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INTRODUCTION

The serious disruption to financial markets and banking systems in south-east Asia in the late 1990s provided a timely reminder of how disruptively banking crises can erupt and of how difficult it is to foresee the timing and full extent of these dramatic events. Indeed, after the collapse of the Bretton Woods system, banking crises have claimed many victims, as it is estimated that over the 1980–96 period at least two-thirds of IMF member countries experienced significant banking sector problems in the aftermath of a prolonged period of unstable macroeconomic policies, with a severe impact on economic activity. Therefore, not only are banking crises no rare events but also there is a growing concern about their origin.

There are two reasons why banking problems merit particular attention: first, the serious consequences for the local economies, as it is established that they consist the most destructive type of financial crisis, and, secondly, the side effects on other countries as international financial markets have become more integrated. Therefore, a significant body of empirical research has focused on the subject of potential leading indicators of banking crises, trying to establish whether the behavior of several macroeconomic variables prior to the onset of banking crisis follows a consistent pattern and thus, can warn efficiently for an oncoming banking crisis. The list of these variables is quite long, ranging from growth rates and debt ratios to the existence of deposit insurance and capital controls.

There are several common themes emerging from the existing studies, mostly indicating that high real interest rates, low output growth, rapid domestic credit growth and falls in the terms of real exchange rate appear to be associated with an increased likelihood of banking crisis. Nevertheless, all models are subject to some significant weaknesses and limitations, especially as potential tools for policymakers. In fact, in most cases the results are not robust to a change in the sample or the definition of crisis and the explanatory variables are only correlated contemporaneously with the crisis, thus limiting their use in leading indicator models for policymakers. Therefore, there is a growing concern whether the origins of systemic banking crises are potentially numerous or even worse whether bank failures can be predicted at all, occurring because of some random event. Similarly, if the role of contagion is important, the search for leading indicators of bank crises is futile as the diffusion of the distress would be a result of panic.

Despite the poor results of the previous attempts, this thesis aims to contribute to this area of research by suggesting that the likelihood of banking crisis is increased as a result of a period of financial liberalization. The reasoning behind this association is quite straightforward. A liberalized financial sector entails the removal of most restrictions concerning interest rates,

bank lending policy and the entry of new competitors. This is the start of a period of increased private credit, soaring asset prices and low bank reserve ratios, or in other words the basic ingredients of an overheated economy. When this unsustainable pattern ends, banks are left with diluted capital, a high ratio of non-performing loans or virtually in the brink of default. So far, the association between financial liberalization and a following banking crisis has been already examined in most of the significant studies on this field, but usually with the inclusion of a dummy variable, as the removal of interest rate controls (*Demirguc-Kunt and Detragiache [10]*) or the high growth in the domestic credit (*Kaminsky and Reinhart [9]*), in a wide set of macroeconomic and institutional variables. On the whole, there seems to be a consensus that a period of premature financial liberalization can be met prior to most banking crises.

However, this study departs from the previous empirical studies on the subject in several important ways concerning both the sample and the methodology used. Firstly, it focuses entirely at the link between the two events with the use of real variables, meaning the 6 indices of financial repression, as signals of a financial liberalization. Another innovation is the introduction for the first time of a measure of international liquidity, U.S. M3/GDP, as the 7th explanatory variable in the model. Moreover, special priority was given to the construction of reliable model with lagged values, as an attempt to construct an efficient warning system of oncoming banking crises. Finally, the input data is on a monthly basis rather than an annual one like all the previous studies at the cost of a more limited sample.

As far as the empirical methodology is concerned, we estimate a probit model using a panel data with monthly information for 19 countries, both developed and emerging, which have experienced a major banking crisis in the period of 1978-2000. More specifically, the dependent variable (y_i), the crisis dummy, will indicate the incidence of a banking crisis, taking discrete values of either 1,when the crisis occurs, or 0,when it does not and will be related to the continuous series of the 7 independent variables, meaning the 6 indicators of financial repression and the indicator of international liquidity (USM3/GDP). Finally, the criterion for assessing the quality of the reported models is not their explanatory power but mostly, their predictive accuracy, as measured by the percent of in-sample observations correctly predicted as crisis episodes or not.

The thesis organized as follows. Chapter 1 provides the necessary conceptual background while Chapter 2 examines the origin and impact of most banking crises. A comprehensive review of the relevant bibliography and the dynamics of the most significant banking crises are presented in Chapters 3&4 respectively. Chapter 5 describes the empirical model, the sample and the data transformation. Finally in Chapter 6, there is an analytical presentation of the results of the regressions. The final section offers conclusions and underscores some policy implications.

1. CONCEPTUAL BACKGROUND

1.1 What is a banking crisis?

The term banking crisis refers to a situation in which actual or potential bank runs or failures induce a bank to suspend its financial intermediating activity or which forces the government to intervene to prevent this by extending assistance on a large scale. A banking crisis may be so extensive as to assume systemic proportions, meaning that it impairs markets' ability to function effectively.

In a more formal context, the majority of relevant empirical studies identify banking crises according to the operational criteria set by *Demirgüç-Kunt and Detragiache [10]* who have adopted one or more of the following criteria in defining a banking crisis periods:

- The ratio of non-performing assets to total assets in the banking system exceeded 10 %

- The cost of the rescue operation was at least 2% of GDP

- Banking sector problems resulted in large-scale nationalization of banks

- Extensive bank runs took place

- Emergency measures such as deposit freezes, prolonged bank holidays, or generalized deposit guarantees were enacted by the government in response to the crisis.

Other authors use slightly different criteria to define a banking crisis. For example, *Kaminsky and Reinhart [9]* assess a banking crisis to have occurred if:

- Bank runs lead to the closure, merger or takeover by the public sector of one or more financial institutions or

- In the absence of runs, the closure, merger, takeover or large-scale government assistance to a bank triggered a string of similar outcomes for other financial institutions.

An alternative way of defining a banking crisis is to use aggregate balance sheet data. If a banking crisis were the result of bank runs, namely the simultaneous withdrawal of deposits from one or more banks, then one could interpret a sharp fall in aggregate bank deposits as the beginning of a banking crisis. But it is clear that in recent years most banking problems in

developed countries have not been associated with bank runs, but rather with problems on the asset side of the balance sheet. Moreover, a bank run (or a large-scale government intervention to prevent a potential bank run) is likely to have been preceded by a period of deterioration in the quality of a bank's assets. This is confirmed by Hardy and Pazarbasioglu [20], who find that bank deposits in their large sample of banking crises in both developed and emerging markets start falling in real terms before a banking crisis is fully acknowledged, and continue to fall during the crisis. Another problem with using deposits is that changes in aggregate deposit growth may reflect macroeconomic factors rather than critical problems in the banking sector.

This disagreement in the definition of a banking crisis has resulted in differences across the various studies concerning both the periods of crises and in the dates attributed to them and thus, has affected their statistical robustness. Japan's banking crisis, for example, is dated by *Demirgüç-Kunt and Detragiache [10]* criteria as starting in 1992. This is the first year of substantial government attention to the problem. However, the first substantial plans for restructuring a significant part of the financial sector wasn't until 1993 and many observers wouldn't characterize the Japanese banking problem as a full-blown "crisis" until 1995. On the other hand, using realistic estimates of non-performing loans as an indicator might date the beginning of Japan's banking distress already in 1991.

Identifying a banking crisis

The measurement and dating of banking crises pose various practical difficulties because of the nature of the problem and data limitations. Although data on bank deposits is available, and thus could be used to identify crises associated with runs on banks, most recent banking crises have originated from the assets' side of the balance sheet, especially in industrial countries. Moreover, large deposit withdrawals, or in other words bank runs, have occurred but only as the result rather than the cause of banking crisis. Therefore, identifying banking sector distress by the deterioration of bank asset quality is quite difficult, as it requires direct market indicators of asset value, which are usually lacking, such as the share of non-performing loans in banks' portfolios, large fluctuations in real estate and stock prices and indicators of business failures. Moreover, it is often weakness in government analysis of banking fragility and slow follow-up action once a problem is recognized, that allows the situation to deteriorate to the point of a major bank crisis involving large-scale government intervention.

1.2 Other types of financial crisis

Apart from banking crisis, other types of financial crisis can be also defined:

- *Currency crisis*

Such a crisis occurs when a speculative attack in a currency leads to the devaluation of the currency or to its defense through the loss of international reserves or the sharp increase in interest rates.

- *Foreign debt crisis*

A foreign debt crisis entails the failure of a country fails to service its foreign debt, sovereign or private.

- *Systemic crisis*

A systemic financial crisis defines the severe disruption of financial markets that by impairing markets' ability to function properly can have adverse effects on the real economy.

Crises of all types seem to have common origins and thus, at times, currency and banking crises may occur simultaneously, as in the Mexico crisis in 1994-95. Moreover, what may start as one type of crisis may develop to others in the end. Banking crises tend to be followed by turmoil in currency markets especially in developing countries like in Turkey in mid 1990s. However, the opposite has also occurred as in Mexico in 1982 where the withdrawal of external financing led to a banking crisis. In general, the fact that one type of crisis precedes another does not always imply causality, because the vulnerability of the banking sector may be revealed only after a pressure on a currency has undermined the confidence in the whole economy.

The Twin Crises

An empirical study of *Kaminsky and Reinhart [9]*, has examined empirically the links between a banking and a currency crisis and more specifically, the event of "twin crises" meaning the episodes where a banking crisis follows the onset of a currency crisis within the next 48 months. This study indicated that there is no apparent link between banking and currency crises during the 1970s, when financial markets were highly regulated, while these two types of distress become strongly associated in the 1980s after the financial liberalization in most countries. Most often, the beginning of a banking sector distress predates currency turmoil, without, however, a direct causal link. Obviously, the collapse of a currency deepens the banking crisis, activating a vicious spiral as the peak of the banking crisis follows the currency crash. On the whole, it seems that when comparing episodes of joint banking and

currency crises, a case of "twin crises", to simple incidents, both the original economic instability and the following impact were far more severe in the first case.

1.3 The information approach to the banking system

A key element of the operation of any financial institution is the information flows between the institution and the consumers. Similarly, these flows not only exist in the banking system but can also signal a banking crisis through their breakdown.

Asymmetric information in the financial system

The main obstacle to the efficient functioning of the financial system is asymmetric information, a situation in which one party to a financial contract has much less accurate information than the other party. For example, borrowers who take out loans usually have much better information about the potential returns and risk associated with the investment projects than lenders do. Asymmetric information generates three basic problems in the financial system: adverse selection, moral hazard and the free-rider problem.

- *Adverse selection*

Adverse selection is an asymmetric information problem that occurs prior to the transaction when potential bad credit risks are the ones who most actively seek out a loan. Thus, the parties who are the most likely to produce an undesirable (adverse) outcome are most likely to be selected. For example, those who want to take on big risks are likely to be the most eager to take out a loan because they know that they are unlikely to pay it back. Since adverse selection makes it more likely that loans might be made to bad credit risks, lenders may decide not to make any loans even though there are good credit risks in the marketplace. Clearly, minimizing the adverse selection problem requires that lenders must screen out good from bad credit risks.

- *Moral hazard*

Moral hazard occurs after the transaction takes place, as the lender is subjected to the hazard that the borrower has incentives to engage in activities that are undesirable (immoral) from the lender's point of view, meaning activities that make it less likely that the loan will be paid back. Moral hazard occurs because a borrower has incentives to invest in projects with high risk from which the borrower gains if the project succeeds but the lender bears most of the

loss if the project fails. The conflict of interest between the borrower and lender stemming from moral hazard (the agency problem) implies that many lenders will either decide to avoid loans or to impose restrictions (restrictive covenants) on borrowers in order to minimize the moral hazard problem. In this way, lenders must monitor the borrowers' activities and enforce the restrictive covenants ensuring that borrowers do not engage in risky behavior.

- *Free-rider problem*

Another important feature of a financial system is the so-called free-rider problem, meaning the fact that people who do not spend resources on collecting information can still take advantage of the information that other people have collected in a "free ride" form. As a result, investors who have acquired information will have no incentive to acquire information and the moral hazard will be aggravated.

Factors leading to information problems in the banking system

A banking crisis presupposes that shocks to the banking system aggravate the above-mentioned information problems by disrupting information flows so that banks can no longer do their job of channeling funds to those with productive investment opportunities. More specifically, there are four categories of factors that consist such disruptive shocks and can eventually lead to financial instability: increases in interest rates, increases in uncertainty, asset market effects on balance sheets, and government insurance.

- *Increase in interest rates or uncertainty*

A higher interest rate leads to even greater adverse selection, as borrowers with the riskiest investment projects are exactly those who are willing to pay the highest interest rates since if the high-risk investment succeeds, they will be the main beneficiaries. Similarly, an increase in uncertainty makes information in the financial markets even more asymmetric and worsens the adverse selection, as it makes it harder for lenders to screen out good from bad credit risks.

- *Asset Market effect on balance sheets*

The asset market effects on the balance sheet of both non-financial firms and banks is the most critical factor for the severity of asymmetric information problems in the financial system. Deterioration of balance sheets worsens both adverse selection and moral hazard problems in financial markets, thus promoting financial instability. Events like a stock market crash, a real estate market decline, a large volatility in inflation rates or in exchange rates, especially in emerging countries, are likely to increase adverse selection and moral hazard

problems in banking system because they may lead to a large decline in the market value of firms' net worth.

- *Government Insurance*

Government protection of banks is likely to magnify the information problems of the banking system. The role of bank depositors and debt holders is to ensure prudent behavior and value creation by banks, as the prospect of withdrawing their funds discourages excessive risk taking and insider lending. However, government protection insulates banks form such pressures by offering guarantee of bank deposits and other bank liabilities. In this way, public agents are charged with bank monitoring and banking risk becomes socialized and thus, is likely to increase, for government discipline is more permissive than market one. On the whole, government insurance of bank deposits tends to aggravate moral hazard and connective lending.

How can banks manage information problems

Although banks face the same problems from asymmetric information as any other financial institution, they seem to have particular advantages in solving them. For example, banks' advantages in information collection activities are enhanced by their ability to engage in long-term customer relationships and issue loans using lines of credit arrangements. In addition, their ability to scrutinize their borrowers provides banks with an additional advantage in monitoring the borrowers' behavior. Banks also have advantages in reducing moral hazard because, as demonstrated *by Diamond (1984)*, they can engage in lower-cost monitoring than individuals. Banks' natural advantages in collecting information and reducing moral hazard explain why banks have such an important role in financial markets throughout the world. Furthermore, the greater difficulty of acquiring information on private firms in emerging-market countries makes banks even more important in the financial systems of these countries.

1.4 Why are banks so vulnerable to banking crises?

Much of the theory on banks' vulnerability to adverse shocks focuses on the special role of banks in asset maturity and currency transformation in an uncertain world with asymmetric information. Indeed, banks' operation features the following particularities, accounting for their high vulnerability to instability or more commonly to a crisis:

- *Banks are highly leveraged*

Bank leverage has two important implications. Firstly, capital is the "cushion" that stands between adverse shocks and bankruptcy, and because it is quite thin relatively small shocks can drive a bank to insolvency. Therefore, the amount of capital that should be held depends upon the volatility of the financial environment, as capital acts like a crucial buffer stock for banks. Secondly, leverage, combined with limited shareholder liability, generates the above-mentioned problem of moral hazard, arising from the fact that shareholders receive the entire benefit of good outcomes, while debtors pay the price of bad outcomes. Although banks are not unique in being leveraged, the problems created by leverage are more serious for them for two reasons. Firstly, banks are much more leveraged than any typical non-financial firm, as the value of a bank's equity typically totals about a tenth of the value of its debt. Secondly, for reasons that will be discussed below, bank depositors are in a poor position to perform the functions of corporate governance that are typically performed by creditors of a non-financial corporation.

- *Banks are relatively illiquid*

In most economies, banks perform an explicit transformation of maturities, taking relatively short-term deposit liabilities and holding longer-term loan assets. Even in emerging markets where bank lending tends to be relatively short- term, there is a maturity mismatch. Firstly, although bank lending tends to be short-term, loans are still longer-term than deposits, as they actually operate as longer-term commitments because enterprises count on the loans being rolled over. Otherwise, borrowing firms will be forced into actions that undermine their own profitability and perhaps that of their business partners, thus resulting in a decline in the quality of banks' loans. Thus, whatever the stated maturity of its loan portfolio, the banking system is illiquid in the sense that an attempt to rapidly liquidate its portfolio would sharply reduce the value of its assets. This illiquidity risk has important consequences especially in financially volatile regions where, as will be discussed in more detail below, macroeconomic shocks to banks' funding sources are very large.

- *Banks manage information problems.*

A third and crucial feature of banks is their role in resolving the information problems that were described above. On this, two points are particularly relevant. Firstly, it is the business of banks to generate private information about their borrowers, a situation that puts both depositors and supervisors at an informational disadvantage vis-à-vis the banks. Secondly, to the extent that borrower liquidity is an important signal of solvency, the quality of the signal received by an individual bank depends very much upon conditions in the loan market as a whole. In short, during lending booms banks may have a very difficult time determining which of their loans are going bad. And, if bank managers have a hard time determining

which borrowers are at risk, it follows that supervisors will be at least as deeply in the dark, and probably more so.

- *Bank solvency and liquidity interact.*

As it was discussed above, the essential illiquidity of banks means that a sudden need to contract lending of the banking system as a whole is likely to reduce the quality of bank assets, leading to a decline in asset markets and, default of borrowers. Thus, bank liquidity problems can immediately be translated into solvency problems, and to the extent that there is a policy interest in ensuring that banks are solvent, there is an interest in ensuring that they are liquid. At the same time, real or imaginary bank solvency problems are likely to generate a flight by depositors, generating a liquidity shock that will, in turn, reduce the quality of the bank portfolios, possibly by enough to validate the initially exaggerated fears that motivated the bank run. This means that bank runs can occur as self-fulfilling expectations of bank failure, driving even well- run banks into insolvency.

