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Chapter Authors: Dongchul Cho, Kiseok Hong

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Currency Crisis of Korea
Internal Weakness or External Interdependence?

Dongchul Cho and Kiseok Hong

10.1 Introduction

During the 1997–98 period, the international capital market experienced arguably the most severe turmoil since the Great Depression. Many economists as well as international investors were greatly surprised by the magnitude and abruptness of capital flow reversals from the emerging markets.

This surprise was possibly amplified by the fact that the crisis took place in East Asia, which has long been regarded as a model economy; it exhibited rapid growth combined with macrostability. To the economists and policy makers who sought the causes of the remarkable achievements in this region (e.g., World Bank 1993), the Asian Crisis came as a shock. Even to those who were skeptical about the Asian Miracle, the abrupt collapse of the region may not be a natural implication of their skepticism. The main implication of input-driven growth (e.g., Krugman 1994 and Young 1995) is the erosion of efficiency, and thus the natural prediction would be a long-term slowdown of growth instead of an immediate collapse. For this reason, many have been led to pay more attention to the effects of contagion (e.g., Agenor and Aizenman 1997 and Perry and Lederman 1998).

This paper examines the currency crisis of Korea—a key country in the Asian Crisis as well as the Asian Miracle—in the context of this upheaval

Dongchul Cho and Kiseok Hong are research fellows at the Korea Development Institute.
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in the international capital market. In particular, this paper attempts to provide some clues to the question of whether Korea was a poor victim of or a major contributor to the crisis in the global capital market. As is expected from this sort of formidable question, the answer will be indefinite.

Nevertheless, this paper tries to distinguish quantitatively the effects of weaknesses in domestic fundamentals from the effects of external interdependence (called *contagion effects* in this paper). We found that the magnitudes of contagion effects were huge, but the Korean crisis could not be completely attributable to these effects alone. Weak domestic fundamentals and poor management of the government appeared to play significant roles as well, particularly at the triggering moment of the crisis.

More specifically, the following three conclusions summarize this paper's analyses. First, the outbreak of the Korean crisis may not be completely attributable to the contagion effects alone, although the crises of other countries substantially worsened the situation. Second, Korea's fundamentals prior to the crisis were not so strong that economists were astonished with the outbreak of the crisis of Korea, although they were not so weak that investors should have been able to anticipate the crisis. Third, if one considered the structural vulnerability of Korea's financial market in addition to the conventional macrofundamentals, and if one could have foreseen the stubborn policies of the government in coping with financial turmoil, the Korean crisis might have been easier to anticipate.

This paper is organized as follows. Employing the conventional probit model methodology for data from approximately 100 developing countries, section 10.2 evaluates the position of Korea's fundamentals, which are usually considered important in explaining currency crises in developing countries. Among those fundamental factors, Korea's domestic macroeconomic fundamentals were strong (high growth, low inflation, and mild current account deficits), whereas its external finance structure was fragile (low reserve to short-term debt ratios and low FDI to GDP ratios). Overall, Korea's fundamentals were not particularly strong, but not particularly weak either. It is true that Korea's fundamentals sharply deteriorated in 1996 (thus raising the probability of a crisis in 1997) compared to the 1994–95 period, but the overall condition in 1996 was not terrible relative to its historical average, except for the contagion effects. In this section, we also examine the effect of neighbor countries (or contagion effect) using our own index of geographical proximity as well as the trade linkage index developed by Glick and Rose (1998). An important finding is that our geographical proximity index dominates the trade linkage index, which may suggest that investors' perceptions and expectations really matter in transmitting currency crises.

Section 10.3 takes a further look at the contagion issue, using daily-frequency data of the exchange rates and sovereign spreads on the U.S.

dollar–denominated debts for selected countries. We use standard time-series methodologies, and similar analyses can be found in Baig and Goldfajn (1998). Unlike Baig and Goldfajn, however, we extend the sample to non-Asian countries such as Latin American countries, Russia, China, and Japan, while focusing on the case of Korea. By doing so, we are able to provide a more complete picture and to decompose explicitly the contribution of the contagion effects from other parts of the world. We also relate the chronology of daily news on Korea's financial market to the shocks identified by the time series analyses giving us a sense of the sort of news which would negatively impact the financial market at the triggering moment of the crisis. Overall, we found that the news about the series of *chaebol* bankruptcies and the government's continued bailout policies for these *chaebols* and financial institutions appeared to operate negatively in preventing foreign investors from fleeing.

Section 10.4 notes some additional weaknesses in Korea's financial market structure that deserve mention. In this section, we do not provide a formal analysis to the degree we did in sections 10.2 and 10.3. Instead, we briefly summarize several points made by other researchers in Korea, so that readers do not miss important aspects of the Korean crisis simply because the effects of those aspects cannot be easily quantified. In particular, we note the facts that the corporate sector of Korea had long suffered from low profitability and high leverage ratios, whereas a small number of *chaebols* had extraordinarily high influence in the financial system. Section 10.5 offers some concluding remarks.

10.2 Domestic Fundamentals versus Contagion: Cross-Country Analysis

In this section we examine Korea's economic fundamentals during the precrisis period in comparison with other developing countries as well as the role of the contagion effect in the outbreak of Korea's currency crisis. To this end, we employ a probit model using a data set of roughly 100 developing countries.

10.2.1 Theory

Existing theories on currency crises are often classified into two generations of models.[1] Whereas the first-generation model stresses economic fundamentals such as domestic credit expansion and liquidity (Krugman 1979), the second-generation model puts more emphasis on investors' expectations and inherent instability in the international capital market (Obstfeld 1995). In empirical investigations of a currency crisis, however, it is hard to distinguish between the two classes of models. Although the second-generation model emphasizes the role of expectations, expectations

1. See Eichengreen, Rose, and Wyplosz (1995) for a detailed survey on the literature.

are likely to be systematically related to economic fundamentals. Thus, in practice, both classes of models commonly predict that the probability of a currency crisis increases with deterioration of economic fundamentals. The only way to distinguish between the two classes of models is to prove that some crisis episodes are actually generated by self-fulfilling expectations. Clearly, this is a difficult task. Referring to this difficulty, Garber (1996) has concluded that the two classes of models are observationally equivalent.

Similar argument applies to the so-called contagion effect. Contagion effect refers to the phenomenon that a currency crisis spreads contagiously from one country to another, for whatever reasons.[2] Because contagion can take place due either to cross-country correlation in economic fundamentals or to pure investor psychology, the existence of contagion itself cannot be used as evidence for self-fulfilling expectations. For more concrete evidence, one needs to prove the existence of contagion after controlling for all relevant economic fundamentals. In practice, however, it is not feasible to control for every relevant variable.[3]

For this reason, this section does not intend to test the relevance of a particular model. The goal of this section is simply to estimate a probit equation that relates crisis episodes to standard macroeconomic fundamentals along with contagion measures, and to evaluate how well Korea's currency crisis episode fits in the model.

10.2.2 Dependent Variable

The dependent variable for our probit estimation is a crisis index, which has a value of 1 if a currency crisis occurs and 0 otherwise. Specifically, following Frankel and Rose (1996), we define a currency crisis as a depreciation of the nominal exchange rate (with respect to the U.S. dollar) of at least 25 percent that is also at least a 10 percent increase in the rate of depreciation.[4]

2. For discussion on various channels of contagion effects, see Calvo and Reinhart (1996) and Valdes (1996).

3. Nevertheless, there exists pioneering research that attempts to identify fundamental channels of contagion effects. For example, see Doukas (1999) for the channel through comovements of major macrovariables; Glick and Rose (1998) for the channel through trade; and Frankel and Schmukler (1998) for the channel through the New York investor fund community. For more microdata analyses that particularly stress the role of incomplete information, see Aharony and Swary (1983, 1996); Park (1991); Karafiath, Mynatt, and Smith (1991); Calomiris and Mason (1994).

4. Ideally, definition of a currency crisis should be comprehensive enough to incorporate various events fully, such as violent depreciation of the exchange rate, sharp reduction in foreign exchange reserves, and rapid increase in interest rates. For developing countries, however, it is hard to find an interest rate measure that is consistent across countries and free from direct government control. Also, developing countries with weak fundamentals tend eventually to develop a currency crisis regardless of their efforts to defend their currencies using foreign exchange reserves. Thus, we use only the nominal exchange rate in constructing our crisis index.

10.2.3 Explanatory Variables

For possible causes of a currency crisis, we consider the following three sets of variables:

1. Macroeconomic indicators: GDP growth rate, real domestic credit growth, inflation rate, fiscal deficit/GDP ratio.
2. External variables: current account/GDP ratio, changes in the terms of trade, changes in the real exchange rate, foreign reserves/short-term debt ratio, FDI/GDP ratio, total foreign debt/GDP ratio, short-term debt/total foreign debt ratio.
3. Foreign conditions: GDP growth rate and interest rate in developed countries, crisis incidents of foreign countries.

A decrease in the GDP growth rate increases the possibility of a crisis by weakening general solvency of the country or by engendering expansionary monetary policy. Also, rapid expansion of domestic credit or fiscal deficit increases the possibility of a crisis by generating inflationary pressures in the goods market and depreciation pressures in the foreign exchange market. Factors such as deterioration in the terms of trade, appreciation of the real exchange rate, and current account deficits can produce a crisis by reducing both profitability of the exporting sector and net foreign assets of the economy. Lastly, whereas a high foreign debt/GDP ratio increases the probability of a crisis by making the country vulnerable to a negative shock, high foreign reserves/short-term debt or FDI/GDP ratios reduce the probability of a crisis by providing greater liquidity.

In addition to domestic fundamentals, foreign conditions can also play a key role in the outbreak of a currency crisis. Because developed countries are the net creditors in the international capital market, economic booms in developed countries can lead to reductions in capital supply for developing countries. Among developing countries, a currency crisis in one country may increase the possibility of crisis in another country. As was mentioned earlier, this contagion effect may reflect either cross-country correlation in economic fundamentals or merely investors' psychology. In this section, we simply define the contagion index for each country as a weighted average of the crisis index of all other countries, with the weights given by either the inverse of geographical distance between the country in question and other countries or the trade linkage used in Glick and Rose (1998).[5] Because currency crises appear to be regionally concentrated, we suspect that geographical distance is perhaps the most important determinant of the contagion effect. Glick and Rose, on the other hand, argue

5. Because distributions of thus-constructed indexes are close to lognormal, we prevent influence of potential outliers by taking logarithms of the indexes. Main results remain unaffected by the use of the original indexes.

that contagion takes place mainly through trade channels. This section considers both our own contagion index and the trade contagion index.[6] Detailed definitions of explanatory variables are provided in the appendix.

