of banks headquartered in core countries. Fourth, in regressions (2), (4) and (6), the signs and significance of many coefficients are different in these two tables. For example, in regression (4) in table 4-10, shadow rate is negative and significant with LRMES of banks headquartered in periphery countries. Conversely, in regression (4) in table 4-9, shadow rate is positive and insignificant with LRMES of banks headquartered in core countries. This different result reflects that LRMES of banks headquartered in periphery

countries is generally more sensitive to the accommodative monetary policy (e.g. more negative shadow rate) than LRMES of banks headquartered in core countries. Moreover, the more expansionary monetary policy

Table 4-10 Results of Banks' LRMES in Periphery Countries

Variable	(1) LRMES Periphery Countries	(2) LRMES Periphery Countries	(3) LRMES Periphery Countries	(4) LRMES Periphery Countries	(5) LRMES Periphery Countries	(6) LRMES Periphery Countries
Standard Taylor Rule Residuals	-0.3250	-0.3604				
	(0.2753)	(0.2716)				
Shadow rate			-0.2789***	-0.2776***		
			(0.0234)	(0.0231)		
Log difference of ECB balance sheet					0.0224*	0.0313***
					(0.0124)	(0.0110)
Loan/earning assets	0.0225	0.0236	0.0243	0.0233	0.0223	0.0224
	(0.0174)	(0.0172)	(0.0173)	(0.0180)	(0.0174)	(0.0173)
Non-interest income/total income	0.0728***	0.0745***	0.0758***	0.0764***	0.0731***	0.0746***
	(0.0178)	(0.0176)	(0.0177)	(0.0175)	(0.0178)	(0.0178)
Non-performing loan/total loan	0.2356***	0.2368***	0.2364***	0.2386***	0.2350***	0.2339***
	(0.0166)	(0.0164)	(0.0165)	(0.0152)	(0.0166)	(0.0165)
Deposits/total liabilities	0.0324**	0.0321**	0.0239***	0.0242***	0.0329**	0.0338**
	(0.0151)	(0.0152)	(0.0091)	(0.0091)	(0.0152)	(0.0152)
Equity/assets	0.0550***	0.0543***	0.0256***	0.0284***	-0.0546***	-0.0539***
	(0.0144)	(0.0146)	(0.0061)	(0.0063)	(0.0144)	(0.0144)
Total assets	0.0282	0.0277	0.0280***	0.0270***	0.0285	0.0284
	(0.0186)	(0.0186)	(0.0087)	(0.0085)	(0.0186)	(0.0185)
Loan/EA*MPS		0.0204		-0.0100		0.0026
		(0.0145)		(0.0065)		(0.0203)
Income structure*MPS		0.0275*		-0.0485***		-0.0192
		(0.0149)		(0.0157)		(0.0167)
NPL/Loan*MPS		-0.0194		-0.0828***		-0.0003
		(0.0145)		(0.0146)		(0.0138)
Deposits/Liabilities*MPS		0.0045		0.0025		0.0043
		(0.0128)		(0.0145)		(0.0119)
Equity/assets*MPS		0.0023		0.0305**		0.0351
		(0.0158)		(0.0131)		(0.0264)
Total assets*MPS		-0.0030		-0.0610***		0.0164
		(0.0153)		(0.0171)		(0.0225)
Obs.	3728	3728	3728	3728	3728	3728
R^2	0.0426	0.0442	0.1076	0.1167	0.0422	0.0433

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

contributes to the buildup of systemic risk in long-term for banks headquartered in periphery

countries. This can be possibly explained as follows: banks headquartered in periphery countries have poorer fundamentals than banks headquartered in core countries and are more sensitive to more accommodation monetary policy.

4.6.3 Results of Crisis and Non-crisis Period

Prior to the financial crises, major central banks adopted the conventional monetary policy (e.g. changes in interest rate and required reserve ratio). However, they implemented more expansionary unconventional monetary policy tools in crisis period (e.g. quantitative easing or asset purchase programs). European banks may respond to the expansionary monetary policy differently. In order to examine whether this difference holds, we will divide our full sample into two subsamples: banks in crisis and non-crisis period.

In order to investigate the different effects of monetary policy shocks on banks' systemic risk measures, we follow Afonso et al. (2018) to divide the full sample into banks in crisis period (August 2007 – July 2012) and banks in non-crisis period. This latter covers the two pricing regimes (September 2004 – July 2007 and August 2012 – March 2017) that have low/reduced absolute values of coefficients of risk factors while crisis period covers the one pricing regime that have relatively high absolute values of coefficients of risk factors. Then we will analyze the results of banks' SRISK and LRMES in crisis and non-crisis periods.

