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**Probability of Bank Crises in the Emerging
Markets of Asia and South America**
- An exploratory and empirical study of determinants

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Earlier literature sought to find the causes of bank crises in bank-specific factors, which are useful for assessing the soundness of individual institutions. Detailed examination of actual cases of banking crises can also provide insights about the role of institutional factors in precipitating these crises. However, such approaches are not particularly rewarding in the analysis of wide-spread, systemic bank crises. IN the analyses of crises of such magnitude and spread, the study of the macroeconomic environment at the time of – or immediately preceding – the crisis seems quite mandatory. The present paper is a contribution in this vein, and develops and tests leading indicators for predicting bank crises, using data on crises experienced in several industrial and emerging market nations.

1. Introduction

It is a matter of considerable interest that countries with widely differing economic structures and history of economic policy-making have been afflicted with – sometimes repeated – crises in their national banking systems. It may be also pertinent to note that even countries generally considered as being on the path of stable development or following pragmatic stabilization policies have had such crises erupting seemingly out of the blue.

Yet, in hindsight, these upheavals ought not have been quite so unexpected, and policy-makers could have taken certain actions to reduce the real cost to the economy, though perhaps it would have called for quick reflexes and a broad consensus – across power groups - in the economy, to say the least. Available literature on the topic now speaks about the possibility of focusing on leading indicators, which portend a crisis, drawing from the historical experiences of countries that have undergone such turbulences. The present paper is a contribution in this vein, and considers some additional real and financial variables which may have some forecasting ability with respect to looming bank crises, and, may be useful as prospective additions to the array of leading indicators that have been proposed for this purpose. Most of the countries in Asia and Latin America that have suffered such crises are included in the analysis, including the industrial nations of the Asia-Pacific region.

2. Backdrop of the Study and Review of the Empirical Literature

Much of the earlier literature on the causes of bank crises sought answers among variables that are primarily bank-specific, useful for assessing the financial soundness of individual institutions. This literature emphasizes certain features in the banking system, such as maturity transformation and asymmetric information can make the system vulnerable to a sudden collapse. The work by Jacklin and Bhattacharya (1988), and that by Diamond and Dybvig (1986), represent this strand of literature. Detailed examination of actual cases of banking sector crises, as in Sundararajan, and Balino (1991), can also provide insights about the (negative) impacts of macroeconomic disturbances and institutional structures. However, such an approach is not particularly rewarding in the analysis of widespread, systemic banking crises. Thus, the results in Cole and Gunther (1995); and Gonzalez-Hermosillo et al (1997) are difficult to generalize since it is the experiences of particular institutions, which are under the microscope.

Also, it is quite often not possible to get the bank-specific variables for a longer period in a consistent fashion for analysis¹. Such a perception seems to have made the study of the general macroeconomic environment at the time of – or immediately preceding – the crisis an important factor in assessing the vulnerability of a country to upheavals in the banking system.

It has been pointed out (see Calomiris and Gorton, 1991), for instance, that banking crises are usually preceded by recessions. These downturns themselves are quite often the final outcomes of an excessive credit boom, reminiscent of the thesis in Minsky's (1986) work. Thus, both important macroeconomic variables of the real as well as the financial type may be useful for the prediction of depositor panic and the ensuing banking crises.

The macroeconomic environment preceding the crisis may be thus characterized by boom and bust cycles, but other factors are also usually at work, throwing the system off the rails. Even the process of economic reforms, especially financial liberalization, which usually follows successful trade reforms, can be a factor, throwing the door wide open to long and short-term capital flows. The problem arises because the process of financial liberalization is often not accompanied by the required installation of prudential banking norms. Another related development is the creation of excess liquidity that often occurs as the reforming economy leaves a regime of financial repression and strictly government-controlled issue of credit to targeted sectors. Indeed, one of the main conclusions in the paper by Kaminsky and Reinhart (1999) is that the occurrence of banking and currency crises (the 'twin' crises) appears to be a consequence of the process of financial liberalization. They also note that while currency crises deepen banking crises, the latter usually precede and may be able to explain the occurrence of currency crises. The authors also stress the fact that weak fundamentals are at the root of both types of crises.