10.2.4 Data

Our data set covers 103 developing countries, including the Asian and Latin American countries hit by the crisis, mostly for the years 1980–96. The nominal exchange rate, however, covers the period 1980–97. As we will show, this enables us to relate the dependent variable to one-year-lagged values of explanatory variables. Using lags of explanatory variables better serves our goal of identifying the "causes" of a currency crisis. Unlike other explanatory variables, however, we let the contagion index take contemporaneous values with the dependent variable, because the contagion effect is expected to be coincident with currency crises. According to our definition of currency crisis, about 10 percent of the total country-years are classified as crisis episodes.

10.2.5 Probit Estimation Results

Probit estimation results using the aforementioned variables are reported in table 10.1. Because coefficients from probit estimation are hard to interpret, we calculate the marginal contribution of each regressor to the probability of a crisis, using historical means of the variables. We first report in columns 1 and 2 of the table the estimation results without the contagion effect. For most variables, the estimated coefficients are significant and of the correct signs. This suggests that incidence of a currency crisis is not randomly distributed across countries but is systematically related to economic fundamentals. Variables such as government deficit, current account, and total foreign debt, however, are insignificant or of the wrong signs. Frankel and Rose (1996) have reported similar findings. As column 2 shows, when these insignificant variables are excluded from the regression, coefficients on the remaining regressors change only slightly.

In columns 3 and 4, we add a contagion index to the equation. We find that the trade contagion index and our contagion index each have significantly positive effects.[7] As was mentioned earlier, however, it is not clear what the correlation between the crisis index and the contagion index truly implies. Although we have included standard macroeconomic variables in

6. One may argue that contagion of crises may take place through financial linkages as well (see, for example, Kaminsky and Reinhart 2000). In a separate paper, Hong (2000) has constructed a financial contagion index using the BIS data on international claims, and compared it with the regional and trade contagion indexes of this paper. Hong has found that the main result of this section still holds: The regional contagion index dominates the trade and financial contagion indexes.

7. According to the estimates, a one-unit increase in the trade contagion index and our contagion index (100 percent increase in the original contagion indexes) increases the probability of a currency crisis by 4 and 6 percentage points, respectively.

Table 10.1 **Cross-Country Probit Analyses: Causes of Currency Crises**

	(1)	(2)	(3)	(4)	(5)
Per capita GDP growth	−0.346 (−2.05)	−0.282 (−2.11)	−0.195 (−1.36)	−0.205 (−1.61)	−0.254 (−1.23)
Fiscal deficit/GDP	−0.001 (−0.61)				
Inflation rate	0.043 (2.02)	0.039 (2.10)	0.040 (2.08)	0.036 (2.12)	0.059 (2.14)
Real domestic credit growth	0.110 (2.32)	0.055 (1.40)	0.068 (1.64)	0.063 (1.74)	0.105 (1.80)
Current account/GDP	−0.002 (−0.93)				
Terms of trade changes	−0.160 (−1.89)	−0.136 (−1.97)	−0.145 (−1.98)	−0.123 (−1.90)	−0.210 (−2.02)
Real exchange rate depreciation	−0.216 (−3.19)	−0.175 (−2.92)	−0.189 (−2.96)	−0.195 (−3.34)	−0.295 (−3.16)
Reserves/short-term debt	−0.015 (−2.24)	−0.008 (−2.27)	−0.009 (−2.05)	−0.008 (−2.47)	−0.015 (−2.34)
FDI/GDP	−0.017 (−2.51)	−0.015 (−2.66)	−0.014 (−2.17)	−0.011 (−2.01)	−0.017 (−1.86)
Total foreign debt/GDP	−0.058 (−2.82)				
Short-term debt/total foreign debt	0.001 (0.86)				
Foreign GDP growth	0.021 (2.52)				
Foreign interest rate	−0.001 (−0.37)				
Trade contagion index			0.043 (3.07)		0.018 (0.82)
Our contagion index				0.069 (4.98)	0.095 (3.70)
Sample size	675	1,028	999	1,028	999
Unconditional probability of crisis	0.114	0.117	0.118	0.117	0.118
Average estimated probability of crisis countries	0.198	0.157	0.165	0.184	0.181
Average estimated probability of no-crisis countries	0.103	0.111	0.111	0.107	0.109

Note: Numbers in parentheses are *z*-statistics.

the regression, the possibility of important excluded variables still remains. In addition, using one index without the other may produce biased estimates because the two indexes are likely to be correlated.[8] Only by considering both indexes at the same time, will one be able to properly evaluate the independent contribution of each index to the probability of a currency crisis.

We report the results from this experiment in column 5 of table 10.1. Note that when the two indexes are included in one regression, our index dominates the trade contagion index and the latter becomes insignificant. This result suggests that the trade contagion index works only as a proxy for our contagion index, and thus the trade linkage is probably not the main channel of regional contagion of crises.[9] For this reason, we will use column 3 as our benchmark estimates for the rest of this section. Under the benchmark estimates, the average of the fitted probability for all actual crisis episodes is 0.18.

10.2.6 Korea's Currency Crisis and Contagion

In this section, we focus on Korea's currency crisis based on results from previous sections. First, we report the fitted values for Korea and other countries hit by crisis, such as Mexico, Thailand, Malaysia, and Indonesia. As column 1 of table 10.2 shows, when only economic fundamentals in 1996 are considered, the fitted value was 0.127 for Korea and below 0.1 for the other Asian countries. Considering the fact that the unconditional probability of a currency crisis is 0.1 in our sample, the Asian crisis as a whole was rather unanticipated. The only exception is Korea, whose economic fundamentals in 1996 appear to have been weak enough to imply a possible crisis in the following year.[10] The finding that the crisis probability of Korea in 1996 was relatively high may be surprising, because many people have argued that Korea's economic fundamentals were sound before the crisis. Column 1 of table 10.2 does not support this popular claim.[11]

The crisis potential of Asia in 1997 was small, not only by international standards, but also by its own historical trends. As shown in column 2 of table 10.2, the fitted probability for the Asian countries was not substantially greater in 1997 than it was in the earlier years. For example, Korea's

8. It is obvious that trade is more active among countries in geographical proximity. In fact, correlation of the two indexes in our pooled data set is 0.7.

9. One problem is that due to data availability, we used only the 1997 international trade matrix, assuming that the trade linkage is constant over time. For more rigorous results, we need to construct the trade linkage for every year. However when the sample period is restricted to 1992–97, however, our index still dominates the trade linkage.

10. Rigorously speaking, the estimated probability is not ex ante, because the contagion index takes contemporaneous values. For countries like Korea where a crisis took place at the end of the year, however, the probability may well be considered as ex ante.

11. Table 10.3 (heading C) is not a true out-of-sample exercise, because observations in 1997 are used in the estimation. An out-of-sample exercise, however, changes the results only slightly.

Table 10.2 **Cross-Country Probit Analyses: Probability of a Currency Crisis**

	With Contagion Index (from eq. [2] in table 10.1)		With Contagion Index (from eq. [3] in table 10.1)		With Contagion Index (from eq. [4] in table 10.1)	
	(1)	(2)	(3)	(4)	(5)	(6)
Mexico						
(1987–93)		0.133		0.100		0.140
(1994)	0.132		0.115		0.168	
Thailand						
(1987–96)		0.088		0.093		0.082
(1997)	0.084		0.106		0.182	
Malaysia						
(1987–96)		0.041		0.043		0.040
(1997)	0.081		0.075		0.138	
Indonesia						
(1987–96)		0.111		0.114		0.102
(1997)	0.070		0.101		0.171	
Korea						
(1987–96)		0.112		0.100		0.102
(1997)	0.127		0.148		0.208	

crisis potential was about 0.1 even before 1996. Although we find that the Korean economy in 1996 was in fact much weaker than it was during the economic boom of 1994 and 1995, 1996 was not the worst year of the decade.

In columns 3–6 of table 10.2, we examine whether the crisis probability increases for Asian countries when the contagion effect is included as an additional regressor. Depending upon which contagion index is used the results vary substantially. When the trade linkage index is used, the estimated probabilities of the Asian countries change only slightly. However, our geographical linkage index substantially increases the estimated probability for the Asian countries from the range of 0.08–0.13 to the average level of ex post crisis countries, 0.19! According to this result, one could naturally have predicted the Korean crisis after the outbreak of the Southeast Asian turmoil.

Next, we examine which variables were particularly important in Korea's currency crisis compared with other crisis episodes. To this end, we calculate the contribution of each explanatory variable to the incidence of each crisis by multiplying the benchmark coefficient estimates in column 4 of table 10.1 with the corresponding values of explanatory variables. Deviation of each crisis from a reference-group mean of similarly constructed contribution measures can be used to illustrate distinguishing features of each crisis episode. Before examining each individual country's episode in detail, however, we first compare the average values of the crisis

countries with those of the whole sample in table 10.3. This table clearly shows that, on average, the crisis countries exhibit weaknesses in all of the considered fundamentals. Apart from the contagion, in particular, the reserves to short-term debt ratio makes the greatest contribution to the crisis probability.

Table 10.3 also reports the results from the same experiment for each individual country's episode, using all crisis countries (column 1) as our reference group to be compared. A negative number in the table implies that the contribution of the variable to the corresponding crisis episode is smaller than to the whole crisis group in our data set. In Korea's crisis, for example, external factors (such as the terms-of-trade shock, low reserves, and low FDI) have been particularly important, whereas domestic macro-

Table 10.3 **Cross-Country Probit Analyses: Contribution of Each Explanatory Variable to the Asian Crisis**

Deviations from Average Values of the Whole Sample			
	Sample Mean		
	Whole Sample (1)	Crisis Countries (2)	Marginal Contribution[a]
Per capita GDP growth	0.00477	−0.01056	0.00314
Inflation	0.18787	0.30629	0.00429
Real domestic credit growth	0.01930	0.03707	0.00113
Terms of trade changes	−0.00804	−0.03552	0.00337
Real exchange rate depreciation	−0.01699	−0.05357	0.00715
Reserves/short-term debt	3.39132	1.27950	0.01752
FDI/GDP	1.25291	0.71543	0.00600
Our contagion index	−2.39022	−2.10817	0.01946
Sum of deviations			0.06206

Deviations from Average Values of Crisis Countries					
	Mexico (1994)	Thailand (1997)	Malaysia (1997)	Indonesia (1997)	Korea (1997)
Per capita GDP growth	−0.00106	−0.00987	−0.01049	−0.01150	−0.01154
Inflation	−0.00772	−0.00904	−0.00985	−0.00831	−0.00935
Real domestic credit growth	−0.00046	−0.01887	0.00525	0.00575	0.00561
Terms of trade changes	−0.00398	−0.00484	−0.00710	−0.00879	0.00549
Real exchange rate depreciation	0.00641	−0.00275	−0.00466	−0.00346	−0.00930
Reserves/short-term debt	0.00492	0.00241	−0.00898	0.00602	0.00609
FDI/GDP	−0.00416	−0.00610	−0.04260	−0.03133	0.00263
Our contagion index	0.00724	0.05687	0.05392	0.04985	0.03376
Sum of deviations	0.00118	0.00781	−0.02452	−0.00176	0.02339

[a]Marginal Contribution to Crisis Probability = $x[(b) - (a)]$.

