

Preliminary
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**The Determinants of Banking Crises: Evidence from Developed and
Developing Countries[†]**

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Abstract

The paper studies the factors associated with the emergence of systemic banking crises in a sample of developed and developing countries in 1981-94 using a multivariate logit econometric model. The results show that a weak macroeconomic environment with low growth and high inflation makes crises more likely; high real interest rates have also contributed to banking sector fragility, and so does vulnerability to balance-of-payments crises. Countries with an explicit deposit insurance scheme were also particularly at risk, and so were countries with weak law enforcement.

Keywords: banking sector, banking crises, deposit insurance.

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1. Introduction

In the 1980s and early 1990s several countries, including developed economies, developing countries, and economies in transition have experienced severe banking crises. Such proliferation of large scale banking sector problems has raised widespread concern, as banking crises disrupt the flow of credit to households and enterprises, reducing investment and consumption and possibly forcing viable firms into bankruptcy. Banking crises may also jeopardize the functioning of the payments system and, by undermining confidence in domestic financial institutions, they may cause a decline in domestic savings and/or a large scale capital outflow. Finally, a systemic crisis may force sound banks to close their doors¹. In most countries policy-makers have attempted to shore up the consequences of banking crises through various types of intervention, ranging from the pursuit of a loose monetary policy to the bail out insolvent financial institutions with public funds. Even when they are carefully designed, however, rescue operations have several drawbacks: they are often very costly for the budget; they may allow inefficient banks to remain in business; they are likely to create the expectation of future bail-outs reducing incentives for adequate risk management by banks; managerial incentives are also weakened when -- as it is often the case -- rescue operations force healthy banks to bear the losses of ailing institutions. Finally, loose monetary policy to shore up banking sector losses can be inflationary and, in countries with an exchange rate commitment, it may trigger a speculative attack against the currency.

¹ In some circumstances widespread bank failures may be efficient; for instance, when new financial intermediaries enter the market, the demand for banking services falls and the banking sector should downsize. However, the banking crises considered in this study are usually episodes in which a large number of banks suddenly becomes illiquid or insolvent. Since the entry of new financial intermediaries typically occurs slowly over time, it is unlikely to be the main cause of the crises considered here.

Preventing the occurrence of systemic banking problems is undoubtedly a chief objective for policy-makers, and understanding the mechanisms that are behind the surge in banking crises in the last fifteen years is a first step in this direction. Recently, a number of studies have analyzed various episodes of banking sector distress in an effort to draw useful policy lessons (see Section 3 below)². Most of this work consists of case studies, and econometric analyses are few. González-Hermosillo *et al.* (1996) use an econometric model to predict bank failures using Mexican data for 1991-95. Using a sample of 20 countries, Kaminsky and Reinhart (1996) examine the behavior of a number of macroeconomic variables in the months before and after a banking crisis; using a methodology developed for predicting the turning points of business cycles, they attempt to identify variables that act as “early warning signals” for crises.³ A loss of foreign exchange reserves, high real interest rate, low output growth, and a decline in stock prices tend to signal an incoming crisis.⁴

The goal of our study is to identify the features of the economic environment that tend to breed banking sector fragility and, ultimately, lead to systemic banking crises. Thus, rather than focusing on the behavior of high frequency time series around the time of the crisis, we study the determinants of the probability of a banking crisis in a multivariate logit specification with annual data. Our panel includes all market economies for which data were available in the period 1981-94⁵. Many countries in our sample do not experience banking crises in the period under consideration, and therefore serve as controls. The explanatory variables capture many of the factors suggested by the theory and highlighted by case studies, including not only macroeconomic variables but also structural characteristics of the economy in general and of the financial sector in particular. This approach allows us to identify a number of interesting correlations; however, because we estimate a reduced form relationship without deriving it from a specific structural model of the economy, such correlations should not be interpreted as direct causal links.

Our findings reveal strong evidence that the emergence of banking crises is associated with a deteriorated macroeconomic environment. Particularly, low GDP growth, high real interest rates, and high inflation significantly increase the likelihood of systemic problems in our sample; thus, crises do not appear to be solely driven by self-fulfilling expectations as in Diamond and Dybvig (1983). This confirms the evidence presented by Gorton (1988) on the

²Some of these studies also discuss at length the strategies adopted to rescue the banking system, a topic that we do not address in this paper.

³ While this approach provides numerous interesting insights, it is open to the criticism that the criteria used to judge which variables are useful signals is somewhat arbitrary.

⁴ The study also examines balance-of-payments crises using the same methodology.

⁵ Economies in transition are excluded from our study even though they have experienced some of the worst banking crises. We believe that banking problems in these economies are due to the process of transforming a centrally planned economy into a market economy, and are therefore of a peculiar nature.

determinants of bank runs in the U.S. during the eighteenth century.⁶ Adverse terms of trade shocks also tend to increase the likelihood of banking sector problems, but here the evidence is weaker. The size of the fiscal deficit and the rate of depreciation of the exchange rate, on the other hand, do not seem to have an independent effect.

⁶ It should be pointed out, however, that without a theory of how beliefs are formed in rational expectations models with multiple equilibria, this evidence cannot rule out that crises have a self-fulfilling component, since pessimistic, self-fulfilling beliefs may tend to emerge when macroeconomic fundamentals are weak.

