



## Annex III

# Leading Indicators of Currency and Banking Crises

Given the global integration of financial markets over the last decade, large capital flow reversals can occur quite quickly, considerably shortening the time in which appropriate policy responses have to be made. As a consequence, and in no small part stimulated by the recent crises in Europe, Mexico, and Asia, researchers are taking a fresh look at the determinants of currency and banking crises and attempting to develop early warning signals of brewing trouble in currency markets and banking systems.<sup>1</sup> The lack of transparency in the operation of financial systems, especially in emerging markets, considerably complicates such a task.

To start, researchers have to identify situations that can be termed full-fledged currency and/or banking crises. Defining currency crises as instances when a “large” currency depreciation takes place excludes situations where a currency was under substantial pressure but the authorities managed a successful defense by, among other measures, raising interest rates and/or intervening in the foreign exchange market. As a result, most researchers define currency crises by using indices that weight changes in the exchange rate, foreign exchange reserves and (if available) short-term interest rates—the construction of these indices as well as the thresholds used for identifying crises differ across researchers. Even this definition may not completely capture crisis situations because in several instances, the authorities have responded to exchange market pressures by introducing capital controls.

Stresses in the banking system are even more difficult to quantify. The data necessary for making an assessment are generally not available and, as a result, dating of banking crises must rely on events such as

the closure of banks and official support for (and/or government takeover of) financial institutions. Generally, banking sector weaknesses emerge because of deterioration in asset quality. Reliable and timely data on nonperforming assets is not always available and even indirect evaluations of asset quality require information on bankruptcies, exposures of financial intermediaries to different sectors, and movements in real estate and other asset prices—information that is generally not available in many developing and transition economies.

After dating crisis periods, two types of empirical methodologies have been used in the search for leading indicators of currency crises. Many researchers have identified leading indicators by comparing the behavior of a variable prior to crises with its behavior in tranquil periods.<sup>2</sup> A variable is a useful leading indicator if it displays anomalous behavior prior to crises while not providing false signals of an impending crisis in normal or tranquil times. What is construed as anomalous behavior for a particular variable is defined by choosing a selection rule that achieves a balance between decreasing the probability of not predicting crises and decreasing the probability of giving false signals of stress. The advantage of such “univariate” event analyses is that they are easy to implement and do not impose much a priori structure on the data. However, when multiple indicators are available one has to address the question of combining them for predicting the possibility of a crisis. Efforts to do this are still at a preliminary stage (see Kaminsky, 1998).

A second approach has been to directly estimate the probability of a currency or banking crisis (using limited-dependent variable models) and identify the variables that statistically aid in predicting crises (see Frankel and Rose, 1996). This approach has the advantage that indicators are evaluated simultaneously and the statistically significant ones can then be used to calculate the probability of a crisis occurring in a specific period. It should be noted, however, that this methodology has been used with annual data and further refinement of leading indicators would require a

<sup>1</sup>For analyses of leading indicators, see Eichengreen, Rose, and Wyplosz (1995); Frankel and Rose (1996); Goldstein (1996); Aziz, Caramazza, and Salgado (forthcoming); Berg and Patillo (forthcoming); Demirgüç-Kunt and Detragiache (forthcoming); International Monetary Fund (1998); and Kaminsky, Lizondo, and Reinhart (1998). For recent analyses of the determinants of currency and banking crises, see Gavin and Hausmann (1996); Kaminsky and Reinhart (1996); Sachs, Tornell, and Velasco (1996); Goldstein and Turner (1996); Caprio and Kliengebiel (1997); González-Hermosillo, Pazarbaşıoğlu, and Billings (1997); Demirgüç-Kunt and Detragiache (1998); and Eichengreen and Rose (1998). A brief survey of the determinants of currency and banking crises is provided in International Monetary Fund (1997), pp. 245–49.

<sup>2</sup>See, for example, Eichengreen, Rose, and Wyplosz (1995); Frankel and Rose (1996); Aziz, Caramazza, and Salgado (forthcoming); Kaminsky, Lizondo, and Reinhart (1998); and International Monetary Fund (1998).

large number of observations on the “rare” events categorized as crises. Mere use of, say, quarterly or monthly data is not enough. While such disaggregation potentially allows for greater refinement of the dynamics leading up to crises, the complexity of estimation requires more information on a larger number of the key informative events, the crises. For currency and banking crises, such large data sets are, typically, not available.