Tables 4-11 and 4-12 present the results of banks' SRISK in crisis period and non-crisis period, respectively. On the one hand, most coefficients in the two tables have the same signs and significance. First, in all regressions in the two tables, Taylor rule residuals and shadow rate are negative and significant with banks' SRISK while log difference of ECB monthly total assets is positively and significantly related with banks' SRISK in crisis and non-crisis periods. These results are consistent with our previous findings and provide further evidence for our hypothesis that the expansionary monetary policies will contribute to the buildup of

Table 4-11 Results of Banks' SRISK in Crisis Period

Variable	(1) SRISK Crisis	(2) SRISK Crisis	(3) SRISK Crisis	(4) SRISK Crisis	(5) SRISK Crisis	(6) SRISK Crisis
Standard Taylor Rule Residuals	-0.0200*	-0.0193*				
	(0.0107)	(0.0115)				
Shadow rate			-0.0730***	-0.0701***		
			(0.0270)	(0.0256)		
Log difference of ECB balance sheet					0.0283***	0.0252***
					(0.0053)	(0.0051)
Loan/earning assets	0.0058	0.0102	0.0068	0.0248	0.0056	0.0053
	(0.0246)	(0.0247)	(0.0246)	(0.0265)	(0.0248)	(0.0250)
Non-interest income/total income	0.1036***	0.0977***	0.1031***	0.1055***	0.1025***	0.1026***
	(0.0222)	(0.0227)	(0.0222)	(0.0287)	(0.0220)	(0.0220)
Non-performing loan/total loan	0.2236***	0.2234***	0.2235***	0.2632***	0.2220***	0.2215***
	(0.0237)	(0.0232)	(0.0232)	(0.0275)	(0.0236)	(0.0239)
Deposits/total liabilities	0.1488***	0.1474***	0.1505***	0.1358***	0.1501***	0.1514***
	(0.0276)	(0.0282)	(0.0276)	(0.0364)	(0.0275)	(0.0277)
Equity/assets	0.1189***	0.1156***	0.1185***	0.1461***	0.1192***	0.1190***
	(0.0243)	(0.0245)	(0.0245)	(0.0320)	(0.0244)	(0.0253)
Total assets	0.0769***	0.0826***	0.0811***	0.1190***	0.0776***	0.0777***
	(0.0243)	(0.0254)	(0.0244)	(0.0311)	(0.0242)	(0.0242)
Loan/EA*MPS		0.0148		-0.0395		-0.0106
		(0.0227)		(0.0389)		(0.0095)
Income structure*MPS		-0.0177		-0.0064		0.0046
		(0.0185)		(0.0321)		(0.0106)
NPL/Loan*MPS		-0.0015		-0.0796**		0.0080
		(0.0195)		(0.0371)		(0.0145)
Deposits/Liabilities*MPS		-0.0075		0.0307		0.0118*
		(0.0241)		(0.0360)		(0.0063)
Equity/assets*MPS		-0.0115		-0.0487		-0.0001
		(0.0335)		(0.0344)		(0.0076)
Total assets*MPS		0.0098		-0.0704**		-0.0028
		(0.0199)		(0.0316)		(0.0071)
Obs.	2529	2529	2529	2529	2529	2529
R^2	0.0729	0.0738	0.0741	0.0786	0.0736	0.0741

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

systemic risks of euro area banks in the long term. Second, in all regressions in both tables, all coefficients of bank-specific variables except loan/earning assets ratio are positive and significant with banks' SRISK in crisis and non-crisis periods. These results confirm our previous findings that banks with more diversified income structure, poorer asset quality, more rely on deposit funding, more capital and larger size will have higher systemic risk.