Adverse macroeconomic shocks, however, are not the sole factors behind systemic banking sector problems. Structural characteristics of the banking sector and of the economic environment in general also play a role. Our tests show that vulnerability to sudden capital outflows increases the probability of a crisis, as suggested by Calvo *et al.* (1994); we also find some evidence that problems are more likely where a larger share of credit goes to the private sector, possibly indicating a connection between the degree of financial liberalization and banking sector fragility.⁷

Another interesting result, which is quite robust to the specification of the regression, is that the presence of an explicit deposit insurance scheme makes bank unsoundness more likely. While deposit insurance should reduce bank fragility by eliminating the possibility of self-fulfilling panics, it is well-known that it creates incentives for excessive risk-taking by bank managers (moral hazard). Our evidence suggests that, in the period under consideration, moral hazard played a significant role in bringing about systemic banking problems, perhaps because countries with deposit insurance schemes were not generally successful at controlling the perverse effects of moral hazard through appropriate prudential regulation and supervision. Also, a variable capturing the effectiveness of the legal system is found to be significantly negatively correlated with the emergence of banking sector problems, possibly suggesting that banking crises are more likely where fraudulent behavior tends to go unpunished.

The multivariate logit model treats banking crises as uniform event, while in practice crises were of different magnitude. Using estimates of the cost of banking crises from Caprio and Klingebiel (1995), we test whether the set of explanatory variables used in the logit model can also account for the severity of each crisis. We find that most of the same variables that tend to make crises more likely also tend to make them more costly. A notable exception is output growth, that appears not to be significant in these regressions. Since the size of the sample is small due to data limitations, these results should be interpreted with caution.

To test the robustness of the results, we perform some sensitivity analysis by loosening and tightening our criteria for classifying episodes of fragility as systemic crises. The results by and large remain unchanged. We also split the sample between developed and developing countries to test whether banking crises are of a different nature in the two sets of countries. Interestingly, the presence of explicit deposit insurance and the effectiveness of the legal system become even more significant when the sample is restricted to developing countries.

The paper is structured as follows: the next section reviews the theory of the banking firm to identify potential sources of systemic banking crises. Section 3 explains the design of

⁷ Galbis (1993) finds that the share of credit to the private sector is a good proxy for financial liberalization. High real interest rates may also reflect financial liberalization.

our econometric tests, while Section 4 contains the main results. In Section 5 we present further results on the determinants of the severity of banking crises. Section 6 briefly details the sensitivity analysis, and Section 7 concludes.

2. The Determinants of Banking Crises: The Theory

Banks are financial intermediaries whose liabilities are mainly short-term deposits and whose assets are usually short and long-term loans to businesses and consumers. When the value of their assets falls short of the value of their liabilities, banks become insolvent. The value of a bank's assets may drop because borrowers become unable or unwilling to service their debt (credit risk). Credit risk can be reduced in various ways, such as screening loan applicants, diversifying the loan portfolio by lending to borrowers who are subject to different risk factors, or asking for collateral. Appropriate screening can ensure that projects that are unprofitable *ex ante* are not financed; but risky projects that are profitable in an *ex ante* sense may still fail *ex post*. Also, portfolio diversification is unlikely to eliminate default risk completely, especially for banks that operate in small countries or regions, or that specialize in lending to a particular sector. Finally, collateral is costly to establish and monitor, and its value is typically subject to fluctuations. Thus, default risk cannot be entirely eliminated without severely curtailing the role of banks as financial intermediaries⁸. If loan losses exceed a bank's compulsory and voluntary reserves as well as its equity cushion, then the bank is insolvent. When a significant portion of the banking system experiences loan losses in excess of their capital, a systemic crisis occurs.

Thus, the theory predicts that shocks that adversely affect the economic performance of bank borrowers and cannot be diversified should be positively correlated with systemic

⁸ The amount of risk that bank managers choose to take on, however, is likely to exceed what is socially optimal because of limited liability (Stiglitz, 1972). Hence the need for bank regulators to impose minimum capital requirements and other restrictions. When bank deposits are insured, incentives to take on excessive risk are even stronger (see below).

banking crises. Furthermore, for given shocks banking systems that are less capitalized should be more vulnerable. The empirical literature has highlighted a number of economic shocks associated with episodes of banking sector problems: cyclical output downturns, terms of trade deteriorations, declines in asset prices such as equity and real estate (Gorton, 1988, Caprio and Klingebiel, 1995, Lindgren *et al.*, 1996, Kaminsky and Reinhart, 1996).

Even in the absence of an increase in non-performing loans, bank balance sheets can deteriorate if the rate of return on bank assets falls short of the rate that must be paid on liabilities. Perhaps the most common example of this type of problem is an increase in short-term interest rates that forces banks to increase the interest rate paid to depositors.⁹ Because the asset side of bank balance sheets usually consists of loans of longer maturity at fixed interest rates, the rate of return on assets cannot be adjusted quickly enough, and banks must bear losses. All banks within a country are likely to be exposed to some degree of interest rate risk because maturity transformation is one of the typical functions of the banking system; thus, a large increase in short-term interest rates is likely to be a major source of systemic banking sector problems. In turn, the increase in short-term interest rates may be due to various factors, such as an increase in the rate of inflation, a shift towards more restrictive monetary policy that raises real rates, an increase in international interest rates, the removal of interest rate controls due to financial liberalization (Pill and Pradhan, 1995), the need to defend the exchange rate against a speculative attack (Velasco, 1987, Kaminsky and Reinhart, 1996)¹⁰.

