

The Effects of Innovation and Regulation on Financial Crises

by
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AUTHOR'S DECLARATION

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners.

I understand that my thesis may be made electronically available to the public.

Abstract

Although financial innovations and deregulations are often argued to be one of the main causes of the current global financial crises, there are only a few cross-country empirical evidences. Using several proxy variables for different types of innovations and regulations of a total of 132 countries, this thesis analyzes the effects of various types of financial innovations and regulations on several types of financial crisis such as currency crisis and banking crisis, for countries with different income levels. The thesis shows that financial innovation in the form of securitization has a negative effect on a country's financial stability, while stronger regulations in the form of restrictions on bank activities and entry requirements are positively associated with the financial stability. However, judicious implementation of financial regulations is required to cope with the financial crisis because some types of regulations, if implemented simultaneously, have countervailing effects and may exacerbate the financial crisis.

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Dedication

To my wife Eunmi, whose tolerance and help enabled this thesis to be written, mother in law, whose generosity kept me studying, and my parents, whose love and inspiration made me endure any difficulties.

Table of Contents

AUTHOR'S DECLARATION	ii
Abstract	iii
Acknowledgements	iv
Dedication	v
Table of Contents	vi
List of Figures	viii
List of Tables	ix
Chapter 1 Introduction	1
Chapter 2 Literature Review	4
2.1 Financial Crisis	4
2.1.1 Types of financial crisis	4
2.1.2 Current Financial Crisis	7
2.2 Factors Affecting Financial Crises	9
2.2.1 Financial Innovation	9
2.2.2 Regulation	10
Chapter 3 Theoretical Framework	14
Chapter 4 Data	18
4.1 Dependent Variable: Financial Crisis	19
4.1.1 Currency Crisis	19
4.1.2 Banking Crisis	21

4.1.3 Debt Crisis	23
4.2 Independent Variables.....	23
4.2.1 Financial Innovation.....	23
4.2.2 Regulatory and Supervisory Variables	25
4.2.3 Other Control Variables.....	28
4.3 Summary Statistics.....	29
Chapter 5 Regression Results	31
5.1 Effects of Financial Innovation on Financial Crisis.....	32
5.2 Effects of Regulations on Financial Crisis	33
5.2.1 Effects of individual regulatory and supervisory variables	33
5.2.2 Effects of regulatory combinations.....	38
5.3 Controlled Variables	40
Chapter 6 Conclusions	42
Bibliography	52

List of Figures

Figure 1: History of Financial Crises in Advanced and Emerging Economies (2007 – 2009)
..... 46

Figure 2: Trend of Banking Crisis during 2007 – 2009: Extensive Liquidity Support 46

List of Tables

Table 1: Description and source of variables.....	47
Table 2: Summary statistics of each variable (N = 132 countries).....	48
Table 3: Correlations among independent variables (N = 132 countries)	49
Table 4: Effects of innovations and regulations on crises	50
Table 5: Effects of interactions of regulations on crises.....	51

Chapter 1

Introduction

The current global financial crisis which started in 2007 has not ameliorated and continued to affect many countries. Housing bubble and credit boom are commonly attributed to the collapse of financial institutions around the world. As of 2010, for example, several countries such as Portugal, Italy, Ireland, Greece, and Spain are still struggling with their sovereign debt crises. However, the degree of impacts of these crises varies by countries, and an important policy concern is to point out the factors that affect the extent and frequency of financial crisis.

Many studies argue that hyperactive financial innovations and the trend of deregulation on the financial sector are the main causes of the current financial crisis. Like the case of portfolio insurance in the 1987 Black Monday financial crisis and derivatives in the 1998 Long-Term Capital Management (LTCM) crisis, some studies attribute the current crisis to the financial innovations such as collateralized debt obligation (CDO)¹ and credit default swap (CDS).² Several studies argue that securitization such as CDO caused credit boom and asset bubble, leading to financial crisis due to lax screening (Keys et al. 2010) or frictions in the securitization process (Ashcraft and Schuermann 2008), and that derivatives led to

¹ Collateralized debt obligation is a structured credit security backed by a pool of credit-sensitive assets, where the interests in the security are divided into tranches with differing repayment and interest earning streams. The reference pool of assets typically includes a diverse range of assets, such as senior secured bank loans, high-yield bonds, and credit default swaps (IMF 2009d).

² Credit default swap is a credit derivative whose payout is triggered by default. CDS settlements can either be “physical” in which the protection seller buys a defaulted reference asset from the protection buyer at its face value or “cash” in which the protection seller pays the protection buyer an amount equal to the difference between the reference asset face value and the price of the defaulted asset (IMF 2009d).

systemic financial risk (Dodd 2000) and risk contagion (Allen and Carletti 2006). In addition, the regulation and supervisory systems in many countries fail to keep up with the rapidly evolving financial industry. Eichengreen and Portes (1987) argue that regulations of financial innovations can make economy less vulnerable to financial collapse, though the benefits of deregulation are apparent. On the other hand, Barth et al. (2006) show that restrictions on bank activities have contributed to financial crises in many countries.

The objective of this thesis is to examine (i) whether financial innovations have contributed to the current financial crisis, (ii) whether deregulation has intensified the crisis, and (iii) which combinations of regulations have exacerbated the crisis. Though a number of countries are reforming their regulatory systems to redress the imbalance between financial innovation and regulations (Financial Services Authority 2009, Department of Treasury 2009), there is lack of empirical studies to answer these questions with cross-country database. Most existing studies examine the issue of innovations, regulations and financial crises with the cases of the United States or a small region (Dodd 2000, Ashcraft and Schuermann 2008, Brunnermeier 2009). However, the innovation or regulatory systems of a country do not change much in a short term, and it is difficult to generalize the results of existing studies in a global context. With the global data of 132 countries which exhibit a wide variety of innovations or regulatory systems, this thesis can provide more generalized implications of innovation and regulation.

The main contributions of this thesis are the followings. First, it considers both currency crisis and banking crisis separately and measures these variables as a count variable

instead of a binary variable considered in most existing studies (Lestano et al. 2003, Beck et al. 2006, Barth et al. 2008a). Second, it categorizes the 132 countries into high income and low income countries, and compares the effects of each factor under different market environments. Third, it considers various types of financial regulations and analyzes the effects of specific combination of regulatory measures on the degree of financial crisis.

The organization of the thesis is as follows. Chapter 2 reviews the existing literature on the relation between financial crises and financial innovations or regulations. Chapter 3 lists several testable hypotheses drawn from the literature review. Chapter 4 describes the source of data, the definitions of each variable, and its summary statistics. Chapter 5 examines the main results of the thesis with a few regression models, and chapter 6 provides the conclusion.

Chapter 2

Literature Review

2.1 Financial Crisis

2.1.1 Types of financial crisis

Modern financial crises are characterized by their global scale in which a crisis in one country is quickly transmitted to other countries. For example, the Mexican debt crisis in 1982, the Thailand currency crisis in 1997, and the Russian debt crisis in 1998 were all rapidly transmitted to other countries and caused global financial crises (Kaminsky et al. 2005). Several studies examine various factors that affect the financial crises and regulatory measures that can prevent or lessen the crisis (Morris and Shin 1998, Georgievska et al. 2008, Reinhart and Rogoff 2008a).

A few types of financial crisis have been defined depending on the focus of research. Allen and Snyder (2009) define financial crisis as a state of a wider range of disturbances in financial sectors, such as sharp declines in asset prices, failures of large financial intermediaries, or disruption in foreign exchange markets. Hoffman et al. (2007) define financial crisis as a situation where a large number of financial contracts are suddenly broken. In most literatures, financial crisis is broadly classified into three types: banking crisis, currency crisis, and debt crisis (Jacobs et al. 2005, Laeven and Valencia 2008).

Banking crisis refers to the situation where banks and financial sectors face difficulties in repaying contracts on time and experience a large number of defaults. A few specific events are used in identifying the banking crisis, such as bank runs, forced bank closures, mergers, and government intervention (Kaminsky and Reinhart 1999, Reinhart and Rogoff 2008b). In addition, quantitative thresholds are also applied in its identification, such as the ratio of nonperforming assets to total bank assets (Demirgüç-Kunt and Detragiache 1997) and the ratio of holding deposit to total deposit (Dziobek and Pazarbasioglu 1997). After the global financial liberalization in the 1970s, banking crises have been observed all over the world: in the United States in 1984, in the Nordic countries in 1980s, in Japan and Eastern European countries in 1990s, and in Argentina and Uruguay in early 2000s.

A few explanations on the causes of banking crises are suggested in several studies. Based on the data of 18 banking crises of several countries from the postwar period, Reinhart and Rogoff (2008a) argue that financial liberalization, run-up of asset prices, debt accumulation, growth patterns, and current account deficits are the likely causes of all sampled banking crises. Honohan and Laeven (2005) explain that fluctuations in inflation and exchange rate are the most important causes of instable banking system in the 1970s. In addition, greater ownership and involvement of government in the banking system in many developing countries in 1960s and 1970s have resulted in insecure credit and higher nonperforming loans. Bubbles in credit and asset often lead to systemic banking crises (Reinhart and Rogoff 2008b).