- *Bank depositors are protected.*

As noted above, not only it is particularly difficult to monitor bank behavior but also bank depositors are ill-equipped to control the incentive problems that face bank managers. In order to reduce the likelihood of bank runs implicit or explicit government-provided deposit insurance is a common feature of banking systems. However, this insurance completely disrupts the corporate governance of banks, for it eliminates any incentive for bank depositors to monitor managers of the banks and thus, aggravates the "moral hazard" problem.

- *Limits of bank regulation.*

The particular features of the banking system limit in several ways bank supervision and regulation, thus impeding the efficient prevention of banking crises. Firstly, prudential regulation is costly as by forcing banks to reduce their leverage and increase their holdings of liquid assets their efficiency is likely to be affected. Therefore, a balance needs to be struck between the need to contain bad incentives created by bank leverage and information problems and the advantages of financial intermediation. Moreover, bank supervision must be made in a transparent fashion, respecting private ownership and business judgment and restricting the arbitrary or discriminatory treatment of individual banks. This means that supervision must be based upon observed data with limited scope for discretionary decisions. However, in this way there is a "regulatory lag", as observable indicators of problems typically arrive well after problems have actually begun to emerge. Finally, bank supervision is limited by regulators' information set, meaning that banks will often have an incentive to hide portfolio problems from supervisors. Overall, this places important limits on the ability of regulators to detect and prevent problems and particularly during credit booms when problems are most likely to develop.

1.5 Why should we care about banking crises?

After establishing that it is the special nature of banks that renders them so vulnerable to banking crises, it is hardly surprising to remind that banking crises have occurred throughout history since their first appearance. Yet, the magnitude of losses following the most recent cases has marked a change from the past.

Therefore, the concern about banking crises and their reliable prediction is not surprising given their potentially huge cost and their long-lasting impact. Actually, the aftermath of a banking crisis tends to last more than any other type of crisis since it entails not only fiscal cost and real output loss, as with other crises, but also a turmoil in financial markets. A second explanation, not mutually exclusive, is that a banking crisis cuts off both external and domestic sources of funding whereas a currency crisis cuts off only the former. Moreover, banking crises are likely to trigger off a currency crisis leading to, the so-called, twin crises, with an overwhelming total cost. Finally, there is the risk of the propagation of the crisis to other economies.

The cost of banking crises to the originating country

The actual cost of a banking crisis is hard to measure, for it can take many forms:

- *The bailout cost*

The use of public money to recapitalise insolvent banks can seriously handicap efforts to control budget deficits and hinder the effort of private creditors to monitor the behavior of banks in the future, thus, increasing the moral hazard.

- *The loss of output*

The lower availability and higher cost of bank credit can undermine the real economy, particularly for small and medium-sized firms, which have fewer alternative sources of financing.

- *Information problems*

The worsening of information and adverse selection problems that typically occurs during a financial crisis, as it is the least creditworthy borrowers who will be prepared to pay high interest rates, means that the quality of investment is likely to suffer.

- *The disruption of monetary policy.*

Fears of pushing an already strained banking sector over the edge may constrain the monetary authorities from tightening monetary policy to deal with, for instance, a loss of confidence by foreign investors or a rise in incipient inflationary pressures.

- *The risk of a fully-fledged crisis for emerging economies*

The handicaps of emerging economies, such as the short duration of debt, the large amount of debt denominated in foreign currency and the lack of inflation-fighting credibility can interact with a banking crisis to drag the economy into a full-fledged financial crisis. The rise in actual and expected inflation and the effort to defend the currency can push interest rates to sky-high levels. For example, in the aftermath of the Mexican December 1994 devaluation, domestic short-term interest rates in Mexico rose to above 100 % at an annual rate. On the whole, the interaction of the rise in interest rates with the short duration of debt leads to a huge increase in interest payments, with a dramatic deterioration in households and firms' cash flow.

Table 1-1 illustrates the devastating output loss, in terms of GDP, in the South East Asia region after the outbreak of the crisis in mid-1997. It is striking to notice the difference between the projections for 1998 and the actual figures, reaching even 20% for Indonesia.

Table 1-1: South East Asia: Real G.D.P. Losses from Banking Crisis

Country	1996	1997	1998(*)	Actual 1998
Hong-Kong	4.9	5.3	5.5	-5.1
Indonesia	7.8	4.9	7.5	-13.7
Malaysia	8.6	7.8	7.9	-6.7
Philippines	5.7	5.1	6.4	-0.5
South Korea	7.1	5.0	6.3	-5.8
Thailand	6.4	-1.3	7.0	-8.0

Source: International Monetary Fund, World Economic Outlook
(*) As projected in May 1997

Table 1-2 summarizes the resolution cost of the most significant banking crises in both the industrial and developing countries, only to highlight the much more devastating impact of a banking crisis to the developing countries.

Table 1-2: Resolution Cost of Banking Crises

Country	Period	Loss of GDP(%)
Industrial Countries		
Spain	1977-1985	17
Japan	1990s	12
Finland	1991-94	8
Sweden	1991-94	6
Norway	1991-94	4
Developing Countries		
Argentina	1980-82	55
Indonesia	1997-99	50
Thailand	1997-99	42
Chile	1981-83	41
Israel	1977-1983	30
Uruguay	1981-84	24
Korea	1997-99	20
Az Venezuela	1994-95	18
Mexico	1995	15

Table 1-3 summarizes the macroeconomic context of the post-crisis period, by stating the average number of months it takes for each variable to return to its normal value and whether the level or growth rate of the variable remains above or below its normal value in the post crisis period.

Table 1-3: Average Length of Recovery Time from a Banking Crisis

Indicator *(in descending order)*	Months for a variable to return to its "normal" behavior
Stock Prices	30(below)
Bank Deposits	30(below)
Imports	29(below)
Exports	20(below)
Output	18(below)
M2/Reserves	15(above)
Real interest rate	15(above)
Real interest rate differential	15(above)
Domestic Credit/G.D.P.	15(above)
Excess M1 balances	9(above)
Real Exchange rate	8(below-overvalued)
M2 multiplier	7(above)
Terms of trade	4(below)
Lending –Deposit ratio	0(above)

Note: The parenthesis indicates whether the variable remained above or below its "normal" value during the crisis.

Table 1-4 shows that the rate of currency depreciation, average rate of inflation, and the M2/Reserve ratio are significantly higher in the countries in crisis. Real interest rates also appear to be marginally lower and stock price increases somewhat higher. Finally, average values of budget deficits, contrary to conventional wisdom, are not markedly higher in the crisis countries.

Table 1-4: The macroeconomic impact of banking crises

	Countries not in crisis[1]	Countries in crisis[2]
Real G.D.P. Growth	3,7	3,5
Budget Surplus	-3,7	-3,8
Inflation	10,2	13,3
Real Interest Rate	0,5	-0,3
M2/Reserve Ratio	14,0	21,7
Credit Growth(%)	11,7	9,8
Stock Price Change	12,9	16,5
Budget Surplus	-3,7	-3,8
Exchange Rate Depreciation (%)	8,8	20,2

Source: Hutchinson and Mc Dill [22]
1: Mean Value over 1975-97 period of the countries not experiencing banking sector distress.
2: Mean Value for 5-year period preceding episodes of banking sector distress for countries in sample experiencing banking crisis.

Table 1-5 indicates that mean real GDP growth for the crisis countries during the "tranquil" period preceding the onset of distress was 3.5 %, which is not significantly different from the non-crisis mean value (Table 1-4). Moreover, real GDP growth during the first year of the crisis 0,77% was significantly lower than the preceding five-year period and growth during the crisis episode 2,4% was significantly higher than the initial year. Finally, other three variables indicate a distinct shift over crisis episodes: exchange rate depreciation, credit growth and stock prices. Movements in credit growth are striking and mirror real GDP growth: strong growth rates prior to the crisis, credit contraction during the first year of the crisis, and moderate rebounds during the latter phase of the crisis episode. Exchange rate depreciation also jumps significantly at the onset of the crisis and the rate of stock price increase drops markedly.

Table 1-5: Macroeconomic indicators prior to, during

and after the banking crisis

	Average		
	Before	1st year	During
Real G.D.P. Growth	3,5	0,7	2,4
Exchange Rate Depreciation	20,2	40	17,7
Inflation	13,3	14,3	10,7
Real Interest Rate²	- 0,3	-0,3	0,5
M2/Reserve Ratio	21,7	21,7	29,5
Credit Growth	9,8	4,8	1,8
Budget Surplus	-3,8	-3,2	-3
Stock Price Change³	16,5	1,9	13,7

Source: Hutchinson and Mc Dill [22]
1: Mean Values over period for countries experiencing banking sector distress.
2: Length varies by duration of episode
3: Excludes high inflation countries.

The Cost of Twin Crises

According to the above-mentioned study of *Kaminsky and Reinhart [9]* the coincidence of a banking and a currency crisis generates by far more severe losses than either type of crisis occurring alone, as they form a vicious circle. Practically, episodes in which the beginning of a banking crisis is followed by a currency crisis within 48 months are classified as twin crises. On average, financial sector problems tend to undermine the currency and thus, lead to devaluation, which, in turn, aggravate the existing banking problems especially when lacking hedging of foreign-exchange risk.

The overall economic losses of a "twin crises" episode was defined as the sum of the cost due to the banking distress, meaning the bailout costs as % of G.D.P., and the cost due to the currency crash, measured by a composite index averaging reserve losses and real exchange-rate depreciation. Table 1-6 summarizes the results of this comparison between single and twin crises, confirming the hypothesis of the devastating impact of a twin crises episode. Indeed, it is clear that the total cost of the twin crises episodes can reach even 3 times higher than the cost of a single banking or currency crisis.

Table 1-6 The Severity of the Twin Crises

Severity Measure	Banking Crises		Currency Crises	
	Twin	Single	Twin	Single
Cost of Bailout (% G.D.P.)	13,1	5,1	-	-
% Loss of Reserves	-	-	25,4	8,3
% Real Depreciation	-	-	25,7	26,6
Composite Index	-	-	25,6	17,5

Source: Kaminsky & Reinhart [9]
Notes: Loss of reserves is the % change in the level of reserves in the 6 months preceding the crises, while real depreciation is the % change in the R.E.R. in the same period. The composite index is the unweighted average of the loss of reserves and the real depreciation.

The risk of contagion to other countries

The risk of contagion stems from the fact that the existence of a crisis elsewhere increases the probability of a crisis at home, even when fundamentals have been taken into account. In the absence of a common shock, a crisis can spread via links of trade and finance. Some studies call this case spillover rather than contagion, reserving the term contagion for cases where a crisis spreads despite the absence of any links whatsoever and possibly due to shifts in sentiment and confidence on the part of investors. Another issue is that banking crises in emerging economies can also be costly for industrial countries, particularly as the importance of emerging countries in the world economy and in international financial markets has grown. In short, to the extent that banking crises depress developing countries' growth and foreign trade, strain their ability to service and to repay private capital inflows, and eventually add to the liabilities of developing country governments, industrial countries are very likely to feel the repercussions.

Although it was believed that the contagion of financial crisis, in general, usually runs from large economies to smaller ones, the Asian crisis of 1997 showed that severe financial distress even in a small economy, namely Thailand, can have major spillover effects in similar economies through one of the following channels:

- *Perceived similarities in the macroeconomic and financial vulnerability*

After the Mexican peso devaluation, Argentina and Brazil were the countries to come under severe speculative pressure as in the Central Bank of Argentina lost about 20% of its foreign exchange reserves and bank deposits fell about 18%, leading to massive capital outflow and a liquidity crisis in the banking system.

- *Competitive devaluation in the presence of trade links.*

Once one country has devalued after a currency crisis it is costly in terms of lost competitiveness for other countries with comparable export orientation to maintain their parities. In this setting, there are subsequent devaluations even for "strong" currencies, generating financial turmoil.

- *Information Asymmetries*

It has been established that an increase in the costs of gathering and processing country-specific information give rise to herding behavior, even when investors act on a rational basis. Therefore, a crisis in one country may lead investors or creditors to reevaluate the fundamentals of other countries even if these remain unaltered. The most notable case is the Mexican crisis in 1995, known as the tequila effect, when institutional investors ended up selling off equities in many more emerging markets despite the heterogeneity of macroeconomic fundamentals between them.

- *Liquidity and margin call effects operating via the regulatory framework*

A leveraged investor facing margin calls needs to sell his assets at a fire sale price in order to increase his liquidity in anticipation of future redemptions. The common strategy calls for the sale not of the assets that have already collapsed but of the ones that are still in their money. In this way, asset markets across countries are depressed and the banking system gets in distress.

- *Financial linkages through banks or international capital markets*

The need to rebalance the overall risk of the bank's asset portfolio and to recapitalise the initial losses can lead to a marked reversal in commercial bank credit, both in the original crisis country and in the others that rely heavily on this bank. For example, the Japanese commercial banks had large loan exposure in the South East Asia and were forced to cut off any lending in the entire region after the initial crisis in Thailand in 1997.

2. THE BACKGROUND OF A BANKING CRISIS

An efficient analysis of a banking crisis has to distinguish between the search for the fundamental factors generating the banking crisis and the identification of variables acting as warning signals of an oncoming crisis. Therefore, this chapter will examine the essential factors, both macroeconomic and institutional that that generate the imbalances, rendering an economy vulnerable to a banking crisis, while the next one will present the major empirical models for determining the reliable leading indicators of banking crises and their results.

2.1 Macroeconomic factors leading to a banking crisis

As it can be expected, the roots of such a major financial distress stem from the macroeconomic environment and can be grouped under the following categories:

Macroeconomic Volatility: External and Domestic

It is obvious that the special nature of the banking activity renders it extremely vulnerable to the volatility of the most important macroeconomic variables and to losses of confidence. For example volatility in the terms of trade can disrupt the export-driven and little diversified economies of emerging economies. Indeed, *Caprio and Klingebiel [17]* report that 75% of the developing countries in their sample which experienced banking crises suffered a terms-of-trade decline of at least 10% prior to the crisis, with an average fall of 17%. Moreover, a fluctuation in interest rates affects not only the cost of borrowing of these countries but also the volume of private capital inflows. For example, empirical evidence suggests that movements in international interest rates can explain approximately two-thirds of the surge in private capital inflows to various economies in the 1990s. Likewise, the movement of real exchange rates can cause difficulties for banks either directly, when there is a currency mismatch between assets and liabilities, or indirectly, if it entails big losses for bank borrowers. Turning on the domestic side, it seems that the common feature of most emerging economies to suffer from a large volatility of growth and inflation rates can hamper the risk-assessment process for the local banks. Once more, *Caprio and Klingebiel [17]* reported that the volatility of growth and inflation rates was on a rising trend over the 1960–94 period for

countries experiencing systemic banking crises over this period, while no such trend was evident for countries experiencing less severe or no banking difficulties.

Lending Booms, Asset Price Collapses & Surges in Capital Inflows

A second cause of banking crises is the bursting of the bubble created by excessive lending and soaring of asset and equity prices. The argument goes that discriminating between good and bad credit risks is harder when the economy is expanding rapidly because many borrowers are at least temporarily very profitable and liquid. Moreover, sharp swings in real estate and equity prices intensify these crises because of high loan concentration; and asset price declines depress the market value of collateral. Nonetheless, the empirical evidence on the effects of lending booms and equity price declines in banking crises has been mixed. More specifically, *Kaminsky and Reinhart [9]* find that lending booms have only moderate predictive power for banking crises in emerging markets and small industrial countries. In contrast, drawing on a larger sample, *Caprio and Klingebiel [17]* conclude that, outside Latin America, the link between lending booms and bank crises becomes quite weak. As for sharp declines in equity prices, *Kaminsky and Reinhart [9]* established that they are among the best leading indicators of banking crises and better than lending booms.

Increasing Bank Liabilities with Large Maturity/Currency Mismatches

The rise in ratios of broad monetary aggregates to GDP, a strong indicator of the financial deepening of an economy, can develop into another important source of banking distress if it is not followed by a maturity match and the necessary capital provisions. For example, it was recorded that right before the Mexican crisis of 1994-95 the dollar value of M2 had climbed to a level almost five times higher than the maximum level of international reserves ever recorded in the country. Moreover, high local interest rates often lead local banks and their customers to short-term foreign currency denominated debt, creating both a currency and maturity mismatch in their balance sheets. This dangerous strategy not only generates solvency and liquidity problems in case of devaluation but also complicates the resolution of a banking crisis. This is because the strategy of easier monetary policy to reduce real interest rates and currency devaluation to reduce the real value of existing local-currency denominated obligations will be devastating when debts are denominated in foreign currencies. Obviously, these risks of maturity mismatches are typically higher for banks in the emerging markets because they have less access to longer-term sources of funding and receive less assistance from securities markets in increasing liquidity and than do banks in the industrial world.

Exchange rate regimes

The exchange rate regime can affect vulnerability to speculative attack, through the dilution of the real value of impaired bank assets and the ability of the central bank to act as lender of last resort to illiquid but solvent banks. More specifically, a poor track record on inflation led many emerging economies to adopt exchange-rate-based stabilization plans in the 1970s and 1980s. These plans were often successful in cutting inflation but were also accompanied by significant real exchange rate appreciation, so much so that in some cases, heavy market pressure forced a return to greater exchange rate flexibility, often entailing massive devaluation. On the whole it seems that the sharp appreciation of the real exchange rate has been shown to be a useful leading indicator of banking crises.

Moreover, fixed exchange rate regimes have also been criticized for increasing the fragility of the banking system to external adverse shocks. *Gavin and Hausmann* [20], for example, argue that, under fixed rates, an adverse shock will lead to a balance-of-payments deficit, a decline in the money supply and higher domestic interest rates. The reduced availability and higher cost of credit will put pressure on banks and their customers and add to any problems associated with the effect of the shock itself on the quality of bank assets. Under flexible rates, by contrast, the shock will be associated with a depreciation of the nominal exchange rate and a rise in the domestic price level, which will serve to reduce the real value of bank assets and bank liabilities to a level more consistent with bank solvency. Finally, with a fixed exchange rate, the central bank must ensure that any liquidity it injects into the system to provide temporary assistance to illiquid but solvent banks does not undermine its exchange rate obligations with the recent noteworthy example was Argentina's response to the large liquidity shock to the banking system that followed the Mexican crisis in early 1995.

