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Three Essays on Twin Crises

A Dissertation

Presented to the Faculty of the Graduate School

of

Yale University

in Candidacy for the Degree of

Doctor of Philosophy

by

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Dedication

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Abstract

Three Essays on Twin Crises

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2001

A “twin crisis” is defined as the joint occurrence of a domestic banking crisis and a currency crisis. Twin crises have been evident in both emerging and industrialized countries over the last two decades. Until recently, however, the analysis of currency crises has been done without considering the financial system. In order to fill this gap, we aim to construct new models and suggest directions for further research.

After reviewing the recent literature on the twin crises in Chapter 2, Chapter 3 presents a model that shows how an increase in international borrowing changes the probability of twin crises under the fixed exchange rate regime. Our model is a variation of the Diamond and Dybvig (1983) model of a bank run by incorporating international capital flows and slightly noisy signals into the original model. We find that an increase in capital inflows decreases the likelihood of runs, when the long-term return on investment is higher than the short-term return and foreign interest rates. This result looks consistent with the previous twin crisis episodes.

While the model in Chapter 3 takes capital inflows as exogenously given, Chapter 4 models the connection between bank runs and currency crises in a simultaneous game between small depositors and a large trader. Economic fundamentals affect the prospects of

the bank and those of the domestic currency in the same direction through foreign liabilities in the banking sector. This pattern becomes more important as the proportion of deposits denominated in dollars increases. In addition, the presence of a large trader makes small depositors more likely to run on the bank. Such an influence becomes larger, when the large trader has more precise information than a typical small depositor.

Instead of banking crises, Chapter 5 focuses on insurance crises that are potentially important under the situation where cross-industry M&As are increasing. This chapter reviews recent insurance crisis episodes and explains with clear statements and intuitive examples that show linkages between banks and insurers and/or insurers' assimilation of banking activities can make the financial system vulnerable to economic shocks.

1 Introduction

A “twin crisis” can be defined as the joint occurrence of a domestic banking crisis and a currency crisis. Twin crises have been seen in not only emerging countries but also industrialized countries in the last two decades. For example, most East Asian countries (1997) and several Latin American countries (Chile in 1982, Argentina in 1982 and 1995, Venezuela in 1994, and Mexico during 1994-5) have experienced both banking and currency crises at the same time. Three North European countries (Sweden, Norway, and Finland) also experienced such crises in the beginning of 1990s. These episodes have raised interests in investigating how banking crises and currency crises may be connected. Until very recently, however, the analysis of currency crises has been done without considering the financial system. In order to fill this gap, we aim at constructing new models that characterize these crises and suggest directions for further research.

After reviewing the recent literature on twin crises in Chapter 2, Chapter 3 presents a model that shows how an increase in international borrowing changes the probability of twin crises under a fixed exchange rate regime. We reinterpret the open economy bank run model of Chang and Velasco (1998a and b) based on the Goldstein and Pauzner’s (1999) framework. Chang and Velasco extend Diamond and Dybvig (1983) model into an open economy framework, in which agents’ budget constraints include international borrowing. Their model uses multiple equilibria, however, which cause difficulty in explaining how a particular equilibrium is selected and in deriving meaningful implications. Following Goldstein and Pauzner (1999), by introducing slightly noisy signals into the model, we provide a unique equilibrium in which economic fundamentals determine whether a twin crisis will occur. This enables us to compute the probability of a bank run or a currency crisis and relate it to the parameters of international borrowing.

We find that whether capital inflows increase the probability of runs depends on the return on domestic investment and foreign interest rates. An increase in capital inflows decreases the likelihood of runs, when the return on long-term investment

is higher than the short-term return and foreign interest rates. Instead, if the return on long-term investment is lower than the short-term return and foreign interest rates, capital inflows may increase the likelihood of runs. The recent East Asian financial crisis showed that the return on long-term investment decreased, while foreign interest rates were rising before the crisis. These facts suggest that the increase in capital inflows may have raised the likelihood of runs.

Despite our efforts to modify the model, capital inflows in this model are still exogenously given. Since the model does not include currency market, we cannot illustrate the speculative attacks on the currency, which is another important phenomenon in the twin crisis episodes. In order to improve this point, Chapter 4 models the connection between domestic bank runs and currency crises in a simultaneous game between small depositors and a large trader. The model presented in Chapter 4 modifies that of Goldstein (2000) by varying the relative precision of information between two types of the agents and by incorporating one large trader in the currency market. The technique used here follows Corsetti, Dasgupta, Morris, and Shin (2000), which build a model of currency crises where a single large trader and a continuum of small traders independently decide whether to attack a currency based on their private information about economic fundamentals.

In the model presented in Chapter 4 economic fundamentals affect the prospects of the bank and those of the domestic currency in the same direction through foreign liabilities in the domestic banking sector. This pattern becomes more important as the proportion of deposits denominated in dollars increases. Another finding is that the presence of a large trader makes small depositors more likely to withdraw their money from the bank. That is, compared to the case in which there is no large trader, small depositors withdraw their money from the bank when economic fundamentals are stronger. Nonetheless, when a typical small depositor has more precise information than the large trader, the large trader's influence on the small depositor is moderate. But when the large trader has more precise information than a typical small depositor, his influence becomes much larger.

All of the twin crisis models discussed so far incorporate elements of bank run

models. This seems to be reasonable in the sense that most previous literature regards a twin crisis as a joint occurrence of a banking crisis and a currency crisis, and that banks are the biggest financial institutions in many countries. Instead of banking crises examined in the previous literature, however, Chapter 5 focuses on recent insurance crises and their linkages to macroeconomic circumstances and the banking sector. This line of studies can potentially be very important in the future, because the increasing cross-border and cross-industry M&As and cooperation among financial institutions including insurance companies create new challenges and enhance the need for upgrading supervision and regulation. In fact, such a change of insurance industry has been regarded by many to carry potential sources of vulnerability that could jeopardize systemic stability.

Specifically, Chapter 5 reviews recent crisis episodes and explains with clear statements and intuitive examples that show the links between banks and insurers and/or insurers' assimilation of banking activities can make financial system vulnerable to economic shocks. We find that most life insurance crises occurred after financial deregulation and economic expansion, followed by large output and price fluctuations. Financial deregulation caused insurance companies to employ more bank-type products to compete with other financial institutions. Economic expansion induced insurers to invest in risky assets such as mortgages and junk bonds. The resulting maturity mismatch between assets and liabilities and illiquidity of assets made insurers vulnerable to economic shocks such as large output and price fluctuations. In addition, cross-share holdings between banks and insurance companies and close business relationships between the two industries increased the risk of contagion. In the past crisis episodes, most ailing insurance companies ceased their operation and transferred their policies to relatively sound insurers. Some governments relied on public funds to cover the losses and made consumers share the burden. The use of public funds may have disturbing effects on money demand, and subsequently consumption and investment.

2 Perspectives on the Recent Twin Crisis Literature

2.1 Introduction

This chapter aims at surveying recent work on twin crises. A twin crisis can be defined as the simultaneous occurrence of a bank run and a currency crisis. Such a joint occurrence of two crises has been seen in not only emerging countries but also industrialized countries in the last two decades. For example, East Asia (South Korea, Thailand, Indonesia, Malaysia, and the Philippines in 1997) and several Latin American countries (Chile in 1982, Argentina in 1982 and 1995, Venezuela in 1994, and Mexico during 1994-5) have all experienced both banking and currency crises. The three Baltic countries (Finland, Norway, and Sweden) also experienced the same things in the beginning of 1990's. These twin crisis episodes raised interests in investigating how banking crises and currency crises may be connected. Until very recently, however, the analysis of currency crises has been done without considering the banking system.

As discussed among researchers and policy makers, developments of currency crisis models involve long-standing debate between two competing interpretations: one viewing crises as caused by fundamental weaknesses and policy inconsistencies, the other as due to self-fulfilling expectations and panic psychology.¹ This classification between fundamentals and panics can also be applied to twin crisis models. The leading models of twin crises rely on an analogy of "bank runs." These models

¹Before 1990, currency crises were thought to be predictable as described in the first-generation models such as Krugman (1979). In the first-generation models, fiscal deficits financed by domestic credit creation invite speculative attacks through drain in foreign reserves. The empirical studies of 1970s and 1980s support the prediction of the first-generation models.

However, after the ERM crisis, speculative attacks on the currency challenged the view that government's inability to discipline fiscal and monetary policies causes currency crises [see Obstfeld (1996) and Jean (1997) for example]. The crises were not preceded by expansionary policies. Instead, expectations that the currency peg might be abandoned were considered to have become self-fulfilling. Such shifts in expectations are thought to be arisen from governments' costs to maintain the peg under fragile banking systems, highly indebted firms or unemployment.

For more comprehensive discussion on currency crisis models, see Flood and Marion (1999) and Corsetti (1998).

describe panic-based runs but entail multiple equilibria. Instead, the recent models integrate both views in which self-fulfilling expectations are based on economic fundamentals.

From the empirical point of view, the expectation-driven crises raised questions as to whether such episodes are unpredictable events or they can be predicted through systemic early warning signals. Contrary to the empirical studies based on the first-generation model of currency crises, today's empirical works focus on a broad set of economic indicators. In particular, more recent empirical tests include variables related to contagion, as well as macroeconomic and financial indicators which are applied only to one country. Such a development can be enhanced by the integration of capital markets. Although this chapter does not intend to explore theories of contagion fully, we will discuss this line of papers in the last section.

In order to focus on the development of twin crisis models, we mostly exclude the models that do not describe banking crises explicitly. For example, Corsetti, Pesenti and Roubini (1999a,b, and c) show how a hidden cost of nonperforming loans can be translated into the possibility of a government bailout, which implies a sizable contingent fiscal imbalance. Their models are a combination of the first- and the second-generation models of currency crisis literature, but do not include panics in the banking sector. Other examples are the models constructed by Aghion, Bacchetta, and Banerjee (1999 and 2000). They succeed in relating the currency crisis to the degree of financial development. Regarding firms' financial constraints as a measure of the degree of financial development, they show that the medium degree of financial constraints as seen in emerging countries makes the countries most vulnerable to the currency attacks than the low and high degrees do. Since they describe the financial distress by the firms' financial condition, their models also do not capture the financial panics explicitly.

The rest of the chapter is organized as follows. Section 2 describes the models that extend bank run models into an open economy framework. These models provide multiple equilibria that cannot explain how an particular equilibrium is

selected within the model. In order to fill this gap, the models based on global games framework are introduced in Section 3. While a lack of common knowledge about economic fundamentals leads to coordination among agents in the global games framework, another explanation like information cascades and observational learning do not require such an assumption. Instead, information cascades and observational learning require actual observation of other agents' behavior. In contrast to the previous sections, which describe the models to explain the crisis in one country, Section 4 focuses on contagious aspects of the crises. Although both the theoretical and the empirical works of contagion are still controversial in their methodology, provisional conclusion is provided in Section 5.

2.2 Leading Models of Twin Crises

Leading models of twin crises rely on an analogy of "bank runs." The key argument is that investors' withdrawal of funds from a country may lead to an early liquidation of domestic investment. Such liquidation costs the country by reducing its external solvency, even if all of its investment projects would be economically viable. Only investors' fear for the country's insolvency can cause a crisis. The fundamentals that are relevant to this theory are only the mismatches in the maturity and the currency denomination of the assets and liabilities.²

Goldfajn and Valdes (1997) extend a Diamond and Dybvig (1983) model by endogenizing the probability of runs.³ Assuming all deposits are denominated in

²Analyzing the period immediately after the Mexican peso crisis in December 1994, Sachs, Tornell and Velasco (1996) find that the maturity mismatch between the country's assets and liabilities was an important determinant of the crises, though their data is are not random both in time and sample countries [see Eichengreen, Rose, and Wyplosz (1996)]. Radelet and Sachs (1998) also argue that such a maturity mismatch was seen in East Asian crisis.

³Diamond and Dybvig (1983) provide the first coherent model to explain the fragility of the bank. In their model the business of the bank is characterized as maturity-transformation. By taking advantage of economies of scale, banks offer demand deposits' contracts to many investors and enable these investors to be engaged in profitable long-term investment. By responding to the idiosyncratic liquidity needs of their investors', banks can share risks and improve welfare, but also create the possibility of self-fulfilling bank runs. The Diamond and Dybvig model has two equilibria. In the first equilibrium, only investors who face liquidity needs withdraw their deposits at an early stage of the game and risk sharing is achieved. In the second equilibrium, however, all investors, including those with no liquidity needs, withdraw their deposits at an early

dollars, they reinterpret depositors as international investors, who invest short-term international assets into domestic long-term technology. They show that financial intermediation may generate larger capital inflows, but a higher probability of a run at the same time. There is one caveat, however, that their model neglects the possibility of panic-based runs.

Chang and Velasco (1998a, b and c) also extend the Diamond and Dybvig model into an open economy bank run model, in which depositors' budget constraints include international borrowing. By doing so, they succeed in introducing the analyses of exchange rate regime and the Central Bank policy [see Chang and Velasco (1998a)]. They show how domestic bank runs lead to international balance of payments crises under the fixed exchange rate regime where the Central Bank acts as a lender of last resort. The Central Bank faces a policy dilemma under the fixed rate regime. If it prevents runs, it has to allow its currency to be devalued. If it keeps the value of its currency, it cannot eliminate a run equilibrium. Thus under the fixed rate regime the lender of last resort only switches a bank-run equilibrium into a balance of payments crisis equilibrium.

In spite of the insightful predictions of their model, one important feature of the model, that is, multiplicity of equilibria, raises a number of difficulties. In particular, as Goldstein and Pauzner (1999) suggest, the models with multiple equilibria contain three important difficulties. First, financial crises do not seem to be solely driven by a panic psychology. Several empirical studies have found that a country's growth rate and domestic and foreign interest rates are also important determinants of financial crises.⁴ It has also been argued that the dangers of bank runs are heightened by an increase of international capital inflows.⁵ In a stage, creating a "bank run." This equilibrium cannot achieve risk sharing and is Pareto inferior to the first equilibrium.

For a survey of the Diamond and Dybvig models, see Freixas and Rochet (1997) and Allen and Gale (2000).

⁴Eichengreen and Rose (1998) find that an increase in foreign interest rates, in particular industrial countries' interest rates, and low GDP growth rates are important sources of banking crises. Demirguc-Kunt and Detragiache (1997) show that the low GDP growth rates and high domestic interest rates have significant effects in determining the occurrence of banking crises.

⁵For example, Kaminsky and Reinhart (1999) claim that banking crises are preceded by lending booms that have been fueled by capital inflows.

dition, there are a lot of empirical studies that focus on identifying macroeconomic variables as early warning signals of the crises, in order to predict the likelihood of crises.⁶ Second, their models cannot explain how a particular equilibrium is selected or under what conditions a bank run is more likely to happen. Third, since the probability of runs is unknown, the models can hardly examine the connection between runs and other economic parameters. Consequently, they cannot derive meaningful policy implications.

Both the Chang and Velasco and the Goldfajn and Valdes models show that the withdrawals of the deposits lead to the collapse of the peg, if the increased liquidity resulting from a government bailout is inconsistent with the currency peg. While their models describe one channel of the origin of the crises, Miller (1998b) argues that there can be the opposite channel in which a currency crisis may lead to a banking crisis as well.

From this point of view, Miller (1996 and 1999) presents a model of currency crises that are financed by credit from healthy banks. In her first version of the model the Miller (1996) assumes that speculators use deposit money to run on the currency. She claims that the US experience in 1893 can be applied to this case. More broadly, the Miller (1999) modifies her previous model and assumes that the banks will increase their loans.⁷ When bank loans increase in response to interest rate hikes, the growth in bank loans provides an additional increase in the money multiplier. This makes the attack more profitable than in the case in which bank loans are insensitive to interest rates, since a speculative attack is profitable, when the post-attack money supply is larger than the post-attack demand for money. Hence, the more bank loans increase with interest rates, the sooner the fixed exchange rate regime will be collapsed, and consequently, the larger the size of the devaluation will be. This result is more important in the emerging countries, in the sense that banks seem to manage poorly their balance sheets. Such healthy

⁶For example, see Goldfajn and Valdes (1998), and Kaminsky and Reinhart (1999).

⁷This assumption follows Krugman's (1979) first-generation model. There a continual expansion of domestic credit causes a gradual decrease of foreign reserves and a collapse of currency peg when reserves fall to a predetermined minimum level.

but mismanaged banks cannot hedge interest rate risks fully. Thus, if banks suffer from maturity mismatches, an increase in interest rates squeezes profit margins and urges banks to extend loans further.

Despite her contribution to a new possibility of interaction between banking and currency crises, her models entail multiple equilibria. Thus, as mentioned above, these models still face criticism that they cannot explain how one of the equilibria was selected. In the next section, we will introduce models that incorporate both self-fulfilling expectation and a unique outcome. The new models give us more useful implication and enable us to examine the relationship between the probability of the crises and other economic variables.

2.3 Models with Unique Equilibrium

2.3.1 Private and Asymmetric Information

The models to be introduced in this section incorporate Carlsson and van Damme (1993) technique in order to endogenize the probability of the crises and derive a unique outcome in a framework with self-fulfilling beliefs.⁸ The games based on the Carlsson and van Damme technique are so called global games. The key assumption of the global games is that agents do not have common knowledge of economic fundamentals. But they share knowledge about the distribution of both economic fundamentals and noises in the signals. This assumption enables agents to construct their beliefs about the economic fundamentals and other agents' signals and their behavior, after observing the noisy signals regarding the economic fundamentals. Such coordination leads to a unique equilibrium which corresponds to each realization of the economic fundamentals.

The important property of introducing this framework is that the possibility of self-fulfilling expectations arises only if the economic fundamentals are weak enough to begin with. In the bank run models, the more sound the bank is, the more

⁸Carlsson and van Damme (1993) pioneer the global game. The feature of the global game is that the type space of the game is generated by adding a small amount of signals of the players concerning some payoff relevant state. Morris and Shin (2000a) discuss general results and applications.

depositors will eliminate the possibility of bank runs. Likewise, in the currency attack models, the stronger the economic fundamentals, the more traders will rule out the possibility of devaluation. Thus, weak fundamentals are considered to be a necessary condition for self-fulfilling expectation. It is also important to note that each agent's conjecture is based only on his/her own signals. That is, the coordination does not include communication among agents.

The existence of a unique equilibrium in this framework is proved by Morris and Shin (1998) and Goldstein and Pauzner (1999). In the Morris and Shin model, the Carlsson and van Damme technique provides a unique equilibrium in a model of self-fulfilling currency attacks, while in the Goldstein and Pauzner models, their technique provides a unique equilibrium in a model of bank runs. The unique equilibrium enables them to compute the probability of a currency crisis or a bank run and relate it to other economic variables. Morris and Shin show that the increase in transaction costs reduces the probability of currency crises, while Goldstein and Pauzner find that banks become more vulnerable to runs, when they promise higher interest payments to agents demanding early withdrawal. In the next subsection, we will introduce twin crisis models that incorporate the global games framework.

Besides global games framework, other imperfect information models can derive a unique equilibrium that is based on the economic fundamentals. Bhattacharya and Jacklin (1988) construct a model in which agents obtain interim private information about bank loan/asset payoffs.⁹ Like global games framework, a random long-term return on investment has a common prior. After observing their private signals, agents update the probability distribution of a random return. It is important to note that the difference between the Bhattacharya and Jacklin and global games lies in the fact that the former assumes that only a fraction of agents can observe signals which are identical, while the latter assumes that all agents observe signals which are not the same among agents. In the Bhattacharya and Jacklin model uninformed patient agents keep their deposits in the bank, while

⁹Shi (2000) extends the Jacklin and Bhattacharya model to a twin crisis model.

informed patient agents withdraw their money early, if the posterior of the bad return is above a certain threshold value. As a result, the higher the long-term return, the lower the likelihood of bank runs.

Similarly, Chari and Jagannathan (1988) and Chen (1999) analyze information induced bank runs where the early withdrawals cause both information and payoff externality. Like Bhattacharya and Jacklin (1988), they assume that some depositors are better informed than others about the value of bank assets. The difference is that now uninformed late depositors infer information from the early withdrawals. Some informed depositors withdraw their money early, because they receive a signal that future returns are likely to be low. Observing this, uninformed depositors have an incentive to follow them. Knowing that the uninformed depositors may respond to other information, the informed agents also have an incentive to run on the bank. The difference between the Chari and Jagannathan and the Chen is that the former describes a run caused by uninformed depositors who misinterpret liquidity withdrawal shocks as withdrawals caused by pessimistic information about bank assets, while the latter explains a run resulted from depositors' response to early noisy signal due to the payoff externality imposed by the sequential service constraint of the deposit contract.

2.3.2 Twin Crisis Models Based on Global Games

This subsection picks up three twin crisis models that are based on global games framework. In the first model that is presented in Chapter 3, we simply apply global games framework to an open economy bank run model. The model takes capital inflows exogenously given, following Chang and Velasco (1998a and b). Instead, the other two models describe both the currency market and the banking sector. The second model [Goldstein (2000)] uses symmetric agents, while the third model that is presented in Chapter 4 varies agents' size and information.

The model in Chapter 3 reinterprets the model of Chang and Velasco (1998b) based on that of the Goldstein and Pauzner (1999). By introducing slightly noisy signals into the model, following the Goldstein and Pauzner, the model provides

a unique equilibrium in which economic fundamentals determine whether a twin crisis will occur. Such an analysis enables us to compute the probability of the crisis and relate it to capital inflows. The finding of the model is that capital inflows may increase the probability of crises, when the return on domestic investment is lower than foreign interest rates. This result is consistent with three previous empirical findings. First, the dangers of bank runs are heightened by the increase of international capital inflows. Second, the mismatches in the maturity and the currency denomination of the assets and liabilities are associated with the occurrence of currency crises. Third, lower growth rates and higher domestic and foreign interest rates are strongly associated with the onset of banking crises.

Despite our efforts to modify the model, capital inflows in this model are still exogenously given. Since the model does not include the currency market, we cannot illustrate the speculative attacks on the currency, which are important phenomena in the twin crisis episodes. Also, the model can be applied to the Miller's (1998a) criticism for exclusion of the possibility that currency attacks give rise to banking crises.

Goldstein (2000) incorporates both depositors' and currency traders' problems. The economy has two markets, a domestic banking sector and a currency market. In the banking sector there exist a continuum of symmetric depositors, while in the currency market a continuum of symmetric traders. Several twin crisis models that extend bank run models assume the passive monetary authority that reacts to withdrawals of funds from the country. Instead, the Goldstein (2000) considers the case in which the monetary authority decides their optimal course of action by comparing the costs and benefits of defending the currency peg to those of abandoning the peg.¹⁰

There are two key factors that connect bank runs to currency crises. First, the return on long-term domestic technology depends on the exchange rate as well as economic fundamentals and the number of depositors who run on the bank.

¹⁰Such an assumption on the monetary authority is widely used in the currency attack models. For example, see Obstfeld (1996) and Morris and Shin (1998).

Second, the cost function of the government that defends against the currency attack is associated with early withdrawals of deposits from the banking system as well as economic fundamentals and the proportion of currency traders who attack the currency.

Based on these assumptions, Goldstein (2000) examines two cases that cause twin crises, that is, the case in which banking panics are more likely to occur than currency crises and vice versa. In the model, an exogenous real variable affects the prospects of the bank and those of the domestic currency in the same direction through foreign liabilities in the domestic banking sector. This pattern becomes more important as the proportion of deposits denominated in dollars increases. In other words, foreign liabilities increase the correlation between domestic bank runs and currency crises and that foreign liabilities render the economy more vulnerable to crises as a whole.

The model in Chapter 4 modifies Goldstein's model by varying the relative precision of information between two types of the agents and by incorporating one large trader in the currency market. The technique used here follows Corsetti, Dasgupta, Morris, and Shin (2000).¹¹ The variation of asymmetric information and size of the agents are potentially very important, as the financier George Soros was accused of causing the Asian crisis by Dr. Mahathir, the prime minister of Malaysia.¹² We find that the presence of a large trader makes small depositors more likely to withdraw their money from the bank. That is, compared to the

¹¹Corsetti, Dasgupta, Morris, and Shin (2000) build a model of currency crises where a single large trader and a continuum of small traders independently decide whether to attack a currency based on their private information about economic fundamentals. They find that the presence of the large trader makes all other traders more aggressive in their selling. In particular, small traders are more likely to attack the currency when the large trader has relatively more precise information.

¹²Such accusation is still controversial, however, because the estimated size of large traders' is too small, compared to the entire forex market and the amount of international reserves available to the monetary authority, to cause a currency crisis [see Brown, Goetzmann, and Park (1998)]. But if there is information asymmetry, that is, markets believe that large traders have more precise information, even modest short positions by large traders may cause a herd-like behavior of other traders.

Corsetti, Pesenti, and Roubini (2000) present a comprehensive discussion about the role of large traders in the currency crises. Financial Stability Forum (2000) also provides good guidance and empirical results regarding hedge funds.

case in which there is no large trader, small depositors withdraw their money from the bank when economic fundamentals are stronger. Nonetheless, when a typical small depositor has more precise information than the large trader, the large trader's influence on the small depositor is moderate. But when the large trader has more precise information than a typical small depositor, his influence becomes much larger. The model also shows that these patterns become more important as the proportion of deposits denominated in dollars increases.

2.3.3 Information Cascades and Observational Learning

In the global games framework, a lack of common knowledge about economic fundamentals leads to coordination among agents. Related but different explanations for the onset of the crises are information cascades and observational learning.¹³ The terms information cascades are sometimes used in the same way as herd behavior. But as Smith and Sorenson (2000) point out, there is a significant difference between them. An information cascade occurs when agents ignore their private information and follow others blindly, while herd behavior occurs when they make the same decision, not necessarily ignoring their private information. Thus, an information cascade implies a herd but a herd does not necessarily result in an information cascade.

Unlike global games' story, information cascades and observational learning do not require the lack of common knowledge to derive a unique outcome. Instead, they rely on actual observation of other agents' behavior. Agents now decide their action based on the revealed information of those who came before him. This sequential decision rule results in 'herd' behavior. Another difference from the models presented in the previous section, the cascades and observational learning models need dynamic settings. Three models based on global games are constructed in a static framework, in which the game occurs at one time. Instead, cascades reflect herding or learning that is based on sequential games.

In the original cascades models pioneered by Banerjee (1992) and Bikhchan-

¹³For a survey of this area, see Devenow and Welch (1996) and Brunnermeier (2001).

dani, Hirshleifer, Welch (1992),¹⁴ agents will be doing what others are doing rather than using their own information. Consequently, everyone would make the same decision that may not bring the best possible outcome. That is, such a uniform behavior might not be efficient. However, there are some criticisms for this assumption. In particular, it seems unlikely that agents ignore their own information or new information under the situation where agents can adjust their strategies continuously to new information [see Lee (1993)]. In other words, this criticism requires the cascades story to include observational learning and resulting herding. Another difficult point is an assumption of prices. As Devenow and Welch (1996) address, the basic cascades model applies only in fixed-price situations, where the prices do not reflect the information in the preceding agents. Though there are a couple of exceptions, they also assume that prices do not move instantaneously and smoothly.

In order to fill these gaps, Lee (1997) constructs a model in which each agent makes an investment decision based on his own private information and the history of previous agents' decision.¹⁵ In his model, the agents can trade at most twice, first to exploit the information advantage due to the private signal, and second to unload the risky asset possessed by them at the price that reflects the result of the first trade. He explains how the crashes in stock market prices occur without any news.

In the context of currency attacks, the last section of the Corsetti, Dasgupta, Morris and Shin (2000) consider a sequential move game with a large and small traders in the currency market in which agents are now able to observe the action choices of others' as well as receive their own private signal. That is, agents can

¹⁴Banerjee (1992) and Bikhchandani, Hirshleifer, Welch (1992) have a common feature that all agents are assumed to be able to observe the decisions that have been made before them. That is, they assume perfect information about the history of decisions. Instead, Celen and Kariv (2000a and b) construct a model with imperfect information about the history of decisions. In the model, the best a typical agent can do is to make a Bayesian inference about the entire history, based on a few recent observations. They find that though imperfect information causes stochastic instability, agents become increasingly imitate their predecessors, ignoring their private information over time.

¹⁵Lee (1997) calls such a situation as "information avalanches."

learn from others' actions and use their own actions as a signal to other agents. Payoffs are realized in the last period, but do not depend on the timing of traders' actions, that is, there is no cost of waiting.¹⁶ Assuming that small traders ignore the signalling effect of their actions, the model shows that when the large trader has more precise information than small traders, they follow him without any other considerations. That is, all the followers ignore their own information completely. This equilibrium is similar to the original cascades models.¹⁷ On the contrary, when the large trader has less precise information than small traders, he does not have signalling ability. Thus, his influence depends on his size of funds relative to the market.

Although such an observational learning story has not been formally applied to twin crisis phenomenon, if we reinterpret the model presented in Chapter 4 by this approach, the resulting argument might go as follows. Consider a sequential move game with a large trader and small depositors. Each agent receives his own private signal of economic fundamentals, as well as observes in the beginning of the last period, the action choices made by other agents in the preceding period. Payoffs are realized in the last period, but do not depend on the timing of agents' actions, that is, there is no cost of waiting. Assuming that small depositors ignore the signalling effect of their actions, we can show that when a large trader has more precise information than small depositors, all the depositors ignore their own information completely. They run on the bank, when the large trader attacks the currency, while they keep their money in the bank, when he does not attack. Instead, when the large trader has less precise information than small depositors, his influence depends on his size of funds relative to the depositors.

2.4 Contagion

All the models described above explain elements of a twin crisis, but they have been developed only for countries considered in isolation. However, as seen in the

¹⁶This means that the model is still based on a fixed-price assumption.

¹⁷Dasgupta (2000) calls this equilibrium as strong herding.

recent crises, such as the Tequila crisis of 1994-5, the Asian flu of 1997, and the Russian virus of 1998, the financial shocks could spread regionally and globally. Such a phenomenon is called 'contagion.' Eighengreen, Rose, and Wyplosz (1996) regard contagion as a case in which knowing that there is a crisis elsewhere increases the probability of a crisis at home. Masson (2000) distinguishes the concepts of contagion in three categories by its causes; common shocks, trade and financial spillovers, and self-validating shifts in expectation.

Among categories classified by Masson, theories of systematic twin crises seem to be more related to the financial spillovers and shifts in expectations. Before the East Asian crisis, however, researchers focus mainly on the propagation of the currency crisis via trade links. Buiters, Corsetti, and Pesenti (1998) construct a model of monetary games within a N-country allowing for both trade and financial spillovers, in order to explain the ERM crisis. Corsetti, Pesenti, Roubini, and Tille (1998) build a three-country model to explore the logic of competitive devaluations. In the empirical studies, Eighengreen, Rose, and Wyplosz (1996) find that contagion arises more easily from international trade linkages than similarity in macroeconomic circumstances. They use a quarterly panel data of 20 industrialized countries from 1959 to 1993. Glick and Rose (1999) also provide empirical support that patterns of trade are important to understand how currency crises spread regionally. They use data for five currency crises including the East Asian crisis and do probit estimation.

The East Asian crisis motivated models based on the financial shocks via changes in the balance sheets of financial intermediaries that operate in multiple countries. Their basic mechanism is that a financial crisis in one country may prompt liquidation of assets of other countries. In the empirical studies, Kaminsky and Reinhart (2000) and Caramazza, Ricci, and Salgado (2000) find that financial spillover through common lenders is highly significant. Using more broad definition than common lenders, Van Rijckeghen and Weder (2000) support the view that financial linkage is more significant than trade linkage by examining 18 industrialized countries. They use the measure of competition for bank funds, which do

not include off-balance trades and indirect exposures. There are also other ways to measure contagion by focusing on price (co-)movement. Forbes and Rigobon (1999) and Corsetti, Pericoli, and Sbracia (2000), however, claim that empirical tests using stock market prices fail to discriminate contagion and interdependence.

Theories of systemic twin crises are still limited. Yet there are several ways to describe the mechanism of contagion. One way is to rely on a transmission of information including observational learning. King and Wadhvani (1990) construct a model in which contagion arises from agents' attempts to infer information from price changes in other markets. Another way is a portfolio rebalancing. Schinasi and Smith (1999) present a model of how portfolio diversification and leverage may be sufficient to cause a contagion. It is noteworthy that their model does not depend on market imperfections to explain contagion. By mixing portfolio rebalancing and imperfect information, Calvo and Mendoza (2000) suggest that the costly information may weaken incentives for gathering information on individual countries and strengthen incentives to imitate other markets. Such imitation induces contagion in the currency market. Assuming two types of agents, rational and irrational, Lagunoff and Schreft (1999) show how portfolio rebalancing of these agents will or will not cause a crisis, without mentioning coordination failures. In addition, Allen and Gale (2000) construct models in which the connections between banks induce a chain of crises, though one caveat of their models is multiple equilibria, which arise from perfect information setting.