Another case of rate of return mismatch occurs when banks borrow in foreign currency and lend in domestic currency. In this case, an unexpected depreciation of the domestic currency threatens bank profitability. Many countries have regulations limiting banks' open foreign currency positions, but sometimes such regulations can be circumvented (Garber, 1996). Also, banks that raise funds abroad may choose to issue domestic loans denominated in foreign currency, thus eliminating the open position. In this case, foreign exchange risk is shifted onto the borrowers, and an unexpected devaluation would still affect bank profitability negatively through an increase in non-performing loans. Foreign currency debt was a source of banking problems in Mexico in 1995, in the Nordic countries in the early 1990s, and in Turkey in 1994 (Mishkin, 1996).

When bank deposits are not insured, a deterioration in the quality of a bank's asset portfolio may trigger a run, as depositors rush to withdraw their funds before the bank declares bankruptcy. Because bank assets are typically illiquid, runs on deposits accelerate the onset of insolvency. In fact, as Diamond and Dybvig (1983) have shown, bank runs may be self-fulfilling, i.e. they may take place simply because depositors believe that other depositors

⁹ According to Mishkin (1996), most banking panics in the U.S. were preceded by an increase in short term interest rates.

¹⁰ Higher real interest rates are likely to hurt bank balance sheets even if they can be passed on to borrowers, as higher lending rates result in a larger fraction of non-performing loans.

are withdrawing their funds even in the absence of an initial deterioration of the bank's balance sheet. The possibility of self-fulfilling runs makes banks especially vulnerable financial institutions. A run on an individual bank should not threaten the banking system as a whole unless partially informed depositors take it as a signal that other banks are also at risk (contagion).¹¹ In these circumstances, bank runs turn into a banking panic.

Bank runs should not occur when deposits are insured against the risk of bank insolvency; deposit insurance may be explicit, i.e. banks may purchase full or partial insurance on behalf of depositors from a government agency or from a private insurer, or it may be implicit, if depositors (correctly) believe that the government will either prevent the bank from failing or that, in case of failure, it would step in and compensate depositors for their losses. If the premia do not fully reflect the riskiness of bank portfolios, then the presence of deposit insurance creates incentives for taking on excessive risk (moral hazard) (Kane, 1989). The effects of moral hazard are likely to be negligible when the banking system is tightly controlled by the government or by the Central Bank. On the other hand, when financial liberalization takes place -- as it has been in many countries in the last 15 years -- the opportunities for moral hazard increase substantially. Thus, if financial liberalization takes place in countries with deposit insurance, and it is not accompanied by a well-designed and effective system of prudential regulation and supervision, then excessive risk taking on the part of bank managers is likely, and banking crises due to moral hazard may occur. To summarize, the theory is ambiguous as to the sign of the correlation between deposit insurance and banking crises: on the one hand, when deposits are insured self-fulfilling crises should not occur; on the other hand, banking crises due to adverse macroeconomic shocks should be more likely because bank managers choose riskier loan portfolios.

In countries in which the banking sector is liberalized but bank supervision is weak and legal remedies against fraud are easy to circumvent, banking crises may also be caused by widespread "looting": bank managers not only may invest funds in projects that are too risky, but they may invest in projects that are sure failures but from which they can divert money for personal use. Akerlof and Romer (1993) claim that looting behavior was at the core of the Savings and Loans crisis in the U.S. and of the Chilean banking crisis of the late 1970's. Thus, a weak legal system that allows fraud to go unpunished should increase the probability of a banking crisis.

¹¹ For an in-depth discussion of the theory of bank runs, see Bhattacharya and Thakor (1994).

A sudden withdrawal of bank deposits with effects similar to those of a bank run may also take place after a period of large inflows of foreign short-term capital, as indicated by the experience of a number of Latin American, Asian, and Eastern European countries in the early 1990's. Such inflows, often driven by the combined effect of capital account liberalization and high domestic interest rates due to inflation stabilization policies, result in an expansion of domestic credit (Khamis, 1996). When domestic interest rates fall, or when confidence in the economy wavers, foreign investors quickly withdraw their funds, and the domestic banking system may become illiquid (Calvo *et al.*, 1994). As discussed by Obstfeld and Rogoff (1995), in countries with a fixed exchange rate banking problems may also be triggered by a speculative attack against the currency: if a devaluation is expected to occur soon, depositors (both domestic and foreign) rush to withdraw their bank deposits to convert them into foreign currency deposits abroad leaving domestic banks illiquid.¹²

¹² This mechanism seems to have been at work in Argentina in 1995: following the Mexican devaluation in December 1994, confidence in the Argentinean peso plunged, and the banking system lost 16 percent of its deposits in the first quarter of 1995 (IMF, 1996).

Banking sector problems may also follow successful stabilization in countries with a history of high inflation; as shown by English (1996), chronic high inflation tends to cause an overblown financial sector, as financial intermediaries profit from the float on payments. When inflation is drastically reduced, banks see one of their main sources of revenue disappear, and generalized banking problems may follow¹³.

The literature, therefore, suggests a variety of mechanisms that can bring about banking sector problems. In what follows, we attempt to use our data set to identify which of these mechanisms have played a major role in the crises of the 1980's and early 1990's.