2.2 Institutional factors leading to banking crises

As it turns out form the majority of the recent banking crises, a banking sector distress evolves into a fully-fledged crisis only if the above-mentioned unsustainable macroeconomic policies coincide with a weak institutional environment. More specifically, the following features can precipitate, if not trigger off, a banking crisis:

Inadequate preparation for financial liberalization

As far as financial liberalization is concerned, it seems that both the lack and the excess of it are sources of potential vulnerability to a banking crisis. As it turns out for the majority of banking crises in emerging economies, banks were not prepared for the increased competition

and the new types of risks in liberal and globalized banking environment. When interest rates are liberalized, banks may lose the protection they previously enjoyed, as the volatility in interest rates tends to rise, at least during the transition period. Moreover, lifting restrictions on bank lending and lowering reserve requirements permit banks to accommodate increased loan demand. At the same time, the entry of new competitors, foreign and domestic, may well increase the pressures on banks to engage in riskier activities. Indeed, *Kaminsky and Reinhart [9]* stressed that in 18 of the 25 banking crises in their sample, the financial sector had been liberalized some time during the previous five years.

Heavy government involvement and loose controls on connected lending

Nevertheless, the opposite case of heavy government involvement and connected lending are equally or even more harmful for banking stability because they allow political objectives of governments or personal interests of bank insiders, owners or directors, to intrude on almost all aspects of bank operations, damaging bank profitability and efficiency. While this case is still present in some industrial countries, the frequency and severity of the problem are generally regarded as being greater in developing countries. For example, in many emerging economies the banking sector is still dominated by state-owned banks, operating under political control and protection. Obviously, these banks are run under explicit political direction at the cost of low performance and quality. But government involvement extends even at the private banks through controlled allocation of credit or mandatory holding of government bonds. As it has been established, banks in Indonesia, Korea, Malaysia, the Philippines and Thailand have, at some time over the past two decades, been subject to regulatory requirements or pressures to allocate fixed proportions of their loan portfolios to particular sectors. Likewise, the practices of connective lending or in other words loans to bank owners or managers, and large exposures to single borrowers can also trigger off a banking crisis like the banking crisis in Chile during 1977-1980 and in Russia during 1991-94.

Weaknesses in the accounting, disclosure and legal framework

Another potential weakness of the banking system is the inefficiency of the accounting, disclosure and legal framework, which creates a distorted and overoptimistic image about banks' financial status. Especially for emerging economies, most analysts regard existing accounting systems, disclosure practices and legal frameworks as hindering the operation of market discipline and the exercise of effective banking supervision and hurting bank profitability. For example, several banks in Latin America reported net income even during crises and about 20% of banks worldwide do not submit consolidated financial statements.

Distorted incentives…

A system of crisis prevention can be expected to operate well only if the main actors face the proper incentives to discourage excessive risk-taking and to take corrective action at an early stage. Bank owners, managers and creditors, as well as bank supervisors, each need to "have something to lose" if they fail to act in a manner consistent with their mandate.

➢ *for bank owners*

Bank owners' risk-taking activity is hindered by at least three factors: bank capital, their share in the cost of restructuring and the franchise value of the bank. Therefore, bank capital serves a twofold function: it provides a cushion against unusual losses and it promotes better governance. However, relevant studies have shown that banks in most emerging economies do not appear to have risk-based capital ratios significantly higher than those in the larger industrial countries despite the higher risk environment they face. In a similar way, incentives for prudent behavior will be encouraged if those who benefited from risk-taking absorb most of the costs in case of insolvency. The franchise value of the bank, meaning the profitability of a banking license, is also important because owners enjoying a big rate of return from normal banking operations should be less tempted, ceteris paribus, to put that return in jeopardy by engaging in high-risk activities.

➢ *for bank managers*

Although ensuring that banks maintain good credit and internal risk management systems is the job of bank managers and directors, poor management has often been singled out as the leading cause of bank failures, for imprudent management endangers bank operation even to the point of insolvency. Indeed, *Caprio and Klingebiel [17]* reported that senior management was replaced in the majority of bank restructuring cases in their sample, consisting of mostly developing countries.

➢ *for bank depositors*

The potential contribution of bank depositors to market discipline is determined by the quality of accounting systems and by the extent of public disclosure and is therefore especially limited for the depositors in emerging economies. Moreover, some analysts have argued that government bailouts have undermined their incentive to monitor the creditworthiness of banks and that they are probably too small, too dispersed and too financially unsophisticated to exert much discipline.

➢ *for bank supervisors*

The last kind of actors in the banking system, the supervisors, may well suffer pressures for regulatory forbearance given a significant government involvement. Moreover, the slower supervisors are to close an insolvent bank, the greater the dangers that losses will multiply, as owners or managers risk even more. One common answer to potential political pressures is to place supervision in a politically independent government agency or in the central bank and to reduce the discretion available to supervisors, so as to establish a more rule-based supervisory regime.

2.3 Policy Options for Strengthening Banking Systems

The good news is that there are several possible policy measures that can significantly reduce the incidence of each of these factors underlying banking crises. Greater macroeconomic stability, a larger role for foreign-owned banks, the wider use of market-based hedging instruments and higher levels of bank capital would all help either to reduce volatility or to make the consequences for the domestic banking system less damaging. Limiting the allocation of bank credit to particularly interest-rate-sensitive sectors, close monitoring of lending by weakly capitalized banks and employing the right mix of macroeconomic and exchange rate policies would similarly limit vulnerability to lending booms, asset price collapses and surges of capital inflows. Maintaining an ample cushion of both liquid assets and international reserves and adopting a cautious attitude towards short-term, foreign-currency-denominated borrowing can limit banks' liquidity or currency mismatches and discourage runs on both bank and government liabilities. Careful screening of applicants for banking licenses along with a prior strengthening of banking supervision can reduce the risks that often go hand-in-hand with financial liberalization. The privatization of state-owned banks and strong efforts to increase the transparency of implicit and explicit government involvement in the banking system should help to put more of the banking system on a commercial footing, with sizable dividends in terms of efficiency and lower loan losses.

3. EMPIRICAL RESULTS ON THE LEADING INDICATORS OF BANKING CRISES

3.1 Leading Indicators of Banking Crises

After examining the fundamental origins of banking crises, it is essential to focus on identifying basic empirical regularities in the run-up to banking crises that would enable officials and private market participants to recognize vulnerability at an earlier stage. In this way, the corrective policies could follow efficient preventive policies.

Although this has been the main interest of the empirical research in this field, it has been difficult, so far, to identify a set of indicators that could detect future crises sufficiently early and with a high degree of certainty without giving false signals. Indeed, if such indicators existed they would lose their usefulness because they would affect the actors' behavior: either markets would incorporate them and precipitate an oncoming crisis or policymakers would take actions to prevent them. Consequently, indicators would lose their efficiency. Nevertheless, it remains useful to examine whether there are variables associated systematically with vulnerability to crises.

What is an efficient leading indicator?

The leading indicators of a banking crisis consist a set of variables whose behavior prior to crises is systematically different from the one during normal or tranquil periods. By closely monitoring these variables, it may be possible to detect consistent patterns, having preceded past crises. The essential point is to determine the relevant variables as those that not only warn efficiently of an impending crisis but also do not produce frequent false signals. In the majority of the empirical studies, the list of candidate variables consists of the following 3 large groups of indicators:

- *Real Sector*: Growth rates of real GDP, Private Consumption and Investment, Incremental Capital Output Ratio, Change in Terms of Trade, Inflation, Government surplus/GDP, Industrial Production, an Index of Equity prices.

- *Financial Sector*: M2/ Foreign exchange reserves, Credit growth/GDP, Bank cash/Bank assets, Private credit/GDP, Real interest-rate, Ratio of lending to deposit rates.

- *External Sector*: Depreciation of the exchange rate, Exports, Imports, International reserves, Deviation (%) of the real exchange rate from trend and the Differential between domestic and foreign interest rate.

- *Bank-specific Indicators:* Level of Bank Capitalization, Changes in Bank Capitalization, Shifts in the Structure of Balance-Sheets, Change in the Maturity Structure of Bank's Assets and Liabilities.

- *Institutional Indicators*: GDP per capita, Presence of explicit Deposit Insurance, Central Bank independence and an Index of Financial Liberalization.

3.2 A review of the empirical literature

Although the literature on early warnings of individual bank failure is well established, with the earliest empirical studies dating back to the mid-1970s, the intrinsic problems of the relevant empirical work is reflected in the absence of consensus. As there is no agreed-upon list of crises, different investigators focus on different episodes, including a wide range of countries from advanced industrial economies and transition economies to low-income African economies.

The empirical literature can be roughly divided to four major categories: the multinomial regression models, the models using the signaling approach, the country-specific studies and the studies focusing on external factors.

The multinomial regression models

Two of the most robust studies in the field of leading indicators are those of *Demirguc-Kunt and Detragiache [10]* and *Hardy and Pazarbasioglu [2]*, who tried to determine several reliable leading indicators of banking crises through the multinomial regression approach. This model employs regression techniques to estimate the relationship between the various potential indicators and identified discrete outcomes such as a bank failure or a banking crisis. Practically, the regression analysis is used to capture the effect of movements in the indicator variables on the probability of the event occurring.

Demirguc-Kunt and Detragiache [10] considered the role of macroeconomic and institutional variables in 65 industrial and developing countries. They did so by econometrically estimating the probability of a systemic crisis, applying a multivariate logit model to data

from a large panel of countries, both industrial and developing, for the period 1980-94. The authors find that crises tend to occur in a weak macroeconomic environment characterized by slow GDP growth and high inflation. When these effects are controlled for, neither the rate of currency depreciation nor the fiscal deficit is significant. Vulnerability to sudden capital outflows, low liquidity in the banking sector, a high share of credit to the private sector, and past credit growth are also associated with a higher probability of crisis. Another factor significantly and robustly associated with increased vulnerability in the banking sector is the presence of explicit deposit insurance, suggesting that moral hazard has played a major role. Finally, countries with weak institutions, as measured by a "law and order" index, are more likely to experience crises.

On the whole, they found that the risk of a banking crisis rises with macroeconomic imbalances and inadequate market discipline. Their 1998 follow-up considered in addition the role of financial liberalization and found that recent liberalization, as proxied by the removal of interest-rate controls, increased the likelihood of a banking crisis, but less so where the institutional environment, as proxied by the rule of law and the level of corruption, is strong. In a 2000 supplementary study, they distinguish a variety of additional aspects of deposit insurance schemes, to conclude that explicit deposit insurance tends to increase banking fragility, more so where bank interest rates are deregulated and the institutional environment is weak.

In a similar way, *Hardy and Pazarbasioglu [2]* expanded the range of macroeconomic indicators but considered a smaller sample of countries. Their objective was to construct an early warning system, so the institutional variables were of relatively little interest, given that these change only slowly over time. Their main findings are that crisis risk rises when GDP growth rates fall, domestic credit growth is rapid, inflation is variable, and domestic interest rates and capital inflows are high. The role of lending booms in setting the stage for banking crises has been a particular bone of contention.

The signaling approach

This group of studies examines the interdependence between currency and banking crises and is dominated by the pioneering study here of *Kaminsky and Reinhart [9],* perhaps the most widely accepted study in the issue of leading indicators, which concluded that banking crises contribute to currency crises, rather than the other way around, and that recent financial liberalization sets the stage for banking crises.

This study is based on the signaling model, which compares information on indicators in periods of tranquility with identified periods of crisis. These indicators are selected on the basis of whether changes in their behavior between normal times and periods of crisis provide a reliable 'signal 'of a crisis and are usually macroeconomic measures. More specifically, an indicator, like the fiscal balance, is said to 'signal 'an impending crisis if it crosses some threshold value which is chosen so as to strike a balance between having many false alarms

(type II errors) and the risk of missing many crises (type I errors). Actually, the 'optimal' threshold for each indicator is typically set so as to minimize the noise-to-signal ratio and naturally a lower the noise-to-signal ratio indicates a more informative indicator. The results of this study regarding the most reliable monthly and annual leading indicators are summarized in the following Table 3-1,Table 3-2 &Table 3-3.

Table 3-1: The 5 Monthly Indicators with the Best Predictive Power

Indicator (in descending order)	% of crises accurately called
Real exchange rate	52
Stock Prices	76
M2 multiplier	63
Output	90
Exports	79

Source: Kaminsky & Reinhart [9]
Note: The ranking is based on their marginal predictive power, **measured by the difference between the probability of a crisis actually occurring conditional on its signaling and the unconditional one.**

Table 3-2: The 5 Annual Indicators with the Best Predictive Power

Indicator (in descending order)	% of crises accurately called
Short-tern capital inflows	43
Current account balance	38
Budget deficit/G.D.P.	52
Current account balance/G.D.P.	33
Central bank credit to public sector/G.D.P.	23

Source: Kaminsky & Reinhart [9]
Note: The ranking is based on their marginal predictive power, measured by the difference between the probability of a crisis actually occurring conditional on its signaling and the unconditional one.

Table 3-3: The 5 Microeconomic Indicators with

the Best Predictive Power

Indicator (in descending order)	% of crises accurately called
Lending-Deposit interest rate spread	73
Interbank debt growth	80
Interest rate on deposits	80
Rate of growth of loans	58
Net profits to income	60

Note: The ranking is based on their marginal predictive power, measured by the difference between the probability of a crisis actually occurring conditional on its signaling and the unconditional one.

Country-specific Studies

Another strand of research has focused on different parts of the world, with the two most important studies of this group coming from *Hutchinson [21]* and, most notably, *Hutchinson and Mc Dill [22]*, who focus on the European and the Japanese banking crisis respectively.

Hutchinson and Mc Dill [22] tried to fit the case of the Japanese crisis in the typical model of a banking crisis. They established that at the onset of the banking crisis, Japan was in a much stronger macroeconomic position than most countries experiencing similar difficulties, as its inflation performance, output growth, budgetary situation, external balances, and so on, did not indicate an emerging banking crisis. Indeed, macroeconomic developments during the period preceding Japan's banking crisis failed to give a warning signal of a banking sector distress. However, dynamics of the Japanese banking crisis presented many common features with a typical crisis case, such as a sharp asset price decline, recent financial liberalization and explicit deposit insurance (Table 3-4). In particular, the general malaise over the Japanese economy associated with its episode of banking sector distress appears unusually large and long lasting, as the failure of asset prices to recover and the weak GDP growth/ near-recession that prevailed in Japan over much of the 1990s reveal. On the whole, it seems that the slow regulatory response and the delay in the commitment of public funds to re-capitalize the banking sector partly explain the large adverse effects on the economy.

Indeed, the probit model estimated by *Hutchinson and Mc Dill* predicted that Japan was particularly vulnerable to banking sector distress in the early 1990s, giving a 20% probability of crisis in 1992. Moreover, extensions of the model show the basic prediction results to be quite robust to the rest of the estimated sample. On the whole, institutional variables appear to be the most important, including the political independence of the Central Bank, and only two macroeconomic variables, real interest rates and stock prices, appear to be reliable, statistically significant, leading indicators of a banking crisis.

Table 3-4: Where does Japan fit in?

	Control group[2]	Countries in crisis[3]	Japan[3]
Real G.D.P. Growth	3,7	3,5	4,6
Budget Surplus	-3,7	-3,8	-1,8
Inflation	10,2	13,3	1,6
Real Interest Rate	0,5	-0,3	3,7
M2/Reserve Ratio	14,0	21,7	42,4
Credit Growth	11,7	9,8	7,0
Stock Price Change	12,9	16,5	9,3
Budget Surplus	-3,7	-3,8	-1,8
Exchange Rate Depreciation	8,8	20,2	-4,8

Source: Hutchinson and Mc Dill [22]
1:Countries not experiencing banking crisis
2: Mean Value over 1975-97 period of the countries not experiencing banking sector distress.
3: Mean Value for 5-year period preceding episodes of banking sector distress for countries in sample experiencing banking sector distress

Studies focusing on external factors

The role of external factors has been a flashpoint in the literature on banking crises, as researchers have noticed how the sharp tightening of credit and the slowdowns of growth in the industrial countries triggers off banking difficulties in emerging markets. As a matter of fact, the dramatic monetary tightening and recession in the United States in 1979-81 is believed to have set the stage for debt and banking problems in Latin America in 1982, or similarly the monetary contraction in the United States in 1994 for the Mexican crisis. Others are inclined to dismiss this emphasis on external factors as an attempt to divert attention from policy problems in the emerging markets, clearly pointing to the Asian crisis in 1997.

Probably the most robust study in this field comes from *Eichengreen and Rose [15]*, who established that higher world interest rates, slower world growth, real exchange rate overvaluations and budget deficits strongly increase the probability of crises in emerging markets. On the other hand, they found little evidence of a connection between crises and the exchange rate regime.

Subsequently, *Eichengreen [13]* reestimated the *Eichengreen and Rose [15]* model with five additional years of data until 1997 but found less evidence of an OECD effect with the expanded time frame. It seems that the role of external factors turns significantly weaker in the 1997 crisis.

A sensitivity analysis of the empirical results on leading indicators

The efficiency of all the major leading indicator models, which were just presented, was assessed by *Eichengreen and Arteta [15]*. They considered a range of alternative explanatory variables in regressions, corresponding to the factors cited by previous researchers, and tested them across a common set of crisis dates, sample intervals and countries.

A key conclusion of the *Eichengreen and Arteta [15]* analysis is that a number of the results of earlier studies are not robust across different sample and variables specifications. For example, the study finds that deposit insurance does not necessarily increase the risk of a banking crisis as there is at least as much evidence that deposit insurance reduces crisis risk by solving the depositor-run problem than there is of it encouraging crises by weakening market discipline. Similarly, there was not robust empirical evidence that systems with weaker legal and regulatory structure are likely to suffer a greater likelihood of banking crises. Finally, there is little evidence of any concrete relationship between the exchange-rate regime and banking crises as different results are obtained for different specifications and different classifications of exchange-rate regimes.