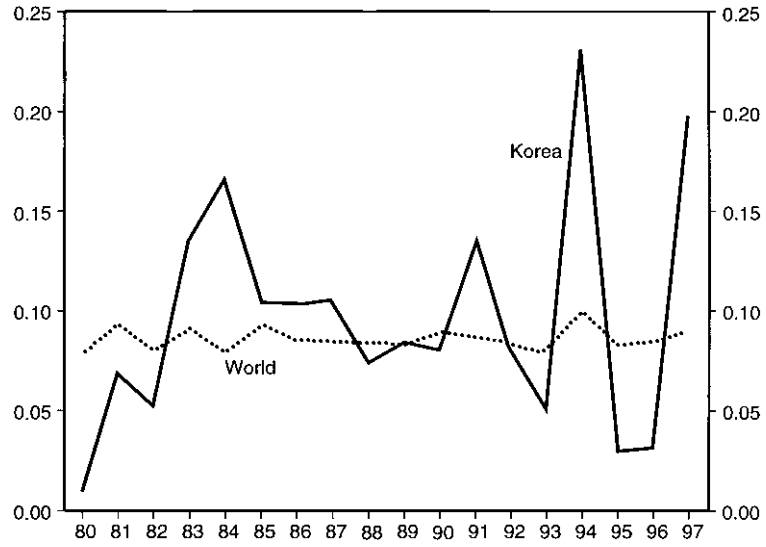

Fig. 10.1 Distance contagion index of Korea (1980–97)

conditions (such as GDP growth and inflation) had limited effects. Also, in most Asian countries the growth rate of real domestic credit has had a positive impact, supporting the popular view that overlending and overinvestment were critical factors in the Asian crisis.

Table 10.3 also indicates that the role of the contagion effect has been more important in the Asian crisis than in other crisis episodes. Even for Korea, which was the least affected by contagion of the Asian countries, the contagion effect appears to have played a key role. Figure 10.1 plots the contagion index of Korea along with the world average of the index.

We have so far examined Korea's currency crisis on the basis of a general probit model. In short, the results suggest that the role of the contagion effect in Korea's crisis was significant, but economic fundamentals of Korea (particularly external factors) were not sound prior to the crisis, relative to the other Asian countries in particular. Although the above exercises produce many interesting results, one should acknowledge many limitations as well. Perhaps the most important limitation is that our exercise was performed for virtually a single observation out of more than 2,000 sample points, and thus the related error margin is potentially very large.

10.3 Country Shock versus Contagion: Further Analysis with Daily Data

The previous section of cross-country analyses suggests that the contagion effect may have been a major cause of the Korean crisis as well as the Asian crises in general. However, the cross-country analyses cannot

examine dynamic diffusion processes of shocks across countries. With respect to the analysis of contagion effects, this seems to be an important limitation. For example, when many countries fall into crises in the same year, it is impossible to investigate whether one country's crisis causes another or whether they altogether generate a vicious circle of crises through mutual interactions. With the binary definition of the crisis, it becomes even harder to examine to what extent the crises of other countries worsened the situation of one country. In addition, it seems persuasive to argue that shocks in financial markets are transmitted so rapidly that analyses with annual data can hardly capture the complete picture.

In this section, therefore, we analyze the high-frequency data of the relevant variables, namely, daily data of the exchange rates (against the U.S. dollar) and the spreads (over the Treasury bill rate) of the U.S. dollar–denominated sovereign debts. When high-frequency data are used, the limitation of data coverage across countries as well as the relevant macrovariables that can help identify the sources of contagion are obvious disadvantages. For this reason, we will not seriously question the ultimate sources of the contagion effects in this section. Instead, we will attribute the whole magnitude "explained" by the shocks of other countries in the regressions to contagion effects, and the remaining parts to effects from domestic shocks.[12]

Considering data availability and its importance in the recent crisis, we selected ten countries: Brazil, Argentina, Mexico, Russia, China, Korea, Malaysia, Thailand, Indonesia, and Japan. Japan is included in order to check whether we can find any systematic evidence for the popular argument that the weakness of the Japanese economy played a significant role in triggering the Asian crisis. The sample period was chosen from 19 June 1997 to 31 December 1998, so that we can cover the situation right before Thailand's crisis. The sample size is approximately 400 for each country. The recent paper by Baig and Goldfajn (1998) presents similar analyses to those in this section, but we examine data largely from Korea's viewpoint using a wider set of countries. Details of the data sources can be found in the appendix.

10.3.1 Exchange Rates

A serious difficulty with using the exchange rate data is that the government, implicitly or explicitly, controls this variable in many countries. For example, the exchange rates of the three Latin American countries, Russia, and China are virtually uncorrelated with the exchange rates of other countries (not reported) because the governments of these countries managed their exchange rates. We dropped these five countries from our sample

12. Put more precisely, *domestic shock* is defined as the component that is orthogonal to shocks to other countries in the sample. Therefore, it is likely that more variations are attributed to domestic shocks when a smaller number of countries are included in the sample.

Table 10.4 Analyses for the Exchange Rate

	Korea	Malaysia	Thailand	Indonesia	Japan
A. ADF Test for Unit Root (daily data, lag = 2, including intercept)[a]					
Test statistic	−2.24	−2.31	−2.62	−1.71	−1.52
B. Pair-wise Correlation Coefficients (daily data, log-difference)[b]					
Korea	1.00				
Malaysia	0.10	1.00			
Thailand	0.09	0.41	1.00		
Indonesia	0.22	0.49	0.27	1.00	
Japan	0.08	0.12	0.20	0.11	1.00
C. Pair-wise Correlation Coefficients (daily data, log-level)[b]					
Korea	1.00				
Malaysia	0.81	1.00			
Thailand	0.82	0.82	1.00		
Indonesia	0.67	0.83	0.56	1.00	
Japan	0.51	0.68	0.56	0.77	1.00
D. *p*-Value for the Granger Causality Test (daily data, log-difference)[c]					
Korea		0.07	0.40	0.25	0.13
Malaysia	0.01		0.00	0.48	0.01
Thailand	0.00	0.02		0.01	0.77
Indonesia	0.00	0.00	0.00		0.16
Japan	0.82	0.26	0.65	0.87	

[a]1% critical value −3.45, 5% critical value −2.87, 10% critical value −2.57.

[b]Asymptotic standard error 0.05.

[c]Numbers are *p*-values of the tests for the nulls of no Granger causality from the country in the column to the country in the row.

for this reason and analyzed the five Asian countries, even though it is known that the governments in these countries also intervened in the foreign exchange markets from time to time. A more accurate reading of the pure market responses probably can be found from the sovereign spread data in secondary markets, the results for which we will discuss in the next section.

Cross-Country Correlation

Having confirmed that the null hypotheses of unit roots in the log of the exchange rates are not rejected (see heading A of table 10.4), heading B of table 10.4 reports the pair-wise correlation coefficients of the log differences for the five Asian countries. This table shows that the daily fluctuations are closely correlated with one another.[13] However, the correlation coefficients of Korea with other countries are far smaller than those among

13. All of the exchange rates are against the U.S. dollar, and correlation across countries may be spurious in that it may reflect the common fluctuation of the U.S. dollar. In this sense, an interpretation about the absolute degree of the correlation coefficient should be made with caution. However, comparison of the coefficient with other countries is largely immune to this problem.

the three Association of Southeast Asian Nations (ASEAN) countries. This result may be regarded as consistent with the finding from the cross-country data that the contagion effect was small for Korea relative to the ASEAN countries.

In addition, Japan's exchange rate does not appear to be significantly correlated with that of Korea; it is more correlated with the exchange rates of the ASEAN countries. At least from the daily variations for the sample period used in this paper, it appears difficult to justify the casual argument that the weakness of the Japanese yen was a major cause of the Asian crisis, particularly the crisis of Korea.

The relatively low frequency data or the level data shows a slightly different picture. For example, the correlation coefficients of Korea with the other countries are significant for the first differences of the weekly averages (not reported) and for the levels under heading C of table 10.4, although the degrees are still smaller than other coefficients. This may indicate that sizable lagged effects exist in transmitting one country's shock to another country, and if so, the Granger causality test exercise can be meaningful.

Granger Causality Test

Heading D of table 10.4 reports the *p*-values of the test statistic under the null of no Granger causality for each pair of countries, using two days of time lags. It may not be surprising that shocks in many countries Granger-cause movements in many other countries. What is impressive, however, is that Korea Granger-caused devaluations of the ASEAN countries far more significantly than vice versa. In addition, it is hard to find any causality connections between Japan and Korea, which is consistent with the result from the contemporaneous correlation coefficients.

VAR Simulation

How much of Korea's devaluation can be attributed to the contagion, and how much to the country's own shock? In order to provide a mechanical answer to this question, we applied the vector autoregression (VAR) technique for these five countries' data, using two lagged variables and no drift terms.[14] As for the ordering of the countries, we used the Granger causality results of table 10.4: Korea → Malaysia → Thailand → Indonesia → Japan. Because the VAR results are usually sensitive to the orderings, however, we tried the other extreme case for Korea: Malaysia → Thailand → Indonesia → Japan → Korea. Figure 10.1 plots the actual exchange rate of Korea, along with the two simulated paths by the respec-

14. Experiments with more than two lagged variables did not greatly change the simulation results, and the null of no drift term was accepted for all of the regressions.

tive VAR estimations that would have been realized if the shocks to other countries had not occurred. That is, the two dotted lines depict the exchange rate variations that can be attributed to the domestic shocks of Korea and its repercussions through the other four countries in the VAR models.