Currency crisis is typically defined as large changes in certain indices of actual or potential currency value. Defining an appropriate index has been the focus of debates. Some studies focus on the size of depreciation (Frankel and Rose 1996), while others include speculative pressure and government intervention (Eichengreen et al. 1995, Kaminsky and Reinhart 1999). The 1997 Asian crisis was a typical example of currency crisis, in which some governments stopped defending their currencies after continuous pressure associated with high economic growth (Allen and Gale 2007). The potential causes of currency crisis include weak banking sector (Obstfeld 1994), bank run (Velasco 1987), and asymmetric information about fundamentals (Morris and Shin 1998).

Debt crisis refers to the situation where a country is in default on its sovereign bonds, and is observed by the presence of a debt rescheduling agreement or negotiation, unpaid principal repayment or interest, and an International Monetary Fund (IMF) loan agreement (Lestano et al. 2003). Some studies use the combination of these events as a measure of debt crisis (Hajivassiliou 1994, Detragiache and Spilimbergo 2001), while others use a single indicator as its measure (Lanoie and Lemarbre 1996, Marchesi 2003). The 1997 Asian crisis had the features of debt crisis, and the default of syndicated bank debts in early 1980s by several Latin American and African countries was also an example of debt crisis (Detragiache and Spilimbergo 2001). The factors that affect the likelihood of debt crisis include increases in the proportion of short-term debt and debt service coming due, decrease in foreign exchange reserves, the exchange rate policy which affects a country's solvency,

financial openness, high inflation and illiquidity as well as political factors (Detragiache and Spilimbergo 2001, Georgievska et al. 2008).

Last few decades observed numerous incidences of financial crises around the world. Banking crises were most frequently observed during the early 1990s, reaching their peak in 1995 with 13 banking crises. Several currency crises also happened during the same period, though they were more prevalent in the 1980s with a maximum of 45 occurrences in 1981. Debt crises mostly happened in the early 1980s with a maximum of 10 crises in 1983. Laeven and Valencia (2008) report that a total of 124 banking crises, 208 currency crises and 63 debt crises were observed globally during the period of 1970 to 2007. Both banking and currency crises were occurred simultaneously in 42 cases, and all three types of crisis were reported in 10 cases. However, the number of these crises is sensitive to the definition of financial crises, and a single definition cannot encompass all aspects of crises due to their interdependence (Allen and Gale 2007).

2.1.2 Current Financial Crisis

The current financial crisis in the late 2000s is rarely studied, mainly due to the ongoing nature of the crisis and the lack of available data. However, a few anecdotal studies report that the current crisis is preceded by low real interest rate, credit boom, and rise in asset prices (BIS 2009, Taylor 2009, World Bank 2009b). Low interest rates and excessive savings in early 2000s have precipitated investments in housing market in developed countries. As the housing prices dropped in 2006 due to tightening credit and negative expectation of housing price, disturbances in subprime mortgage industry have started from June 2007.

Then, asset prices decreased after large losses on subprime mortgage assets and the bankruptcy of Lehman Brothers. Uncertainty about economic outlook hit the global financial market, and governments intervened through nationalization and temporary guarantee of money market funds since March 2008. Though a few optimistic signs, such as decreased volatilities and recovering of asset prices, have been observed since March 2009, the macroeconomic indicators still show negative signs. For instance, Libor-OIS spread which indicates the soundness of banking sector and forward rate which measures the investors' expectations still remain negative (BIS 2009).

Financial innovations in many countries might have precipitated the current crisis. Financial innovations, such as securitized instruments and structured financial products, facilitated the asset boom and led to a sharp increase in leverage throughout major financial systems (World Bank 2009b). The crisis is conspicuous in the United States due to its hyperactive innovations. Financial liberalization or deregulation also had a role in the crisis. Regulators failed to control the high leverage in financial sectors and could not detect the risks of banks' capital positions. Shadow banking system, engaged in a number of maturity transformations such as long-term lending with short-term borrowing through off-balance-sheet transactions, was not subjected to the same level of scrutiny as deposit-holding institutions, and regulators relied on banks' own evaluation of capital positions (World Bank 2009b).

The current crisis is similar to past banking crises in which the banking industry was vulnerable to the problems in the mortgage market (Allen et al. 2009). With a large volume

of mortgage-backed securities and risky short-term loans, banks were directly hit from the mortgage crisis. In addition, the current crisis synchronizes globally due to worldwide financial contagion; the 12-month average correlation of G-20 equity prices was 0.44 before the crisis, but now 0.92 after the crisis (IMF 2009b).

2.2 Factors Affecting Financial Crises

As discussed in the previous sections, bubbles in credit and asset, financial liberalization, debt accumulation, and current account deficits are common factors leading to the banking crisis, while weak banking sector, bank run, and asymmetric information about fundamentals are potential causes of the currency crisis. The exchange rate policy, financial openness, high inflation and illiquidity, and political factors are believed to affect the likelihood of the debt crisis. However, both financial innovations and regulatory measures are considered the most important factors that affect each type of financial crisis.

2.2.1 Financial Innovation

Financial innovation refers to the act of creating and implementing new financial instruments as well as new financial technologies, institutions, and markets. The innovations are often observed as products such as new derivatives and new securities or processes such as new means of distributing securities, new processing transactions, and new pricing transactions (Tufano 2003). Although financial innovation is often associated with the occurrence of financial crisis, few studies examine this relation due to obscure definition of financial innovation and lack of available data (Frame and White 2004). Financial service firms do not

have separate R&D budget, and there are no observable measures of financial innovation such as patents.

However, a few recent studies try to shed light on the relation between financial innovation and crisis. Brunnermeier (2009) claims that while financial innovation has made banking system stable by transferring risks, it has led to an unprecedented credit expansion and housing price bubble. Reinhart and Rogoff (2009) argue that financial innovation is a strong indicator of a bubble. Extensive use of securitization has resulted in interconnected obligations and increased systemic risk. Several studies argue that financial innovations, such as credit default swaps, securitizations, and derivatives, have contributed risk contagion (Allen and Carletti 2006, Ashcraft and Schuermann 2008, Keys et al. 2010). On the other hand, other studies argue that securitization by itself may not enhance financial stability, but it helps cushion the immediate impact of interest rate shocks to loan origination (Goswami et al. 2009, Shin 2009).

2.2.2 Regulation

Financial regulations are implemented in most countries to secure financial stability and to prevent systemic financial risk. Prudent financial regulation and supervision are considered essential in banking industry since consumers cannot monitor banks' complexity of financial products effectively (Dewatripont and Tirole 1994). However, the fragility of financial market can be originated from inconsistent government policy which hampers the effective regulations and supervisions and leads to financial crisis (Caprio et al. 2008).

Different views about the role of financial regulation (or deregulation) in the current crisis are suggested. Some point out the economic benefits of deregulation in financial sector and argue that deregulation is not the cause of the recent crisis (Kaminsky and Schmukler 2003, Wallison 2009). Others support the importance of stringent regulation and supervision in preventing financial crisis (Skott 1996). In the empirical analysis, Beck et al. (2006) find that overall restrictions on bank activities have a negative effect on the financial stability, while Barth et al. (2004 and 2008a) find that regulation on diversification is positively associated with the financial stability with cross-country data.

Three types of financial regulations—capital regulation, official supervisory power, and private monitoring—are often discussed in existing studies because they are consistent with the three pillars of the Basel II Accord (Petersen et al. 2009).³ Gordy and Howells (2006) argue that the Accord reduces the financial stability since capital requirements under the Accord will increase in bust and fall in boom. On the other hand, Barth et al. (2008a) categorize 7 regulatory indices including the three pillars of the Accord: overall restrictions on bank activities, entry requirements, diversification, capital regulation, private monitoring, government-owned banks, and official supervisory power. The extended indices are worth considering since particular regulatory combinations can have different effects on financial stability. However, the effects of each element of the indices on containing financial crisis are controversial.

³ The Basel II Accord is a list of recommendations on banking laws and regulations, issued by the Basel Committee on Banking Supervision. The Accord consists of three pillars: a regulatory standard for minimum capital requirements (pillar 1), the supervisory review process (pillar 2), and market discipline (pillar 3).

- *Overall restrictions on bank activities:* Some studies argue that stringent restrictions on bank activities exacerbate bank fragility and that there was no evidence about the conflict of interest in universal banking, such as operating both commercial and investment banking activities, before the Glass-Steagall Act (Kroszner and Rajan 1994, Barth et al. 2008a).⁴ Others argue that tightened restrictions on bank activities contribute the soundness of banking industry through banks' moral hazard problems and conflicting interests (John et al. 1994, Boyd et al. 1998).
- *Entry requirements:* Some insist that strict entry requirements to banking sector hamper efficient competition and negatively affect the economy (Shleifer and Vishny 1998), while others argue that big hurdle for the entry prompts the soundness of banking industry (Keeley 1990).
- *Regulation of diversification:* Some argue that banks with greater diversification are exposed to currency risk and various country risks (Stigum 1990), while others find that greater diversification has a positive effect on bank stability (Buch et al. 2004, Barth et al. 2006).
- *Capital regulations:* Some claim that tightened capital regulation cannot maintain bank stability (Allen and Gale 2003, Barth et al. 2008a), while others argue that

⁴ The Glass-Steagall Act of 1933 was introduced to separate the commercial banking from the investment banking.

strong capital regulations enhance the financial stability by protecting the financial system from bank runs (Dewatripont and Tirole 1994, Berger et al. 1995).