3. The Empirical Specification and the Choice of Explanatory Variables

The Sample

Our study is focused on the 1981-94 period, because most banking crises are concentrated in this period. To determine which countries to include, we began with all the countries for which data are available through the IFS; we then eliminated centrally planned economies and economies in transition because the interrelation between the banking system and the rest of the economy is likely to be of a peculiar nature in these countries. Other countries had to be eliminated because the main macroeconomic and financial data series were missing or incomplete. A few countries such as Bangladesh and Ghana were left out because their banking system was in a state of chronic distress for the entire period under consideration. Finally, three countries (Argentina, Brazil, and Bolivia) were excluded because they were outliers with respect to two of the regressors that we use (inflation and the real interest rate).¹⁴ This process of elimination left us with a number of countries ranging from a maximum of 65 to a minimum of 45 depending on the specification of the regression.¹⁵ A list of the countries included in the sample can be found in the data appendix.

The Econometric Model

¹³ Recently, banking sector difficulties in Brazil and Russia have been explained in this way (Lindgren *et al.*, 1996).

¹⁴ We have also estimated the model including the three outliers. See Section 5 below.

¹⁵ Due to lack of data, for some countries the observations included in the panel do not cover the entire 1981-94 period.

We estimate the probability of a financial crisis using a discrete-time hazard model. In each period the country is either experiencing a crisis, or it is not. Accordingly, our dependent variable, the crisis dummy, takes the value zero if there is no crisis, and takes the value one if there is a crisis. Since we cannot predict a crisis with certainty, we will estimate the probability that a crisis will occur at a particular time in a particular country given that the country is at risk, i. e. we will estimate the hazard rate. We hypothesize that the hazard rate is a function of a vector of n explanatory variables $X(i, t)$. The choice of explanatory variables is discussed below. Let $P(i, t)$ denote a dummy variable that takes the value of one when a banking crisis occurs in country i and time t and a value of zero otherwise. β is a vector of n unknown coefficients and $F(\beta'X(i, t))$ is the cumulative probability distribution function evaluated at $\beta'X(i, t)$. Then, the log-likelihood function of the model is:

$$\text{Log } L = \sum_{t=1..T} \sum_{i=1..n} \{P(i,t)\ln[F(\beta'X(i,t))] + (1-P(i,t)) \ln[1- F(\beta'X(i,t))]\}.$$

In modeling the hazard rate we use the logistic functional form, which implies a hazard function that first increases and then declines.¹⁶

When interpreting the regression results it is important to remember that the estimated coefficients do not indicate the increase in the probability of a crisis given a one-unit increase in the corresponding explanatory variables. Instead, in the above specification, the coefficients reflect the effect of a change in an explanatory variable on $\log(P(i,t)/(1-P(i,t)))$. Therefore, the increase in the probability depends upon the original probability and thus upon the initial values of all the independent variables and their coefficients. While the sign of the coefficient does indicate the direction of the change, the magnitude depends on the slope of the cumulative distribution function at $\beta'X(i,t)$. In other words, a change in the explanatory variable will have different effects on the probability of a crisis depending on the country's initial crisis probability. Under the logistic specification, if a country has an extremely high (or low) initial probability of crisis, a marginal change in the independent variables has little effect on its prospects, while the same marginal change has a greater effect if the country's probability of crisis is in an intermediate range.

After the onset of a banking crisis, the behavior of some of the explanatory variables is likely to be affected by the crisis itself. For instance, the credit-to-GNP ratio is likely to fall as a result of the crisis, and the reduction in credit may lead to smaller GNP growth. Also, real interest rates may fall and inflation may rise due to the adoption of a looser monetary policy to shore up the banking sector; the crisis may induce the authorities to implement an explicit deposit insurance scheme, and so on. Clearly, these

¹⁶ The logistic distribution is commonly used in studying banking difficulties. See for example, Cole and Gunther (1993) and Gonzalez-Hermosillo, Pazarbasioglu and Billings (1996).

feed-back effects would muddle the relationships that we try to identify, so in a first set of regressions we eliminate from the panel all observations following a banking crisis. The drawback of this approach is that we lose episodes of multiple crises, and that many observations for the late 1980s and early 1990s are excluded from the sample.

As an alternative approach, we identify the year in which each banking crisis ended based on information available in existing case studies (see below), and in a second set of regressions we include in the panel all observations following the end date. This panel, of course, is considerably larger and it includes repeated banking crises. The drawback of this approach is that determining when the effects of a banking crisis come to an end is quite difficult, so the choice of which observations to include in the panel is somewhat arbitrary.¹⁷ Furthermore, in this set of regressions the probability that a crisis occurs in a country that had problems in the past is likely to differ from that of a country where no crisis ever occurred. To take this dependence into account, we include different additional regressors in the estimated equations such as the number of past crises, the duration of the last spell, and the time since the last crisis.

The estimated model is still somewhat restrictive because it implies that the only changes that occur in the hazard over time and across countries are those resulting directly from changes in the explanatory variables. To allow for the possibility that the hazard may change cross-country or over-time independently of the included explanatory variables, we also try specifications with country and time dummy variables. Finally, we also experiment with different lag structures for the explanatory variables.