In the global games framework, Dasgupta (2000) and Goldstein and Pauzner (2000) construct a contagion model. Dasgupta (2000) describes a situation in which two symmetric banks in two regions insure against the regionally aggregate liquidity shocks by holding interbank deposits.¹⁸ Assuming that aggregate liquidity is fixed, bank runs in one country may cause runs in the other through capital connection. In addition, assuming seniority of interbank deposits, Dasgupta (2000)

¹⁸This setting is similar to Allen and Gale (2000). The main difference between them lies in the assumption of information. In the Allen and Gale (2000), the spillover of bank panics occurs from aggregate liquidity shocks on the part of depositors. Instead, the Dasgupta (2000) assumes incomplete information. In his model bank runs occur due to adverse information about asset returns.

shows that contagion flows from debtors to creditors. This means that contagion spreads only in a specific direction and can be localized. The last implication is interesting, but it is contradictory to the result of Miller's (1998a) model.¹⁹ If we interpret the East Asian crisis according to Dasgupta (2000), Thailand, the debtor country, can be regarded as an important origin of the spread. However, many economists including Miller (1998a) accuses Japan, the creditor country, of spreading the crisis by reducing bank loans to the East Asian countries due to its prolonged financial turmoil. The Dasgupta model does not include currency market, either.

In Goldstein and Pauzner (2000), connection between two countries arises from the two assumptions. First, agents hold investment in two countries. Second, the return of the investment depends not only on the economic fundamentals of each country, but also on the number of agents who keep their investments there. Like usual arguments of global games literature, agents do not share knowledge of economic fundamentals of country 2 that moves later in a sequential game, but receive slightly noisy signals about the fundamentals as private information. After observing the signal, each agent guesses the true fundamentals and information received by others and their action in country 2. Goldstein and Pauzner (2000) show that agents will withdraw early in country 2 only if the economic fundamentals are below a certain threshold value, which also depends on the outcomes in country 1.

2.5 Concluding remarks

In closing this chapter, we should suggest a few issues to be addressed in future research. The models introduced in Subsection 2.3.2 integrate the two competing

¹⁹Miller (1998a) describes a situation in which a bank run will lead to devaluation of a foreign currency through repatriation of capital from the foreign country when domestic banks are net investors in the foreign country. If the repatriation causes a reduction of the international reserves of the foreign country, the foreign currency will be devalued. When such a devaluation will make domestic banks insolvent, the expectation for bank runs will be self-fulfilled. This mechanism can interpret the Japanese banks' turmoil and its effect on the East Asian crisis in late 1990s. However, her model uses multiple equilibria and cannot describe how one of the equilibria is chosen.

views between 'fundamentals' and 'panics.' There the panics occur only when the economic fundamentals drop below a certain threshold value. Despite the virtue of the models, their static nature prevents us from describing agents' reactions to the new prices reflecting the first move. Information cascades and observational learning models like Lee (1997) fill these gaps in a reasonable way. However, as Devenow and Welsh (1996) argue, more work needs to be done in modelling dynamically how rational herding or learning aggregates information into markets with constantly moving prices. In addition, there is no model that applies the cascades story to the twin crisis models where both banking sector and currency markets exist.

Along with the development of theoretical models, we need empirical tests to verify the validity of the models. As we see in the preceding sections, there are already plenty of papers that test the determinants of the occurrence of the crises. As well as macroeconomic and financial factors, more recent models incorporate the factors related to the contagion. However, as discussed above, what kinds of variables should be used to capture contagion is still debatable. In addition, it is methodologically difficult to distinguish the contagion and the interdependence from the price comovement, which is most commonly used due to data availability. In order to fill this gap, we may need to focus more on communication channels and/or sequential move of individuals' decision making, as Devenow and Welsh (1996) suggest. Though it is very difficult to obtain such data, this line of research can upgrade the models which are based mainly on anecdotal observations.

3 A Twin Crisis Model with Exogenous Capital Inflows

3.1 Introduction

Recent currency and financial crises have raised yet explained a fundamental question as to the effect of capital inflows in developing countries. On one hand, foreign capital provides developing countries more opportunities to invest in profitable projects and to raise productivity. On the other hand, huge capital inflows often subject developing countries to currency and financial crises. The Mexican peso crisis and the East Asian crisis can be seen as good examples that an increase in capital inflows destabilizes the currency and the domestic banking system.

This chapter examines how an increase in international borrowing changes the probability of bank runs or currency crises under a fixed exchange rate regime. We reinterpret the open economy bank run model of Chang and Velasco (1998a and b) based on that of the Goldstein and Pauzner (1999). Chang and Velasco extend Diamond and Dybvig (1983) model into an open economy framework, in which agents' budget constraints include international borrowing. By doing so, they introduce an analysis of exchange rate regimes and Central Bank policy into the existing framework. Their key argument is that investors' withdrawal of funds from a country may be financed by an early liquidation of long-term domestic investment. Such liquidation is costly to the country, since it reduces the country's external solvency, even if all of its investment projects would be economically viable. In their model only investors' fear for the country's insolvency can cause a crisis. The fundamentals that are relevant to this theory are only the mismatches in maturity and currency denomination between assets and liabilities.²⁰

Such multiplicity of equilibria causes several problems, as discussed in the previous chapter (see Section 2.2 in Chapter 2). By introducing slightly noisy signals into the model, following Goldstein and Pauzner, we provide a unique equilibrium in which economic fundamentals determine whether a currency and financial cri-

²⁰See footnote 2.

sis will occur. After observing the signals, each depositor guesses the number of agents who will withdraw deposits and the probability of bank runs. Based on their conjectures, depositors decide whether they should withdraw their deposits from the bank or leave them in the bank. Since their signals are related to the economic fundamentals, the equilibrium is determined uniquely, corresponding to the economic fundamentals. Such an analysis enables us to compute the probability of the crisis and relate it to capital inflows.

Our main finding is that capital inflows may increase the probability of crises, when the return on domestic investment is lower than foreign interest rates. This result is consistent with three previous empirical findings. First, the dangers of bank runs are heightened by the increase of international capital inflows.²¹ Second, the mismatches in the maturity and the currency denomination between assets and liabilities are associated to the occurrence of currency crises.²² Third, a country's lower growth rate and higher domestic and foreign interest rates are strongly associated with the onset of banking crises.²³

Going back to the recent East Asian financial crisis, the return on long-term investment decreased prior to the crisis, while foreign interest rates were rising. These facts suggest that the increase in capital inflows may have raised the likelihood of runs.

In the rest of the chapter we first describe the game under a fixed rate regime (Section 2) and introduce a unique equilibrium into the model (Section 3). Then we do comparative statics to examine how an increase in capital flows affects the probability of bank runs (Section 4). We confirm that the prediction of the model can be applied to the economic data before the recent Asian crisis (Section 5). Finally, we give our conclusions in Section 6.

²¹See footnote 5.

²²See footnote 2.

²³See footnote 4.

3.2 A Model with Multiple Equilibria

Our basic setup is a slight variation of the Chang and Velasco (1998a and b) model. It assumes a small open economy populated by a continuum $[0,1]$ of ex ante identical depositors. There are three periods $(0,1,2)$, one good, and two types of depositors. With probability λ the depositor is impatient and with probability $1 - \lambda$ she is patient. Depositors' types are *i.i.d.*, and are revealed as their private information in the beginning of period 1. Let c_1 and c_2 denote depositors' consumption levels. Impatient depositors can consume only in period 1 and obtain utility of $u(c_1)$, where u is twice continuously differentiable, increasing, and has a relative risk-aversion coefficient, $-cu''(c)/u'(c) > 1$. Patient depositors derive utility from consumption either in period 1 or in period 2. Their utility is $u(c_1 + c_2)$.²⁴ Expected utility of the representative depositor can be represented by:

$$\lambda u(c_1) + (1 - \lambda)u(c_1 + c_2) \tag{1}$$

Each depositor has an endowment good 1 in period 0, and can borrow from abroad an amount d in period 0 and b in period 1 at the world interest rate of zero. There is a credit ceiling $f \geq d + b$, which constrains the depositors borrowing freely. The depositors invest the amount $k = 1 + d$ in long-term technology in period 0.²⁵ For each unit of input in period 0, the technology generates $r \leq 1$ unit of output in period 1 or R units of output in period 2. Following Goldstein and Pauzner (1999), we assume that R is not a fixed parameter, but rather depends on the random state of the world θ . This is the major departure from the Chang and Velasco model. State θ is uniformly distributed over $[0,1]$ and is revealed to depositors only in period 2. The long-term return $R(\theta)$ is increasing in θ , and satisfies $E_\theta R(\theta) > r$, so that the long-term return is superior to the short-term return. This assumption creates costly liquidation, which leads to multiple equilibria.²⁶

²⁴Equally, we can assume that patient agents consume only at period 2, and that goods can be stored with no depreciation.

²⁵Following Chang and Velasco (1998a), we assume, for simplicity, that f is sufficiently large relative to endowment 1 so that investment in the illiquid asset takes up the whole of the initial endowment and the difference is made up by period 0 borrowing.

²⁶For detailed explanation about how costly liquidation generates multiple equilibria, see Allen

The introduction of capital inflows f causes a currency mismatch. We first assume that depositors demand domestic currency (“baht”²⁷) to invest in domestic technology, while they borrow from abroad in the dollar terms. Second, depositors withdraw “bahts” from the commercial bank, while they need dollars to buy consumption in the world market.

Suppose that the commercial bank and the Central Bank, which are assumed, for the moment, to be able to verify depositors’ types when they are realized, can act together to achieve the social optimum, where the exchange rate will be fixed at one. The country’s planning problem is to maximize the depositor’s utility (1) subject to

$$\lambda c_1 \leq b + rl \quad (2)$$

$$(1 - \lambda)c_2 + (d + b) \leq R(\theta)(k - l) \quad (3)$$

$$c_2 \geq c_1 \quad (4)$$

$$c_1, c_2, k, l, d, b \geq 0 \quad (5)$$

where l denotes liquidation of domestic assets in period 1, if the depositor turns out to be impatient. (2) is the feasibility constraint in period 1. It says that the consumption of impatient agents must be financed by borrowing in period 1 and liquidation of domestic assets. (3) requires that the return on the long-term investment is sufficient to pay for the patient agents’ consumption and the service of accumulated external debt. (4) is the incentive compatibility condition for patient agents. This condition prevents patient agents from withdrawing c_1 in period 1 when there is no run. If a patient depositor leaves deposits in period 1, she will consume c_2 in period 2. If she withdraws deposits in period 1, she will only consume c_1 units of consumption in period 1. She can do best then

and Gale (1998).

²⁷We use “baht” to designate the domestic currency, since the baht is the currency of Thailand, the first victim of the recent East Asian financial crisis.

to exchange them for c_1 dollars and use them to buy c_1 units of consumption in period 2. Thus (4) requires the value of withdrawing their money early for patient depositors not to be larger than the value of telling the true type. (5) establishes the non-negativity constraints.

The solution of the above problem will be denoted by $c_1^+, c_2^+, k^+, l^+, d^+, b^+$. At the optimum, it can be shown that $l^+ = 0$, that is, there is no liquidation of the long-term investment in period 1. The optimal allocation must satisfy a social transformation curve:

$$R(\theta)\lambda c_1^+ + (1 - \lambda)c_2^+ = 1 \cdot R(\theta) + f(R(\theta) - 1) \quad (6)$$

and the first order condition:

$$u'(c_1^+) = E_\theta R(\theta) u' \left(\frac{R(\theta)(1 - \lambda c_1^+) + f(R(\theta) - 1)}{1 - \lambda} \right) = E_\theta R(\theta) u'(c_2^+) \quad (7)$$

Equation (6) says that the introduction of capital inflows increases the economy's wealth by adding the possible cross-border return differential, $f(R(\theta) - 1)$, to the endowment when $R(\theta) \geq 1$, while it decreases the wealth when $R(\theta) < 1$. This effect is growing as the credit ceiling f increases. Equation (7) says that the gain from risk sharing offsets the loss of return. The early liquidation is costly, since the short-term return of r is lower, on average, than the long-term return of $R(\theta)$. Note that, since $E_\theta R(\theta) > r$ and $u(\cdot)$ is concave, (7) guarantees that the incentive constraint (4) does not bind.

Next we will show that this allocation can be implemented in a decentralized system by adding the following three conditions. First, we assume that the commercial bank makes demand deposit contracts with its depositors and invest money in the long-term asset.²⁸ Second, the bank does not know the depositors' true type,

²⁸Contrary to Diamond and Dybvig (1983) and Chang and Velasco (1998), we do not assume sequential service constraints. These constraints require that both the commercial bank and the Central Bank respond to the requests of depositors on a first come-first served basis. Instead, following Allen and Gale (2000), we model this type of situation by assuring the available liquidity is split on an equal basis among those withdrawing early.

and meet their demands according to their claims. Third, in order to isolate issues related to international defaults we assume, following Chang and Velasco (1998a and b), that external debts are repaid under all circumstances. This requires the Central Bank to sell \tilde{l}^+ such that $d^+ + b^+ = f \leq R(\theta)(k^+ - \tilde{l}^+)$, or²⁹:

$$\tilde{l}^+ = \frac{R(\theta)k^+ - f}{R(\theta)} \quad (8)$$

This assumption ensures that new loans are always repaid even if the bank fails. Hence, it is rational for foreign creditors to extend loans even in the case of a run. Note that this assumption allows us to focus only on the domestic depositors' behavior, that is, a foreign creditors' refusal to extend credit does not matter here.

To satisfy the demand for bahts, the Central Bank is required to lend an unlimited number of bahts to the commercial bank if more than λ depositors claim impatience. This is the key assumption for a lender of last resort. When the Central Bank acts as a lender of last resort, the commercial bank does not close even in the run. Instead, the Central Bank is forced to sell the reserves to extend loans and allow the exchange rate to devalue. Thus, whether the international illiquidity causes a currency crisis depends on the Central Bank's credit arrangement.

Now we can complete the description of this regime. In period 1, the commercial bank meets withdrawals of depositors. Withdrawals of impatient depositors are covered first by borrowing abroad up to b^+ and by selling the resulting dollars to the Central Bank, and then by drawing on the emergency credit line. Since the Central Bank acts as a lender of last resort, the emergency credit line is unlimited. Thus no commercial bank closes in this regime.

The Central Bank sells dollars for bahts at a fixed exchange rate, by using first the amount b^+ dollars purchased from the commercial bank and then liquidating the long-term investment up to the amount \tilde{l}^+ ; hence the maximum amount of dollars that the Central Bank can sell in period 1 is equivalent to $b^+ + r\tilde{l}^+$. The

²⁹The constraint (8) implies that the quantity of \tilde{l}^+ is the largest amount that the bank can liquidate in period 1, with period 2 revenue enough to pay back loans totalling f .

Central Bank will have nothing to sell further, after selling this quantity. If this happens while there still remain some depositors who want to exchange bahts for dollars, the situation will become a currency crisis. At this stage the only remaining option for the Central Bank is to sell the reserves to repay depositors and allow the exchange rate to devalue.

If there is no run, the impatient depositor receives $c_1 = c_1^+$, and the patient depositor receives $c_2 = c_2^+ = \frac{R(\theta)(1-nc_1^+) + f(R(\theta)-1)}{1-n}$. Reasonably, we do not allow a run unless it is unavoidable. Hence, when there are multiple equilibria corresponding to a given value of $R(\theta)$, we assume that the equilibrium without runs is chosen. This assumption requires us to consider two possible cases. First, a run will occur if and only if it is impossible for the bank to meet the demand of the impatient depositors. That is, the condition for a run equilibrium is $nc_1^+ > b^+ + r\tilde{l}^+$, while that for no run is $nc_1^+ \leq b^+ + r\tilde{l}^+$, where $n = \lambda$ in no run case. The bank has to liquidate all of its assets in period 1 and all the patient depositors will join the run. In this case, all the depositors will receive $\frac{b^+ + r\tilde{l}^+}{n}$.

Since runs occur if and only if $c_1 < c_1^+$, we know that runs occur if and only if $R(\theta) < R^*(\theta)$, where $R^*(\theta)$ is defined implicitly by the condition:

$$(1-n)c_1^+ = R(\theta)(1-nc_1^+) + f(R(\theta)-1)$$

or

$$R^*(\theta) = \frac{(1-n)c_1^+ + f}{1-nc_1^+ + f}$$

In other words, if there are no runs and the impatient depositors are paid the promised amount c_1^+ , there will be just enough to provide the patient depositors with a level of consumption that satisfies the incentive-compatibility constraint. Then a run occurs if and only if $R(\theta) < R^*(\theta)$, since it is not feasible for the bank to pay the patient depositors c_1^+ and impatient depositors cannot get less unless there is a run. Conversely, if $R(\theta) \geq R^*(\theta)$, it is always feasible and optimal for

the bank to avoid a run. We focus on the interior case where $R^*(\theta) > 0$. Figure 1 illustrates the equilibrium consumption levels of impatient and patient depositors, respectively, as a function of the long-term asset return $R(\theta)$.

The analysis above reduces to the analysis of the equilibria of the induced game. The payments of patient depositors are depicted in Table 1 where n denotes the proportion of depositors demanding c_1^+ in period 1:

Table 1: Ex post payoffs of a patient depositor

Period	$nc_1^+ \leq b^+ + rl^+$	$nc_1^+ > b^+ + rl^+$
1	c_1^+	$\frac{b^+ + rl^+}{n}$
2	$c_2^+ = \frac{R(\theta)(1-nc_1^+) + f(R(\theta)-1)}{1-n}$	0

As shown in the Chang and Velasco (1998a), a fixed rate regime in which the Central Bank serves as a lender of last resort has multiple equilibria. In the first equilibrium, the social optimum is implemented, since all depositors behave honestly. In the second equilibrium all depositors claim to be impatient in period 1 and a currency crisis occurs. The two possible equilibria prevent us from calculating the probability of a crisis. In order to obtain firmer prediction, we need to introduce a unique equilibrium into the model.

3.3 Equilibrium under Incomplete Information

We now modify the model by assuming, as Goldstein and Pauzner (1999) do, that each depositor receives a private signal about the economic fundamentals in the beginning of period 1. After observing these signals, depositors will coordinate their actions.

Although we assume that each depositor does not know true θ in period 1, she receives a private signal about it. A typical depositor i observes signal $\theta_i = \theta + \varepsilon_i$, where $\varepsilon_i > 0$ represent small error terms that are independently and uniformly distributed over the interval $[-\varepsilon, \varepsilon]$.

The introduction of private signals changes the results in two ways. First, the signal allows an inference about true value of θ . Second, based on her signal, each depositor can guess other depositors' signals and their actions. If she observes a

high signal, she believes that other depositors receive high signals as well. Consequently, she attributes a low likelihood to the possibility that other depositors will run on the bank. Since the strategy is complementary, this conjecture makes her incentive to run smaller.

Now we can analyze the entire events. The banking contract is chosen in period 0, which offers c_1^+ ($r \leq c_1^+ \leq \frac{b^+ + r\bar{r}^+}{\lambda}$) to depositors who withdraw their money from the bank in period 1. All depositors save their endowments in the bank, which invests the endowments and the overseas borrowing into domestic technology in period 0. While all impatient depositors withdraw their money from the bank in period 1, patient depositors choose their action by comparing the expected payoffs from withdraw their money from the bank in period 1 to that in period 2. As seen in Table 1, the ex-post payoff of a patient depositor from these two options depends on both θ and n , the proportion of depositors who withdraw their money from the bank in period 1. Each depositor observes a signal, which gives her (partial) information on both θ and n . Thus, her signal affects her action.

Next we assume that $\bar{\theta}(c_1^+)$ and $\underline{\theta}(c_1^+)$ are feasible signals that are extremely good ($\bar{\theta}$) or extremely bad ($\underline{\theta}$) for which a patient depositor will select her best action, without any regard to her belief concerning other patient agents' behavior. From Table 1, we can give an exact definition of the region with extremely bad signals. Denote $\underline{R}(c_1^+) = \frac{c_1^+(1-\lambda)+f}{1-\lambda c_1^+ + f}$. If a patient depositor knew $R < \underline{R}(c_1^+)$, she would withdraw her money early from the bank, regardless of what she believes $n(\geq \lambda)$ to be. We denote by $\underline{\theta}(c_1^+)$ the value of θ for which $R(\theta) = \underline{R}(c_1^+)$, and refer to the interval $[0, \underline{\theta}(c_1^+)]$ as the lower dominance region. Since the difference between depositor's signal and the true θ is no more than ε , the depositor will always withdraw her money from the bank in period 1, if she observes a signal $\theta_i < \underline{\theta}(c_1^+) - \varepsilon$. We assume that for any $c_1^+ > r$ there are feasible values of θ for which all depositors receive signals that show θ is in the lower dominance region. Since $\underline{\theta}$ is increasing in c_1 , the condition that guarantees this for any $c_1^+ > r$ is $\underline{\theta}(r) - 2\varepsilon > 0$.

Similarly, we assume the upper dominance region $[\bar{\theta}(c_1^+), 1]$, where $R(\theta)$ is so

high that no patient depositor withdraws her money from the bank in period 1, since she knows that $\theta \in [\bar{\theta}(c_1^+), 1]$. Depositors who receive signals $\theta_i > \underline{\theta}(c_1^+) + \varepsilon$ believe that θ is in the upper dominance region. Since this condition is difficult to meet when c_1^+ is larger, we need to assume that $\bar{\theta}(\frac{b^+ + r\bar{t}^+}{\lambda}) + 2\varepsilon < 1$ for any conceivable values of c_1^+ ($r \leq c_1^+ \leq \frac{b^+ + r\bar{t}^+}{\lambda}$).

In sum, when $\theta < \underline{\theta}(c_1^+) - 2\varepsilon$, all depositors receive signals below $\underline{\theta}(c_1^+) - \varepsilon$ and n must be 1. When $\theta > \underline{\theta}(c_1^+)$, no patient depositor receives a signal below $\underline{\theta}(c_1^+) - \varepsilon$ and must run. Thus, the lower bound of n is λ . When θ increases from $\bar{\theta}(c_1^+) - 2\varepsilon$ to $\bar{\theta}(c_1^+)$, the proportion of patient depositors who observe signals below $\underline{\theta}(c_1^+) - \varepsilon$ decreases linearly, since ε is uniformly distributed. Similarly, we can construct the upper bound, referring to the fact that patient depositors will not run if they observe a signal above $\underline{\theta}(c_1^+) + \varepsilon$.

There is no guarantee that these two bounds are close to each other. Rather they can be far apart with a large intermediate region where a depositor's optimal strategy depends on her beliefs about other depositors' actions. Depositors' beliefs in this intermediate region are not arbitrary. Since each depositor can observe only her own noisy signals of the economic fundamentals, she does not know what kind of signals other depositors observe. Hence, in choosing the equilibrium action, a depositor has to consider the equilibrium actions at nearby signals, which also depend on the equilibrium actions taken at further signals. Repeating these decision making process, the eventual equilibrium must be consistent with the behavior in the dominance regions.

Proposition 1 *For any $c_1^+ > r$ there is a unique threshold $\theta^*(c_1^+)$ such that each patient depositor who observes a signal above $\theta^*(c_1^+)$ will leave her money in the banks, while each depositor who observes a signal below $\theta^*(c_1^+)$ will run on the bank.³⁰*

Our model with noisy signals has a unique equilibrium. In other words, a patient depositor's action is uniquely determined by her signal. She withdraws

³⁰For Proof of Proposition 1, see the Appendix.

her money early, if she observes a signal below a certain threshold value, while she leaves money in the bank, otherwise. Thus, the behavior of depositors can be characterized throughout the entire state space. We denote the unique threshold, which determines whether depositors will run on the bank, by $\theta^*(c_1^+)$ such that all the patient depositors run if they observe a signal below $\theta^*(c_1^+) - \varepsilon$, while no patient depositors will either tell a lie or run on the bank if they receive a signal above $\theta^*(c_1^+) + \varepsilon$. Given that threshold, we can compute the number of depositors demanding c_1^+ in period 1 as a function of the realized value of θ .

Corollary 2 *Given c_1^+ , the proportion of depositors who withdraw their money in early period depends only on the economic fundamentals. It is given by:*

$$n(\theta, \theta^*(c_1^+)) = \begin{cases} 1 & \theta \leq \theta^*(c_1^+) - \varepsilon \\ \lambda + (1 - \lambda) \left(\frac{1}{2} + \frac{\theta^*(c_1^+) - \theta}{2\varepsilon} \right) & \theta^*(c_1^+) - \varepsilon \leq \theta \leq \theta^*(c_1^+) + \varepsilon \\ \lambda & \theta^*(c_1^+) + \varepsilon \leq \theta \end{cases}$$

The corollary 2 is derived as follows. All impatient depositors with proportion of λ withdraw their money from the bank in period 1. The patient depositors who observe a signal below $\theta^*(c_1^+)$ also withdraw early. When $\theta \leq \theta^*(c_1^+) - \varepsilon$, all patient depositors receive signals below $\theta^*(c_1^+)$ and withdraw early. Instead, when $\theta \geq \theta^*(c_1^+) + \varepsilon$, they all receive signals above $\theta^*(c_1^+)$ and leave their money in the bank until period 2. When $\theta^*(c_1^+) - \varepsilon \leq \theta \leq \theta^*(c_1^+) + \varepsilon$, the $n(\theta)$ proportion of depositors withdraw early. The proportion $n(\theta)$ decreases linearly, corresponding to the equation $\theta_i = \theta + \varepsilon_i$, that is, higher θ implies that fewer depositors observe signals below $\theta^*(c_1^+)$.

Finally, we derive the threshold signal $\theta^*(c_1^+)$. A patient depositor who receives the signal $\theta^*(c_1^+)$ must be indifferent about whether withdrawing c_1^+ or leaving money in the bank in period 1. Hence we obtain an implicit definition of $\theta^*(c_1^+)$:

$$\frac{1}{2\varepsilon} \left(\int_{\theta = \theta^*(c_1^+) - \varepsilon}^{\tilde{\theta}(c_1^+)} u(A) - u(0) d\theta \right) = \frac{1}{2\varepsilon} \left(\int_{\tilde{\theta}(c_1^+)}^{\theta^*(c_1^+) + \varepsilon} u(B) - u(c_1^+) d\theta \right) \quad (9)$$

where

$$A = \frac{b^+ + r l^+}{n(\theta, \theta^*(c_1^+))}$$

$$B = \frac{R(\theta)(1 - n(\theta, \theta^*(c_1^+))c_1^+) + f(R(\theta) - 1)}{1 - n(\theta, \theta^*(c_1^+))}$$

3.4 Comparative Statics

Although we cannot obtain closed form solutions of the equilibrium for all ε , we can obtain closed form solutions in the limiting cases when depositors receive very accurate information about θ . Particularly, we examine the limiting case where ε tends to zero.

Proposition 3 *At the limit as ε tends to zero, $\theta^*(c_1^+)$ is given by the unique solution to the equation:*

$$u(c_1^+) - u(A') + u(0) = u(B') \quad (10)$$

where

$$A' = \frac{b^+ + rl^+}{n(\theta^*(c_1^+))}$$

$$B' = \frac{R(\theta^*(c_1^+))(1 - n(\theta^*(c_1^+))c_1^+) + f(R(\theta^*(c_1^+)) - 1)}{1 - n(\theta^*(c_1^+))}$$

Proof. Consider the threshold point $\theta^*(c_1^+)$, which is the solution to the equation (9). Let

$$F(\varepsilon) = \int_{\tilde{\theta}(c_1^+)}^{\theta^*(c_1^+)+\varepsilon} u(B) - u(c_1^+)d\theta - \int_{\theta=\theta^*(c_1^+)-\varepsilon}^{\tilde{\theta}(c_1^+)} u(A) - u(0)d\theta,$$

we can express the equation (9) as $\frac{F(\varepsilon)}{2\varepsilon} = 0$. By using *L'Hôpital's* rule, and knowing that $\tilde{\theta}(c_1^+)$ and θ become $\theta^*(c_1^+)$ as ε tends to zero, we obtain:

$$\lim_{\varepsilon \rightarrow 0} \frac{F(\varepsilon)}{2\varepsilon} = \frac{F'(0)}{2} = \frac{u(B') - u(c_1^+) + u(A') - u(0)}{2}$$

Thus, in the limit as ε tends to zero, (9) yields:

$$u(c_1^+) - u(A') + u(0) = u(B').$$

■

We next examine the effect of shifts in f .

Proposition 4 $\theta^*(c_1^+)$ decreases in f , if $R(\theta^*(c_1^+)) > 1 \geq r$.

Proof. Let $G = u(B') - u(c_1^+) + u(A') - u(0)$. Differentiating with respect to f and $\theta^*(c_1^+)$, and using (3), we obtain:

$$\frac{\partial G}{\partial f} = u'(B') \cdot \left(\frac{R(\theta^*(c_1^+)) - 1}{1 - n(\theta^*(c_1^+))} \right) + u'(A') \cdot \left(\frac{R(\theta^*(c_1^+)) - r}{n(\theta^*(c_1^+))R(\theta^*(c_1^+))} \right) = \alpha$$

$$\frac{\partial G}{\partial \theta^*(c_1^+)} = C \cdot \frac{\partial R(\theta^*(c_1^+))}{\partial \theta^*(c_1^+)} - D \cdot \frac{\partial n(\theta^*(c_1^+))}{\partial \theta^*(c_1^+)} = \beta$$

where

$$C = u'(B') \cdot \left[\frac{1 - c_1^+ n(\theta^*(c_1^+)) + f}{1 - n(\theta^*(c_1^+))} \right] + u'(A') \cdot \left[\frac{f(2R(\theta^*(c_1^+)) - r)}{n(\theta^*(c_1^+))R^2(\theta^*(c_1^+))} \right]$$

$$D = u'(B') \cdot \left[\frac{(1 - c_1^+)R(\theta^*(c_1^+)) + f(R(\theta^*(c_1^+)) - 1)}{(1 - n(\theta^*(c_1^+)))^2} \right] + u'(A') \cdot \frac{b^+ + r l^+}{n^2(\theta^*(c_1^+))}$$

When $R(\theta^*(c_1^+)) > 1 \geq r$, we have $\alpha, \beta > 0$. Then by implicit function theorem, we obtain:

$$\frac{\partial \theta^*(c_1^+)}{\partial f} = -\frac{\partial G / \partial f}{\partial G / \partial \theta^*(c_1^+)} = -\frac{\alpha}{\beta} < 0 \quad (11)$$

Though we do not specify all the cases under which we have the opposite result of (11), suppose $1 \geq r \geq R(\theta^*(c_1^+)) \geq \frac{r}{2}$ and $R(\theta^*(c_1^+)) \geq \frac{f}{1-c_1^++f}$. Then we have $\alpha \leq 0$, $\beta > 0$, and

$$\frac{\partial \theta^*(c_1^+)}{\partial f} = -\frac{\partial G / \partial f}{\partial G / \partial \theta^*(c_1^+)} = -\frac{\alpha}{\beta} \geq 0 \quad (12)$$

■

This proposition says that an increase in capital inflows decreases the likelihood of crises, when the return on long-term investment is higher than the short-term return and the interest rate of external debts. Instead, if this condition $R(\theta^*(c_1^+)) > 1 \geq r$ is not satisfied, capital inflows may increase the likelihood of crises. This result is consistent with the previous empirical findings that show that lower growth rates, higher domestic and foreign interest rates are strongly associated with the onset of banking crises in developing countries.

3.5 Macroeconomic Fundamentals in East Asia

In this section, we will examine the data before the Asian financial crisis, and confirm that the Asian crisis were seen to be caused by fundamental factors and maturity mismatches between assets and liabilities like Latin American countries that also experienced “twin crises”, as the model above predicts. Such phenomena cannot be captured by the previous first-generation and second-generation models of currency crises.