Bank-specific approaches and specific case studies do not, as noted earlier, stress the underlying economic fundamentals. The emphasis on market events, which can be also used to identify crises, also removes the focus from fundamentals. Market events such as the breakdown of fixed exchange rate pegs, devaluations or changes in exchange rate bands, large-scale government interventions such as forced bank holidays, take-overs or bail-outs of banks in dire straits are all considered as indicators of bank crises. However, Ho and von Hagen (2004) note that relying on market events to identify crises can be misleading. Government interventions could be aimed at getting to grips with long-lasting structural problems in the banking sector, and need not signify the occurrence of a crisis. Also, government reports about interventions may be delayed in publication, so that there could be biases in dating the crisis, if at all one has occurred. Similarly, in the case of exchange rate realignments, as Eichengreen, Rose and Wyplosz (1995) observe, note, these may have been carried out to adjust for past anomalies, and need not signify a currency or a twin crisis in the making.

While the present paper is confined to an empirical investigation of the determinants of bank crises, it may be appropriate to define currency and bank crises so as to distinguish them carefully and to trace links between the two. A currency crisis can be defined as a state of the economy in which an increase in the relative (to domestic currency) demand for foreign currency leads to a large loss of reserves, a sharp increase in short-term interest

¹ But see Ahumada and Budnevich (2001) who propose an early warning indicator system for Chile, and includes macroeconomic variables as well as a set of bank-specific variables such as earnings, loan growth, capital etc.

rates, or a large currency depreciation (Goldstein et al., 2004): It may well be the case that all these three developments occur simultaneously. A banking crisis can be defined to be a situation in which the demand for bank reserves increases greatly, due to various reasons. The underlying causes could include an increase in non-performing assets, a decline in the quality of bank loans, a large-scale withdrawal of deposits by non-bank public, or a sharp reduction in inter-bank credit. The net result is a drastic reduction in liquidity in the banking sector, forcing banks to turn to the central bank for refinancing. The final outcome could be large-scale government interventions, including even fundamental restructuring of the banking industry.

A twin crisis associates the two crises, with Kaminsky and Reinhart (1999) defining this as a phenomenon in which the beginning of a bank crisis is followed by a balance of payments crisis within 48 months. Twin crises have occurred in the 1990s, but were also frequent (more so) in the 1980s. Kaminsky and Reinhart (1996) find that past banking crises help to predict currency crises, but could not establish a reverse causal linkage. They used a probit model, estimating a binary index of currency crises on a binary index of bank crises with varying lag specifications. A similar conclusion is also drawn by Glick and Hutchison (2001). All the same, theoretical considerations can point to a causal relationship running from currency crises to bank crises also; the loss of international reserves could result in a credit crunch that can lead to a financial crisis and bankruptcies (see Stocker, 1994.).

One of the earliest, pioneering empirical studies on bank crises is the one by Kaminsky and Reinhart (1996), which looks at the experiences of twenty industrial nations and developing countries. They isolate important domestic and external sector variables, whose values and behavior seem to differ markedly – from normal conditions – during or just prior to a crisis. The variable movements of interest from their study, with important relevance for explanations of bank crises, are falling terms of trade, stock market downturns, real exchange rate appreciations, credit expansions, money multiplier increases and increases in real interest rates.

While Kaminsky and Reinhart (1996) worked with high frequency (monthly) data around the crisis dates, recent work has tended to concentrate on annual data, for longer time series to evaluate the probability of a crisis occurrence. Starting with the observation that the occurrence of a bank crisis is a binary discrete event, it becomes possible to use a multivariate logit or probit model to estimate the probability of such a crisis. The crisis indicator is a binary, zero-one, variable, estimated using a set of explanatory variables. With the logit or probit estimation, the predicted outcomes are restricted to lie in the unit interval, and are interpreted as the probabilities of the crisis. The contribution of each explanatory variable can be easily assessed as usual from the regression results of this constrained dependent variable model approach. Eichengreen and Rose (1998) use such a model to estimate the probability of bank crises, covering close to 40 episodes. They find the overvaluation of the exchange rate and high levels of foreign debt to be significant determinants of a crisis, as well as certain external factors such as the foreign interest rate. The unity probability value for the dependent variable is given only for the starting year of the crisis.

