

The Korean Financial Crisis: A Banking Perspective

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### Abstract

We describe the Korean financial crisis and discuss some effective measures for overcoming the crisis. We develop a simple model of banking behavior that incorporates capital–asset ratios, rollover ratios, non–performing asset ratio and banks’ weight on maturation match. We perform a simulation analysis to evaluate the relationship between each of those variables and the banks’ liquidity problem. We also discuss four proven propositions to the Korean crisis in order to provide a more systematic understanding of the crisis.

## **1.Introduction**

Is the Korean miracle over? Can we say the same about the East Asian miracle? Did those miracles ever exist? Krugman (1994) argues that East Asia's economies did not experience significant productivity growth despite their rapid growth. The implicit prediction was that sooner or later the bubble would burst. The current crisis facing the East Asian economies seems to bear out the dire prediction. Even economists who do not share Krugman's perception of the East Asian miracle agree that structural change is needed if the region's economies are to regain their dynamism. The main purpose of this paper is to explore Korea's economic and financial difficulties in some detail so as to gain a deeper understanding of the dynamics of the East Asian crisis.

Bernanke and Blinder (1988) show the importance of credit channels in a modern monetary economy. Vegh and Edwards (1997) expand upon this line of research to explain shock propagation. By applying the same methodology to financial crises, we can better explain the Korean crisis in terms of a credit crunch. This is the basic approach of this paper, and we try to open the "black box" in the manner of Bernanke and Gertler (1995).

The research strategy of this paper is as follows. By developing a model of financial institutions, we show their vulnerability to shocks. We also show that different prudential measures differ in their effectiveness in reducing such vulnerability. Based on a simple model, we discuss the shock propagation mechanism in a macroeconomic framework. Section 2 provides a simple description of the Korean economy both before and after the foreign exchange crisis. Section 3 develops a simple model to explain the behavior of financial institutions in Korea. Section 4 presents the results of a simulation analysis

performed to test the propositions stated in Section 3. Section 5 addresses the implications of these propositions for Korea's financial crisis. Section 6 discusses the economy after the shock. The paper concludes with section 7.

## **2.The Korean Economy before the Financial Crisis**

We need to address three issues to understand the Korean crisis. First, we must identify the reasons for Korea's increased vulnerability to shocks. Second, we will try to find out who should bear the responsibility for the increase in vulnerability. Third, we have to determine whether we can predict such a crisis. We can discuss the first issue, which is the main issue, in various ways. We first approach the issue from a macroeconomic perspective. We then address microeconomic policies and banking behavior, before moving on to institutional behavior and incentive problems such as fraud, corruption and moral hazard.

We can best tackle the second issue by using an econometric model that can give us the probability of a crisis. The Markov switching model or simple logit model is appropriate if there are sufficient data. In this section, we assess some data to describe the Korean economy before and after the crisis.

### **Deteriorating Macroeconomic Situation**

In terms of the business cycle, the economy bottomed out in 1993, and boomed in 1994 and again 1995. The economic growth rate in 1994 was 8.6% and 8.9% in 1995. This period of economic recovery exhibited a slightly different pattern of structural adjustment than before. Small and medium-sized firms hardly grew while larger firms benefited the most from the recovery and expansion. This led the investment rate to rise from 35.1% in 1993 to 37.5% in 1994, and to 38% in 1995, exceeding the domestic saving rate in both

years. Korea thus experienced current account deficits.

The growing dependency of the business cycle on larger firms paralleled the growing vulnerability of the economy to sudden shocks. The unit cost of exports rose by 13.4% in 1995 and by 25% in both 1996 and 1997, resulting in deteriorating terms of trade. The export of semi-conductors, steel, and chemicals fell sharply in 1996, contributing to the large current account deficit. The interest rate, however, dropped from 13.8% in 1995 to 11.9% in 1996. The lower interest rate hindered the structural adjustment of large firms, which used the cheaper capital to invest in even more capacity. The investment rate rose even further to 38.8% in 1996.

What do these figures tell us? That larger firms were losing their international competitiveness, slowing down Korea's heavily export-oriented economy, and that extra liquidity kept losers from going out of business. But the economy then shifted gears and fell into an adjustment process toward a lower state of equilibrium. The investment rate fell, as did income growth. Large conglomerates such as Hanbo, Korea's second largest steel-maker, and Kia, Korea's second largest auto-maker, went bankrupt and the economy moved into a recession. Stock prices fell sharply, and market sentiment soured. The recession intensified and exposed inherent inefficiencies in financial intermediation.