Table 3-5: Results of Sensitivity Analysis of Indicators of Banking Crises (Eichengreen and Arteta 2000)

Indicator	Sign of coefficient	Robust	Comments
Macroeconomic			
Domestic Credit Growth	+	✓	
M2/Reserves	+	✓	
OECD output growth	-	✓	
OECD Interest rates	+		
Budget Surplus	+		*Significance only due to colinearity with insignificant variables*
Exchange rate	-		*Correlation likely to reflect "causality" from banking crises to currency ones.*
Institutional			
Domestic financial liberalization	+	✓	
Deposit Insurance	-		*Not robust to different deposit insurance schemes*
Institutional Quality	-		*Not robust to changes in the sample.*
International financial liberalization	-/+		*Significant only when interacted with domestic financial liberalization*

Source: "Leading indicator models of banking crises –A critical review", Bank of England [13]

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According to Table 3-5, some results do appear to be more robust. Rapid domestic credit growth, large bank liabilities relative to reserves and domestic financial liberalization all appear to be influential in generating systemic banking crises. This suggests that banking systems are most at risk when financial deregulation and the macroeconomic environment coexist only to create an unsustainable lending boom. Domestic interest-rate liberalization, which allows banks to compete for deposits, finances these unsustainable lending activities, while the associated reduction in franchise values encourages the pursuit of risky activities.

These results are verified in the case of all three Nordic countries experiencing banking crises in the early 1990s. For example, the crisis was preceded by the liberalization of banks' funding sources and deregulation-related credit booms. In Norway, the ratio of bank loans to GDP increased from 40 % in 1984 to 65 % in 1988. The surge in lending occurred later in Finland and Sweden but was equally dramatic, rising between 1984 and 1990 from 55% in Finland and from 41 to 58% in Sweden. In all three cases the increase in funding opportunities and reduction in franchise values encouraged the rapid growth of bank lending followed by a credit-financed surge in capital formation, deterioration in the current account balance and a reluctance to tighten monetary conditions.

On the whole, it seems that individual bank failures are even more difficult to predict, for intrinsic reasons meaning that random vents can trigger self-fulfilling bank runs. On the causes of banking crises in emerging markets, it is fair to say that the jury remains out.

3.3 An assessment of the models

In order for the models described above to develop to potential tools for policymakers, the following weaknesses and limitations have to be dealt with:

- *Choice of sample and indicators*

Although the concentration on banking crises in the Emerging Markets may be understandable given their greater frequency, it has affected the selection of indicators. The available data for emerging market economies is typically much less complete in terms of quality and quantity than that for the industrial world. In fact, a number of authors use data availability as a criterion for selecting which countries to include in the study, which in itself could create sample selection bias.

- *Differences between Emerging and O.E.C.D. countries*

It is only evident that banking crises in developed and developing countries may evolve quite differently. For example, banks account comparatively for a larger share of total assets of financial institutions in the first ones. Moreover, the maturity of bank liabilities is typically shorter, supervision and regulation is typically weaker and opportunities to hedge risk are fewer in emerging economies. However, such structural differences are not taken into account by studies focusing on banking crises.

- *Leading versus coincident indicators*

Many of the empirical models proposed in the literature are based on coincident correlations between the dependent and explanatory variables and are designed, therefore, to explain crises rather than to predict them. Moreover, the lagged values of many of the variables, rather than contemporaneous observations, are often not significant when introduced into the regressions. Therefore, the practical use of such empirical models as leading indicators depends on the ability to accurately forecast values for the explanatory variables. However, the restriction of the model only to the variables for which frequent and often external forecasts are available the estimated crisis probabilities are affected by forecast errors. Indeed, *Demirguc-Kunt and Detragiache [10]* computed the crisis probabilities for 1996 and 1997 in five Asian crisis countries using actual data for the main indicators in their model to compare them to those that could have been constructed based on forecast information available in May 1997. Their results suggest that forecast crisis probabilities were low for the five Asian countries, in large part reflecting their strong economic performance in the years up to 1996, whereas the actual data gave a much clearer indication of crisis. On the whole, it is clear that leading indicator models would have failed to alert people that the banking sectors in these five Asian countries would undergo crises in the second half of 1997.

- *Contagion effects*

Another weakness of the models stems from the way in which they capture the notion of contagion, meaning that there are hardly any variables included in the studies to represent the risk for the propagation of the crisis. For example, although it can be expected that the size and nature of interbank exposures is likely to turn an individual bank distress to a system-wide disruption, this risk is not well captured in the statistical leading indicators models.

- *Failure to capture exogenous events*

The majority of these models concentrate on economic variables, failing to capture exogenous events like political events, which have often triggered off a financial crisis. The most notable

example of this sort is the Colosio assassination in Mexico in 1994 that is widely considered as the starting point of the devastating Mexican crisis of 1994.

- *The "Lucas critique"*

This type of empirical study is not immune to the "Lucas critique", meaning that if a reliable set of indicators is indeed identified policymakers would adjust their policies accordingly and thus, transform these variables into early warning indicators of corrective policy action rather than of banking crisis.

- *Inclusion of institutional variables in the models*

Although it is acknowledged that institutional characteristics do matter in terms of banking vulnerability, these factors have only recently begun to enter the list of possible leading indicators mainly because of the lack of reliable, timely or even available data. Therefore, there would be more scope to examine these factors for a cross- section study, in other words the analysis of cross-country differences, rather than in a time-series context.

- *Setting the end of a banking crisis*

Identifying the end of a banking crisis is the most unresolved problem of the empirical literature, meaning the lack of consensus on the criteria for declaring the crisis to be over, i.e. the resumption of the bank normal behavior, the marked decrease in the share of non-performing loans or an end to bank closures? For the majority of the studies, it is stated that the end of crisis coincides with its resolution, for example the end of heavy government financial intervention, and not when the bank balance sheets cease to deteriorate.

On the whole, it seems that no single index is likely to capture the complexity of developments leading up to a crisis, which usually includes not only elements of financial vulnerability but also political events, changes in the investors' sentiment and potential contagion effects. Therefore, all models need to include country-specific information and focus on certain institutional issues like labor market conditions. Finally and most importantly, an efficient model depends on the timely availability of the necessary information so as to generate a real warning system and not an analytical tool.

4. A Brief History Of Recent Banking Crises

Banking crises have a long history. From the Great Depression of the 1930s, which was exacerbated by bank failures in the United States and elsewhere, to recent decades where a large number of countries have experienced financial distress of varying degrees of severity, and some have suffered repeated bouts of distress.

The first section of this chapter reviews, in brief, the most significant cases of banking crises, and examines their origins, while the second one analyzes the Japanese case, which consists the most long-lasting and persistent banking crisis so far.

4.1 The situation until the late 1970s

The end of World War II inaugurated four decades of tranquility in the global banking system, as economies were growing buoyantly prior to the first the OPEC oil-price shock. The fact that a stable world price level was maintained through the 1960s, as a result from the operation of the Bretton Woods System, enhanced the transparency of loan and collateral evaluation. With prices and interest rates relatively stable, the book and market values of bank assets and liabilities never moved far out of line. Competition from nonblank intermediaries developed only slowly, reflecting the relative stability of financial services technologies, and banks were protected from excessive competition by a heavy layer of regulation. On the whole, banking stability was sustained by a combination of favorable microeconomic and macroeconomic circumstances.

The impact of the OPEC oil shocks

All this changed in the 1970s, as inflation increased the difficulty of assessing credit quality, and the two OPEC oil shocks undermined borrowers' ability to repay. Rising interest rates accentuated adverse selection, as safer borrowers dropped out of the market and petro-dollar recycling encouraged money-center banks to seek out higher-yielding investments abroad.

Much of this money was channeled through developing-country banks who acted as agents for their national governments or as independent borrowers. This same ample supply of funds weakened the incentive for the money-center banks to carefully scrutinize the quality of the customers approaching them for loans. In the late 1970s, the U.S. disinflation brought this lending boom to a halt, as interest rates rose, and U.S. economic growth slowed. It is no coincidence that the Savings & Loan crisis followed on the heels of these events. It was no surprise since 80% of the industry's assets were fixed rate mortgages, the return on which no longer matched the cost of attracting funds, and agricultural land prices declined by as much as 30 %. Although restrictions on the geographical diversification of S&L's investments had been phased out in the 1960s, tradition and limited management competence left their investment portfolios regionally concentrated, allowing regional economic cycles to disproportionately affect bank balance sheets. In the aftermath of this crisis, the U.S. government and the Fed launched the most expensive bank bailout in history in the second half of the 1980s.

4.2 The lending boom in Latin America of the late 1970s

The developing countries were on the other end of the lending boom of the 1970s. The debt crisis in which that boom culminated is too well known to be recounted here. What are relevant for present purposes are the role and the consequences for the banks. The typical sequence of events was financial liberalization followed by exchange rate based stabilization and large-scale foreign borrowing.

The Argentina crisis of 1980-82

Argentina, for example, used a crawling peg as a stabilization tool from late 1978 through early 1981. With exchange risk minimized, residents were able to borrow offshore: there was a boom in real estate markets, apartment prices in Buenos Aires rising by 50 % between 1977 and 1980. Inevitably, however, the exchange-rate peg together with inertial inflation resulted in overvaluation and the competitive difficulties of Argentine exporters set the stage for recession. When the Argentine economy turned down in early 1980, a banking crisis erupted almost immediately. As capital inflows fell off, real lending rates turned strongly positive, leaving borrowers financially strapped and banks burdened with non-performing loans. The end of 1982 found 43 financial institutions, including the country's largest commercial bank, in the process of liquidation.

The Chile crisis of 1981-83

Chile in 1981 is another case where capital-account liberalization and exchange-rate-based stabilization unleashed a surge of capital inflows and generated a banking crisis. In the second half of the 1970s, banks were freed to borrow abroad in dollars with no exchange risk. Capital inflows fueled a consumption boom, mainly in the form of consumer durables purchased by households skeptical of the durability stabilization, until the banking crisis in neighboring Argentina put sudden upward pressure on interest rates. The financial position of borrowers had already been undermined by a long period of overvaluation. Eventually, those borrowers experienced growing distress and the position of the banks was undermined. Eleven Chilean financial institutions accounting for 15 % of total loans had to be liquidated in 1981-82. Apart from macroeconomic factors and exchange rate policy, lax regulation and supervision aggravated even more the problems of the banking sector, by allowing the banks to succumb to adverse incentives.

While banking problems in Argentina and Chile preceded the developing-country debt crisis, the opposite was true in Colombia, Mexico, Peru and Uruguay. There, banking crises were precipitated by the curtailment of foreign financing in 1982. In each case the capital account had been liberalized and the exchange rate stabilized, encouraging inflows of foreign funds. The rise in the cost of borrowing and decline in credit availability resulting from the debt crisis provoked loan defaults and bank insolvency. In most cases, the government responded to its deteriorating financial position by pressuring the central bank to print money. The resulting inflation further depressed the ratio of deposits to national income, which in turn undermined the banks' ability to fund loans and withstand runs.

4.3 The banking crisis in Nordic countries in the early 1990s

The typical sequence of exchange rate pegging, macroeconomic disturbance and banking crisis was also evident in Northern Europe. For the Nordic countries the 1980s was a decade of deregulation and relaxation of restrictions on cross-border financial transactions. Encouraged by lax monetary and fiscal policies, banks responded by lending freely, fueling a consumption boom and soaring real estate and equity prices. When central banks and governments finally retrenched to counter the inflationary consequences, bank borrowers and the banks themselves ran into the wall. Thus, in the Nordic countries, as in Japan later on, banks' substantial exposure in the equity and real estate markets was the main source of banking problems.

The Norwegian crisis started in 1986-7 and was precipitated by a sharp decline in the price of oil, which raised the rate of corporate bankruptcy by nearly half between 1986 and 1989. A recession followed the drop in oil prices and led to sharp falls in commercial property prices, in 1987, and housing prices in 1988.

Similarly, the Finnish crisis of 1990-1 was precipitated by monetary tightening in 1989 and by the collapse of trade with the Soviet Union.

Finally, the Swedish crisis of 1991-92 was affected by many of the same factors as in neighboring Finland and in addition by a tax reform introduced in the late 1980s which limited the tax deductibility of interest payments and put a damper on the housing market.

The role of exchange-rate regime

Nevertheless, the exchange rate pegging was the final ingredient in this combustible mix. As Norway, Finland and Sweden had pegged their currencies from 1983, capital inflows were encouraged by limited exchange risk and all three countries imported the higher level of European interest rates consequent upon German unification.

In Finland, banking and macroeconomic problems forced the government to devalue in 1991 and then abandon the peg in 1992. The devaluation undermined the financial position of Finnish corporations, which had borrowed in foreign currency. In Sweden, there were widespread doubts about the durability of the exchange rate peg and as early as 1990 devaluation expectations led to a decline in deposits amounting to 5% of GDP. Desperate attempts to defend the exchange rate peg in the autumn of 1992, which forced the central bank to raise lending rates to as much as 500%, increased the cost of funding loans relative to the return on assets.

In Both Finland and Sweden major banks were not allowed to fail and in both cases the government opted instead to abandon the currency peg, freeing it to run budget deficits and recapitalize the banks. Still, it can be argued that following a more flexible exchange rate policy previously would have averted some of the subsequent problems. Given the circumstances of the early 1990s -German unification, a weak dollar, and uncertainty about the prospects for European monetary unification- a unilateral currency peg meant an unstable macroeconomic environment and, potentially, problems for the banks.

An overall evaluation would thus be that the Nordic banking crises were enhanced but not caused by exchange-rate policy. Their seeds were lax banking supervision and overly accommodating monetary and fiscal policies.

4.4 The Mexico Crisis in 1994-95 and its spill over effects

The macroeconomic facts of the crisis

Mexico was severely damaged during the debt crisis of the 1980s, but went through an impressive set of reforms along with the Brady Plan debt restructuring-opening to foreign competition, aggressive privatization, deregulation and fiscal reform. The peso was attached to the dollar with a floating trading band, inflation had declined substantially and Mexico had attracted foreign capital during the early 1990s. As a result, it had built up foreign exchange reserves.

The Mexican economy slipped into recession in late 1993 and capital inflows began to slow. Stock prices peaked in early 1994 but a series of political seatbacks, like President Colosio's assassination, later on began to shake confidence in Mexico's stability. To stem a possible flight of capital by both external and internal investors, the famous "tesobonos", notes payable to pesos but indexed to the dollar-peso exchange rate, were introduced. Indeed, tesobonos became so popular that they consisted about 50% of all government debt outstanding and succeeded in stabilizing foreign exchange reserves. However, by November it was clear that the exchange rate was at an unsustainable path.

Table 4-1 summarizes the macroeconomic indicators of the Mexican economy during the period 1990-94. It is clear that there is a currency overvaluation as some inflation persists even when the currency was held relatively stable. Moreover, the trade balance deteriorated during 1990-92 and private saving dropped materially in the 1990-93 period. This has been interpreted as the result of rising imports and consumption financed by the capital flows.

Table 4-1: Mexican Macroeconomic Indicators 1990-1991

Measures (%)	1990	1991	1992	1993	1994
Exports/GDP	15,8	13,8	12,6	12,4	13,1
Imports/GDP	16,9	17,0	18,1	16,7	18,9
Trade Balance/GDP	-1,1	-3,2	-5,5	-4,3	-5,8
Private Consumption/GDP	70,9	71,8	72,2	71,5	71,0
Private Saving/GDP	12,5	10,3	9,5	8,9	10,7
Inflation	26,7	22,7	15,5	9,8	7,0
Exchange Rate (pesos/$)	2,9	3,1	3,1	3,1	5,3

Source: Sachs, Tornell and Velasco

The problematic Mexican banking sector

Looking onto the macroeconomic data, it is clear that some currency overvaluation was present in the early 1990s but that its magnitude was not so large so as to generate such a deep crisis. Therefore, a consideration of the banking sector problems is required.

Banking problems were well known since the nationalization of banks in 1982, which eliminated any skills in credit analysis and modern banking in the Mexican banks. Therefore, a privatization of banks and liberalization of the financial sector was decided and completed by 1992. However, this only aggravated the problem of inadequate supervision and reserve requirements, while full government backing of bank deposits enhanced the problem of moral hazard. Finally, many banks were hastily sold without their new owners proceeding to their proper capitalization.

The financial liberalization resulted in an expanded credit boom form the banking system to the private sector. For example, in 1988 commercial bank loans to the private sector equaled 10,6% of GDP, while in two years this grew to 20,6% and by 1993 it reached 34,5%.

In short, there was any reason to believe that Mexican banks were in trouble in 1994, with high levels of non -performing loans, currency and maturity mismatches.

The outbreak of the crisis

This round of banking problems started in December 1994 with the devaluation of the Mexican peso, shooting up interest rates to high double digits. In this way, firms relying on short-term bank credit and with dollar-denominated loans outstanding experienced severe distress. Eventually, bank balance sheets, which were already weak from the familiar combination of deregulation and lax supervision, were even more undermined.

Until then, the Mexican government was forced to resist the devaluation, giving priority to the need to recapitalise banking sector. To contain the spread of problems, the Mexican government purchased subordinated debt from the banks in order to raise their capitalization and provided dollar loans to banks with dollar-denominated liabilities. Finally, it liberalized rules governing the acquisition of Mexican banks by foreign financial institutions and encouraged large banks to absorb their smaller, weaker counterparts. This has forced the government to agree to buy bonds issued by troubled banks in an effort to recapitalise them without resorting to direct intervention.

Without question, macroeconomic policy, notably the overvaluation and the deadly combination of inflation and exchange rate pegging, contributed to Mexico's banking problems, by undermining the competitiveness of firms and adding to non-performing loans. Similarly, the deterioration of the competitiveness by the inability of the central bank to

defend the currency through higher interest rates generated balance-of-payments problems. Once more it was the familiar combination of financial deregulation and lax supervision that had already set the stage by as early as 1992 and much prior to the recent episode of real appreciation.

The spillover effects in Argentina's banking system

Argentina's banks found themselves in the same position when they felt the repercussions of the Mexican crisis, as they held large stocks of Brady bonds, whose prices collapsed with Mexico's difficulties. Sensing that the exchange rate might have to be devalued, deposit withdrawals, amounting to some $2 billion in two weeks, began in early 1995. Overnight rates reached 30% in Buenos Aires in mid-January and by the end of March deposits in Argentine banks had fallen by $7.5 billion, or 17 %, with the most serious losses being suffered by smaller provincial and cooperative banks.