Demirguc-Kunt and Detragiache (1998) study the determinants of bank crises in developed and developing nations using such a multivariate binomial logit model. Besides the usual choice of macroeconomic and financial variables, they even include proxies for

institutional development. Their finding is that low GDP growth; high real interest rates and high inflation increase the probability of a crisis materializing. There is also evidence presented for at least a weak effect from adverse terms of trade, while fiscal deficits and exchange rate depreciations do not exert any significant effects. There is a problem in that the independent variables are contemporaneous with the dependent (crisis) variable, so that no rigorous statement can be made about the direction of causation. Thus it cannot be ruled out that while a relationship does exist between the macroeconomic indicators and the crisis variable, the developments of these variables may well be due to the impact of the crisis that has already occurred.

While the results above underline again the importance of the macroeconomic environment in relation to a crisis, the contribution of the authors may be even more in their attempts to capture the consequences of institutional factors in this context. They note that the existence of an explicit deposit insurance scheme increases the probability of a bank crisis. In a way, this may be similar to what has been observed in relation to external debt crises. Financial innovation and lending by a consortium of banks which limited the liability and – seemingly their risk – resulted in an excess supply of debt, which was the counterpart of the consumption-led borrowing that many developing countries resorted to in the 1980s. The willingness of multilateral financial institutions to bail-out the creditor banks also seems to have played a role in this process, to the benefit of creditor banks again, who did not have to pay the penalty for imperfect risk analyses of debtor countries.

The importance of a developed bank supervisory system as a country integrates financially with the rest of the world is noted in a number of empirical studies. When the banking system is liberalized, there is always an incentive to invest in projects that are risky, and also in projects that may benefit the managers personally. This occurs in the absence of prudential norms and a properly functioning legal system. Akerlof and Romer (1993) suggest that such looting behavior may underlie the Chilean bank crisis of the 1970s.

In a liberalized economy, the role of expectations in generating a crisis comes to the forefront. Expectations-generated speculative attacks on currencies leading to bank crises are emphasized in Obstfeld and Rogoff (1995). A fall in a country's competitiveness may itself generate expectations about impending devaluations when the country has a fixed exchange rate regime and aggravate banking problems. Both domestic and foreign depositors crowd to covert deposits in domestic currency to foreign currencies, creating tremendous liquidity problems for the banking sector. The 1995 crisis in Argentina can be accounted for in this fashion (IMF, 1996). Also, as Khamis (1996) and Calvo et al., (1994) point out, capital account liberalization may also invite large volumes of short-term, foot-loose capital, which may fly when domestic interest rates fall due to the large, additional creation of liquidity. Such short-term *reverse flows* lie at the heart of many of the recent bank crises.

Hutchinson and McDill (1999) include institutional factors in their crop of explanatory variables for estimating the probability of bank runs using a similar approach. Other than explicit deposit insurance, the institutional factors chosen were central bank independence, financial liberalization and moral hazard. Financial liberalization, of course, may be also considered to be an integral part of the macroeconomic environment of transition economies. All these institutional factors were found to be successful by the authors in

explaining the probability of bank crises. Among the macroeconomic indicators chosen, they found that downturn in GDP and in stock prices had significance for the precipitation of turmoil in the banking system.