Table 4-12 Results of Banks' SRISK in Non-Crisis Period

Variable	(1) SRISK Non-crisis	(2) SRISK Non-crisis	(3) SRISK Non-crisis	(4) SRISK Non-crisis	(5) SRISK Non-crisis	(6) SRISK Non-crisis
Standard Taylor Rule Residuals	-0.0592***	-0.0539***				
	(0.0169)	(0.0157)				
Shadow rate			-0.0762***	-0.0740***		
			(0.0093)	(0.0092)		
Log difference of ECB balance sheet					0.0223**	0.0215**
					(0.0090)	(0.0085)
Loan/earning assets	0.0115	0.0170	0.0152	0.0087	0.0165	0.0170
	(0.0163)	(0.0179)	(0.0161)	(0.0163)	(0.0168)	(0.0167)
Non-interest income/total income	0.0857***	0.0882***	0.0895***	0.0812***	0.0899***	0.0896***
	(0.0131)	(0.0140)	(0.0130)	(0.0135)	(0.0132)	(0.0133)
Non-performing loan/total loan	0.1649***	0.1753***	0.1692***	0.1572***	0.1684***	0.1691***
	(0.0176)	(0.0177)	(0.0174)	(0.0159)	(0.0180)	(0.0179)
Deposits/total liabilities	0.1025***	0.1072***	0.1025***	0.0979***	0.1009***	0.1001***
	(0.0150)	(0.0148)	(0.0150)	(0.0149)	(0.0150)	(0.0150)
Equity/assets	0.0832***	0.0894***	0.0822***	0.0788***	0.0832***	0.0828***
	(0.0150)	(0.0150)	(0.0151)	(0.0143)	(0.0150)	(0.0150)
Total assets	0.0696***	0.0797***	0.0708***	0.0659***	0.0731**	0.0715***
	(0.0128)	(0.0130)	(0.0128)	(0.0136)	(0.0128)	(0.0131)
Loan/EA*MPS		-0.0277		-0.0127		-0.0202
		(0.0275)		(0.0119)		(0.0133)
Income structure*MPS		-0.0177*		-0.0233**		0.0066
		(0.0172)		(0.0119)		(0.0099)
NPL/Loan*MPS		-0.0398**		-0.0572***		-0.0129
		(0.0156)		(0.0134)		(0.0103)
Deposits/Liabilities*MPS		-0.0208		-0.0147		0.1713***
		(0.0173)		(0.0112)		(0.0057)
Equity/assets*MPS		-0.0198*		-0.0230*		0.0149***
		(0.0118)		(0.0125)		(0.0047)
Total assets*MPS		-0.0486**		-0.0122		0.0112*
		(0.0208)		(0.0103)		(0.0058)
Obs.	4003	4003	4003	4003	4003	4003
R^2	0.0716	0.0740	0.0781	0.0855	0.0723	0.0738

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

Third, in regression (4) in both tables, the interaction term between non-performing loans/total loans and shadow rate is negative and significant with banks' SRISK in crisis and non-crisis periods. Fourth, in regression (6) in both tables, the interaction term between deposits/liabilities and log difference of the ECB monthly total assets is positive and significant with banks' SRISK in crisis and non-crisis periods. These results provide further evidences to support our

previous finding that riskier banks will be more sensitive to expansionary monetary policy than their less risky counterparts.

On the other hand, there are still several critical differences among the coefficients in the two tables. First, in regression (2), the interaction terms between non-interest income/total income and Taylor rule residuals, non-performing loans/total loans and Taylor rule residuals, equity/assets and Taylor rule residuals, total assets and Taylor rule residuals are negative and significant with banks' SRISK in non-crisis period while they are negative and insignificant with banks' SRISK in crisis period. The former result supports for our previous finding of riskier banks will be sensitive to expansionary monetary policy while the latter one does not. These different results reflect that riskier banks benefit more from expansionary monetary policy in non-crisis period than in crisis period. This can be interpreted as follows: in crisis period, the marginal effect of the more accommodative monetary policy on riskier banks declines. On the one hand, riskier banks receive more loans and capital from banking regulators (and lower capital shortfall) and make more loans to small and medium-sized enterprises. On the other hand, however, small and medium-sized enterprises have more non-performing loans due to poor macroeconomic condition in crisis period. Therefore, riskier banks may incur more losses and thus have more capital shortfall. The two effects are offset with each other and result in the lower marginal effect of expansionary monetary policy on riskier banks. Second, in regression (4), the interaction terms between non-interest income/total income and shadow rate, equity/assets and shadow rate are negative and significant with banks' SRISK in non-crisis period while the interaction term between total assets and shadow rate is negative and significant with banks' SRISK in the crisis period. Third, in regression (6), the interaction terms between equity/assets and log difference of the ECB monthly total assets, total assets and log difference of the ECB monthly total assets are positive and significant with banks' SRISK in non-crisis period while they are negative and insignificant with banks' SRISK in crisis period.

These results reflect that banks with higher equity ratio and larger size seem to have higher systemic risk in non-crisis period but not in crisis period.