Figure 2 and 3 show the real GDP in 3 NIEs and 4 ASEAN countries. Figure 2 tells that among Asian NIEs, Korea and Hong Kong were severely damaged by the crisis, while Taiwan, which has abundant international reserves, was not. Figure 3 indicates that among the ASEAN 4 countries three countries - Indonesia, Malaysia, and Thailand, experienced a large drop in the real GDP, while the Philippines, which employs the flexible exchange rate system before the crisis, was not. From now on, we will examine only the data of the four countries that took the fixed exchange rate regime and were severely damaged, that is, Korea, Indonesia,

Malaysia, and Thailand.³¹

The classic Krugman (1979) model has been used to criticize money-financed budget deficits for a decrease in foreign reserves and the eventual collapse of an exchange rate peg. This explanation describes well the facts in some currency crises in emerging markets, such as Mexico in 1976 and Argentina, Brazil, Peru and Mexico in the early and mid-1980s. These crises could be attributed to fiscal irresponsibility. A striking feature of the Asian economies is that their fiscal performances were quite different from this traditional explanation. Figure 4 shows that the four Asian countries enjoyed fiscal surplus between 1993 to 1996. Figure 5 indicates that public debts as a share of GDP were low, compared both to other emerging countries and to advanced countries [see Chang and Velasco (1998c) for example]. In addition to the tight fiscal balance, monetary growth could be reasonably tight, resulting in low inflation. Figure 6 shows that CPI growth rates in these countries were kept below six percent before the crisis. There is no sign of increase in the inflation. Hence, we can conclude that the economic fundamentals prior to the crisis were rather different from the phenomena described by the “first-generation” model a la Krugman.

The “second-generation” model can capture the features of the ERM crisis of 1992 and Mexican crisis of 1994. That is, stagnation and resulting unemployment undermined the credibility of fixed exchange rates and eventually caused speculative attacks by investors expecting future devaluation. However, the Asian episode shows a relatively high GDP growth rates before the crisis as described in Figure 7. Again, we can conclude that the economic fundamentals were not similar to that described in the second-generation model.

Given the theory outlined in the preceding section, we will examine whether the four countries matched the sterilized facts of the “twin crisis” at the time their crises erupted. First, financial collapse has clearly been the most dramatic aspect of the Asian crises. Bank failures and closures have taken place in all the four

³¹We do not include Hong Kong and the Philippines. Hong Kong employs a currency board system, while the Philippines take a flexible exchange rate regime. Both systems are not covered by the model presented in this paper.

countries. In addition, Indonesia, Korea, and Thailand experienced a number of default of domestic financial institutions on their external short-term obligations. For Korea and Thailand, default was prevented by emergency reschedules of liabilities. Indonesia declared effective moratorium on debt service by its corporate sector in January 1998.

Financial collapse is regarded to have been a major cause of the sharp currency depreciation since mid-1997. As Figure 8 shows that Thailand and Malaysia pursued low-interest rate policies until well into the crisis. Central Banks kept from raising interest rates enough to defend their exchange rate pegs, as Chang and Velasco (1998b) strongly insisted. Such a policy could be maintained only until international reserves were exhausted.

Hence, the recent Asian crisis can be regarded to have resulted from a collapse of their financial systems. In addition, both theory and data suggest that the financial vulnerability came from huge capital inflows and resulted international liquidity mismatch.

As seen in Latin American countries, Korea and the ASEAN 3 countries also experienced large capital inflows before the crisis and fall during the crisis (Figure 9). Capital inflows (based on the balance of payments statistics) reached its recent peak during 1995-96 and dropped below zero in all countries during the crisis. Although the maturity composition of international bank loans did not show remarkable changes during 1990s (Figure 10), the increase of total international borrowing, accompanied by accumulated current account deficits in 1996, made the maturity mismatch in a whole country more serious than before. Figure 11 shows the ratio of short-term international borrowing (up to one year) to international reserves. The ratio increased steadily before the crisis because both of the increase in short-term borrowing and of the decrease in the reserves, which was caused partly by the current account deficits (Figure 12). As Chang and Velasco insist, reserves are particularly important to measure the country's capacity to fix its exchange rate, since they can be used both for preventing domestic runs and for intervening in the exchange markets. We should note that the portion of the

external debts denominated by the local currency was below 10% in 1997 (Figure 13), indicating that the four countries were highly vulnerable to the exchange risks.

In addition to the maturity mismatch, the GDP growth rates show slight decline before the crisis (Figure 7) due mainly to the slowdown of export growth rates (Figure 14).³² In particular, Figure 15 shows that the return on investment of Korean industries actually declined before the crisis. After reaching their peak in 1995, all of the profitability indicators - ordinary income / total assets, growth rate of gross value added per capita, and growth rate of sales per capita - declined before and during the crisis. However, foreign interest rates captured by the Federal Fund rates (Figure 16) were raised just before the crisis. These trends shrank the spread between the return on domestic long-term investment and interests on the liabilities. The reduction of relative profits of the domestic long-term investment seem to have been enough for investors to believe that the economic fundamentals would be worse in the future and coordinate their actions into the run.

Hence, as described in this section, the fundamentals of the four economies before the crisis seemed to support our previous prediction, that is, the increase in capital inflows, along with the maturity mismatch between assets and liabilities denominated in foreign currencies, raised the likelihood of bank runs and currency crisis, under the condition of lower profitability of domestic long-term investment relative to the foreign interest rates.

3.6 Conclusion

This chapter provides an open economy model of bank runs with a unique equilibrium. Bad signals about the economic fundamentals trigger bank runs by forcing depositors to coordinate their actions, while good signals do not. Based on depositors' information structure, we can relate the probability of a bank run or currency crisis to the amount of capital inflows. We find that the capital inflows can increase

³²The loss of export competitiveness was explained by the three factors. First, the yen's depreciation against the dollar eroded the price competitiveness of the other East Asian countries. Second, some ASEAN countries have faced growing competition with the mainland China. Third, semi-conductors were in low demand cycle.

the probability of crises, when the return on domestic investment is lower than foreign interest rates. This result is consistent with the previous empirical findings that show that lower growth rates and higher domestic and foreign interest rates are strongly associated with the onset of banking crises. The recent East Asian financial crisis also shows that the return on long-term investments decreased, while foreign interest rates were on upward trend. These facts suggest that the increase in capital inflows may have raised the likelihood of runs.

4 A Twin Crisis Model with a Large Trader and Small Depositors

4.1 Introduction

A common view of many recent international financial crises is the simultaneous occurrence of a domestic bank run and a currency crisis. This so-called “twin crisis” phenomenon was notable especially in the crises in Chile (1982), Mexico (1994), and East Asia (1997). Kaminsky and Reinhart (1999) first provide empirical findings of this “twin crisis” phenomenon. Using a large data set, they find that domestic banking crises are accompanied by massive devaluations.

Several factors drew researchers’ attention as causes of the twin crisis so far. In particular, as discussed in earlier chapters, the following three factors are examined with considerable efforts and supported by some of the previous empirical papers. First, the mismatches in the maturity and the currency denomination of assets and liabilities are associated with the occurrence of currency crises. Such mismatches rendered the countries vulnerable to the change in the international financial markets and subsequently self-fulfilling crisis.³³ Second, several empirical papers find the connection between the outbreak of the crisis and economic fundamentals, such as growth rates and interest rates.³⁴ These negative factors for the economic fundamentals make investors more pessimistic about the country, and withdraw their money from the country or attack its currency.

Third, some academic researchers and policymakers support the view that large traders in the currency market can be a source of market panic and short-terminism.³⁵ For example, the financier George Soros was accused of causing the Asian crisis by Dr. Mahathir, the prime minister of Malaysia. Such accusation is still controversial, however, because the estimated size of large traders’ is too small, compared to the entire forex market and the amount of international re-

³³See footnote 2.

³⁴See footnote 4.

³⁵Corsetti, Pesenti, and Roubini (2000) present a comprehensive discussion about the role of large traders in the currency crises.

serves available to the monetary authority, to cause a currency crisis.³⁶ But if there is information asymmetry, that is, markets believe that large traders have more precise information, even modest short positions by large traders may cause a herd-like behavior of other traders.³⁷

The model presented in this chapter provides theoretical underpinnings for the twin crisis phenomena mentioned above. In the model small depositors and a large trader engage in a simultaneous game.³⁸ The large trader commands much more resources than the small depositors. Both the large trader and the small depositors are assumed to be well informed about the underlying economic fundamentals, but not to be perfectly informed. The large trader gains if his attack on the peg is successful, but loses if the peg is maintained. Similarly, when the peg is collapsed, a typical small depositor's payoff is bigger when she runs on the bank than that when she waits. In contrast when the peg is maintained, her payoff is bigger when

³⁶Brown, Goetzmann, and Park (1998) estimate the net position of hedge funds and find that there is no unusual short-position during the crisis.

³⁷Financial Stability Forum (2000) suggests that some macro hedge funds obtained a very high reputation about their access to precise information and ability to analyze macro developments. Furthermore, many financial institutions provided credit to hedge funds willingly. Information about the behavior and strategy of hedge funds was considered seriously among a wide range of investors.

The results of empirical studies about herding and positive feedback trading (buying winners and selling losers) are mixed, however.

Frankel and Schmukler (1996) examine the role of domestic investors relative to international investors in the Mexican crisis by using closed end fund data. They find that domestic residents played the leading role in portfolio movement and capital outflows.

Lee, Lin and Liu (1999) study trading patterns of three types of investors: large individual investors, institutional investors, and small individual investors. Their result is that small investors appear to herd, while large individual investors are the most influential in the market.

Choe, Kho and Stultz (1998) examine the impact of foreign investors on Korea's stock returns during 1996-1997. They find evidence of positive feedback trading and herding by foreign investors before the crisis. However, the evidence becomes weaker during the crisis and positive feedback disappears.

Kim and Wei (1999) compare the trading behavior of different categories of foreign portfolio investors in Korea. They find that individual investors herd significantly more than institutional investors, and that non-resident investors herd significantly more than their counterparts.

For more comprehensive discussions, see Corsetti, Pesenti, and Roubini (2000) 55-58.

³⁸We assume that depositors are small and a trader is large in the model. This assumption is based on the fact that average resources of depositors are much smaller than that of a currency trader. Also, a typical depositor is anonymous, while some large traders establish strong reputation in the currency market.

she waits until the last period than that when she runs on the bank. In the face of a withdrawal of deposits and a currency attack, the monetary authority defends its currency peg by using foreign reserves.

The sources of the two crises are explained by two factors; economic fundamentals and foreign liabilities in the domestic banking sector. Economic fundamentals affect the prospects of the bank and those of the domestic currency in the same direction. This mechanism is aggravated through foreign liabilities in the domestic banking sector. Thus, a banking crisis, which is generated by early withdrawals of deposits denominated in dollars, makes the monetary authority more difficult to maintain the peg. As a result, the large trader finds it more advantageous to attack the currency. Consequently, the small depositors become more pessimistic about the prospects of the bank and more likely to withdraw their money from the bank. Since the banking crisis is associated with the currency crisis, the increase of the proportion of deposits denominated in dollars renders the economy more vulnerable to twin crises.

In the subsequent sections, we will investigate how the large trader can exercise strong influence in the crisis in two ways. We first focus on the effects of the size of the large trader. Second, we allow the change in relative precision of information between two types of agents. That is, we examine the case in which the large trader has more precise information than the small depositors and contrast this result with the case in which small depositors have more precise information.³⁹ We then investigate the case in which only some proportion of the deposits is denominated in dollars, and see how the increase of the deposits denominated in dollars affects the results.

Our main findings are that the presence of the large trader generally makes small depositors more likely to withdraw their money from the bank. That is, compared

³⁹ As Corsetti, Pesenti, and Roubini (2000) discuss, there are many reasons to expect that large traders have more precise information than small depositors. For example, large traders may be able to devote more resources to data collection and analysis, and obtain superior information. However, considering the case under which small market participants are better suited to exploit information asymmetries and other market inefficiencies, the influence of large traders may be quite limited.

to the case in which there is no large trader, small depositors withdraw their money from the bank when economic fundamentals are stronger. Nonetheless, when a typical small depositor has more precise information than the large trader, the large trader's influence on the small depositor is moderate. But when the large trader has more precise information than a typical small depositor, his influence becomes much larger. The model also shows that these patterns become more important as the proportion of deposits denominated in dollars increases.

In the previous literature on the "twin crises," Goldfajn and Valdes (1997), Miller (1998) and Chang and Velasco (1998a,b and c) offer models which describe the connection between domestic bank runs and currency crises. Although Goldfajn and Valdes endogenize the probability of crises, they neglect the possibility of panic-based crises. The Miller and the Chang and Velasco models consider self-fulfilling crises, but their models use multiple-equilibria. Such multiple-equilibria approaches have three problems, as discussed in Chapter 2 (see Section 2.2).

In this chapter, we rely on the Carlsson and van Damme (1993) technique in order to endogenize the probability of both types of crises and derive a unique outcome in a framework with self-fulfilling beliefs. Recently, Goldstein (2000) constructs a model which demonstrates the connection between domestic bank runs and currency crises.⁴⁰ His model is also based on the Carlsson and van Damme technique. He finds that foreign liabilities increase the correlation between domestic bank runs and currency crises and that foreign liabilities render the economy more vulnerable to crises as a whole.

The model presented in this chapter modifies Goldstein's model by varying the relative precision of information between two types of the agents and by incorporating one large trader in the currency market. The technique to examine the information problem follows Corsetti, Dasgupta, Morris, and Shin (2000). They build a model of currency crises where a single large trader and a continuum of small traders independently decide whether to attack a currency based on their private information about economic fundamentals. They find that the presence of

⁴⁰See Subsection 2.3.2 in Chapter 2.

the large trader makes all other traders more aggressive in their selling. In particular, small traders are more likely to attack the currency when the large trader has relatively more precise information.

The rest of the chapter is organized as follows. Section 2 presents a description of the economy and agents' information structure assumed in the model. Section 3 derives the equilibrium in a simultaneous game between small depositors and a large trader. Section 4 examines the effect on the equilibrium of changes in the precision of the agents' information. We focus on the interaction between the size of the trader and his information precision. Section 5 investigates a case in which only some proportion of the deposits are denominated in dollars. Conclusions are provided in Section 6.

4.2 The Model

4.2.1 The Economic Environment

We consider a small open economy where the monetary authority pegs the exchange rate to dollars. There are three periods $(0,1,2)$. The economy has a banking sector and a currency market. There are two types of risk-neutral agents; a continuum depositors in the banking sector and a single large trader in the currency market. Let l denote the sum of financial resources that are mobilized by small depositors and a large trader. The variable l is assumed to vary between 0 and 1.⁴¹ We assume that a large trader can mobilize resources up to $\lambda < 1$. Thus, the maximum combined sum of resources available to small depositors amounts to $1 - \lambda$.

Each depositor saves money in the bank in period 0, and has to decide whether to demand her money from the bank in period 1 or to wait until period 2. The commercial bank invests money in long-term domestic technology. The technology generates 1 unit of output at period 1 or R units of output at period 2. We assume that R is not a fixed parameter, but rather depends on θ , the random state of the

⁴¹Following Corsetti, Pesenti and Roubini (2000), the boundaries of θ can be regarded as credit constraints, short-sale restrictions, or official guidelines that limit the speculative positions in the currency market.

world,⁴² and n , the proportion of the depositors who withdraw their money at period 1. The reason for the dependence on n is an increasing return to scale or a liquidity constraint, following Goldstein (2000). State θ has an (improper) uniform prior over real line.⁴³ The long-term return $R(\theta, n)$ is increasing in θ , given that the asset is local, and decreasing in n .

Depositors choose their actions in order to maximize their expected payoffs. Following Goldstein (2000), we assume that all the deposits are denominated in dollars for the moment. This means that there is a currency mismatch between banks' assets and liabilities. This mismatch creates a bi-directional connection between the bank and the currency market. If the depositors withdraw their money early and the peg is maintained, they obtain 1 dollar. If they wait until period 2 and the peg is maintained, they receive $R(\theta, n)$ dollars. If the peg is broken, however, they get 1 if they withdraw their money early, but nothing if they wait. Hence the net payoff for waiting under the peg is $R(\theta, n) - 1$, while the payoff under the collapse of the peg is -1 .

In the currency market, short selling of a large trader consists of borrowing the domestic currency and selling it for dollars. There is a cost of selling short, denoted by $t > 0$. The cost t can be viewed as the sum of interest rate differential and transaction costs. The trader chooses his actions in order to maximize his expected payoffs. The payoff for a successful attack on the currency is given by 1, and the payoff for refraining from an attack is given by 0. Hence, the net payoff for a successful attack on the currency is $1 - t$, while the payoff for an unsuccessful attack is given by $-t$.⁴⁴

⁴²Following Goldstein (2000), we assume that θ can be regarded as either the terms of trade or the productivity level.

⁴³As discussed in Morris and Shin (2000), improper priors allow us to focus on the updated beliefs of small depositors and a large trader conditional on their signals without considering the information contained in the prior distribution. In any case, our results with the improper prior can be regarded as the limiting case when the information in the prior density tends to zero.

⁴⁴As Corsetti, Dasgupta, Morris and Shin (1999) mention, the assumption that the large trader gains in the devaluation may not be widely accepted. If the large trader is an investor who possesses a substantial holding of assets denominated in the currency under attack (a U.S. pension fund with equity holdings in the target country, for instance), he may not want an attack to occur. If this is the case, the presence of the large trader may decrease the probability of twin crises.

The monetary authority tries to maintain a fixed exchange rate. The authority uses foreign reserves in order to defend against currency attacks as well as to respond to the withdrawal of deposits.⁴⁵ Whether the foreign reserve is enough for maintaining the peg depends on the strength of the economic fundamentals, the incidence of early withdrawals of deposits, and the probability of a speculative attack against the peg. Assuming that the monetary authority predetermines some critical level of economic fundamentals θ below which the monetary authority is unwilling to defend the currency peg by using foreign reserves. The currency peg fails if and only if

$$l \geq \theta \quad (13)$$

Thus, when the fundamentals are sufficiently strong (i.e. $\theta > 1$) the currency peg is maintained regardless of the actions of small depositors and the large trader. When $\theta \leq 0$, the peg is abandoned even in the absence of the early withdrawal of deposits and a speculative attack. In the intermediate case when $0 < \theta \leq 1$, an early withdrawal of deposits and an attack on the currency will break the peg, if the aggregate money is large enough, but not otherwise. This three-tier classification of fundamentals follows Morris and Shin (1998).

Both small depositors and a large trader decides their action simultaneously

In this sense, the initial portfolio positions should be important for the large trader.

Empirical studies show mixing results on this issue. Brown, Goetzman and Ibbotson (1997) examine the performance of the offshore hedge funds during 1989-1995 by using annual data on both disfunc and currency operating funds. They find that hedge funds obtain positive systematic risk-adjusted returns. But this superior performances do not seem to be evidence of superior managerial skills.

Fung and Hsieh (1999) also show that large hedge funds actually gained during the ERM crisis in 1992. They find that the 25% net asset value gain of the Quantum Fund in September 1992 can be explained by its positions against the British pound.

Ackermann, McEnally, and Ravenscraft (1999) find contrasting results by analyzing monthly returns for both U.S. and offshore funds during 1988-1995. Controlling survival bias and other data-conditioning biases, they find that hedge funds consistently outperform mutual funds. However, when considering absolute or total-risk-adjusted returns, hedge funds do not consistently beat the market. In addition, the superior performance of hedge funds over mutual funds are associated with higher incentive fees.

⁴⁵For simplicity we abstract welfare considerations for the authority.

and independently.⁴⁶ The timing of the events is as follows:

Period 0	Small depositors deposit money in the bank. Commercial bank invests the money in the domestic technology. A large trader holds domestic currency.
Period 1	Signals are observed. Small depositors decide whether to run. A large trader decides whether to attack the currency.
Period 2	Aggregate outcomes are realized.

4.2.2 Information

We next specify the information structure of the two types of agents. Although the large trader and the small depositors do not know the true θ in period 1, they receive informative private signals about it. The large trader observes signal

$$y = \theta + \gamma\eta$$

where $\gamma > 0$ is a constant, η is a random variable with mean zero and with smooth symmetric density $g(\cdot)$. We denote as $G(\cdot)$ the cumulative distribution function for $g(\cdot)$. Similarly, a typical small depositor i observes signal

$$x_i = \theta + \sigma\varepsilon_i$$

where $\sigma > 0$ is a constant and the individual specific noise ε_i is distributed according to smooth symmetry density $n(\cdot)$ with mean zero. We denote as $N(\cdot)$ the *c.d.f.* for $n(\cdot)$. We assume that ε_i is *i.i.d.* across depositors and that each is independent of η .

It is noteworthy that even if σ and γ are very small, the agents do not share the information of θ . This lack of common knowledge is already a familiar feature in global games literature. While there is no public information about θ , we assume

⁴⁶We abstract from intertemporal considerations and focus only on one-period model in the following sections.

that the distribution of θ and those of η and ε_i are common knowledge. This makes agents coordinate their actions after receiving the signals. The whole story at period 1 is as follows.

After observing her signal, the representative depositor i can guess the true value of θ and the distribution of signals reaching the other agents in the economy, as well as their estimate of the true θ . It is important to stress that she can rely only on her information to form her beliefs. Similarly, the other agents will also rely on their own information to form their beliefs. This departure from the assumption of common knowledge of the economic fundamentals is the key to obtaining a unique outcome. The relative magnitude of the constants σ and γ indicates the relative precision of the information between the depositors and the trader.

In the game outlined above, a large trader's strategy is a rule of action which maps each realization of his signal on one of two actions - to attack or to refrain. Similarly, a typical small depositor's strategy is a rule of action that maps each realization of her signal on one of two actions - to withdraw her money from the bank or to wait. In the next section, we will look for the Bayes Nash equilibria of the game. In the equilibria, the action prescribed by each agent's strategy maximizes his/her expected payoff, conditional on his/her signal, when all other agents follow their strategies.

4.3 Equilibrium

This section characterizes the equilibrium. To make the size effect clear, we will consider first the equilibrium with only small depositors ($\lambda = 0$), and that with only a large trader ($\lambda = 1$). Then we will proceed to the equilibrium with both small depositors and a large trader.

4.3.1 Equilibrium with Only Small Depositors

We first present a case in which there are only depositors in the economy ($\lambda = 0$). This case is similar to the bank run model of Goldstein and Pauzner (1999). We

will consider the trigger strategies in which depositors withdraw their money from the bank if the signal falls below a critical value x^* . This unique equilibrium can be characterized by two variables; a critical value of the true state θ^* , below which the currency peg will always collapse, and a critical value of the signal x^* such that small depositors receiving a signal below this value will always withdraw early. Since the true state is θ and small depositors withdraw only if they observe a signal below x^* , the probability that any particular depositor receives a signal below x^* is:

$$\text{prob}(x_i \leq x^* | \theta) = N\left(\frac{x^* - \theta}{\sigma}\right)$$

Since the noise is independent of the economic fundamentals, the incidence of withdrawals is equal to this probability. We know that a withdrawal will make the peg broken if $l \geq \theta$, that is, $N\left(\frac{x^* - \theta}{\sigma}\right) \geq \theta$. The critical state θ^* below which the currency collapses is determined when $l = \theta^*$, that is,

$$N\left(\frac{x^* - \theta^*}{\sigma}\right) = \theta^* \quad (14)$$

Given x^* , the peg collapses by the early withdrawal of the deposits for any realization of the economic fundamental $\theta \leq \theta^*$, and survives otherwise. This is the first equilibrium condition - a "critical mass condition."

Second, we consider the optimal trigger strategy for a small depositor observing a signal x_i , given θ^* . The small depositor has the conditional probability of a collapse of the peg:

$$\text{prob}(\theta \leq \theta^* | x_i) = N\left(\frac{\theta^* - x_i}{\sigma}\right)$$

Hence the small depositor withdraws her money from the bank, if and only if her expected payoff for waiting is less than that of withdrawing early. A small depositor who receives the signal x^* must be indifferent about whether to withdraw

or leave money in the bank at period 1. Equating her expected payoffs from withdrawing at period 1 to those from leaving money in the bank, we obtain an implicit definition of the trigger point x^* :

$$\int_{\theta^*}^{\infty} R\left(\theta, n\left(\frac{\theta - x^*}{\sigma}\right)\right) d\theta = 1 \quad (15)$$

where $n\left(\frac{\theta - x^*}{\sigma}\right)$ denotes the posterior density over θ for this depositor, conditional on signal x^* . This is called as “optimal cutoff” condition.

The equilibrium is characterized by the equations (14) and (15). Thus we obtain the following proposition.

Proposition 5 *If $\lambda = 0$,*

$$\begin{aligned} \theta^* &= N\left(\frac{x^* - \theta^*}{\sigma}\right) \\ &= 1 - N(\delta^*) \end{aligned}$$

where $\delta^ = \frac{\theta^* - x^*}{\sigma}$, which is the unique solution to the equations (14) and (15).*

The currency peg will collapse if the economic fundamentals θ falls below $1 - N(\delta^*)$, while each small depositor will withdraw her money from the bank if her signal falls below x^* , where δ^* and x^* are the uniquely determined by the equations (14) and (15).

4.3.2 Equilibrium with a Single Large Trader

We next consider the opposite case of $\lambda = 1$, in which there is only a single large trader. Since this single trader controls the market, there is no need for an equilibrium condition corresponding to the “critical mass condition” (14). The only “optimal cutoff” condition matters for a single trader. He will attack the currency if and only if the expected payoff for an attack is non-negative.

$$G\left(\frac{1 - y}{\gamma}\right) \geq t$$

Proposition 6 If $\lambda = 1$,

$$G\left(\frac{1-y^*}{\gamma}\right) = t$$

$$\Leftrightarrow y^* = 1 - \gamma G^{-1}(t)$$

Hence he attacks if and only if $y \leq y^* = 1 - \gamma G^{-1}(t)$. Note that the trigger y^* is smaller than 1, but approaches 1 as γ goes to 0.

4.3.3 Equilibrium with Small Depositors and a Large Trader

We now consider the case where $0 < \lambda < 1$. We will show that there is a unique, dominance solvable equilibrium in the case in which both the small depositors and the large trader follow their respective trigger strategies around the critical points x^* and y^* . The argument will be developed in two steps. We will first solve for an equilibrium in trigger strategies and then show that this solution can be obtained by iterating deletion of strictly dominated strategies.

Suppose that the small depositors follow the trigger strategy around x^* . From the previous subsection we know that $N\left(\frac{x^* - \theta}{\sigma}\right)$ is the proportion of small depositors receiving a signal lower than x^* and therefore withdrawing their money from the bank at θ . Now, the small depositors amount to only a fraction $1 - \lambda$ of the market. A withdrawal by the small depositors alone is sufficient to break the peg at θ if $(1 - \lambda)N\left(\frac{x^* - \theta}{\sigma}\right) \geq \theta$. Denote as $\underline{\theta}$ a level of economic fundamentals below which a withdrawal by the depositors alone is sufficient to make the peg collapse. $\underline{\theta}$ is defined by:

$$(1 - \lambda)N\left(\frac{x^* - \underline{\theta}}{\sigma}\right) = \underline{\theta} \tag{16}$$

That is, when $\theta \leq \underline{\theta}$, a withdrawal will lead to the collapse of the peg regardless of the action of the large trader.

Next, we incorporate an additional pressure brought by the large trader. If the small depositors follow the trigger strategy around x^* , the incidence of withdrawal

at θ is denoted by $(1 - \lambda)N\left(\frac{x^* - \theta}{\sigma}\right)$. If the large trader attacks the currency at the same time, the financial resources mobilized are increased by λ . Hence, if the withdrawals and the attack occur simultaneously, the peg is broken whenever $(1 - \lambda)N\left(\frac{x^* - \theta}{\sigma}\right) + \lambda \geq \theta$. Thus we can define the critical value of the economic fundamentals at which a peg is broken, if and only if the withdrawals and the attack occur simultaneously. Denote $\bar{\theta}$ as such a critical value. It is defined by:

$$(1 - \lambda)N\left(\frac{x^* - \bar{\theta}}{\sigma}\right) + \lambda = \bar{\theta} \quad (17)$$

Obviously, $\bar{\theta}$ lies between $\underline{\theta}$ and 1. Note that both $\underline{\theta}$ and $\bar{\theta}$ depend on the switching point x^* . In turn, x^* is a function of the trader's switching point y^* .

We now consider the expected payoff of the large trader. A large trader receiving signal y assigns probability $G\left(\frac{\bar{\theta} - y}{\gamma}\right)$ to the event that $\theta \leq \bar{\theta}$. Since his expected payoff for attacking conditional on y is $G\left(\frac{\bar{\theta} - y}{\gamma}\right)$, it is optimal for him to attack if and only if $y \leq y^*$, where y^* is defined by:

$$G\left(\frac{\bar{\theta} - y^*}{\gamma}\right) = t \quad (18)$$

When $\theta \leq \underline{\theta}$, the strategies of the small depositors are sufficient to break the peg. When $\theta \in (\underline{\theta}, \bar{\theta}]$ the peg will be broken only if the small depositors withdraw their money from the bank and the large trader attacks the currency at the same time, while if $\theta > \bar{\theta}$, the monetary authority can maintain the peg, irrespective of the actions of the small depositors and the large trader.

A typical small depositor who receives the signal x^* must be indifferent about whether to withdraw or to leave her money in the bank at period 1. Equating the depositor's expected payoffs from withdrawing early to her expected payoffs from leaving money in the bank, we obtain an implicit definition of the trigger point x^* :

$$\int_{\bar{\theta}}^{\infty} R\left(\theta, n\left(\frac{\theta - x^*}{\sigma}\right)\right) d\theta + \int_{\underline{\theta}}^{\bar{\theta}} R\left(\theta, n\left(\frac{\theta - x^*}{\sigma}\right)\right) \left[1 - G\left(\frac{y^* - \theta}{\gamma}\right)\right] d\theta = 1 \quad (19)$$

Since the probability that the trader will attack the currency at θ given his trigger strategy around y^* is given by $G\left(\frac{y^* - \theta}{\gamma}\right)$, the payoffs are weighted by this value. The analysis of the model can be simplified with a change of variables. Let

$$z = \frac{\theta - x^*}{\sigma}, \quad \underline{\theta} = \frac{\theta - x^*}{\sigma}, \quad \text{and} \quad \bar{\theta} = \frac{\bar{\theta} - x^*}{\sigma}.$$

From (18),

$$y^* = \bar{\theta} - \gamma G^{-1}(t) = x^* + \sigma \bar{\theta} - \gamma G^{-1}(t)$$

Then

$$\begin{aligned} G\left(\frac{y^* - \theta}{\gamma}\right) &= G\left(\frac{x^* + \sigma \bar{\theta} - \gamma G^{-1}(t) - \theta}{\gamma}\right) \\ &= G\left(\frac{x^* + \sigma \bar{\theta} - \theta}{\gamma} - G^{-1}(t)\right) \\ &= G\left(\frac{\sigma}{\gamma}(\bar{\theta} - z) - G^{-1}(t)\right) \end{aligned}$$

(19) becomes

$$\frac{1}{\sigma} \int_{\bar{\theta}}^{\infty} R(\sigma z + x^*, n(z)) dz + \frac{1}{\sigma} \int_{\underline{\theta}}^{\bar{\theta}} R(\sigma z + x^*, n(z)) \left[1 - G\left(\frac{\sigma}{\gamma}(\bar{\theta} - z) - G^{-1}(t)\right)\right] dz - 1 = 0 \quad (20)$$

Note that both $\underline{\theta}$ and $\bar{\theta}$ are monotonically decreasing in x^* , since

$$\frac{d\underline{\delta}}{dx^*} = -\frac{1}{(1-\lambda)n(\underline{\delta})+\sigma} < 0$$

$$\frac{d\bar{\delta}}{dx^*} = -\frac{1}{(1-\lambda)n(\bar{\delta})+\sigma} < 0$$

Observe that the left hand side of (20) is continuous and strictly increasing in both $\underline{\delta}$ and $\bar{\delta}$. In turn it is continuous and strictly decreasing in x^* . The left hand side of (20) is positive for a sufficiently small x^* , while it is negative for a sufficiently large x^* . Thus, there is a unique solution to (20). Once x^* is determined, the trader's switching point y^* can be obtained from (18).

4.3.4 Dominance Solvability

In the previous section, we have focused on trigger strategies, and have shown that there is a unique equilibrium within this class of strategies. We can show further that focusing on trigger strategies does not lose generality. The trigger equilibrium derived above turns out to be the only set of strategies that survive the iterated deletion of strictly dominated strategies. The dominance solvability property is understood for both symmetric and asymmetric binary action global games. The sketch of the proof below follows Morris and Shin (2000a and b).

We denote by $\Pi(x, \hat{x})$ the expected utility from leaving one's money in the bank conditional on signal x when all other depositors follow a switching strategy around \hat{x} and when the large trader plays his best response against this switching strategy (which is to switch at $y(\hat{x})$, obtained from (18)). This expected payoff is given by:

$$\Pi(x, \hat{x}) = \int_{\underline{\theta}(\hat{x})}^{\infty} R\left(\theta, n\left(\frac{\theta-x}{\sigma}\right)\right) d\theta + \int_{\underline{\theta}(\hat{x})}^{\bar{\theta}(\hat{x})} R\left(\theta, n\left(\frac{\theta-x}{\sigma}\right)\right) \left[1 - G\left(\frac{y(\hat{x})-\theta}{\gamma}\right)\right] d\theta \quad (21)$$

where $\underline{\theta}(\hat{x})$ denotes the value of $\underline{\theta}$, when small depositors follow the \hat{x} -switching strategy. Similarly, $\bar{\theta}(\hat{x})$ means the value of $\bar{\theta}$, when small depositors follow the

\hat{x} -switching strategy. We assume that \hat{x} takes the value $-\infty$ and ∞ also, which correspond respectively to the provision that the depositors either always and never withdraw early. Note that $\Pi(x, \hat{x})$ is increasing in x and decreasing in \hat{x} .