- *Private monitoring*: Some argue that there is no significant relation between the private monitoring and the likelihood of financial crisis (Barth et al. 2008a), while others claim that the private monitoring is more important than government regulations because politicians can be affected by big bank conglomerates (Shleifer and Vishny 1998).
- *Government ownership of banks*: Some claim that government-owned banks are likely to exploit their assets for political purpose and increase the likelihood of the banking crisis (Carprio and Peria 2006), while others argue that government ownership enhances the stability of financial sector through strategic plan and avoidance of market failure and negative externality (Gerschenkron 1962).
- *Official supervisory power*: Some find no significant relation between official supervisory power and the crisis (Barth et al. 2006), while others argue that strong official supervisory power prevents the economy from market failures (Shleifer and Vishny 1998).

There may be countervailing or amplifying effects between various elements of regulations, if implemented simultaneously (Claessens et al. 2005). Greater restrictions on bank activities can be essential in countries with insufficient private monitoring, whereas restricting bank entry with weak official supervision may lead to financial stability (Barth et al. 2004).

Chapter 3

Theoretical Framework

To analyze the factors that affect the financial crisis, this chapter summarizes the testable hypotheses based on the existing literature.

Hypothesis 1: Securitization as a form of financial innovation has a positive effect on banking crisis.

While financial innovation has been believed to enhance the financial stability, it is now blamed for one of the main causes of the current crisis. Few studies examine the relation between financial innovation and financial crisis with cross-country data on a global scale; existing studies focus on the experiences of a single country or a group of a few countries. With the current crisis of the United States, Brunnermeier (2009) explains that financial innovations such as the “originate and distribute” model led to the financial crisis through lending boom and housing bubble. Under the “originate and distribute” model, financial institutions originate loans such as mortgages, repackage them into securitized products, and then sell via securitization such as CDOs. Large foreign capital flows to the market, but banks have less incentive to take care of the loan applications and monitor the loans because the risks of holding the loans pass on to investors. Similarly, Ashcraft and Schuermann (2008) show that the intrinsic frictions (e.g., moral hazard, adverse selection, and principal-agent problems) from the securitization process have caused the subprime mortgage crisis in the United States.

Derivatives, another form of financial innovation, are believed to allow firms and banks to effectively manage their financial risks at low a cost (Miller 1995). However, derivatives are now attributed to much of the financial turmoil, especially the East Asian currency crisis of 1997. With the data on the over-the-counter derivatives markets such as foreign exchange forwards and swaps, total return swap, and structured notes, Dodd (2000) shows that derivatives increase the systemic financial risk by leveraging, evading regulation, and making the foreign exchange market less stable.

Studies on the relation between the venture capital and financial stability are modest. Some argue that inside investors such as the venture capital and private equity reduce the cost of asymmetric information and resolve diverse agency problem in financial sector (Admati and Pfleiderer 1994, Amit et al. 1998). In sum, most financial innovations are expected to have a positive effect on both currency and banking crisis regardless of the income level of a country, even though a few innovations such as the venture capital are believed to reduce the financial fragility.

Hypothesis 2: Among financial regulations, the restrictions on bank activities and the entry requirements have negative effects on banking crisis in high income countries.

After the onset of the current crisis, financial liberalization or deregulation were regarded as the main causes of the crisis, and a number of governments tried to reform their financial regulation more tightly. The role of financial regulation in the financial crisis is heavily debated and no conclusive result has yet agreed upon. Barth et al. (2004) show that restrictions on bank activities and entry barriers to foreign bank have positive effects on

banking crisis, and the same conclusion is derived by Beck et al. (2006) with the data on 69 countries over the period 1980-1997.

However, both studies have a few shortcomings: (i) they focus only on banking crises, though currency crises or debt crises are considered more important in some major financial crises, (ii) with the data of about 50 – 70 countries, they cannot study the differences in the relation among countries with diverse income level, (iii) their use of binary variable of financial crisis prevents them from analyzing the effects of depth or frequency of the crises, (iv) they use limited number of control variables, while many other macroeconomic variables are significant in the financial crises, and (v) they suffer from the problem of reverse causation because they use the crises data between 1980s and 1990s with the regulation data from 1999. Among the seven regulatory variables, this thesis focuses on two regulation variables: overall restrictions on bank activities and entry requirements. The problem of reverse causation is resolved by collecting the regulatory data from 2006 and the crisis data between January 2007 and October 2009.

Hypothesis 3: The restrictions on bank activities with the private monitoring have a countervailing effect on banking crisis in high income countries.

Some regulatory combinations can enhance financial stability under particular regulatory environment, but increase the fragility under other environments. However, few studies examine the effects of regulatory combinations, except Barth et al. (2004). Barth et al. examine several regulatory combinations which are believed to have countervailing or amplifying effect due to different individual objectives. To analyze whether particular

regulation is associated with stability in specific condition, Barth et al. enter interaction terms into regressions; however, they do not find any significance in the interaction terms. Among Barth et al.'s combinations, I focus on the regulatory combination of the restrictions on bank activities and the private monitoring. Some argue that restricting bank activities is more important in weak institutional environments where the public sector lacks the ability to monitor banks (Barth et al. 2004). Barth et al. (2004) examine this argument using the interaction term but do not find any result supporting this contention. In the study, I add the interaction term (private monitoring) * (overall restrictions on bank activities) into every regression models on both types of crisis for all types of country groups to test the countervailing effect of the combination of the restrictions and the private monitoring on financial crisis.

Chapter 4

Data

IMF (2009c) presents the timeline of the recent financial crises in advanced and emerging economies from 2007 till 2009 (Figure 1). The timeline consists of the TED spread, which refers to the difference between U.S. Treasury bill rate and Eurodollar rate, and the Emerging Market Bond Index (EMBI) global spread. The EMBI global spread stands for an index of default risk relative to advanced benchmark countries and is usually computed as the difference between the yield on a bond in the market access country and that on a bond of comparable maturity in the benchmark country. Two spreads in Figure 1 show the development of the crisis with some key events. Figure 2 presents the number of extensive liquidity supports, which refers to a big increase in claims from monetary authorities on deposit-holding banks, during the same period. Both figures exhibit very similar trend of financial crises and especially a peak in November 2008 with the bankruptcy of Lehman Brothers.

The comparison between two figures clearly shows that the current crisis is mainly banking crisis since the extensive liquidity support is one of the indicators for banking crises. The figures also present that emerging market or other low income countries had not been closely associated with advanced economies until Lehman Brothers bankruptcy in September 2008, but that Lehman's bankruptcy triggered global crisis. This chapter discusses the detailed information of each variable, and Table 1 summarizes the variables with data sources.

4.1 Dependent Variable: Financial Crisis

This section explains the data sources and the method of calculating each type of financial crisis (currency crisis, banking crisis, and debt crisis). Instead of adopting binary variable which describes the existence of financial crisis, this study creates the financial crisis variables which capture the number of crises in each country.

4.1.1 Currency Crisis

Some define a currency crisis as a nominal depreciation of the currency of 30 percent or a 10 percent increase in the rate of depreciation compared to the year before (Laeven and Valencia 2008). Eichengreen et al. (1995 and 1996) calculate the exchange rate market pressure index (EMPI) for different market environments, and identify the currency crisis if the EMPI exceeds a certain threshold. Several studies propose alternative ways of calculating the EMPI, by excluding interest rate differentials (Kaminsky et al. 1998), international reserves and interest rate differentials (Frankel and Rose 1996), or interest rate variables and the link to the reference country (Zhang 2001). However, Eichengreen et al.'s method is considered more accurate because it can capture both successful and unsuccessful speculative attacks and outperforms the other models in the experiment using the crises data of six Asian countries from 1970 to 2001 (Lestano et al. 2003).

A speculative attack associated with extreme pressure in the foreign exchange market often results in a devaluation (or revaluation) or a change in the exchange rate system. If the government raises the interest rate or run down the international reserve, the speculative attack may not affect the exchange rates. Thus, the speculative pressure (or currency crisis) is

explained as exchange rate market pressure index (EMPI) which is measured as a weighted average of the normalized changes in the exchange rate, the ratio of gross international reserves to M1, and the nominal interest rates (Eichengreen et al. 1995 and 1996).

$$EMPI_{i,t} = \frac{1}{\sigma_e} \frac{\Delta e_{i,t}}{e_{i,t}} - \frac{1}{\sigma_r} \left(\frac{\Delta rm_{i,t}}{rm_{i,t}} - \frac{\Delta rm_{NR,t}}{rm_{NR,t}} \right) + \frac{1}{\sigma_i} \Delta(i_{i,t} - i_{NR,t}),$$

where $EMPI_{i,t}$ is the exchange rate market pressure index for country i in period t ; $e_{i,t}$ is the unit of country i 's currency per Norway krone in period t ; $rm_{i,t}$ is the ratio of gross foreign reserves to M1—a measure of money supply consisting of currency in circulation, demand deposit, and checkable deposit—for country i in period t ; $i_{i,t}$ is the nominal interest rates for country i in period t ; $i_{NR,t}$ is the nominal interest rates for Norway in period t ; σ_e is the standard deviation of the relative change in the exchange rate ($\Delta e_{i,t}/e_{i,t}$); σ_r is the standard deviation of the difference between the relative changes in the ratio of foreign reserves and money (M1) in country i and Norway ($(\Delta rm_{i,t}/rm_{i,t}) - (\Delta rm_{NR,t}/rm_{NR,t})$); and σ_i the standard deviation of the nominal interest rate differential $\Delta(i_{i,t} - i_{NR,t})$.