Attempts have been made also to overcome the limitations of the multivariate binomial logit or probit approach in terms of early signaling. Hardy and Pazarbasiogulu (1999) have estimated a multivariate, multinomial logit model that seems successful in this respect. The dependent variable is a discrete variable which is allotted the value of two in the year of a bank crisis, a value of one in the year preceding the crisis, and zero when no crisis has occurred or is forthcoming in the immediate future. Such a specification makes it possible to use the predictive power of leading indicators in a wider sense, not just limited in capability to the crisis year. So there are two thresholds, and when the first threshold is crossed, an early warning noise is generated.

Before we go on to present the empirical approach in this paper, it may be appropriate to mention also some of the early warning systems (EWS) which have been proposed for individual banks and even for the banking system as a whole. A fairly recent survey on supervisory risk assessment and early warning systems is provided in Sahajwala and Van den Bergh (2000) of the Basel Committee on Banking Supervision. These systems incorporate statistical models for determining causal relationships between macroeconomic and financial variables and the financial fragility of banks. These models can be used for predicting probable ratings that banks would receive in a scrutiny, or for predicting failure, or for forecasting future losses, which have a bearing on the future solvency of the bank.

The US Federal Reserve Bank has used the rating prediction methodology, which predicts the so-called CAMELS rating. The model traces the historical relationship between a number of financial and non-financial variables, such as net income, past due loan, tangible capital and assigned ratings. A limited dependent variable regressions technique is used, with the dependent variable taking a value of one for a predetermined interval, and zero otherwise. The failure prediction model also uses a similar technique with the dependent variable taking the value of 1 for failure and zero for survival. The output of the failure prediction model, which uses about 11 explanatory variables, gives a risk profile analysis, which included a comparison with peers. Finally, the models predicting future losses are used for countries without frequent incidence of bank failures in the past. The methodology estimates a potential future loss amount from all outstanding individual and corporate loans of a banking institution. Potential losses for each credit account are summed up to get a total for the entire portfolio for a three-year period, and then adjusted against the current level of reserves. To be considered as capable of remaining solvent, own funds should be greater than the minimum requirement of 8% after this adjustment. This methodology is in use with the French Banking Commission, in their model called Support System for Banking Analysis, (SAABA).

The Signal Extraction Approach uses a different methodology from the early warning systems for individual banks as well from the limited dependent variable technique for explaining crisis episodes. Kaminsky and Reinhart (1999) and Goldstein, Kaminsky and Reinhart (2000) use this as a leading indicator approach for predicting bank crises. The list of explanatory variables varies between contributions in this area, but include both macroeconomic and financial variables. Real interest rates, domestic credit to GDP ratio, lending to deposit rate differences, terms of trade, real exchange rate, government deficit

to GDP ratio, foreign liabilities to reserves ratio etc. are commonly used, some of these serving as proxies for financial liberalization.

The approach uses high frequency data so that some valuable information about the structure of the banking system and prudential regulations etc cannot be included. The chosen variables are considered to set off a warning when they touch abnormal levels. This cut off threshold level has to be arrived at after scrutinizing the experiences of countries that have suffered crises in the past. The usual definition of the threshold is as the value of the explanatory variable that minimized the ratio-of false alarms to correct warnings of financial crises during a horizon of 24 months before the crisis. If a number of signals have been set off from different explanatory variable, a crisis may be considered to be imminent.

Since warning signals can erupt from several indicators, it may be a problem to evaluate the marginal contribution of each of these in precipitating a crisis. Clearly, some kind of aggregation is required to tackle this problem. Kaminsky (1999) handles this problem by constructing composite indices of financial distress based on the different individual indicators. While the simplest composite index is just an aggregate of all the various indicators, a more complex one incorporates measures of the severity of the signals by defining another threshold for extreme indicator values. Recent past signals may be added on to increase the predictive power. A criticism of this approach is that construction of such composite indices is arbitrary, since the weights may not be reflecting individual contributions.

In this paper we chose to work with a multivariate binomial logit model, applied to a sample of 24 countries, including developed industrial countries and emerging market economies in the Asia-pacific region and South America. African emerging markets also finds representation in the sample. The data and the model are described in the next section.

