

## Determinants and Leading Indicators of Banking Crises: Further Evidence

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*This paper examines episodes of banking system distress and crisis in a large sample of countries to identify which macroeconomic and financial variables can be useful leading indicators. The best warning signs of the recent Asian crises were proxies for the vulnerability of the banking and corporate sector. Full-blown banking crises are shown to be associated more with external developments, and domestic variables are the main leading indicators of severe but contained banking distress. [JEL: E44, G21]*

Recent events in East Asia have reminded the world of how rapidly and with what disruptive force banking crises can erupt, and of how difficult it is to foresee the timing and full ramifications of these dramatic events. Yet financial crises have a long history, and in recent decades many countries have experienced financial sector distress of various degrees of severity, and some have suffered repeated bouts (Lindgren, Garcia, and Saal, 1996, provide a listing and discussion).

This history lends importance to the identification of conditions under which banking crises are likely to occur so as to preempt them or prepare for their resolution. In this paper we concentrate on finding robust coincident and leading indicators that might be available in most countries. Since plausibly the causes of banking system distress differ across economies with different structural characteristics, leading indicators are differentiated by region. In particular, the recent Asian crises are shown to differ in several regards from episodes elsewhere. Furthermore, banking

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sector difficulties may also differ greatly in severity: some may be categorized as severe distress and others as full-blown crises. Results are presented showing that the precursors of crises and coincident economic developments are rather different from those of severe but limited financial system distress.

This study is a contribution to the new but growing body of research that attempts to evaluate econometrically the economic precursors and causes of banking sector weakness or crisis. Some studies, such as Cole and Gunther (1995) for the United States and González-Hermosillo, Pazarbaşıoğlu, and Billings (1997) for Mexico, have included as explanatory variables primarily bank-specific variables, and looked at the experience of individual institutions. These results are difficult to generalize, however, because for many countries reliable bank-specific data are rarely available to the more general public on a timely basis, if at all, and so cannot be used to make predictions. González-Hermosillo (1999) represents an attempt to overcome some of these limitations.

Another and more recent group of studies, to which this paper belongs, focuses primarily on macroeconomic variables and other indicators that are available in most countries on a fairly timely basis. A pioneering work in this area is the study by Kaminsky and Reinhart (1996), which examines the behavior of various macroeconomic indicators during episodes of both banking and currency crises.

A paper by Demirgüç-Kunt and Detragiache (1998) in this journal, which was written concurrently with the research reported here, examines the determinants of the probability of a banking crisis using annual, macroeconomic data. Their sample includes 31 instances of what are judged to be full-fledged banking crises, rather than more moderate distress. They find that low GDP growth, excessively high real interest rates, and high inflation significantly increase the likelihood of systemic problems. They also find weak evidence that adverse terms of trade shocks and rapid credit growth increase the probability of a banking crisis. The size of the fiscal deficit and the rate of depreciation of the exchange rate do not seem to have an independent effect. An interesting finding is that structural characteristics, such as the availability of deposit insurance and the degree of “law and order” achieved by a country, are also relevant. In addition, Demirgüç-Kunt and Detragiache present results, albeit from a very small sample, on the determinants of the cost of resolving banking crises.<sup>1</sup>

Demirgüç-Kunt and Detragiache use almost exclusively contemporaneous variables on the right-hand side (only a measure of the growth in bank credit is lagged two periods), and therefore, as the authors acknowledge, the direction of causality is not always unambiguous. By the same token, their findings are of only limited usefulness in predicting crises in advance. On a more methodological issue, their emphasis on coincident indicators hampers the identification of dynamic features of the lead-up to banking crises, such as cyclical turning points. Nor do they distinguish periods in which banking sector difficulties may be incubating but have not yet reached crisis levels from more normal periods of economic activity.

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<sup>1</sup>Eichengreen and Rose (1998) is another related paper, which concentrates on the influence of world-wide economic trends on the incidence of banking crises in developing countries.

Furthermore, they apply a common methodology to the full sample, and do not differentiate by region or severity of banking crisis. Our research complements that of Demirgüç-Kunt and Detragiache by addressing these issues.