All variables in the above index are measured relative to a reference country, and Lestano et al. (2003) use the United States as their reference country due to the dollar's role as an anchor to other currencies. However, this study uses Norway as the reference country because the United States is the centre of the current global crisis and its currency is not stable, while the Norwegian krone is considered one of the safest currencies (Smith 2009). In addition, a big surge of U.S. international reserve in July 2009 may bias the timing of the currency crisis of other countries. Eichengreen et al. used Germany as the reference country

because German mark was strong and stable at the time of their study. This index captures the changes in domestic exchange rate if the speculative attack is successful, and captures the changes in international reserves or nominal interest rates if the attack does not lead to devaluation. A period of speculative attack or currency crisis is identified when the index exceeds a given upper bound:

$$Currency\ Crisis_{i,t} = \begin{cases} 1 & \text{if } EMPI_{i,t} > \beta\sigma_{EMPI_i} + \mu_{EMPI_i} \\ 0 & \text{otherwise,} \end{cases}$$

where σ_{EMPI_i} equals the sample standard deviation of $EMPI$ and μ_{EMPI_i} is the sample mean of $EMPI_{i,t}$. This study sets a threshold of $\beta = 2$ based on Lestano et al. (2003).

The global data (e.g., exchange rate, gross foreign reserve, M1, and interest rate) in the EMPI are obtained from the International Financial Statistics (IFS) of IMF during the period from January 2007 to October 2009 (see Table 1). I calculate the sum of the number of months for the count outcomes if the currency crisis is one in the given month.

4.1.2 Banking Crisis

Banking crises are identified with several observable measures, such as bank runs, increase in nonperforming assets, emergency measures by monetary authorities, and bank nationalizations. Following Laeven and Valencia (2008), this study measures the banking crisis with bank runs, introduction of deposit freezes, introduction of blanket guarantees, extensive liquidity support, and bank interventions. Bank run is identified if the monthly percentage decline in the total deposits with national currencies is larger than 5%. Deposit freeze indicates whether the authorities imposed a freeze on deposits, and blanket guarantee

is the government guarantee on all bank liabilities. Extensive liquidity support is defined if the ratio of claims on deposit-holding institutions to total deposits is larger than 5% and is at least double the ratio compared to the previous year.⁵ Large-scale government interventions include nationalizations, closures, mergers, sales, and recapitalizations of large banks.

In addition to the above measures, this study includes the Stand-By Arrangement (SBA) loans from IMF, which are designed to help the short-term balance of payments problems. SBA loans are considered as clear evidences that the country is suffering from banking crisis. According to IMF (2009c), several fund-supported programs based on the SBA loans are being implemented to avoid systemic banking crises or restore bank solvency if a country is faced with banking crisis.

Both quantitative thresholds (bank runs and extensive liquidity support) and chronologies of events (deposit freezes, blanket guarantees, bank interventions, and SBA loans) are used to identify the banking crisis during the period of January 2007 to October 2009. The number of bank runs and extensive liquidity support in each country are counted using the monthly data on total deposits and claims on deposit-holding banks from the IFS. Regarding deposit freezes, blanket guarantees, and SBA loans, I do not calculate a summation since each action is taken at most once in a country. The event of each bank intervention is counted for each country. The count measure of banking crisis for each country is the summation of the number of occurrences of each index.

⁵ Both extensive liquidity support and blanket guarantees are two commonly used crisis containment measures by the government (Laeven and Valencia 2008).

4.1.3 Debt Crisis

Debt crisis is identified if either of the following conditions occur (Detragiache and Spilimbergo 2001): (i) arrears of principal or interest on external obligations toward commercial creditors (banks or bondholders) exceed 5 percent of the total outstanding commercial debt and (ii) a rescheduling or debt restructuring agreement with commercial creditors exists as listed in the World Bank's *Global Development Finance*. Debt crisis is counted as 1 if a country experiences a rescheduling or a debt restructuring. Since only seven countries⁶ have experienced at most one debt crisis during the study period, this measure is not examined in this empirical analysis.

4.2 Independent Variables

4.2.1 Financial Innovation

While the changes in M1 or M2 were often used as a proxy for financial innovation (Arrau et al. 1991, Aubry and Nott 1999), recent studies measure financial innovation with securitization and risk transfer instruments (Tufano 2003).⁷ Following Gropp et al. (2007), this study considers three indicators as proxy for financial innovations: securitization and issuance of covered bonds, turnover in single-currency interest rate derivatives, and venture capital investments, and all variables are transformed as a percentage of GDP.

⁶ Togo, Gabon, Jordan, Congo, Peru, Central African Republic, and Macedonia.

⁷ M1 is a measure of money supply consisting of currency in circulation, demand deposit, and checkable deposit, and M2 is a measure of money supply consisting of M1, savings deposits, and timing deposits.

For securitization, which refers to the creation of securities from a reference portfolio of preexisting assets or future receivable, the data for 45 countries are collected from the European Securitization Forum (2008), International Finance Services London (2009), Deutsche Bank (2007), and International Finance Corporation (2008). The collected sample countries cover most of issuances according to the International Financial Services London (2009).

The turnover in single-currency interest rate derivatives is the representation of derivatives because the interest rate derivatives market was the largest in 2005 and 2006 (International Swaps and Derivatives Association 2007). This data is collected from BIS (2007) under “The over-the-counter single currency interest rate derivatives turnover by country and counterparty in April 2007, daily average.” This dataset covers only 54 countries, and the turnovers for the rest of countries are assumed zero because the derivatives market is still not common in many of the non-sampled countries.

Venture capital covers the early stage venture capital and private equity for management buy-outs and buy-ins (Wright et al. 2005). The data for 22 countries, which covers over 91 percent of the global venture capital investment, are collected from PricewaterhouseCoopers (2008), Latin America Venture Capital Association (2008), British Private Equity and Venture Capital Association (2008), European Private Equity and Venture Capital Association (2008), Emerging Markets Private Equity Association (2009), Israel Venture Capital Research Center (2008), and PRNewswire (2008).

4.2.2 Regulatory and Supervisory Variables

Barth et al. (2008a) implemented a survey on bank regulation and supervision for 143 countries during 2005 – 2006. To construct the regulation-related variables from the survey, I focus on seven indices. For missing values of a few countries, I either use the 2000/2003 data or calculate the average value of countries with the same income level in the same region.

(a) *Overall restrictions on bank activities*: This index measures the extent to which banks have regulatory restrictions on their activities in (1) securities markets, (2) insurance, (3) real estate, and (4) having shares in non-financial companies. The values in each of the four class range from 0 to 4, and the index varies from 0 to 16, where the index of 16 indicates the most restrictive regulation on bank activities.

(b) *Entry requirements*: This index counts the number of requirements for a banking license: (1) draft by-laws, (2) intended organizational chart, (3) financial projections for first 3 years, (4) financial information on main potential shareholders, (5) background/experience of future directors, (6) background/experience of future managers, (7) sources of funds to be used to capitalize the new bank, and (8) market differentiation intended for the new bank. The index ranges from 0 to 8, and a larger value implies a higher hurdle for entrants.

(c) *Diversification*: This index measures whether there exist explicit, verifiable, quantifiable guidelines for asset diversification, and banks are allowed to make loans abroad. The index is made up of two questions: (1) Are there explicit, verifiable, quantifiable guidelines for asset diversification? (2) Are banks prohibited from making loans abroad? Higher values indicate more diversification.

(d) Capital regulation: This index estimates the overall and initial capital stringency, and consists 9 questions: (1) Is the minimum capital-asset ratio requirement risk weighted in line with the Basel guidelines? (2) Does the minimum ratio vary as a function of market risk? (3) Are market value of loan losses not realized in accounting books deducted? (4) Are unrealized losses in securities portfolios deducted? (5) Are unrealized foreign exchange losses deducted? (6) What fraction of revaluation gains is allowed as part of capital? (7) Are the sources of funds to be used as capital verified by the regulatory/supervisory authorities? (8) Can the initial disbursement or subsequent injections of capital be done with assets other than cash or government securities? (9) Can initial disbursement of capital be done with borrowed funds? The index ranges from 0 to 9, and higher value indicates more restrictive regulation.

(e) Private monitoring: This index measures the degree to which regulations empower, facilitate, and encourage the private sector to monitor banks. It consists of the questions about whether (1) bank directors and officials are legally liable for the accuracy of information disclosed to the public, (2) whether banks must publish consolidated accounts, (3) whether banks must be audited by certified international auditors, (4) whether 100% of the largest 10 banks are rated by international rating agencies, (5) whether off-balance sheet items are disclosed to the public, (6) whether banks must disclose their risk management procedures to the public, (7) whether accrued, though unpaid interest/principal, enter the income statement, while the loan is still non-performing, (8) whether subordinated debt is allowable as part of capital, and (9) whether there is no explicit deposit insurance system and

no insurance was paid the last time a bank failed. The index varies from 0 to 9, and larger value implies more stringent regulation on private monitoring of banks.