3. Data and Models For Estimation

3.1. Selected Variables:

It is clear from the results of earlier work in this area presented in the previous section that both macroeconomic and financial variables need to be included as explanatory variables for predicting episodes of banking crises. Among real macroeconomic variables, the rate of growth of GDP is a good candidate inasmuch as (a reduction in) it represents a macroeconomic shock that affects banks adversely by increasing the share of non-performing loans. We also include the rate of change in employment, which may be a proxy for the same kind of effect. In fact, it will be seen later that the change in employment performs better as an explanatory variable for bank crises.

One of the factors underlying the Asian crisis of the 1990s, and perhaps predating it to some extent, was a loss of competitiveness, especially in the export sector. While a number of factors could be appealed to capture such a loss of international comparative advantage, a couple of the most prominent candidates would be real effective exchange rates and productivity levels. We could not find consistent unit labor costs for all the countries in the sample, for the entire period. The real effective exchange rate, would, of course, incorporate an element of expectations also; while banking crises are associated

with a sharp decline in the real exchange rate, a real effective exchange rate appreciation may precede the crisis.

As noted in the previous section, financial liberalization, while a laudatory motive, may have contributed to bank crises in many of the merging markets. The ratio of credit to the private sector to GDP may well be the best proxy for financial liberalization, according to Pill and Pradhan (1995). Accordingly, this explanatory variable is a given choice in our model too. We also include the ratio of short-term foreign liabilities to international reserves. The government fiscal deficit is considered to be an important variable because large deficits may prevent moves towards financial liberalization, and also because such deficits may prevent an active role of the government in mending bank balance sheets (Lindgren, Garcia and Saal (1996)). However, quite a few studies, Demirguc-Kunt and Detragiache (1998), for instance, find that the surplus/deficit variable is not significant, so that we have chosen not to include it among explanatory variables.

It has been stressed in the literature that bank crises have a regional dimension, so that the explanatory power of determinants can vary between, say, Latin American and Asian countries, and it is even plausible that certain variables – such as the real effective exchange rate - may exhibit differing signs for different group of countries. Hence it may be worthwhile to distinguish between groups of countries by regional dummies. We use regional dummies for differentiating the Latin American countries and the Asian countries in the sample.

Finally, we also include the rate of change of equity prices among the array of explanatory variables. Asset price shocks, particularly those of real estate and equities, have played an important part in the developments leading up to the crises in Southeast Asia as well as in Japan. It may be added that now there is a strand of literature which points to the predictive ability of asset price changes with respect to important economic variables such as consumer price inflation (Christoffersen, and Slok, 2000). Such a predictive power of equity prices is apparent since they have ‘painted in ’ expectations about future profitability etc. in their movements.

Table 1 presents the sample of countries, 22 in all, included in the study:

Table 1: Sample for Estimations

Latin America	Asia	Asia-Pacific, Industrial	Others
Argentina	Singapore	Japan	Israel
Brazil	Thailand	Australia	South Africa
Chile	The Philippines	New Zealand	
México	Malaysia	Papua New Guinea	
Venezuela	India		
Colombia	Korea		
Guyana	Sri Lanka		
Uruguay	Nepal		

These countries, have between them, suffered 97 years of bank crises during the period 1982 - 1997, including all the years during which a crisis has endured, i.e., not just the beginning years. The period 1982-1997 has been chosen to capture most of the important bank crises undergone by the countries in the sample. The crisis years for each country are given within brackets.

3.2. Models for Estimation

Estimation of the probability of a banking crisis is done using a multivariate logit model. Starting from the observation that in each period (year) a country in the sample is either experiencing a crisis or not, limited values are assigned to the dependent variable. The dependent variable representing the crisis takes the value of 1 in a year of crisis and the value of zero in a normal year. The probability of experiencing a crisis is a function of 'n' explanatory variables $X(i,t)$ (discussed above in this section), and the log-likelihood function in the model can be represented as (with 'i' representing countries and 't' time period)

$$[1] \quad LnL = \sum_{i,t} P_{i,t} \ln(F\beta'X) + (1-P)\ln(1-F)(\beta'X)$$

where β is the vector of unknown coefficients and $F(\beta'X)$ is the cumulative probability distribution function. For details of this approach please refer to Greene (1990), Demircuc-Kunt and Detragiache (1998), Hardy and Pazarbasiogulu (1999, Cole and Gunther (1995), and Gonzalez-Hermossilo, Pazarbasiogulu and Billings (1997).