The Banking Crisis Variable

A key element in our study is the construction of the banking crisis dummy variable. To do it, we have identified and dated episodes of banking sector distress during the period 1980-95 using primarily four recent studies: Caprio and Klingebiel (1995), Kaminsky and Reinhart (1996), Lindgren *et al.* (1996), and Sheng (1995). Taken together, these studies form a comprehensive survey of banking sector fragility around the world; from our perspective, it was important to distinguish between fragility in general and crises in particular, and between localized crises and systemic crises. To this end, we established -- somewhat arbitrarily -- that for an episode of distress to be classified as a full-fledged crisis in our panel at least **one of the following** four conditions had to hold:

1. The ratio of non-performing assets to total assets in the banking system exceeded 10%;
2. The cost of the rescue operation was at least 2% of GDP;
3. The episode involved a large scale nationalization of banks;

4. Extensive bank runs took place or emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government.

Therefore, the premise behind our work is that when one or more of the above conditions obtains the problem is of a systemic nature and should be considered a banking crisis, while when none of the above occurs the problem is localized and/or relatively minor. The criteria above were sufficient to classify as a crisis or not a crisis almost all of the fragility episodes identified by the literature. In a few cases, however, we had insufficient information and made a decision based on our best judgement. According to our classification, there were 31 episodes of systemic banking crises in the largest of our samples (Table 1). 23 crises took place in developing countries and 8 in developed countries. Of the crises in developing countries, 6 were in Latin America, 7 in Asia, 7 in Africa, and 3 in the Middle East. Thus, our sample includes a relative diverse set of economies.

The Explanatory Variables

Our choice of explanatory variables reflects both the theory of the determinants of banking crises summarized in Section 2 above and data availability. A list of the variables and their sources is in the data appendix. To capture adverse macroeconomic shocks that hurt banks by increasing the share of non-performing loans, we use as regressors the rate of growth of real GDP, the terms of trade, and the real short-term interest rate. High short-term real interest rates also affect bank balance sheets adversely if banks cannot increase their lending rates quickly enough, as explained in Section 2. Finally, the real interest rate may also be considered a proxy for financial liberalization, as Galbis (1993) found that the liberalization process tends to lead to high real rates. Financial liberalization, in turn, may increase banking sector fragility because of increased opportunities for excessive risk-taking and fraud.¹⁸ Pill and Pradhan (1995) argue that the variable that best captures the extent to which financial liberalization has progress is the ratio of credit to the private sector to GDP. Accordingly, we introduce this variable as

¹⁸ We explored the possibility of constructing a financial liberalization dummy using country by country information on the timing of liberalization; however, we abandoned the idea because for most countries in our panel the transition to a more liberalized regime was a very gradual process, sometimes taking a decade or more. Kaminsky and Reinhart (1986) find that a financial liberalization dummy variable tends to predict the occurrence of banking crises in their sample of 25 countries.

a regressor in our equations. Another variable that can proxy the progress with financial liberalization is the change in the credit-to-GDP ratio. Since case studies point to a number of episodes in which banking sector problems were preceded by strong credit growth, we experiment with various lags of this variable.

Inflation is introduced as an explanatory variable because it is likely to be associated with high nominal interest rates, and because it may proxy macroeconomic mismanagement which adversely affects the economy and the banking system through various channels. Because stabilization from chronic inflation may lead to a reduction in the size of the banking system which, in turn, may take place through a banking crisis, we also introduce the change in the rate of inflation as a regressor. In addition, the rate of depreciation of the exchange rate is used to test the hypothesis that banking crises may be driven by excessive foreign exchange risk exposure either in the banking system itself or among bank borrowers. To test whether systemic banking sector problems are related to sudden capital outflows we introduce as a regressor the ratio of M2 to foreign exchange reserves. According to Calvo (1996), this ratio is a good predictor of a country's vulnerability to balance-of-payments crises.

The government surplus as a percentage of GDP captures the financing needs of the central government. In many developing countries, due to the lack of a domestic market for government securities, deficits are financed through loans more or less voluntary from the banking system or through other forms of "financial repression". Thus, when fiscal deficits are large, the banking system may suffer and it may be more vulnerable.

Adverse macroeconomic shocks should be less likely to lead to crises in countries where the banking system is liquid. To capture the liquidity of the banking system we use the ratio of bank cash and reserves to bank assets. We also construct a dummy variable that takes a value of one in countries/years in which an explicit deposit insurance scheme is in place. As discussed in Section 2, the predicted sign of this variable is ambiguous, because explicit deposit insurance should reduce the incidence of bank runs but it is likely to increase risk due to moral hazard. Finally, banking sector problems may be due to widespread fraud in countries where the legal system is not very efficient; to test this hypothesis, we introduce as regressors indexes of the quality of the legal system, of contract enforcement, and of the bureaucracy. Since these indicators tend to be strongly correlated with the level of development, we also introduce GDP per capita as a control variable. These indexes may also reflect the government administrative capability which, in turn, is likely to be positively correlated with the effectiveness of prudential supervision of the banking system. Thus, low values for the indexes may mean more opportunities for moral hazard.

4. The Results

Tables 2 and 3 contain the main results of our econometric tests. Table 2 reports four regressions using the panel in which all observations following a banking crisis are

dropped, while Table 3 reports the same regressions for the panel with multiple crises. The first specification includes only the macroeconomic variables and GDP per capita, and it encompasses the largest set of countries. In the second specification we add the variables capturing the characteristics of the banking sector; in the third regression the deposit insurance dummy variable is included. The fourth regression relies on the smallest sample, and it includes the “law and order” index.

The quality of the model specification is assessed based on three criteria recommended by Amemiya (1981): model chi-square, Akaike’s information criterion (AIC), and in-sample classification accuracy. The model chi-square tests the joint significance of all the right-hand side variables in the model by comparing the likelihood of the model with that of a model with only the intercept; as shown in Tables 2 and 3, in all the specifications the hypothesis that the coefficients of the independent variables are jointly equal to zero is rejected at the one percent significance level. The AIC criterion is computed as the number of parameters being estimated minus the log-likelihood of the model, and it is therefore smaller for better models. This criterion is useful in comparing models with different degrees of freedom. The specifications without multiple crises typically do better than those with multiple crises, and model four appears to be the best based on AIC.