### **Deteriorating Situation of Financial Institutions**

A deeper-than-expected recession sent the economy reeling into another phase of the business cycle. The combination of capital account liberalization and the recession created a type of foreign exchange crisis Korea had never experienced before. Fundamentals that had previously served as important indicators failed to provide government officials with any solid information or warning about the impending crisis.

In Korea, merchant banks specialize in short-term financing, selling such products as commercial paper, discounting corporate bills, and operating cash management accounts (CMAs). In taking making heavy use of financial liberalization, they created various problems, most notably in foreign exchange. They depended on short term foreign loans to finance loans to domestic firms. Once a financing problem emerged, they relied heavily on the domestic money market to finance their foreign debt. The resulting shock to the foreign exchange market affected every domestic bank, and made the foreign investors think twice. Moreover, foreign reserves began to fall due to intervention in the foreign exchange market. The situation worsened primarily because the banks were neither accustomed to a liberalized environment nor familiar with new financial techniques.

### **Inefficient Financial Intermediation**

Microeconomic policies for financial intermediation did not play a big role in Korea. The central bank basically pursued policies for macroeconomic stabilization, and neglected the important task of exercising prudential control. The financial system tends to take more risks during a process of financial liberalization. The Ministry of Finance and Economic Planning did not have proper measures in place for maintaining the socially optimum level of risk in the financial system. From a political perspective, heavy-handed government intervention in credit allocation prevented the development of a sound financial system. Efficiency in credit allocation took a back seat for a long time in Korea. Borensztein and Lee (1998) found that the previous year's profit turns out to have a negative effect on the current year's amount of credit in an inter-industry study. This means that credit was allocated preferentially to sectors that performed the worst!

The proportion of non-performing loans rose sharply from 0.8% in 1996 to 1.6% in 1997 according to official statistics. These figures, however, could be considered normal during a slowdown – it reached 2.0% and 1.6% in 1990 and 1992 respectively, before falling to 0.9% in 1994 and 0.8% in 1996. The average rate of return on equity of major commercial banks fell sharply from 6.04% in 1994 to 3.18% in 1995 and 1.2% in 1996. The ratio of corporate sector debt to GDP grew from 1.6 in 1991 to 1.45 in 1994 and further to 1.49 in 1995 and 1.63 in 1996.

What is the upshot of all this? We feel that financial intermediation became more vulnerable to shocks. Firms raised more debt, and banks in turn were saddled with more non-performing assets, thus showing lower returns on assets with which to service their foreign debts. Despite lower unit prices and worsening terms of trade, industrial output rose as a result of debt financing, lowering the marginal return on foreign debt. The monetary authority did not exercise appropriate prudential supervision over the banks.

### **Pouring Fuel Onto Fire**

Drawing on Hawtrey's view of monetary theory, Hart and Mehling (1995) assert that credit systems tend to magnify any economic disturbance. We can apply this to explain the Korean economic crisis. The loss of confidence in the Korean market on the part of foreign creditors lowered Korea's credit rating, stopped them from rolling over Korean debts and created a run on Korean banks. This spelled trouble for the banks, which had depended heavily on short term financing for their asset operations. The banks' increased vulnerability due to the prolonged recession created a host of problems from illiquidity to insolvency.

The central bank could not provide enough foreign exchange at short notice, making a

currency crisis inevitable. The government and the central bank had limited options. The first step in resolving a currency crisis is to obtain dollars. To get dollars, the government had to assume the risk of backing the debts of commercial banks as well as seek the assistance of the International Monetary Funds (IMF).

A high interest rate policy, while necessary to some extent, has helped to paralyze normal business trade and the banking system. Bank credit had remained a vital component of expansion in the most recent business cycle, and the sudden reduction of liquidity led to a sharp fall in credit. The hike in interest rates meant a hike in the financial cost of firms, and the value of their assets consequently suffered. Many financial institutions faced insolvency due to the depreciation of assets and loan defaults of their clients.

### **What Can We Expect, and What Should We Explain?**

Various statistics tell us that the Korean economy has become more vulnerable to shocks, but increased vulnerability is not a sufficient condition for a crisis. Even though economists agree on the importance of prudential supervision and structural adjustment of banking industry as preventive measures, they are not able to predict a financial crisis. Park and Rhee (1998) show that the probability of a crisis was not particularly high, and argue that it would have been difficult to predict the crisis *ex ante*. One undeniable fact is that financial institutions played a central role in the crisis, and the solution of the crisis also rests on them. Examination of banking behavior can thus help us to identify the appropriate resolutions for the crisis.

In the next section, we make reasonable assumptions about the economic crisis in Korea, and seek to identify the most effective measure to prevent the recurrence of

financial crisis.