From these experiments, one can see that the contagion effects on Korea's exchange rate were large throughout the whole sample period, which is consistent with the results from the cross-country analyses. According to the lower dotted line that attributes Korea's variation wholly to the contagion effects, the exchange rate would have returned to the precrisis level during the second half of 1999 if there had been no foreign shocks. Also, the decomposition of the variation between domestic shocks and foreign shocks is rather insensitive to the ordering of the equations; that is, the two dotted lines are close to each other. This robustness of the results for Korea may have been expected from the above results for the correlation coefficients and the Granger causality tests.

Perhaps a more important message of figure 10.2 is, however, that the domestic shock must have played a critical role at least in triggering the explosion during the period of November and December 1998. Of course, this experiment has many limitations. As was noted earlier, for example, the exchange rate data are contaminated by the government intervention, and thus the analysis of the contagion effects was performed for only a limited number of countries. In particular, the redevaluation of the Asian exchange rates in the second half of 1998 was often attributed to the crises of Russia and Brazil, but the above analysis could not give support to this conjecture. In section 10.3.2, therefore, we present the results for the sovereign spread data in the secondary market for a wider set of countries.

10.3.2 Sovereign Spreads

The general methodology employed here is virtually identical to that in the previous section except for the coverage of the sample countries: For the sovereign spread data, we can include three Latin American countries (Brazil, Argentina, Mexico), Russia, and China, in addition to the previous Asian five. Parallel to the previous section, we focus on the results for the first differences. This is different from Baig and Goldfajn (1998), whose study analyzed the results for the levels of the sovereign spreads. It is not clear to us which one of the two is a superior concept in the context of contagion effects. Our choice of the first difference is based on the test results that do not reject the nulls of the unit roots in the data (see heading A of table 10.5). However, we also report some of the results for the level data as well because the correlation of the first differences only shows the contemporaneous daily contagion, whereas the correlation of the levels may indicate that the contagion cumulated over time with time lags.

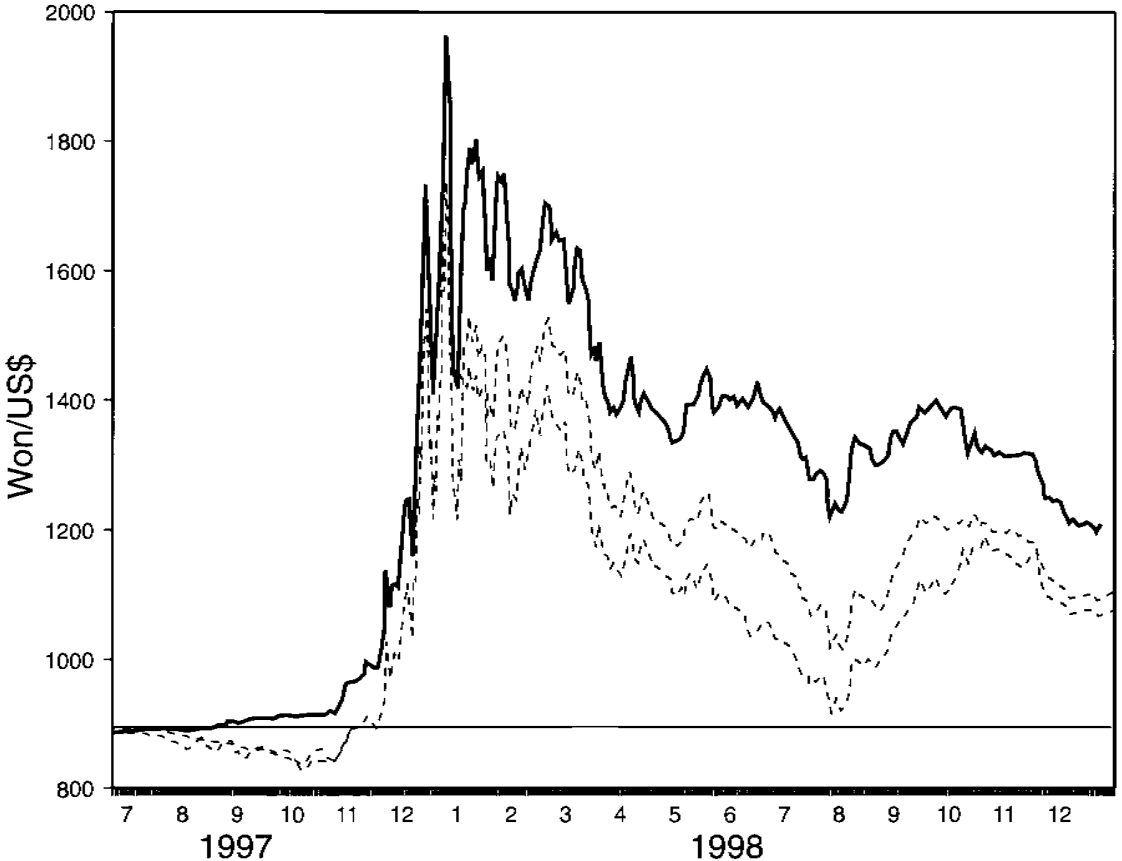

Fig. 10.2 Decomposition of Korea's exchange rate: Domestic versus foreign shock–driven components

Notes: The solid line is the actual won–dollar exchange rate, and the dotted lines are generated using the VAR estimation results with the foreign shocks set to be zeros. The upper dotted line is from the VAR with Korea at the highest in the ordering, while the lower dotted line with Korea at the lowest. See the text for details.

Table 10.5 **Analyses for the Sovereign Spreads**

	Brazil	Argentina	Mexico	Russia	China	Korea	Malaysia	Thailand	Indonesia	Japan
	A. ADF Test for Unit Root (daily data, lag = 2, including intercept)[a]									
Test statistic	−1.65	−1.53	−1.74	−0.16	−1.47	−1.70	−0.99	−1.72	−1.59	−3.01
	B. Pair-wise Correlation Coefficients (daily data, first difference)[b]									
Brazil	1.00									
Argentina	0.71	1.00								
Mexico	0.76	0.79	1.00							
Russia	0.35	0.45	0.49	1.00						
China	0.08	0.08	−0.02	0.05	1.00					
Korea	0.30	0.36	0.24	0.18	0.17	1.00				
Malaysia	−0.09	0.09	−0.02	0.03	0.09	0.22	1.00			
Thailand	−0.03	0.07	−0.02	0.06	0.03	0.05	0.12	1.00		
Indonesia	0.20	0.14	0.16	0.07	−0.06	0.01	0.04	0.01	1.00	
Japan	−0.10	−0.12	−0.18	−0.16	0.07	0.09	0.12	−0.01	−0.03	1.00
	C. Pair-wise Correlation Coefficients (daily data, level)[b]									
Brazil	1.00									
Argentina	0.93	1.00								
Mexico	0.95	0.97	1.00							
Russia	0.80	0.86	0.80	1.00						
China	0.81	0.90	0.85	0.87	1.00					

(*continued*)

Table 10.5 (continued)

	Brazil	Argentina	Mexico	Russia	China	Korea	Malaysia	Thailand	Indonesia	Japan
Korea	0.81	0.88	0.83	0.74	0.89	1.00				
Malaysia	0.86	0.90	0.84	0.93	0.93	0.88	1.00			
Thailand	0.85	0.88	0.84	0.67	0.81	0.92	0.83	1.00		
Indonesia	0.66	0.70	0.62	0.80	0.80	0.81	0.89	0.72	1.00	
Japan	0.01	0.08	0.05	−0.26	−0.03	0.19	−0.15	0.22	−0.18	1.00
	D. *p*-Value for the Granger Causality Test (daily data, first difference)[c]									
Brazil		0.00	0.03	0.08	0.00	0.01	0.00	0.02	0.39	0.42
Argentina	0.00		0.79	0.12	0.09	0.00	0.00	0.01	0.39	0.34
Mexico	0.00	0.06		0.16	0.00	0.00	0.01	0.00	0.16	0.92
Russia	0.00	0.00	0.00		0.00	0.92	0.00	0.00	0.61	0.36
China	0.00	0.00	0.00	0.00		0.02	0.70	0.63	0.99	0.81
Korea	0.00	0.00	0.00	0.00	0.33		0.03	0.98	0.23	0.07
Malaysia	0.00	0.12	0.01	0.01	0.06	0.00		0.00	0.48	0.19
Thailand	0.00	0.00	0.00	0.01	0.08	0.00	0.01		0.02	0.16
Indonesia	0.00	0.12	0.04	0.30	0.65	0.42	0.89	0.55		0.45
Japan	0.00	0.00	0.00	0.01	0.00	0.06	0.01	0.02	0.28	

[a]1% critical value −3.45, 5% critical value −2.87, 10% critical value −2.57.

[b]Asymptotic standard error 0.05.

[c]Numbers are *p*-values of the tests for the nulls of no Granger causality from the country in the column to the country in the row.

Cross-Country Correlation

Heading B of table 10.5 reports the pair-wise correlation coefficients of the first differences of the sovereign spreads for the ten countries. First, the correlation coefficients among the three Latin American countries are extremely high: They are over 0.7! One may be able to argue that the three countries are taken to be virtually a single market in the international capital market.

In contrast, the correlation coefficients among the three ASEAN countries are far smaller: The correlation coefficient between Malaysia and Thailand is barely significant at the 5 percent level, whereas the coefficients between Indonesia and the other two countries are not significant at all. In fact, Indonesia appears to be more correlated with Latin American countries than with other Asian countries. Russia is also more correlated with Latin American countries than with the Asian countries, and China is not significantly correlated with any other countries. It is interesting that Japan shows negative correlation with Latin American countries, which seems to indicate that the international capital market perceives the crises in Latin America as positive shocks to Japan (or negative shocks to the United States; recall that we use the spreads over the U.S. Treasury bill rate).

Finally, it is surprising that Korea shows stronger correlation with the Latin American countries than with Asian countries. As in the exchange rate analyses, however, the cross-country correlation appears to be far more significant when the first differences of the weekly average or the levels of the daily data are used.[15] For the first differences of the weekly average data (not reported) or for the levels under heading C in table 10.5, for example, Korea turns out to be significantly correlated with all other countries except Indonesia. Again, this divergence of results when the data frequency is varied seems to suggest that substantial time lags exist in the contagion effects that cannot be captured by the contemporaneous daily correlation.

Granger Causality Test

This argument is confirmed by the Granger causality test results reported under heading D in table 10.5. Allowing for just two days of time lags, the nulls of no causality were rejected in many pairs for which the contemporaneous daily correlation did not appear to be significant. For example, Thailand appeared to be significantly correlated only with Malaysia in the daily difference correlation, but it appeared to Granger-cause, as well as to be Granger-caused by, many other countries. The passive role of Japan is confirmed again: It was Granger-caused by most of the sample

15. For example, Valdes (1996) used the average of weekly data for the sovereign spreads for Latin American countries.

countries, but it did not Granger-cause the crisis countries. As in the previous section, the role of Japan in triggering the crises appeared to be minimal.