(f) *Government-owned banks*: This index measures the extent to which the banking system's assets are government owned. The index consists of only one question; what fraction of the banking system's assets is in banks that are 50% or more government owned as of yearend 2005? The index ranges from 0 to 1, and larger value implies greater government ownership in banking industry.

(g) *Official supervisory power*: This index measures the extent to which the country's commercial bank supervisory agency has the authority to take specific actions. It consists of the information on (1) Does the supervisory agency have the right to meet with external auditors about banks? (2) Are auditors required to communicate directly to the supervisory agency about elicited activities, fraud, or insider abuse? (3) Can supervisors take legal action against external auditors for negligence? (4) Can the supervisory authority force a bank to change its internal organizational structure? (5) Are off-balance sheet items disclosed to supervisors? (6) Can the supervisory agency order the bank's directors or management to constitute provisions to cover actual or potential losses? (7) Can the supervisory agency suspend the directors' decision to distribute (a) dividends, (b) bonuses, and (c) management fees? (8) Can the supervisory agency supersede the rights of bank shareholders and declare a bank insolvent? (9) Can the supervisory agency suspend some or all ownership rights? (10) Can the supervisory agency (a) supersede shareholder rights, (b) remove and replace

management, and (c) remove and replace directors? The index ranges from 0 to 14, and larger value means greater power.

4.2.3 Other Control Variables

4.2.3.1 Financial Structure

While some countries have bank-based financial structure, others have market-based one. For the countries with the bank-based financial structure such as Japan and Germany, banks are considered to enhance the capital allocation with detailed information about firms, increase the investment efficiency and economic growth through liquidity risk management, and mobilize more capital for economies of scale. However, corruption is likely to happen for powerful banks with lax government regulations. On the other hand, for the countries with the market-based structure such as the United Kingdom and the United States, market is regarded to foster incentives to monitor firms, to improve corporate governance, and to facilitate risk management. However, greater market development may hinder corporate control and economic growth due to fewer incentives to exert corporate control (Levine 2002). Countries with a particular financial structure can be more vulnerable to financial crisis, and thus the financial structure difference has to be controlled in the regression analysis.

Beck et al. (2009) provide a database on the indicators of financial structure for each country. For missing data, this study uses previous database, collects other sources such as central banks or monetary authorities, or substitutes the data from countries in the same

region with the same income level. The financial structure indicators are composed of the activity, size, and efficiency. As a first step, four measures are calculated based on Beck et al.'s method: (1) private credit by deposit money banks/GDP, (2) bank overhead costs/total assets, (3) stock market capitalization/GDP, and (4) stock market total value traded/GDP. Then, each indicator is computed by natural logarithm of following ratios: the measure (4) to the measure (1) for the activity indicator, the measure (3) to the measure (1) for the size indicator, and the measure (4) to the measure (2) for the efficiency indicator. Higher value in each indicator implies more market-based financial structure. To reduce the number of variables, I construct an aggregate index of financial structure using the factor analysis.

4.2.3.2 Other Macroeconomic Variables

Macroeconomic variables of a country are generally considered to have close relation with its financial stability. This study includes, as control variables, the 12-month percentage changes in M1 and M2, commercial bank deposits, GDP per capita, and national savings in the period of 2005 to 2006, because these five macroeconomic variables are related to the three types of financial crises (Lestano et al. 2003). These data are collected from the IFS, the central banks, and statistic authorities of each country.

4.3 Summary Statistics

Summary statistics of all variables are presented in Table 2. For currency crisis, Cyprus, Fiji, and Moldova have experienced serious crises most often during the study period. For banking crisis, Greece experienced most crises, followed by Russian Federation and Ireland.

With regard to debt crisis, only seven countries (Togo, Gabon, Jordan, Congo, Peru, Central African Republic, and Macedonia) have experienced it. While Kaminsky and Reinhart (1999) argue that currency and banking crises are closely associated each other, the data on the recent financial crisis do not show any relation between them.

Table 3 shows the correlations among independent variables at the 0.05 significant level. Three innovation variables are positively correlated with each others, while the private monitoring and the aggregate index of the financial structure has positive correlations with all types of financial innovation. The overall restrictions on bank activities are positively correlated with the government-owned banks and the official supervisory power, and negatively correlated with the diversification. Table 3 also illustrates that the government ownership and the entry requirements have a negative correlation.

Chapter 5

Regression Results

With a count variable as the dependent variable of financial crisis, either negative binomial or Poisson regression model is employed for estimation. To verify whether the assumptions of each model are satisfied, I first transform the relevant variables. With various tools for normality such as a symmetry plot, a normal quantile plot, and a normal probability plot, I transformed the overall restrictions on bank activities variable, the private monitoring variable, and the official supervisory power variable by square function, the government ownership variable and the GDP per capita variable by square root function, and the commercial bank deposit variable by reciprocal function (Garson 2010). To control for heteroskedasticity, I apply robust standard errors to all regressions. The multicollinearity problem is tested using the Variance Inflation Factor (VIF), in which further investigation is required if a VIF value is greater than 10. All variables in this study have VIF values less than 7, and there is no multicollinearity problem.

Two variables of financial crisis are separately estimated as a dependent variable: currency crisis and banking crisis. With three groupings of country (all countries, high income countries, and low income countries), a total of 6 separate regression models are estimated. Based on the World Bank classification (World Bank 2009c), high income countries include both high income and upper middle income countries with a total of 76 countries, and low income countries cover both lower middle and low income countries with

a total of 56 countries in our sample. Since the Poisson regression model assumes that standard deviation is equal to the mean, I instead use the negative binomial model. Three types of innovation variables and all seven regulation variables are applied in each regression model.

5.1 Effects of Financial Innovation on Financial Crisis

To test the relation between financial innovation and crisis, I estimate several models using three types of innovation variables with different income groups. *Hypothesis 1* is supported because the securitization as a form of financial innovation variable has a strong positive effect on banking crisis for all types of country groups in Table 4. The result is consistent with Brunnermeier (2009) who argues that the originate-and-distribute model via securitization is one of the causes of the current crisis, and Ashcraft and Schuermann (2008) who find that the securitization process causes several frictions such as moral hazard, adverse selection and principal-agent problems. This result is also consistent with the fact that most securitization is related to mortgages which are originated from banks. Based on the standardized regression coefficient, the expected count of the banking crisis in high income countries increases by 1.4308 and by 4.5697 for low income countries, for a standard deviation increase in securitization to GDP variable. This result indicates that regulators should be in control of the extent of securitization to contain the banking crisis. On the other hand, the securitization variable has negative effect on the currency crisis in all countries group because most international investors tend to invest in local currency and are able to reduce the exposure to currency risk (IFC 2008).

Table 4 shows that the interest rate derivatives variable has negative effects on the banking crisis for both high income and low income countries. The interest derivatives are applied as a hedging device for long-term loans and a tool for managing exposure to interest rate risk in banking industries, so it is likely to stabilize banking sector (Gropp et al. 2007). However, the derivatives variable does not have significant relation with the currency crisis because the underlying assets of the derivatives are in general independent of the changes in currency or exchange rate. On the other hand, the venture capital is strongly positively related to the banking crisis in high income countries. This result suggests that most venture capital and private equity herd into high risk activities in large economies and venture capital firms, especially in Europe, tend to obtain their funds from banks (Bottazzi et al. 2002, Wright et al. 2005). The standardized coefficient of the variable is large at 1.5908 for the banking crisis in high income countries.

5.2 Effects of Regulations on Financial Crisis

5.2.1 Effects of individual regulatory and supervisory variables

To test *Hypothesis 2* of the effects of financial regulations, I include two variables—overall restrictions on bank activities and entry requirements—of regulations as well as other five variables for different types of dependent variable with different income groups (Table 4). *Hypothesis 2* stands because two regulations have negative effect on the banking crisis for all types of country groups. The result is different from Barth et al. (2004) and Beck et al. (2006) who show that restrictions on bank activities and entry barriers to foreign bank have positive

effects on banking crisis. The outcome suggests that stronger regulations in the form of restrictions on bank activities and entry requirements are positively associated with the financial stability. Effects of each regulation as well as other five regulations are followings.

(a) *Overall Restrictions on Bank Activities:* In terms of the currency crisis, I do not find any significant relation between the overall restrictions on bank activities and the crisis for all countries group and high income countries; however, the restrictions present limited negative associations with the crisis for low income countries. This result is consistent with the view that tightened restrictions on bank activities prompt the soundness of banking industry (Boyd et al. 1998, John et al. 1994) because the potential causes of currency crisis include weak banking sector (Obstfeld 1994). Regarding the banking crisis, the restrictions have negative relation with the crisis only for high income countries. This result is different from Barth et al. (2004 and 2006) and Kroszner and Rajan (1994) who argue that intensifying regulatory restrictions on bank activities increases banking-system fragility. Apart from different data used in this study, this discrepancy may be explained by the fact that the current crisis is different from previous crises in that the excessive financial innovation plays a key role in the recent global crisis with contagion effects. For instance, when a bank, which participates in both banking and insurance, face idiosyncratic liquidity risk and hedge this risk using financial innovation such as credit risk transfer instruments in an interbank market, credit risk transfer can lead to contagion between banking and insurance parts and increase the risk (Allen and Carletti 2006).