Table 4-13 and table 4-14 report the results of banks' LRMES in crisis period and non-crisis period, respectively. On the one hand, most coefficients in the two tables have the same signs

Table 4-13 Results of Banks' LRMES in Crisis Period

Variable	(1) LRMES Crisis	(2) LRMES Crisis	(3) LRMES Crisis	(4) LRMES Crisis	(5) LRMES Crisis	(6) LRMES Crisis
Standard Taylor Rule Residuals	0.0114	0.0116				
	(0.0227)	(0.0224)				
Shadow rate			-0.2481***	-0.2458***		
			(0.0410)	(0.0408)		
Log difference of ECB balance sheet					0.0335*	0.0325*
					(0.0196)	(0.0192)
Loan/earning assets	-0.0009	0.0015	-0.0006	0.0054**	-0.0015	-0.0017
	(0.0207)	(0.0205)	(0.0206)	(0.0250)	(0.0208)	(0.0207)
Non-interest income/total income	0.0273	0.0303*	0.0271	0.0402*	0.0271	0.0263
	(0.0172)	(0.0171)	(0.0171)	(0.0237)	(0.0172)	(0.0170)
Non-performing loan/total loan	0.1777***	0.1758***	0.1781***	0.2096***	0.1775***	0.1777***
	(0.0160)	(0.0164)	(0.0158)	(0.0198)	(0.0160)	(0.0162)
Deposits/total liabilities	0.0688***	0.0650***	0.0694***	0.0479*	0.0692***	0.0690***
	(0.0195)	(0.0208)	(0.0196)	(0.0266)	(0.0196)	(0.0199)
Equity/assets	-0.0198	-0.0217	-0.0205	-0.0232	-0.0200	-0.0197
	(0.0156)	(0.0166)	(0.0157)	(0.0204)	(0.0156)	(0.0164)
Total assets	-0.0039	-0.0033	-0.0017	0.0077	-0.0044	-0.0048
	(0.0165)	(0.0174)	(0.0165)	(0.0221)	(0.0166)	(0.0168)
Loan/EA*MPS		0.0074		-0.0146		-0.0165*
		(0.0149)		(0.0267)		(0.0087)
Income structure*MPS		0.0076		-0.0257		-0.0183***
		(0.0117)		(0.0226)		(0.0070)
NPL/Loan*MPS		-0.0123		-0.0633***		0.0059
		(0.0120)		(0.0195)		(0.0060)
Deposits/Liabilities*MPS		-0.0088		0.0447		0.0033
		(0.0122)		(0.0273)		(0.0071)
Equity/assets*MPS		-0.0081		0.0072		0.0031
		(0.0173)		(0.0238)		(0.0049)
Total assets*MPS		0.0024		-0.0177		-0.0084
		(0.0165)		(0.0237)		(0.0068)
Obs.	2529	2529	2529	2529	2529	2529
R^2	0.0448	0.0455	0.0765	0.0786	0.0477	0.0489

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

and significance. First, in regressions (3)-(6) in the two tables, shadow rate and are negative

and significant with banks' SRISK while log difference of the ECB monthly total assets is positive and significant with banks' SRISK in crisis and non-crisis periods. These results are consistent with our previous findings and provide further evidence for our hypothesis of the expansionary monetary policies will contribute to the buildup of systemic risks of euro area banks in the long term.

Second, in all regressions in both tables, most coefficients of non-interest income/total income, non-performing loans/total loans, deposits /total liabilities are positive and significant with banks' LRMES in crisis and non-crisis periods. These results confirm our previous findings that banks with more diversified income structure, poorer asset quality, more rely on deposit funding will have higher systemic risk. Third, in regression (4) in both tables, the interaction term between non-performing loan/total loan and shadow rate is negative and significant with banks' SRISK in both crisis and non-crisis periods. This result provides further evidence for our previous finding of riskier banks will have greater sensitivities towards the expansionary monetary policy.

On the other hand, there are some important differences among the coefficients in the two tables as well. First, in regressions (1) and (2) in both tables, Taylor rule residuals are negative and significant with banks' LRMES in non-crisis period while they are positive and insignificant with banks' LRMES in crisis period. The former results support for our hypothesis that expansionary monetary policies will contribute to the buildup of systemic risks of euro area banks in the long term while the latter results do not. Second, in all regressions in both tables, most coefficients of loans/earning assets and non-interest income/total income are positive and significant with banks' LRMES in non-crisis period while most coefficients are insignificant with banks' LRMES in crisis period. The former results provide further evidences for our previous findings that banks with poorer asset quality and more diversified income structure will have higher systemic risk while the latter results only provide limited evidences.