For sufficiently low values of x , withdrawing money is a dominant action for a small depositor, regardless of the actions of other agents. Let \underline{x}_0 be the threshold value of x below which it is a dominant action for the depositor to withdraw early. Any belief $x < \underline{x}_0$ will indicate that a depositor withdraws. Both small depositors and the large trader recognize this and eliminate any strategy for the other depositors who leave their money on deposit for signals below \underline{x}_0 . But then, leaving money on deposit cannot be optimal for a depositor whenever her signal is below \underline{x}_1 where \underline{x}_1 solves:

$$\Pi(\underline{x}_1, \underline{x}_0) = 1$$

This equation comes from the fact that the switching strategy around \underline{x}_1 is the best response to the switching strategy around \underline{x}_0 , and even the most optimistic depositor believes that the incidence of withdrawals is higher than that implied by the switching strategy around \underline{x}_0 and the large trader's best response $y(\underline{x}_0)$. Since the higher the payoff for withdrawing, the more the incidence of withdrawal of the other depositors, any strategy that leaves money in the bank for signals lower than \underline{x}_1 is dominated. Hence, these two rounds of deletion of withdrawal by other depositors rule out any strategy that leaves money in the bank for signals lower than \underline{x}_1 . Repeating this procedure, we can generate the increasing sequence:

$$\underline{x}_0 < \underline{x}_1 < \dots < \underline{x}_k < \dots$$

where any strategy that leaves money in the bank for signal $x < \underline{x}_k$ is eliminated after $k + 1$ rounds of deletion of dominated strategies. The sequence is increasing, since $\Pi(x, \hat{x})$ is increasing in the first argument and decreasing in the second argument. The smallest solution \underline{x} to the equation $\Pi(x, x) = 1$ is the smallest upper

bound of this sequence, and its limit. Any strategy that leaves money in the bank for signal lower than \underline{x} does not remain after iterating deletion of all dominated strategies.

If x is the largest solution to $\Pi(x, x) = 1$, we can conduct a similar argument from “above.” That is, a strategy that withdraws early on the signal larger than x does not remain after eliminating all iteratively dominated strategies. But if there is a unique solution to $\Pi(x, x) = 1$, the smallest solution just equals the largest solution. There is precisely one strategy surviving iterated dominance. This also indicates that this is only one equilibrium strategy.

4.4 Precision of Information and Size of a Trader

Unlike the economy with only one type of agents, we cannot obtain closed form solutions of the equilibrium for all σ and γ . However, we can obtain closed form solutions in limiting cases by letting agents have arbitrarily more precise information about the economic fundamentals. We will consider the two cases where either the large trader has more precise information than the small depositors ($\sigma > \gamma$) and where the large trader has less precise information than the small depositors ($\sigma < \gamma$). Particularly, we examine the limiting case where both σ and γ tend to zero (that is, both the small depositors and the large trader observe very precise information about θ), but where one of the coefficients approaches zero faster than the other. When the large trader has relatively more precise information than a typical small depositor, we have $\frac{\sigma}{\gamma} \rightarrow \infty$, as $\sigma \rightarrow 0$ and $\gamma \rightarrow 0$. In contrast, when the large trader has relatively less precise information than a typical small depositor, we have $\sigma \rightarrow 0$ and $\gamma \rightarrow 0$, but $\frac{\sigma}{\gamma} \rightarrow 0$.

Note that, as $\frac{\sigma}{\gamma}(\bar{\delta} - z) \geq 0$ for $\bar{\delta} \geq z$, the value of $G\left(\frac{\sigma}{\gamma}(\bar{\delta} - z) - G^{-1}(t)\right)$ in equation (20) will lie between 1 and $1 - t$ which corresponds to the optimal cutoff for the large trader.

4.4.1 A Large Trader with Precise Information ($\frac{\alpha}{\gamma} \rightarrow \infty$)

First, we make the large trader's information more precise compared to the small depositors. That is, we take the limit of the equilibrium expressions as $\frac{\alpha}{\gamma} \rightarrow \infty$. In this case, the small depositors do not consider the noise of the large trader's information. The reason for this result is that the small depositors regard the signal of the large trader equivalent to the true state of the economic fundamental. As $\frac{\alpha}{\gamma} \rightarrow \infty$, the expression $G\left(\frac{\alpha}{\gamma}(\bar{\delta} - z) - G^{-1}(t)\right)$ in equation (20) approaches 1, for all $\bar{\delta} \geq z$. Equation (20) becomes:

$$\frac{1}{\sigma} \int_{\bar{\delta}}^{\infty} R(\sigma z + x^*, n(z)) dz = 1 \quad (22)$$

$$\Leftrightarrow \int_{\bar{\delta}}^{\infty} R\left(\theta, n\left(\frac{\theta - x^*}{\sigma}\right)\right) d\theta = 1 \quad (23)$$

The equilibrium consists of equations (16), (17), (18), and (22) or (23). We obtain the following proposition:

Proposition 7 *In the equilibrium at the limit as $\frac{\alpha}{\gamma} \rightarrow \infty$, we have (16), (17), (18), and (22) or (23). Then, we get:*

$$\begin{aligned} \bar{\theta} &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ \frac{\bar{\theta} - x^*}{\sigma} &\rightarrow \bar{\delta} \\ \frac{\bar{\theta} - y^*}{\gamma} &\rightarrow G^{-1}(t) \\ \underline{\theta} &\rightarrow (1 - \lambda) [1 - N(\underline{\delta})] \end{aligned}$$

where $\bar{\delta}$ and $\underline{\delta}$ are the unique solutions to the equations (22) and:

$$\lambda = (1 - \lambda) [N(\bar{\delta}) - N(\underline{\delta})] + \sigma(\bar{\delta} - \underline{\delta}) \quad (24)$$

The equation (24) is given by combining (16) and (17).

It is worthwhile to examine the behavior of the model for $\frac{\sigma}{\gamma} \rightarrow \infty$, when we also allow the information of both small depositors and a large trader to become arbitrarily precise, that is, $\sigma \rightarrow 0$ and $\gamma \rightarrow 0$. The following corollary summarizes the result.

Corollary 8 *As $\sigma \rightarrow 0$, $\gamma \rightarrow 0$ and $\frac{\sigma}{\gamma} \rightarrow \infty$,*

$$\begin{aligned} x^* &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ y^* &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ \bar{\theta} &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ \underline{\theta} &\rightarrow (1 - \lambda) [1 - N(\underline{\delta})] \end{aligned}$$

where $\bar{\delta}$ and $\underline{\delta}$ are the unique solutions to the equations (22) and (24).

4.4.2 A Large Trader with Less Precise Information ($\frac{\sigma}{\gamma} \rightarrow 0$)

Next consider the case in which the large trader has less precise information than the small depositors. In this case, the typical small depositor regards her own signal almost equal to the economic fundamentals. In contrast, she considers the information of the large trader as less precise. When $\frac{\sigma}{\gamma} \rightarrow 0$, the expression $G\left(\frac{\sigma}{\gamma}(\bar{\delta} - z) - G^{-1}(t)\right)$ in equation (20) approaches $1 - t$, for all $\bar{\delta} \geq z$. Equation (20) becomes:

$$\frac{1}{\sigma} \int_{\bar{\delta}}^{\infty} R(\sigma z + x^*, n(z)) dz + \frac{1}{\sigma} \int_{\underline{\delta}}^{\bar{\delta}} R(\sigma z + x^*, n(z)) t dz = 1 \quad (25)$$

$$\Leftrightarrow \int_{\bar{\theta}}^{\infty} R\left(\theta, n\left(\frac{\theta - x^*}{\sigma}\right)\right) d\theta + \int_{\underline{\theta}}^{\bar{\theta}} R\left(\theta, n\left(\frac{\theta - x^*}{\sigma}\right)\right) t d\theta = 1 \quad (26)$$

We note that the behavior of the large trader is crucial for the small depositors' payoff when the economic fundamental lies between $\bar{\theta}$ and $\underline{\theta}$. Since the signal of the large trader is rather noisy, the probability of $G\left(\frac{\sigma}{\gamma}(\bar{\delta} - z) - G^{-1}(t)\right)$ will remain almost

constant and equivalent to $1 - t$ corresponding to the economic fundamentals in the interval between $\bar{\theta}$ and $\underline{\theta}$. That is, the small depositor regards the probability of an currency attack constant over the economic fundamentals between $\bar{\theta}$ and $\underline{\theta}$.

The equilibrium consists of equations (16), (17), (18), and (25) or (26). We obtain the following proposition:

Proposition 9 *In the equilibrium at the limit as $\frac{\sigma}{\gamma} \rightarrow 0$, we have (16), (17), (18) and (25) or (26). Then, we get:*

$$\begin{aligned}\bar{\theta} &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ \frac{\bar{\theta} - x^*}{\sigma} &\rightarrow \bar{\delta} \\ \frac{\bar{\theta} - y^*}{\gamma} &\rightarrow G^{-1}(t) \\ \underline{\theta} &\rightarrow (1 - \lambda) [1 - N(\underline{\delta})]\end{aligned}$$

where $\bar{\delta}$ and $\underline{\delta}$ are the unique solutions to the equations (24) and (25).

In closing, we summarize the relevant findings with the following corollary.

Corollary 10 *As $\sigma \rightarrow 0$, $\gamma \rightarrow 0$ and $\frac{\sigma}{\gamma} \rightarrow 0$,*

$$\begin{aligned}x^* &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ y^* &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ \bar{\theta} &\rightarrow \lambda + (1 - \lambda) [1 - N(\bar{\delta})] \\ \underline{\theta} &\rightarrow (1 - \lambda) [1 - N(\underline{\delta})]\end{aligned}$$

where $\bar{\delta}$ and $\underline{\delta}$ are the unique solutions to the equations (24) and (25).

4.5 A Comparison

So far we have established the equilibrium conditions for the four cases:

	Conditions	Results
1)	$\lambda = 0$	Proposition 5
2)	$\lambda = 1$	Proposition 6
3)	$0 < \lambda < 1, \frac{\sigma}{\gamma} \rightarrow \infty$	Proposition 7 and Corollary 8
4)	$0 < \lambda < 1, \frac{\sigma}{\gamma} \rightarrow 0$	Proposition 9 and Corollary 10

In this section we compare the trigger points of the above equilibria. First, we compare the equilibria between 1) and 3). Note that the equations (15) and (23) are the same except for $\bar{\theta}$ and θ^* . So we just compare (14) and (17). Subtracting (14) from (17), we get:

$$\begin{aligned}\bar{\theta} - \theta^* &= (1 - \lambda)N\left(\frac{x^* - \bar{\theta}}{\sigma}\right) + \lambda - N\left(\frac{x^* - \theta^*}{\sigma}\right) \\ &= \left[N\left(\frac{x^* - \bar{\theta}}{\sigma}\right) - N\left(\frac{x^* - \theta^*}{\sigma}\right)\right] + \lambda \left[1 - N\left(\frac{x^* - \bar{\theta}}{\sigma}\right)\right]\end{aligned}$$

This is equivalent to:

$$\left[\bar{\theta} - N\left(\frac{x^* - \bar{\theta}}{\sigma}\right)\right] - \left[\theta^* - N\left(\frac{x^* - \theta^*}{\sigma}\right)\right] = \lambda \left[1 - N\left(\frac{x^* - \bar{\theta}}{\sigma}\right)\right] \geq 0 \quad (27)$$

Since the right hand side of (27) is non-negative, the left hand side of (27) should be non-negative, too. Hence, we conclude that $\bar{\theta}$ is greater than θ^* . That is, with a large trader, the peg will be broken at a higher value of economic fundamentals. In addition, since $\bar{\theta}$ is increasing in λ from (27), the cutoff for small depositors, x^* , is also increasing in the size of the trader λ . Intuitively, when the large trader has more precise information, small depositors believe that the trader's signal will be close to their best estimates of the value of the economic fundamental. Hence, they become more likely to withdraw their money from the bank, that is, they find it optimal to withdraw even given higher values of the fundamentals.

Second, we compare the equilibria between 2) and 3). Regarding the trader's signal, from the equation (18), we know that in the limit as $\frac{\sigma}{\gamma} \rightarrow \infty$,

$$\frac{\bar{\theta} - y^*}{\gamma} = G^{-1}(t) \iff y^* = \bar{\theta} - \gamma G^{-1}(t)$$

This trigger point is smaller than $y^*(= 1 - \gamma G^{-1}(t))$ in the case where there is only one trader in the economy. This means that the presence of small depositors makes the large trader more cautious, because the large trader now realizes that

small depositors will not coordinate with him to increase the probability of the currency collapse by withdrawing money from the bank.

Third, compare the equilibria between 3) and 4). Observe that both equilibria have the same conditions (16), (17), and (18). The only difference lies in (22) and (25). We also notice that the right hand sides of both equations are one. The left hand sides of these equations should be the same. The left hand side of the equation (25) is bigger than the left hand side of the equation (22) by $\int_{\underline{\delta}}^{\bar{\delta}} R(\sigma z + x^*, n(z)) t dz$. Since the left hand sides of (22) and (25) are increasing in $\underline{\delta}$ both $\bar{\delta}$ and $\underline{\delta}$, $\bar{\delta}$ in equation (25) must be smaller than that in (22). This means that $N(\bar{\delta})$ in equation (22) is bigger than $N(\bar{\delta})$ in (25), and consequently, x^* in equation (22) is smaller than $N(\bar{\delta})$ in (25).

In closing this section, we provide a synthesis of what we have accomplished so far. The presence of the large trader makes small depositors more likely to withdraw their money from the bank. Compared to the case in which $\lambda = 0$, the trigger point under $\lambda > 0$ can be higher, irrespective of the relative information precision of the large trader. In particular, when the large trader has more precise information than the small depositors (given by Corollary 1), the small depositor's trigger point tends to

$$x^* = \lambda + (1 - \lambda) [1 - N(\bar{\delta})]$$

This trigger point x^* is increasing in the size of the large trader λ . We also observe that every value converges to the two benchmark cases, that is, $\lambda = 0$ and $\lambda = 1$. To see this, from (14) we get

$$\begin{aligned} \theta^* &= N\left(\frac{x^* - \theta^*}{\sigma}\right) \\ &= 1 - N(\delta^*) \end{aligned}$$

where $\delta^* = \frac{\theta^* - x^*}{\sigma}$. Regardless of the relative precision of information (i.e., regardless of whether $\frac{\sigma}{\gamma} \rightarrow \infty$ or $\frac{\sigma}{\gamma} \rightarrow 0$), we have all values converging to $1 - N(\delta^*)$, as

$\sigma \rightarrow 0$, $\gamma \rightarrow 0$ and $\lambda \rightarrow 0$; and all values converging to 1 as $\sigma \rightarrow 0$, $\gamma \rightarrow 0$ and $\lambda \rightarrow 1$.

Furthermore, if the large trader has more precise information relative to the small depositors (i.e., if $\sigma \rightarrow 0$, $\gamma \rightarrow 0$ and $\frac{\sigma}{\gamma} \rightarrow \infty$) then the convergence is more smooth than the case in which the large trader has less precise information relative to the small depositors (i.e., if $\sigma \rightarrow 0$, $\gamma \rightarrow 0$ and $\frac{\sigma}{\gamma} \rightarrow 0$).

4.6 An Equilibrium Mixing Domestic and Foreign Deposits

So far we assumed that all the deposits are denominated in dollars. In this section we modify this assumption and study the case in which some of the deposits are denominated in domestic currency. The conclusion of this analysis is that the probability of a twin crisis becomes lower as the proportion of deposits denominated in domestic currency increases. That is, the vulnerability of the economy to a twin crisis increases with the proportion of deposits denominated in dollar.

Following Goldstein (2000), we assume that the proportion of deposits denominated in dollar (foreign deposits) is α , while the proportion of deposits denominated in domestic currency (domestic deposits) is $(1 - \alpha)$. The other components of the model remain the same. The introduction of domestic deposits changes the monetary authority's problem. Since the monetary authority does not have to respond to the early withdrawal of domestic deposits, the optimal cutoff conditions will be changed as follows.

In the case of $\lambda = 0$, (14) becomes:

$$\alpha N \left(\frac{x^* - \theta^*}{\sigma} \right) = \theta^* \quad (28)$$

Similarly, in the case of $0 < \lambda < 1$, (16) and (17) become:

$$\alpha(1 - \lambda)N \left(\frac{x^* - \underline{\theta}}{\sigma} \right) = \underline{\theta} \quad (29)$$

$$\alpha(1 - \lambda)N \left(\frac{x^* - \bar{\theta}}{\sigma} \right) + \lambda = \bar{\theta} \quad (30)$$

These changes suggest that the trigger points will be smaller in the equilibrium than those in the case without domestic depositors. Importantly, the probability of a twin crisis increases as α rises. This is because when α is higher, the monetary authority has to respond to more withdrawals of dollars. This gives both depositors who own domestic and foreign deposits stronger incentives to withdraw money early, and a large trader a stronger incentive to attack the currency. Therefore, when α rises, small depositors will demand early withdrawal and a large trader will attack the currency at higher realization of the economic fundamentals.

4.7 Conclusion

This chapter presents a model that highlights the connection between domestic bank runs and currency crises in a framework in which small depositors and a large trader engage in a simultaneous game. In the model, economic fundamentals affect the prospects of the bank and those of the domestic currency in the same direction through foreign liabilities in the domestic banking sector. This pattern becomes more important as the proportion of deposits denominated in dollars increases. Another finding is that the presence of a large trader makes small depositors more likely to withdraw their money from the bank. That is, compared to the case in which there is no large trader, small depositors withdraw their money from the bank when economic fundamentals are stronger. Nonetheless, when a typical small depositor has more precise information than the large trader, the large trader's influence on the small depositor is moderate. But when the large trader has more precise information than a typical small depositor, his influence becomes much larger. The model also shows that these patterns become more important as the proportion of deposits denominated in dollars increases.

5 Issues in Recent Insurance Crises

5.1 Introduction

The insurance industry has traditionally been regarded as a relatively stable segment of the financial system. The long-term maturity of both assets and liabilities of insurance companies has prevented insurance companies from contagious runs, which frequently occur in the banking sector. Sound insurance sectors contribute to economic growth and efficient resource allocation through promoting transfer of risk and mobilizing savings. In addition, they enhance financial system efficiency by reducing transaction costs, creating liquidity, and facilitating economies of scale in investment.

The recent change of the insurance industry, however, has been considered by many to carry potential sources of vulnerability that could put to risk in systemic stability. In particular, the increasing cross-border and cross-industry M&As and cooperation among financial institutions including banks create new challenges and enhance the need for upgrading supervision and regulation. Such development requires both financial supervisors and regulators to understand its implication for financial and systemic stability concerns related to the insurance sector. However, there are limited papers that focus on stability and risks of the insurance sector in the macroeconomic framework.

This chapter aims at filling these gaps by investigating the causes, economic effects and resolution of the insurance crises. The systemic risk emerges as one of the important issues associated with financial crises in general. The concept of systemic risk is, however, quite different between banks and insurers and also between life and non-life insurance companies. Compared with banks, the risk of bankruptcy contagion may be smaller for the insurance sector, since the insurance companies hold longer-term liabilities than banks. Unlike life insurance companies, non-life insurance companies face a catalytic risk that life insurance companies do not in general. Also, the failure of non-life insurance companies can create a situation in which certain services are interrupted due to a lack of insurance protection

for users of these services. When a non-life insurance company dominates the market, such a failure can cause a significant and costly disruption, though it may not necessarily lead to financial instability.

In order to focus on the causes of the instability of the insurance sector and its relation to the entire financial stability, we exclude the non-life insurance sector from our examination in most part of this chapter. We find that most life insurance crises occurred after financial deregulation and economic expansion, followed by large output and price fluctuation. Financial deregulation caused insurance companies to employ more bank-type products to compete with other financial institutions. Economic expansion induced insurers to invest in risky assets such as mortgage and junk bonds. The resulting maturity mismatch between assets and liabilities and illiquidity of assets made insurers vulnerable to economic shocks such as large output and price fluctuation. In addition, cross-share holding between banks and insurance companies and close business relationship between two industries increased the risk of contagion. In the past crisis episodes, most ailing insurance companies ceased their operation and transferred policies to relatively sound insurers. Some governments relied on public funds to cover the loss and made consumers share the burden. The use of public funds may have disturbing effects on money demand, and subsequently consumption and investment.

The rest of the chapter is organized as follows. Section 2 describes the role of insurance sector and defines the insurance crisis with a brief survey of the previous studies on insurance sector. Section 3 reviews the previous crisis episodes in which insurance sector played a major part. From the viewpoint of systemic crisis, we select four countries (Jamaica, Japan, Korea, and the USA), which experienced collapse of multiple life insurance companies. Section 4 derives lessons from the past episodes for causes of the crises and resolution. The concluding remarks are provided in Section 5.

5.2 The Role of Insurance Sector and Its Crisis

5.2.1 The Role of Insurance Sector

The Role of Insurance Sector in Economic Growth Like banks and securities firms, insurance companies are financial intermediaries. It is not sufficient to view the insurance sector simply as pass-through mechanisms for diversifying risk under which the unfortunate few who suffer losses are compensated for funds collected from many policyholders. Such a view does not cover other fundamental contributions that the insurance makes to economic development. In particular, in many countries the role of insurance companies has changed rapidly during the last two decades. In order to meet consumers' investment and retirement savings needs, the insurance sector recently plays more a role of providers of contract savings (pension funds and insurance products),⁴⁷ and rely less on income from traditional life insurance products.

Financial intermediaries in general are credited with improving resource allocation through mobilizing and allocating savings, monitoring investment projects and credit risk, and mitigating negative shocks on capital investment. Skipper (1997) classifies insurance services in which insurance contributes to economic growth, into seven categories:

- (1) To promote financial stability by compensating those who suffer loss.
- (2) To complement government security programs.
- (3) To facilitate trade and commerce.
- (4) To help mobilize savings.
- (5) To make risk manageable more efficiently through pricing risk, transforming risk, pooling risk, and reducing risk.
- (6) To encourage loss mitigation
- (7) To foster capital allocation efficiently.

Category (1) is the most traditional and basic role of insurance companies. Cat-

⁴⁷Catalan, Impavido, and Musalem (2000) state that contract savings have long-term and illiquid liabilities, compared with banks' deposits and open-end mutual funds with short-term and liquid liabilities.

egory (3) is mainly applicable to non-life insurance companies. Categories (2) and (4) to (7) are more important for modern contract savings. Like banks, insurance companies channel savings into investment. They enhance the financial system efficiency in three ways; by reducing transaction costs associated with matching savers and borrowers and collecting information, by creating liquidity, and by facilitating economies of scale in investment. The difference between banks and insurance companies is that the maturity of both assets and liabilities of banks is shorter than that of insurance companies. This makes insurance companies to play a big role in long-term bond market and their activities more stable than those of banks.

Causality Between Insurance and Economic Growth A number of empirical studies show supportive evidence that the development of financial intermediaries has a strong correlation with economic growth. As Patrick (1966) suggests, financial sector could have either a supply-leading or demand-following relationship with economic growth. In supply-leading finance view economic growth can be induced through the supply of financial services, while in demand-following finance view its demand for financial services can induce growth in financial institutions and their assets.

Both supply-leading and demand-following finance are likely to coexist. As Patrick suggests that causation runs from financial to economic development (supply-leading relationship) in the early stage of development while the direction of causation is reversed (demand-following relationship) in the later stage. For recent studies on demand-following relationship in the insurance sector, Outreville (1996) examines factors to contribute to insurance growth. He conducts ordinary least squares estimation by using cross-sectional data of 48 developing countries in 1986. Enz (2000) examines the S-curve-shaped relation between per-capita income and insurance penetration, by incorporating a logistic demand function for insurance that allows income elasticity to vary as the economy matures.

But many subsequent researchers pose the question mainly on how important the existence and sequence of financial sector development is to economic growth.

By using panel data of 80 countries from 1960 to 1989, King and Levine (1993a and b) find that initial indicators of financial sector depth and banking activity predict subsequent levels of economic growth. Odedokun (1996) employs bi-directional Granger causality tests by using panel data of 71 countries during the 1960s and 1980s, and finds evidence suggesting that the financial sector depth Granger-causes economic growth. Also, limiting to the causality test between insurance sector and economic growth, Ward and Zurbruegg (2000) employ Granger-causality tests by using data of 9 leading OECD countries during 1961-1996. They find that the insurance sector Granger causes economic growth in some countries, while the reverse is true in other countries.

Recently, Webb (2000) investigates the mechanisms by which insurance and banking jointly stimulate economic growth through increasing productivity gains. In addition, he finds evidence of synergies among financial intermediaries. That is, each financial sector can fuel economic growth independently, but they provide greater growth impetus collectively. His result indicates that the more developed and efficient a country's financial sector, the greater its contribution to economic growth.

Moreover, recent empirical studies show that whether the economy relies on the bank-based or market-based (including insurance sector) financial system is not closely associated with economic growth.⁴⁸ This result is consistent with the view that insurance is also a part of financial intermediaries. Beck, Demirguc-Kunt, Levine and Maksimovic (2000) evaluate the impact of financial structure on economic growth using more than 33 countries data from firm-level, industry-level, and country-level. They find that distinguishing countries by financial structure does not help explaining cross-country differences in long-run GDP growth.

⁴⁸For detailed description about major countries' financial structure, see Allen and Gale (2000). Recently, Demirguc-Kunt and Levine (1999) examine the relationship between financial structure and law system. They find that countries with a Common Law tradition tend to be more market-based with strong protection of shareholders rights, good accounting regulations, low level of corruption, and no explicit deposit insurance. Instead, countries with a French Civil Law tradition, tend to have underdeveloped financial systems with poor protection of shareholders and creditor rights, poor contract enforcement, high levels of corruption, poor accounting standards, restrictive banking regulations, and high inflation.

In addition to the contribution to the economic growth on the whole, the insurance sector can contribute to the development of capital markets, by making a pool of funds accessible to both borrowers and issuers. This comes from the feature of insurance companies that deal with longer-term assets and liabilities than banks. Catalan, Impavido and Musalem (2000) study the relationship between the development of contractual savings (assets of pension funds and life insurance companies) and capital markets. By analyzing the Granger causality between contractual savings and both market capitalization and value traded in stock markets for industrialized countries, they find that the growth of contractual savings cause the development of capital markets.

5.2.2 Recent Development of Insurance Sector

The economic role of the insurance sector has kept growing, with insurance companies constituting a larger part of the domestic financial sector in most developed and some developing countries. During the 1990s, total assets of insurance companies in developed countries grew faster than those of banks. Insurance companies have also become significant players in the international capital markets. The share of the insurance sector in the money and capital markets exceeds 30% in several countries (Table 2).

Such a trend is backed by the liberalization of the financial systems, including privatization, financial consolidation, and the increase of the use of contractual savings products including the pension funds. Table 3 presents countries that permit insurance activities for banking organizations, suggesting that the majority of countries now permit such activities. In many countries rapid expansion of the life insurance industry results from the growing integration of the life insurance and contractual savings sectors. Table 4 and 5 show the recent trend of cross-border and cross-industry M&As. Most of the M&As are conducted in the USA and Europe, while their number has been increasing in Japan, too. In these countries, pensions and insurance should be closely related to each other.

Despite the rapid development of the insurance sector, the advances in regu-

lation during the last two decades have not yet kept pace with the complexity, sophistication of the insurance products and the investment strategies. Table 6 classifies forms of regulators of financial conglomerates into three categories.⁴⁹ It shows that in many countries, financial conglomerates including insurance companies are subject to multiple regulatory agencies. Such a mismatch between the development of the industry and the regulatory agencies may be insufficient to regulate and supervise the modern financial complex and add potential fragility to the financial system.

5.2.3 Insurance Crisis

The insurance industry has traditionally been regarded as a relatively stable segment of the financial system. The long-term maturity of both assets and liabilities of insurance companies has prevented insurance companies from contagious runs as seen in the banking sector. But as financial intermediaries that depend on creditors' confidence, insurance companies are not necessarily immune to the crisis situation, particularly when insurance companies assimilate banking-type activities and/or have close business relationship with banks. This subsection defines the terms "insurance crisis" and highlights the macroeconomic consequences of such situations.

After surveying several literatures, Balino and Sundararajan (1991) define financial crisis in general as "a situation in which a significant group of financial institutions have liabilities exceeding the market value of their assets, leading to runs and other portfolio shifts, collapse of some financial firms, and government intervention." Hence the term crisis refers to "a situation in which an increase of non-performing loans, an increase in losses (because of foreign exchange exposure, interest rate mismatch, contingent liabilities, etc.), and a decrease in the value of investment cause generalized solvency problem in a financial system and lead to liquidation, mergers, or restructuring." These events usually follow a shock to the economy, and reinforce the subsequent declines in output.

⁴⁹For more comprehensive discussion, see OECD "Policy Issues in Insurance" and The Tripartite Group (1995).

Such a crisis situation can be caused and exacerbated by information asymmetry. The creditors of financial institutions face informational asymmetry with regard to financial soundness of the insurance companies. The costly liquidation and/or the payoff externality like a first-come-first-served repayment⁵⁰ make creditors rush to withdraw their money from the financial institution, when they believe that it is vulnerable to runs (self-fulfilling runs). Moreover, when there are costs to collect and analyze information, creditors may be more inclined to follow others' behavior, even blindly (cascades).

Runs on individual financial institutions that depend on the confidence of their creditors can destabilize the financial system on the whole. Instability may result either from major macroeconomic or sectoral shocks (common shocks) or from the payment difficulties in one financial institution spread through the system, reflecting the financial interdependence among institutions (financial linkages). In addition, a failure of one financial institution may erode borrowers' ability to repay their debts from other financial institutions. The lack of adequate information of the soundness of various financial institutions may again cause creditors to lose confidence in the financial system as a whole when an individual institution fails (shift in sentiment).

The definition of the financial crisis discussed above can be applied to the crisis situation in the insurance sector. However, compared to banking crises, we should note that the risk of bankruptcy contagion may be smaller for the insurance sector. Bank deposits can be withdrawn in full amounts with minimum losses. Depositors may need to accept lower interest (costly liquidation) or give up favorable future interest (foregone interest), but are more likely to withdraw their money swiftly when they think that the bank might go bankrupt. In contrast, the cancellation

⁵⁰Diamond and Dybvig (1983) provide the first coherent model to explain the fragility of the bank. They make the first-come, first-served assumption. This assumption has been the subject of some debate in the literature, however, since it is not an optimal arrangement in the basic Diamond and Dybvig model. Instead, Allen and Gale (1998) model a bank run by assuming the available liquidity is split on an equal basis among those withdrawing early. Chen (1999) analyzes information induced bank runs where early withdrawal causes payoff externality. His model explains a run resulted from depositors' response to early noisy signal due to the payoff externality imposed in the sequential service constraint of the deposit contract.

of insurance contracts requires policyholders to incur losses due to cancellation deductions. In addition, repayments of insurance products usually take more time than bank deposits. Since insurance companies hold longer-term assets than banks, they should have more time to build liquidity for repayments in order to meet policyholders' obligations. Consequently, policyholders may give a second thought before rushing to withdraw their money from the insurance companies.

It is noteworthy that even among insurance companies, non-life insurance companies tend to have different strategies or risk characteristics from those of life insurance companies. The differences in risk characteristics and risk management practices between life and non-life insurers can be substantial in the crisis situation. The failure of a non-life insurance company could create a situation in which certain services are interrupted due to the loss of insurance protection for users of these services. In the case where an insurance company dominates the market, this could cause a significant and costly disruption of economic activity. In Australia, for example, the collapse of non-life insurance company, HIH, second largest non-life insurance company, had wide economic effects. Unfinished construction projects were halted, making workers unemployed. Small businesses became bankrupt, and local and community organizations were endangered by public liability claims. A substantial portion of the country's professionals such as accountants, doctors, and lawyers lost their professional liability coverage.

