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Introduction

This study analyzes and provides empirical tests of early warning indicators of banking and currency crises in emerging economies. The aim is to identify key empirical regularities in the run-up to banking and currency crises that would enable officials and private market participants to recognize vulnerability to financial crises at an earlier stage. This, in turn, should make it easier to motivate the corrective policy actions that would prevent such crises from actually taking place. Interest in identifying early warning indicators of financial crises has soared of late, stoked primarily by two factors: the high cost to countries in the throes of crisis and an increasing awareness of the insufficiency of the most closely watched market indicators.

There is increasing recognition that banking and currency crises can be extremely costly to the countries in which they originate. In addition, these crises often spill over via a variety of channels to increase the vulnerability of other countries to financial crisis.

According to one recent study, there have been more than 65 developing-country episodes during 1980-95, when the banking system's capital was completely or nearly exhausted;[1] the public-sector bailout costs of resolving banking crises in developing countries during this period have

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[1]. See Caprio and Klingebiel (1996b). Other identifications of banking crises over this period can be found in Demirgüç-Kunt and Detragiache (1998), Eichengreen and Rose (1998), IMF (1998c), Kaminsky and Reinhart (1999), and Lindgren et al. (1996).

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been estimated at around $250 billion.[2] In more than a dozen of these banking crises, the public-sector resolution costs amounted to 10 percent or more of the country's GDP.[3] In the latest additions to the list of severe banking crises, the cost of bank recapitalization for the countries most affected in the ongoing Asian financial crisis is expected to be huge—on the order of 58 percent of GDP for Indonesia, 30 percent for Thailand, 16 percent for South Korea, and 10 percent of GDP for Malaysia (World Bank 2000).

In addition to the enormous fiscal costs, banking crises exacerbate declines in economic activity, prevent national saving from flowing to its most productive use, limit the room for maneuver in the conduct of domestic monetary policy, and increase the chances of a currency crisis as well (Lindgren, Garcia, and Saal 1996; Goldstein and Turner 1996). Illustrative of the magnitude of output losses, an International Monetary Fund study (IMF 1998c), drawing on a sample of 31 developing countries, reported that it typically takes almost three years for output growth to return to trend after the outbreak of a banking crisis and that the cumulative output loss averaged 12 percent.[4] Probably the main reason Mexican authorities did not make more aggressive use of interest rate policy after the assassination of presidential candidate Luis Donaldo Colosio in March 1994 is that bad loan problems in the banking system had by then already become serious, and they were worried that recourse to higher interest rates would push Mexican banks over the edge. Yet failure to increase domestic interest rates in the face of international investors' rising concern contributed to a rapid decline in international reserves and helped to transform a banking problem into a currency and debt crisis (Calvo and Goldstein 1996). This pattern in the timing of the banking and currency crises is not unique to the Mexican case. Drawing on a broader sample of banking and currency crises in emerging economies, there is evidence that the onset of a banking crisis typically precedes a currency crash (Kaminsky and Reinhart 1999; IMF 1998a).[5]

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2. This figure is net of the estimated amount of loans that were eventually repaid. See Honohan (1997).

3. See Goldstein (1997) for a list of these severe banking crises. For comparison, the public-sector tab for the US saving and loan crisis is typically estimated at about 2 to 3 percent of US GDP.

4. In chapter 7, we present our own estimates of how long it takes growth rates of real output to recover after banking and/or currency crises.

5. In chapter 3, we provide further evidence that the presence of a banking crisis is one of the better leading indicators of a currency crisis in emerging economies. At the same time, the evidence also suggests that a currency crash aggravates the problems in the banking sector, as the peak of a banking crisis most often occurs following the collapse of the currency. The dating of currency and banking crises is discussed in detail in chapter 2.

Table 1.1 Emerging Asia: real GDP growth forecasts, 1996-98

Country	1996	1997	1998 (as of May 1997)	Actual 1998
Indonesia	7.8	4.9	7.5	−13.7
Thailand	6.4	−1.3	7.0	−8.0
South Korea	7.1	5.0	6.3	−5.8
Malaysia	8.6	7.8	7.9	−6.7
The Philippines	5.7	5.1	6.4	−0.5
Hong Kong	4.9	5.3	5.5	−5.1

Source: International Monetary Fund, *World Economic Outlook*.