In some related work, as in Hardy and Pazarbasiogulu (1999), a distinction is made between the year in which the crisis started and the continuing years, or the years immediately proceeding of the crisis. Thus, the crisis indicator may take a value of 2 in the period in which banking problems reached crisis proportions, a value of 1 in the year preceding that, and zero otherwise. The crisis period years beyond the starting period also may be thus differentiated. The advantage seems to be that differences between the lead-up to the crisis and the ongoing crisis years can be captured, so that lagged effects of variables are obtained. We do not distinguish between the start of the crisis episode and the on-going crisis years, which is not clearly drawn for all countries in the sample, but do capture lag effects by including lag specifications for all the explanatory variables.

The effects of macroeconomic and financial variables were first estimated in separate regressions, and then a complete estimation done. The country samples differed slightly due to the availability of data, as indicated below:

With only macroeconomic explanatory variables: the limited dependent factor model takes the form

$$[2] \quad \text{Crisis probability} = f(\text{gdp}, \text{emp}, \text{prody}, \text{LD}, \text{AD})$$

gdp is the rate of change of gdp, emp the rate of change in employment, LD a regional dummy for Latin America, and AD a regional dummy for Asian emerging markets. All the variables are given a lag specification as well. For this estimation, Guyana, Papua New Guinea and Uruguay were omitted due to lack of complete data.

With only financial variables, the estimation is done for

$$[3] \quad \text{Crisis probability} = f(\text{crdt}, \text{sdt}, \text{equity}, \text{reffx}, \text{LD}, \text{AD})$$

In equation [3], estimated using data for all 22 countries in the sample, crdt is the ratio of total private credit to GDP, sdt is the ratio of short-term foreign liabilities to total reserves, and reffx is the real effective exchange rate. The variables crdt and sdt would capture the effects of financial liberalization, leading to excess credit creation, and perhaps unconstrained foreign borrowing. The short-term foreign liabilities data refers to liabilities other than long-term, and may not be consistent in nature across the entire sample.

The final estimation is done using all explanatory variables, macroeconomic and financial:

$$[4] \quad \text{Crisis probability} = f(\text{gdp}, \text{emp}, \text{prody}, \text{crdt}, \text{sdt}, \text{equity}, \text{reffx}, \text{LD}, \text{AD})$$

Since real macroeconomic data was not fully available for Guyana, Papua New Guinea and Uruguay, these countries were left out of this final estimation. Data for all the variables was taken from IMF's International Financial Statistics.

4. Empirical Results

The results of the estimations for equations 2) to 4) are presented in Table 2. T statistics are given within brackets, with 1%, 5% and 10% significance levels represented by three, two and one stars respectively. The estimation period is 1982 – 1997, and the estimation with all countries is using a total of 352 observations. The bivariate limited dependent variable is the probability of crisis occurrence.

Table 2: Determinants of The Probability of a Bank Crisis

Explanatory Variable	ESTIMATIONS FOR EQUATION				
	2	2*	3	3*	4
Gdp	-1.17039 (1.13)				
Emp	-2.072 (1.234)				-2.840 (2.102**)
Prody	-1.117 (1.13)				
Reffx			-0.763 (2.2734**)	-0.7714 (2.364**)	-0.91 (2.789**)
Crdt			0.0428 (2.451**)	0.0425 (2.471**)	2.770 (1.076**)

Sdt			0.0043 (1.93**)	0.039 (2.52**)	0.0401 (0.267)
Equity			-0.03869 (1.05)		
Lgdp		-1.6701 (1.767**)			
Lemp		2.8263 (1.862**)			
Lprody		-1.1056 (1.410*)			
Lequity				-0.0489 (1.92**)	-0.171 (1.893**)
LΔsdt					0.011 (1.392*)
LD				0.031 (0.75)	
AD				0.081 (1.25*)	0.0809 (1.55*)

A lag specification is represented by the prefix 'L', except in the case of the variable 'LD*', which is the regional dummy for South American nations.