### 3.The Simple Model

Here we explain the Korean financial crisis by applying a simple model of banking behavior to examine the liquidity problem and financial crisis. There has been a lot of research on identifying the causes of financial crisis. Krugman (1998) classified models of currency crisis into a canonical currency crisis model, a more sophisticated model, and a self-fulfilling model. This section, however, sets up a model of banking behavior instead, and seeks to arrive at effective solutions based on it. The model does not go far beyond Pyle (1971, 1972) in theoretical rigor, but it provides highly useful tools for analyzing the banking crisis. This section also attempts to provide answers about effective measures for resolving the banking crisis.

#### Banking Behavior

This paper combines classical approach to the study of banking behavior and a new technique known as simulation analysis. We assume a representative bank that maximizes profits and considers various risks. We assume the bank minimizes the following loss function:

$$\begin{aligned} \min_{\{x(i)\}} \text{Loss}(x) \\ \text{s.t. } \sum_i x(i) \leq \sum_i d(i) \\ \text{Loss}(x) = - \sum_i [r^l(i)x(i) - r^d(i)d(i)] + w \sum_i [x(i) - d(i)]^2 \end{aligned}$$

where  $x(i)$  and  $d(i)$  are financial assets and liabilities with maturity  $i$ ,  $r^l(i)$  and  $r^d(i)$  are the interest rates on loans and deposits with maturity  $i$ , and  $w$  indicates the weight on the difference between the maturity structures of loans and deposits.

The only risk management component of the loss function concerns the maturity difference between assets and liabilities. The loss function characterizes banking

behavior as optimizing the trade-off between profitability and safety. We can add more variables to this basic setup as discussed in the existing literature.

**Proposition 1:**

The bank is assumed to minimize the loss function by  $x(i)$ , the sequence of asset operations, given the sequence of interest rates on loans and deposits, and given domestic savings. Under the previous assumptions, one can show that the relative size of the short term asset portfolio is proportionate to the relative level of the foreign interest rate on short term loans. The long term loan is also proportionate to the short term interest rate on foreign debt. Moreover, the relative size of the short term asset portfolio also depends on the maturity mismatching weights.

This proposition is in accordance with intuition about banks' portfolio management. The proposition also indicates the importance of prudential supervision in the sense that it affects the bank's weight of the loss function.

**Proposition 2:**

Given the previous assumptions, if the rollover of debts suddenly stops, then conservative behavior on the part of the bank, as defined by weight in the loss function, becomes important. The weight characterizes the bank in terms of how it assesses the importance of maturity mismatch between assets and debts relative to profit. Proposition 1 suggests that this weight is important in reducing the probability of a banking crisis.

**Proposition 3:**

Given the previous assumptions, the capital-asset, non-performing asset, and not-rolled-over ratios all affect the probability of a financial crisis. Moreover, one can show that there are cases in which capital-asset and not-rolled-over ratios are more significant.

There are many tools for controlling the liquidity problems of banks. Each tool has a different impact on reducing the probability of crisis and the size of a credit crunch. It is important to ask which tool is more effective and how much each can reduce the probability of crisis. These questions are more empirical than theoretical, but even in the theoretical domain, we can show that one tool is more effective than the other under different circumstances.

**Proposition 4:**

Given the previous assumptions and the additional assumption of passive intermediation, one can show that there is a region in the domain of the variables in which tightening the money supply and maintaining the foreign exchange rate tend to cause banking problems.

**4.Simulation Analysis**

In this section, we test the propositions stated in the previous section through simulation analysis. This method, which is not yet a standard analytical tool, performed well in various applications. In this section, we use the simple loss function and logit analysis to examine data from 2000 simulated observations in order to address the issues raised by proposition 1 through 4.

The loss function that we use is the quadratic function of the maturity mismatch in assets and liabilities with 12 terms minus the profit. We assume deposits in banks and the foreign debt of banks as well as interest rates to be given. Interest rate parity is assumed to hold all the time, so that interest cost depends on the foreign interest rate and the depreciation rate. We further assume that the foreign debt is converted to domestic currency in the foreign exchange market.

There are several types of shocks. One type affects the ratio of non-performing assets. Other shocks involve the bank's capital, deposits, and foreign borrowings. In this environment, our simulation analyzes the relationships between the variables in the banks' loss minimization function, and investigates their relationships with liquidity problems that arise when foreign lenders suddenly stop rolling over their loans. The liquidity problem here refers to a situation in which the bank cannot cover short term foreign debt with interest payments from performing assets and liquid assets.