Third, in all regressions in both tables, the total assets is positive and significant with banks' LRMES in non-crisis period while it is insignificant with banks' LRMES during the crisis period. Fourth, in regression (4), the interaction term between loan/earning assets and shadow rate, total assets and shadow rate are negative and significant with banks' LRMES in

Table 4-14 Results of Banks' LRMES in Non-Crisis Period

Variable	(1) LRMES Non-crisis	(2) LRMES Non-crisis	(3) LRMES Non-crisis	(4) LRMES Non-crisis	(5) LRMES Non-crisis	(6) LRMES Non-crisis
Standard Taylor Rule Residuals	-0.0818***	-0.0830***				
	(0.0292)	(0.0293)				
Shadow rate			-0.1474***	-0.1446***		
			(0.0202)	(0.0202)		
Log difference of ECB balance sheet					0.0353***	0.0375***
					(0.0093)	(0.0078)
Loan/earning assets	0.0365**	0.0344*	0.0388**	0.0241	0.0355**	0.0342**
	(0.0171)	(0.0190)	(0.0169)	(0.0164)	(0.0172)	(0.0174)
Non-interest income/total income	0.0719***	0.0672***	0.0745***	0.0684***	0.0719***	0.0713***
	(0.0150)	(0.0170)	(0.0148)	(0.0150)	(0.0150)	(0.0149)
Non-performing loan/total loan	0.1945***	0.1990***	0.1972***	0.1830***	0.1945***	0.1947***
	(0.0151)	(0.0165)	(0.0150)	(0.0132)	(0.0151)	(0.0151)
Deposits/total liabilities	0.0576***	0.0542***	0.0579***	0.0613***	0.0560***	0.0548***
	(0.0163)	(0.0169)	(0.0162)	(0.0155)	(0.0163)	(0.0164)
Equity/assets	-0.0082	-0.0103	-0.0090	-0.0056	-0.0085	-0.0082
	(0.0156)	(0.0170)	(0.0155)	(0.0145)	(0.0157)	(0.0156)
Total assets	0.0329*	0.0342*	0.0339**	0.0196	0.0314*	0.0313*
	(0.0171)	(0.0185)	(0.0170)	(0.0161)	(0.0173)	(0.0173)
Loan/EA*MPS		0.0104		-0.0435***		0.0085
		(0.0309)		(0.0161)		(0.0063)
Income structure*MPS		0.0163		-0.0087		0.0167***
		(0.0257)		(0.0131)		(0.0046)
NPL/Loan*MPS		-0.0185		-0.0590***		-0.0077
		(0.0176)		(0.0142)		(0.0048)
Deposits/Liabilities*MPS		0.0150		0.0111		0.0165
		(0.0168)		(0.0133)		(0.0102)
Equity/assets*MPS		0.0084		0.0163		-0.0023
		(0.0126)		(0.0139)		(0.0089)
Total assets*MPS		-0.0061		-0.0374**		-0.0012
		(0.0318)		(0.0153)		(0.0072)
Obs.	4003	4003	4003	4003	4003	4003
R^2	0.0417	0.0421	0.0586	0.0637	0.0424	0.0434

Note: *** ** * = statistically significant at the 1%,5% and 10% level, respectively
Numbers in parentheses are heteroscedasticity-robust standard errors

non-crisis period while they are negative and insignificant with banks' LRMES in crisis period. Finally, in regression (6), the interaction term between non-interest income/total income and

log difference of the ECB monthly total assets is negative and significant with banks' LRMES in crisis period while it is positive and significant with banks' LRMES in non-crisis period. These results indicate that banks with more diversified income structure will benefit more from the expansionary monetary policy in crisis period while they will not benefit from the expansionary monetary policy in non-crisis period.

4.7 Conclusions and Policy implications

4.7.1 Conclusions

The aims of this study are: this chapter aims to (1) investigate the impact of ECB's expansionary monetary policy on banks' systemic risk in euro area countries; (2) examine the heterogeneity of banks response towards monetary policy changes; (3) identify the key bank-specific variables that affect the banks' systemic risk if the ECB implements the expansionary monetary policies.