In the estimation 3) using only macroeconomic variables, only lagged GDP and employment changes were significant, both at the 5% level. Current changes in these variables were not significant, as was the case also with productivity change. Lagged productivity is weakly significant, at the 10% level. Only one period lags were significant for GDP and employment changes. In the estimation using lags, no current variables were significant, and they are not reported. Regional dummies had no significant effect either as explanatory variables.

In equation 4, estimated using only financial variables, all the variables, i.e., the real effective exchange rate, the credit to GDP ratio, the short-term foreign liabilities to reserves ratio, and the change in the equity price, are all significant at the 5% level. Finally, in the combined regression with all financial and macroeconomic variables, the only macroeconomic variable that is significant is the current period change in employment. Among financial variables, the credit ratio, the real effective exchange rate, and the lagged change in stock prices are significant at the 5% level, while the lagged rate of change in the foreign liabilities to reserves ratio is marginally significant at the 10% level. The Asian dummy is also significant only at the ten percent level, while the Latin American regional dummy was insignificant in all runs.

The signs of the significant variables hold no surprises. In the final combined regression, a rise in employment reduces the probability of a bank crisis occurring. In the estimation excluding financial variables, the lagged employment gives the same effect, as does the lagged change in GDP. A rise in the ratio of total private credit to GDP is seen to increase the probability of a crisis occurring. The variable has no effect in lagged form. The ratio of short-term foreign liabilities to reserves has a *positive* significant effect on

crisis probability in the run with only financial variables, but fails to be significant in the combined estimation. However, it is marginally significant at the 10% in the lagged rate of change form, with an increase in the ratio adding to the probability of a bank crisis. An appreciation of the real exchange rate reduces the probability of a crisis

One usual criticism of the analyses of the determinants of banking crises has concerned the use of contemporaneous variables as explanatory factors. The problem is that the crisis may affect the rest of the economy fairly rapidly, in which case it becomes impossible to disentangle cause and affect relationships. The use of lagged specifications in the present paper tackles this problem to some extent. Kaminsky and Reinhart (1996) found that a downturn in economic activity precedes a banking crisis by about eight months, i.e., by less than an year. In our combined regression with financial and real variables, the employment downturn in the current period is related to a crisis, with no lagged effect. But in the run with only real variables, both GDP and employment downturn in the preceding period is seen to be predictors of a crisis. A fall in productivity in the preceding period is also weakly significant, indicative of an impending crisis. Thus the causal relationship would seem to run from real economic activity to a crisis.

It has been also noted that total private credit in the economy could be still increasing as the crisis takes form, so that a lagged effect may not be apparent. This observation is borne out in our estimations where lagged credit had no significant effect at all in runs with financial variables and in combined estimations along with real factors. But lagged changes in stock prices have a significant effect. This is to be expected given the forward-looking nature of equity price formation, with considerable evidence available for the predictive power of equity prices for important variables such as consumer price inflation, with implications even for monetary policy formulation². The dependence on foreign capital, especially of the shorter-term, clearly increases the vulnerability of the banking system, and is expected to be a leading indicator, with a positive sign in estimation. We get this expected positive sign on lagged changes in this variable, which is consistent with earlier results, for instance in Hardy and Pazarbasogulu (1999).

Banking crises in Asian countries have been linked with sharp real exchange rate depreciation, preceded by appreciation. In our estimation, real exchange rate appreciation in the current period has a negative effect on crisis formation. The lagged effect is not significant, and seems to be consistent with earlier studies in which the lagged effect is only marginally significant.