Differing methodologies, different time periods and selection of countries, and the diversity in defining what constitutes exchange market pressure make it difficult to compare results across the various studies and come up with a clear-cut answer to the question: What set of leading indicators of currency and banking crises are likely to prove most useful? That said, some tentative conclusions about indicators of vulnerability can be drawn. Currency crises tend to be preceded by an overvaluation of the real exchange rate, rapid domestic credit growth, expansion of credit to the public sector, a rise in the ratio of broad money to foreign exchange reserves, an increase in the domestic inflation rate, a decline of FDI flows, and an increase in industrial country interest rates. Other factors that receive some, though less, support as leading indicators of currency crises are a widening of the trade deficit, an increase in the fiscal deficit, a deterioration in export performance, and a slowdown in real GDP growth. It is noteworthy that current account and fiscal deficits do not seem to garner a lot of support as important indicators.<sup>3</sup> With regard to banking crises, these are often preceded by large inflows of short-term capital, rapid expansion of domestic credit (frequently a consequence of financial liberalization coupled with inadequate supervision by bank managements as well as regulators), slackening of real activity, and declines in the stock market and prices of other assets. Case studies suggest that, in many instances, liberalization without adequate strengthening of the regulatory regime not only sets the stage for a banking crisis but also makes it more difficult to cope with a crisis if it erupts.

How well do current models perform in out-of-sample crisis prediction? Recent events raise the following question: Using data until end-1996, would these models have alerted policymakers to the possibility of the kind of turmoil that has been witnessed in Asia? Berg and Patillo (1998) and International Monetary Fund (1998) attempt an answer to this question by comparing the out-of-sample performance of different approaches in predicting the Asian currency crises. They conclude that, while the forecasts are informative, these models do not as yet provide much improvement over informed guesses. Using aggregate

(publicly available) data to predict banking crises, Demirgüç-Kunt and Detragiache (forthcoming) meet with similar success. In this context, two points should be noted: First, leading indicator models are still in their infancy and more rigorous data reporting requirements for financial and nonfinancial institutions that are just beginning to be introduced may enhance the usefulness of such models. Second, the entire sovereign credit rating industry did not foresee the vulnerable situation of many Asian economies and was taken by surprise when the crisis broke.

The timing of events in the economic arena are notoriously difficult to analyze. Economic theory, while relatively good at characterizing equilibrium situations, tends to be less informative about the dynamics that could lead from one equilibrium to another. To predict the timing of rare events such as financial crises, which may critically depend on factors that are hard to capture such as structural features of the economy, institutional developments, changes in the political landscape, and expectations of domestic and foreign players in various markets, is likely to be even more demanding. More important, the process of policymaking and the policy responses themselves have a crucial bearing on whether situations of stress degenerate into crises. And, typically, these cannot be taken into account in modeling exercises. Hence, it is not surprising that models based on quantifiable factors that do not endogenize policy responses have not met with much success.

The paucity of data on crisis episodes is a major hurdle in the further refinement of current models that examine such events and attempt to identify leading indicators. For example, researchers are forced to assume that the parameters characterizing the behavior of certain variables in the buildup to crisis situations (and their aftermath) are similar across time and across countries. Given the diversity in institutional arrangements, the dramatic changes that have taken place in industrial and developing country financial systems in the last decade, and the increased integration of global markets, such assumptions may well be untenable. Thresholds defining what are acceptable levels for certain variables are likely to differ across countries and could well change over time for the same country. Lack of adequate data makes it difficult, if not impossible, to test such assumptions.

In the end, the holy grail of crisis prediction may be intrinsically unattainable. Indeed, the very success of such models in predicting crises would eliminate the phenomenon they were trying to predict if policymakers took appropriate action in response to early warning indicators. Further, since foreknowledge of crises would typically allow trading profits to be made, the existence of a successful prediction model is unlikely in efficient markets.

Crises that result because weak fundamentals make a country vulnerable to adverse shocks may be pre-

<sup>3</sup>See, Milesi-Ferretti and Razin (forthcoming) for further discussion of current account deficits as predictors of currency crises.

dictable. Crises that arise because of a unique concatenation of events, or from pure contagion effects, or because technology, new instruments, and new ways of doing business transform the financial system in unforeseen ways, or because some widely held belief is falsified by events are less likely to be foreseen by economic models. The Latin American debt crisis of the 1980s shattered the then prevailing myth that sovereign states “could not default.” The 1992 ERM crisis showed that countries, even industrial ones, with high unemployment may find it preferable to exit a fixed exchange rate system than live with the consequences of higher interest rates for a brief period. The 1994 Mexican crisis taught us about vulnerabilities associated with short-term sovereign foreign currency debt and a weak banking system. The Asian crisis, though inextricably linked to domestic macroeconomic and financial developments, has put the spotlight on structural features of financial systems more broadly and has revealed that debt exposures and currency imbalances of private corporations and financial institutions can be as lethal as those of the public sector. Hence, what is needed is not only a better understanding of the run-up to crises past but also a better grasp of what factors could precipitate crises in the faster paced and evolving new international financial environment.

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