(b) Entry requirements: The regulation is negatively associated with the banking crisis for all types of country group. This result suggests that fostering competition in banking industries or allowing less capable entrants might cause a banking crisis regardless of income level of a country. The result is consistent with the argument that big hurdle for the entry prompts the soundness of banking industry (Keeley 1990), but different from the claim that strict entry requirements hamper efficient competition and negatively affect economy (Shleifer and Vishny 1998). On the other hand, Barth et al. (2006) do not find any significant relation in their 2004 study.

(c) Diversification: Diversification has different relations with the currency and banking crisis. The diversification index has strong negative relations with the currency crisis for all countries group and low income countries, whereas it has positive associations with the banking crisis for all types of country group. This result is consistent with the argument that banks are exposed to various risks with the greater diversification (Stigum 1990), but different from Barth et al. (2004) who find a negative relation between the banking crisis and the diversification in small economies and Busch et al (2004) who claim that greater diversification has a negative relation with banking crisis. In terms of the negative effect on the currency crisis, banks make loans from foreign investors for local currency financing for the liability diversification; therefore, they can reduce the exposure to currency risk (IFC 2008). Regarding the positive effect on the banking crisis, banks usually securitize their mortgages and sell them for the asset diversification. However, the toxic waste is usually remained in the issuing banks and the waste can result in huge losses (Brunnermeier 2009).

The size of standardized coefficient is also relatively large in all regressions on the banking crisis, namely 1.5286 in high income countries, and 1.6259 in low income countries.

(d) Capital regulation: The capital regulation is important regarding the Basel II Capital Accord which was implemented in most countries around 2008. For bank stability or efficiency, the Accord recommends countries to strengthen the capital regulation, official supervisory power, and the private monitoring. The capital regulation retains strong negative association only with the currency crisis of low income countries. Barth et al. do not find any association between them in their studies (2004, 2006, and 2008a). This may support the argument that the regulation enhances the financial stability by protecting the financial system from bank runs on illiquid banks (Dewatripont and Tirole 1994, Berger et al. 1995) because weak banking sector and bank runs are common factors of currency crises.

(e) Private monitoring: While the third pillar of Basel II recommends empowering the private monitoring for the bank stability, Barth et al. find no association between the private monitoring and crisis. This study also does not find any significant association between private monitoring and the banking crisis. However, the private monitoring is negatively associated with the currency crisis for all countries group and high income countries, whereas it has a positive relation with the currency crisis among low income countries. One of the common causes of the currency crisis is the asymmetric information, and greater private monitoring which prompts more transparent disclosures, auditing, and rating tends to prevent high income countries from speculative attacks. However, the effectiveness of the private monitoring in low income countries has been a continuous issue in policy debate. Some

argue that market discipline is forward-looking, flexible, adaptive, and nonbureaucratic, while official oversight is usually rule-based, bureaucratic, and slow to change (Herring 2004). Others claim that countries with poorly developed capital markets, accounting standards, and legal systems, benefit from official supervision since increased trust in the private monitoring in weak institutional environments results in exploitation of small savers and much less financial development (Barth et al. 2006). The result supports the latter argument. Greater private monitoring in weak institutional settings where a few people possess important information tends to result in condition of asymmetric information inducing the currency crisis. The standardized coefficient of the private monitoring is large in the regression on the currency crisis among low income countries, namely 1.1703. The result presents the poor financial environment for the private monitoring in low income countries and suggests that improving institutional environments for effective private monitoring can be the most important policy goal of currency crisis containment.

(f) Government-owned banks and official supervisory power: The government ownership of banks has a positive effect on the banking crisis in high income countries but does not have any association in other models. This is consistent with the argument that higher government ownership of bank increases the likelihood of the banking crisis (Carprio and Peria 2006). The size of standardized coefficient is also large in the regression on the banking crisis with high income countries. On the other hand, although greater supervisory power is one of the recommendations of the Basel II Capital Accord, I find that the official supervisory power has a limited negative relation with the banking crisis in high income

countries. In high income countries, the result is consistent with the contention that strong official supervisory power prevents the economy from market failures (Shleifer and Vishny 1998). Barth et al. (2004 and 2006) do not find any significant relation regarding the regulation.

5.2.2 Effects of regulatory combinations

Particular regulatory combinations might have different outcomes due to their countervailing or amplifying effects. The effects are analyzed by adding interaction terms in the models; however, the result should be interpreted with care since the interaction term has to be taken into account to estimate a partial effect of each regulatory variable and some regulatory variables are transformed (Table 5). In the study, I analyze two interaction terms consisting of one of the individual regulations tested in *Hypothesis 2*. To test *Hypothesis 3* on this effect of a regulatory combination of the restrictions on bank activities and the private monitoring, I add the interaction terms in the regression on the banking crisis for high income countries. The interaction term enters the regression with positive and significant coefficients, while two individual regulatory variables retain significantly negative relations with the crises. *Hypothesis 3* is supported because the result shows that if the extent of one regulation is beyond a certain level, enhancing the other regulations cause a countervailing effect which reduces banking stability. For the models with the currency crisis as a dependent variable, the interaction term shows the same results for all countries group and high income countries. However, the result also indicate that enhanced restrictions on bank activities with weak private monitoring can still have a negative effect on financial crisis in high income countries.

The effect is consistent with *Hypothesis 2* and, for the high income countries, with the contention that restricting bank activities is more important in weak institutional environments where the public sector lacks the ability to monitor banks. Regarding Barth et al.'s simulation (2008a), the result indicates that the effects of the regulatory combination in both Mexico and Korea depend on the relative degrees of both regulations.

Some argue that restricting bank entry with weak official supervision results in banking stability (Barth et al. 2004); therefore, I analyze this argument adding the interaction term (official supervisory power * entry requirement) in each regression. I find a strong positive interaction term in the regression on the currency crisis among for low income countries, while individual regulatory variables enter the model with strongly negative and significant coefficient. The result is consistent with the argument regarding the currency crisis in low income countries. However, the result also suggests that the effects of the regulatory combination in low income countries depend on the relative degrees of both regulations and that more entry requirements with stronger official supervisory power can have countervailing effect precipitating the currency crisis in the countries. On the other hand, the results of both interaction terms suggest that some regulatory mixes of one of the three pillars of the Accord and other type of regulation can retain countervailing effect on financial crisis in certain conditions, and that the effects of the combinations depend on the extent of other regulation.

5.3 Controlled Variables

Table 4 illustrates that the financial structure has a positive effect on the currency crisis for all countries group while it does not have any significant relation in other models. On the other hand, the bank-based structure has nothing to do with the banking crisis because the factors related to the current banking crisis are not bank-based structure; rather they are low interest rate, credit boom, asset bubble, and high leverage. While there is no relation between the M1 growth and the crises, M2 growth positively affects the banking crisis in all income level groups. This is consistent with the banking crisis since excessive liquidity is one possible cause of asset bubble associated with the current crisis. This implies that M2 is more accurate indicator of liquidity than M1. The standardized coefficients of M2 growth are also larger than any other significant variables in regression analyses, implying that the liquidity control is one of the most essential tools of avoiding banking crisis.

The growth of commercial bank deposit is negatively associated with the currency crisis in high income countries and positively related with the crisis in low income countries. The variable is an indicator of capital inflow, and this result shows the inflow of large capital with speculative attacks in high income countries. On the other hand, in low income countries with pegged or fixed exchange rate, capital inflow is mostly from foreign direct investment and reduces the exposure to currency risk, and the standardized coefficient of the variable is the largest among all significant variables in the regression on the currency crisis in the low income countries. The growth of GDP per capita variable is positively associated with the banking crisis among low income countries and has the largest standardized

coefficient in the regression, while the national savings growth variable does not have any significant relation in every model.

Chapter 6

Conclusions

This study examines the effects of financial innovation and regulation on the current global crisis with a global dataset of 132 countries, and the effects are explored for different types of financial crises for countries with different income levels. The result suggests that financial innovation in the form of securitization has a negative effect on banking stability, while regulations and supervision in the form of restrictions on bank activities and entry requirements has a positive effect on the stability. However, when these two regulations are implemented together with one of the Basel II Capital Accord, such as the restrictions on bank activities with the private monitoring or the entry requirements with official supervisory power, these regulatory combinations can have negative effect on the stability in particular regulatory settings. The result suggests that some regulatory combinations can have countervailing effects on financial stability, and the effects depend on the extent of both regulations.

The effects of other financial innovations or regulations depend on the type of crisis and the income level of a country. In terms of derivatives, it has a negative relation with the banking crisis in both high and low income countries. Venture capital is positively associated with the currency crisis for low income countries and has a strong positive relation with the banking crisis in high income countries. Regarding regulation and supervision, this study shows that diversification has strong negative relations with the currency crisis in both all

countries group and low income countries, while it has positive associations with the banking crisis in every income level group. Capital regulation has a strong negative association with the currency crisis in only low income countries. Private monitoring is associated with only currency crisis; however, the effects depend on the income level of a country. Private monitoring has a negative relation with the crisis in both all countries group and high income countries, while it has a positive association with the crisis in low income countries. Government ownership of banks has a positive relation with the banking crisis for only high income countries, while official supervisory power has a limited negative relation with the banking crisis for high income countries.