Although the contagion of financial disturbances usually runs from large countries to smaller ones, the Asian financial crisis has shown that severe financial-sector difficulties in even a relatively small economy (namely Thailand) can have wide-ranging spillover effects if it acts as a "wake-up call" for investors to reassess country risk and if a set of other economies have vulnerabilities similar to those in the economy first affected.[6]

The costs of currency crises have likewise been shown to be significant both in terms of reserve losses and output declines (see chapter 7). During the Exchange Rate Mechanism (ERM) crises of the fall of 1992 and summer of 1993, about $150 billion to $200 billion was spent on official exchange-market intervention in a fruitless effort to stave off the devaluation and/or floating of ERM currencies. Mexico's peso crisis was accompanied in 1995 by a decline in real GDP of 6 percent—its deepest recession in 60 years. In emerging Asia, consensus forecasts for 1998 growth issued just before the crisis (that is, in May-June 1997) generally stood in the 6 to 8 percent range. As indicated in table 1.1, these forecasts were subject to unprecedented downward revisions in the midst of the currency, banking, and debt crises enveloping these economies. The IMF (1998c) estimates that emerging economies suffer, on average, an 8 percent cumulative loss in real output (relative to trend) during a severe currency crisis. And like banking crises, currency crises seem contagious. One recent study found that a currency crisis elsewhere in the world increases the probability of a speculative attack by an economically and statistically significant amount even after controlling for economic and political fundamentals in the country concerned (Eichengreen, Rose, and Wyplosz 1996; see also Calvo and Reinhart 1996; Kaminsky and Reinhart 2000).

The more costly it is to clean up after a financial crisis, the greater the returns to designing a well-functioning early warning system.

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6. See Calvo and Reinhart (1996) and Goldstein (1998a). Kaminsky and Reinhart (2000) provide an analysis of contagion in the Asian crisis that stresses the financial links among these countries—including the sudden withdrawal of funds by a common commercial bank lender or mutual fund investor. See also chapter 6.

Table 1.2 Rating agencies' performance before the Asian crisis: Moody's and Standard & Poor's long-term debt ratings,[a] 1996-97

	15 January 1996		2 December 1996		24 June 1997		12 December 1997	
	Rating	Outlook	Rating	Outlook	Rating	Outlook	Rating	Outlook
Moody's foreign currency debt								
Indonesia	Baa3		Baa3		Baa3		Baa3	
Malaysia	A1		A1		A1		A1	
Mexico	Ba2		Ba2		Ba2		Ba2	
The Philippines	Ba2		Ba2		Ba2		Ba2	
South Korea	A1		A1	stable			Baa2	negative
Thailand	A2		A2		A2		Baa1	negative
Standard & Poor's							**October 1997**	
Indonesia								
Foreign currency debt	BBB	stable	BBB	stable	BBB	stable	BBB	negative
Domestic currency debt			A+		A+		A−	negative
Malaysia								
Foreign currency debt	A+	stable	A+	stable	A+	positive	A+	negative
Domestic currency debt	AA+		AA+		AA+		AA+	negative

Mexico								
Foreign currency debt	BB	negative	BB		BB			
Domestic currency debt	BBB+		BBB+	stable	BBB+	positive		
The Philippines								
Foreign currency debt	BB	positive	BB	positive	BB+	positive	BB+	stable
Domestic currency debt	BBB+		BBB+		A−		A−	stable
South Korea								
Foreign currency debt	AA−	stable	AA−	stable				
Domestic currency debt								
Thailand								
Foreign currency debt	A	stable	A	stable	A	stable	BBB	negative
Domestic currency debt			AA		AA		A	negative

a. From highest to lowest, Moody's rating system includes Aaa, Aa1, Aa2, Aa3, A1, A2, A3, Baa1, Baa2, Baa3, Ba1, Ba2, and Ba3, and Standard & Poor's runs AAA, AA+, AA, AA−, A+, A, A−, BBB+, BBB, BBB−, BB+, BB, and BB−.

Source: Radelet and Sachs (1998).

The second reason for the increased interest in early warning indicators of financial crises is that there is accumulating evidence that two of the most closely watched ''market indicators'' of default and currency risks—namely, interest rate spreads and changes in credit ratings—frequently do not provide much advance warning of currency and banking crises (see chapter 4).