We analyze the simulated data by using least squares and logit analysis. Logit analysis is a useful tool for analyzing binomial data, and it also provides the probability of unit increments in the variable of interest.

### **Simulation Result of Proposition 1:**

The simulation result is summarized in the equation below and shows that the relative amount of short term assets is determined by the relative level of short term interest rate and weight on the maturity mismatch between assets and liabilities. Our basic findings are as follows: (1) As the short term interest rate increases, the relative amount of short term lending decreases. (2) The relative amount of long term assets also depends on the short term lending and borrowing interest rates, and on the amount of short term assets. (3) The higher the weight of the penalty on the mismatch, the less will be the relative amount of short term assets. In this particular calibration of the parameters, the relative effective cause of short term asset allocation is the penalty weight on the mismatch.

$$X_1 = 11.55^{***} - 0.08 X_2 - 0.01^{***} X_3, R^2 = 0.03$$

(0.07)      (0.07)      (0.002)

where  $X_1$  is the amount of short term assets,  $X_2$  is the interest rate on short term foreign debt,  $X_3$  is the penalty weight on maturity mismatch, and the number inside the

parentheses indicates standard error. \* denotes significance at the 10% level, \*\* at the 5% level and \*\*\* at the 1% level.

$$X_1 = 7.76^{***} - 0.03^{***} X_1 + 0.006^* X_2 + 1.10^{***} X_5, R^2 = 0.96$$

$$(0.07) \quad (0.07) \quad (0.002) \quad (0.007)$$

where  $X_4$  stands for the size of long term assets, and  $X_5$  is the interest rate on short term lending.

### **Simulation Results of Proposition 2 and 3:**

To show the validity of proposition 2 and 3, we use logit analysis, the results of which are reported in the equation below. Our main results are as follows: (1) The greater the weight of the maturity mismatch penalty, the less likely are liquidity problems. (2) As the capital asset ratio rises, the likelihood of liquidity problems falls. (3) Liquidity problems increase with the amount of non-performing assets. (4) Liquidity problems increase when foreign lenders suddenly stop rolling over their loans.

$$\text{Prob}(X_6 = 1) = F(-0.42 - 0.02 X_3 + 1.47^{***} X_7 - 1.62 X_8 - 9.71^{***} X_9)$$

$$(0.32) \quad (0.04) \quad (0.16) \quad (2.61) \quad (3.69)$$

$$\text{Log likelihood} = - 1,231.5$$

Where  $F(z)$  is the logistic function ( $F(z) = e^z/(1 + e^z)$ ).  $X_6$  indicates the extent of liquidity problem ( $X_6 = 1$  means there is no liquidity problem),  $X_7$  is the ratio of bank's capital to its total assets,  $X_8$  is the ratio of non-performing assets to total assets, and  $X_9$  is the ratio of not-rolled-over debt to total funds available.

### **Simulation Results of Proposition 4:**

Our final results concern the effects of changes in the rate of domestic inflation and exchange rate, and increases in the required reserve ratio. The results are very intuitive. An increase in the domestic inflation rate increases the financing cost of foreign debt

under the assumption of interest rate parity. Higher financing costs tend to cause liquidity problems, although this channel is not as strong as some other channels. A higher exchange rate or depreciation reduces the likelihood that banks will suffer liquidity problems. From an ex-ante domestic point of view, a weaker currency makes available more funds available to banks even though it also raises the value of short term foreign debt.

Domestic monetary policy bears greater impact on liquidity problems. If the monetary authority implements a tight money policy in the sense of a higher required reserve ratio, the amount of funds available to banks falls, and the likelihood of liquidity problems rises.

$$\text{Prob}(X_6 = 1) = F(3.30^{***} - 0.45 X_{10} + 0.05 X_{11} - 5.97^{***} X_{12})$$

(0.27)      (2.00)      (0.20)      (0.26)

$$\text{Log likelihood} = - 931.99$$

where  $X_{10}$  is the domestic inflation rate,  $X_{11}$  is exchange rate, and  $X_{12}$  is the required reserve ratio.

### **5.Implications for the Korean Financial Crisis**

The simple model we have just discussed illustrates the multidimensional aspects of the liquidity problems banks suffer when foreign creditors suddenly stop rolling over their loans. In the absence of prudential supervision, banks place less emphasis on mismatch, and moral hazard thus creeps into credit allocations. Proposition 1 states that, if the short term interest rate is relatively low, and prudential supervision is lax, then short term assets will take up a larger share of the portfolio. It also asserts that the long term portfolio of assets depends on the short term interest rate of debts and assets. We can apply these basic properties of financial intermediation to study Korean banking portfolio

and debt financing. However, relying on short term financing creates a problem if creditors suddenly stop rolling over debts.