### 1. Specification, Estimation, and Sample Definition

Our approach to the empirical investigation of banking crises is dictated by the goals set out above.<sup>2</sup> The main subject used in estimation will be an indicator, or dummy, variable (denoted  $y_0$ ) taking on the value 2 in a period when banking sector difficulties emerged, 1 in the preceding period, and zero otherwise. The approach of treating the pre-crisis year and the crisis year as separate events has several advantages. First, in many countries intervention defines the start of the crisis, but often the difficulties might have been widely known and been the cause of serious disruption for some time before then. Thus, economic behavior in the run-up to the declared start of an episode may differ significantly from that in more normal times, and the differences may themselves be of interest.<sup>3</sup> Second, this approach, rather than using just the crisis as the dependent variable and including lagged values of the explanatory variables, allows one to establish the predictive power of the leading indicators independently of what is known only in the crisis year, and provides a rough indication of the time to crisis. Results will also be reported for an indicator variable (denoted  $y_1$ ) that takes on the value 2 at the start of a full-fledged banking system crisis, 1 at the start of an episode of severe but limited banking system distress, and zero otherwise. Results for this variable will suggest how the determinants of crises differ from those of more contained episodes. The discrete indicator variables will be related to other, usually continuous economic series using a multinomial logit model estimated by maximum likelihood; details of the econometric procedure can be found, for example, in Greene (1990).

The definition of a financial crisis, its severity, its onset, and its duration is a matter of judgement and debate. In this study the identification of episodes of banking system distress and their timing follows that provided in Table 2 (pp. 21–35) of Lindgren, Garcia, and Saal (1996). The sample includes all listed cases of crises or banking system distress for which adequate data were available, except for cases in the formerly socialist transition economies, which can be considered *sui generis* due to their exceptional historical circumstances. Countries suffering hyperinflation were also excluded because of the difficulty in measuring real variables during periods of very high and variable inflation. The experience of countries that have not recently experienced significant banking sector problems should also be relevant, because they constitute a kind of control group. Therefore, data on a number of such non-crises countries were also collected. The full sample eventually obtained covered 50 countries, 38 of which suffered a total of 43

<sup>2</sup>Details of the approach and some additional results are contained in Hardy and Pazarbaşıoğlu (1998).

<sup>3</sup>Estimation was also performed for a dependent variable that identified separately crisis years and the two preceding years (i.e., a dummy variable with the values 0,1,2,3). However, finding any significant explanatory variables singling out the periods two years before crises was difficult.

episodes of banking system crisis or significant problems (23 instances of severe problems and 20 crises).

At least eight, and usually more, years of annual data on the explanatory variables were obtained from the IMF's *International Financial Statistics* for each country for each of the explanatory variables, so the sample comprised 323 observations (253 from crisis countries). Most explanatory variables are included in first difference form, and all variables except where noted are in logs and differences (denoted by a prefix *D* in the acronyms). The prefix *Ln* denotes the *n*-th lag relative to that observation.

The list of candidate explanatory variables was inspired by the existing empirical and theoretical literature on banking crises, concentrating on those that are widely available on a timely basis. These variables can be split into three groups. The first group relates to the real sector in an attempt to capture the degree of efficient use of credit as well as changes in the repayment capacity of borrowers, and includes the real growth rates of GDP (*DRGDP*), private consumption (*DRPCN*) and investment (*DRFCF*). The incremental capital output ratio (*ICOR*) is used as a proxy for efficient use of investment. A sharp increase in this ratio may imply the emergence of over-investment in aggregate or in certain sectors such as real estate.

The second group of indicators relates to banking sector variables. These include the change in the deposit liabilities of the banking system as a percent of GDP (*DRBDL*), which may indicate the existence of deposit runs and a loss of confidence in the banking system, or of the shrinkage of banks' balance sheets for other reasons. The growth in the ratio of total bank credit to the private sector to GDP (*DRBCP*) reflects how extended is the banking sector. The change in the ratio of gross foreign liabilities of the banking system to GDP (*DSGFL*) is used as a measure of the banking system's reliance on foreign capital to fund its operations, and thus is a proxy for its vulnerability to a sudden withdrawal of capital inflows.