Compared to the banking crisis, the role of the insurance sector in systemic stability has not yet emerged as a major issue. Nonetheless, a number of linkages have been observed, indicating the potential problems. As we look at the crisis episodes, insurance companies actually played a role similar to banks in their investment activity in some countries (Japan, Korea, etc.), sold deposit-like products (Jamaica, the USA, etc.), or held equity or guarantee (including credit and mortgage guarantee insurance) linkages to the banking sector (Jamaica, Japan, Ethiopia, etc.). In other words, the closer insurance companies to banks, the more systemic risks they potentially can hold. In this sense, the recent trend of financial integration and convergence between insurance companies and banks can be

regarded as additional risk to the insurance sector.

As financial intermediaries, insurance companies may face risks similar to those faced by other financial intermediaries. Previous research, however, primarily has focused on identifying financial statement variables and insurer-specific ratios to employ as independent variables in empirical models to differentiate between low- and high-risk insurers. For example, Babel and Staking (1995) examine the relation among capital structure, interest rate sensitivity captured by duration, and market value in the US property-liability insurance industry. They find that the market value of equity grows at first but then declines as the leverage increases, while it declines first and then increases as interest rate risk rises. Grace, Harrington, Klein (1998) compare the power of risk-based capital and solvency screening to identify financially weak property-liability insurance companies in the USA. Cummins, Grace, and Phillips (1999) compare further the power of risk-based capital, solvency screening, and cash flow simulation to predict insolvencies in the US property-liability insurance companies.

Although the market condition has the significant impact on the number and the size of insolvencies in the insurance sector, the overall economic environment is also potentially significant. Recently, Browne, Carlson and Hoyt (1999) examine the linkages between macroeconomics and insolvencies in the life-health insurance industry by using the US data from 1972 and 1994. They find that insolvencies of life-health insurance companies are positively related to long-term interest rates, personal income, unemployment, stock market prices, and the number of insurers, and negatively related to real estate returns.

Like other financial intermediaries, an insurance crisis and its destabilizing effect on the financial system could have substantial economic effects. They interrupt normal risk sharing patterns and raise the cost of financial intermediation. The policyholders' reserves are sometimes reduced to significant extent, even in the case where policies are transferred to the succeeding insurance companies. When the government supports ailing insurance companies, the possible fluctuation in the demand for money, in the price level and in economic activities complicates the

task of regulating monetary growth and stabilizing economy. There have also been a few instances where failure of an insurance company alone has led to authorities to use public funds to assist in the resolution of systemic problems. For example, the Canadian Confederation Life was taken control of by the regulator in 1994 (one of the four largest financial collapses in history at the time in which the problem hinged primarily on liquidity, and not solvency concerns).⁵¹

Thus the insurance crisis potentially has the negative effect on the financial system and the real economic activity. Some of the effects may be intensified by the changes in interest rates and monetary expansion after the breakout of the crisis. In the case where public funds are used to resolve the crisis situation, consumers directly share the burden and the demand for money can be destabilized.

The next section investigates selected episodes of collapses of multiple insurance companies, and explains with clear statements and intuitive examples we think that the linkage between banks and insurance companies and/or insurers' assimilation of bank-type activities can destabilize the financial system.

5.3 Insurance Crisis Episodes

Since the beginning of 1990s, there have been several financial crisis episodes involving the insurance sector (Table 7). This section examines the recent insurance crises in four countries - Jamaica (1996-1999), Japan (1997-2001), Korea (1998-2002), and the USA (1991). All of these countries experienced the collapse of multiple life insurance companies. We focus on the linkages between macroeconomic conditions and financial crises, and the effectiveness of regulators' resolution to deal with financial crises. Although we do not pick up non-life insurance cases explicitly, since their risks are more of variety than life insurance's, a few big non-life insurance crises are also included in Table 7.

The analyses of sample countries consider the following questions:⁵²

⁵¹For more detailed information on Confederation Life, please see the following URL: <http://www.confederationlife.com/>

⁵²These questions correspond to questions of Balino and Sundararajan (1991) about the banking crisis.

1. Did the crises mainly reflect major macroeconomic shocks and macroeconomic instability?
2. What was the contribution of factors specific to the insurance sector (such as financial reform and change in prudential regulation related to the insurance sector) in mitigating, aggravating, or causing the financial crises? In particular, did financial reform increase financial fragility?
3. How did the crises alter the behavior of monetary and credit aggregates? What was the contribution of monetary policy in alleviating or aggregating the crises?
4. How did the authorities respond to the crises? What were the key support operations and regulatory adaptations?

In most of the sample countries, the life insurance crises occurred after the financial deregulation and the economic expansion, followed by large output and price fluctuation. Financial deregulation caused insurance companies to employ more bank-type products to compete with other financial institutions. Economic expansion induced insurers to invest in risky assets such as mortgages and junk bonds. The resulting maturity mismatch between assets and liabilities and illiquidity of assets made insurers vulnerable to economic shocks such as large output and price fluctuation. In addition, cross-share holding between banks and insurance companies and close business relationship between two industries increased the risk of contagion. In the past crisis episodes, most ailing insurance companies ceased their operation and transferred policies to relatively sound insurers. Some governments relied on public funds to cover the loss and made consumers share the burden. The use of public funds may have disturbing effects on money demand, and subsequently consumption and investment.

5.3.1 Jamaica

Macroeconomic Conditions and Structure of Financial Sector Jamaica has had negative GDP growth rates for many of the last 25 years, with the average GDP growth rate between 1989 and 1999 was 0.6% (see Figure 17). After the

years of exchange controls, interest rate controls, and high reserve requirements, the government initiated a series of economic reforms in the middle of 1980s, which focused on the trade and financial liberalization. The government's main concern was to reduce the size of the public sector in a privatization process. In this process, banks, which had been acquired by the government in the 1970s, were sold back to the private sector. By 1989, the government freed interest rates, removed credit controls, reduced the liquidity asset ratio, and started open market operations to replace credit ceilings as the primary instrument of monetary control.

In the early 1990s, Jamaica experienced a credit boom with a rapid growth in variety and number of financial institutions. A large number of financial institutions emerged, motivated by regulatory and tax arbitrage opportunities to avoid relatively strict commercial banking regulation.⁵³ Between 1981 and 1990, the number of merchant banks increased from 6 to 21 (see Table 8). After reserve requirements were raised on merchant banks, other financial institutions, building societies, which were not subject to reserve requirements and have lower prudential standards, increased from 6 in 1990 to 32 in 1995, when the Bank of Jamaica assumed supervisory responsibility for these sectors.

Between 1990 and 1994, domestic credit grew at an average rate of 37%. Most of the growth of credit was concentrated on the real estate and the tourism sectors. By taking advantage of the regulation arbitrage, the nonbank financial institutions, which had close relationship with commercial banks, invested high percentages of their loans into the real estate and party lending. For example, more than 20% of merchant banks' assets were invested into mortgage loans in the end of 1980s, and loans to affiliate commercial banks in most years before the mid-1980s (see Figure 18).

According to the Financial Sector Adjustment Company Limited (FINSAC), most financial institutions were poorly managed and did not have appropriate organizational structure with little strategy planning. Almost all financial institutions

⁵³For information on Jamaica's financial institutions see the web site of the Bank of Jamaica: <http://www.boj.org.jm>.

were undercapitalized given the large role that real estate played as collateral. Illiquid real-estate collateral also made financial institutions difficult to conduct proper evaluation techniques. Asset portfolios of financial institutions were highly concentrated on related party lending and mortgage investment, and there was little assessment of loans. Non-performing loans were not adequately provisioned for and the maturity mismatch between assets and liabilities existed widely.

Under the financial liberalization and resulting increase in competition, insurance companies introduced lump-sum interest-sensitive products that guaranteed rates of return. These products were highly competitive with those of other financial institutions. Once the real estate market ended its boom, however, their investment returns became too low to match guaranteed rates of return on interest sensitive policies of between 12-24%. In many cases the actuarial valuation of the insurance component was worth less than 1% of investment. For example, in the case of Mutual Life, only 0.07% of a total lump-sum portfolio liability went to insurance coverage for its 6,513 lump-sum policyholders. In more than 90% of lump-sum interest sensitive policies, the policyholder's life was insured for J\$60,000 or less, compared to average coverage of about J\$250,000 in the savings-type interest sensitive policies.

In sum, the financial deregulation, which enabled insurance companies to invest actively into real estate markets by taking advantage of the regulation arbitrage, the introduction of interest-sensitive policies, and the close linkages between banks and insurance companies, brought the over-competition and the credit boom to Jamaica's financial institutions. Once the Central Bank increased its interest rates, however, all of these three factors turned into negative factors to the economy and spread the instability over the financial system.

Crisis Situation The government introduced tight monetary policies during 1991 and mid-1990s, in order to curtail the high inflation, and subsequently brought high real interest rates and a recession in 1996. Many of the projects invested during the credit boom did not match the expected returns, widening credit defaults.

As defaults increased, the maturity mismatch between assets and liabilities became evident, particularly at several insurance companies. These insurance companies demanded more credit from their associated banks within the same financial conglomerate, which affected negatively the liquidity of the system. Intensified liquidity and solvency problems caused the financial crisis which originated in insurance companies, and spread to the banks and other financial institutions.

In late 1996, starting with a collapse of an insurance company, liquidity and solvency problems widely spread over the financial industry, and inflationary pressures built up. The combined threat was a loss of approximately J\$341 bil (146% of GDP), which could have affected 500,000 policyholders, if the government had allowed Life of Jamaica, Island Life, Jamaica Mutual Life Assurance, Dyoil Life, and Crown Eagle Life to collapse. These potentially huge losses caused the government to intervene in the financial system.

Resolution The government initially focused on reducing inflation through tight monetary policy, maintaining a stable nominal exchange rate, intervening in the financial sector through a full guarantee for all deposits, strengthening the regulatory and supervisory framework of the financial sector, and recapitalizing weak financial institutions. At the same time, the government attempted to implement loss-sharing arrangements with depositors, causing erosion of depositor confidence. Then it began to use government-backed debt issued by a newly created institutions - the Financial Sector Adjustment Company Limited (FINSAC), which was established in 1997.⁵⁴

The FINSAC implemented a series of interventions and acquired a large share of the ownership of the financial institutions. It gave financial assistance to five commercial banks and five life insurance companies, two building societies, and nine merchant banks. For insurance companies, the FINSAC intervened through the purchase of common and preferred shares and/or the issuance of subordinated loans. Under the FINSAC's initiative, 78.8% of policyholders were planned to get

⁵⁴For overall FINSAC's activities, see its web site: <http://finsac.com>.

back all their money as soon as their accounts were opened and others were to get up to J\$200,000 in cash soon and the balance later. For the 21.2% of policyholders with over J\$200,000 in lump-sum, interest-sensitive policies, the balance of their funds was planned to be placed on 7-year Certificates of Participation at trust companies with tax-free interest and no principal payment until 7 years maturity.⁵⁵ Since many pensioners were affected by the fallout in the insurance sector, the Ministry of Finance decided that pensioners over 65 years old could receive monthly interest payments in order to meet their expenses before their Certificates of Participation matured.

The government did not have the resources to service all FINSAC notes in cash, however. Instead, it resorted to capitalizing interest on the FINSAC paper by issuing more FINSAC paper. The FINSAC papers carried mostly floating interest rates, which were usually indexed to the 6-month Jamaican Treasury bill notes. As of August 2000, the FINSAC's gross support to the financial system amounted to about J\$ 127 billion (43.9% of GDP).

The FINSAC's intervention was in several modes such as acquisition of cross-holding, purchase of non-performing loans, direct capital injection, provision of loans and advances, payoff of depositors through new accounts in other sound financial institutions. Later the FINSAC changed the direction of its intervention to focus more on rehabilitation through introduction of better management and cost-cutting measures such as staff and branch rationalization. It is particularly important for insurance companies that the FINSAC cut off the financial ties that existed between insurance companies and related banks. Such a measure could improve transparency and soundness in the financial system and make insurance companies return to the core business, moving away from other financial activities in which they were actively involved in the past.

While the FINSAC attempted to restore liquidity and recapitalize weak financial institutions, the government undertook reform of the regulatory and super-

⁵⁵The government made a decision to reduce the maturity from 7 years to 5 years on the Certificates of Participation, in the interest of equity later.

visory framework. The government's measures covered over the following areas; redefinition of regulatory capital, asset classification and provisioning guidelines, improvements in the "ladder of enforcement," improvements in effectiveness of power of intervention, restrictions on connected and unsecured lending, restrictions on investments and fixed assets, norms for disclosure and audit, changes in reserve requirements, self assessment of core principles, strengthening of on-and off-site supervision, and regulation of credit unions.

Overall, the government has succeeded in stabilizing the financial sector and curbing inflation. However, the stabilization of the financial sector entailed a substantial cost. In particular, the status of the FINSAC paper is not yet clear, since Jamaica remains to be under severe financial stresses. Considering the already high (non-FINSAC) public debt that existed prior to the crisis, i.e., over 100% of GDP in 1995, Jamaica now faces a severe fiscal problem, as well as weak economic fundamentals.

5.3.2 Japan

Macroeconomic Conditions and Structure of Financial System The Japanese life insurance industry is one of the largest life insurance market in the world, when measured by total premium income as a percentage of GDP (11.17% in 1999 according to Swiss Re). The industry is highly concentrated, however. The top 17 companies (7 largest and 10 mid-sized insurers) with more than Y 1 tril assets occupy about 95% of the industry assets. Among them, 8 middle-sized life insurance companies have failed during 1997-2001 (Table 9), largely because of prolonged recession and historically low interest rate policy.

The prolonged recession in 1990s was rooted in the collapse of the bubble economy in late 1980s. During the late 1980s, major Japanese financial institutions provided with large amounts of money real estate and construction sectors. Once the Bank of Japan turned its monetary stance from easy to tight, the exuberance finished, generating huge amounts of non-performing loans. With ailing financial sectors, the private consumption and investment did not show signs of recovery,

despite the government's fiscal stimulation and monetary ease. After the collapse of large financial institutions including securities companies, banks and insurance companies in November 1997, Japan's economy reached its deepest post-war recession in 1998, when GDP shrank by 3% (Figure 19).

In order to stimulate the economy and help the banking system, the Bank of Japan started historically low interest rate policy, so-called zero interest rate policy. This low interest policy deepened the problem of insurance companies, however, which had already suffered from the decline of investment return, the mounted non-performing loans, and the decrease in stock prices.

It is noteworthy that Japan accelerated financial deregulation after the late 1980s.⁵⁶ This deregulation resulted partly from the US-Japan economic partnership, and partly from growing interests of insurance companies in looking for new investment opportunities during the bubble era. The series of deregulation increased competition among the industry, and induced insurance companies to introduce products with high guaranteed rates of return.

Causes of the Crisis On the back of the deepening economic recession, all of the Japan's eight middle-sized life insurance companies have failed during 1997-2001 (Table 9). This is because insurance companies faced difficulty to earn investment returns enough to match returns on liabilities for the following four reasons.

First, Japanese life insurance companies provided policyholders with very high guaranteed rates of return between the late 1980s and 1990s. The factors mentioned later reduced the investment returns that were not sufficient to match guaranteed rates of return. The average minimum rate of return guaranteed by the 14 companies was between 3.3 and 4.2% in the end of March, 2000, while the investment yield was between 2 and 3%, according to Japan Center for Economic Research (JCER). The guaranteed rates of return for group pension were reduced from 5.5% to 4.5% in April, 1994, to 2.5% in 1996, and then to 1.5% in FY 1999. Even now

⁵⁶For detailed discussion on the deregulation of insurance sector, see Ostrom (1998) and Choy (1999) for example. Ostrom writes that Japan's Big Bang that started in 1996 affected insurance sector less than other financial sectors.

the products with more than 5% return still squeeze insurers' profits. Since funding costs of insurers exceeded their investment returns, they had negative spread that amounted to Y1.6 tril in March, 2000.

Second, the prolonged low interest rate policy, which was employed for revitalizing the economy and helping ailing banking sector, decreased the yields on bonds, which occupied about 20-30% in total assets held by life insurance companies in the second half of 1990s. The decline of interest rates squeezed insurance companies' profits and made insurance companies difficult to meet the guaranteed rates of return on liabilities. For example, Chiyoda Mutual Life plunged into deficit of Y 285.6 bil, and was supposed to create Y 30 bil loss each year, if it would continue operation.⁵⁷

It is noteworthy that the monetary policy seems to have asymmetric effects between banks and insurance companies. The objective of the current low interest rate policy was to save the ailing banking industry as well as to stimulate real economy. Reflecting the maturity mismatch in the banking sector, i.e., long-term assets vis-a-vis short-term liabilities, low interest rates are likely to cause banks to make profits easier by favorable interest spread. However, low rates actually are rather harmful for insurance companies, which have long-term liabilities.

Third, Japanese life insurance companies made substantial amounts of loans to either financial or non-financial sectors. The loans other than mortgage loans amounted to more than 30% in the 1990s (Table 10). During the prolonged recession in the last decade, insurance companies faced non-performing loans problems that were just the same as banks, partly because of depressed values for real estates that reduced the value of collateral.

According to the JCER, non-performing loans amounted to 3% of total loans in the end of FY 1999. The non-performing loan ratio was 2.5% for the largest 7 insurers, while it was 5.1% for the middle-sized 7 insurers. In particular, Chiyoda Mutual Life, which was collapsed in 2000, held 12.6% of its loans in the form of

⁵⁷For detailed process of the bankruptcy of Chiyoda Mutual Life, see AIG Star Life's web site: <http://www.aigstar-life.co.jp>.

non-performing loans in the end of FY 1999. Among non-performing loans, 51.8% of them were covered by reserves in all industry. Reserve ratio was 58.9% for the largest 7 insurers, while it was 36.4% for the middle-sized 7 insurers. Especially, Chiyoda Mutual Life and Kyoei Mutual Life had only around 25% ratios.

Loans to banks had another problem. About 67% of all loans were corporate loans, in which 26% of total loans were extended to financial institutions. Among them, insurance companies held Y6.7 tril subordinated debts issued by banks by the end of March 2000 according to the JCER. 14 life insurers held 23.5% of stocks (Y7.7 tril) that were issued by financial institutions. These funds contributed to increasing capital accounts of insurers, since subordinated debts can be included into capital accounts in both the BIS capital adequacy ratio for banks and the solvency margin ratio for insurance companies.

In turn, banks held Y1.4 tril subordinated debts and Y 0.9 tril equities issued by banks by the end of March 2000. Combining subordinated debts and equities, banks provided life insurers with about Y 2.3 tril in total. Such a cross shareholding relationship may have increased the systemic risk in both banking and insurance sectors, however. When Hanwa Bank, regional bank, collapsed, insurance companies received only about 60% of their loans to the banks.

Fourth, shares occupied 15-18% in total assets of Japanese life insurance companies in the second half of 1990s. This is because the rise in the value of stocks and real estates produced huge unrealized capital gains in the bubble years of the 1980s, which represented by the difference between book and market values. The decline of stock prices reduced unrealized capital gains on stocks. This was particularly serious, because substantial stocks were crossly held in the long term for governance reasons. Hence, as Figure 20 shows, the relationship between the stock price index and capital gains on securities has been correlated in Japan.

On the whole, consolidated investment profiles of life insurance companies show that only 66% of the industry's assets were invested in fixed income and cash in 1999 (Table 10). With limited shares of fixed income and cash, the industry had extreme maturity mismatch. Also, there existed currency mismatch. Foreign portfolio,

which consist of more than 10% of total assets recently, mostly unhedged against exchange rate risk, includes mainly US Treasuries (about Y 10 tril according to Moody's Dec. 1997). This was also a potential risk that makes insurers vulnerable to exchange rate swings.

Fifth, after the collapses of multiple financial institutions in the fall 1997, erosion of consumer confidence in the financial system led to high levels of surrender and lapse. Table 11 shows that how large numbers of contracts decreased after the collapse of insurance companies. Such panic behavior together with the decrease in revenues for the reasons led to the decline of policy reserves (Figure 21), and made insurers more vulnerable to the shifts in expectation.

Resolution After the amendments to the Insurance Business Law were passed in 1996, the government established the Life Insurance Policyholders Protection Corporation (PPC) of Japan in 1998. The Insurance Business Law requires all of the life insurance companies doing business in Japan to join the PPC. The objective of the PPC is to protect the policyholders of failed insurance companies by maintaining their insurance contracts.⁵⁸ The PPC represents the successor to the policyholder protection fund, which had been exhausted by the failure of Nissan Mutual Life in 1997.

Originally, the PPC was supposed to be financed mainly from contributions made by member life insurance companies. The upper limit of contributions was set at Y 460 bil. But the collapse of Toho Mutual Life cost Y 360 bil, 80% of the target. In the amendment to the Insurance Business Law in May 2000, the contribution of member insurance companies was raised by Y 100 bil, from Y 460 bil to Y 560 bil. In addition, the government subsidies for failures before March 2001 were approved up to Y 400 bil. In total, the borrowing capacity of the PPC increased from Y 460 bil to Y 960 bil.

The increase of the fund resources seemed to solve the problems of the financial resources of the PPC. The total amount of financial assistance so far amounted

⁵⁸For comprehensive discussion on policyholders protection fund in general, see Yasui (2000) for example. The PPC's web site is <http://www03.u-page.so-net.ne.jp/kd5/kikou/>.

to Y 737.5 bil. In addition, after the collapse of Chiyoda Mutual Life, companies that acquired ailing insurance companies covered the loss. This is based on the legislation that the government enacted in June 2000 by strengthening the regulation and allowing life insurers to apply for court-supervised rehabilitation. The new law requires life insurers to report to the Financial Supervisory Agency (FSA) five-year projections of the main components of their balance sheets, and also allows them to apply for reorganization under the Civil Rehabilitation Law, to lower future guaranteed rates of return on policies with court approval, and to cut general credits and subordinated debts to reconstruct their balance sheets.

The cost to the remaining life insurance companies is not small. The Life Insurance Association planned to provide Y 46 bil to the PPC each year. Plus, it had to give Y 23 bil each year to cover the cost of Nissan Mutual Life. In total, the cost per year amounts to Y 69 bil. This is not small for insurers, taking into account the severe economic and financial conditions.

Policies of the collapsed insurance companies were shifted to the acquired companies, most of which were foreign financial companies so far. Those changes do not mean that all the policies were fully protected, however. As shown in Table 12, policy reserves were cut by 8-10%, and the guaranteed rates of return were reduced to 1-1.75% except for Tokyo Mutual Life. These changes of the contract condition were allowed by the amended Insurance Business Law. Liability reserves can be cut corresponding to the amount of the excess liabilities, though the Protection Corporation would provide 90% of the liability reserves after April 2001.⁵⁹ Combining all the measures, simulation by the collapsed life insurers shows that policyholders would receive only 60-70% of the full amounts.

In addition, the acquired companies can set up Early Surrender Reduction System. The policyholders who want early surrender are supposed to receive only 80-85% of full amounts in the first year, though the reduction rate will be cut from 15-20% to 0-2% in 8-10 years. But as in Table 11, this measure does not seem to

⁵⁹In the transition period before April 2001, the PPC covered 100% of policy reserves for individual annuities and asset-formation insurance and annuities, excluding group pensions. The calculation for liability reserves was based on the Constant Zillmer Method .

have prevented policyholders from early surrender.

In order to strengthen the capital base, many mutual life insurance companies plan to be converted to stock companies over the next few years. This conversion is allowed by the amended Insurance Business Law, and is expected to improve access to capital markets, as well as to enhance market discipline resulting from new ownership structure and a new currency to facilitate acquisition.

The updated Insurance Business Law introduced the Solvency Margin Ratio as a measure to judge the soundness of insurance companies.⁶⁰ The Solvency Margin Ratio is the surplus of Policy Reserves divided by the weighted-value of risk assets. Life insurance companies began to announce the Solvency Margin Ratio officially in FY1997. The ratio was used for the early warning system that was introduced in FY1998, in which the Financial Reconstruction Commission (FRC) had the power to invoke an order to any insurance companies in trouble. The Early Warning Measures employ the Standard of Substantial Default, which compares the market prices of assets and debts, not their book values.

Nonetheless the new measures did not work in the bankruptcies of Toho Mutual Life in 1999 and Daihyaku Mutual Life in 2000. The JCER claims that the new Standard has four problems. First it reflects the market value of stocks and real estates, but not of bonds and foreign securities. Bonds and foreign securities are evaluated on the book value, and thus include unrealized profits and losses. Second, the new Standard uses the risk coefficients calculated by the standard deviation of past earning rates, which does not reflect recent dramatic fluctuation in stocks and lands. Third, its estimation is based on the assumption that insurance companies are going concerns. But considering the fact that the objective of the ratio is to find unsound insurance companies, the ratio should be calculated based on the liquidation standard. Fourth, the problem of subordinated debts is not taken care of in the new standard.

In the process to deal with financial crisis including banks and nonbanks, the

⁶⁰The difference between Policy Reserve and Solvency Margin is that the former is among insurers' debts and corresponds to the normal risk, while the latter is among equities and corresponds to the risk that exceeds normal expectation.

regulator and supervisor of the insurance industry have been changed their shapes. In the past, the Ministry of Finance was responsible for regulating and supervising banks and insurance companies. In June 1998 two governmental agencies - Financial Reconstruction Commission (FRC) and Financial Supervisory Agency (FSA)- were established to deal with the problems of all financial institutions. Since January 2001, the Financial Services Agency, former Financial Supervisory Agency (June 1998 - June 2000), absorbed the FRC and became the only agency to be responsible for all financial institutions.

Such a change of regulatory agencies can meet the demand of the financial institutions that have been integrated over the industry. Many financial institutions experienced M&As and cooperation with other firms recently, in order to strengthen their financial services. Encouraged partly because of the Big Bang that started in 1990s, there are 4 big financial groups covering banks and insurance companies - Mizuho Financial Group, Mitsubishi-Tokyo Financial Group, UFJ, and Mitsui-Sumitomo Financial Group. As a result, financial groups that include banks and insurance companies emerged. Such developments potentially can cause complexity and difficulty in regulation and supervision in the future, without integrated regulatory and supervisory agencies.

5.3.3 Korea

Macroeconomic Conditions and Financial Structure Korea's insurance industry plays an important role of risk diversification for the real sector and channels savings into investments through financial and capital markets. According to Swiss Re, Korea ranked the 7th largest country in the world in terms of total life insurance premium volumes after the USA, Japan, Germany, the UK, France, and Italy, and 12th in terms of total non-life insurance premium in 1999. At the end of March 1998, there were 33 stock life insurance companies and 2 branches of foreign life insurance companies in Korea (Table 13 and 14). Unlike Japan, there was no mutual life insurance company in Korea. There were 17 non-life insurance companies of which 2 were specialist financial guarantee companies and 1 is a specialist

reinsurer.

The history of Korea's insurance industry is quite short. All but 6 of the stock life insurance companies were established in the late 1980s and early 1990s. Two branches of foreign insurance companies started their operation in the middle of 1980s. The life insurance market was heavily concentrated, with top 3 life insurance companies, all old companies, occupying 64% of premium revenues in 1997/98. The largest Samsung Life alone had 29% of the market. On the back of financial deregulation during the 1980s and 1990s, the presence of the insurance sector has become increasing, as well as other nonbank financial institutions. In late 1990s, insurance policyholder savings account liabilities were around W 100 tril, which equaled to approximately 60% of commercial bank deposits and about 50% of total bank deposits.

The financial deregulation brought overcompetition within the industry. For only five years from 1988 and 1993, as many as 27 life insurance companies were established under the trend of financial liberalization. Such a rapid increase in the number of life insurance companies intensified the competition in the domestic market. Most of the new insurance companies took the growth-driven strategy, that is, pursuing the increase in market share rather than profitability. Reflecting degraded soundness, life insurance companies as a whole have been in deficit situation since FY95, well before the Asian crisis.

Korea's insurance sector has long been required to act as quasi banks in order to intermediate capital to other sectors. Almost 50% of total assets were direct loans to individual and business sectors with substantial cross-guarantees (see Table 15). This is an extremely high proportion, compared to other OECD countries. High proportion of loans caused the non-performing problems like banks, when the crisis hit the overall economy. In addition, the industry has much shorter maturity of policies on average than in other countries, making policyholders easier to run on the insurers during the crisis. Since Korea's insurance companies assimilate banks both in asset and liability activities, these features led to illiquidity of their assets and a rush of surrenders during the crisis.

The currency and financial crisis in 1997 gave Korea huge damages, with a sharp decline of GDP growth rates of a fall of nearly 7% in 1998 and a rise of inflation and unemployment (Figure 22). Mounted debts of the corporate sector turned into massive non-performing loans to the financial sector, including both banks and insurance companies.⁶¹ The crisis caused the Korea's insurance industry to face a sharp decline in its business performance. The premium income for life insurance companies dropped in FY 1998 for the first time since FY1971 (Figure 23), because of a decline in the disposable income and a surge of lapses and surrenders, which reflected the negative consumer sentiment and disintermediation brought by the rise in bank deposit rates after the government employed tight monetary policy. Instead, the amount of claims paid increased drastically, squeezing the insurers' profits.

Under the supervision of the IMF, the Korean government embarked on comprehensive financial and corporate structural reforms. The reforms included resolution of distressed financial institutions, injection of public funds to recapitalize banks, strengthening prudential regulation and improvement of governance, accounting, and disclosure standards. As a whole structural reforms seemed to establish the base for economic recovery, recording more than 10% GDP growth rate in 1999.

Resolution The government strategy to solve the financial problem was clear; support the good companies through government institutions, and stop operation of non-viable companies. In order to promote the restructuring of insolvent insurance companies, the government allowed top five chaebols to enter the insurance industry in February 1998.⁶² Among 33 life insurance companies, 6 insurers were merged and sold, and 5 were suspended or revoked their license during Jan. 1998 and Dec. 2000. One life insurer (Korea Life) was nationalized. Many of other insurance companies were recapitalized by the government and sold to either do-

⁶¹For overall investigation on Korea's financial crisis, see Chopra et al. (2001), and Financial Supervisory Commission and Financial Supervisory Service (2001).

⁶²Chaebols were not allowed to hold shares of insurance companies previously, in order not to control and make use of insurance companies arbitrarily.

mestic or foreign insurance companies. Some non-life insurance companies (KGI and HFS) were merged following the acquisition of non-performing loans by the Korea Asset Management Corporation (KAMCO).

The government extended the bank deposit guarantee (Korea Deposit Insurance Corp.=KDIC) to cover insurance liabilities in order to prevent runs. In the past, the Insurance Guarantee Fund was responsible for providing insurers with emergent credit. After April 1998, five institutions - the Deposit Insurance Fund for Banks, the Securities Investors Protection Fund, the Korea Non-Banking Deposit Insurance Fund, the Credit Union Stabilization Fund, and the Insurance Guarantee Fund - were unified into the KDIC. All insurance contracts issued before July 1998 were fully protected by the KDIC until the end of 2000. But those issued afterwards were only protected up to W 20 mil. In turn, insurance companies must pay insurance premium to the KDIC, which equals to 0.15% of their total covered premium income. This percentage could be increased up to 1%.

The Financial Supervisory Council and Service (FSC/FSS) reported that the gross injection of public funds to non-bank financial institutions amounted to W 18.8 tril (3.5% of 2000 GDP), as of the end of October 2000. Among them, the KDIC provided nonbanks with W 15.6 tril and the KAMCO W 3.2 tril. Combining public funds used for banks (W 45.2 tril), and other public funds, the government used W 118 tril (22% of GDP) for the entire financial restructuring.

During the crisis period, regulatory supervision was changed and integrated in Korea. In the past, both the Ministry of Finance and Economy and the Insurance Supervisory Board were responsible for the insurance sector. After a new supervisory system was introduced in April 1998, the Financial Supervisory Commission and the Financial Supervisory Service were established and became responsible for all the financial institutions' activities.

As an effort to enhance transparency and credibility of financial information, the FSC/FSS revised the regulatory insurance accounting principles to the international standards in March 1998. The new guideline requires insurance companies to hold at least two-thirds outside directors in the audit committee. The FSC/FSS

also revised the investment and lending guidelines. The new guideline prohibits insurance companies from holding more than 15% of their assets in real estates and extending credit more than 5% of their assets to single entity. Instead, it allows insurance companies to invest no more than 30% of their assets in equities.

In May 1999, the FSC/FSS updated the solvency margin regulation to the level of EU in five years, which were to be phased in from September 1999 to March 2004. The new solvency margin ratio will be calculated based on the new loan provisioning requirements. In addition to updating accounting system, the FSC/FSS issued new regulations that aimed at improving corporate governance at insurance companies by strengthening the roles of actuaries, auditors and outside directors.

5.3.4 The USA

Macroeconomic Conditions and Financial Structure The US life insurance industry is very large, with 2,400 life insurance companies, 2 million employees, and total assets of \$1.2 trillion in 1989, which grew to \$ 3 tril in 1999 (Table 16). Total assets of life insurance industry were more than 80% of those of commercial banks in 1989. This means that most of the American people held almost the same amounts of policies as bank deposits. Like other financial institutions, the US insurance industry is regulated and supervised by the state government. The industry experienced the collapses of multiple companies in 1991, which were associated with financial deregulation and real estate boom in late 1980s.