Finally, Korea was Granger-caused by the Latin American countries as well as it Granger-caused them, but it Granger-caused the other Asian countries and was not Granger-caused by them. All of these results are not in accordance with the casual assertion that the ASEAN or Japanese financial crises triggered the Korean crisis. Instead, these results seem to support the hypothesis that the Korean crisis was largely triggered by domestic weaknesses and that it was deepened by the crises of Russia and Brazil later on.

VAR Simulation

Using similar methodology as described in the previous section, figure 10.3 plots the actual sovereign spread of Korea, along with the simulated paths by the VAR estimations (two lagged variables and no drift terms) that would have been realized if the shocks to other countries had not occurred.[16] As for the ordering of the countries, again, we referred to the Granger causality test results (Brazil → Argentina → Mexico → Russia → China → Korea → Malaysia → Thailand → Indonesia → Japan). In order to check the sensitivity of the result, we also report an additional simulation result that placed Korea at the bottom in the ordering of the countries.

A literal interpretation of this graph is that the spike in Korea's spread in mid-1998 would not have occurred if there had been no crises in other countries (Brazil in particular): The simulated spread does not exceed 400 basis points, whereas the actual spread peaked at 1,000 basis points. This is somewhat different from the result for the exchange rate in figure 10.2 in which Russia and Latin American countries were not considered. That is, this difference indicates that Korea's crisis was significantly affected by the contagion effects from the Russian and Latin American crises in the second half of 1998. Nevertheless, the rise of Korea's spread in 1997 cannot be fully attributed to contagion effects, which is the same conclusion as in the analyses with the exchange rates.

10.3.3 News

An important result from the analyses of both the exchange rates and sovereign spreads is that the outbreak of the Korean crisis at the end of 1997 is hardly attributable to contagion effects. In this section, therefore, we examine more closely what happened inside Korea during this critical period from October to December 1997. For this purpose, we collect major news on the financial market and examine how the market reacted to each incident.

16. Experiments with more than two lagged variables did not greatly change the simulation results, and the constant terms appeared to be insignificant for most countries.

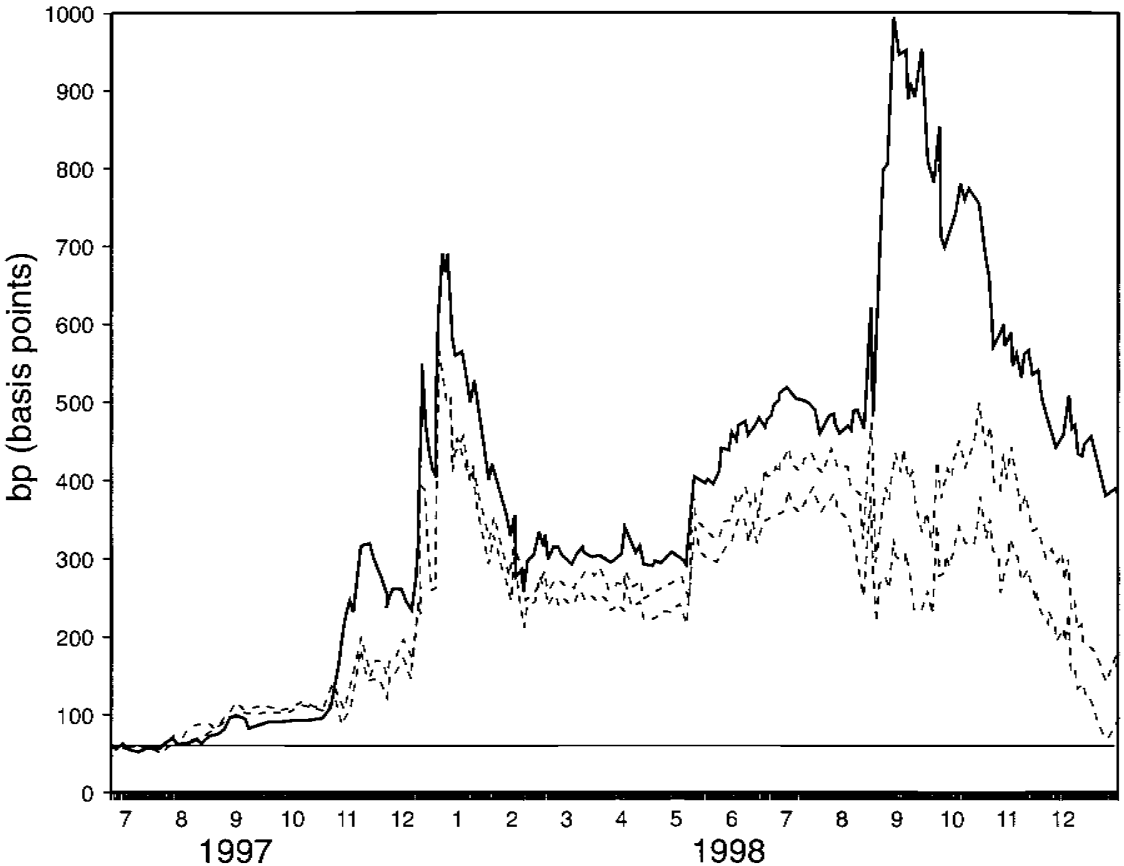

Fig. 10.3 Decomposition of Korea's sovereign spread: Domestic versus foreign shock–driven components

Notes: The solid line is the actual spread of KDB bond over the U.S. Treasury bill rate, and the dotted lines are generated using the VAR estimation results with the foreign shocks set to be zeros. The upper dotted line is from the VAR with Korea at 6th in the ordering, while the lower dotted line with Korea at the lowest. See the text for details.

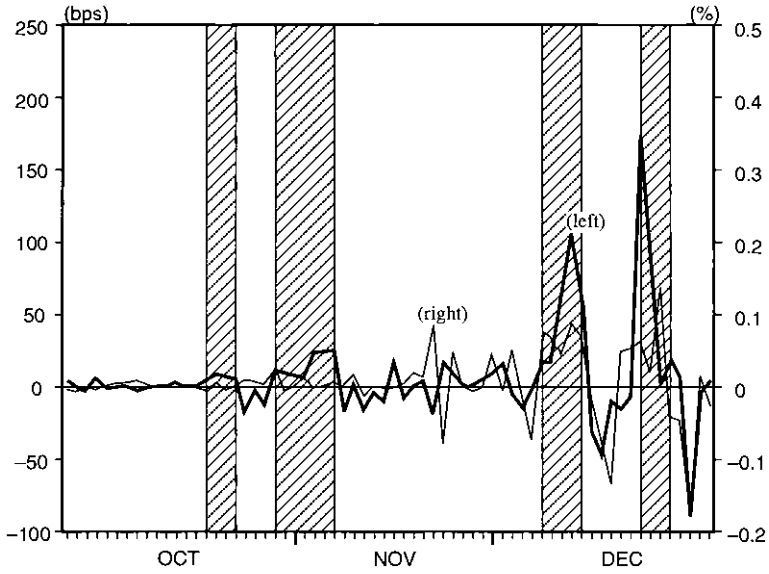

Fig. 10.4 Domestic shocks identified by the VAR, 1997
Note: The thick line is the shock on the sovereign spread; the thin line is the shock on the exchange rate.

Figure 10.4 reports Korea's residuals that were identified from the VAR estimation of the exchange rate and sovereign spreads (with Korea at the fifth position from the bottom in the ordering). From this figure, one may find the four subperiods that experienced serious negative shocks (or the positive residuals), which we highlighted with the shaded areas: 10/21–10/25, 10/30–11/8, 12/8–12/13, and 12/22–12/24.

Table 10.6 reports the relevant news that we collected from several Korean newspapers (Maeil Economic Daily, Hankuk Economic Daily, and so forth) and Bloomberg. In order to reduce possible selection bias, we tried to collect only the headline news of the financial sections in domestic newspapers, and simply skipped the dates on which the headline news were mere descriptions of the financial market situation. From Bloomberg, in contrast, we included the comments on Korea's situations and government policies.

One can notice that the news for the International Monetary Fund's (IMF) rescue plan was not a big shock to the market; it may have been anticipated. Rather, the news that stirred the financial market was the bankruptcies of several *chaebols* and financial institutions and the bailout policies of the government. Readers can also refer to table 10.11 to see how many conglomerates of Korea had gone bankrupt right before the crisis and how large they were in the Korean financial market. The first

Table 10.6 **News on the Korean Financial Market, October–December 1997**

	Korean Newspapers	Bloomberg
3 October	Standard & Poor's downgrades commercial banks.	
4 October	Euromoney downgrades Korea.	
14 October	Bank of Korea makes special loans of 1 trillion won to merchant banks.	
20 October	Government leads commercial banks to syndicated loans to ailing *chaebols.*	
23 October	**Government decides to undertake Kia Motors as a public enterprise through KDB's debt-equity swap.**	
24 October		**Standard & Poor's downgrades Korea because the government rescued Korea First Bank and "nationalized" the near-bankrupt Kia.**
25 October	**Standard & Poor's downgrades Korea.**	
27 October		Free-fall of currency raises concern Korea will follow other Asian nations in seeking IMF assistance, although government denies it.
29 October	Moody's downgrades Korea.	
29 October	Bond market will be opened from 1998.	Korea accelerates opening bond market, but it is too late to allure foreign investors.
30 October		**Government orders banks and companies to stop hoarding dollars, and investors suspect that BOK's official reserve of $30 billion does not include dollars borrowed through forward transactions.**
3 November	**Haitai group applies for composition.**	
4 November	**Newcore group applies for composition.**	
5 November		**A costly—and probably futile—attempt to stabilize the currency value increases systemic risks. Many estimate actual reserves could be as low as $15 billion. The focus of Korean banks' lending to a handful of customers, or *chaebol,* could make matters even worse.**

(*continued*)

Table 10.6 (continued)