Finally, to determine the prediction accuracy of the various specifications, we report the percentage of crises that are correctly classified, the percentage of non-crises that are correctly classified, and the total percentage of observations that are correctly classified. The latter accuracy criterion is very stringent for non-crisis observations, because observations that are classified as crisis in the year prior to the actual crisis are considered as incorrectly classified. Nonetheless, our specifications appear to perform fairly well: the overall classification accuracy of the model varies between 67 percent and 84 percent, while up to 70 percent of the banking crises are accurately classified.

Let’s now turn to the role of the individual explanatory variables. The results of regressions using alternative specifications not reported in Tables 2 and 3 are briefly discussed in section 5 below. In both panels, low GDP growth is clearly associated with a higher probability of a banking crisis, confirming that real shocks to the economy have been a major source of systemic banking sector problems in the 1980s and 1990s. Also a decline in the terms of trade appears to worsen banking sector unsoundness, but this variable is significant only in two of the specifications and only at the 10 percent confidence level. GDP growth loses significance if it is lagged by one period, indicating that negative shocks work their way to bank balance sheets relatively quickly. Another possible interpretation is that the banking crisis itself causes a decline in the contemporaneous rate of GDP growth as credit to the economy withers. This interpretation would imply that causality runs in the opposite direction than we suggest. However, since credit goes to finance future production and not current production, it seems likely that a decline in credit would affect GDP only with a lag. This interpretation is also supported by the findings of Kaminsky and Reinhart (1996), who examine monthly

data around the time of a banking crisis and find that the decline in GDP growth tends to precede the onset of the banking crisis by about 8 months.¹⁹

¹⁹ Recall that our panels exclude years in which banking crises are under way, so periods in which growth is likely to be negatively affected by the decline in credit due to the crisis are not in the sample.

Both the real interest rate and inflation are highly significant in all the specifications and have the expected sign, confirming the well-known vulnerability of the banking system to nominal and real interest rate shocks;²⁰ on the other hand, the behavior of the exchange rate does not have an independent effect on the likelihood of a banking sector crisis once inflation and terms of trade changes are controlled for. Also the fiscal surplus is not significant. External vulnerability as measured by the ratio of M2 to reserves significantly increases the probability of a crisis in most of the specifications, as predicted by the theory.²¹

In the previous sections we conjectured that countries where the banking sector has a larger exposure to private sector borrowers should be more vulnerable to banking crises. This conjecture finds some support in our regression results, but the level of significance is low except in one of the specifications. Also the other financial variables (credit growth and the liquidity variable) fail to develop a consistent significant coefficient in all of the specifications, although the liquidity variable is significant in the fourth regression using the multiple crisis panel and credit growth is significant (and positive) if lagged by two periods in the third specification of the single crisis panel. Thus, there is some evidence that a boom in credit precedes banking crises, but the evidence is not very strong.

As predicted by the theory high values of the “law and order” index, which should measure the potential for looting and/or the ability to carry out effective prudential supervision, tend to reduce the likelihood of a crisis. It should be noted, however, that it is difficult to disentangle the effect of this index from that of GDP per capita, given the high degree of correlation between the two variables in our sample. Finally, the presence of an explicit deposit insurance system significantly increases the probability of banking sector problems in both our panels. Hence, although it may have reduced the incidence of self-fulfilling bank runs, the introduction of explicit deposit insurance has probably worsened banking sector fragility by encouraging excessive risk-taking. Our results also suggest that, in practice, regulatory efforts to counteract the moral hazard created by deposit insurance have not been very successful.

5. The Cost of Banking Crises

²⁰ In a specification that is not reported we also introduced the change in the rate of inflation to test whether crises are correlated with inflation stabilization. This variable was not significant.

²¹ This variable, however, tends to lose significance when the surplus-to-GDP variable is omitted. On other proxies of external vulnerability, see Section 5 below.

The approach taken in the previous sections is to treat all banking crises as uniform events. In practice, however, the crises in our panel were of different severity. In this section, we test whether the set of macroeconomic, structural, and institutional variables that are associated with the occurrence of banking crises can also explain observed differences in the severity of the crisis. We measure the severity of the crises by their cost (as a share of GDP) using the estimates in Caprio and Klingebiel (1995), which are available for 23 of the crises episodes in our sample. The explanatory variables are measured in the year in which the crisis begins. Of course, the cost of a crisis is an imperfect measure of the severity of the problems because it is influenced also by how well monetary authorities and bank supervisors deal with the crisis. As a proxy for the quality of the policy response we tried to use the duration of the crisis, but this variable does not appear to be significant. Perhaps a better proxy would be the number of years during which problems accumulate before the crisis explodes, but unfortunately this information was not available.

Table 4 reports the results. Surprisingly, low GDP growth does not affect the cost of a crisis, while a high real interest rate and high inflation do (except in the last specification). Of the structural variables, vulnerability to a balance-of-payments crisis is significant, while liquidity, and credit growth are not. The share of credit that goes to the private sector is significant only in one of the specifications. The “law and order” variable and the deposit insurance dummy are significant, but only at the 10 percent level (and only in model no. 4 in the case of deposit insurance). Since the low level of significance may be partly due to the small sample size, these results are still indicative that the presence of explicit deposit insurance may not only make banking crises more likely, but it may also make the such crises more expensive to clean up. Conversely, an effective legal system that sanction fraudulent behavior is likely to reduce both the occurrence of systemic banking problems and their cost.