The third group includes shocks that may directly or indirectly (through the real sector) affect the health of the banking sector, or which may indicate the advent of such a shock. These include the inflation rate (specifically, the GDP deflator, *DPGP*), the real deposit interest rate (*DRDIR*), changes in the real exchange rate (*DERR*), the growth of imports in real terms (*DRIMP*), and terms of trade developments (*DTOT*). Higher real interest rates would likely hurt the non-financial corporate sector, in particular companies that are highly indebted. An adverse terms of trade shock and a real exchange rate appreciation may affect the competitiveness of the country and lead to a deterioration in corporate sector profitability. A subsequent correction, that is, a sharp depreciation of the exchange rate, may lead to losses for corporations (financial and nonfinancial) indebted in foreign currency.

Several countries in the sample suffered repeated financial crises. Possibly, economic behavior will be permanently affected by a banking crisis and economic agents may behave differently when faced with such events a second time. Furthermore, repeated crises may indicate that inherent weaknesses in the banking sector were not adequately resolved. A dummy variable (*RPTD*) equal one in a repeat crisis and its lead-up, and zero otherwise, was used to capture this effect.

A number of what will be termed “regional” variables were defined. These were constructed by multiplying the macroeconomic explanatory variables with dummy variables that identified the region to which a country belongs (for example, the “Asia dummy” equals unity for Korea, Thailand, Indonesia, etc.). Attention focused on the Asian and African regional variables, which will be denoted by the suffixes *A* and *B*, respectively.<sup>4</sup> Of course, when such variables are included in the specification, the “nonregional” variables explain events in the remaining countries.

A specification search was undertaken to eliminate insignificant terms, starting from a very general specification containing up to two lags of the candidate explanatory variables. The risk of omitted variable bias, and the presence of multicollinearity suggest that variables on the border of significance should not be excluded. However, the dependent variable contains a preponderance of “zeros,” that is, the proportion of non-zero terms is low. The danger exists that particular right-hand side variables serve to “explain” only one or two episodes, and results will be spurious or not robust. Hence, parsimony is important. The final specification of the regression equations was determined so as to balance these considerations.

## II. Empirical Results

Table 1 contains the summary statistics, estimated parameters, and standard errors for the dependent variables  $y_0$  and  $y_1$ . The first two sub-columns report the results for  $y_0$  using the same explanatory variables for all countries, and the second pair of sub-columns contain the results taking into account regional effects.

Reviewing the results shows that reasonable predictive power has been obtained. For example, when the specification for  $y_0$  including regional variables is estimated, more than half of the episodes of banking system distress are predicted correctly, and about one-third of the pre-crisis periods are identified correctly or as a crisis period.<sup>5</sup> Predictive power for crisis years ( $y_0 = 2$ ) is usually somewhat better than for pre-crisis years ( $y_0 = 1$ ), largely because in the former case several contemporaneous variables (such as the change in the real effective exchange rate, *DERR*) are highly significant. A visual impression of the ability of the model to differentiate crisis, pre-crisis, and calm periods can be obtained from Figure 1, where the estimated probabilities of  $y_0 = 2$  and  $y_0 = 1$  are plotted. For most countries an upward “spike” in these probabilities in the crisis and pre-crisis years is apparent.

The  $y_0$  specification excluding regional variables was estimated over a sample that omits four recent East Asian crises (detailed results are available upon request). The estimated coefficients are robust to this change, except that the estimated coefficient on the real effective exchange rate term is somewhat larger in the full sample.

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<sup>4</sup>Eichengreen and Rose (1998) concentrate on banking crises in developing countries, arguing that such crises differ qualitatively from those in industrialized countries. We prefer to single out the newly industrialized countries in Asia and the mostly primary product exporting countries of Africa.

<sup>5</sup>In a few crisis or pre-crisis years, the estimated probability of  $y_0 = 0$  is larger than that of each of the other two possibilities, but still less than 50 percent. Hence, the model predicts either  $y_0 = 1$  or  $y_0 = 2$  in 41 out of 86 instances where this is the case. Conversely, it predicts either  $y_0 = 1$  or  $y_0 = 2$  in 14 of 167 instances where in fact  $y_0 = 0$ .

