Developing Indicators to Provide Early Warnings of Banking Crises

Bank failures and banking system crises can have very painful effects. Developing basic indicators that provide early warnings of incipient banking crises, therefore, is an essential step in improving countries' abilities to manage their financial sectors and their economies.

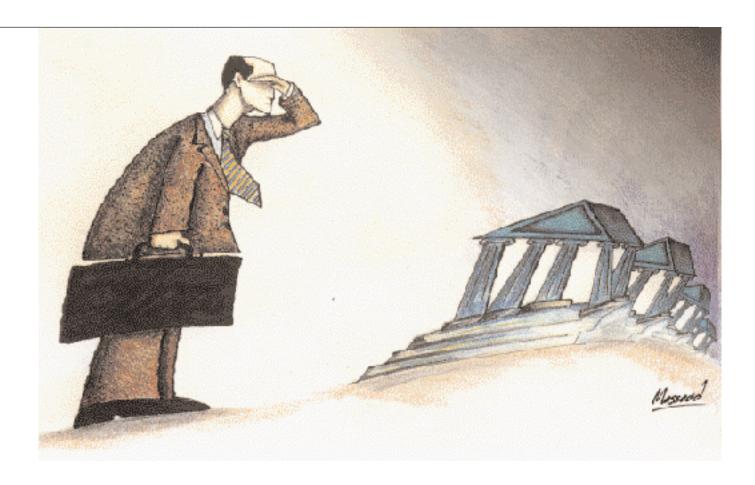*B r e n d a   G o n z á l e z - H e r m o s i l l o*

DURING the past two decades, many countries have experienced significant financial sector distress. Perhaps the most acute bouts were brought about by the financial problems encountered in some emerging markets. The banking system problems that began in the mid-1990s in some Asian countries (including Indonesia, Korea, and Thailand) have also made apparent the possibility of regional contagion. In Latin America, severe banking crises occurred in Chile and Colombia during the 1980s, and in Mexico and Venezuela during the first half of the 1990s. Banking crises, however, do not occur only in emerging economies. Episodes of profound banking system distress occurred in the United States during the mid-1980s and early 1990s, in the Nordic countries during the early 1990s, and more recently in Japan. Finding basic indicators that can provide early warnings of incipient banking crises and understanding their dynamics are critical, particularly in the current context of financial globalization.

Current literature

Most of the empirical literature has relied on explaining bank failures and banking crises only after they have occurred. In particular, probability models assign values of one to known episodes of banking crises (or of failed banks) and zero to periods of tranquility (or sound banks). Waiting for a crisis to occur in order to be able to explain it, however, is clearly not a satisfactory strategy. Measures that signal an increased probability of bank failures and, more generally, of banking crises before they actually occur are urgently needed.

The current literature on the subject is largely divided into two kinds of studies: those that examine data on specific banks in an effort to explain why they have failed, and those that examine how changes in various macroeconomic variables (such as interest rate changes and exchange rate movements) have contributed to banking crises. Although economists and policymakers have increasingly become convinced that banking crises are influenced by changes in both macroeconomic and microeconomic factors, few empirical studies have systematically examined the contributions of both toward creating bank failures.

Despite significant advances that have been made in the research on bank failures and banking crises, many issues remain

unresolved. For example, why is it that although all banks in a country are hit by the same macroeconomic shock, generally not all of them fail? Do banks that fail have different characteristics from those that don't? If so, are some of those characteristics different several periods before banks actually fail? Are there some indicators that could act as pressure gauges by signaling immediate danger of bank failures? Could these indicators be used to assess the degree of banking system distress before a crisis occurs? How can "moral hazard"—which is created when banks take excessive risks based on assumptions that they will be protected by third parties against possible losses—be measured? How does bank contagion occur? Are banking crises in advanced economies fundamentally different from those in developing countries?

Determinants of banking problems

If we assume that both micro- (or bank-specific) and macro-economic influences can lead to bank failures and banking crises, how can their impacts be measured systematically? One way is to view bank failures as being influenced by market risk, default risk, and liquidity risk. Market risk is the risk that market conditions will change the value of the underlying assets. Banks are subjected to high market risk when their investment portfolios are concentrated in sectors strongly affected by cyclical economic conditions, sectors where returns are significantly higher than market levels, booming sectors prone to be depressed by a subsequent bust, or various sectors that are adversely and similarly affected by economic shocks. Default, or credit, risk is the risk that debtors will be unwilling or unable (perhaps as a result of changed economic conditions) to repay their debts. Liquidity risk, in the context of bank failures, is the risk that depositors will withdraw their deposits in large amounts or that banks will not have enough liquid assets to cover these withdrawals.