5. Sensitivity Analysis

In classifying episodes of banking sector fragility as crises or non-crises we have relied on somewhat arbitrary cutoffs; thus, it is important to verify that the main results of the analysis are not sensitive to small changes in the threshold values for the ratio of non-performing loans to bank assets and for the cost of the crisis as a share of GDP. To this end, the regressions in Tables 2 and 4 were replicated for a sample that uses a more restrictive definition of a crisis (ratio of non-performing loans to bank assets above 15 percent and/or cost of crises above 3 percent of GDP) and for a sample with a less restrictive definition (ratio of non-performing loans to bank assets above 5 percent and/or cost of crises above 1 percent of GDP). In the set of regressions with single crises, the more restrictive criterion reduces the number of crises to 24 in model 1 and to 14 in model 4, while the less restrictive criterion increases the number to 30 in model 1 and to 20 in model 4. All of the results in Tables 2 and 4 remain essentially unchanged. Not surprisingly, the model with the more stringent definition of a banking crisis seems to be

the best in terms of goodness of fit, since with the more stringent definition it becomes easier to identify a crisis from a non-crisis.

To scrutinize the robustness of our results further, we have run two more sets of regressions in which we do not exclude from the sample years in which banking crises were on-going. In the first set of regressions, such years in which banking crises are treated as crisis years, while in the second set they are treated as non-crisis years. The results of these regressions look very much like those of the multiple crises specification. We also ran our regression including the three outlier countries (Argentina, Brazil, and Bolivia). In this case, the rate of inflation and the real interest rate are no longer significant, and some of the other macroeconomic variables become slightly less significant.

Finally, we have run specification using different proxies for balance-of-payments vulnerability, such as the ratio of foreign exchange liabilities (gross and net) of the banking sector to reserves, or the size of the capital account surplus; these variables, however, are less significant than the M2-to-reserves ratio. Indexes of corruption, quality of contract enforcement, quality of the bureaucracy, and delays in the justice system, fail to develop a significant coefficient. Also, a specification including the depth of the banking system as measured by the ratio of bank assets to GDP instead of the liquidity of the banking system does not perform any better than the regressions reported in Tables 2 and 3.

7. Conclusions

Since the early 1980s systemic banking sector problems have emerged repeatedly all over the world, and the need to understand the connections between banking sector fragility and the economy is all the more urgent. The now numerous case studies indicate that, while experiences vary quite substantially across countries and over time, there may be factors common to all banking crises. This paper attempts to identify some of these common threads by estimating a multivariate logit model for a large panel of countries.

We find that the macroeconomic environment plays a key role in breeding banking crises; particular, low GDP growth is associated to increased risk to the banking sector. Vulnerability to aggregate output shocks is not necessarily a sign of an inefficient banking system, as the role of banks as financial intermediaries by its very nature involves some risk-taking. However, banks could hedge some of the credit risk due to fluctuations of the domestic economy by lending abroad. From this perspective, the expansion of cross-border banking activities should improve the strength of banks all over the world. Small developing countries, whose output is typically more volatile, should especially benefit from increased internationalization. In future work, we plan to explore in more depth the connection between volatility, country size, and banking sector fragility.

Our results also indicate that an increased risk of banking sector problems may be one of the consequences of a high rate of inflation, possibly because high and uncertain nominal interest rates due to high inflation make it difficult for banks to perform maturity transformation. Thus, restrictive monetary policies that keep inflation in check are

desirable from the point of view of banking sector stability. However, when such policies are implemented in the context of an inflation stabilization program they may lead to a sharp increase in real interest rates; as our empirical evidence shows, high real rates tend to increase the likelihood of a banking crisis. Thus, the design and implementation of effective inflation stabilization programs should be accompanied by a careful evaluation of the impact on the domestic banking system, and measures to strengthen the bank balance sheets and managerial incentives may have to be taken before stabilization is attempted.

High real interest rates may also be the consequence of financial liberalization which, in turn, is often named as one of the culprits for banking sector fragility in the policy debate. We have found some (not very strong) evidence that a proxy for the degree of financial liberalization significantly increases the likelihood of banking crises even when real interest rates are controlled for; we plan to explore this issue further in future extensions by developing more accurate indicators of financial liberalization.

Our regressions indicate rather unambiguously that the presence of an explicit deposit insurance scheme tends to increase the probability of systemic banking problems. This suggests that, while deposit insurance may reduce the incidence of self-fulfilling banking panics, it introduces a significant degree of moral hazard which is often not successfully curbed through prudential supervision and regulation. Thus, reducing the moral hazard induced by deposit insurance should be a priority for policy-makers interested in strengthening the banking system; also, opting for an implicit rather than explicit deposit insurance scheme may be preferable while the administrative capability needed to enforce a system of prudential regulation is being created. To explore this issue further, we plan to test whether banking sector fragility is affected by specific features of the deposit insurance system such as the extent of the coverage, the type of premia charged to banks, the public or private nature of the scheme, and others.