Empirical studies of the 1992-93 ERM crisis have typically concluded that market measures of currency risk did not raise the specter of significant devaluations of the weaker ERM currencies before the fact (Rose and Svensson 1994). Another study, encompassing a larger number of crisis episodes, similarly concluded that the currency forecasts culled from survey data are useless in anticipating the crises (Goldfajn and Valdés 1998). In the run-up to the Mexican crisis, market signals were again muted or inconsistent. More specifically, measures of default risk on *tesobonos* (dollar indexed, Mexican government securities) jumped up sharply in April 1994 (after the Colosio assassination) but stayed roughly constant between then and the outbreak of the crisis (Leiderman and Thorne 1996; Obstfeld and Rogoff 1995). From April 1994 on, market expectations of currency depreciation on the peso usually were beyond the government's announced rate; nevertheless, this measure of currency risk fluctuated markedly. The gap between market expectations and the official rate was widest in summer of 1994, but the attack came with most ferocity only in late December (Obstfeld and Rogoff 1995; Leiderman and Thorne 1996; Rosenberg 1998).

The evidence now available suggests that the performance of interest spreads and credit ratings was likewise disappointing in the run-up to the Asian financial crisis. Examining interest rate spreads on three-month offshore securities, one study found that these spreads gave no warning of impending difficulties (i.e., were either flat or declining) for Indonesia, Malaysia, and the Philippines and produced only intermittent signals for Thailand (Eschweiler 1997b). A recent analysis of spreads using local interest rates for South Korea, Thailand, and Malaysia similarly found little indication of growing crisis vulnerability (Rosenberg 1998).

Sovereign credit ratings (on long-term, foreign-currency debt) issued by the two largest international ratings firms were even less prescient in the Asian crisis (see chapter 4, as well as Radelet and Sachs 1998; Goldstein 1998c).[7] As shown in table 1.2, there were almost no downgrades for the

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7. In a recent report, Moody's (1998) argues that its rating record in the East Asian crisis was better than it appears at first sight from ratings changes alone. More specifically, the report argues, inter alia, that Moody's went into the crisis with lower ratings for the crisis countries than the other major ratings agencies (i.e., Standard & Poor's and Fitch-IBCA), that it took ratings actions before its main competitors, that its low bank financial strength ratings identified many of the banks that subsequently experienced stress in the crisis countries, that changes in sovereign credit ratings led to a widening of yield spreads in the crisis countries, and that one should examine the sovereign research reports—not just the

most severely affected countries in the 18-month run-up to the crisis. As *The Economist* (13 December 1997, p. 68) put it, "[I]n country after country, it has often been the case of too little, too late." Looking at a larger sample of cases, a recent study by the Organization for Economic Cooperation and Development (OECD) was unable to find consistent support for the proposition that sovereign credit ratings act more like a leading than a lagging indicator of market prices (that is, of interest rate spreads; see Larraín, Reisen, and von Maltzan 1997).

Furthermore, international organizations such as the IMF did not do better than the rating agencies in anticipating several of the recent crises. A recent external evaluation of IMF surveillance concludes:

> We found that the Fund—in both bilateral and multilateral surveillance—largely failed to identify the vulnerabilities of the countries that subsequently found themselves at the center of the Asian financial crisis, except in the case of Thailand. In particular, it failed until rather late in the day to address a number of systemic issues. Moreover, to the extent that surveillance did identify these vulnerabilities, the tone of published Fund documents—notably [the *World Economic Outlook*]— was excessively bland prior to the December 1997 update of WEO [and the *International Capital Markets Report*], after the crisis had erupted. (IMF 1999, 56)

There are, of course, several reasons interest rate spreads or changes in sovereign credit ratings may not anticipate financial crises well.[8] For one thing, market participants may not have timely, accurate, and comprehensive information on the borrower's creditworthiness. Several recent examples underscore the point (see also Goldstein 1998a; Corsetti, Pesenti, and Roubini 1998; BIS 1998). Thailand's commitments in the forward exchange market and South Korea's lending of international reserves to commercial banks meant that official figures on gross international reserves gave a misleading (i.e., overoptimistic) view of each country's net usable reserves. Similarly, external foreign-currency denominated debt of Indonesian corporations, along with nonperforming bank loans in South Korea, Thailand, Malaysia, and Indonesia, turned out to be considerably larger than precrisis published official data suggested. Ceteris paribus, one could conjecture that if the true size of liquid assets and liabilities were known at an earlier stage, interest rate spreads would have been higher and credit ratings would have been lower than actually observed before the Asian crisis; this in turn could well have moderated the sharp

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ratings—in looking for early warning signals. At the same time, the report acknowledges that the firm is studying several potential enhancements to its analytical methodology to help improve the predictive power of its sovereign ratings.