**Table 1. Estimation Results**

	Dependent variable					
	y0 (Excluding regional variables)		y0 (Including regional variables)		y1 (Including regional variables)	
	y0 = 1	y0 = 2	y0 = 1	y0 = 2	y1 = 1	y1 = 2
No. of observations	323		323		323	
Constrained log-likelihood	-246.79		-246.79		-156.41	
Max. log-likelihood	-198.63		-169.43		-94.331	
Predictions   $y_j = 0^1$	227/5/5		226/7/4		276/3/1	
Predictions   $y_j = 1$	31/10/2		28/12/3		16/5/2	
Predictions   $y_j = 2$	30/0/13		20/0/23		9/0/11	
Explanatory variable						
Constant	-2.118 <i>0.335**</i>	-2.132 <i>0.381**</i>	-2.336 <i>0.392**</i>	-2.623 <i>0.502**</i>	-3.613 <i>0.635**</i>	-3.595 <i>0.771**</i>
<i>DRGP</i>	-6.438 <i>4.149</i>	-14.585 <i>4.306**</i>	-8.048 <i>4.305+</i>	-14.303 <i>4.824**</i>	-5.865 <i>5.167</i>	-22.438 <i>6.824**</i>
<i>LDRPCN</i>	...	6.562 <i>5.017</i>	...	8.610 <i>5.725</i>	16.331 <i>6.833*</i>	0.723 <i>8.584</i>
<i>LICOR</i>	0.019 <i>0.014</i>	...	0.028 <i>0.027</i>	...	...	...
<i>L2ICOR</i>	...	0.019 <i>0.014</i>	...	0.009 <i>0.030</i>	-0.016 <i>0.034</i>	0.027 <i>0.025</i>
<i>DPGP</i>	-8.453 <i>3.109**</i>	...	-10.731 <i>3.356**</i>	...	...	...
<i>LDPGP</i>	10.992 <i>2.992**</i>	-7.896 <i>3.477*</i>	12.852 <i>3.235**</i>	-10.955 <i>3.967**</i>	-11.185 <i>4.583*</i>	-9.324 <i>6.593</i>
<i>L2DPGP</i>	...	9.253 <i>3.057**</i>	...	14.671 <i>3.703**</i>	14.770 <i>4.201**</i>	8.088 <i>5.740</i>
<i>DRBDL</i>	-5.213 <i>2.110*</i>	-2.626 <i>2.341</i>	-4.092 <i>2.281</i>	-4.857 <i>2.624+</i>	-4.335 <i>3.239</i>	-0.466 <i>3.515</i>
<i>LDRBDL</i>	...	-1.578 <i>1.476</i>	...	-0.839 <i>1.793</i>	-1.437 <i>1.987</i>	2.307 <i>3.194</i>
<i>DRBCP</i>	-1.526 <i>1.942</i>	-2.863 <i>2.064</i>	-2.658 <i>2.129</i>	-4.329 <i>2.227*</i>	-4.136 <i>2.729**</i>	-1.582 <i>2.932</i>
<i>LDRBCP</i>	1.425 <i>1.467</i>	...	2.066 <i>1.481</i>	...	...	...
<i>L2DRBCP</i>	...	2.262 <i>1.482</i>	...	2.871 <i>1.727+</i>	3.500 <i>1.794+</i>	0.915 <i>3.750</i>
<i>DRDIR</i>	...	0.064 <i>0.026*</i>	...	0.106 <i>0.033**</i>	0.097 <i>0.038*</i>	0.028 <i>0.047</i>
<i>LDRDIR</i>	0.045 <i>0.029</i>	...	0.054 <i>0.030+</i>	...	...	...
<i>L2DRDIR</i>	0.600 <i>0.025*</i>	0.030 <i>0.026</i>	0.061 <i>0.026*</i>	0.057 <i>0.027*</i>	0.063 <i>0.030*</i>	-0.010 <i>0.039</i>