The Bank for International Settlements (BIS) uses the capital-asset ratio as a key tool of prudential supervision. Our simple simulation confirms its importance. Korean banks have long suffered from chronic government and political intervention. We therefore cannot determine whether a moral hazard problem exists or not. The actual consequences are, however, similar to those that would have resulted from moral hazard. Most banks do not meet sound capital-asset ratios, and are saddled with a relatively heavy burden of non-performing assets. This is in part due to the current recession, but mostly due to structural weaknesses such as inability to accurately assess risks and other factors in their lending decisions. Those weaknesses increase the likelihood of a liquidity problem as shown in proposition 2 and 3.

Overcoming a currency crisis requires the monetary authority to tighten the money supply for a certain period of time. According to Proposition 4, this increase the banks' vulnerability to shocks. We can also apply Proposition 4 to the case of falling domestic savings. Domestic saving is an important source of investments. Proposition 4 suggests that banks' vulnerability will increase when domestic saving falls. In addition, if an economy depends significantly on foreign debt for investment, it is likely to have more short term debt. As Propositions 2 and 3 suggest, this increases the likelihood of liquidity problems.

Exchange rate volatility is always a cause for concern for central bankers, and induces them to try and stabilize it. The question is whether stabilization benefits banks. The discussion is complex, but here we focus on the issue of liquidity problems. Proposition 4

suggests that devaluation would decrease the chances of liquidity problems. We think that this is a tentative and somewhat controversial result, but Proposition 4 does clearly suggest that the defense of the exchange rate should be carefully planned. During the Korean currency crisis, the central bank lost a lot of foreign reserves trying to defend the currency, and created doubts among foreign creditors about the reserves, increasing uncertainty and precipitating the crisis.

The discussion of increased vulnerability to shocks is fairly straight forward, but the issue of what motivates creditors is difficult to address. Song (1998) deals with this by asking whether Asian countries had similar environments ripe for speculative attacks, or they were instead linked in a contagion network. Another difficult issue is the ability to predict crisis. Park and Rhee (1998) confirm the inherent difficulties of prediction. In terms of a game theoretic framework, the most probable equilibrium is one in which the creditor is able to calculate the possibility of crisis, and results in a balance of payments crisis regardless of contagion effects. The better strategy for preventing crises is to reduce vulnerability rather than invest resources in prediction.

## **6. Financial Shock and the Economy**

Ordinary people doing business in Korea claim that the sudden recession came during the adjustment process begun under the International Monetary Fund's guidance. But even in the absence of such a process, we usually observe credit crunch in the aftermath of a foreign exchange crisis. Remember that the cessation of debt rollovers and futile efforts to defend the value of domestic currency are what create the crisis.

Once a currency crisis is in progress, it is difficult to secure rollover of foreign debt, new foreign direct investment, and new foreign lending without policy actions such as

government guarantees and higher interest rates. The recession further magnifies the banks' vulnerability, and pushes many of them deep into illiquidity or even insolvency.

The tight ex-post prudential supervision caused the collapse of the credit system. The banks took all necessary survival measures. A byproduct was turbulence in the money markets. The call rate soared, and the inter-bank markets also dried up. The banks' attempt to build up their capital-asset ratios intensified the credit crunch.

The sudden stop in the flow of credit created problems in the payment systems, including those for foreign trade. Corporate debt burdens had increased due to over-investment in excess capacity, and the interest hikes cause many firms, especially small and medium enterprises (SMEs), to fail due to higher financial costs. The financial turbulence also destroyed both the formal and informal credit systems, sharply increasing the level of uncertainty in the business world. In order to reduce uncertainty and restore confidence, it is crucial to re-establish a semblance of order and stability in the financial system in the short run.

## **7. Concluding Remarks**

Uncertainty in inter-temporal resource allocation creates problems in the financial system. The combined effects of synergy, contagion and lax supervision of the financial system led Korean businessmen to excessive optimism and over-investment. According to Kindleberger (1978), booms turn into panics, and panics entail a cascade of selling. This causes asset prices to fall, and renders the financial system increasingly vulnerable to exogenous shocks.

Prudential supervision, which is essential to managing a crisis, should be strengthened soon, so as to avoid a vicious cycle of turmoil in the financial markets. Once the financial

system stabilizes, the government should provide sufficient liquidity as well as implement other confidence-boosting measures. A complete financial structural adjustment would be not be possible in the short run, because it would further debilitate the feeble financial system. In any case, what the Korean economy needs at this point is a restoration of confidence in the economy among both Koreans and foreigners.

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