The degree of exposure to these risks that individual banks' managements decide to assume depends on their risk preferences, given the expected future returns associated with their portfolio strategies, and regulatory guidelines. However, after a banking crisis, changes in macroeconomic conditions often contribute to the actual outcomes associated with those risks. For example, a large loan exposure to a booming sector is often profitable initially. Although such a portfolio strategy can make good sense for banks at a given time (as, for example, lending to oil-related businesses did in the late 1970s), changing economic conditions could lead to a bust in that sector and harmful consequences for banks that had made substantial portions of their total loans to that sector. By focusing on these kinds of risk (market, default, and liquidity) rather than on actual definitions of banks' balance sheet items or specific economic variables, one can broadly compare episodes of banking problems even though the specific circumstances and accounting systems may vary among countries.

Other potentially important factors determining bank failures are contagion and moral hazard. Contagion occurs when problems at some banks in the system adversely affect other, financially sound banks. One result of contagion could

be generalized deposit runs on the banking system, and another could be a weakening of the banking system because of banks' "herding behavior." Through the latter, individual banks could increase their risk taking because other banks were doing so—this could be the result, for example, of banks' efforts to maintain their market shares or to keep up with competitor banks that they think have better information. Moral hazard can be created when banks take excessive risks by lending in situations where the short-run payoff (for example, in the form of up-front fees) can be very high, but for which the long-term prospects of repayment are dim and the associated risks are expected to be absorbed by a third party, such as the country's government or international financial institutions.

Examination of recent cases

Examining five recent episodes of banking system distress—three in the United States: the southwest (1986–92), the northeast (1991–92), and California (1992–93); one in Mexico (1994–95); and one in Colombia (1982–87)—may shed some light on these issues and point to some lessons learned. The data (covering close to 4,000 banks for up to eight years) suggest that unsound banks and sound banks had different characteristics that could be observed several periods before bank failures (for example, through bankruptcy or regulatory intervention) actually occurred. The data also indicate that these two kinds of banks differed principally in their approaches to risk taking.

A consistent finding from the data is that banks' nonperforming loans increased sharply and their capital ratios deteriorated rapidly—signaling growing distress—shortly before they failed. These indicators thus provided clear signals of the increasing probability of near-term bank failure. (Several periods before failures occurred, banks that would eventually fail had virtually the same levels of nonperforming loans and capital as banks that would survive.) In this context, it should be pointed out that a large number of nonperforming loans in a bank's portfolio are a result of earlier poor loan decisions and, sometimes, deteriorating economic conditions. Minimum levels of capital serve as a cushion to absorb economic shocks, but if the value of a bank's assets declines relative to that of the liabilities it does not own, its capital can soon be exhausted. A composite indicator based on the ratio of capital equity *plus* loan reserves *minus* nonperforming loans to total assets (the *coverage ratio*) was also constructed to allow for a more general indicator of bank fragility. Focusing on banks' coverage ratios has the advantage of taking into account the possibility that two banks with equal ratios of nonperforming loans to total assets would be in different financial condition if one bank had set aside significant reserves to cover its problem loans or increased its capital equity and the other bank had not.

I considered banks to be in distress if their coverage ratio was below a given threshold. For U.S. banks, the threshold was set at zero, because their own resources—capital equity

Summary of empirical results

Proximate indicators of	Increased probability of failure/distress	Reduced survival time
Fragility		
High ratio of nonperforming loans to total assets		
United States		
Southwest	Yes	Yes
Northeast	Yes	Yes
California	Yes	Yes
Mexico	Yes	Yes
Colombia	n.s.	Yes
Low ratio of capital to total assets		
United States		
Southwest	Yes	Yes
Northeast	Yes	Yes
California	Yes	Yes
Mexico	Yes	Yes
Colombia	n.s.	Yes
Market risk		
United States		
Southwest	Yes	Yes
Northeast	Yes	Yes
California	Yes	Yes
Mexico	Yes	Yes
Colombia	n.a.	n.a.
Credit risk		
United States		
Southwest	ind.	Yes
Northeast	ind.	ind.
California	ind.	ind.
Mexico	Yes	n.s.
Colombia	ind.	ind.
Liquidity risk		
United States		
Southwest	Yes	Yes
Northeast	Yes	Yes
California	Yes	Yes
Mexico	Yes	Yes
Colombia	Yes	Yes
Moral hazard		
United States		
Southwest	Yes	Yes
Northeast	n.s.	n.s.
California	n.s.	Yes
Mexico	n.s.	n.s.
Colombia	Yes	No
Contagion		
United States		
Southwest	No	Yes
Northeast	n.s.	No
California	No	n.s.
Mexico	Yes	Yes
Colombia	Yes	Yes