Predicting Crises

The emphasis in this paper has been on a search for key determinants of bank crises in emerging markets. It is also possible to use the results of the estimation model for making predictions about actual crises that has occurred in the period of study. But this process, although easily carried out, is fraught with certain problems. The prediction requires the arbitrary specification of a cut-off probability level, a threshold level. It may be best to choose this cut-off level as the in-sample crisis frequency as done, for instance, by Demirugc-Kunt and Detragiache, but there could be other contenders for the specification. Peltonen (2002), while remarking on the robustness of his results, states that the threshold value for the predicted probabilities critically affected the prediction ability of his limited

² See Christoffersen and Slok (2000) for discussions and evidence on this issue.

dependent factor model. He varies the threshold value from 52 to 5% in his sample, which has a proportion of about 8% of crises to tranquil periods, but notes that a threshold value of 50% would lead to a severe understatement of the predictive ability of the model. He also tried out a threshold value, which maximizes the average of three components: the share of correctly classified crises, the share of correctly classified tranquil periods, and the share of the actual crises of the predicted crises. But this method seems to have produced too many wrong signals, so that a threshold value of 20% was finally selected. (See also Greene (2000) on this point.). Given the rather arbitrary possibilities at hand to pick a threshold level, we decided not to proceed with crisis predictions, though, of course, conducting some kind of sensitivity analysis using different cut-off probability levels may be worthwhile.

5. Concluding Remarks

This study has focused on the possibility of identifying some additional leading indicators for predicting bank crises, using data on crises undergone by 22 emerging market nations and developed industrial countries in Asia and Latin America. Much of the findings conform to the results obtained earlier in the literature on this topic. Variables representing a downturn in economic activity and serving as proxies for financial liberalization increase the probability of a crisis occurring.

The specification of lag structures for each of the explanatory variables help in identifying some leading indicators of bank crises. Lagged changes (reductions) in GDP, as well as in employment and in productivity seems to precede a crisis, but the relationships are only weakly significant in some of the estimations. The fall in productivity may be serving as a proxy for the fall in international competitiveness, which hurt exports. But the real effective exchange rate is not significant in lag specifications. Other leading indicators identified are lagged changes in equity prices and in short term liabilities, with a fall in equity prices portending a crisis while increases in short-term liabilities seem to precede a crisis.

It may be a limitation of this study that the specific factors contributing to crises only in some specific region, such as Latin America or Asia, have not been separated out. The presence of region-specific crisis indicators is indicated, albeit in a weak fashion, by the effect generated in estimations by the regional dummy for A. But a rigorous resolution of this uncertainty will require the use of a larger sample from each region, and a longer estimation period, which covers more crises. The present paper has not undertaken such an exercise due to certain constraints on data availability. It is, of course, possible to proceed by multiplying all explanatory variables by dummies, which take different values for different regions, but this will not capture the effects comprehensively as a comprehensive estimation confined to particular regions only in each case. Factors such as a fall in real economic activity and a process of financial liberalization which opens the floodgates to foreign capital inflows and to largely increased private credit seem robust as indicators of a crisis, and these results are unlikely to be region-sensitive. But it is possible that some other developments such as the appreciation or depreciation in the real effective exchange rate may have some region-specific effects depending on the underlying currents of expectations formation and competitiveness.

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Abstract: <p>Earlier literature sought to find the causes of bank crises in bank-specific factors, which are useful for assessing the soundness of individual institutions. Detailed examination of actual cases of banking crises can also provide insights about the role of institutional factors in precipitating these crises. However, such approaches are not particularly rewarding in the analysis of wide-spread, systemic bank crises. IN the analyses of crises of such magnitude and spread, the study of the macroeconomic environment at the time of – or immediately preceding – the crisis seems quite mandatory. The present paper is a contribution in this vein, and develops and tests leading indicators for predicting bank crises, using data on crises experienced in several industrial and emerging market nations.</p>	
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