However, the convertibility law requiring the central bank to peg the exchange rate severely limited its ability to undertake lender-of-last-resort operations. Monetary authorities could reduce the banks' reserve requirements, from 33 to 30%, to make liquidity available for meeting depositor demands and use their excess reserves to extend some $2 billion extraordinary liquidity assistance above the limits of bank capital. Instead, they authorized banks with excess reserves to loan these to their weaker counterparts, persuading the top five banks to provide some $250 million. The government for its part loaned to the banks out of its own financial reserves, but the $1 billion allocated for this purpose was exhausted by the end of April.

Only a major package of international assistance along with President Menem' s reelection in mid-May 1995 quieted fears about the future of the convertibility law and the stability of the banks, leading a third of the deposits which had flowed out of Argentina's banks following the Mexican crisis to flow back in. Public funds were then used to finance the closure or privatization of the main provincial banks.

The policy issues behind these crises

Argentina's crisis confirms that developing countries are vulnerable to sudden shifts in capital flows and, thus cannot afford to peg their currencies. If the confidence of investors is disturbed, such countries can find themselves threatened by banking and balance-of-payments crises which will feed on one another in a vicious circle. Their central banks will have few options for responding to these crises.

For Mexico it is now evident that monetary and fiscal policies were only a minor part of the problem. Equally important were a currency peg that offered one-way bets to speculators and large amounts of short-term, foreign-currency-denominated debt that offered scope for a debt run.

In its turn, Argentina was able to support both its exchange rate peg and its banking system only because it received some $8 billion of foreign financial assistance, mainly from the IMF, part of which was used to recapitalise the banks and fund a deposit insurance scheme. Thus, Argentine experience underscores the need for international cooperation. In the wake of its 1995 crisis, the Argentine government took steps to secure lines of credit with foreign banks in case it needs to inject liquidity into the banking system. In addition, it imposed high reserve and capital requirements, which limit the banks' ratios of liquid liabilities to liquid assets. High reserve requirements could also be lowered in the event of stringency, freeing up resources to meet depositors' demands.

4.5 The Asian Crisis in 1997

The financial crisis in Southeast Asia in 1997 is even more surprising than the previous one of Mexico because this region appeared to contain some of the most successful emerging markets. Real GDP growth for the period 1992-1995 had averaged more that 9% for the region as a whole. Inflation was moderate throughout the region and only the Philippines had fiscal deficits and inflation of double digits, while Thailand boasted of a fiscal surplus every year from 1988 to 1996.

The background of the crisis

Nevertheless, some signs of slowdown were in the air. Asian stocks on average remained below the levels of 1993 and the sustainability of the Asian miracle was questioned ever since 1994. Moreover, Japan the locomotive economy of the region had entered a recession in the 1990s and foreign trade had slowed throughout the region. Serious levels of non-performing loans were reported in local banks.

The Asian currencies were all pegged in some degree to the U.S. dollar. More specifically, Hong-Kong had a currency board and most on the other countries has some version of crawling peg with trading bands. However, before 1997 only two currencies seemed under

pressure: The Korean won and the Thai baht had both appreciated through late 1995 and then depreciated significantly within their trading bands in 1996-1997.

As Table 4-2 indicates, although there was a clear slowing of both exports and imports from 1995 to 1996, the real growth in all 5 economies continued at an impressive pace and inflation was moderate. The Current account deficit in Thailand had become quite large but its debt was moderate compared to GDP, so it appeared that the deficit could be financed. Finally, fiscal deficits were approximately balanced in the whole region.

Table 4-2: Macroeconomic Indicators in Southeast Asia (%)

Indicators	Countries				
	Thailand	Malaysia	Indonesia	Philippines	Korea
1995					
Growth of Imports	25,1	26,0	13,4	31,6	30,3
Growth of Exports	30,0	30,5	27,9	25,7	32,0
1996					
Growth of Imports	-1,3	6,7	10,4	17,5	5,3
Growth of Exports	11,6	1,3	11,1	20,9	12,2
Inflation	5,8	3,5	6,5	8,4	4,5
Curr. Account/GDP	-7,9	-4,9	-3,4	-4,7	-4,8
External debt/GDP	19,8	28,8	38,9	-	11,2
Real GDP growth	5,5	8,6	8,0	5,5	7,1

Source: Garnaut (1998)

The Banking sector

The critical ingredients of that crisis were once more the familiar combination of lax banking supervision and regulation, implicit guarantees for bank creditors combined with pegged exchange rates. More specifically, the whole region faced the same banking conditions:

- International investors were encouraged to establish and maintain positions in emerging markets by the low level of interest rates in leading money centers. More specifically, they funded themselves in mature markets and invested in Asia, mainly with bank-to-bank lending.

- Local banks with implicit guarantees had an incentive to fund themselves abroad and invest in high-yielding securities, with the most striking example of Korean banks obtaining funds from Japanese banks and investing in Indonesian corporate paper and Brazilian Brady bonds.

- Asian governments, having long regarded their financial systems as central to their national economic development strategies, were reluctant to let their banks fail. Aware of this, international investors were indifferent about the risk of banks' assets.

- The exchange rate peg was critical to this story, consisting as it did a key link in the chain of implicit guarantees. As the government guaranteed exchange rate stability, foreign investors were relieved of all exchange risk.

Eventually, these distortions created a one-way bet encouraging excessive capital inflows. But, as in earlier episodes, the situation was not sustainable.

The outburst of the crisis

This unsustainable situation was susceptible to being disrupted by a modest move toward more restrictive global credit conditions, like the one in the spring of 1997 when interest rate increased in the United Kingdom and Germany. As a result, Japanese long rates moved up from 2 to 2,5%. Moreover, the appreciation of the dollar against the yen, which undermined the competitiveness of Asian countries that placed heavy weights on the dollar in their basket pegs, a slowdown in the global electronics industry, and mounting problems in some of the recipient countries, most notably Thailand, these developments triggered off a general crisis.

Originally, it was the ability of the Thai government to honor exchange rate commitment that was cast into doubt. International banks and other investors closed out their long positions in Asian fixed-income securities and began shorting the baht as Thailand's vulnerability became apparent. What had previously been an excessive capital inflow became an unmanageable capital outflow. In Thailand, the failure of the finance companies appears to have been the trigger that set off the run on the currency.

In other Asian countries, the timing of events was generally the reverse, meaning that currency depreciation undermined the balance-sheet positions of banks and bank customers with unhedged foreign exposures. In this way, a run on the banking system was precipitated.

What went wrong

Looking into the currency issue, the currencies of the region except from those of Taiwan, Singapore and Hong Kong were in free fall from June 1997 to September 1998. More specifically, currency declines against the U.S. dollar were 37% for Thailand, 34% for Korea and 38% for Philippines. Obviously, this effect implies a currency overvaluation prior to the crisis, which by no means was so evident as in Mexico few years earlier. Therefore in this case, the origins of the crisis were the liquidity risk and the troubled banking sector.

Capital inflows, mostly in the form of bank lending, in the region were large in the mid-1990s, increasing the liquidity risk for investors. Only Taiwan was a net exporter of capital throughout the decade, while China and Singapore relied mainly on foreign direct investment. It was no surprise that all three escaped serious damage. As Table 4-3 indicates none of the countries had exceptional amounts of foreign debt compared to their capacity to service it and thus, sovereign insolvency did not consist a serious risk. However, the structure of the debt leant heavily towards short-term and foreign currency and although short-term debt as a % of total debt remained constant, reserves as a % of short-term debt declined materially in most countries in the period 1994-97.

Table 4-3: Measures of International Liquidity (%)

Indicators	*Countries*				
	Thailand	**Malaysia**	**Indonesia**	**Philippines**	**Korea**
	Foreign debt/ Exports				
	121,0	42,0	221,0	98,0	-
	Short-tern debt/reserves				
June 1994	99,2	25,2	173,0	40,5	161,0
June 1997	145,3	61,2	170,4	84,8	206,0
	Short-tern debt/total debt				
June 1994	74,3	59,1	61,1	44,2	72,5
June 1997	65,7	56,4	59,0	58,7	67,8
	% Of debt in local currency				
June 1994	5,9	10,9	2,7	5,4	6,6
June 1997	5,6	10,3	2,1	15,9	5,9

Source: Chang and Velasco (1998)

The most efficient measure of bank asset weakness, the fraction of non-performing loans, clearly suggested serious banking problems. The causes varied among the countries of the region. For example, in Korea the blame lies in the continuous government interference in credit decisions while in Thailand and Malaysia 30% to 40% of the loans were made to the real estate sector. In Indonesia a rapid financial liberalization led to more than 200 new banks with very high loan growth. The final levels of non-performing loans unraveled as the crisis evolved and reached 47,5% for Thailand and 75% for Indonesia in 1999.

On the whole, it seems that there is a clear connection between liquidity risk and banking distress. Asian countries made themselves vulnerable by relying on short-term, dollar-based bank loans out of overconfidence in the exchange-rate stability.

The output cost of the crisis

Table 4-4 illustrates the devastating output loss, in terms of GDP, in the South East Asia region after the outbreak of the crisis in mid-1997. It is striking to notice the difference between the projections for 1998 and the actual figures, reaching even 20% for Indonesia.

Table 4-4: South East Asia: Real G.D.P. Losses from Banking Crisis

Country	1996	1997	1998(*)	Actual 1998
Hong-Kong	4.9	5.3	5.5	-5.1
Indonesia	7.8	4.9	7.5	-13.7
Malaysia	8.6	7.8	7.9	-6.7
Philippines	5.7	5.1	6.4	-0.5
South Korea	7.1	5.0	6.3	-5.8
Thailand	6.4	-1.3	7.0	-8.0

Source: International Monetary Fund, World Economic Outlook
(*) As projected in May 1997

4.6 The Japanese Crisis

For a large part of the past decade Japan has experiences a steady deterioration in its banking system. This, which originated from the bursting of the asset bubble at the end of the 1980s, culminated in a full-blown crisis in 1997 following the failure of high profile financial institutions. Given the relatively large size of the Japanese banks and their dominance in corporate funding in Japan, this crisis has profound implications for both the national and global economy.

This crisis consists a very valuable example for several reasons. First, most of its causes (excessive asset expansion in periods of economic boom, liberalization without an appropriate adjustment of the regulatory environment, weak corporate governance and regulatory forbearance) are typical of banking crises. Secondly, this crisis serves as a warning that such a banking crisis can hit even a seemingly robust and sophisticated financial system. Most notably, the fact that only a decade ago Japanese banks were considered to be among the strongest in the world makes this crisis even more remarkable. Finally, the Japanese banking crisis shows that the costs associated with such a crisis can be considerable, as apart from the fiscal costs for the restructuring of the banks, about 12% of GDP, banking crisis has pushed the whole economy to an unprecedented stagnation during the whole decade.

The origins of the crisis

The general features of the banking crisis in Japan are by now well recognized and in many respects resemble banking crises experienced by other industrial countries: booming economies and sharply rising asset prices, followed by recession, severe asset price declines and banking problems.

A number of features of the Japanese financial system in the mid-1980s made the banking system extremely vulnerable to a potential crisis. According to *M. Hutchinson & K. Mc Dill [23]*, these features of the Japanese financial structure include:

- Financial deregulation and liberalization in the late 1970s and early 1980s had increased the portfolio flexibility of banks and other financial institutions, especially small depositories. Japanese financial institutions aggressively pursued lending in speculative real estate ventures during the late 1980s and did so with very little oversight by the supervisory authorities.

- The shift to a slower growth path after the first oil-price shock in 1973 reduced the corporate sector's reliance on bank credit and services. As a result, banks sought out new markets, such as real estate lending, outside traditional corporate finance and were willing to assume new and often higher risks for which they had little previous experience.

- The main bank system of industrial organization and corporate governance began to unravel in response to financial liberalization. No widely available financial-disclosure framework to evaluate and monitor risk was available to replace the main bank system.

- Japanese banks have considerable authority to directly purchase and hold equities, tying their "hidden reserves" directly to the fortunes of the stock market.

- The regulatory monitoring system lagged behind market developments and "administrative guidance" could not keep pace with the fast-changing financial environment.

- Complete deposit guarantees encouraged risk taking at the very time the Bank of Japan provided the liquidity and financial liberalization provided the asset-diversification powers.

The asset price inflation of the late 1980s

Asset deflation in the early 1990s was the single most important factor affecting the profitability of Japanese financial institutions. *M. Hutchinson & K. Mc Dill [23]* noted that financial liberalization and lack of adequate supervision should be added to the following factors contributing to asset inflation in Japan:

- The initial jump in stock and land price during 1985-86 was most likely related to changes in fundamentals: aggregate productivity gains in Japan were very strong at the time, and demand for real estate, particularly in the Tokyo area, increased significantly.

- Expansionary monetary policy pushed interest rates to very low levels and contributed to the run up in bond, stock and real estate values.

- Structural changes were taking place: financial deregulation, changes in the flows of funds, and the increased risk-taking activity of banks also played a role at the beginning of the asset price inflation.

- As corporate firms started to turn away from banks towards securities markets and the liberalization in time deposit interest rates increased the cost of funds for banks, banks were forced to look for lending opportunities with low screening costs. The obvious option was real-estate-related loans where credit analysis was just a matter of estimating the future path of real estate prices. Moreover, the perceived risk of such loans must have been low, given the movements of real estate prices in the postwar period as discussed above.

As Table 4-5 demonstrates, the both loans secured by land and unsecured loans represented an overwhelming portion of Japanese banking loans.

Table 4-5: Security Types of Bank Loans (as % of total loans)

Year	Loans secured by land	Loans secured by Stocks & Bonds	Loans secured by others	Unsecured Loans
1985	21,72	1,96	35,88	40,44
1986	22,08	2,17	35,84	39,91
1987	23,19	2,35	35,05	39,41
1988	23,86	2,62	35,93	37,59
1989	25,69	2,63	37,62	34,06
1990	27,22	2,31	38,53	31,94
1991	28,08	1,91	38,6	31,41
1992	28,41	1,65	37,82	32,12
1993	27,93	1,66	38,09	32,32
1994	26,93	1,52	38,47	33,08
1995	25,36	1,53	39,74	33,37
1996	24,08	1,30	40,54	34,08
1997	23,46	1,38	41,53	33,63

Table 4-6 points out clearly the credit expansion that took place in Japanese financial system and most notably in other banking institutions and insurance companies in the late 1980s. Along with the high GDP growth rate of these years, the Japanese economy was clearly overheating. Naturally, the shift to the minimal GDP growth rates and credit crunch of the mid-1990s was abrupt and painful.

Table 4-6: Credit growth of different sectors of financial system

Year	G.D.P. growth	Credit growth of Banks	Credit growth of OBI [1]	Credit growth of I.C.[2]
1985	6,61	10,83	5,77	7,99
1986	4,69	9,49	8,75	7,37
1987	4,26	11,17	23,66	22,93
1988	6,92	10,94	15,15	22,85
1989	6,96	11,63	10,68	22,54
1990	7,51	9,21	9,91	21,10
1991	6,57	5,29	6,45	12,24
1992	2,79	2,33	9,09	5,55
1993	0,92	-1,12	6,41	5,44
1994	0,82	0,20	5,48	3,17
1995	0,83	1,68	0,98	-1,92
1996	3,44	1,17	3,69	7,03
1997	1,42	0,51	-2,29	-9,82

Source: International Financial Statistics
1:Other banking Institutions, 2:Insurance Companies

By most indicators in Table 4-7 Japan was in a very strong position relative to most countries prior to the onset of its banking problem. Japan experienced stronger GDP growth, less exchange rate depreciation (indeed, strong appreciation), lower inflation, lower budget deficits and somewhat higher real interest rates than even the non-crisis countries. Moreover, Japan demonstrates an extremely high liquidity but average stock price gains and credit growth.

Table 4-7: The Macroeconomic facts in countries in crisis and Japan

	Control group[1]	Countries in crisis[2]	Japan[2]
Real G.D.P. Growth	3,7	3,5	4,6
Budget Surplus	-3,7	-3,8	-1,8
Inflation	10,2	13,3	1,6
Real Interest Rate	0,5	-0,3	3,7
M2/Reserve Ratio	14,0	21,7	42,4
Credit Growth	11,7	9,8	7,0
Stock Price Change	12,9	16,5	9,3
Budget Surplus	-3,7	-3,8	-1,8
Exchange Rate Depreciation	8,8	20,2	-4,8

Source: Hutchinson and Mc Dill [22]
1: Mean Value over 1975-97 period of the countries not experiencing banking sector distress.
2: Mean Value for 5-year period preceding episodes of banking sector distress for countries in sample experiencing banking sector distress

The burst of the bubble

In late 1986 or 1987, the asset inflation process appears to have become a speculative bubble with little restraint either from financial institutions or the regulatory authorities. Expectations of asset price increases fed upon themselves and price/dividend and price/rent ratios increasingly deviated from fundamental values until the crash in the early 1990s. Speculators during the asset inflation typically thought that even though the "levels" of stock and land prices were abnormally high and would eventually fall, further investment was warranted as long as other investors thought prices would continue to rise.

Asset prices declined rapidly in the 1990-1991 period. The Nikkei 225 stock price index reached its 38,915 peak on the last business day of 1989, and then tumbled. By October 1, 1990, the Nikkei stood barely above 20,000, declining almost 50% in nine months. Land prices began to fall in late 1991 and, by 1995 prices were frequently only half of their peak values and similar to those prevailing 10 years earlier

Real estate prices declined for seven consecutive years, through June 1998. A combination of policy actions and the self-correcting mechanism of the speculative process, deflating the bubble, were responsible for the asset price decline:

- By mid-1989, monetary authorities became fully aware of, and concerned about, asset price inflation and started to raise interest rates while the Ministry of Finance introduced several measures to slow land price rises.

- The Iraqi invasion of Kuwait on August 2, 1990 further weakened the world economic outlook and the prospects for oil-dependent Japan in particular.