We formulate and test empirically main hypothesis by using data for banks headquartered in 11 countries (Austria, Belgium, Finland, France, Germany, Greece, Italy, Ireland, Netherlands, Portugal, Spain) between September 2004 and March 2017. Data are drawn from (1) the data of systemic risk measures LRMES and SRISK are downloaded from V-lab; (2) the bank-specific data are obtained from S&P market intelligence platform and Bloomberg; (3) the macroeconomic data in calculating monetary policy shocks (Taylor-rule type residuals) are collected from ECB Statistics Data Warehouse; (4) the ECB policy rate (Main Refinancing Operation rate, MRO) and annual total assets are obtained from ECB website; (5) the ECB's Shadow rate is collected from Quandl website. The main methodology we use is fixed effects panel data model. Our empirical evidence offers support to our hypothesis that postulates that expansionary monetary policies will contribute to the buildup of systemic risks of euro area banks in the long term. Moreover, our results indicate that banks that poorer asset quality will

have higher systemic risks. We also identify some evidences for banks that are riskier (e.g. riskier asset composition, poorer asset quality) will benefit more from the expansionary monetary policy. These results support our previous finding of riskier banks will have a greater sensitivity towards the expansionary monetary policy compared to their less risky counterparts. These results can be explained as follows: if the ECB adopts expansionary monetary policies, riskier banks will have improvements in asset composition and asset quality, thus they will have be able to obtain higher profits and lower profitability of default. This will likely will have a favorable impact on their stock prices and lower their systemic risks. However, we do not find sufficient evidences that banks headquartered in core countries have heterogeneous responses towards the expansionary monetary policy from banks headquartered in periphery countries. Similarly, we do not identify sufficient evidences that banks in crisis period have different responses to the accommodative monetary policy from banks in non-crisis period.

4.7.2 Policy Implications

The evidence produced in this paper offers some useful policy implications. First, our main results support our hypothesis and provide implications for bank supervisors and regulators that they should not keep the expansionary monetary policy for too long. Central banks could use the accommodative monetary policy to achieve financial stability in short-term but should gradually quit from the accommodative monetary policy once financial stability is achieved. Second, our other main results give bank supervisors, regulators and managers some important policy implications that they should use the expansionary monetary policy to improve the financial conditions of riskier banks (or less healthy banks).

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Appendix:

Table A4-1 Result of Standard Taylor Rule Model

Variable	Coefficient	Std. Error	t-statistic	Prob.
Constant	-0.0311	0.0211	-1.4748	0.1417
MRO(-1)	0.9764	0.0076	127.8188	0.0000
INF(12)	3.8237	1.1121	3.4382	0.0007
GAP	1.8739	0.3695	5.0710	0.0000
R^2: 0.9907 F-statistic: 7612.43 Prob(F-statistic): 0.0000				

Chapter 5

Conclusions

5.1 Introduction

This thesis offers three separate but related studies on the European banking sector focusing on various important topics including M&As, operating performance, financial integration, systemic risk and monetary policy. The thesis consists of five chapters. Chapter 1 discusses the background of the whole thesis, it highlights the contributions to the literature and the chapters preview. Chapter 2 examines (1) the determinants of acquirers' performance changes of bank M&As in Europe; (2) whether there is any positive or negative relationship between acquirers' performance changes of cross-border bank M&As and banking integration in Europe; and (3) the impacts of the 2007-2009 Financial Crisis on acquirers' performance changes after M&As. Chapter 3 seeks to investigate (1) the determinants of acquirers' systemic risk changes of bank M&As in Europe ; (2) whether there is any positive or negative relationship between acquirers' systemic risk changes of cross-border M&As and banking integration in Europe; and (3) the impacts of the 2007-2009 Financial Crisis and the European Sovereign Debt Crisis on acquirers' systemic risk after M&As. Chapter 4 mainly aims to (1) investigate the impacts of the ECB's expansionary monetary policy on banks' systemic risk; (2) whether there is any heterogeneous response of euro area banks towards monetary policy changes; and (3) identify the key bank-specific variables that affect banks' systemic risk if the ECB implements the expansionary monetary policies.