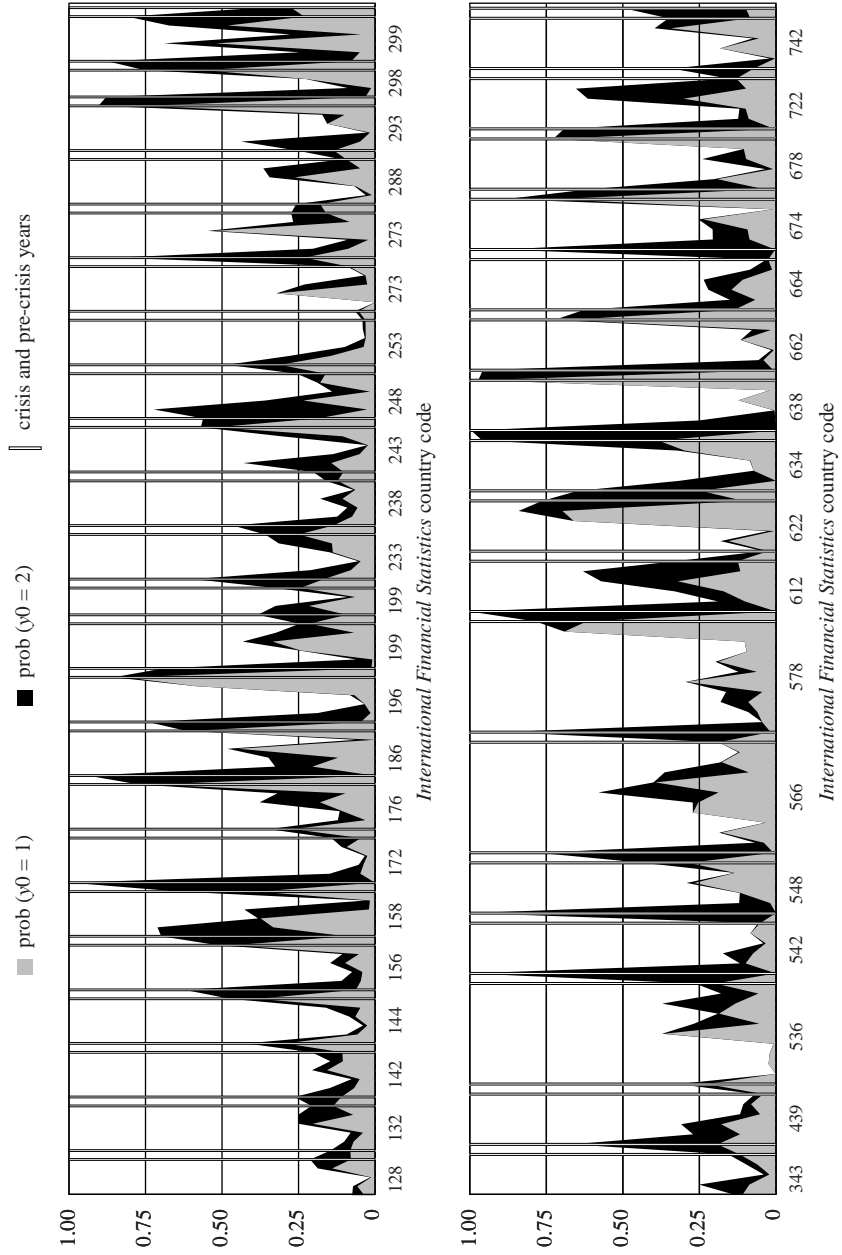
Table 1 (concluded)