	Korean Newspapers	Bloomberg
8 November	**Government requests foreign press to stop spreading "groundless" bad rumors about Korea.**	
10 November		Foreign investors dismiss government optimism in coping with the turmoil.
11 November	Government will support 1.3 trillion won for Kia group.	
12 November	Financial Reform Amendment is rejected by the National Assembly.	
18 November	BOK makes $1 billion in emergency loans to the five major commercial banks on the brink of bankruptcies.	Korea may need IMF assistance, although IMF and government deny it.
19 November		Finance minister is replaced to clear the way for the government to seek $40 billion from the IMF.
20 November	Government guarantees all deposits and interest for three years.	
20 November	Exchange rate band is widened from 2.5 to 10 percent per day.	
21 November	Government asks for IMF support.	
26 November	Foreign exchange treatments of eight merchant banks are suspended.	
28 November	IBRD and ADB decide to support Korea.	
2 December		Government orders nine crippled finance companies to suspend business.
3 December	Halla group asks for syndicated loan.	
3 December	Nine merchant banks are closed.	Korea agrees to a $55 billion international bailout.
4 December	IMF and government agree upon a $55 billion rescue package.	
6 December	Korea Securities Co. goes bankrupt.	
8 December	**Daewoo group acquires Ssangyong Motors with syndicated loans.**	
8 December	**BOK injects 1.2 trillion won to ailing merchant banks, and will make more special loans if necessary.**	
9 December	**Government invests 1.8 trillion won in Seoul Bank and Korea First Bank.**	

11 December	**Five more merchant banks are closed.**	
11 December	**BOK makes 5 trillion won in special loans to commercial banks.**	
11 December	**Dongseo Securities Co. is closed.**	
13 December	**BOK will inject 11 trillion won to nonbank financial institutions.**	
15 December	Government will allow for redundant layoffs.	
16 December	Exchange rate band is abolished.	Government ends limits on foreign exchange trading.
16 December		Government will cancel plans to inject capital into six banks because of objections from IMF officials.
17 December		Government delays plans to bolster banks and offers aid to brokerages, resisting the reform package of the IMF.
18 December	Dae-Jung Kim is elected as the new president.	Finance and Economy Ministry says financial institutions have "less than $10 billion" in short-term foreign currency debt maturing in January, but independent economists say the government figure is optimistic.
23 December	**Moody's downgrades Korea to a junk-bond level.**	**Korea is pushed closer to the economic brink as Moody's cuts the country's credit rating to junk status.**
23 December	**IMF is discontent with the government treatment of the ailing financial institutions.**	
23 December	**Vice minister of Finance Department acknowledges that there exist more than $100 billion in offshore borrowings.**	**U.S. officials deny a report that the Clinton administration offered $5 billion in "emergency credits."**
24 December		**BOK asks Japan banks to roll over debts.**
25 December	IMF and G7 promise to support $10 billion early.	
25 December	Financial market will be completely opened.	
26 December		Korea will allow bank layoffs.
26 December		Korea's courts reject applications from Koryo and Dongsuh Securities Co. for court receivership, making it likely the brokerages will be sold or shut down.
27 December	Cheongku Group applies for composition.	
30 December		Korea's external debt totals $156.9 billion at the end of November, according to IMF standards.
30 December		National Assembly passes a package of economic reform bills.

period matches the news about the bailout policy for Kia, whereas the second period coincides with the bankruptcy news of Haitai and NewCore. The third period matches the news on the acquisition of Ssangyong Autos by Daewoo and the unconditional rescues of many distressed financial institutions, including two major bankrupt banks (First Korea and Seoul) by the government (and the Bank of Korea). Finally, the last period was driven by the news that Moody's downgraded Korea's sovereign debt to a junk-bond level and the finance department vice minister's acknowledgment that Korea's foreign debt may exceed $250 billion instead of the official $100 billion.

In short, the news that the Korean government still tried to stick to old-fashioned bailout policies appears to have operated as bad shocks. At least at the triggering moment of the Korean crisis, the market's reaction appeared to be most negative to the series of *chaebol* bankruptcies and the government's bailout policies.

10.4 Further Discussion on the Korean Crisis

The previous section suggests that the Korean crisis was triggered more by domestic shocks than by contagion effects, although the contagion effects substantially deepened the crisis. This is basically in accordance with the result from the probit analyses, with more emphasis on domestic weaknesses. Yet, the probit analyses indicate that the domestic fundamentals were not extremely bad. This section, therefore, adds some discussion about some important weaknesses of Korea's financial market structure that we could not systematically analyze due to the limitations of comparable cross-country data availability. Instead of providing formal analysis results, we will briefly sketch the crucial points that have been made by other researchers.

10.4.1 Bank Runs rather than Currency Speculation

Table 10.7 shows Korea's balance-of-payment situation during the 1997–98 period. From this table, one can be astonished at how abrupt the capital flow reversal was during the fourth quarter in 1997. The usable foreign reserve, which had been fluctuating around $30 billion until the third quarter, abruptly decreased by $15 billion during just one month, November 1997. In fact, the foreign reserve would have been completely depleted by the end of December had there not been the emergency loan of $16 billion through the public sector institutions, such as the IMF and the World Bank.

An important point of this table, however, is that the major component of this abrupt capital flow reversal was the withdrawal of foreign debt rather than the shift of portfolio investment. Private external debt decreased by $6.5 billion in November and by $11.3 billion in December,

Table 10.7 Trends of the Balance-of-Payment Components (in US$ billions)

	1997							1998			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	October	November	December	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Foreign reserve decrease[a]	8.28	−4.17	2.89	13.55	0.12	15.04	−1.61	−15.28	−12.89	−6.33	−5.14
Private foreign asset decrease[a]	−1.88	−1.44	−1.76	−10.00	−1.14	2.37	−11.23	−5.87	−0.80	2.84	3.83
Total	6.40	−5.61	1.13	3.55	−1.02	17.41	−12.84	−21.15	−13.69	−3.49	−1.31
Decrease in external debt[b]	−5.59	−6.47	−2.94	−1.10	−2.95	6.55	−4.70	4.26	−0.83	3.23	2.06
(public)	0.07	0.17	0.06	−15.92	0.04	0.05	−16.01	−6.69	−5.67	−1.42	−0.47
(private)	−5.66	−6.64	−3.00	14.82	−2.99	6.50	11.31	10.95	4.83	4.64	2.53
Increase in deposit at overseas branches[b]	4.20	0.00	0.00	3.33	0.00	8.91	−5.58	−5.93	−1.74	−0.26	−0.07
Net direct investment outflow[a]	0.51	0.23	0.66	0.21	0.10	−0.05	0.16	0.34	−0.34	−0.47	0.08
Net equity securities outflow[a]	−0.54	−2.54	−0.50	1.38	0.76	1.07	−0.46	−2.99	−0.01	0.22	−1.31
Errors and omission	0.02	−0.15	1.17	4.03	0.50	2.35	1.18	0.50	1.25	1.16	2.16
Current account deficit[a]	7.35	2.72	2.05	−3.96	0.49	−0.86	−3.59	−10.83	−10.91	−9.62	−8.69

Sources: Bank of Korea, *Balance of Payments* (various issues), and the data for external debt are from the Ministry of Finance and Economy.

[a]Negative numbers denote increase, inflows, or surplus.

[b]External debt is reckoned based on IBRD standards, and deposit at overseas branches denotes the deposit of the Bank of Korea at the overseas branches of the domestic banks.

whereas the magnitude of equity securities outflow was rather small. If one includes the emergency loan of the Bank of Korea to the overseas branches of the Korean banks that were on the brink of bankruptcies, the decrease of private foreign debt in November was over $15 billion!

Based on this inspection, Shin (1998) argues that the triggering mechanism of the currency crisis in Korea fits the bank-run theories (e.g., Cole and Kehoe 1996; Goldfajn and Valdes 1997; Chang and Velasco 1998) better than the speculative attack hypotheses (e.g., Krugman 1979; and Obstfeld 1995). Somewhat arbitrarily, table 10.8 decomposes the demand for foreign reserves into two parts: the component that was not affected by the exchange rate movement from the creditor's point of view, and the other component that was subject to the capital loss from currency depreciation. According to this decomposition, one can confirm that the first component outweighs the second in magnitude. This finding seems to support the hypothesis that the abrupt reversal of the capital flow in Korea was triggered by the bankruptcy risks of the major Korean banks, rather than the hypothesis that currency speculation in pursuit of capital gain triggered massive capital outflow.

This argument appears to be reinforced by the external liability rollover rate of the seven major Korean banks in table 10.9, cited from Shin (1998). That is, the rollover rate of the major Korean banks, which already remained below 100 percent before November, sharply declined in November and further in December.

In relation to the contagion issue and the contagious effects from the weak financial system of Japan in particular, table 10.10 shows that Japan's role was not particularly prominent. That is, the absolute amount of credit withdrawn by Japan was large because of its high exposure to the Korean market, but the flight from Korean banks was a general phenomenon regardless of the creditors' region. This information is also consistent with the result of the above section that Japan's role appears to be minimal in triggering the Korean crisis.

10.4.2 Fragile Financial Market Structure That Was Not Considered Above

We argued that the Korean crisis appeared to be triggered by bank runs rather than speculative currency attacks. We also argued that the critical news triggering the crisis seemed to be the *chaebol* bankruptcies and the bail out policies of the government. In relation to these arguments, this section briefly mentions the fragile aspects of Korea's financial system that were not considered in the probit model analyses.

Perhaps the most important weaknesses in Korea's financial structure that were overlooked in the probit analyses were the low profitability and the high leverage ratios of the corporate sector. Figure 10.5 shows that the corporate sector of Korea had the lowest profitability and the highest debt/

Table 10.8 Demand Factors of the Foreign Reserves

	1997							1998			
	First Quarter	Second Quarter	Third Quarter	Fourth Quarter	October	November	December	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Outflow of foreign currency denominated assets[a]	−1.30	−6.47	−2.93	2.24	−2.95	15.46	−10.28	−1.68	−2.57	2.97	1.99
Outflow of domestic currency denominated assets 1[b]	−0.51	−2.69	0.66	5.41	1.27	3.42	0.72	−2.49	1.24	1.38	0.85
Outflow of domestic currency denominated assets 2[c]	6.84	0.03	2.71	1.45	1.75	2.56	−2.87	−13.32	−9.66	−8.24	−7.83

Sources: All numbers are from table 10.7.

Note: Negative numbers denote capital inflow.

[a]Sum of the decrease in external debt and the increase in the deposit at the overseas branches of the domestic banks.

[b]Sum of net equity securities outflow, and errors and omissions.

[c]Sum of the net equity securities outflow, errors and omissions, and current account deficit.