5.2 Summary of Findings and Policy Implications

In chapter 2, we examine the determinants of acquirers' performance changes after M&As between 1997 and 2003. We find robust that evidences for acquirers with lower insolvency risks and that operate in less concentrated banking markets may have greater profitability ratios. Additionally, we obtain some results that confirm our finding of acquirers can benefit from geographic diversification to raise ROE after M&As. Other determinants of acquirers' changes

in net interest income after M&As, including larger size, liquidity ratio, efficiency; and lower leverage. In terms of market-specific variables, significant determinants include: banking market concentration and less stringent capital regulation. These results provide implications for the bank managers and regulators about how they can use M&As (both domestic and cross-border) to boost acquirers' operating performances in European banking markets. We then test whether the relationship between acquirers' performance changes and banking integration indicators. To measure this latter, we first employ PCA method to select some important financial integration indicators and then contain them in main regressions. We find that interest rate difference between distressed and non-distressed countries in the euro area is negatively and significantly associated with several performance change measures. Second, we use Granger-causality tests for different performance measures and find that increased integration in European banking markets has a positive impact on acquirers' operating performance after M&As. Third, we investigate the determinants for acquirers' performance changes in cross-border M&As and discover that acquirers that are headquartered in countries with less stringent supervisory power and less powerful deposit insurance may have higher ROE and NIM. Fourth, we find some supports that the main characteristics that affect ROA and NIM are size and asset quality while those influence profits after M&As are capitalization, growth rate, asset quality, capital regulatory power, supervisory power and deposit insurers power. These results provide bank managers and regulators with further implications about how they can use cross-border M&As to increase acquirers' operating performances after M&As. Finally, we adopt some t-tests to examine to what extent the 2007-2009 Financial Crisis had a negative impact on acquirers' performance after M&As. Our evidence reveals that acquirers in pre-crisis could increase their profitability through M&As while acquirers in post-crisis period could decrease their profitability ratios and increase fewer profits through M&As. We further conduct mean-comparison t-test and find, as expected, that the difference between the average performance

change in post-crisis period and the average performance change in pre-crisis period are negatively and statistically significant.

In chapter 3, we first calculate the average changes of acquirers' MES, LTD and ΔCoVaR and use t-tests to investigate whether systemic risk increased or decreased significantly after M&As. We identify that acquirers' MES, LTD and ΔCoVaR increased significantly after M&As. These results provide evidences that acquirers' systemic risks increase significantly after M&As. In order to identify more evidences, we then compute the average changes of competitors' MES, LTD and ΔCoVaR. We find that both MES and LTD of competitors increase significantly while change of ΔCoVaR increases the coefficient is insignificantly. We employ t-test again and demonstrate that merging banks and their competitors suffer the same extent from the increase in systemic risks.

This study provides useful implications for bank managers, regulators and supervisors as we find evidence that (1) M&As may boost acquirers' systemic risks; and (2) some factors other than M&As may also contribute to the buildup of systemic risk in European banking markets. Our results are robust as we use t-tests as well as more sophisticated propensity-score (p-score) matching techniques. For this latter, we match merging banks with non-merging banks based on total assets and market-to-book ratio and compute the average changes of three systemic risk measures for acquirers, combined banks and non-merging banks. We find that all three systemic risk measures increase significantly for acquirers and combined banks while they decreased significantly for non-merging banks. These results further confirm our previous findings that acquirers increase systemic risks due to bank M&As. In order to check whether acquirers with different characteristics will have different systemic risks, we divide the full sample into different sub-samples based on different characteristics. We find that (1) large acquirers have higher systemic risks after M&As than small and medium-sized acquirers; (2) acquirers that engage in cross-border M&As have higher systemic risks after M&As than

acquirers that engage in domestic M&As; (3) acquirers from core countries have higher systemic risks after M&As than acquirers from periphery countries. Next we employ fixed-effect models to identify more determinants of acquirers' systemic risk changes after M&As. First, we find strong evidences that acquirers with higher asset diversity will have lower systemic risks after M&As. This important finding implies that product diversification can contribute to lower bank-specific risk and help achieve greater financial stability. Second, we find evidence for the hypothesis that larger acquirers will have higher systemic risks post M&As. This gives support to safety-net subsidies hypothesis whereby large acquirers can engage in M&As to become even larger and become "too-big-to-fail", a situation that allows them to receive safety-net subsidies. This worsens moral hazard problem and enables banks to take on more risks, and finally, leads to banks' higher systemic risk contributions to banking system. Third, we obtain some evidences that acquirers from operating in more integrated banking markets will have higher systemic risk post M&As. This gives support to the destabilizing effect of banking integration to some extent exists, at least in the short-run. Besides these findings, we further identify some evidences for acquirers (1) with lower asset quality in previous year; (2) with lower capital ratio in previous year; (3) with lower price-to-book ratio; (4) that not rely much on short-term debt; (5) that receive bailouts; (6) from countries whose deposit insurers have more authorities and (7) from countries that more encourage investors to engage in private monitoring will have lower risks after M&As. These findings provide implications for European banking regulators what types of bank mergers are more likely to contribute to financial stability. Finally, for robustness, we use a variety of tests, like post-crisis and pre-crisis sub-samples and include and exclude banking integration indicators. We identify that some explanatory variables have opposite signs with three systemic risk measures. These results imply that those variables have significantly different effects on acquirers' systemic risks in post-crisis period, compared with those in pre-crisis period.