Explanatory variable	y0 (Excluding regional variables)		y0 (Including regional variables)		y1 (Including regional variables)	
	y0 = 1	y0 = 2	y0 = 1	y0 = 2	y1 = 1	y1 = 2
	<i>DERR</i>	-2.099 2.290	-7.215 1.899**	-3.796 2.660	-6.223 2.500*	-3.605 3.266
<i>LDERR</i>	4.567 2.392+	...	3.630 2.420	...	...	...
<i>L2DERR</i>	...	4.357 2.419+	...	2.133 2.690	1.167 3.295	2.627 4.409
<i>DRGFL</i>	-7.765 6.782	...	-9.685 7.725	...	...	...
<i>LDRGFL</i>	10.241 7.170	-7.456 7.707	3.673 8.790	-7.065 10.747	-9.284 13.533	-15.758 13.480
<i>L2DRGFL</i>	...	16.064 8.886+	...	10.703 11.454	7.278 14.886	22.278 15.908
<i>DRIMP</i>	-1.028 1.402+	...	-1.829 1.751	...	...	...
<i>LDRIMP</i>	...	-1.058 1.351	...	-4.465 1.965*	-4.396 2.322+	-6.321 3.398+
<i>RPTD</i>	1.191 0.613+	1.130 0.725	0.850 0.664	1.040 0.888	0.653 1.024	1.259 1.426
<i>ADERR</i>	...	...	19.421 8.683*	-22.482 12.372+	-27.463 12.615*	-29.477 13.053*
<i>ALDERR</i>	...	...	...	35.048 10.775**	35.932 12.083**	30.259 14.285*
<i>ADRGFL</i>	...	...	...	-91.762 33.824**	-92.661 35.410**	-86.384 43.821*
<i>ALDRGFL</i>	...	...	30.595 16.830+	...	...	...
<i>AL2DRGFL</i>	...	...	...	38.689 21.948+	38.104 25.967	26.424 31.605
<i>BDPGP</i>	...	...	...	20.527 9.151*	21.878 9.186*	19.009 9.970+
<i>BL2DPGP</i>	...	...	...	-23.227 11.428*	-25.317 12.363*	-26.107 15.241+
<i>BDTOT</i>	...	...	-10.210 4.033*	...	...	...
<i>BDLTOT</i>	...	...	...	-9.148 4.298*	-12.585 5.552*	-5.206 5.737*
<i>BDRIMP</i>	...	...	3.727 3.211+	...	...	...
<i>BLDRIMP</i>	...	...	...	7.967 3.534*	9.272 4.007*	2.382 6.067

Standard errors in italics; \*\*: significant at 1 percent. \*: significant at 5 percent. +: significant at 10 percent.

<sup>1</sup>Under "Predictions |  $y_j = i$ " are reported the number of observations when the model predicts  $y_j = 0$ ,  $y_j = 1$ , and  $y_j = 2$ , respectively, when in fact  $y_j = i$ , for  $i = 0, 1, 2$ ,  $j = 0, 1$ .

Figure 1. Estimated Probabilities for  $y_0$





Three of the four East Asian crises are correctly identified out of sample. In only one of these cases was the pre-crisis period identified, however, confirming the impression that these crises were not preceded by typical macroeconomic disturbances.

An examination of the lag structure of the estimated equations reveals several regularities. First, the explanatory variables for  $y_0 = 2$  (except for contemporaneous terms) tend to be lagged one period relative to those for  $y_0 = 1$ , which is as one would expect. Second, a number of explanatory variables display a “boom and bust” pattern, with a large positive coefficient lagged one or two years, and a large negative coefficient in the crisis or pre-crisis year. This pattern, which accords with some of the proposed explanations of banking crises, applies to inflation, credit growth, the real effective exchange rate, and banks’ gross foreign liabilities. In some instances the interval from “boom” to “bust” is at least two years. Third, variables capturing financial market prices (the real exchange rate and the real effective exchange rate) are the main contemporaneous indicators of banking crises; the variables measuring quantities, such as stocks of financial assets or GDP components, more often enter with a lag.

The estimation results for individual explanatory variables largely corroborate the findings of others, including Demirgüç-Kunt and Detragiache. Among the first group of explanatory variables, banking distress is associated with a largely contemporaneous fall in real GDP growth, but for at least some countries the fall in GDP growth begins earlier, and this variable has some information content in predicting  $y_0 = 1$ . The empirical findings also suggest that a consumption boom in the years preceding a crisis (*LDPRCN*) can be a leading indicator. The estimated coefficient on the lagged incremental capital output ratio (*ICOR*) is not significant at conventional significance levels, but including the variable improves predictive power, and the estimate is robust to changes in specification. Furthermore, the (positive) sign accords with the theory that overinvestment at decreasing returns often leads to a banking crisis.

Turning to the banking-sector variables, deposits at banks (*DRBDL*) tend to start falling in real terms before a banking crisis is fully acknowledged, possibly due to declining confidence in the domestic banking system, and continue to fall during the crisis. This fall presumably contributes to liquidity problems in the banking sector. There is also a persistent and robust tendency for credit to the private sector (*DRBCP* and its lags) to follow a boom and bust pattern in advance of crises, with a further decline in credit growth during the crisis. The coefficients of the indicator used to capture the vulnerability of the banking system to private capital inflows (the change in the gross foreign liabilities of the banking sector relative to GDP, denoted by *DRGFL*) are sometimes significant and contribute to the predictive power for the model. They carry the expected sign, namely positive on a longer lag and negative as the crisis approaches.