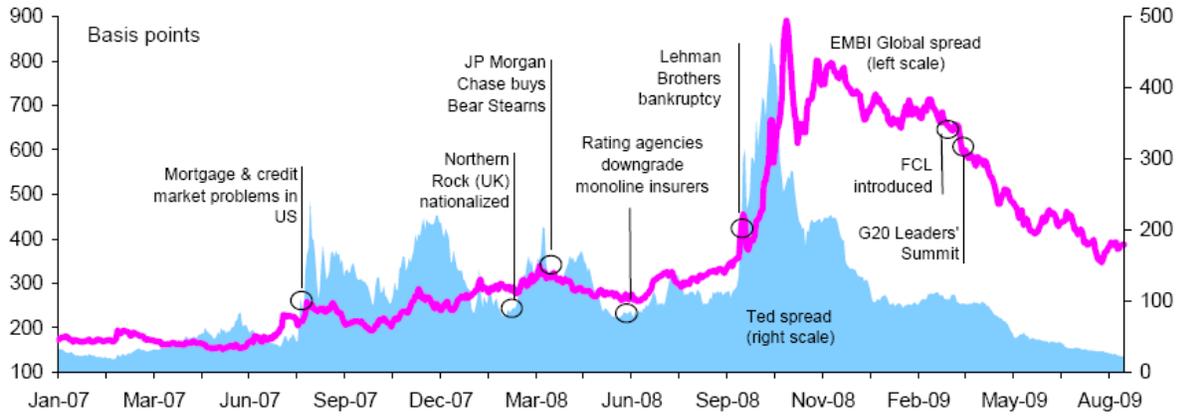
Yet, this study has some limitations which need further studies. First, even though I remedy the problem of reverse causation by using 2005-6 regulatory data and 2007-9 crisis data, there might be a longer time lag between the implementation of the regulation and detectable effects in the financial sector. Moreover, contrary to the past crises, the banking crisis and the currency crisis have no correlation in the current crisis, and only banking crisis is the central in the current crisis. However, recent 2010 European debt crisis shows that there might be a time lag between banking crises and debt crises or between banking crises and currency crises because weak banking system and bank run are one of the common causes of the currency crisis. Second, the study shows that the effects of financial innovation and regulations on financial stability tend to depend on the income level of a country. In the study, countries are classified into only three groups, such as all countries group, high income countries, and low income countries. However, if future study applies more detailed

income classes with other regression models such as the threshold model for sample splitting, it can shed light on appropriate innovations and effective regulations according to the stage of economic development. Third, while I apply only three proxies to measure the extent of financial innovation, more sophisticated other indicators can present more accurate relation between financial innovation and crisis. For instance, foreign exchange swap or currency swap can shed light on detailed association between currency crisis and financial innovation. Fourth, a number of studies argue that financial fragility has a close relation with the generosity of deposit insurance, financial openness, legal origin, or degree of corruption; however, I cannot examine the associations due to the lack of worldwide data. Fifth, the regulatory variables focus on banking industry and do not cover other important financial sectors such as insurance industry, stock market, bond and money market, OTC derivatives markets, and foreign exchange market. Even though the banking industry is the most prominent of the financial sector and plays a key role in all financial services, current failures of institutions in other sectors such as AIG and Fannie Mae show that it is well worth examining regulations and supervisions of other financial sectors. Finally, the effectiveness of Basel II Accord is currently under debate, and this study also raises cautionary flag on its influence by exploring interaction terms. Most countries implemented the Accord around 2008; therefore, further study on the effectiveness is required.

Meanwhile, based on their simulations of banking crises, Barth et al. (2008a) argue that Mexico's reform is more optimistic than Korea's since Mexico enhanced the private monitoring and reduced the overall restrictions, while Korea reduced the private monitoring

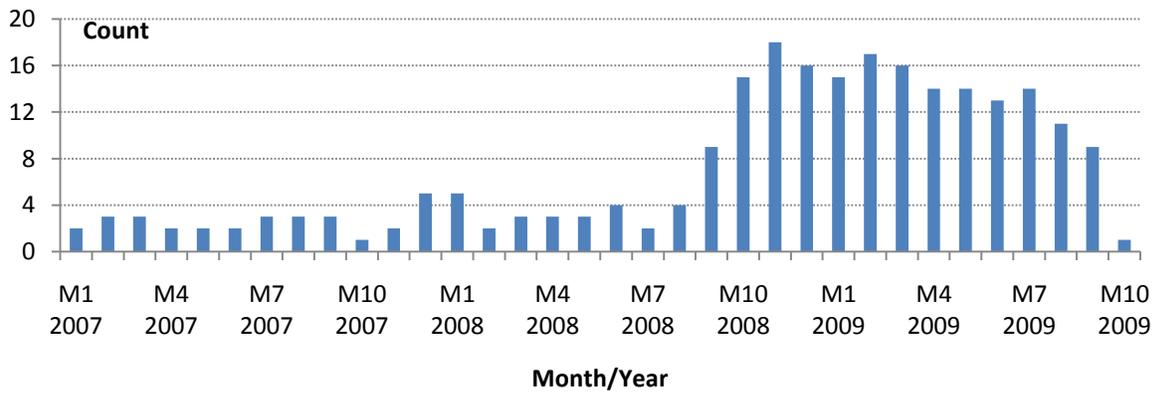
and imposed greater restrictions. Interestingly, real count outcomes of the current crisis in this study are different since Korea is much below the average, while Mexico is above the average in terms of the banking crisis. This result is generally consistent with defined relations of the restrictions on bank activities in this study and also might show the significance of interactions among individual regulations. Therefore, regulators require the judicious implementation of financial regulations to enhance the financial stability.

Figure 1: History of Financial Crises in Advanced and Emerging Economies (2007 – 2009)



Source: IMF (2009c)

Figure 2: Trend of Banking Crisis during 2007 – 2009: Extensive Liquidity Support



Source: IMF (2009a)

Table 1: Description and source of variables

Variable	Unit	Period	Data source
Financial crisis			
Currency crisis	Count	2007 - 2009	IMF (2009a)
Banking crisis	Count	2007 - 2009	IMF (2009a, 2009b, 2009c), Pomerleano (2009), CGAP (2009)
Debt crisis	Count	2007 - 2009	World Bank (2008, 2009b)
Financial innovation			
Securitization	Percent	2006/2007	Europe Securitisation Forum (2008), International Financial Services London (2009), Deutsche Bank (2007), IFC(2008)
Derivatives	Percent	2007	BIS (2007)
Venture capital	Percent	2007	PWC (2008), LAVCA (2008), EVCA (2008), EMPEA (2009), IVC (2008), PRNewswire (2008)
Regulation			
Restrictions on bank activities	Count	2006	Barth et al. (2008b)
Entry requirements	Count	2006	Barth et al. (2008b)
Diversification	Count	2006	Barth et al. (2008b)
Capital regulation	Count	2006	Barth et al. (2008b)
Private monitoring	Count	2006	Barth et al. (2008b)
Government-owned banks	Percent	2006	Barth et al. (2008b)
Official supervisory power	Count	2006	Barth et al. (2008b)
Financial structure			
Activity	Ratio	2003-2007	Beck et al. (2009)
Size	Ratio	2003-2007	Beck et al. (2009)
Efficiency	Ratio	2003-2007	Beck et al. (2009)
Aggregated structure	Index	2003-2007	Own calculation
Macroeconomic variable			
M1 growth	$\Delta\%$	2005-2006	IMF (2009a)
M2 growth	$\Delta\%$	2005-2006	IMF (2009a)
Commercial bank deposits	$\Delta\%$	2005-2006	IMF (2009a)
GDP per capita	$\Delta\%$	2005-2006	IMF (2009a)
National saving growth	$\Delta\%$	2005-2006	IMF (2009a)

Table 2: Summary statistics of each variable (N = 132 countries)

Description	Mean	Std. Dev.	Min	Max
Financial crisis				
Currency crisis	1.21	0.64	0.00	3.00
Banking crisis	2.84	4.05	0.00	17.00
Debt crisis	0.05	0.23	0.00	1.00
Financial innovation				
Securitization	0.01	0.03	0.00	0.27
Derivatives	0.01	0.05	0.00	0.41
Venture Capital	0.00	0.01	0.00	0.04
Regulation				
Restrictions on bank activities	10.77	2.24	4.00	16.00
Entry requirements	7.57	0.97	3.00	8.00
Diversification	1.39	0.58	0.00	2.00
Capital regulation	5.08	1.67	1.00	8.00
Private monitoring	5.90	1.25	2.00	9.00
Government-owned banks	0.16	0.22	0.00	0.94
Official supervisory power	10.93	2.05	5.00	14.00
Aggregated structure				
Activity	-2.66	2.31	-11.64	1.87
Size	-1.18	1.94	-7.27	1.82
Efficiency	-7.10	2.73	-17.64	-2.05
Macroeconomic variable				
M1 growth	0.19	0.18	-0.07	1.50
M2 growth	0.19	0.18	-0.51	0.89
Commercial bank deposits	0.15	0.14	-0.02	0.72
GDP per capita	0.12	0.07	0.01	0.33
National savings growth	-0.55	11.43	-105.94	51.50