- Furthermore, once the decline in asset prices began, banks had an incentive to reduce lending for real estate and other purposes. The introduction of the Basle risk-based capital ratio increased the cost of capital for banks reducing the incentive of banks to make loans and contributing to the drop in credit expansion.

- The most important reason for the collapse in asset prices was the self-correcting mechanism inherent in stochastic speculative processes. Expectations of further price declines generated selling which in turn led to price declines.

1990s: The lost decade

The 1990s may be divided into three sub-periods:

- *Until 1994*

Until 1994, the authorities did very little to stop the decline in the banking system, because of what turned out to be a false hope that the economy would soon recover and banks would catch up. Only bank specialists started to recognize the seriousness of the bad loans problem. The first small troubled banks were closed, while deposit insurance funds were injected into rescuing banks.

- *1994-1997*

In late 1994, the regulators embarked on serious attempts at resolving banks' problems, which they thought were most serious among the credit cooperatives and housing finance companies. Thus, they tried to mobilize public money, but faced serious objections from taxpayers. As a result, the sum of public money mobilized was very small, less than 1 trillion yen. In addition, the implementation of the prompt corrective action (PCA) was decided as a way to make the regulatory approach more transparent and rules-based. Unfortunately, even with these measures, the problems did not disappear.

Therefore, until 1997 regulators are thought to have exercised forbearance out of their fear to trigger off a public panic, especially in the absence of an adequate deposit insurance scheme and a legal framework for bank restructuring to deal with a full blown crisis. In any event this forbearance probably only served to further weaken the banks as the consequent moral hazard problem resulted in banks engaging in a gamble for resurrection

- *After1997*

The year of 1997 was a turning point for the Japanese crisis as it was characterized by an increased distress in the financial system and market scrutiny and led to a major shift to the lending behavior of banks and eventually to a serious credit crunch.

Several large and high profile financial institutions went into effective bankruptcy in 1997. This led to a sharp curtailment in interbank activities and to a sell-off of bank shares in Tokyo stock market as well as to an increase in the cost of funding of Japanese banks overseas. In 1997 authorities introduced the Prompt Corrective Action framework, which had two major components:

➢ The introduction of a self-assessing process, placing banks responsible for valuing their own assets on a realistic basis according to well-defined guidelines and under external supervision.

➢ The specification of the capital ratio thresholds under which regulators can order banks to take remedial action ranging from reduction of branches to liquidation in case of insolvency.

The government finally decided to mobilize a large sum of public money, 30 trillion yen initially, subsequently adjusted upwards to 60 trillion yen, to protect creditors of insolvent banks and to recapitalise some of the solvent ones. From this 30 trillion yen, 17 trillion yen was used to deal with bank failures until March 2001 and 13 trillion yen for the recapitalization of banks through the purchase of preferred shares and subordinated debt.

More specifically, Japanese banks tried to achieve at least two ends, reducing bad loans and meeting the Basel capital standards. Large Japanese banks had capital ratios of barely above 8% at the start of the 1990s, with about half of it consisting of unrealized capital gains on their equity positions. This meant that every time equity prices plunged, banks faced the risk of not being able to meet the Basel standards or having to slow down the pace of bad loan write-offs. As of March 1998, latent gains stood at 2.7 trillion yen for the top 20 banks, only 15% of their 1993 levels, almost a negligible portion of their capital base. Therefore, the subordinated debt and preferred shares, injected by the government, were needed in order to fill the gap.

Table 4-8 illustrates the deterioration of the Japanese banking sector during the 1990s. The most remarkable point is the increase in the amount of Loan loss provision and the plunge in Profit before tax after 1993.

Table 4-8: Aggregated Bank income statement (billions of yen)

	1991	1992	1993	1994	1995	1996	1997	1998
Net Interest revenue	14.618	19.189	18.456	19.539	19.523	19.080	17.408	10.562
Other op. income	4.649	4.648	6.269	5.670	6.853	5.272	6.740	3.386
Overheads	13.193	15.332	15.593	16.654	14.474	14.744	14.888	10.256
Loan loss provision	*1.650*	*3.897*	*9.163*	*12.544*	*23.342*	*11.532*	*25.809*	*21.202*
Other	982	6	3.163	5.610	6.534	2.160	6.243	7.790
Profits before tax	*5.410*	*4.616*	*3.131*	*1.619*	*-4.905*	*236*	*-10.304*	*-9.990*
Tax	3.045	2.780	1.618	1.347	442	597	-619	-2.515
Net income	2.367	1.835	1.515	271	-5.346	-360	-9.683	-7.474

Source: Bank Scope

The macroeconomic facts of the crisis

The deterioration in the quality of loans to the real estate sector was the primary problem, but was compounded by the drop in the value of banks' large equity holdings and growing loan problems associated with a prolonged period of slow growth and recession through most of the 1990s.

Consumption fell as households saw the real value of their equity and real estate holdings decline precipitously. The fall in consumption induced a fall in fixed investment, which was weakened further, in turn, by the overhang of excess capacity accumulated during the asset inflation phase and the credit crunch induced by the decline in bank "hidden" capital.

The "bubble" pattern, and similarities with a number of crisis countries, comes out more clearly in Table 4-9. Japan clearly had a boom economy prior to the banking crisis as reflected by rapid real GDP and credit growth, rising inflation, and strong asset price appreciation, meaning rapid stock price increase. However, the onset of banking sector distress was followed by a sharp slowdown in output and credit growth and collapse in stock prices. However, there is one striking difference emerging from Table 4-9. Japan failed to recover from its banking crisis and recession at the same pace as other countries facing banking sector distress. The economies of other countries generally rebounded fairly quickly, as output and credit growth picked up markedly and stock prices sharply rebounded after the first crisis year. On the contrary, real output growth, credit growth, and the stock market in

Japan remained very weak and continued to languish seven years after the onset of banking sector distress.

Table 4-9: Macroeconomic developments prior to, during, and after episodes of Banking Sector Distress[1]

	Average			Japan		
	Before	1st year	During	Before	1st year	During
Real G.D.P. Growth	3,	0,7	2,4	4,6	1	1,5
Exchange Rate Depreciation	20,	40	17,7	-4,8	-0,4	0,8
Inflation	13,	14,3	10,7	1,6	1,7	0,1
Real Interest Rate[2]	- 0,	-0,3	0,5	3,7	2,8	1,7
M2/Reserve Ratio	21,	21,7	29,5	42,4	56,7	35,2
Credit Growth	9,	4,8	1,8	6,9	1,2	0,8
Budget Surplus	-3,	-3,2	-3	-1,7	0,3	-1,5
Stock Price Change[3]	16,	1,9	13,7	9,3	-25,9	1,2

Source: Hutchinson and Mc Dill [22]
1: Mean Values over period for countries experiencing banking sector distress.
2: Length varies by duration of episode
3: Excludes high inflation countries.

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5. THE ECONOMETRIC MODEL

The interest for identifying early warning indicators is currently soaring, due to two major factors: the high cost to countries experiencing banking crises and an increasing awareness of the insufficiency of the major market indicators, meaning the interest rate spreads credit ratings. However the previous chapters have illustrated that although the search for leading indicators of banking crises has generated considerable interest in recent years the empirical studies had until now only limited success. Some common themes do emerge from the studies but most of the models lose their robustness when tested for different countries or periods.

This study is set to contribute to the existing literature of leading indicator models of banking crises with our focus on a measure of financial liberalization and namely the degree of financial repression. In more detail, based on a sample of past banking crises we examine whether a precedent period of financial liberalization increases the likelihood of a banking crisis.

In this chapter, we will outline the basic features of this study, meaning the explanatory variables, the sample and the method used.

5.1 The links between financial liberalization and a banking crisis

The links between financial liberalization and a following banking crisis have been already examined in most of the significant studies on this field usually with the inclusion of several proxies of financial liberalization, in a wide set of macroeconomic and institutional variables. For example, *Demirguc-Kunt and Detragiache [9]&[10]* and their followers *Hutchinson and Mc Dill [22]* and *Eichengreen and Rose [15]*, constructed the variable of financial liberalization on the basis of the beginning of observed policy changes to liberalize interest rates, taking a value of unity during the liberalized period of market-determined rates and zero otherwise. Indeed, there was clear evidence that this proxy increases significantly the likelihood of banking crises. even when real interest rates are controlled for. Moreover, *Kaminsky and Reinhart [9]* confirm that an increase in the growth of private credit, which they used a proxy for financial liberalization, is strongly associated with banking distress.

On the whole, the existing literature suggests a number of explanations for this association of financial liberalization with the risk of banking crises:

- Bank credit managers accustomed to a controlled financial environment may not possess the skills needed to evaluate additional sources of credit and market risk in an environment with higher interest rate volatility interest rate.

- The elimination of restrictions on bank lending and the lower reserve requirements permit banks to accommodate increased loan demand.

- The entry of new competitors, foreign and domestic, may well increase the pressures on banks to engage in riskier activities.

All these factors point to the fact that a period of financial liberalization allows for excessive risk-taking, credit growth, imprudent banking policies and thus, to the increase in the number of non-performing loans and even worse, to troubled banks.

In our study, we will concentrate exclusively on the association between financial liberalization and banking crises, by measuring it with the specific indexes of financial repression, rather than with an arbitrary dummy variable, which was mostly the case until now.

What is financial repression?

Beim & Calomiris [4] identify financial repression as the government intervention in the operation of the financial system, indicating the lack of financial development and liberalization. More practically, they have determined six ways through which the authorities exercise this control:

- By imposing ceilings on interest rates paid by banks for deposits

- By imposing high reserve requirements on banks

- By lending to industry and/or directing bank credit

- By owning and/or micromanaging banks, leaving them little autonomy

- By restricting entry into the financial industry, especially by foreigners

- By restricting international capital inflows and outflows

Measuring financial repression

The task of measuring the extent of financial repression is quite demanding, as some elements are easier to quantify than others. Eventually, *Beim & Calomiris [4]* concluded on these six variables as reliable measures of financial repression:

➤ *1/Reserve ratio*

The ratio of bank reserves to bank deposits measures effectively the effective reserve ratios in the banking system and, thus the size of taxation to banking system.

➤ *Real interest rates*

While restrictions on deposit interest rates are hard to quantify, we can observe the effect of such restrictions by examining real interest rates, that it the amount by which savers gained or lost the ability to buy real goods and services as a result of saving.

➤ *Credit to private sector/ domestic credit*

In order to measure the financial intermediation development, we use the ratio of private credit to total credit.

➤ *Commercial bank assets/ (Commercial bank + Central bank assets)*

This ratio seems to capture effectively the intermediation efficiency, as it is signaled by the size of the private banking sector relative to the total banking sector.

➤ *M3/GDP*

To measure the size of the financial intermediation sector, we use a measure of relative money holdings across counties, namely the ratio of liquid liabilities (M3) to GDP.

➤ *Stock market capitalization/GDP.*

This index measures the relative size of the stock market, as stock markets have a dual role in the financial system. They help raising capital and focus the attention of managements and investors on value and value creation.

Defining financial liberalization as the lack of financial repression, it is evident that these 6 measures can also be thought as indicators of financial liberalization. Indeed, a sharp increase in real interest rate, liquidity, private borrowing, bank lending and stock prices and a decline in the reserve ratio are strong indications of a period of financial liberalization and usually feature in the pre-crisis period. More specifically, it has been observed, yet not thoroughly tested, that banking crises are preceded by a period of "overshooting" of these variables, which usually starts from an observable turning point in their time series. Therefore, we will use the behavior of these indexes as the explanatory variables of our model so as to capture the effect of financial liberalization on the occurrence of banking crises (Table 5-1).

5.2 Description of explanatory variables and data sources

Apart from the 6 indices of financial repression described above, it was essential to add another variable measuring the international liquidity conditions, as it has been established that external incidents like an increase in OECD countries' interest rates can often trigger off banking turmoil, through the outflow of foreign capitals, especially for emerging countries. One of the most suitable variables capturing this effect is the ratio of liquid liabilities (M3) to GDP, on a monthly basis. The role of international liquidity has been also measured by *Eichengreen and Rose [15]* though, with use of the weighted average of interest rates in major industrial countries rather than with the M3 variable as in our case.

Table 5-2 provides the exact definitions of all the 7 variables and the sources used in order to obtain the necessary data. As it will be analyzed in the following sections, the model was based in monthly data, coming mainly form IMF (IFS) and local central banks' databases.

Table 5-1: Description of explanatory variables and data sources

Variables	Definition	Source
1/Reserve ratio	(M2- currency held outside of banks)∕ Bank reserves	• M2 is money plus quasi-money (lines 34+35 from the IFS). • Currency outside banks is IFS line 14a. • Bank reserves is IFS line 20
Real interest rate	Nominal interest on bank deposits (i) adjusted for annual inflation (π): $r=(1+i)∕(1+\pi)-1$	• Where available, interest rate is the deposit rate (IFS line 60l. Otherwise, the discount rate (IFS line 60..zf). • To measure inflation we used the change in c.p.i. from previous year (IFS line 64…xzf).
Claims on private sector /Dom. credit	Ratio of the credit to private sector to total domestic credit	• Credit to private sector is IFS line 32d. • Domestic credit is IFS line 32.
Deposit banks assets/Total bank assets	Ratio of private banks assets to the sum of central bank and private banks assets	• Deposit banks assets are IFS lines 22a-f. • Central Bank assets are IFS lines 12a-f.
M3/GDP	Ratio of short -term liquid liabilities to GDP	• M3 is line 59mca. of IFS. • Monthly GDP data comes from the interpolation of quarterly or annual data (IFS line 99b) based on the monthly Ind. Production index (line 66..czf)
Stockmarket capitalization/GDP	Ratio of the aggregate market value of listed companies to GDP.	• Stockmarket data comes from DataStream. • Monthly GDP data comes from the interpolation of quarterly or annual data (IFS line 99b) based on the monthly Ind. Production index (line 66..czf)
M3/GDP*(U.S)*	Ratio of short -term liquid liabilities to GDP	• M3 is line 59mca. of IFS. • Monthly GDP data comes from the interpolation of quarterly or annual data (IFS line 99b) based on the monthly Ind. Production index (line 66..czf).

5.3 Banking Crisis Sample

Given that banking problems are usually difficult to identify empirically because of the data limitations mentioned in Chapter 1,most studies have employed a combination of events to identify and date the occurrence of a bank crisis. Therefore, the selection of the exact definition of banking crisis is a basic element of a study in this field, as it will determine the dating of each incident and thus, the sample used.

Nevertheless, although we acknowledge that every method of defining and dating banking sector distress is inevitably, more or less, arbitrary, we decided to identify and date the episodes of banking distress according to the operational criteria already set by *Kaminsky and Reinhart [9],* which is used by the majority of similar studies. Hopefully in this way, we will avoid any suspicion of "data mining", or in other words of identifying the date of the banking crisis after having observed developments in variables thought to be determinants of the crises.

Data description

Given the fact that our model will use monthly data on the explanatory variables, it was requisite to opt for the *Kaminsky and Reinhart [9]* approach, as it is the only one that dates a banking crisis on a monthly rather than annual basis.

Kaminsky and Reinhart [9] mark the beginning of a banking crisis by two types of events:

- Bank runs that lead to the closure, merging or takeover by the public sector of one or more financial institutions.

- Otherwise, the closure, merging or takeover or large-scale government assistance of an important financial institution or group of institutions that marks the start of a string of similar outcomes for other financial institutions.

This approach to dating the onset of the banking crises has several drawbacks. More specifically, it could date the crises either too late because the financial problems usually begin well before a bank is finally closed or merged or too early because the worst of crisis may come later on.

Our sample

Our sample is presented in Table 5-2. It consists of 19 incidents of banking crises in both industrial and developing economies, during the period 1978-2000. We have intentionally excluded the crises of the 1980s in Latin America, as they are classified mainly as debt-driven and not banking crisis.

Where the main macroeconomic and financial data series were missing or mostly incomplete, the relevant crises were removed from the sample. Eventually, these data limitations reduced our sample to the following banking crises (Table 5-2).

Table 5-2: Banking Crises Starting Dates

Country	Starting date
Argentina	December 1994
Brazil	December 1994
Chile	September 1981
Colombia	April 1998
Denmark	March 1987
Finland	September 1991
Indonesia	November 1992
Israel	October 1983
Malaysia	September 1997
Mexico	December 1994
Norway	November 1988
Philippines	July 1997
South Korea	July 1997
Spain	November 1978
Sweden	November 1991
Thailand	May 1996
Turkey	January 1991
Turkey	December 2000
Venezuela	October 1993

Source: Kaminsky and Reinhart [9]

5.4 Econometric methodology

The goal of this study is to test the empirical proposition that financial liberalization is associated with a banking crisis by measuring its effect on the likelihood of a banking crisis. Our methodology to achieve that is twofold. Firstly, we will use a regression technique to estimate a multivariate model that captures the relationship between the behavior of the 7 independent variables and the probability of the crisis occurring. Secondly, we will perform some sensitivity analysis in order to test the robustness of this estimated model.

The basic econometric model

The dependent variable (y_j), the crisis dummy, will indicate the incidence of a banking crisis and take discrete values of either 1,when the crisis occurs, or 0,when it does not. This variable will be related to the continuous series of the 7 independent variables, meaning the 6 indicators of repression and the indicator of international liquidity (USM3/GDP), with the use of a binomial multivariate probit model.

More specifically, the probability of a banking crisis occurring Pr (y_i=1) is considered as a function of the vector of the 7 explanatory variables x_i, and the vector of the 7 unknown parameters β. The likelihood function of the probit model is constructed across n observations (the number of countries times the number of observations for each country) and is then maximized with respect to the unknown β using the non-linear maximum likelihood method.

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. The amount of the increase in the probability depends on the original probability and thus on the values of all the dependent variables and their coefficients. Hence, we need to calculate the derivatives at different levels of the independent variables to get an idea of the range of variation of the resulting change in the probabilities.

The input data

As we have already mentioned, the major difference of this model compared to the previous studies is the use of monthly-based data, rather than annual. This choice involves an obvious tradeoff. On the minus side, the decision to go with higher frequency data resulted in a smaller sample, as monthly data on the specific variables is available for a smaller number of

countries than would be the case for annual data, Yet monthly data permits us to be more accurate on the impact of financial liberalization.