Table 10.9 **Weekly Rollover Rate of Foreign Loans: Seven Major Commercial Banks, 1997**

	July	August	September	October	November	December
First week	157.3	64.1	82.2	83.7	70.0	23.7
Second week	95.5	84.9	82.8	83.9	67.2	26.8
Third week	83.6	86.9	84.1	80.5	55.9	26.2
Fourth week	76.1	76.2	89.8	84.9	48.7	31.9
Fifth week	87.5		127.3			53.3
Average	89.1	79.2	85.5	86.5	58.8	32.2

Table 10.10 **Trend of Regional Composition of Foreign Loans: Thirteen Major Banks**[a]

	96.12	97.3	97.6	97.9	97.12
Japan	259.7 (50.2)	212.8 (42.0)	220.9 (44.8)	206.3 (45.8)	139.5 (47.6)
United States	70.1 (13.5)	88.3 (17.4)	86.4 (17.5)	70.5 (15.7)	46.3 (15.8)
Europe	187.6 (36.3)	205.4 (40.6)	185.8 (37.7)	173.0 (38.5)	107.1 (36.6)
Total[b]	517.4 (100.0)	506.4 (100.0)	493.1 (100.0)	449.8 (100.0)	292.9 (100.0)

[a] Seven commercial banks and six specialized banks.

[b] This figure excludes foreign loans extended by creditor banks in regions other than Japan, the United States, and Europe.

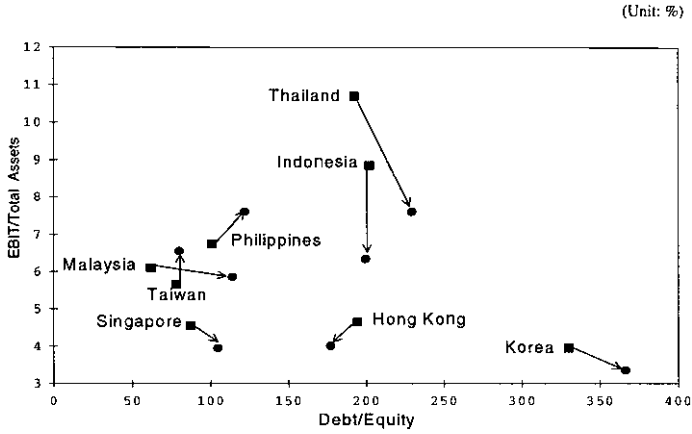

Fig. 10.5 Debt equity ratio and EBIT-total assets for East Asian countries (1991–96)

Source: Nam, Kang, and Kim (1999).

Note: The solid square denotes average for 1991–92; the solid circle denotes average for 1995–96.

equity ratio among the eight Asian countries. This financial structure was a large potential threat to the solvency of the banking sector of Korea.

In addition, the high concentration of financial assets in a small number of *chaebols* was perceived to be another factor causing vulnerability in the financial system. Table 10.11 shows that the top thirty *chaebols* governed almost 50 percent of the total assets in Korea. Under this high concentration ratio, a small negative shock to the *chaebols* could develop into sys-

Table 10.11 **Thirty Largest *Chaebols:* April 1996 (in trillions of won)**

	Total Assets	Leverage (debt/equity)	Number of Subsidiaries	Date of Bankruptcy
1. Hyundai	43.7 (6.94)	440%	46	
2. Samsung	40.8 (6.48)	279%	55	
3. LG	31.4 (4.99)	345%	48	
4. Daewoo	31.3 (4.97)	391%	25	
5. SK	14.6 (2.32)	352%	32	
6. Ssangyong	13.9 (2.21)	310%	23	
7. Hanjin	12.2 (1.94)	559%	24	
8. Kia	11.4 (1.81)	522%	16	07/16/97*
9. Hanhwa	9.2 (1.46)	712%	31	12/17/97***
10. Lotte	7.1 (1.13)	191%	28	
11. Kumho	6.4 (1.02)	480%	27	
12. Doosan	5.8 (0.92)	907%	26	
13. Daelim	5.4 (0.86)	424%	18	
14. Hanbo	5.1 (0.81)	648%	21	01/18/97*
15. Dongah	5.1 (0.81)	362%	16	01/10/98***
16. Halla	4.8 (0.76)	2,457%	17	12/03/97***
17. Hyosung	3.6 (0.57)	362%	16	
18. Dongkuk	3.4 (0.54)	223%	16	
19. Jinro	3.3 (0.52)	4,836%	14	09/09/97**
20. Kolon	3.1 (0.49)	340%	19	
21. Tongyang	3.0 (0.48)	305%	22	
22. Hansol	3.0 (0.48)	291%	19	
23. Dongbu	2.9 (0.46)	219%	24	
24. Kohap	2.9 (0.46)	603%	11	01/30/98***
25. Haitai	2.9 (0.46)	669%	14	08/26/97*
26. Sammi	2.5 (0.40)	3,333%	8	03/20/97*
27. Hanil	2.2 (0.35)	581%	8	12/31/97***
28. Keukdong	2.2 (0.35)	516%	11	
29. Newcore	2.0 (0.32)	1,253%	18	05/23/97**
30. Byucksan	1.9 (0.30)	473%	16	
Total	286.9 (45.6)		669	

Source: Data from the Fair Trade Commission.

Note: Figures in parentheses are the share of total assets in percentages of the corporate sector in Korea (629.8 trillion won as of the end of 1996).

*denotes bankruptcy.

**denotes standstill agreement.

***denotes syndicated loan.

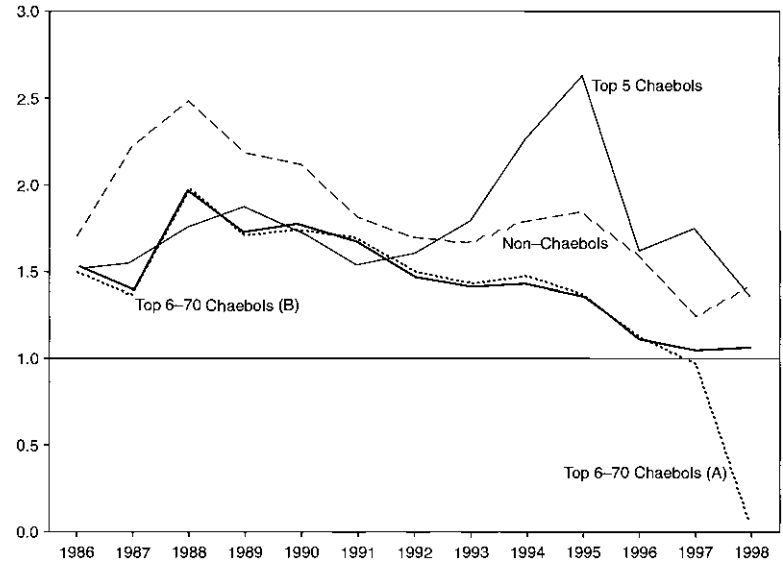

Fig. 10.6 Interest payment coverage ratios for listed firms
Source: National Information and Credit Evaluation, Inc.
Notes: Figures for 1998 are those for the first half of 1998. (A) includes all subsidiaries of the top 6–70 *chaebols;* (B) excludes Kia and Asia automobile companies among the top 6–70 *chaebols.*

temic risk affecting the whole banking sector. In this regard, the severe deterioration in the profitability of the top six to seventy *chaebols* since 1995 as shown in figure 10.6 was a growing threat to the whole banking system of Korea. In table 10.11 we also report the bankruptcy dates to show how many *chaebols* went bankrupt during 1997. Recognizing this aspect of Korea's financial system may help readers better understand why the financial market reacted so drastically to the news of *chaebol* bankruptcies.

10.5 Concluding Remarks

This paper examines the Korean currency crisis, focusing on the weaknesses in domestic fundamentals as opposed to the contagious external effects. The results of this paper appear to suggest that the contagion effects were large, but not sufficient enough to explain Korea's crisis. In particular, the triggering moment of the crisis did not appear to be attributable to the contagion effects.

As for the conventional factors that are considered important in explaining the currency crisis, Korea's fundamentals were weak, but not extreme enough to generate such a deep crisis. While external transactions were loosely managed, domestic macrofundamentals appeared to be

sound. Nevertheless, the Korean currency crisis seems to have been triggered by runs on the major banks, with the triggering moment associated with the bankruptcies of *chaebols* and the nontransparent bailout policies of the government. This observation seems to suggest that additional fragile aspects of the financial system were important in explaining Korea's crisis. Examples of such aspects are the low profitability and high leverage ratio of the corporate sector, the high concentration ratio of financial assets in a small number of *chaebols,* and so forth.

A crucial question that arises here is why the bank runs were triggered by foreign investors while domestic investors were less worried. A possible explanation is the divergence of expectations about conventional practices of the government policies. That is, among Korean investors, expectations about bailout policies for *chaebol* and financial institutions were largely expected while foreign investors were surprised. If this proposition is true, Korea's crisis was a more fundamental crisis for the whole financial system of Korea rather than a simple liquidity crisis for foreign exchanges. In other words, the crisis may have been an inevitable outcome when the implicit bailout expectation among Korean investors (or the crony capitalism of Krugman 1998) was broken by foreign investors. This is a complex issue that should be further investigated.

Appendix

Data Sources

Cross-Country Data

Most of the data used in section 10.2 are extracted from the *World Development Indicators on CD-ROM 1998* by the World Bank (hereafter WDI98), unless otherwise indicated.

Crisis index. The crisis index takes value 1 for a currency crisis and value 0 otherwise. A crisis is defined as annual depreciation of the nominal exchange rate (with respect to the U.S. dollar) of at least 25 percent that is also at least a 10 percent increase in the rate of depreciation.

Growth rate of per capita GDP. The per capita GDP growth rate is constructed by taking the log difference of per capita GDP.

Growth rate of real domestic credit. Real domestic credit denotes domestic credit extended to the private sector by the banking sector divided by the consumer price index (CPI). The banking sector comprises monetary authorities, depository banks, and other financial institutions (e.g., mutual credit unions and housing financial cooperatives).

Ratio of foreign exchange reserve to short-term foreign debt. The data for foreign exchange reserves are from the *International Finance Statistics CD-ROM March 1999* (hereafter IFS), and short-term foreign debt is obtained by multiplying total foreign debt by the share of short-term foreign debt in total foreign debt. Total foreign debt includes foreign borrowings by the government sector, government-guaranteed foreign borrowings, non–government-guaranteed private borrowings, and credit and short-term debt provided by the International Monetary Fund.

Depreciation of the real exchange rate. The real exchange rate depreciation is the log difference of the nominal exchange rate over CPI. The nominal exchange rate is the year-end market exchange rate from IFS, whereas CPI is from WDI98.