Traditionally, life insurance companies competed with a relatively small group of financial intermediaries for consumer savings. Their products were to provide policyholders with a means of accumulating retirement savings and protecting their families financially in the case of premature death. Before 1970s, life insurance companies enjoyed low inflation and interest rates, and did not experience disintermediation problems associated with policy loans and surrenders. It was relatively easy for life insurance companies to match maturities of assets and liabilities and to concentrate on long-term investment.

The situation changed dramatically when a surge of inflation and interest rates reached unprecedented level during 1977-1981 (Figure 24). Such a change made traditional life insurance products less attractive to policyholders. At the same time, deregulation allowed financial institutions to offer consumers higher-yielding investment returns. To stop the outflow of funds from the S&Ls, which were also wounded by high inflation, the Depository Institutions Deregulation and the Monetary Control Act of 1980 phased out the regulation of interest rates. In addition, the Garn-St Germain Depository Institutions Act of 1982 permitted thrifts to expand their business in non-traditional areas, and the Federal Home Loan Bank Board granted FSLIC-insured thrifts additional powers to invest in low-grade bonds, reduce minimum capital requirements, and broaden the items included in capital account.

Life insurance companies responded to these changes for increasing competition by introducing interest-sensitive products and new, highly competitive pension funding contracts. They employed universal life, single-premium deferred annuities (SPDAs), and guaranteed investment contracts (GICs). These products were welcomed in the market place, particularly annuities were in great demand. Annuities accounted for the largest percentage of the life/health industry's total premiums, i.e., 47.8% in 1990, compared to 14% in 1975. Like other life insurance products, annuities had increasingly been sold as investment vehicles, offering tax-deferred inside advantage that non-insurance investment products did not have.

Also, investments in GICs more than doubled in the second half of 1980s to reach \$150 in 1989. GICs were sold for pension plans and became the most popular products during the 1980s. While GICs had a five-year maturity, they typically allowed early withdrawal with little penalty on as short as 30 days notice. These debt-like features represented a departure from previous pension investment contracts. Their greater liquidity attracted policyholders, and changed insurers' liability portfolio during the 1980s. From 1980 to 1990 insurance policy reserves declined from 51% to 29% of total policy reserves, while annuity and pension re-

erves increased from 46% to 68%.⁶³ Such liquid liabilities rendered insurance companies vulnerable to the change in the investment climate, once the economy plunged into downward cycle.

These changes in products and market environment gave by-product to life/health insurance industry's operating results. While the industry's average annual premium growth was 11% during 1976-1990, profit margins were under significant pressure during the period. The complexity of new products brought insurers higher administrative costs, and a greater replacement activity led to higher lapse rates on term.

In order to fund the new products and earn profits, insurance companies chose to invest in higher yielding assets. When interest rates declined in the early and mid-1980s, profit margins of many annuity writers were squeezed, mainly reflecting the maturity mismatch between assets and liabilities. Several insurance companies invested more in high-yielding junk bonds, commercial mortgages, and commercial real estate projects. These investments caused the financial problems at several insurance companies in 1991.

Causes of the Crisis Before 1990, the US life insurance industry enjoyed reputation for stability, and consumers regarded life insurance products as conservative investments. These perceptions changed rapidly in 1990, however, as consumers found that investments in junk bonds and real estates, which plagued banks, also affected life insurance companies (Table 17).⁶⁴

Nine large life insurance companies failed in 1991: Mutual Benefit Life, Executive Life, First Capital Life, Monarch Life, Executive Life of NY, Fidelity Bankers Life, Guarantee Security Life, Fidelity Bankers Life, and Industry Life (Table 18).⁶⁵

⁶³The most popular savings products are single-premium deferred annuities, because of its tax-favored status.

⁶⁴A.M. Best Company Special Report (1991 and 1992) provides detailed examination of the causes and resolution of non-life and life insurance crises prior to 1991. IDS Financial Services (1990) suggests the risks that life insurers held before the crisis. Subcommittee on Oversight and Investigations of the Committee on Energy and Commerce, U.S. House of Representatives (1990) presents the detailed examination of failures of non-life insurance companies.

⁶⁵Saeqczyk, Thomas, and Tsetsekos (1997) examine contagious effects in stock returns and

The failure of these insurance companies affected more than a million policyholders through reduction in retirement benefits and loss of access to savings. These failures themselves raised concerns among policyholders and affected the failures on other insurance companies.

The problem of insurance companies stemmed mainly from two factors; the overinvestment in real estates and junk bond markets, and the large amounts of investment-oriented contracts that promised fixed yields on principal for one or more years - annuities, GICs, and interest-sensitive life insurance products (see Figure 25).⁶⁶ The overinvestment in real estates and junk bond markets caused illiquidity problems of insurers' assets, once the economy got into the downward cycle in the beginning of 1990s. This contrary wind made insurers difficult to pay back the claims for GICs. Short-term and liquid nature of GICs also made policyholders easier run on the troubled insurance companies, and subsequently rendered insurance companies vulnerable to the change of the market sentiment.

In the case of Mutual Benefit Life, it invested in real estates and mortgages totaling more than \$5 bil. The huge loss on real estates and mortgages reduced its capital rapidly. The problems were intensified by runs on GICs and policyholder surrenders, which totaled \$ 1 billion. Within weeks, cash reserves decreased to \$ 300 million and \$ 500 million GICs were canceled. New Jersey regulator put a hold on further surrenders of policies and loans against policies. The run at Executive Life was prolonged with cash surrenders exceeding \$3 bil in the year preceding its insolvency. Other life insurance companies, such as Monarch and First Capital Life also experienced the increase of surrenders before the regulatory action.

analysts' forecasts of the failure of Mutual Benefit Life. Fenn and Cole (1994) investigated contagion effects in share prices associated with First Executive Life's announcement of writing down the value of its bond portfolios in 1991.

⁶⁶Lee and Stock (2000) examine the impact of embedded options on the interest rate risk of financial institutions. They find that both asset and liability durations decrease when embedded options are present. In addition, liability duration declines more substantially than asset duration. This causes a duration-mismatch and a negative change in equity value when interest rates rise, while a positive change for rate declines.

Resolution The US insurance companies are regulated and supervised by their states, and supported by their state own guaranty fund. The measures taken during the crisis, however, were not so different state by state. Most business of the collapsed insurers was sold to other financial institutions, and their policies were transferred to the successor, with their losses covered by the state guaranty fund.

New Jersey regulator sold off parts of Mutual Benefit Life, while Massachusetts regulators arranged the sale of large block of Monarch Life's business to Merrill Lynch. The New York Insurance Department arranged the sale of Executive Life of NY business to Metropolitan Life. Shearson Lehman Brothers Holdings, Inc., a 28% owner of First Capital Holdings that sold large amounts of First Capital Life business, submitted bids to California regulator that would guarantee the policy values of First Capital Life. A large part of Executive Life's business was arranged by California Insurance Department to be spun off to a French investor group, Axa, which would contribute toward the capitalization of a new insurer. All contract holders of Executive Life were paid in full by the state guaranty fund a new capital. Guarantee Security Life was liquidated and its policies were transferred to the Life and Health Guaranty Association. Virginia regulators negotiated the sale of Fidelity Bankers Life to First Dominion Mutual Life.

State legislators and the National Association of Insurance Commissioners responded to the increased frequency and severity of insurer failures. Major developments include establishment of an accreditation program in 1990 for states that meet minimum legislative, administrative, and funding standards for solvency regulation. The association adopted a number of new model bills as part of the minimum standards program. By the end of 1991 the association had accredited nine states. 42 states adopted legislative packages in 1991 that were designed to improve solvency regulation and help qualify for accreditation. In addition, legislative packages were introduced in 5 other states.

5.4 Lessons From the Insurance Crises

The previous insurance crisis episodes provide us with the following observations about how the crises occurred, how they affected other parts of the economy, and what are the useful measures to resolve the problem.

5.4.1 Causes and Spread of the Crisis

Causes of insurance crises can be summarized as follows:

- 1) Financial deregulation and liberalization
- 2) Large macroeconomic fluctuations both in output and price levels
- 3) Insurers' assimilation of banking-type activities
- 4) Close business linkages between banks and insurers

Financial deregulation and liberalization provide three important factors that lead to the instability of the insurance sector. First, they intensify the competition among financial institutions. Second, they enable insurance companies to employ bank-type products, in order to compete with products of other financial institutions. Insurance companies introduce short-term, and/or interest-sensitive products with guaranteed rates of return. Such products make insurance companies very vulnerable to the adverse change of economic fundamentals and consumer sentiment.

As we saw in the cases of Jamaica and the USA, these products had become popular among consumers, and very competitive compared with other financial products. However, once the massive amounts of lapses and surrenders came at the same time during the economic downturn, the insurance companies faced the difficulty to meet the claims, since markets for their assets including real estates, mortgages, and junk bonds plunged, once the economy got into the downward trend. In Japan's case, things developed differently and more slowly. The guaranteed rates of return on liabilities which were set high in the late 1980s, so-called bubble era, made insurance companies very difficult to earn high investment return enough to meet the high guaranteed rates, once the economy declined and the low interest rate policy was taken. The loss of insurance companies was accumulated

for several years and pushed them into deficit.

Third, insurance companies rush to invest in more risky and high-yielding assets including real estates, mortgages, and junk bonds, in order to meet the high guaranteed rates of return on liabilities. Financial deregulation also potentially contributes to regulation arbitrage between banks and other financial institutions including insurance companies, and makes them more aggressive to invest in risky markets such as real estates and junk bonds. Once the economy plunges into recession, however, such risky investment could be a heavy burden to insurance companies.

Macroeconomic shocks are of important factors to trigger the insurance crisis. All the crisis countries presented in Section 3 experienced economic expansion with credit boom, followed by large fluctuation in both output and prices. The credit boom induced insurance companies to invest in risky assets including real estates, mortgages, and junk bonds. Macroeconomic shocks may not be so important when insurance companies match the maturity of assets and liabilities. However, when they actually hold mismatches, the fluctuation in output and prices can cause difficulty to repay the insurance claims. In the crisis episodes in Section 3, Jamaican and American insurance companies held sharp maturity mismatch with long-term assets and short-term liabilities, since they employed deposit-like and interest-sensitive products.

Then what cause the maturity mismatch between assets and liabilities? We know that maturity mismatch is generally considered to be an inherent nature of banking institutions. They collect short-term deposits and transform them into long-term investment. Instead, insurance companies traditionally hold long-term maturity of both assets and liabilities. What promotes maturity mismatch of insurance companies is the fact that more and more insurance companies assimilate banking-type activities.

Insurers' assimilation of banking-type activities can occur in either asset or liability side. In liability side, as we discussed in the case of Jamaica and the US, modern insurance companies have employed short-term, interest-sensitive products

with guaranteed rates of return. In asset side, as we saw in Japan and Korea, insurance companies in some countries traditionally complement banks' roles in the economy and invest large amounts of assets into loans both to financial and to non-financial corporations. Such an investment pattern caused non-performing loans problems for the insurers, when the economy plunged into recession. In addition, cross-holding of shares and subordinated debts of banks had potential systemic risk in Japan.

What is more, when insurance companies hold close business relationship with banks, the systemic risk among them becomes much larger. In Jamaica's case, insurance companies and banks belonged to the same financial conglomerates, while in Japan's case there was cross-holding of shares and subordinated debts between banks and insurance companies.

Such financial linkage can be more significant potentially in the developing countries where capital markets are underdeveloped. Dowsley (2001) examines the systemic risk of Ethiopian life insurance sector (see Table 7). With underdevelopment of capital markets, all of the Ethiopian insurance companies are closely connected to the banks through common ownership except for one smallest insurance company. Insurance companies hold 60% of their assets exposed to banking sector. In addition, the insurance companies depend on the banks as a marketing source. Thus, Dowsley (2001) states that there is the systemic risk from the banking sector to the insurance sector. Instead, he concludes that the systemic risk of any bank failing can hardly cause an insurance company to fail, given the small investments by the banks in the insurance companies relative to the banks' minimal capital requirements.

5.4.2 Resolution and Economic Effects

Measures to Deal with Failed Insurance Companies When an insurance company becomes insolvent, its operation is ceased and its policies are shifted to more sound financial institutions by the regulator. In order to cover the potential losses and protect policyholders' interest, the regulator often establishes a fund

to compensate their losses. Such schemes, so-called policyholder protection funds, are usually designed to collect necessary contributions or levies, when an insurance company goes bankrupt. Policyholder protection funds are quite common among OECD countries. In major countries such as Canada, France, Ireland, Japan, Korea, the United Kingdom and the United States, the policyholder protection fund covers most of the insurance contracts subscribed by the member insurance companies, rather than protecting particular insurance products.

Policyholder protection funds have two important objectives; to protect the interest of policyholders, in particular individual or non-professional policyholders in the event of bankruptcy of an insurance company; and to maintain the public's confidence in the business. Policyholders face informational asymmetry with regard to that financial soundness of the insurance companies. They tend to rely on information others gave them, when collecting information is costly for each of them. Such an individual behavior could easily lead to herd-like behavior, making the financial system more vulnerable. In this sense, the fund is expected to provide sufficient liquidity to the ailing insurance companies in order to maintain policyholders' confidence in the system, as well as serve as the safety net for such policyholders in the case of bankruptcy of insurance companies.

Financial resources of the scheme have some variation. In Jamaica, Japan and Korea, public funds were used to compensate for the loss of insurance companies. Initially, the loss was financed by other insurance companies in the US and Japan prior to 1998 or other industry including banks in Jamaica. But such a loss-sharing scheme brought burden to sound financial institutions and could have caused fear for the systemic risk spreading to other relatively sound companies. Thus, the government was forced to provide insurers with public funds to avoid systemic risk. In Korea, former Insurance Guarantee Fund, which was responsible for providing insurance companies with emergent credit, was replaced by Korea Deposit Insurance Corp. (KDIC), which covered only banks in the past.

In Japan's case, unlimited financial assistance through public funds was avoided by changing the law in 1996. After that, foreign companies that acquired the

troubled insurers paid the costs. In addition, several life insurance companies plan to change their form from mutual to stock company, in order to raise funds easily. Such a reshape was also seen in the case of Executive Life in the USA. In Jamaica's case, however, the government monetized the costs. Since the government has already had huge amounts of public debts, the burden to taxpayers cannot be assessed exactly.

In contrast to the "bailout" for the banking industry, the government does not provide with public funds to recapitalize the life insurance industry. Hence, there is an argument that the government should limit its commitment to the minimum level. Another by-product of public funds is moral hazard. The use of public funds may reduce insurers' incentives to conduct discrete business, and also regulators' and supervisors' incentives for stricter and prudential guidance.

In addition to initial emergent measures, several governments attempted to update their regulatory and supervisory measures. Japan and Korea now have the integrated government entity to deal with financial institutions on the whole. All the crisis countries improved the accounting system, risk measures and assessment in order to prevent the future occurrence of the financial crisis. Such measures are expected to enhance the risk management of insurance companies and establish a base for the future financial stability.

Economic Effects Unlike banking crises, there are debates on whether life insurance crises can give damage to the entire economy. Optimists say that the insurance crisis does not bring serious damage to the economy. Such a view relies mainly on the following arguments. Even if insurance companies collapse, policies are protected either by Policy-Holders Protection Fund or by other financial institutions that acquire the ailing insurance companies. In the case of Jamaica, Japan prior to the collapse of Chiyoda Mutual Life, and Korea, however, public funds were used to protect the policies. Public funds are cost the government and ultimately taxpayers. If the government monetizes the costs like Jamaica, the distortion may cause problems in other business area.

In addition, even in the case where other healthy financial institutions acquired the troubled insurance companies, policies were not always fully protected, when the whole economy suffered from the financial crisis. In Japan's case, some insurers reduced their policies by 10%. They also employed Early Surrender Reduction System, so as for the massive policyholders not to rush to withdraw their money from the ailing insurance companies. Such resolution can provide policyholders with an opportunity cost in the form of foregone interest.

The use of public funds can bring another problem in the economy. It may disturb the demand for money and consequently price level. Such disturbance is considered to reduce the productivity and efficiency of the economy and give negative effects on the economic activity on the whole. Thus, we conclude that there are tangible costs associated with insurance crises, even though they are not clearly captured as in the case of banking crises.

5.4.3 Lessons for the Future Regulation and Supervision

Most of the insurance crises have occurred in the situation where insurance companies assimilate banking-type activities, or have close business relationship with banks. Such a fact creates a new fear about the current trend of financial integration between banks and insurance companies. The increase in both competition and cooperation between banks and insurance companies might cause insurance companies to take additional risks by employing products similar to deposits, or by investing more into risky projects and bonds.

In order to reduce such potential risk, the regulator may need consolidated supervision to monitor intra-group exposures over multiple industries. In the crisis episodes, Japan and Korea established the new regulatory and supervisory bodies that are responsible for the financial institutions on the whole. The regulator also may need to improve the current accounting system, the risk measurement and the assessment, which sometimes do not capture the actual risk in some countries. Since the economic impact of the insurance crisis was substantial in some countries, we believe that such a change in policy direction should be important in the future.

5.5 Concluding Remarks

This chapter reviews the recent insurance crisis episodes and explains with clear statements and intuitive examples that show linkages between banks and insurers and/or insurers' assimilation of banking-type activities can increase systemic risk and destabilize financial system. We find that most life insurance crises occurred after financial deregulation and economic expansion, followed by large output and price fluctuation. Financial deregulation caused insurance companies to employ more bank-type products to compete with products of other financial institutions. Economic expansion induced insurers to invest in risky assets such as mortgages and junk bonds. The resulting maturity mismatch between assets and liabilities and illiquidity of assets made insurers vulnerable to economic shocks such as large output and price fluctuation. In addition, cross-share holding between banks and insurance companies and close business relationship between two industries increased the risk of contagion. In the past crisis episodes, many ailing insurance companies ceased their operation and transferred policies to relatively sound insurers. Some governments relied on public funds to cover the loss and made consumers share the burden. The use of public funds may have disturbing effects on money demand, and subsequently consumption and investment. The recent change of insurance industry has been regarded by many to carry potential sources of vulnerability that could put to risk systemic stability. In particular, the increasing cross-border and cross-industry M&As and cooperation among financial institutions create new challenges and enhance the need for upgrading supervision and regulation.

6 Appendix: Proof of Proposition 1

Proof of Proposition 1 follows Goldstein and Pauzner (1999). First we say that a patient depositor withdraw her money from the bank in period 1, when she receives signal below (above) θ . We denote by $n(\theta, \theta')$ the number of depositors who withdraw early when the state is θ and each depositor acts according to threshold θ' . We also let $v(\theta, n)$ denote a patient depositor's expected difference in utility from leaving her money in the bank until period 2 rather than withdrawing her money early, when she knows that the state is θ and that the number of depositors withdrawing their money early is n . That is:

$$v(\theta, n) = \begin{cases} u(0) - u(A) & \text{if } 1 \geq n \geq \frac{b^+ + r\bar{t}^+}{c_1^+} \\ u(B) - u(c_1^+) & \text{if } \frac{b^+ + r\bar{t}^+}{c_1^+} \geq n \geq \lambda \end{cases}$$

We next let $\Pi(\theta_i, n(\theta))$ denote a patient depositor's expected difference in utility from leaving her money in the bank until period 2 rather than withdrawing her money early, when she observes signal θ_i and holds belief $n(\theta)$. When a depositor observes signal θ_i , her posterior distribution of θ is uniform over the interval $[\theta' - \varepsilon, \theta' + \varepsilon]$. Hence, $\Pi(\theta_i, n(\theta))$ is given by:

$$\Pi(\theta_i, n(\theta)) = \int_{\theta = \theta_i - \varepsilon}^{\theta_i + \varepsilon} v(\theta, n(\theta)) d\theta.$$

Note that $\Pi(\theta_i, n(\theta))$ is continuous in θ_i and $n(\cdot)$, because small changes in θ_i only change the limits of integration in the computation of Π , and because the integrand is continuous in n . In addition, a positive shift in the signal, followed by the same shift of n , increases the gain from waiting. That is, if $a > 0$ and there exists $\theta \in [\theta_i - \varepsilon, \theta_i + \varepsilon]$ for which $n(\theta) < \frac{b^+ + r\bar{t}^+}{c_1^+}$, then $\Pi(\theta_i, n(\theta)) < \Pi(\theta_i + a, n(\theta + a))$. To show this claim, we should note that the only difference between the integrals that define $\Pi(\theta_i, n(\theta))$ and $\Pi(\theta_i + a, n(\theta + a))$ is that in the first we use $R(\theta)$, while in the second we use $R(\theta + a)$, which is larger. Hence, the second integral is strictly larger, if there is a segment where $n(\theta) < \frac{b^+ + r\bar{t}^+}{c_1^+}$ over the limits of integration.

Next we first show that a threshold equilibrium. We know that $\Pi(\theta', n(\theta, \theta'))$ is continuous in θ' , and negative below $\underline{\theta}(c_1^+) - \varepsilon$ and positive above $\bar{\theta}(c_1^+) + \varepsilon$.

Hence, there exists some threshold value θ^* at which it equals 0. Assuming that all depositors act according to the threshold θ^* , then this is an equilibrium if:

- (1) $\Pi(\theta_i, n(\theta, \theta^*)) > \Pi(\theta^*, n(\theta, \theta^*)) = 0$ for $\theta_i > \theta^*$, and
- (2) $\Pi(\theta_i, n(\theta, \theta^*)) < \Pi(\theta^*, n(\theta, \theta^*)) = 0$ for $\theta_i < \theta^*$

To show that (1) holds, see that $\Pi(\theta_i, n(\theta, \theta^*)) - \Pi(\theta^*, n(\theta, \theta^*)) = \int_{\theta \in d^i} v(\theta, n(\theta)) - \int_{\theta \in d^*} v(\theta, n(\theta)) > 0$, where d^i and d^* are disjoint intervals of two integrals, that is, $d^i = [\theta_i - \varepsilon, \theta_i + \varepsilon] \setminus c$, $d^* = [\theta^* - \varepsilon, \theta^* + \varepsilon] \setminus c$, and $c = [\theta_i - \varepsilon, \theta_i + \varepsilon] \cap [\theta^* - \varepsilon, \theta^* + \varepsilon]$. The inequality comes from the condition $\theta_i > \theta^*$ and continuity.

To show that (2) holds, we need to show that the game between the depositors satisfies a weak form of strategic complementarities. That is, under some restrictions, the more depositors run on the bank, the higher incentive to follow them other depositor will have.

Suppose $0 \leq \theta_2 - \theta_1 \leq 2\varepsilon$ and for all $\theta \in [\theta_1, \theta_2]$, $f(\theta) \leq \theta_1$ and $n'(\theta) \geq n(\theta) = n + (1 - n)(\theta_2 - \theta)/2\varepsilon$. We need to show that if $\int_{\theta_1}^{\theta_2} v(\theta, n(\theta)) d\theta \geq 0$ then

$\int_{\theta_1}^{\theta_2} v(\theta, n(\theta)) d\theta > \int_{\theta_1}^{\theta_2} v(f(\theta), n'(\theta)) d\theta$. This inequality holds if $v(\theta, n(\theta)) > 0$ for all $\theta \in [\theta_1, \theta_2]$. Otherwise let θ_0 be $\theta \in [\theta_1, \theta_2]$ at which $v(\theta, n(\theta)) = 0$, and let θ'_0 be the smallest $\theta \in [\theta_1, \theta_2]$ at which $v(\theta, n'(\theta)) = 0$. Since $n'(\theta) \geq n(\theta)$, $\int_{\theta_1}^{\theta_0} v(\theta, n(\theta)) d\theta >$

$\int_{\theta_1}^{\theta'_0} v(f(\theta), n'(\theta)) d\theta$. Since v is decreasing in n and increasing in θ when v is positive,

we also have $\int_{\theta_0}^{\theta_2} v(\theta, n(\theta)) d\theta > \int_{\theta'_0}^{\theta_2} v(\theta, n(\theta)) d\theta > \int_{\theta'_0}^{\theta_2} v(f(\theta), n'(\theta)) d\theta$. Thus,

$\int_{\theta_1}^{\theta_2} v(\theta, n(\theta)) d\theta > \int_{\theta_1}^{\theta_2} v(f(\theta), n'(\theta)) d\theta$.

Second, we need to show that this threshold equilibrium is unique. To see this, let $\theta_B = \sup\{\theta_i : \Pi(\theta_i, n(\theta)) \leq 0\}$. By the existence of the upper dominance region, we need $\theta_B < 1 - 2\varepsilon$. By continuity of Π , $\Pi(\theta_B, n(\theta)) = 0$. Since $n(\theta_B - \varepsilon) \leq n(\theta_B + \varepsilon) = \lambda$ and $\theta_B - \varepsilon < \theta_B + \varepsilon$, we have $\frac{\partial}{\partial \theta_B} \Pi(\theta_B, n(\theta)) = v(\theta_B + \varepsilon, n(\theta_B + \varepsilon)) - v(\theta_B - \varepsilon, n(\theta_B - \varepsilon)) > 0$. This means that $\Pi < 0$ in the segment to the left of θ_B . If the equilibrium is a threshold equilibrium, this segment is $[0, \theta_B]$.

To show this is true, we use contradiction. Suppose there are signals below

θ_B at which $\Pi \geq 0$. Denote $\theta_A = \sup\{\theta_i < \theta_B : \Pi(\theta_i, n(\theta)) \geq 0\}$. By continuity $\Pi(\theta_A, n(\theta)) = \Pi(\theta_B, n(\theta)) = 0$. Let $c = (\theta_A - \varepsilon, \theta_A + \varepsilon) \cap (\theta_B - \varepsilon, \theta_B + \varepsilon)$, $d_A = [\theta_A - \varepsilon, \theta_A + \varepsilon] \setminus c$, and $d_B = [\theta_B - \varepsilon, \theta_B + \varepsilon] \setminus c$. Denote the interval d_B as $[\theta_1, \theta_2]$. We have $\Pi(\theta_A, n(\theta)) - \Pi(\theta_B, n(\theta)) = \int_{\theta_1}^{\theta_2} v(\theta, n(\theta)) - \int_{\theta_1}^{\theta_2} v(\theta_1 + \theta_2 - 2\varepsilon - \theta, n(\theta_1 + \theta_2 - 2\varepsilon - \theta))$. Then for $\theta \in [\theta_1, \theta_2]$, we have $n(\theta_1 + \theta_2 - 2\varepsilon - \theta) \geq n(\theta)$. Since $\int_{\theta_1}^{\theta_2} v(\theta, n(\theta)) \geq 0$ and $\theta_1 + \theta_2 - 2\varepsilon - \theta < \theta_1$ for all $\theta \in (\theta_1, \theta_2]$. Hence, we have $\int_{\theta_1}^{\theta_2} v(\theta, n(\theta)) > \int_{\theta_1}^{\theta_2} v(\theta_1 + \theta_2 - 2\varepsilon - \theta, n(\theta_1 + \theta_2 - 2\varepsilon - \theta))$. This implies $\Pi(\theta_A, n(\theta)) > \Pi(\theta_B, n(\theta))$, a contradiction.

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Figure 1

Relationship Between Consumption and Long-Term Return

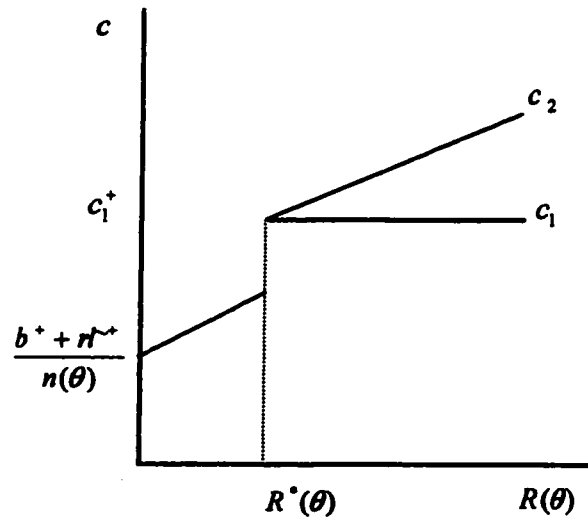
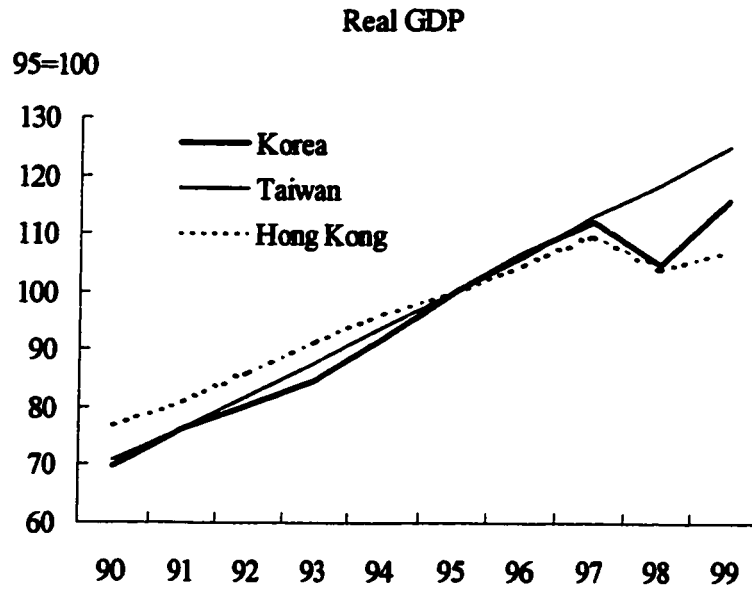
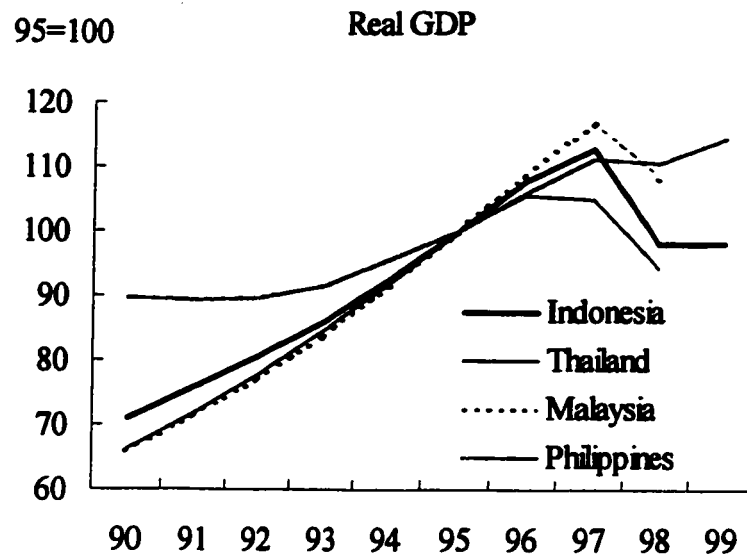


Figure 2



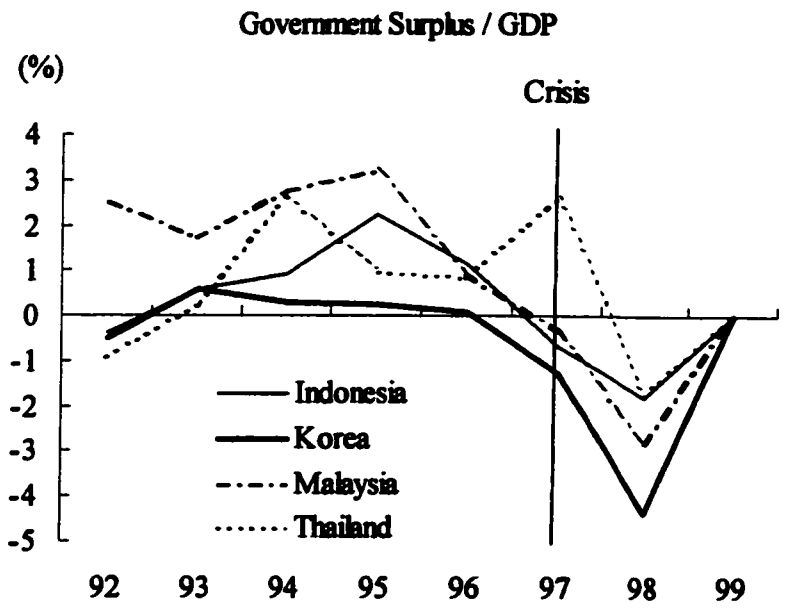
Source: IMF "International Financial Statistics," Bank of Korea and Taiwan Ministry of Economic Affairs.