Among other variables, a rise followed by a sharp fall in inflation seems to be one of the most reliable early indicators of impending banking sector problems. Real interest rates (*DRDIR*) usually rise in the crisis year, and reliably tend to start increasing already in the preceding years.<sup>6</sup> Banking crises are associated with a

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<sup>6</sup>Unfortunately, a measure of interest rate spreads was not available for many countries over most of the sample.

sharp decline in the real effective exchange rate, but an appreciation in this rate often precedes a crisis. A sharp slowdown in the real growth in imports is a good leading indicator of a financial crisis. This contraction may be symptomatic of a general economic slowdown and especially a decline in certain sectors, or of foreign exchange shortage. The estimate of the coefficient on the “repeat crisis” dummy variable is close to significant and relatively robust.

Other candidate explanatory variables found not to be systematically significant for this sample included: real gross fixed capital formation, the current account balance, reserve money, credit from the monetary authorities, banks’ reserves, banks’ net foreign assets, and foreign exchange reserves (relative to imports or deposits). These variables often seem to contain useful information and to have predictive power when used in isolation, but statistical significance is lost when used in conjunction with the other explanatory variables.<sup>7</sup>

The inclusion of regional variables has a major effect on the estimates, even if most of the qualitative results are preserved. Indeed, some estimated coefficients become larger and more significant when the regional variables are included (e.g., on most of the interest rate terms, or the change in real GDP for  $y_0 = 1$ ); once certain regional factors are accounted for the indicative value of other variables becomes clearer. The importance of regional effects is demonstrated by the improvement in predictive power that is obtained through their inclusion.

The banking crises in Asian countries are strongly associated with an appreciation followed by a sharp depreciation in the real effective exchange rate (*DERR*), and a parallel movement in the gross foreign liabilities of the banking sector (*DRGFL*). With this specification the estimated coefficients on these terms for the non-Asian countries are lower. These results are consistent with the weight given to capital inflows and real exchange rate movements in accounts of the recent Asian crises. Inclusion of the Asian regional variables also eliminates the significance of the “repeat crisis” dummy (*RPTD*), which largely serves to identify several of the recent Asian crises. The estimated coefficient on the “Asia dummy” itself (not cross-multiplied with another explanatory variable) was insignificant, however, suggesting that a pure regional reputation effect was small.

The results for the African regional variables suggest that banking crises in that region were not closely linked to a rise and sudden fall in inflation or a slowdown in import growth. Rather, a deterioration in the terms of trade seems to have been a major contributing factor in these countries, many of which rely heavily on the export of primary commodities.

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<sup>7</sup>Demirgüç-Kunt and Detragiache find that a number of institutional features of the countries in their sample are significant determinants of banking crises. We instead estimated a fixed effects model using a technique from Chamberlain (1980) to capture all persistent institutional or structural differences between countries. The dependent variable took a value of unity at the onset of an episode of banking system distress, and zero otherwise, and all non-crisis countries had to be excluded from the sample. The fixed effects themselves were found to be always jointly highly significant, indicating that country-specific phenomena are indeed important. However, the estimated parameters on the other variables of interest were not greatly affected by the inclusion of fixed effects, and in some instances their significance increased. Detailed results are available on request.

So far all cases of banking system distress have been considered without regard to how profound or pervasive they were, but it is obvious that they differ greatly in these respects, and possibly in their causes. An indication of the importance of these differences can be obtained by considering the estimated coefficients for  $y_1$  presented in the last two sub-columns of Table 1, albeit with the caveat that the relatively small number of each type of event may reduce the generality of the results.