Our study has several limitations, some of which we hope to address in future work. One is that we have focused on macroeconomic variables at the expenses of variables that capture the structure of the banking system and, more generally, of financial markets, and that are likely to play an important role. Aspects such as the degree of capitalization of banks, the degree of concentration and the structure of competition of the market for credit, the liquidity of the interbank market and of the bond market, the ownership structure (public versus private), the quality of regulatory supervision, and so on ought to be controlled for but are neglected here because of lack of data. Perhaps a study limited to a smaller set of countries that included more structural variables could yield interesting results, and allow us to control for the quality of impact of the regulatory response to the crisis. Another direction for future work is to develop a structural macro-model of the economy in which the banking sector plays an explicit role; with the help of such a model, it should be possible to obtain a more precise interpretation for the reduced form coefficients estimated here.

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Table 1

Country	Banking Crisis Date
Colombia	1982-85
Finland	1991-94
Guyana	1993-95
Indonesia	1992-94
India	1991-94
Israel	1983-84
Italy	1990-94
Jordan	1989-90
Japan	1992-94
Kenya	1993
Sri Lanka	1989-93
Mexico	1982, 1994
Mali	1987-89
Malaysia	1985-88
Nigeria	1991-94
Norway	1987-93
Nepal	1988-94
Philippines	1981-87
Papua New Guinea	1989-94
Portugal	1986-89
Senegal	1983-88
Sweden	1990-93
Turkey	1991, 1994
Tanzania	1988-94
US	1981-92
Uganda	1990-94
Uruguay	1981-85
Venezuela	1993-94

South Africa	1985
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Data Appendix

The countries included in the largest sample (regression no. 1, multiple crises panel) are the following: Austria, Australia, Burundi, Belgium, Bahrain, Canada, Switzerland, Chile, Congo, Colombia, Cyprus, Denmark, Ecuador, Egypt, Finland, France, United Kingdom, Germany, Greece, Guatemala, Guyana, Honduras, Indonesia, India, Ireland, Israel, Italy, Jamaica, Jordan, Japan, Kenya, Korea, Sri Lanka, Mexico, Mali, Malaysia, Niger, Nigeria, Netherlands, Norway, Nepal, New Zealand, Peru, Philippines, Papua New Guinea, Portugal, Puerto Rico, Paraguay, Senegal, Singapore, El Salvador, Sweden, Swaziland, Seychelles, Syria, Togo, Thailand, Turkey, Tanzania, Uganda, Uruguay, USA, Venezuela, South Africa, Zaire.

For most countries the years included are 1981-94; for some countries, however, a shorter subperiod was included because of lack of data. Thus, some countries in the sample had a banking crisis during 1981-94, but because of missing data in the years of the crisis that crisis does not appear in Table 1 (Chile, Thailand, and Peru are such examples). The following table provides details on the composition of each of the samples used:

	Countries excluded from sample no. 1
Regression 2, multiple crises	United Kingdom, Sweden, Zaire
Regression 3, multiple crises	Burundi, Bahrain, Congo, Cyprus, Gabon, United Kingdom, Guyana, Mali, Niger, Nepal, Papua New Guinea, Senegal, Singapore, Sweden, Swaziland, Seychelles, Tanzania, Zaire
Regression 4, multiple crises	Burundi, Congo, United Kingdom, Niger, Nepal, Senegal, Singapore, Swaziland, Seychelles, Zaire
Regression 1, single crisis	Chile, Peru, Turkey
Regression 2, single crisis	Chile, United Kingdom, Peru, Singapore, Sweden, Turkey, Zaire
Regression 3, single crisis	Burundi, Bahrain, Chile, Congo, Cyprus, Gabon, United Kingdom, Guyana, Mali, Niger, Nepal, Peru, Papua New Guinea, Senegal, Singapore, Sweden, Swaziland, Seychelles, Turkey, Tanzania, Zaire
Regression 4, single crisis	Burundi, Bahrain, Chile, Congo, Cyprus, Gabon, United Kingdom, Guyana, Israel, Mali, Niger, Nepal, Peru, Papua New Guinea, Senegal, Singapore, Sweden, Swaziland, Seychelles, Turkey,

Description of the Explanatory Variables

Variable Name	Definition	Source
Growth	Rate of growth of GDP per capita	IFS data base where available. Otherwise, WEO data base.
Tot change	Change in the terms of trade	IFS
Depreciation	Rate of change of the exchange rate	IFS
Real interest rate	Nominal interest rate minus rate of inflation	IFS. Where available, nominal rate on short-term government securities. Otherwise, a rate charged by the Central Bank to domestic banks such as the discount rate; otherwise, the commercial bank deposit interest rate
Inflation	Rate of change of the GDP deflator	IFS
Surplus/GDP	Ratio of Central Government budget surplus to GDP	IFS
M2/reserves	Ratio of M2 to foreign exchange reserves of the Central Bank	M2 is money plus quasi-money (lines 34 + 35 from the IFS). Reserves are from the IFS.
Private/GDP	Ratio of domestic credit to the private sector to GDP	Domestic credit to the private sector is line 32d from the IFS.
Cash/bank	Ratio of bank liquid reserves to bank assets	Bank reserves are line 20 of the IFS. Bank assets are lines 21 + lines 22a to 22f of the IFS.
Credit growth	Rate of change of the ratio of bank assets to GDP	see above
Deposit insurance	Dummy variable for the presence of an explicit	Data assembled by A. Demirgüç-Kunt from various sources

	deposit insurance scheme	
Law and order	An index of the quality of law enforcement	International Country Risk Guide