Source: González-Hermosillo (1999).
Notes: n.s. = not statistically significant.
      n.a. = variables not available.
      ind. = indeterminate; the variable used can take either sign and still be consistent with the presence of a certain type of risk. For example, a high yield on loans may be consistent with a high default risk, but a low yield can indicate that risk is not priced properly.
   "Yes" indicates that one or more variables in the failure or distress equations suggest the presence of this type of risk. If so, the probability of failure/distress would increase and/or the expected survival time would diminish. "No" indicates that the results do not suggest that this type of risk was present.

and reserves for problem loans—would then be insufficient to cover nonperforming loans. For Mexican and Colombian banks, the threshold was set higher because the definitions of nonperforming loans used were narrower than the one used for the United States. After examining several different thresholds for the coverage ratios, I decided to set the threshold for Colombia and Mexico at 1.5 percent, because this most closely predicted which banks actually failed. Bank distress, as measured by the deterioration in the banks' coverage ratios, was consistently evident before actual failure. Banks were regrouped based on whether they had experienced episodes of distress or not, and empirical models taking account of microeconomic (or bank-specific) and macroeconomic variables were estimated for cases of both bank failure and bank distress (that is, fragility that becomes apparent before actual failure).

The models confirmed that both macroeconomic and microeconomic factors were important in determining banks' failure and distress. Models based on bank-specific variables including measures of market, credit, and liquidity risks, as well as proxies for the impact of moral hazard (but not including capital equity or nonperforming loans), performed reasonably well in most cases. These variables would seem, then, to account for the fundamental sources of ex ante risk. The variables used in analyzing banking problems sometimes differed in accordance with the specific circumstances of each episode. Conceptual equivalencies were, however, broadly maintained across regions, which suggests that the main elements of risk are comparable across countries. This approach based on the different types of risk is particularly useful when one attempts to make inferences about different episodes of banking problems in which the circumstances or accounting systems differ.

One empirical finding, which is consistent for all regions and countries examined, that most clearly emerges from the analysis is that a high ratio of nonperforming loans to total assets and a low ratio of capital to total assets signal a bank's distress and both an increase in the probability that it will subsequently fail and a decrease in its expected survival time. (The table summarizes the empirical results across regions and countries.) Market risk and liquidity risk were generally found to be important in determining bank distress and eventual bank failure, and in determining a bank's expected survival time. In particular, problem banks had significantly higher exposures than nonproblem banks to sectors that had initially been booming but had gone bust shortly before banking crises hit. Problem banks also generally faced liquidity problems (owing to deposit withdrawals or low liquidity ratios) before crises hit. In contrast, measures of default risk

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and moral hazard were less consistent, giving mixed signals in some instances. Contagion, measured by the ratio of total loans of the region's overall banking system to the value of the region's output, seemed to have an impact in some cases, but, except in Mexico, it was generally small.

For each period, the predicted probabilities and times of distress and failure for individual banks were then aggregated to measure the fragility of the overall banking system. The expected probability of banking system failures based on the coverage ratio was generally an accurate predictor of actual crisis. Although the models based on bank-specific variables (excluding nonperforming loans and capital) predicted crises reasonably well in most cases, introducing macroeconomic regional variables into them generally improved their predictive power, once again suggesting that both microeconomic and macroeconomic influences are important in determining banking crises.

Indicators of banking system fragility based on the coverage ratio clearly worsened before actual banking crises began. Not all banks that were in distress failed—those that survived presumably adopted corrective measures or benefited from improved economic conditions. Nonetheless, banks that eventually failed typically showed signs of distress beforehand on more than one occasion. In this context, it should be borne in mind that regulatory intervention (through, for example, bank closings, capital infusions, or the removal of bad loans from banks' portfolios) is an extreme measure whose timing is determined largely by regulators.

Conclusion

Based on the country cases examined, emerging market countries and industrial countries appear to be similar in that both microeconomic and macroeconomic factors account for the fundamental risks that result in bank failures and, more generally, in banking crises. The same fundamental risks also determine banks' distress. The advantage of focusing on banking distress, rather than on actual bank failures, is that the fragility of the banking system can be assessed before a crisis occurs. Thus, analyzing the risks that banks face, and how they may be affected by changes in a country or region's economy, can be a useful exercise for both policymakers and researchers. **F&D**