8. It is sometimes also argued that even when credit rating agencies or international financial organizations (such as the IMF) conclude that crisis vulnerability is high, they will be reluctant to go "public" with a downgrade or a warning for fear of being accused of precipitating the crisis.

change in market sentiment that was associated with the ''news'' of the lower-than-expected net worth of Asian debtors.

The other reason market prices may not signal impending crises is that market participants strongly expect the official sector—be it national or international—to bail out a troubled borrower.[9] In such cases, interest rate spreads will reflect the creditworthiness of the guarantor—not that of the borrower. Again, it is not difficult to find recent examples where such expectations could well have impaired market signals. In Asian emerging economies, several authors have argued that implicit and explicit guarantees of financial institutions' liabilities were important in motivating the large net private capital inflows into the region in the 1990s. Others have emphasized that the disciplined fiscal positions of these countries may have convinced investors that, should banks and finance companies experience strains, governments would have the resources to honor their guarantees.[10]

In the case of the Mexican peso crisis, it has similarly been argued that, after the United States had agreed to the North American Free Trade Agreement, or NAFTA, it would have been very costly for it to stand by while Mexico either devalued the peso or defaulted on its external obligations and that expectations of a US bailout blunted the operation of early warning signals (Leiderman and Thorne 1996; Calvo and Goldstein 1996). Looking eastward, investments in Russian and Ukrainian government securities have in recent years sometimes been known on Wall Street as ''the moral hazard play''—reflecting the expectation that geopolitical factors and security concerns would lead to a bailout of troubled borrowers. Suffice it to say that the size and frequency of IMF-led international financial rescue packages—including commitments of nearly $50 billion for Mexico in 1994-95; over $120 billion for Thailand, Indonesia, and South Korea in 1997-98; over $25 billion for Russia and Ukraine in 1998; and another $42 billion for Brazil late that year—illustrate that market expectations of official bailouts cannot be dismissed lightly.

If interest rate spreads and sovereign credit ratings only give advance warning of financial crises once in a while increased interest attaches to the question of whether there are other early warning indicators that would do a better job and if so, what they might be. This is a key question for this book.

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9. Michael P. Dooley has stressed this point in several papers (see Dooley 1997, for instance).

10. See Krugman (1998), Dooley (1997), and Calomiris (1997) on the role of expected national and international bailouts in motivating capital flows and/or banking crises. Zhang (1999), on the other hand, tests for such ''moral hazard'' effects in private capital flows to emerging markets and finds no evidence for it. Claessens and Glaessner (1997) highlight the link between fiscal positions and the wherewithal to honor explicit and implicit guarantees in the financial sector. The Council on Foreign Relations (1999) offers a set of proposals on how the moral hazard associated with international financial rescue packages might be reduced.

Organization of the Book

Chapter 2 takes up the leading methodological issues surrounding the forecasting of crisis vulnerability, including the choice of sample countries, the definition of currency and banking crises, the selection of leading indicators, the specification of the early warning window, and the signals approach to calculating optimal thresholds for indicators and the probability of a crisis.

Chapter 3 presents the main empirical results for the in-sample estimation (1970-95), with a focus on the best-performing monthly and annual indicators, on a comparison of credit ratings and interest rate spreads with indicators of economic fundamentals, and on the ability of the signals approach to predict accurately previous currency and banking crises. In chapter 4, we offer some preliminary results on the track record of rating agencies in forecasting currency and banking crises.

In chapter 5, we use two overlapping out-of-sample periods (namely, January 1996 through June 1997 and January 1996 through December 1997) to project which emerging economies were recently the most vulnerable to currency and banking crises. This exercise also permits us to gauge the performance of the model in anticipating the Asian financial crisis. In chapter 6, we analyze the contagion of financial crises across countries, with particular emphasis on how fundamentals-based contagion is influenced by trade and financial sector links. Chapter 7 examines data on the aftermath of crises in order to assess how long it usually takes before recovery from financial crises takes hold. Finally, chapter 8 summarizes our main results and contains some brief concluding remarks, along with suggestions for how the leading-indicator analysis of currency and banking crises in emerging economies might be improved.