The second important feature of this model is that the observations of the 6 indices of financial repression will not enter the model with their absolute values but with their deviations from their historical average, which is constructed with a standard procedure. This transformation has two appealing results: it eliminates the non-stationarity problem of the variables and makes the indicators more comparable across countries and time.

More specifically, through an analysis of the monthly time-series of the variables of each country for a period of 10 years before the crisis, we located the start of a liberalization period, signaled by an overshooting of the variables and followed by a period of accumulated tension. After having determined this turning point for each country, we calculated the historic average of each variable for a previous period of minimum 120months (5 years). In this way, we obtain an estimation of the behaviour of the variables before the liberalization period.

Finally, it should be noted that during this process special weight was given to the variables of M3/GDP and 1/reserve ratio, as they were considered to be the most reliable signals of a start of the liberalization period. In other words, we relied mainly on the behaviour of these 2 indicators for determining the turning point of each country.

Testing the estimated model

The quality of the model specification will be measured by its classification accuracy. More specifically, in order to determine the accuracy of the estimation, we will report the in-sample forecasting accuracy, meaning the percentage of actual observations correctly classified as crisis ($y_i=1$) or non-crisis ($y_i=0$) episodes.

5.5 Data availability and model specifications

Table 5-3 summarizes the 19 banking crises, the starting dates of the available data for the 6 independent variables and the turning point for each country, signalling the start of the overshooting period. As we have already mentioned, the data from the period of the 5 years before the turning point is necessary for the calculation of the average value of the variables.

As Table 5-3 indicates, the only problematic variable is Stockmarket Cpitalization/GDP as it was impossible to obtain monthly Stockmarket capitalization data for the whole period prior

to the banking crisis for 5 countries (Brazil, Chile, Colombia, Israel and Spain). For another group of 4 countries (Argentina, Indonesia, Turkey 1991and Venezuela), the Stockmarket data was available only for a period starting after the turning point, so it was equally impossible to calculate its historic average value. Finally in the case of Argentina, as the period for which there is available Stockmarket data is only 12 months prior to the turning point, it was considered inadequate for the calculation of a reliable average value.

Table 5-3:Data availability and turning point for each country

Crisis Onset	Starting date of available data						Turning point
	1/Reserve ratio	Real i-rate	Private credit/Total credit	Dep.Banks assets/Total bank assets	M3/GDP	Stockmkt/GDP	
Argentina- *December 1994*	Jan.1987	Jan.1987	Jan.1987	Jan.1987	Jan.1987	Jan.1988	Jan.1992
Brazil -*December 1994*	Aug.1989	Dec.1987	July 1988	July 1988	June 1988	n.a.	Dec.1992
Chile -*September 1981*	Dec.1973	Dec.1973	Dec.1973	Dec.1973	Dec.1973	n.a.	Dec.1978
Colombia-*April 1998*	Oct.1989	Oct.1989	Oct.1989	Oct.1989	Oct.1989	n.a.	Oct.1994
Denmark- *March 1987*	Jan.1978	Jan.1978	Jan.1978	Jan.1978	Jan.1978	Jan.1978	Jan.1983
Finland-*September 1991*	Jan.1982	Jan.1982	Jan.1982	Jan.1982	Jan.1982	Jan.1989	Jan.1987
Indonesia-*November 1992*	Nov.1984	Nov.1984	Nov.1984	Nov.1984	Nov.1984	March 1990	Jan.1989
Israel-*October 1983*	Jan.1976	Jan.1979[2]	Jan.1976	Jan.1976	Jan.1976	n.a.	Jan.1981
Malaysia-*September 1997*	Oct. 1988	Oct. 1988	Oct. 1988	Oct. 1988	Oct. 1988	Oct. 1988	Oct.1993
Mexico-*December 1994*	Oct.1986	Oct.1986	Oct.1986	Oct.1986	Oct.1986	Jan.1988	Oct.1991
Norway-*May 1988*	Jan.1990	Jan.1990	Jan.1990	Jan.1990	Jan.1990	Jan.1990	Jan.1995
Philippines-*July 1997*	Jan. 1989	Jan. 1989	Jan. 1989	Jan. 1989	Jan. 1989	Jan. 1989	Jan.1994
South Korea-*July 1997*	Jan. 1987	Jan. 1987	Jan. 1987	Jan. 1987	Jan. 1987	Jan. 1987	Jan.1992
Spain-*November 1978*	Nov.1967	Nov.1967	Nov.1967	Nov.1967	Nov.1967	n.a.	Nov.1972
Sweden-*November 1991*	Jan.1982	Jan.1982	Jan.1982	Jan.1982	Jan.1982	Jan.1982	Jan.1989
Thailand- *May 1996*	Jan.1985	Jan.1985	Jan.1985	Jan.1985	Jan.1985	Jan.1985	Jan.1989
Turkey- *January 1991*	Jan.1981	Jan.1981	Jan.1981	Jan.1981	Jan.1981	Jan.1988	Jan.1986
Turkey- *December 2000*	Jan.1992[1]	Jan.1992[1]	Jan.1992[1]	Jan.1992[1]	Jan.1992[1]	Jan.1992[1]	Jan.1996
Venezuela -*October 1993*	June 1982	June 1982	June 1982	June 1982	June 1982	Jan.1990	June 1989

1:The period of 5 years is limited to 4, so as to avoid the impact from the aftermath of the previous banking crisis of January 1991.

The baseline specifications of the model

By now, it has become obvious that the choice to use monthly data presents the risk of lack of necessary data and thus, of a reduced sample. Indeed, it was impossible to obtain enough or any Stockmarket data for 9 countries (Brazil, Chile, Colombia, Israel, Spain, Argentina, Indonesia, Turkey 1991and Venezuela). In order not to remove altogether this important explanatory variable, it was decided to estimate two different models, with different samples and sets of explanatory variables. The two model specifications can be described in the following way:

- The first model specification has a total set of 7 explanatory variables, including Stockmarket Capitalization/GDP, but a quite limited number of countries. Indeed, Table 5-4 presents the set of 10 countries for which Stockmarket data is available and thus, will be included in the country panel for the estimation of this model. Thailand and Mexico will be both included in the first country set (Table 5-4), although there is Stockmarket data only for 3 years before the turning point of each country (Table 5-3). Actually, this period of 3 years was considered sufficient for calculating a historical average of the variable of Stockmarket/GDP for both countries.

Table 5-4: The first set of 10 countries

Country	Starting date
Denmark	March 1987
Finland	September 1991
Malaysia	September 1997
Mexico	December 1994
Norway	November 1988
Philippines	July 1997
South Korea	July 1997
Sweden	November 1991
Thailand	May 1996
Turkey	December 2000

- According to the second specification, the model will have a more limited number of explanatory variables after the exclusion of Stockmarket Capitalization/GDP, yet, a more extensive sample with all the 19 countries as they appear in Table 5-2. Obviously, it is a case of a tradeoff between large sample and few explanatory variables.

6. THE EMPIRICAL RESULTS

This section presents the results of the regressions performed, which can be divided into two basic subgroups depending on the values of the independent variables being contemporaneous or not. As it has been already mentioned, the regressions with contemporaneous values aim at examining the existence of causality between the various explanatory variables and the occurrence of a banking crisis, while those with lagged values can serve as a warning signal of an oncoming banking crisis.

Assessing the quality of the models

All the data associated with the output and the quality of the model is summarized in two separate tables, the first one regarding the significance of the estimated coefficients and the goodness-of-fit of the model and the second one the in-sample prediction performance of the estimated model.

More specifically, the main part of the first table examines the statistical significance of the estimated coefficients, based on their value, standard error, appropriate t-statistic and the level of statistical significance. On the other hand, the goodness-of-fit of the model is measured with the pseydo-R^2 and the χ^2. In probit regressions, this R^2 compares the Log-likelihood of the actual regression with the one that would have been obtained with only the constant term in the regression. Although this R^2 still has a minimum value of 0, its maximum value must be less than 1 and does not have the natural interpretation like in a standard regression. Therefore, the relevant bibliography names it pseydo-R^2 and prefers to test the explanatory power of the model with the most reliable likelihood ratio statistic which is distributed as a χ^2 statistic with k-1 degrees of freedom, where k-1 is the number of explanatory variables.

The second table presents the prediction accuracy of the regression as this is measured by the number of the in-sample events correctly classified as crisis or non-crisis by the estimated model. Given that the sample is strongly unbalanced in favor of the non-crisis events, meaning that the crisis months hardly exceed the 7% of the set of observations in any specification, the accuracy of the model would be underestimated if we accept the 50% probability as threshold value for classifying an estimated event as crisis or non-crisis. Therefore, the relevant bibliography suggests that this threshold value should equal the

percentage of crisis events in the whole sample. We will also follow this methodology in our study, reporting this value in every specification.

6.1 Models with contemporaneous values

This section presents the results of the estimation of the model when the independent variables enter with contemporaneous values. As we have previously mentioned, there are two model specifications depending on the inclusion or not of the variable of Stockmarket/GDP in the regression. Henceforth and for practical reasons, the specification with all the 7 variables will be denoted as broad, while the second one with the 6 variables as narrow.

The empirical results under the broad specification of the model

With the inclusion of the Stockmarket variable in this specification, the data sample extends to 171 monthly observations of which only 10, or a 5,9%, are entered as crisis episodes (y_i=1). Therefore, this will be the threshold value for classifying an event as crisis or not, as shown in Table 6-2.

Table 6-1 &Table 6-2 summarize the results of the first regression. According to the reported coefficients, low reserve ratios, increased private credit, deposit bank assets, domestic and international liquidity and a fall in the Stockmarket and real interest rates are associated with the onset of a banking crisis. However, only 3, the reserve ratio, the Bank assets and the domestic liquidity variables, appear statistically significant at the 5% confidence level. Obviously, this result confirms the theory that an overly lax monetary policy leads to a surge in bank loans, the dilution of the bank capital, and thus, to the insolvency of certain banks. Moreover, the fall in the Stockmarket and the real interest rates possibly mark the onset of the reversal of the preceding bubble.

As far as the goodness-of-fit of the model, the level of statistical significance of χ^2 (7) is extremely high, while pseydo-R^2 is also quite satisfactory. Finally, Table 6-2 demonstrates the high classification accuracy of the model as the 90% of the crisis episodes and the 99,4% of the whole sample were correctly estimated.

Table 6-1:Probit regression results

Sample: 171 observations				
Convergence after: 9 iterations				
Log Likelihood:-18,18971 Pseudo R²=58,51				
χ²(7)=51,30738 Significance Level=0,0000				
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-4,41958	0,83416	-5,29823	0,00000
1/Reserve ratio	0,64689	0,27202	2,37804	0,01740**
Real i-rate	-0,19955	0,17687	-1,12821	0,25923
Claims on private sector/Dom. credit	1,77648	1,20588	1,47318	0,14070
Dep. Banks assets/ Total bank assets	10,57623	4,42694	2,38906	0,01689**
M3/GDP	2,15055	1,00023	2,15004	0,03155**
Stockmarket/GDP	-0,69276	0,45803	-1,51249	0,13041
M3/GDP *(US)*	42,69298	27,43916	1,55591	0,11973

*** Denotes the 5% level of statistical significance.*

Table 6-2: Measuring the classification accuracy

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	**Total**
Sample	$Y_i=0$ (Non-crisis)	161	0	161
	$Y_i=1$ (crisis)	1	9	10
	Total	162	9	171

In order to test further the results of the first regression, we repeated it with the inclusion of the 3 significant variables of the original model and reported the results in Table 6-3 &Table 6-4. The variable of bank assets reaches the 1% level of significance, while the domestic liquidity variable appears to lose most of its explanatory power. Moreover, both the pseydo-R^2 and the classification accuracy of this regression are lower than previously, indicating a loss of explanatory power.

Table 6-3:Probit regression results

Sample: 171 observations				
Convergence after: 8 iterations				
Log Likelihood:-22,46		Pseudo R²=48,77		
χ²(2)=42,6677	Significance Level=0,0000			
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-3,56228	0,62257	-5,72189	0,00000
1/Reserve ratio	0,36836	0,17746	2,07571	0,03792**
Dep. Banks assets/ Total bank assets	8,86341	2,72939	3,2474	0,00116***
M3/GDP	1,20681	0,82328	1,46587	0,14268

** Denotes the 5% level of statistical significance.
*** Denotes the 1% level of statistical significance.

Table 6-4: Measuring the classification accuracy

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	161	0	161
	$Y_i=1$ (crisis)	2	8	10
	Total	163	8	171

A variation of the previous model with the substitution of the liquidity with the private credit variable is presented in Table 6-5 &Table 6-6. The results are quite similar with the previous specification, though the reserve ratio and the bank assets appear to be even more significant than before.

Table 6-5:Probit regression results

Sample: 171 observations				
Convergence after: 8 iterations				
Log Likelihood:-22,49621		Pseudo R²=48,69		
χ²(2)= 42,694 Significance Level=0,0000				
Estimation results				
Variables	Coefficient	Std. Error	t-statistic	Significance
Constant	-3,60266	0,62844	-5,73270	0,00000
1/Reserve ratio	0,56362	0,23329	2,41593	0,01569**
Claims on private sector/Dom. credit	1,21104	0,84655	1,43056	0,15256
Dep. Banks assets/ Total bank assets	8,87983	2,67315	3,32185	0,00089***

*** Denotes the 5% level of statistical significance.*
*** Denotes the 1% level of statistical significance.*

Table 6-6:Measuring the classification accuracy

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	161	0	161
	$Y_i=1$ (crisis)	2	8	10
	Total	163	8	171

The empirical results under the narrow specification of the model

With the exclusion of the 7th variable the data sample is extended to 308 monthly observations from the whole set of 19 countries. In this specification, there are 19 monthly observations, or a 6,17% of the whole sample, representing crisis episodes (y_i=1).

Table 6-7&Table 6-8 summarize the results of the regression. With the exception of the real interest-rate all the variables hold the same signs with the broad specifications and again only 3 appear statistically significant at the 5% confidence level. As it can be expected, the two most significant variables of the previous specification, namely the reserve ratio and the bank assets variables, are equally robust once more but the domestic liquidity variable is outperformed by the private credit index. The intuition behind these results remains the same as previously: a credit boom threatens the solvency of the banking sector.

As far as the goodness-of-fit of the model, the level of statistical significance of χ^2 (6) is extremely high, while pseydo-R^2 is quite lower than the one produced under the broader specification, 28,67 versus 58,51. The weaker explanatory power of this specification is also confirmed by the moderate classification accuracy of the model. More specifically, only the 63,16 of the crisis episodes and the 94,7% of the whole sample were correctly estimated.

Table 6-7: Probit regression results

Sample: 308 observations Convergence after: 6 iterations Log Likelihood:-59,4192 Pseudo R²=28,67 χ²(6)=47,6677 Significance Level=0,0000				
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-1,86696	0,16927	-11,02919	0,00000
1/Reserve ratio	0,03674	0,01792	2,04973	0,04039**
Real i-rate	0,12449	0,13277	0,93763	0,34844
Claims on private sector/Dom. credit	0,76879	0,37922	-2,02731	0,04263**
Dep. Banks assets/ Total bank assets	2,00355	0,67409	2,97225	0,00296***
M3/GDP	0,00011	0,00028	0,38095	0,70324
M3/GDP *(US)*	4,40857	9,75758	0,45181	0,65140

*** Denotes the 5% level of statistical significance.*

Table 6-8: Measuring the classification accuracy

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	289	0	289
	$Y_i=1$ (crisis)	7	12	19
	Total	296	12	308

In order to test further the results of the baseline regression, we repeated it with the inclusion of the 3 significant variables of the original model and reported the results in Table 6-9 &Table 6-10. The variables of bank assets and reserve ratio are significant at the confidence level of 1% and 5% respectively, while the variable of the domestic credit appears to lose some of its explanatory power and is robust only at the 10% level. Moreover, the pseydo-R^2 is slightly lower than in the original regression, while the classification accuracy of this model remains the same.

It is interesting to compare the results of Table 6-9 &Table 6-10 to those of Table 6-5 &Table 6-6, as it is the same model but with a different size of sample, much more extended in the second case. The more important difference concerns the domestic credit variable, being much more significant in Table 6-9 and the pseydo-R^2 and the classification results indicating a much better fit in the first specification.

Table 6-9: Probit regression results

Sample: 308 observations				
Convergence after: 6 iterations				
Log Likelihood:-60,00046 Pseudo R²=27,97				
χ²(3)=46,6041 Significance Level=0,0000				
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-1,83562	0,15727	-11,67195	0,00000
1/Reserve ratio	0,03712	0,01751	2,11938	0,03406**
Claims on private sector/Dom. credit	-0,63149	0,32554	2,11938	0,05240*
Dep. Banks assets/ Total bank assets	1,89106	0,62821	3,01021	0,00266***

* Denotes the 10% level of statistical significance.
**Denotes the 5% level of statistical significance.
*** Denotes the 1% level of statistical significance.

Table 6-10: Measuring the classification accuracy

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	289	0	289
	$Y_i=1$ (crisis)	7	12	19
	Total	296	12	308

Assessing the overall performance of the two specifications.

The previous analysis established that the broad model outperformed the narrow one both in terms of goodness-of-fit, as it was signalled by the almost double pseydo-R^2, and classification accuracy. This divergence can derive from two basic reasons. Firstly, the addition of a 7th independent variable is bound to increase the explanatory power of the model. Secondly, the data set of the first specification included 10 banking crises of the 1990s, among which the 4 South East Asian ones of 1997 and the 2 Nordic ones of 1991. Therefore, it follows that it was a much more homogeneous sample of crises with similar origins and features in contrast with the extended sample of 19 crisis episodes spanned over the period of 1978-2000.