Table 3: Correlations among independent variables (N = 132 countries)

Variables	Secur- itization	Deri- vatives	Venture capital	Restric- tions on bank active- ties [†]	Entry require- ments	Diver- sifi- cation	Capital regul- ration	Private moni- toring [†]	Gov.- owned banks [†]	Official super- visory power [†]	Agg. Struc- ture	M1 growth	M2 growth	Comm. bank deposit [†]	GDP per capita [†]	Ntnl. savings growth
Securitization	1.00															
Derivatives	0.28*	1.00														
Venture capital	0.22*	0.52*	1.00													
Restrictions on bank activities [†]	-0.19*	-0.29*	-0.27*	1.00												
Entry requirements	-0.03	0.03	-0.11	-0.11	1.00											
Diversification	-0.05	0.09	0.12	-0.19*	0.07	1.00										
Capital regulation	0.03	0.11	0.12	0.00	0.00	-0.12	1.00									
Private monitoring [†]	0.25*	0.25*	0.35*	-0.15	-0.09	0.07	0.10	1.00								
Government- owned banks [†]	-0.14	-0.18*	-0.21*	0.18*	-0.17*	-0.07	-0.09	-0.11	1.00							
Official super- visory power [†]	0.03	-0.04	0.00	0.24*	0.10	-0.05	-0.05	-0.11	-0.06	1.00						
Aggregated structure	0.31*	0.28*	0.39*	-0.23*	-0.07	-0.02	0.23*	0.36*	-0.20*	0.04	1.00					
M1 growth	-0.17	-0.13	-0.13	0.18*	-0.04	-0.07	-0.24*	-0.21*	0.13	0.03	-0.23*	1.00				
M2 growth	-0.05	-0.07	-0.07	-0.03	0.12	-0.08	0.04	-0.14	-0.05	-0.14	-0.04	0.04	1.00			
Commercial bank deposits [†]	0.01	0.02	0.01	0.00	-0.02	0.01	0.14	0.11	0.10	0.08	0.05	-0.01	-0.13	1.00		
GDP per capita [†]	-0.21*	-0.19*	-0.15	0.22*	-0.04	-0.26*	-0.14	-0.27*	0.22*	-0.02	-0.12	0.57*	0.41*	-0.03	1.00	
National savings growth	0.02	0.01	0.03	-0.13	-0.03	0.06	-0.08	0.02	0.13	-0.08	0.15	-0.12	0.07	-0.12	-0.09	1.00

Notes: * p<0.05

[†] Transformed variables

Table 4: Effects of innovations and regulations on crises

VARIABLES	Currency crisis			Banking crisis		
	(C1)	(C2)	(C3)	(B1)	(B2)	(B3)
Securitization	-2.63** (0.04)	-1.61 (0.12)	-18.37 (0.77)	7.33*** (0.00)	9.43*** (0.00)	685.29*** (0.00)
Derivatives	-0.11 (0.86)	0.31 (0.55)	67.89 (0.71)	-2.68 (0.23)	-4.25** (0.04)	-2143.22*** (0.00)
Venture capital	-8.40 (0.24)	-7.68 (0.15)	59.06* (0.08)	32.83 (0.14)	58.53*** (0.01)	-246.98 (0.15)
Restrictions on bank activities [†]	-0.00 (0.17)	-0.00 (0.19)	-0.00* (0.08)	-0.01*** (0.00)	-0.02*** (0.00)	-0.01** (0.01)
Entry requirements	-0.05 (0.36)	-0.08 (0.19)	-0.13 (0.13)	-0.26** (0.01)	-0.38** (0.03)	-0.35* (0.07)
Diversification	-0.21*** (0.00)	-0.13 (0.13)	-0.54*** (0.00)	0.40* (0.07)	0.77** (0.02)	0.79** (0.03)
Capital regulation	-0.03 (0.29)	-0.03 (0.28)	-0.15*** (0.00)	-0.05 (0.52)	-0.09 (0.45)	0.09 (0.56)
Private monitoring [†]	-0.01* (0.08)	-0.02*** (0.00)	0.01** (0.03)	-0.01 (0.15)	-0.02 (0.17)	-0.00 (0.96)
Government-owned banks [†]	0.06 (0.73)	-0.07 (0.71)	-0.07 (0.80)	0.41 (0.41)	1.69** (0.01)	-0.96 (0.15)
Official supervisory power [†]	-0.00 (0.79)	-0.00 (0.64)	0.00 (0.70)	-0.00 (0.12)	-0.01* (0.06)	-0.00 (0.53)
Aggregated structure	0.10** (0.04)	-0.00 (0.99)	0.09 (0.14)	0.04 (0.80)	0.21 (0.40)	-0.14 (0.55)
M1 growth	-0.30 (0.36)	-0.07 (0.83)	-0.87 (0.27)	0.62 (0.45)	1.57 (0.29)	-1.10 (0.47)
M2 growth	0.00 (1.00)	0.44 (0.32)	-0.06 (0.90)	1.94*** (0.00)	2.08** (0.02)	1.78*** (0.00)
Commercial bank deposits [†]	-0.00 (0.78)	-0.00** (0.03)	0.01*** (0.01)	0.00 (0.87)	0.00 (0.89)	0.01 (0.36)
GDP per capita [†]	-0.70 (0.29)	-1.04 (0.17)	-1.86 (0.17)	-0.34 (0.86)	-2.30 (0.51)	5.36** (0.02)
National savings growth	-0.00 (0.29)	-0.00 (0.11)	0.00 (0.77)	0.01 (0.56)	-0.01 (0.79)	0.14 (0.26)
Constant	1.73*** (0.00)	2.41*** (0.00)	3.27*** (0.00)	4.17*** (0.00)	5.48*** (0.00)	2.08 (0.48)
Observations	132	76	56	132	76	56
Pseudo R-squared	0.02	0.04	0.07	0.06	0.08	0.12
Log pseudolikelihood	-155.2	-88.92	-60.79	-265.0	-155.7	-99.67

Notes: P-values in parentheses under the coefficients are based on robust standard errors.

*** p<0.01, ** p<0.05, * p<0.1.

[†] Transformed variables.

All countries: (C1), (B1); High income countries: (C2), (B2); Low income countries: (C3), (B3).

Table 5: Effects of interactions of regulations on crises

VARIABLES	Currency crisis			Banking crisis
	(C1-1)	(C2-1)	(C3-1)	(B2-1)
Securitization	-1.87** (0.03)	-1.50* (0.07)	-32.47 (0.56)	9.90*** (0.00)
Derivatives	0.40 (0.48)	0.64 (0.24)	130.86 (0.38)	-3.39* (0.09)
Venture capital	-3.41 (0.57)	-6.48 (0.19)	28.48 (0.42)	58.68*** (0.01)
Restrictions on bank activities [†]	-0.01*** (0.00)	-0.01*** (0.00)	-0.00** (0.04)	-0.04*** (0.01)
Entry requirements	-0.09** (0.04)	-0.08 (0.10)	-1.44*** (0.00)	-0.38** (0.03)
Diversification	-0.27*** (0.00)	-0.20** (0.03)	-0.49*** (0.00)	0.71** (0.04)
Capital regulation	-0.03 (0.21)	-0.04 (0.24)	-0.15*** (0.00)	-0.10 (0.40)
Private monitoring [†]	-0.04*** (0.00)	-0.04*** (0.00)	0.01*** (0.01)	-0.07** (0.03)
Government-owned banks [†]	-0.02 (0.92)	-0.14 (0.47)	-0.16 (0.59)	1.47** (0.03)
Official supervisory power [†]	-0.00 (0.61)	-0.00 (0.62)	-0.07*** (0.00)	-0.01* (0.06)
Aggregated structure	0.07* (0.10)	0.00 (0.97)	0.10 (0.11)	0.20 (0.42)
M1 growth	-0.37 (0.28)	-0.08 (0.82)	-0.76 (0.33)	1.78 (0.21)
M2 growth	-0.07 (0.86)	0.40 (0.39)	-0.08 (0.86)	1.91** (0.03)
Commercial bank deposits [†]	-0.00 (0.88)	-0.00** (0.03)	0.01** (0.02)	0.00 (0.80)
GDP per capita [†]	-0.60 (0.30)	-0.94 (0.21)	-2.02 (0.13)	-1.86 (0.58)
National savings growth	-0.01 (0.11)	-0.00** (0.03)	0.00 (0.90)	-0.01 (0.77)
Restrictions on bank activities [†] * Private monitoring [†]	0.00*** (0.00)	0.00** (0.02)		0.00* (0.07)
Entry requirements * Official supervisory power [†]			0.01*** (0.00)	
Constant	3.37*** (0.00)	3.31*** (0.00)	13.36*** (0.00)	7.54*** (0.00)
Observations	132	76	56	76
Pseudo R-squared	0.03	0.05	0.08	0.08
Log pseudolikelihood	-153.3	-88.34	-60.16	-154.6

Notes: P-values in parentheses under the coefficients are based on robust standard errors.

*** p<0.01, ** p<0.05, * p<0.1.

[†] Transformed variables.

All countries: (C1-1); High income countries: (C2-1), (B2-1); Low income countries: (C3-1).

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