Changes in the terms of trade. Changes in the terms of trade are constructed by taking the log difference of the ratio of export price to import price. The export and import prices are export and import values (in current U.S. dollars) divided by export and import volumes (in constant local currency), respectively.

FDI/GDP. FDI denotes net foreign direct investment inflow.

Growth rate of foreign GDP. The foreign GDP growth rate is the log difference of the total sum of GDPs of OECD economies.

Foreign interest rates. Foreign interest rates are the weighted average of lending rates in the United States, Japan, the United Kingdom, Germany, and France. The weights are given by the currency composition of the long-term debt in each country. The currency composition ratios are from the World Bank (1997, 1998) and World Bank (various issues).

Regional contagion index. The regional contagion index is a weighted average of the crisis indexes of other countries. The weights are given by the inverse of the geographical distance between the country in question and other countries. For the geographical distance between two countries, latitude and longitude of the corresponding capital cities are used.

Trade linkage index: The trade linkage index in section 10.2 is the same as the one used by Glick and Rose (1998). The trade linkage between two countries 0 and *i* are given by the following:

$$\text{Trade}_i \equiv \sum_k \left[\left(\frac{X_{0k} + X_{ik}}{X_0 + X_i} \right) \cdot \left(\frac{1 - |(X_{ik} - X_{0k})}{X_{ik} + X_{0k}} \right) \right],$$

where X_{ik} denotes aggregate bilateral exports from country i to k ($k \neq i$, 0) and X_i denotes aggregate exports from country i.

Daily Data

Sovereign Spreads. The spread is defined by subtracting the yield rate on the U.S. Treasury bill from the yield rate on each sovereign bond in the secondary market. We collected the yield rate of each country's sovereign bond from Bloomberg Online. The following are the CUSIP numbers of the sovereign bonds, along with the specific name of the bond and due date.

Argentina: 040114AN0, ARGENT 11, 10/06, USD, GOVT.
Brazil: 105756AG5, BRAZIL 9 3/8, 04/08, USD, GOVT.
Mexico: 593048bf7, MEX 8 5/8, 03/12/08, GOVT.
Malaysia: PETRONAS 7 1/8, 10/06, USD, PETRONAS.
China: 712219AE4, CHINA 7 3/4, 07/06, USD, GOVT.
Indonesia: 455780AB2, INDO 7 3/4, 08/06, USD, GOVT.
Thailand: 88322kac5, Thailand Kingdom, Thai, 3/4, 04/07.
Korea: Korea Development Bank due to 2003, 10 years, Global.
Japan: TOKYO MISTZUBISHI, BOT, 7 3/4, 11/02/02.
Russia: XS0077745163, RUSSIA 10, 06/07, USD, GOVT.
Treasury Bill: T 5 1/4, 02/15/29, 30 years.

References

Agenor, Pierre-Richard, and Joshua Aizenman. 1997. *Contagion and volatility with imperfect credit markets.* Cambridge, Mass.: International Monetary Fund.

Aharony, Joseph, and Itzhak Swary. 1983. Contagion effects of bank failures: Evidence from capital markets. *Journal of Business* 56 (3): 305–22.

———. 1996. Additional evidence on the information-based contagion effects of bank failures. *Journal of Banking and Finance* 20:57–69.

Baig, Taimur, and Ilan Goldfajn. 1998. *Financial market contagion in the Asian crisis.* Washington, D.C.: International Monetary Fund.

Bank of Korea. Various issues. *Balance of payments* (in Korean). Available at http://www.bok.or.kr.

Calomiris, Charles W., and Joseph R. Mason. 1994. Contagion and bank failures during the Great Depression: The June 1932 Chicago banking panic. NBER Working Paper no. 4934. Cambridge, Mass.: National Bureau for Economic Research, November.

Calvo, Sara, and Carmen Reinhart. 1996. Capital flows to Latin America: Is there evidence of contagion effects? Policy Research Working Paper no. 1619. Washington, D.C.: Institute for International Economics.

Chang, Robert, and Andres Velasco. 1998. Financial crises in emerging markets: A canonical model. NBER Working Paper no. 6606. Cambridge, Mass.: National Bureau of Economic Research, June.

Chari, V. V., and Ravi Jagannathan. 1998. Banking panics, information, and rational expectations equilibrium. *Journal of Finance* 43 (3): 749–63.

Cohen, Daniel. 1993. A valuation formula for LDC debt. *Journal of International Economics* 34 (1–2): 167–80.

Cole, Harold, and Timothy Kehoe. 1996. A self-fulfilling model of Mexico's 1994–95 debt crisis. Staff Report 210. Federal Reserve Bank of Minneapolis.

Corbo, Vittorio, and Leonardo Hernandez. 1994. Macroeconomic adjustment to capital inflows: Latin American style versus East Asian style. World Bank Policy Research Working Paper no. 1377. Washington, D.C.: World Bank, November.

Doukas, John. 1989. Contagion effect on sovereign interest rate spreads. *Economics Letters* 29 (3): 237–41.

Eichengreen, Barry, Andrew K. Rose, and Charles Wyplosz. 1995. Exchange market mayhem: The antecedents and aftermath of speculative attacks. *Economic Policy* 21 (October): 251–312.

Flood, R., and P. Garber. 1984. Collapsing exchange rate regimes: Some linear examples. *Journal of International Economics* 17 (1–2): 1–13.

Forbes, Kristin, and Roberto Rigobon. 1998. No contagion, only interdependence: Measuring stock market co-movements. MIT–Sloan School of Management, Unpublished Manuscript, November.

Frankel, Jeffrey A., and Andrew K. Rose. 1996. Currency crashes in emerging markets: An empirical treatment. *Journal of International Economics* 41 (3–4): 351–66.

Frankel, Jeffrey A., and Sergio L. Schmukler. 1998. Crisis, contagion, and country funds. In *Managing capital flows and exchange rates,* ed. R. Glick, 1–47. Cambridge: Cambridge University Press.

Garber, Peter. 1996. Are currency crises self-fulfilling? In *NBER Macroeconomics Annual 1996,* ed. Ben S. Bernanke and Julio Rotemberg, 403–06. Cambridge: MIT Press.

Glick, Reuven, and Andrew K. Rose. 1998. Contagion and trade: Why are currency crises regional? University of California at Berkeley, Unpublished Manuscript, August 12. Available at http://haas.berkeley.edu/~arose.

Goldfajn, Ilan, and Rodrigo O. Valdes. 1997. Capital flows and the twin crises: The role of liquidity. IMF Working Paper no. 9787. Washington, D.C.: International Monetary Fund, July.

Haque, Nadeem U., Manmohan S. Kumar, Nelson Mark, and Donald J. Mathieson. 1996. The economic content of indicators of developing country creditworthiness. IMF Working Paper, January.

Hong, Kiseok. 2000. Channels of contagion effects in currency crises. Mimeograph.

Kaminsky, Graciela L., and Carmen M. Reinhart. 2000. On crises, contagion, and confusion. *Journal of International Economics,* forthcoming.

Karafiath, Imre, Ross Mynatt, and Kenneth L. Smith. 1991. The Brazilian default announcement and the contagion effect hypothesis. *Journal of Banking and Finance* 15 (3): 699–716.

Krugman, Paul. 1979. A model of balance of payment crisis. *Journal of Money, Credit, and Banking* 11 (3): 311–25.

———. 1994. The myth of Asia's miracle. *Foreign Affairs* 73 (6): 62–78.

———. 1998. What happened to Asia? Unpublished Manuscript. Cambridge, Mass.: MIT. Available at http://web.mit.edu/krugman/www/DISINTER.html.

Nam, Il-Chong, Yeongjae Kang, and Joon-Kyung Kim. 1999. Comparative corporate governance trends in Asia. Paper submitted to conference, Corporate governance in Asia: A comparative perspective, sponsored by OECD and KDI, Seoul, Korea, 3–5 March 1999.

National Information and Credit Evaluation, Inc. [http://www.nice.co.kr.].
Obstfeld, Maurice. 1995. Models of currency crisis with self-fulling features. NBER Working Paper no. 5285. Cambridge, Mass.: National Bureau of Economic Research, October.
Park, Sangkyun. 1991. Bank failure contagion in historical perspective. *Journal of Monetary Economics* 28 (2): 271–86.
Perry, Guillermo E., and Daniel Lederman. 1998. *Financial vulnerability, spillover effects, and contagion: Lessons from the Asian crises for Latin America.* World Bank Latin American and Caribbean Studies, World Bank.
Rigobon, Roberto. 1998. On the measurement of contagion. MIT-Sloan School of Management, Unpublished Manuscript, December.
Sachs, Jeffrey D., Aaron Tornell, and Andres Velasco. 1996a. Financial crises in emerging markets: The lessons from 1995. *Brookings Papers on Economic Activity,* issue no. 0: 147–98. Washington, D.C.: Brookings Institution.
———. 1996b. The Mexican peso crisis: Sudden death or death foretold? *Journal of International Economics* 41 (3–4): 265–83.
Shin, In-seok. 1998. Currency crisis of Korea: A thought on the triggering mechanism. *KDI Policy Studies* 20 (3–4): 3–55.
Tornell, Aaron. 1999. Common fundamentals in the tequila and Asian crises. NBER Working Paper no. 7139. Cambridge, Mass.: National Bureau of Economic Research, June.
Valdes, Rodrigo O. 1996. Essays on capital flows and exchange rates. Ph.D. diss. Department of Economics, MIT.
World Bank. 1993. *The East Asian miracle: Economic growth and public policy.* New York: Oxford University Press.
———. 1997. *Global development finance.* Washington, D.C.: World Bank.
———. 1998. *Global development finance.* Washington, D.C.: World Bank.
———. Various issues. *World debt tables.* Washington, D.C.: World Bank.
Young, Alwyn. 1995. The tyranny of numbers: Confronting the statistical realities of the East Asian growth experience. *Quarterly Journal of Economics* 110 (3): 641–80.

Comment

Nouriel Roubini

This paper presents an empirical study of the causes of the Korean crisis of 1997–98. The authors analyze whether the crisis was due to domestic fundamentals or external interdependence (or contagion). They present a variety of evidence, both econometric and more qualitative.

There has been a broad debate on whether the Korean crisis was due to fundamentals or rather was caused by a liquidity run (with foreign banks suddenly withdrawing interbank lines) exacerbated by international contagion. In a sense, these alternative explanations are not contradictory but rather complementary. Seriously weak fundamentals may have initially triggered the crisis, but international contagion from East Asia to Korea

Nouriel Roubini is professor of economics at the Stern School of Business, New York University, and a research associate of the National Bureau of Economic Research.