Figure 3



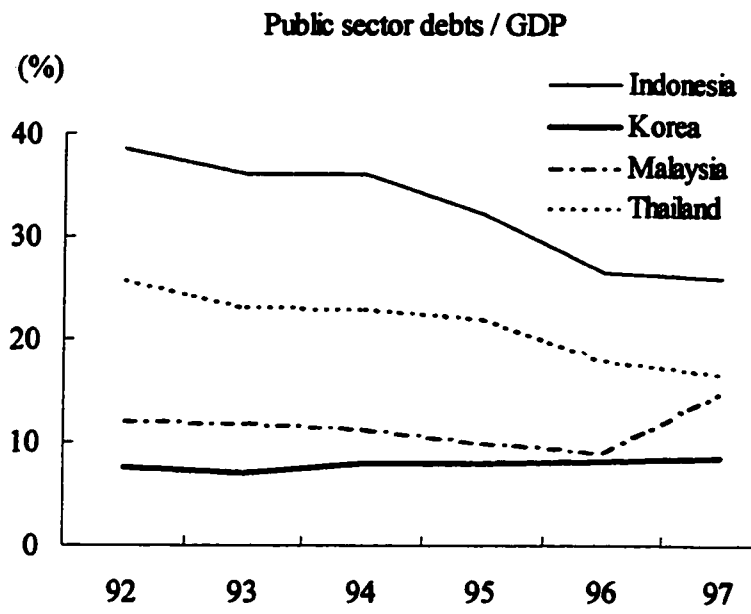
Source: IMF "International Financial Statistics."

Figure 4



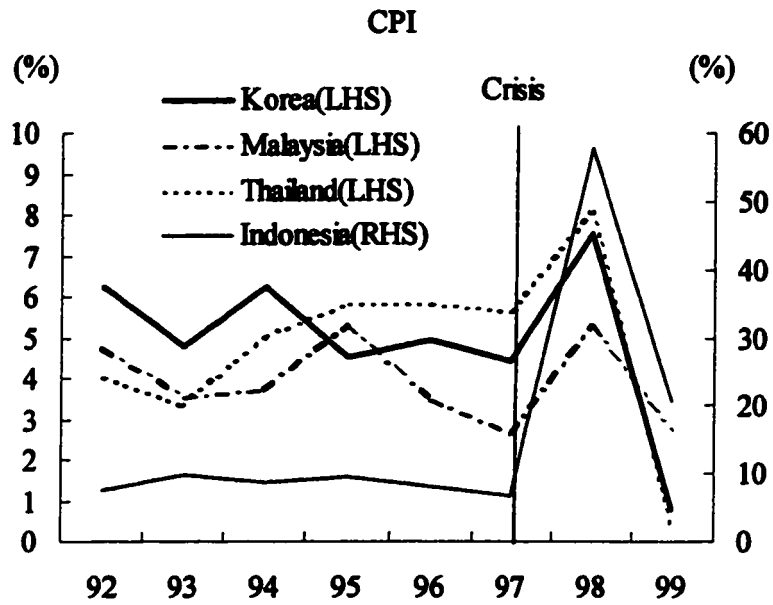
Source: IMF, "International Financial Statistics."

Figure 5



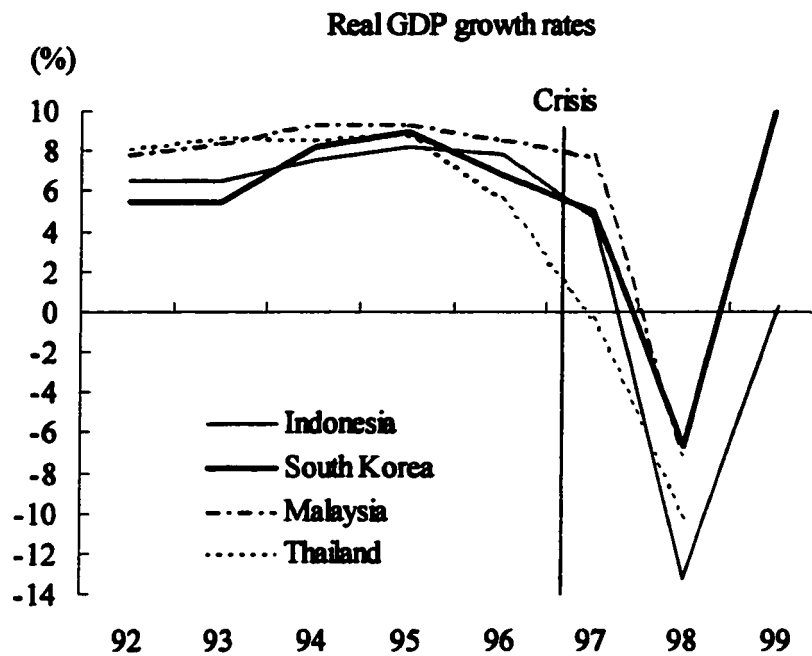
Source: World Bank.

Figure 6



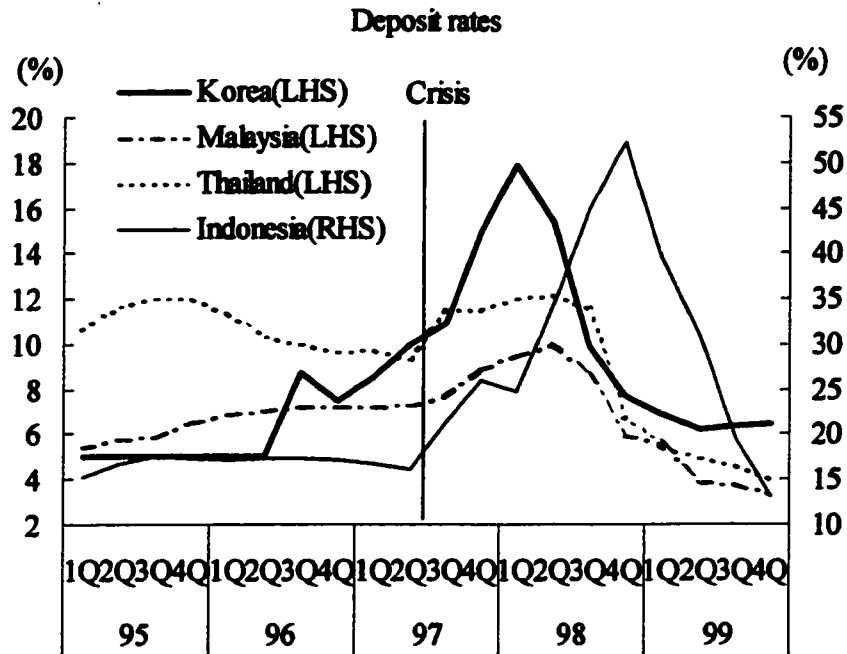
Source: IMF, "International Financial Statistics."

Figure 7



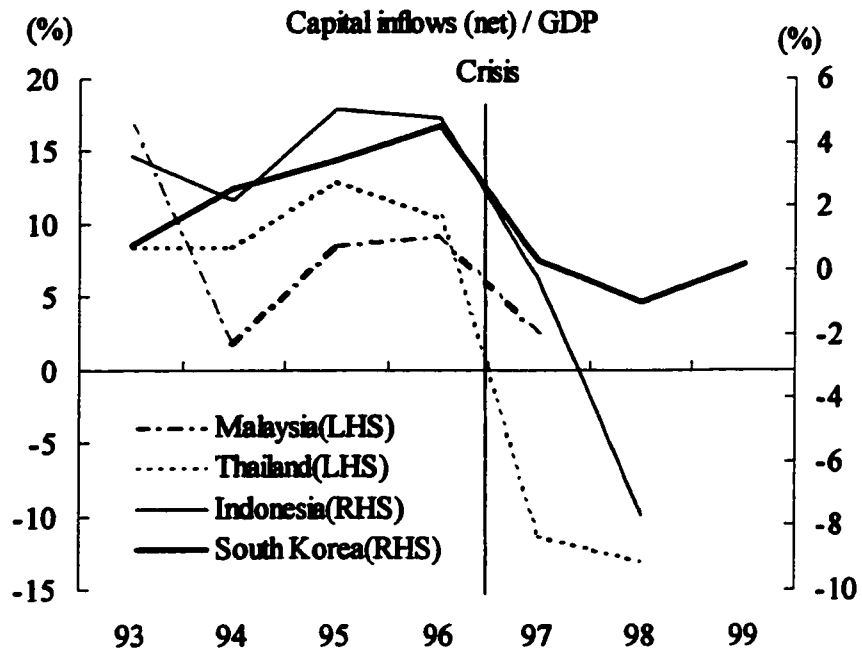
Source: Bank of Korea, and IMF "International Financial Statistics."

Figure 8



Source: IMF "International Financial Statistics," and Bank of Korea.

Figure 9



Note: Capital inflows include financial and capital accounts for Korea and Malaysia, while they consist only of financial account for Thailand and Indonesia.

Source: IMF "International Financial Statistics," and Bank of Korea.

Figure 10

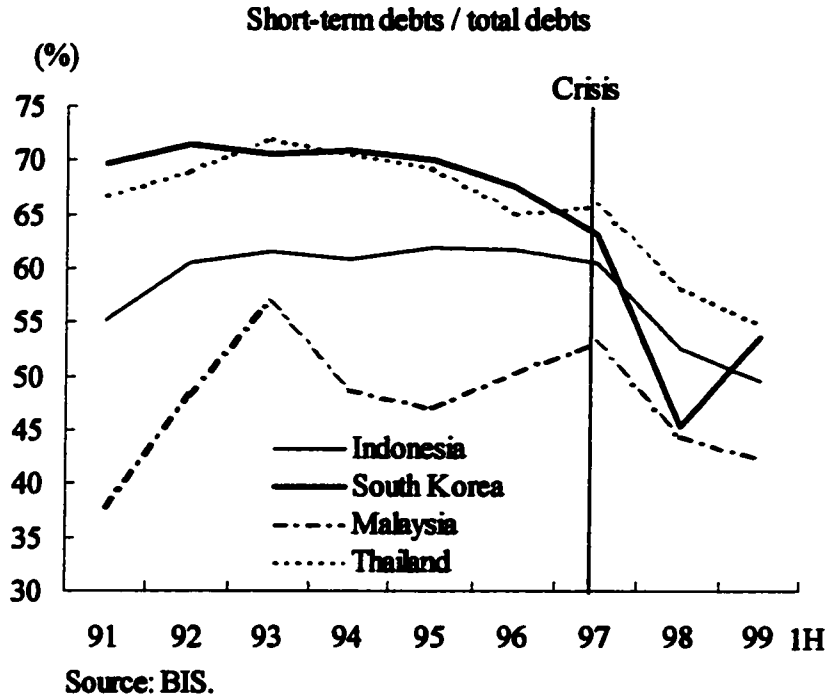


Figure 11

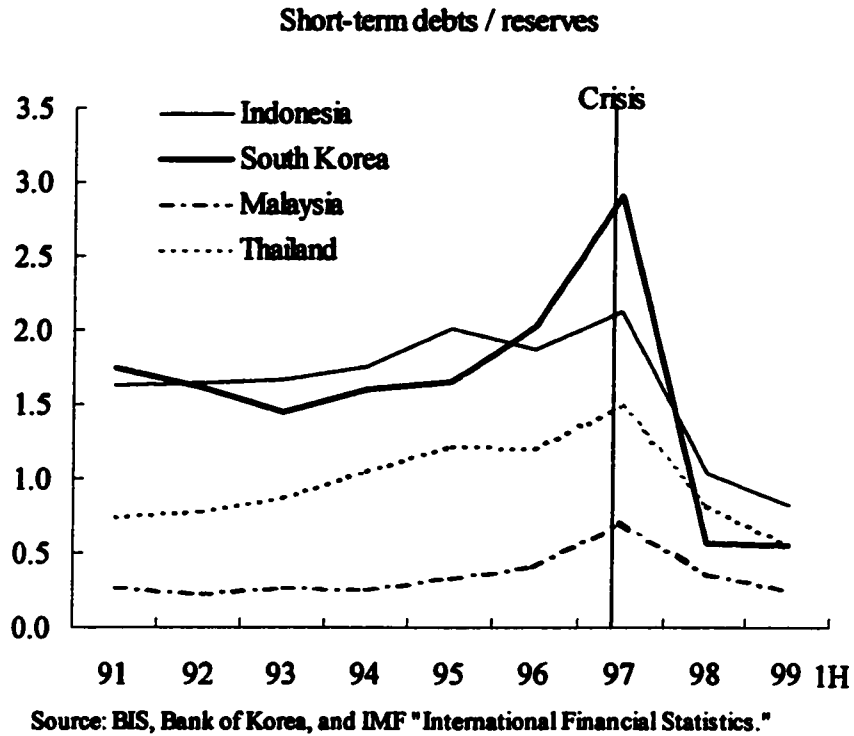
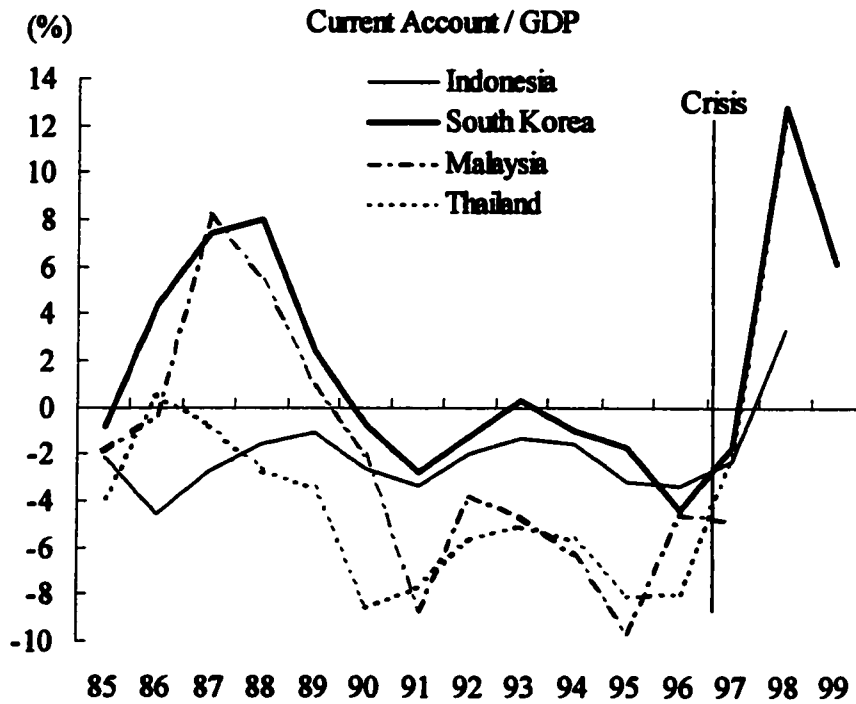
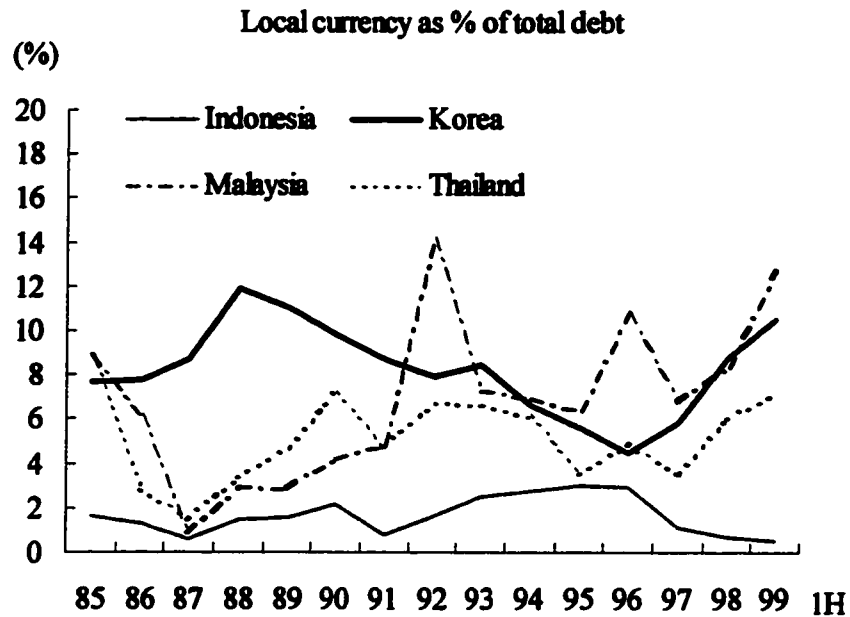


Figure 12



Source: IMF "International Financial Statistics," and Bank of Korea.

Figure 13



Source: BIS.

Figure 14

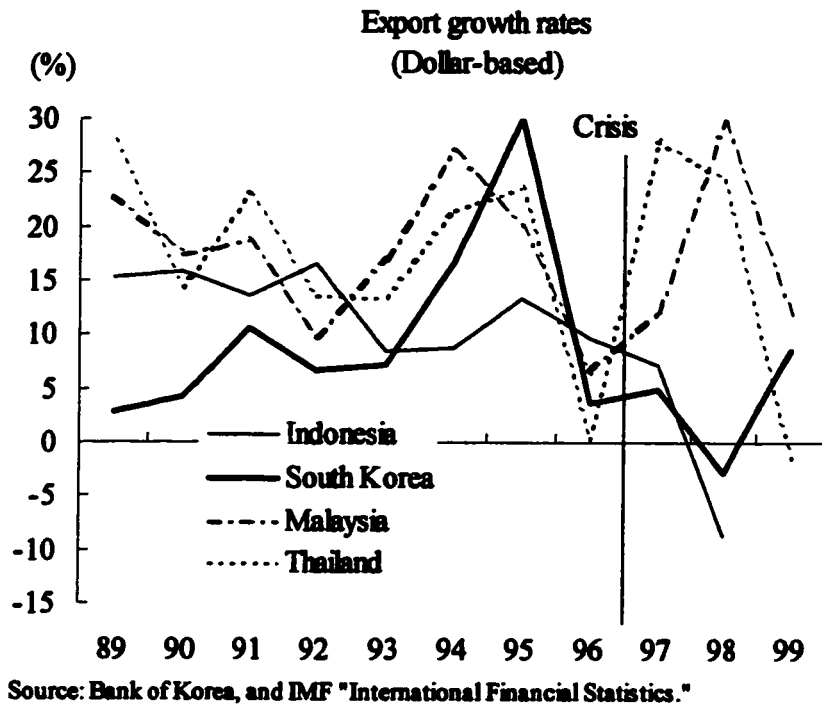


Figure 15

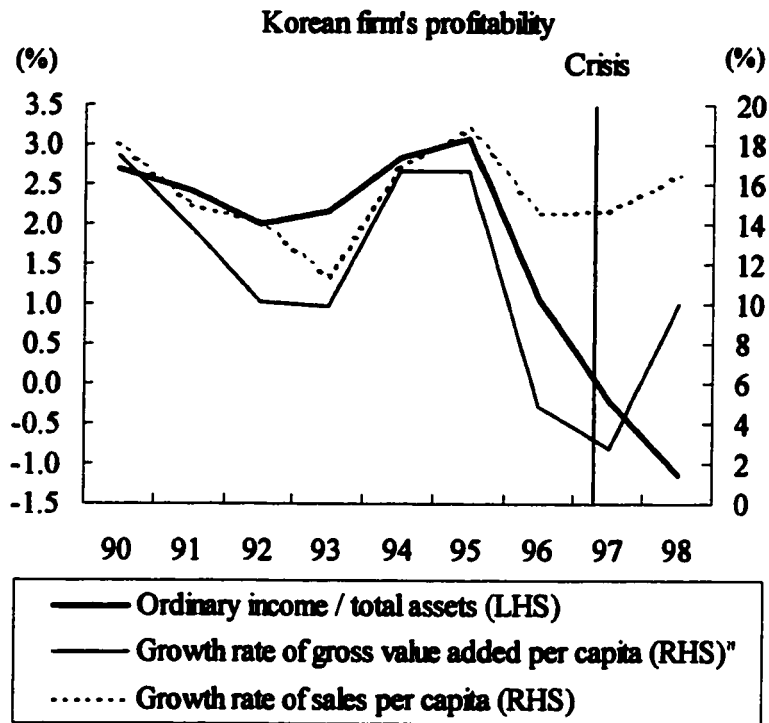
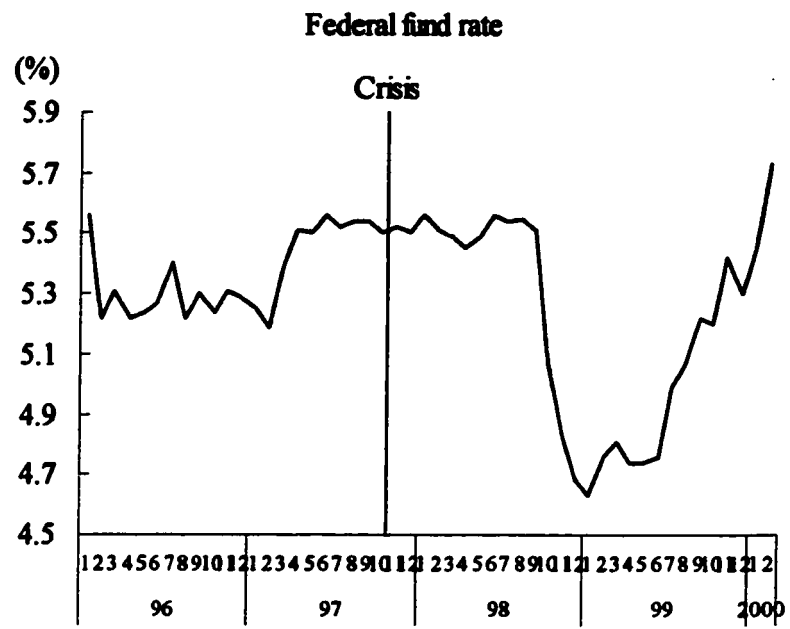
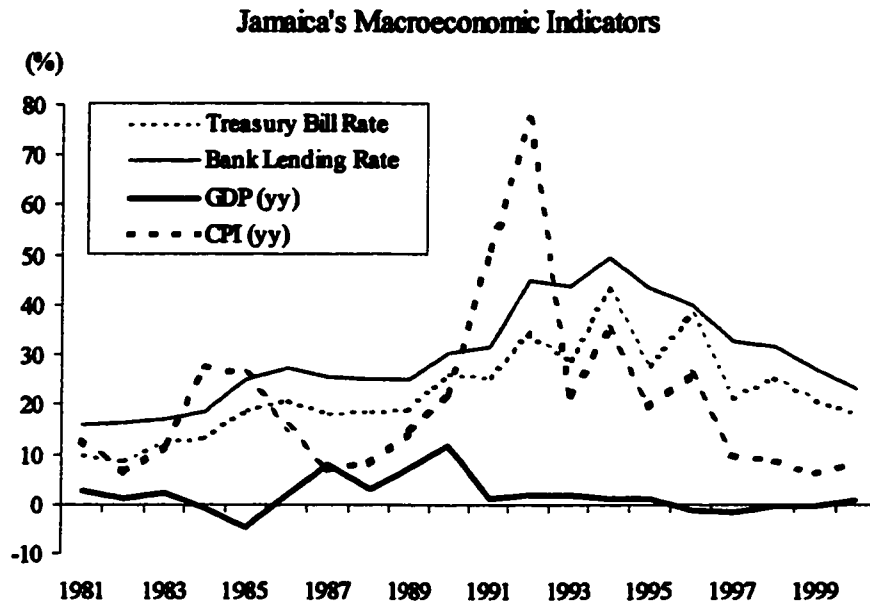


Figure 16



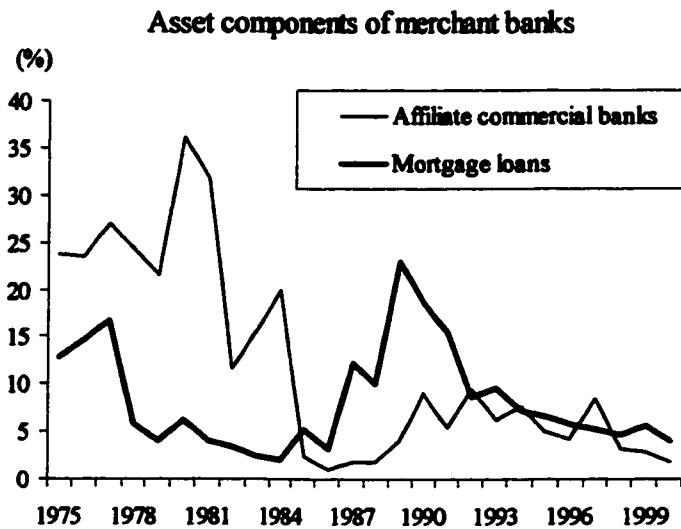
Source: Federal Reserve Board of Governors.

Figure 17



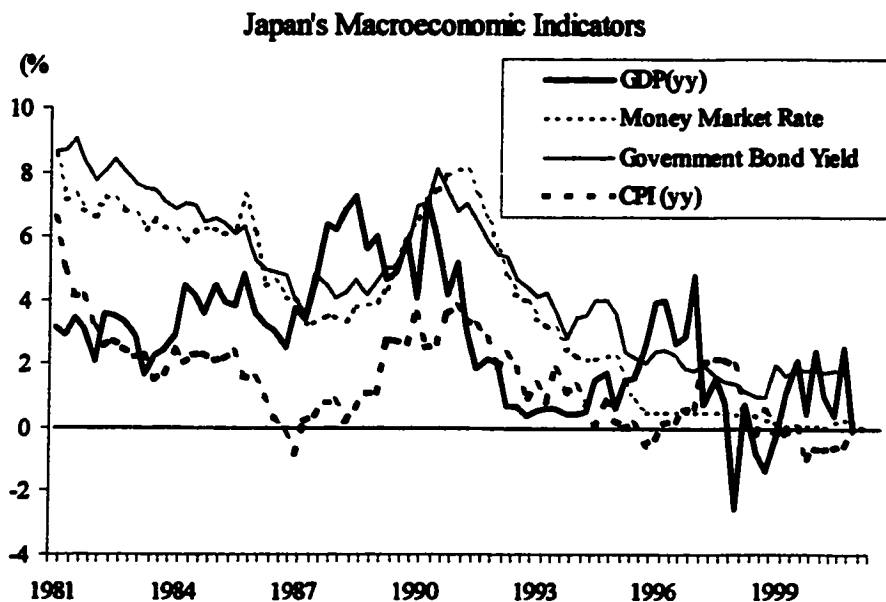
Source: IMF, IFS.

Figure 18



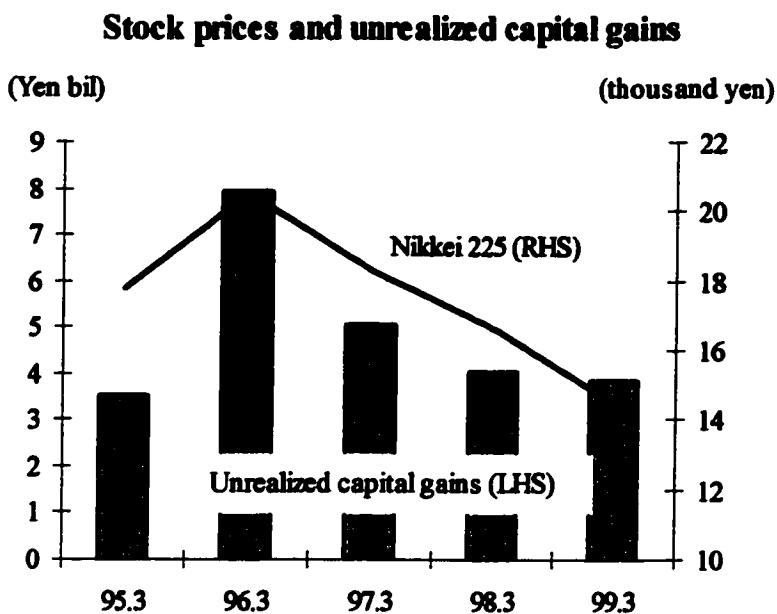
Source: Bank of Jamaica

Figure 19



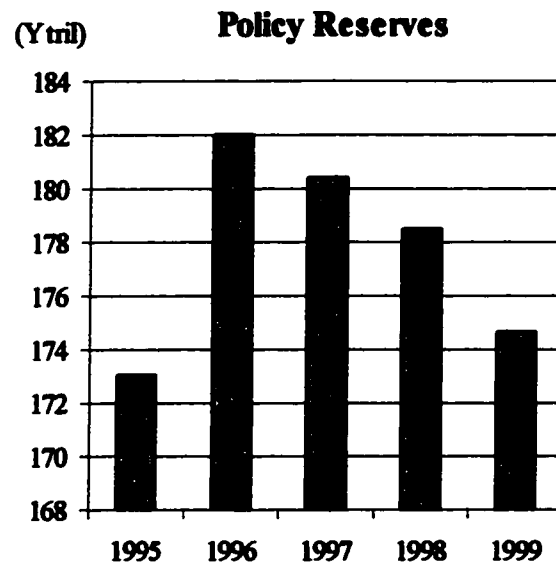
Source: IMF, IFS.

Figure 20



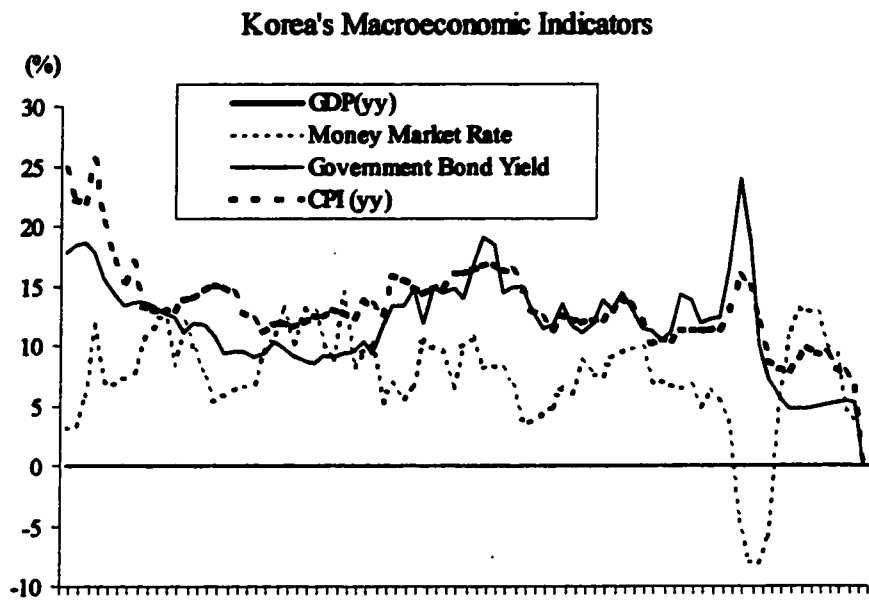
Source: Moody's Industry Outlook and IMF IFS.

Figure 21



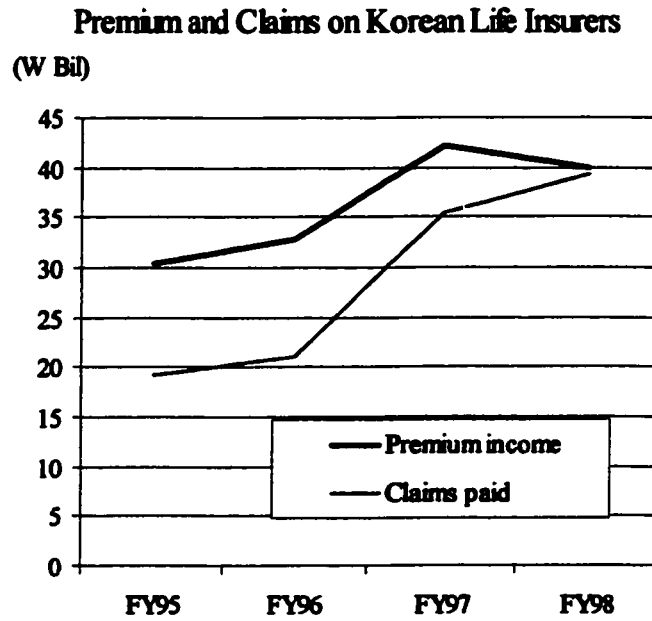
Source: Moody's Investors Service "Japanese Life Insurance."