Therefore, banking regulators, supervisors and managers should scrutinize changes of those variables and take different actions to reduce acquirers' systemic risks before crisis and after crisis.

In chapter 4, we first use Taylor rule type model to compute the standard Taylor rule residuals, collect ECB shadow rate and calculate log difference of ECB monthly balance sheet to represent different monetary policy shocks. Second, we collect monthly LRMES and SRISK of euro area banks from V-lab website and calculate the standardized LRMES and standardized SRISK as systemic risk measures. Third, we use fixed-effect model to examine whether banks will have higher or lower systemic risks when the ECB implements the expansionary monetary policy. We find some evidence that the expansionary monetary policy will contribute to the buildup of systemic risk in euro area banking sector in the long-term. These findings provide bank regulators, supervisors and managers with useful pointers as to what factors other than M&As are relevant for systemic risk, such as the expansionary monetary policy, and may impede the long-term financial stability in European banking markets. Moreover, our results indicate that banks that have more diversified income structure, poorer asset quality, more deposit funding, more equity capitals and larger sizes will have higher systemic risks. We also observed that riskier (e.g. riskier asset composition, poorer asset quality) seem to benefit more from the expansionary monetary policy. These results can be explained as follows: if the ECB adopts the expansionary monetary policy, riskier banks will have more improvements in asset composition and asset quality, thus they will have higher profits and lower profitability of default, and they will have higher stock prices and lower systemic risks. All these findings and explanations have shed light on how bank regulators and supervisors can use the expansionary monetary policy tools (both conventional and unconventional) to reduce systemic risks significantly for riskier banks. However, we do not find sufficient evidences that banks headquartered in core countries have

heterogeneous responses towards the expansionary monetary policy. Similarly, banks in crisis and non-crisis periods have different responses to the accommodative monetary policy.

5.3 Importance of Findings

In addition to policy implications, there is some importance of the empirical findings that emerge from each chapter of the whole thesis. First, the main findings of chapter 2 indicate the benefits of bank M&As and higher level of banking integration as well as the main factors that influence acquirers' operating performance after M&As. Second, the main findings of chapter 3 show the risks of bank M&As and higher degree of banking integration as well as the main determinants that affect acquirers' systemic risk after M&As. Third, the main findings of chapter 4 demonstrate that the negative impacts of ECB's expansionary monetary policy on financial stability in European banking market as well as banks' heterogeneous responses towards ECB's monetary policy changes.

5.4 Limitations and Possible Improvements

This study is not free from limitations. There are several aspects of limitations in this thesis. First, all samples of these three papers are limited in small geographic area (i.e. only the EU countries). Specifically, in chapter 4, the sample only contains 11 euro area member countries. We can solve this limitation if we include banks headquartered in more euro area member countries in the sample. Second, all samples of these three papers have limited time periods. Due to the data inavailability, the sample only covers part of euro's history. We can solve this limitation if we data during longer time period. Third, we have to reduce the original sample size due to data inavailability. Moreover, some results, e.g. in tables 3-20, 3-23. 3-25, are based on small sub-samples of only about 50 observations. Results that based on small sample sizes may be less reliable. We can find a sample with larger size to improve this limitation in

the future researches. Fourth, we mainly employ the fixed-effect panel data models. We will improve this limitation if we can use various types of models to conduct more robustness checks and obtain more confirming evidences. Finally, in chapter 2, we should match merging banks with non-merging banks (as control group) and conduct further empirical analysis (e.g. propensity score matching) to find more confirming evidence for the 2007-2009 U.S. Financial Crisis had negative impacts on acquirers' operating performance changes after M&As.

5.5 Possible Researches in the Future

One of potential applications to practice and policy in terms of banking integration in European market is to identify main determinants of banking integration indicators. This will give bank regulators and supervisors what are key factors that influence banking integration indicators. Another potential application can be: how ECB's monetary policy change affects level of banking integration in Europe? This provides bank regulators and supervisors with policy implications about the effects of monetary policy changes on banking integration.