The differentiation between crisis episodes and those of significant banking system distress reveals important characteristics of these different phenomena. In particular, a decline in growth is an important factor explaining the crisis episodes, but it is not significant for the distress cases. Furthermore, credit expansion funded mainly by capital inflows and leading to over-investment seems to be a critical factor in the crisis cases (significant parameters for *L2DRGFL* and *L2ICOR*). Likewise, movements in the real effective exchange rate seem to have been more important in the crises countries. These findings suggest that certain external developments, in particular heavy reliance on external funds, magnify the impact of a negative shock to the system and constrain the policy response to banking system distress, leading to a full-blown crisis. The causation need not be only one way: a very severe banking system crisis may itself precipitate an exchange rate crisis. In contrast, credit expansion seems to have fueled consumption in the cases of significant banking system distress, where movements in the real interest rate on (domestic) deposits is a better indicator. The inclusion of regional variables if anything reinforce these results, implying that they are not merely due to the recent Asian crises.

### III. Concluding Remarks

This paper concentrates on the role of cyclical movements in macroeconomic, banking sector, and real sector indicators in the lead-up to banking system difficulties. Overall, the empirical findings suggest that banking distress is associated with a largely contemporaneous fall in real GDP growth; boom-bust cycles in inflation, credit expansion, and capital inflows; rising real interest rates and a declining incremental capital output ratio; a sharp decline in the real exchange rate; and an adverse trade shock.

Certain of these tendencies seem to have been especially pronounced in the recent Asian crises, which were relatively difficult to predict using traditional macroeconomic indicators. More generally, the results presented are a reminder of the diversity of problems that come under the heading of banking system distress, and how country-specific circumstances need to be recognized in assessing the likelihood of such difficulties. The banking systems of the primary product exporting countries of Africa are vulnerable to a different range of disturbances than those of, say, the Nordic countries, and, as shown, the relevant leading indicators differ likewise.

Furthermore, it is recognized in the paper that banking sector difficulties may be severe without reaching the level of a crisis. New evidence is presented to suggest that severe banking problems are more domestic in origin and effect than full-

blown crises. External developments and constraints, such as a heavy reliance on external funds, seem to magnify the impact of a negative shock to the financial system, and full-blown banking crises may contribute to foreign exchange market turbulence. In contrast, cases of significant distress are often preceded by especially rapid credit expansion and growth in consumption, and are associated with a rising domestic real interest rate.

## REFERENCES

- Chamberlain, Gary, 1980, "Analysis of Covariance with Qualitative Data," *Review of Economic Studies*, Vol. 47, pp. 225–238.
- Cole, Rebel, and Jeffrey Gunther, 1995, "Separating the Likelihood and Timing of Bank Failure," *Journal of Banking and Finance*, Vol. 19 (September) pp. 1073–89.
- Demirgüç-Kunt, Asli, and Enrica Detragiache, 1998, "The Determinants of Banking Crises in Developing and Developed Countries," *Staff Papers*, International Monetary Fund, Vol. 45 (March), pp. 81–109.
- Eichengreen, Barry, and Andrew K. Rose, 1998, "Staying Afloat When the Wind Shifts: External Factors and Emerging-Market Banking Crises," NBER Working Paper No. 6370 (Cambridge, Mass.).
- González-Hermosillo, Brenda, 1999, "Determinants of Ex-Ante Banking System Distress: A Macro-Micro Empirical Exploration of Some Recent Episodes," IMF Working Paper 99/33 (Washington: International Monetary Fund).
- González-Hermosillo, Brenda, Ceyla Pazarbaşıoğlu, and Robert Billings, 1997, "Determinants of Banking System Fragility: A Case Study of Mexico," *Staff Papers*, International Monetary Fund, Vol. 44 (September), pp. 295–314.
- Greene, William, 1990, *Econometric Analysis* (New York: Macmillan).
- Hardy, Daniel, and Ceyla Pazarbaşıoğlu, 1998, "Leading Indicators of Banking Crises: Was Asia Different?" IMF Working Paper 98/91 (Washington: International Monetary Fund).
- Kaminsky, Graciela, and Carmen Reinhart, 1996, "The Twin Crises: The Causes of Banking and Balance of Payments Problems," International Finance Discussion Papers No. 544 (Washington: Board of Governors of the Federal Reserve System).
- Lindgren Carl-Johan, Gillian Garcia, and Matthew I. Saal, 1996, *Bank Soundness and Macroeconomic Policy* (Washington: International Monetary Fund).