Figure 22



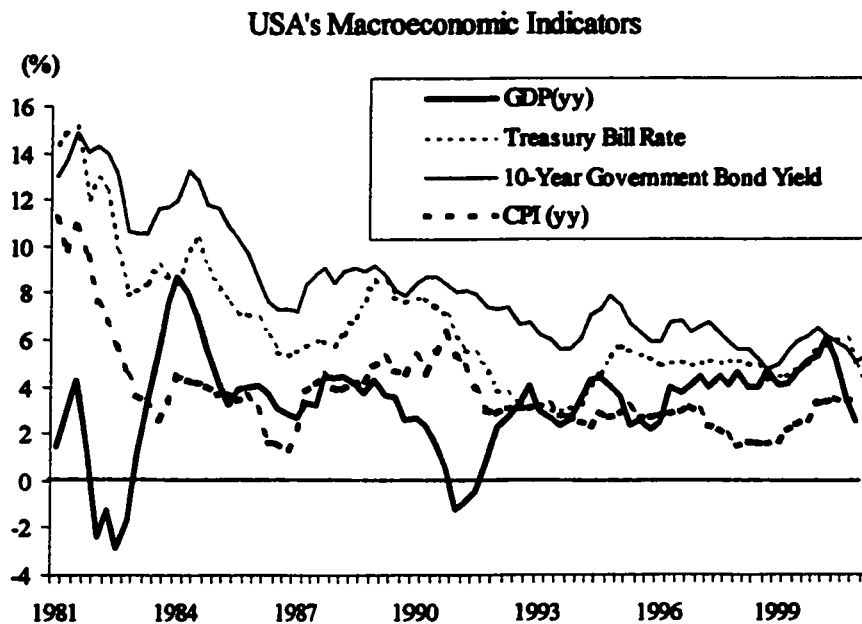
Source: IMF, IFS.

Figure 23



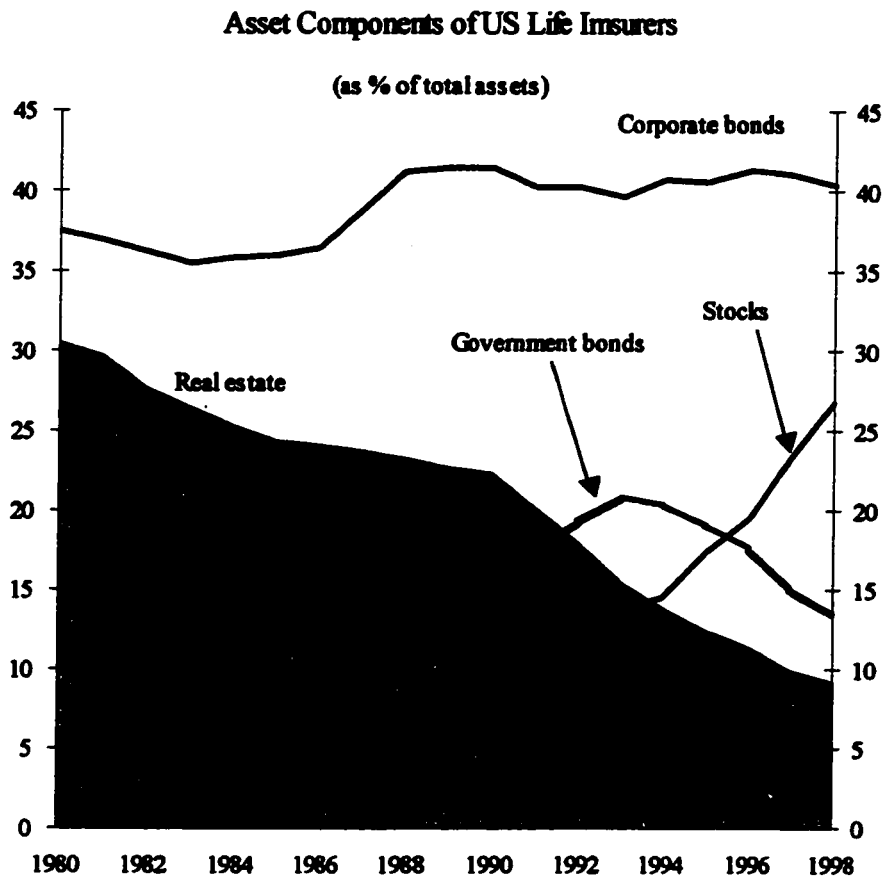
Source: Korea Life Insurance Association.

Figure 24



Source: IMF, IFS.

Figure 25



Source: American Council of Life Insurance.

Table 2**Relative Asset Shares of Financial Intermediaries in Advanced Countries
1997 (Each row sums to 100%)**

	Credit Institutions	Investment Funds	Insurance Companies and Pension Funds
Austria	82.9%	8.0%	9.1%
Belgium	82.3%	9.0%	8.7%
Canada	76.4%	12.4%	11.2%
Denmark	74.1%	2.7%	23.2%
Finland	71.5%	1.9%	26.6%
France	75.1%	11.1%	13.8%
Germany	80.7%	7.6%	11.7%
Italy	80.4%	9.8%	9.8%
Japan	86.6%	0.8%	12.6%
Netherlands	58.0%	4.8%	37.2%
Portugal	79.4%	9.4%	11.2%
Spain	76.2%	14.6%	9.2%
Sweden	63.0%	6.2%	30.8%
U.S	30.9%	35.3%	33.8%

Sources:

US: Board of Governors of the Federal Reserve System "Flow of Funds Accounts of the United States."

Canada: "Review."

Japan: Bank of Japan "Economic Statistics Monthly."

Europe: European Central Bank "Possible Effects of EMU on the EU Banking System in the Medium and Long Term."

Banque de France "Annual Report."

The table above is compiled by Globalization of Financial Institutions and Cross-Border Consolidation,
Brookings-Wharton Papers on Financial Services Third Annual Conference.

Table 3**Countries that permit insurance activity for banking organizations**

<u>Permitted</u>	<u>Not permitted</u>
Argentina	China
Australia	Colombia
Austria	India
Bahrain	Israel
Belgium	Pakistan
Bermuda	Panama
Bolivia	Peru
Brazil	Russia
Canada	
Cayman Islands	
Chile	
Czech Republic	
Denmark	
Egypt	
Estonia	
Finland	
France	
Germany	
Greece	
Hong Kong	
Indonesia	
Ireland	
Italy	
Japan	
Korea	
Latvia	
Luxembourg	
Mexico	
Netherland	
New Zealand	
Nigeria	
Norway	
Philippines	
Poland	
Portugal	
Romania	
Sinagpore	
South Africa	
Spain	
Sweden	
Switzerland	
Turkey	
United Kingdom	
United States	
Uruguay	
Venezuela	

Source: Institute of International Bankers (2000) Global Survey 2000.

Table 4

M&As classified by country and sector of target firm (By deal type)

	(Number)										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Banking	199	311	381	461	525	532	480	534	533	488	4444
Cross-border	23	28	23	26	33	39	32	38	34	42	338
(as % of total)	(11.6)	(9.0)	(6.0)	(5.6)	(6.3)	(7.3)	(6.7)	(7.1)	(10.1)	(8.6)	(7.6)
Cross-industry	46	49	49	52	68	67	64	79	80	92	646
(as % of total)	(23.1)	(15.8)	(12.9)	(11.3)	(13.0)	(12.6)	(13.3)	(14.8)	(15.0)	(18.9)	(14.5)
Insurance	54	89	102	87	80	123	149	145	146	103	1078
Cross-border	20	19	18	19	23	32	33	46	45	32	287
(as % of total)	(37.0)	(21.3)	(17.6)	(21.8)	(28.8)	(26.0)	(22.1)	(31.7)	(30.8)	(31.1)	(26.6)
Cross-industry	7	18	23	14	13	25	30	34	23	32	219
(as % of total)	(13.0)	(20.2)	(22.5)	(16.1)	(16.3)	(20.3)	(20.1)	(23.4)	(15.8)	(31.1)	(20.3)
Securities	71	149	135	134	168	201	213	222	195	296	1784
Cross-border	15	21	19	15	22	45	35	35	34	47	288
(as % of total)	(21.1)	(14.1)	(14.1)	(11.2)	(13.1)	(22.4)	(16.4)	(15.8)	(17.4)	(15.9)	(16.1)
Cross-industry	19	34	27	38	50	72	71	66	55	79	511
(as % of total)	(26.8)	(22.8)	(20.0)	(28.4)	(29.8)	(35.8)	(33.3)	(29.7)	(28.2)	(26.7)	(28.6)

Source: BIS.

M&As classified by country and sector of acquiring firm (By deal type)

	(Number)										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Banking	180	297	366	454	503	552	504	533	528	506	4423
Cross-border	28	28	26	29	34	65	49	59	66	67	451
(as % of total)	(15.6)	(9.4)	(7.1)	(6.4)	(6.8)	(11.8)	(9.7)	(11.1)	(12.5)	(13.2)	(10.2)
Cross-industry	19	33	29	42	45	73	75	66	60	89	531
(as % of total)	(10.6)	(11.1)	(7.9)	(9.3)	(8.9)	(13.2)	(14.9)	(12.4)	(11.4)	(17.6)	(12.0)
Insurance	69	98	97	94	100	142	147	148	163	124	1182
Cross-border	26	33	23	20	34	51	45	56	68	63	419
(as % of total)	(37.7)	(33.7)	(23.7)	(21.3)	(34.0)	(35.9)	(30.6)	(37.8)	(41.7)	(50.8)	(35.4)
Cross-industry	18	16	14	19	21	28	19	28	23	27	213
(as % of total)	(26.1)	(16.3)	(14.4)	(20.2)	(21.0)	(19.7)	(12.9)	(18.9)	(14.1)	(21.8)	(18.0)
Securities	88	170	167	144	189	207	227	255	242	340	2029
Cross-border	17	23	25	21	29	45	42	39	58	74	373
(as % of total)	(19.3)	(13.5)	(15.0)	(14.6)	(15.3)	(21.7)	(18.5)	(15.3)	(24.0)	(21.8)	(18.4)
Cross-industry	36	55	61	45	64	74	79	95	92	114	715
(as % of total)	(40.9)	(32.4)	(36.5)	(31.3)	(33.9)	(35.7)	(34.8)	(37.3)	(38.0)	(33.5)	(35.2)

Source: BIS.

Table 5**M&As classified by country and sector of target firm (By region)**

	(as % of total)										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Banking	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
USA	65.8	48.9	63.8	70.7	69.5	73.3	69.6	70.0	65.3	50.8	65.5
Japan	2.5	2.6	0.5	1.3	0.2	0.8	1.9	2.6	1.9	10.0	2.4
Europe	25.6	43.4	34.4	23.9	28.0	21.8	22.7	20.6	27.8	34.6	27.6
Others	6.0	5.1	1.3	4.1	2.3	4.1	5.8	6.7	5.1	4.5	4.5
Insurance	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
USA	42.6	40.4	45.1	41.4	46.3	45.5	44.3	38.6	47.3	45.6	43.8
Japan	0.0	2.2	0.0	0.0	0.0	0.0	1.3	1.4	2.1	6.8	1.5
Europe	50.0	51.7	48.0	50.6	46.3	45.5	47.0	52.4	41.8	39.8	47.0
Others	7.4	5.6	6.9	8.0	7.5	8.9	7.4	7.6	8.9	7.8	7.7
Securities	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
USA	45.1	23.5	20.7	32.8	31.5	32.8	32.4	44.6	46.2	28.7	33.7
Japan	0.0	0.7	2.2	2.2	1.2	2.5	3.3	7.2	11.3	18.6	6.4
Europe	45.1	61.1	62.2	50.7	54.2	50.7	53.5	35.1	28.2	34.1	45.7
Others	9.9	14.8	14.8	14.2	13.1	13.9	10.8	13.1	14.4	18.6	14.2

Source: BIS.

M&As classified by country and sector of acquiring firm (By region)

	(Number)										
	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Total
Banking	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
USA	62.8	47.8	64.2	72.0	70.8	69.0	67.3	67.7	68.6	50.4	64.9
Japan	2.2	3.0	0.5	2.0	0.4	1.1	1.6	2.6	1.7	9.5	2.5
Europe	27.2	43.8	34.2	22.5	27.4	26.1	25.8	23.5	26.5	36.4	28.6
Others	7.8	5.4	1.1	3.5	1.4	3.8	5.4	6.2	3.2	3.8	3.9
Insurance	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
USA	31.9	34.7	38.1	40.4	43.0	47.2	45.6	41.2	45.4	29.0	40.5
Japan	1.4	0.0	0.0	0.0	0.0	0.0	0.7	0.7	3.1	4.8	1.2
Europe	58.0	59.2	56.7	52.1	47.0	43.7	46.9	45.3	43.6	57.3	49.8
Others	8.7	6.1	5.2	7.4	10.0	9.2	6.8	12.8	8.0	8.9	8.5
Securities	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
USA	47.7	26.5	26.9	32.6	34.9	40.6	34.8	48.6	44.2	30.9	36.7
Japan	1.1	2.4	1.8	2.8	1.1	1.4	4.0	5.9	9.1	17.1	6.0
Europe	40.9	59.4	56.9	49.3	51.3	46.9	50.2	31.0	28.9	35.3	43.4
Others	10.2	11.8	14.4	15.3	12.7	11.1	11.0	14.5	17.8	16.8	14.0

Source: BIS.

Table 6**Regulation of Financial Conglomerates**

A Single Regulator Oversees the Activities of All Financial Conglomerates as a Whole	Identity of the Lead Regulator for a Financial Conglomerate Is Determined on the Basis of the Financial Conglomerate's Principal Activity	Financial Conglomerates Operate without a Single or Lead Regulator
Australia	Argentina	Bahrain
Bolivia	Austria	Belgium
Canada	Estonia	Chile
Cayman Islands	Greece	Czech Republic
Colombia	Ireland	Finland
Denmark	Israel	France
Japan	Latvia	Germany
Korea	Philippines	Hong Kong
Norway	Spain	Italy
Peru	United States	Luxembourg
Singapore	Venezuela	Netherland
Sweden		Panama
United Kingdom		Poland
		Portugal
		Romania
		South Africa
		Switzerland
		Turkey
		Uruguay

Source: Institute of International Bankers (2000) Global Survey.

Table 7: Selected Insurance Crises

Country	Year	Company Name	Causes	Resolution
Australia	2001	HIH (non-life)	HIH was Australia's second largest non-life insurance company. It suddenly went into liquidation maybe due to mismanagement. The crash had wide economic effects. Unfinished construction projects were halted, making workers unemployed. Small businesses became bankrupt, and local and community organizations were endangered by public liability claims. A substantial portion of the country's professionals such as accountants, doctors, and lawyers lost their professional liability coverage.	HIH went into provisional liquidation, under which the provisional liquidators review HIH operations and assess the financial position. HIH is in run-off. It is managing claims, which can take several years to complete.
Canada	1994	Confederation Life Assurance	Confederation Life Assurance actively participated in the derivative markets. As in the case in the US crisis as below, it provided GICs to policyholders. Faced with the decline in real estate market, Confederation Life had difficulty to meet the demand for matured GICs holders.	The regulator took control of the company. After six years in the liquidation process, the estate of the company was able to meet 100% of its obligations to policyholders and a substantial percentage of the obligations to its investors in all of the markets in which it operated.
Ethiopia	1997	Universal Insurance	Universal Insurance was started with borrowed funds. Once the company was given a license the individual gave the funds back to the lenders. Consequently, Universal Insurance was shut down.	The case is still in court.
Ireland	1985	Insurance Corporation of Ireland (non-life)	Insurance Corporation of Ireland (ICI) came nearly to formal liquidation due to poor underwriting in its London branch and under reserving. Its failure caused a run on its parent company, Allied Irish Banks (AIB).	The regulator was obliged to purchase the ICI from AIB and appointed a new administrator.
Jamaica	1996-1999	Life of Jamaica Island Life Jamaica Mutual Life Assurance Dyoll Life Crown Eagle Life	During the early 1990s Jamaica experienced credit boom. Using regulatory arbitrage, insurance companies overinvested in real estate markets by being introduced by banks in the same financial conglomerate. Their investment returns became too low to match guaranteed rates of return on interest sensitive policies of between 12-24%. Contagion occurred between banks and insurers, since both belonged to the same financial conglomerates and invested in the real estate markets.	The regulator initially attempted to implement loss-sharing arrangements with depositors, causing erosion of depositor confidence. Then the government established an asset management company (FIS and FINSAC) that issued illiquid FINSAC notes to fill balance sheet gaps. The status of this paper is not yet clear, since Jamaica continues to be under severe financial stresses.

Japan	1997-2001	Nissan Mutual Life Toho Mutual Life Nihon Dantai Life Daihyaku Mutual Life Taisho Mutual Life Chiyoda Mutual Life Kyoei Mutual Life Tokyo Mutual Life	Japanese life insurers provided policyholders with very high guaranteed rates of return between late 1980s and early 1990s. They also made large amounts of loans (more than 30% of total assets). Prolonged low interest policy, the stock market plunge, and non-performing loans in 1990s made it difficult for insurers to receive investment return (2-3%) high enough to match guaranteed rates of return (3.3-4.2%).	Except for Tokyo Mutual Life, policies of troubled insurers were transferred to foreign insurers, that is, Artemis, GE Edison Life, Axa, Century Life, Manual Life, AIG, and Prudential, respectively. Before Chiyoda Mutual Life, the regulator provided financial assistance to the troubled insurers through Life Insurance Policy-Holders Protection Corporation. After Chiyoda Mutual Life, the acquirer paid the costs.
Korea	1998-2002	First Life Haedong Fire and Marine (non-life) Korea Life Handuk Life Kookmin Life Dongah Life Chosun Life Pacific Life Doowon Life Kukje Life BYC Life Taeyang Life Coryo Life KGI (non-life) HFS (non-life)	Korean life and non-life insurers acted like banks. They made significant amounts of loans (40-50% of total assets). They also provided policyholders short-term savings products. During the currency and financial crisis in 1997, insurance companies suffered from non-performing loans problem and liquidity shortages like banks.	The regulator extended the bank deposit guarantee (Korea Deposit Insurance Corp.=KDIC) to insurance liabilities to prevent runs. Much of the industry has been recapitalized by the government and sold. Korea Life was nationalized. Other insurers were acquired by Allianz, Regent Pacific Group, SK Group, Kumho Group, Hyundai Group, Tomg-Yang Group-Rothchild consortium, Korea Life, Samsung Life, Kyobo Life, Hungdok Life and First Life, respectively. KGI and HFS were merged following the acquisition of NPLs by KAMCO.
USA	1991	Mutual Benefit Life Executive Life First Capital Life Monarch Life Executive Life of NY Fidelity Bankers Life Guarantee Security Life	Many American life insurers invested in real estate markets and junk bond markets in 1980s. They also provided policyholders GICs, 5-year term products with guaranteed rates of return. The collapse of the mortgage market in late 1980s made it difficult for the insurers to obtain liquidity enough to satisfy the repayment under a large portion of GICs. Decline of junk bond markets prices and political consideration also affected insurers badly	Measures varied state by state. But basically, bankrupt insurers were cease operation and their policies were transferred to sound financial institutions. For example, businesses of Monarch Life, Executive Life of NY, Fidelity Bankers Life were sold to Merrill Lynch, Metropolitan Life, and First Dominion Mutual Life, respectively. Executive Life's business was spun off to Axa, that help conversion to stock company. Policies of Executive Life was paid fully by state guaranty fund. Policies of Guarantee Security Life were transferred to the Life and Health Guaranty Association.

Table 8**Jamaica's Financial Structure**

	(J\$ mil)					
	1971	1981	1990	1995	1996	1999
Commercial banks						
Number	6	8	11	11	9	6
Number of branches	131	179	170	205	188	129
Assets	517	2,634	17,328	121,325	135,986	192,843
Deposits	406	2,103	12,098	89,135	94,103	126,814
Loans	330	1,495	8,997	45,864	54,563	36,719
Merchant banks						
Number	3	6	21	25	23	13
Assets	12	93	4,527	17,334	19,778	10,078
Deposits	2	35	2,843	6,868	6,760	4,545
Loans	10	38	2,863	6,024	7,349	2,704
Trust companies						
Number	6	10	3	na	na	na
Assets	24	163	109	na	na	na
Deposits	14	126	86	na	na	na
Loans	14	104	75	na	na	na
Building societies						
Number	16	7	6	32	14	5
Assets	57	388	3,058	29,084	35,926	40,412
Deposits	53	367	2,667	25,217	28,765	32,577
Loans	46	271	1,596	9,714	15,570	14,709
Credit unions						
Number	127	96	80	82	77	66
Savings	10	185	694	3,516	4,681	9,436
Loans	9	184	652	2,831	3,652	6,680
Financial houses						
Number	na	10	5	4	4	2
Assets	na	59	266	639	530	724
Deposits	na	47	157	210	236	393
Loans	na	33	168	206	185	205
Life insurance companies						
Number	20	13	10	12	12	7
Assets	129	403	2,072	na	na	24,000

(Source) Bank of Jamaica

Table 9**Resolution of bankrupt insurance companies****(Y bil)**

Bankruptcy date	Company name	Resolution	Amount of bankruptcy	Amount of financial assistance
April 1997	Nissan Mutual Life	Policies were transferred to Aoba Life in Oct. 1997. Artemis Group acquired stock of Aoba in November 1999.	300.0	200.0 from security reserve
June 1999	Toho Mutual Life	Policies were transferred to GE Edison Life in March 2000.	650.0	366.3 from security reserve
March 2000	Nihon Dantai Seimei	Policies were transferred to Axa.	---	---
May 2000	Daihyaku Mutual Life	Policies were transferred to Manulife Century in April 2001.	320.0	145.0 from security reserve
August 2000	Taisho Mutual Life (Joint Stock)	Policies were transferred to Azami Life in March 2001. Manulife Century acquired Azami's stocks.	36.5	26.2 from security reserve
October 2000	Chiyoda Mutual Life	The court approved rehabilitation plan sponsored by AIG in March 2001. Business restarted under the name of AIG Star Life in April.	311.9	0
October 2000	Kyoei Mutual Life (Joint Stock)	The court approved rehabilitation plan sponsored by Prudential Life in April 2001. Business restarted under the name of Gibraltar Life in April.	689.5	0
March 2001	Tokyo Mutual Life			

Table 10

Investment profile of Japanese insurance companies
(consolidated data, as % of total assets)

	1995	1996	1997	1998	1999
Cash & short-term investment	8.13	7.43	5.60	7.81	7.82
Money held in trust	2.95	2.34	2.45	2.04	1.34
JGBs and government bonds	12.81	16.95	17.21	16.67	17.80
Corporate bonds	5.47	5.73	6.51	7.14	7.60
Domestic equities	18.88	17.31	17.15	15.97	15.19
Foreign securities	7.44	7.49	9.50	10.08	11.61
Other securities	0.65	0.98	1.07	0.97	1.12
Total securities	45.25	48.47	51.45	50.83	53.32
Loans	38.17	36.41	35.12	33.92	31.30
Real estate and movables	5.48	5.35	5.30	5.34	5.20
Others	0.01	0.01	0.08	0.06	1.02

Source: Moody's Investors Service "Japanese Life Insurance: Industry Outlook," March 2000.

Table 11

Change in Contracts Before and After the Collapse

Nissan Mutual Life & Aoba Mutual Life

	Nissan Mutual Life		Aoba Mutual Life		
	1996.3	1997.3	1998.3	1999.3	2000.3
Individual Life	7.3	7.4	3.2	2.4	2.0
y-y, %	(0.7)	(1.2)	(-56.3)	(-24.4)	(-16.2)
Individual Annuities	2.5	2.4	0.9	0.7	0.6
y-y, %	(-3.9)	(-5.4)	(-63.5)	(-21.4)	(-11.9)
Group Life	7.3	7.2	0.1	0.0	0.0
y-y, %	(-1.7)	(-1.2)	(-98.1)	(-88.2)	(-36.0)
Group Pensions	0.4	0.4	0.4	0.3	0.2
y-y, %	(-4.1)	(-7.1)	(-14.8)	(-15.3)	(-19.4)

Toho Mutual Life (& G.E. Edison Life)

	(Y tril)			
	1997.3	1998.3	1999.3	2000.3
Individual Life	23.4	19.5	15.8	9.9
y-y, %	(-1.3)	(-16.6)	(-19.1)	(-37.5)
Individual Annuities	2.8	2.1	1.9	1.2
y-y, %	(-1.4)	(-25.6)	(-8.7)	(-39.0)
Group Life	13.8	11.2	2.5	0.4
y-y, %	(-3.0)	(-18.8)	(-77.6)	(-82.6)
Group Pensions	1.2	0.4	0.2	0.2
y-y, %	(-27.3)	(-68.4)	(-35.1)	(-27.2)

Source: JCER

Table 12**Change of the contracts after acquisition of troubled insurers**

	Aoba Mutual Life	GE Edison Life	Manulife Century	Azami Mutual Life	AIG Star Life	Gibraltar Life	Taiyo & Daido Life
Company acquired	Nissan Mutual Life	Toho Mutual Life	Daihyaku Mutual Life	Taisho Mutual Life	Chiyoda Mutual Life	Kyoei Mutual Life	Tokyo Mutual Life
Guaranteed rates of return	2.75%	1.5%	1%	1%	1.5%	1.75%	2.6%
Reduction of policy reserves	-	10%	10%	10%	10%	8%	N/A
Reduction of repayment for early surrender	From 15 to 3% in 7 years	From 20% to 2% in 8 years	From 20% to 2% in 10 years	From 15 to 3% in 9 years	From 20% to 2% in 10 years	From 15% to 2% in 8 years	N/A

Source:

Manulife Century: <http://www.manulife.co.jp/>

AIG Star Life: <http://www.aigstar-life.co.jp/>

GE Edison Life: <http://www.geedison.com/>

Gibraltar Life: <http://www.gib-life.co.jp/>

Nikkei Shimbun August 9, 2001.

Yasuo Kofuji (2001) "Seiho Kiki no Honshitsu," Toyo Keizai.

Table 13**Korea's Financial Institutions Closed or Suspended**

	Dec. 1997	Jan. 1998-Dec. 2000			Dec. 2000 (*)
		Mergers	License revoked or suspended	Total	
Banks	33	6	5	11	22
Securities Houses	36	1	6	7	43
Merchant Banks	30	3	22	25	6
Insurance Companies	50	6	5	11	40
Leasing Companies	25	9	1	10	19
Investment Trust Management Companies	24	1	5	6	25
Mutual Savings and Finance Companies	231	25	60	85	173
Credit Unions	1,666	101	257	358	1,327
Total	2,095	152	361	513	1,655

Note: Includes newly established companies.

Source: Financial Supervisory Service "Annual Report 2000."

Table 14**Korea's Financial Sector (Share of Assets)**

	(as % of industry total)	
	Dec. 1996	Jun. 2000
Commercial banks	29	38
Trust accounts	21	16
Specialized and development banks	15	18
Investment trust companies	7	10
Life insurance companies	7	7
Merchant banks	5	1
Other financial institutions	16	10

Source: Financial Supervisory Service.

Table 15

Outstanding Investment by Life Insurance Companies

	94	95	96	97	98
Japan (as % of Total)					
Real Estate	5.3	5.2	5.2	5.2	5.1
Mortgage Loans	4.1	3.9	0.0	0.0	0.0
Shares	26.6	25.4	18.9	17.8	17.2
Bonds with Fixed Revenue	18.0	22.4	29.7	30.3	32.8
Loans other than Mortgage Loans	33.6	32.0	34.6	33.4	30.8
Other Investment	12.4	11.1	11.6	13.3	14.1
Total	100.0	100.0	100.0	100.0	100.0
Korea (as % of Total)					
Real Estate	7.6	7.6	7.7	7.6	9.1
Mortgage Loans	0.3	0.3	0.3	0.2	0.1
Shares	12.8	13.6	12.9	11.1	9.2
Bonds with Fixed Revenue	14.2	12.4	13.3	13.8	28.4
Loans other than Mortgage Loans	49.0	48.8	48.2	46.9	37.9
Other Investment	16.2	17.2	17.8	20.4	15.3
Total	100.0	100.0	100.0	100.0	100.0
USA (as % of Total)					
Real Estate	2.7	2.5	2.2	1.8	1.5
Mortgage Loans	13.8	12.9	12.2	11.4	11.3
Shares	5.2	5.5	5.8	6.4	6.6
Bonds with Fixed Revenue	67.9	69.1	70.2	69.9	70.0
Loans other than Mortgage Loans	5.6	5.8	5.7	5.6	5.4
Other Investment	4.7	4.2	3.9	4.9	5.1
Total	100.0	100.0	100.0	100.0	100.0
Canada (as % of Total)					
Real Estate	6.4	5.2	5.3	4.7	4.3
Mortgage Loans	30.8	26.9	4.9	27.7	25.9
Shares	7.7	7.0	8.2	6.7	7.1
Bonds with Fixed Revenue	45.7	46.4	51.4	53.8	55.1
Loans other than Mortgage Loans	3.8	4.0	26.0	3.1	3.1
Other Investment	5.6	10.5	4.2	4.0	4.6
Total	100.0	100.0	100.0	100.0	100.0
Australia (as % of Total)					
Real Estate	8.8	6.1	5.8	9.1	10.0
Mortgage Loans	0.0	0.0	0.0	0.0	0.0
Shares	30.4	34.6	32.5	38.2	36.6
Bonds with Fixed Revenue	24.7	21.9	21.3	40.1	40.8
Loans other than Mortgage Loans	7.0	6.9	6.5	6.2	6.3
Other Investment	29.1	30.6	33.8	6.3	6.3
Total	100.0	100.0	100.0	100.0	100.0
UK (as % of Total)					
Real Estate	9.4	7.6	7.1	6.7	8.1
Mortgage Loans	0.4	0.3	0.2	0.2	1.7
Shares	60.8	62.9	63.3	63.7	52.1
Bonds with Fixed Revenue	25.1	25.5	25.3	25.7	36.8
Loans other than Mortgage Loans	1.4	1.3	1.1	1.2	0.8
Other Investment	3.1	2.3	2.9	2.6	0.6
Total	100.0	100.0	100.0	100.0	100.0

Note: Korea (95) and Canada (95 & 96) cover only domestic insurance companies.
Source: OECD Insurance Statistics Yearbook 1991-1998.

Table 16**The US Principal Financial Intermediaries by Asset Size**

	Asset value (\$ bil)		Average annual growth (%)
	1989	1999	
Contractual savings institutions	4,614	13,141	11.0
Life insurance companies	1,246	3,071	9.4
Private pension funds	1,622	4,996	11.9
Other institutions	1,746	5,074	11.3
Depository institutions	3,231	5,992	6.4
Commercial banks	1,510	1,151	-2.7
Savings institutions	202	415	7.5
Credit unions	4,944	7,558	4.3
Investment intermediaris	1,334	7,373	18.6
Mutual funds	590	4,552	22.7
Brokers and dealers	237	1,000	15.5
Money market mutual funds	425	1,585	14.1
REITs	31	68	8.2
Closed-end funds	53	168	12.2
Government pools/enterprises	1,324	4,013	11.7
Others	779	2,631	12.9
Total	12,994	34,716	10.3

Source: Federal Reserve Board, "Flow of Funds."

Table 17**Life and Health Insurance Company Impairments and Insolvencies, 1986-October 1991**

Year	Number of Insurers	Total Book Value of	Book Value of Assets for	Median Book Value of
		Assets (\$ millions)	Largest Company (\$ millions)	Assets (\$ millions)
1986	10	3,993	3,943	11
1987	19	111	26	11
1988	10	102	46	6
1989	41	964	646	2
1990	26	773	349	6
1991	26	41,246	13,482	52

Note: Assets were not reported for a number of small companies. Median is for companies with reported assets only.

*Combined assets of National Investors Life and University Life (Baldwin United group).

Source: Harrington, S. E. "Policyholder Runs, Insurance Company Failures, and Insurance Solvency Regulation," *Regulation* Vol. 15, No. 2, The Cato Review of Business & Government.

Table 18**Major Life and Health Insurer Insolvencies in 1991**

Company	1990 Book Value of Assets (\$ millions)	1990 Premiums (\$ millions)	1990 Growth Rates (percent)	
			Assets	Premiums
Mutual Benefit	13,482 (21)	3,201 (18)	16.2	13.3
Executive Life	10,167 (33)	354 (138)	-22.8	-44.5
Executive of NY	3,172 (90)	94 (311)	-18.7	-24.9
First Capital	4,458 (69)	511 (104)	-6.0	-47.2
Fidelity Bankers	4,069 (77)	664 (87)	14.0	-2.6
Monarch Life	4,478 (68)	267 (167)	-12.7	15.2
Industry	1,535,886	288,850	8.4	8.4

Note: Values in parentheses are industry rankings.

Source: Harrington, S. E. "Policyholder Runs, Insurance Company Failures, and Insurance Solvency Regulation," *Regulation* Vol. 15, No. 2, The Cato Review of Business & Government.