Looking into the macroeconomic conclusions, the results of both the contemporaneous models appear consistent with the existing literature. Essentially, the onset of the banking crisis coincides with a literal boom in bank assets, the most robust result in both specifications, with an ensuing fall in the bank reserve ratios and with a significant increase in liquidity and private credit, depending on the model specification. The variations of the baseline regressions confirm the primary role of the Deposit bank assets, reaching the 0,1% level of confidence indicating that the banking distress stems from an inherent instability rather than from an external factor. On the whole, it follows that a sharp increase in Bank assets, meaning mainly loans, coupled with a dilution of their capital are the primary symptoms of a banking crisis.

It is essential to compare the results of this model to the ones reported in the similar studies with contemporaneous values, keeping in mind the differences both in the method and the sample used. In most of them, there is clear evidence of a credit boom through excess bank lending but with the use of different variables and annual data. More importantly, the performance of these models seems to be quite lower than ours both in terms of goodness-of-fit and predictive performance. We summarize the results of the two most similar models with contemporaneous values.

To begin with, *Hutchinson and Mc Dill [22]* performed a similar model including a wide set of institutional and macroeconomic variables but with limited success. The pseydo-R^2 ranged from 6 to 23 and the percentage of the episodes of banking crises correctly predicted from 15% to 58%, depending on the specification of the model. While institutional variables and 2 of the macroeconomic variables, namely real GDP growth and change in stock prices, and the OECD dummy, were significant at the 5% level, real credit growth is significant in only one specification.

In their numerous studies, *Kunt & Detragiache [9], [10] &[11]* find that GDP growth is clearly associated with a higher probability of banking crisis, losing significance when lagged by one period, real interest rate, inflation, M2/reserves and financial liberalization dummy, proxied by the removal of interest rates controls, are significant at the 1% level, while the ratio of private credit/GDP is not significant at time 0. On the whole, the model χ^2 is robust at the 1% and the percentage of crises predicted correctly ranges from 56% to 63% and increases from 76% to 78%, when referring to the whole sample.

Finally, *Hardy and Pazarbasioglu [20]* establish that there is an increased likelihood of banking crisis when GDP growth rates fall, domestic credit growth is rapid, inflation is variable and capital inflows are high.

6.2 Models with lagged values by one period

The most challenging part of the analysis of financial crises, in general, is to determine an efficient warning system for their occurrence. Therefore, the estimation of a model with lagged rather than contemporaneous values is essentially the most important part in any such study, though, often, with poor results.

This section will present the estimated models under both specifications, broad and narrow, with all the independent variables entering the regressions with values lagged by one period, which corresponds to 3 months before the onset of the crisis.

The empirical results under the broad specification of the model

The shift from contemporaneous to lagged values reduced the data sample from 171 to 161 monthly observations of which only 10, or a 6,21% are entered as crisis episodes (y_i=1). Therefore, this will be the threshold value for predicting an event as crisis or not, as shown in Table 6-11.

Table 6-11& Table 6-12 summarize the results of the first regression. Except for the real I-rate, all coefficients hold the same signs as in the contemporaneous model but at a quite lower level of statistical significance. For the first time, the variable of international liquidity, M3/GDP (US), appears statistically significant but not with the expected sign. Presumably, a fall in the international liquidity, equaling a rise in foreign interest rates, would set off a capital outflow and thus, threaten the solvency of the banking system of the specific countries. Moreover, the domestic liquidity and the private credit variables are also significant at the confidence level of 5% and 10% respectively. This time, the pattern of an overheated economy generating credit boom seems to be present at a period of 3 months before the onset of the crisis and thus, consists a possible generating factor.

On the whole, Table 6-11& Table 6-12 indicate a loss of explanatory power and a moderate predictive ability of the lagged model. As far as the goodness-of-fit of the model, both the pseydo-R^2 and the level of the statistical significance of χ^2 (7) are quite lower than in the regressions with contemporaneous values. Looking at the prediction table, the model misses 3 out of the 10 crisis episodes, obtaining a rather satisfying 70% of hits.

Table 6-11: Probit regression results with lagged values (t-1)

Sample: 161 observations				
Convergence after: 6 iterations				
Log Likelihood:-33,0871 Pseudo R²=24,5335				
χ²(7)=21,5126 Significance Level=0,0031				
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-2,3120	0,43774	-5,28154	0,00000
1/Reserve ratio$_{t-1}$	-0,16198	0,20058	-0,80579	0,41933
Real i-rate$_{t-1}$	0,06057	0,00946	0,64009	0,52211
Claims on private sector/Dom. Credit$_{t-1}$	1,69848	0,95637	1,77596	0,07574*
Dep. Banks assets/ Total bank assets$_{t-1}$	1,49440	0,98529	1,51671	0,12934
M3/GDP$_{t-1}$	1,84489	0,93816	1,96650	0,04924**
Stockmarket/GDP$_{t-1}$	-0,46508	0,38806	-1,19847	0,23073
M3/GDP *(US)*$_{t-1}$	32,77544	19,10674	1,71539	0,08627*

Denotes the 10% level of statistical significance.
*** Denotes the 5% level of statistical significance.*

Table 6-12: Measuring the prediction accuracy at t-1

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	161	0	161
	$Y_i=1$ (crisis)	3	7	10
	Total	164	7	171

In order to test further the results of the first regression, we repeated it with the inclusion of the 3 significant variables of the original model and reported the results in Table 6-13 &Table 6-14. The output is rather disappointing, as none of the variables appears to be statistically significant and there is no improvement in the percentage of hits.

Table 6-13: Probit regression results with lagged values (t-1)

Sample: 161 observations Convergence after: 6 iterations Log Likelihood:-34,9255 Pseudo R²=20,3406 χ²(3)= 17,836 Significance Level=0,0005				
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-1,94263	0,30628	-6,34251	0,00000
Claims on private sector/Dom. Credit$_{t-1}$	0,49052	0,50358	0,97405	0,33003
M3/GDP$_{t-1}$	0,79623	0,64222	1,23976	0,21506
M3/GDP *(US)*$_{t-1}$	24,50867	16,46512	1,48852	0,13661

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Table 6-14: Measuring the prediction accuracy at t-1

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	161	0	161
	$Y_i=1$ (crisis)	3	7	10
	Total	164	7	171

The empirical results under the narrow specification of the model

With the use of lagged values in this specification, the data sample consists of 289 monthly observations, from which 19, or a 6,57% of the whole sample, represent crisis episodes (y_i=1). Therefore, this will be the threshold value for predicting an event as crisis or not, as shown in Table 6-16.

Table 6-15 & Table 6-16 summarize the results of the regression. Only one variable, the real interest-rate appears statistically significant at the 5% level but with opposite sign to the one in the regression with contemporaneous values. This finding is quite interesting as it signals a period of high real interest rates at a period of 3 months before the banking crisis. According to *Demirguc-Kunt & Detragiache [10],* bank balance sheets can deteriorate if the rate of return on assets, meaning mostly long-term loans, falls short of the rate that must be paid on liabilities, meaning short-term deposits. Obviously, the most common cause of this kind of mismatch is a rise in short-term interest rates as result of among others of the removal of interest rate controls due to financial liberalization. Even if this rise can be passed on to borrowers, the rise in the non-performing loans will eventually hurt bank balance sheets. Therefore, a rise in interest rates may indeed set the stage for future problems in the banking sector especially in recently liberalized economies.

As far as the goodness-of-fit, the level of statistical significance of χ^2 (6) is quite high, while pseydo-R^2 is lower than the one produced under the model with contemporaneous values but higher than the one of the broad specification with lagged values. Unfortunately, the prediction ability of this model is disappointing as it misses 8, or the 42,1%, of all banking crises.

Table 6-15: Probit regression results with lagged values (t-1)

Sample: 289 observations Convergence after: 8 iterations Log Likelihood:-64,01620 Pseudo R²=23,1521 χ²(6)= 38,5726 Significance Level=0,0000				
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-1,63767	0,14894	-10,99564	0,00000
1/Reserve ratio$_{t-1}$	0,01722	0,11717	0,14697	0,88315
Real i-rate$_{t-1}$	0,08927	0,04587	1,94636	0,05161*
Claims on private sector/Dom. Credit$_{t-1}$	0,09538	0,34088	0,27980	0,77962
Dep. Banks assets/ Total bank assets$_{t-1}$	0,16264	0,61961	0,26249	0,79294
M3/GDP$_{t-1}$	0,00024	0,00027	0,88901	0,37399
M3/GDP *(US)*$_{t-1}$	8,63992	9,98841	0,86500	0,38704

* Denotes the 10% level of statistical significance.

Table 6-16: Measuring the prediction accuracy

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	270	0	270
	$Y_i=1$ (crisis)	8	11	19
	Total	278	11	289

In order to test further the results of the baseline regression, we repeated it with the inclusion of the 2 most significant variables of the original model and reported the results in Table 6-17 & Table 6-18. The output is rather disappointing, as none of the variables obtained a higher level of statistical significance and the predictive ability of the model remained unchanged.

Table 6-17: Probit regression results with lagged values (t-1)

Sample: 289 observations				
Convergence after: 8 iterations				
Log Likelihood:-65,1589		Pseudo R²=21,7804		
$\chi^2(2)= 36,2872$		Significance Level=0,0000		
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-1,57086	0,12667	-12,40116	0,00000
Real i-rate$_{t-1}$	0,09023	0,04814	1,87424	0,06089*
M3/GDP$_{t-1}$	0,00022	0,00026	0,85924	0,39021

* Denotes the 10% level of statistical significance.

Table 6-18: Measuring the prediction accuracy

		Estimated		
		$Y_i=0$ (Non-crisis)	$Y_i=1$ (crisis)	Total
Sample	$Y_i=0$ (Non-crisis)	270	0	270
	$Y_i=1$ (crisis)	8	11	19
	Total	278	11	289

When evaluating the robustness of the lagged model, the results are somewhat disappointing especially in terms of prediction accuracy. More specifically, the percentage of misses, 30% for the broad and 42,1% for the narrow specification of the model, is much lower than the one with the contemporaneous model. This loss of explanatory power is also reflected in the levels of pseydo-R^2 and in the statistical significance of the coefficients. On the whole, it seems that the model with lagged values by one period fails at a large degree to predict reliably a future crisis.

However, the reported results in terms of coefficients are consistent with the ones of the contemporaneous model, confirming the hypothesis of a period of credit bubble prior to a banking crisis. More specifically, the regression under the broad model produced significant coefficients for an increase in private credit, domestic and international liquidity 3 months before the onset of the crisis. Oddly enough, these findings are reversed under the narrow specification of the model, which provides statistical evidence only for the rise of real interest rates as a leading indicator of an oncoming banking crisis. As usual, we repeated the regressions with the inclusion of the significant coefficients but without any improvement neither in their level of confidence or in the prediction accuracy. This failure confirms the fragility of the results of all the regressions with lagged values by one period.

6.3 The lagged model with the optimal performance

Due to the moderate results of the previous model with lagged values by one period, it was necessary to continue our search for a reliable lagged model to serve as an efficient warning system for a future banking crisis. Therefore, various specifications were tested with lags ranging from 2 to 8 periods and under both specifications in order to decide on the one with the highest performance in terms of predicting accuracy, which should be the primary criterion for assessing lagged models. This model is presented analytically in this section.

By now, it is evident that the regression under the broad specification provided more robust and reliable results, as the sample was more uniform in terms of time and origins of the crisis and the inclusion of the 7th variable increased the explanatory power Therefore, it came as no surprise that the optimal performance was achieved with use of the broad model and more specifically with the independent variables entering with a lag of 4 periods, or 12 months. Although we tested the same specification, meaning the 4-period lag, under the narrow specification, the results were disappointing and thus, are not reported.

The baseline regression of the "optimal model".

The extension of the lag to 4 periods prior to the starting month of the crisis reduced the data sample of the broad model from 171 to 131 monthly observations, from which 10, or a 7,634% of the whole sample, represent crisis episodes (y_i=1). Therefore, this will be the threshold value for predicting an event as crisis or not, as shown in Table 6-20 & Table 6-22.

 Table 6-19 & Table 6-20 summarize the results of the baseline regression. All the coefficients hold the expected sign, except for the reserve ratio and the bank assets variables. However, the quite low level of their statistical significance leaves no room for a further analysis of this unexpected outcome. On the contrary, the ratio of US M3/GDP appears to be highly significant at the high level of 2,1%. This robust finding clearly signals that an increase in the international liquidity, or in other words a fall in the corresponding interest rates, consists a risk factor for the local banking systems. The explanation for this interdependence is that the low U.S. interest rates generate a massive flight of international capital towards the countries offering higher interest rates and thus, leading to the overheating of the local economies. From that point onwards the course towards a banking distress is familiar, an unsustainable credit boom leaves the banks with depleted capital and a high ratio non-performing loans. Clearly, the findings of all the regressions so far confirm this scenario as a period of high interest rates and private credit appears to precede a banking crisis, and thus, consist a reliable leading indicator.

Looking at the overall performance of the model, it becomes clear why it consists the optimal lagged model so far. Apart from the moderate levels of the pseydo-R^2, its overall significance, as measured by the χ^2 (7), and its predictive accuracy are quite high. In fact, it misses only 2 out of the 10 crisis episodes, predicting correctly the 80% of crisis episodes and the 98,47% of all the in-sample observations.

Table 6-19: Probit regression results with lagged values (t-4)

Sample: 131 observations				
Convergence after: 6 iterations				
Log Likelihood: -28,7378 Pseudo R^2=34,4536				
$\chi^2(7)$=30,2113 Significance Level=0,0000				
Estimation results				
Variables	**Coefficient**	**Std. Error**	**t-statistic**	**Significance**
Constant	-2,1648	0,4258	-5,08375	0,00000
1/Reserve ratio$_{t-4}$	-0,1439	0,2247	-0,6327	0,52690
Real i-rate$_{t-4}$	0,07424	0,09373	0,79209	0,42831
Claims on private sector/Dom. Credit$_{t-4}$	1,06917	0,96889	1,10350	0,26981
Dep. Banks assets/ Total bank assets$_{t-4}$	-0,76260	1,01536	-0,75096	0,45267
M3/GDP$_{t-4}$	0,50693	1,03530	0,48965	0,62438
Stockmarket/GDP$_{t-4}$	0,44226	0,40110	1,10262	0,27019
M3/GDP *(US)*$_{t-4}$	44,31601	19,34621	2,29068	0,02198**

**Denotes the 5% level of statistical significance.

Table 6-20: Measuring the prediction accuracy at t-4

		Estimated		
		Y_i=0 (Non-crisis)	Y_i=1 (crisis)	**Total**
Sample	Y_i=0 (Non-crisis)	121	0	121
	Y_i=1 (crisis)	2	8	10
	Total	123	8	131

An extension to the baseline regression

As in the previous models, we tried to repeat the regression with the inclusion of the 2 most significant variables of the baseline model, the ratios of M3/GDP and of private credit to total credit, in order to test further the original results. Unfortunately the results concerning the significance of the variable of private credit were disappointing. Therefore, we replaced it with the ratio of Stockmarket/GDP with great success, as it can be seen in Table 6-21 & Table 6-22.

More specifically, not only does the ratio of U.S. M3/GDP obtain a higher level of confidence, at around 1,6%, but also the Stockmarket variable appears significant at the 5% level. This outcome is very interesting as it is the first time so far that there is concrete evidence that the likelihood of a banking crisis is positively correlated with the ratio of Stockmarket capitalization/GDP. Essentially, it means that a significant rise in the Stockmarket capitalization precedes the onset of the banking crisis by 2 years, indicating the presence of an "asset bubble" during the pre-crisis period. Moreover, there is a quite straightforward link between the significance of the two variables, as it can be argued that the capital inflow is due to the Stockmarket boom apart from the high interest rates.

As far as the goodness-of-fit of the model, the pseydo-R^2 and the significance of the χ^2 (2) remain at similar levels with those of the original model. However, the predictive performance of the original model is improved despite the removal of 5 explanatory variables. More specifically, it misses only 1 out of the 10 crisis episodes, predicting correctly the 90% of crisis episodes and the 99,2% of all the in-sample observations. Certainly, this is the most impressive result so far regarding the prediction accuracy.

Table 6-21: Probit regression results with lagged values (t-4)

Sample: 131 observations
Convergence after: 7 iterations
Log Likelihood:-29,6547   Pseudo R²=32,3623
χ²(2)= 28,3774   Significance Level=0,0000

Estimation results				
Variables	Coefficient	Std. Error	t-statistic	Significance
Constant	-1,82770	0,28064	-6,51269	0,00000
Stockmarket/GDP$_{t-4}$	0,62367	0,30081	2,07329	0,03815**
M3/GDP *(US)*$_{t-4}$	39,84967	16,53628	2,40983	0,01596**

**Denotes the 5% level of statistical significance.

Table 6-22: Measuring the prediction accuracy at t-4

		Estimated		
		Y$_i$=0 (Non-crisis)	Y$_i$=1 (crisis)	Total
Sample	Y$_i$=0 (Non-crisis)	121	0	121
	Y$_i$=1 (crisis)	1	9	10
	Total	122	9	131

Assessing the overall performance of the model

The results of the lagged model are quite impressive in many aspects, even when compared to the results of the previous studies including lagged values.

Firstly, the findings seem both robust, as confirmed by the quite high percentage of hits, and consistent with the previous regressions. Actually, the finding that an increase in the international liquidity and in the size of the Stockmarket relative to the GDP raises the likelihood of a banking crisis after one year, completes the outline of the pre-crisis period, providing a possible explanation for the start of the typical credit boom prior to a banking crisis. Moreover, it is the first time that a variable of liquidity in the U.S.A., namely the U.S. M3/GDP, is included in a similar study and, most importantly, found significant when lagged two years. This finding has some serious implications about the impact of external factors to banking systems of emerging countries as it is established that in most cases the start of the credit bubble cycle stems from external rather than domestic conditions.

As we have already mentioned, the development of a reliable lagged model, equaling to a warning system, is the primary goal of many similar studies. In most cases, these models consist a simple variation of the ones we presented in the section with contemporaneous values.

Eichengreen and Rose [16] estimated a probit model with a mix of contemporaneous and lagged variables. More specifically, all macroeconomic variables, such as real GDP growth, deviation of GDP from 5-year average, exchange rate depreciation, real interest rate, credit growth, inflation, change in Stockmarket and deviation of Stockmarket index from 5–year average, are lagged one year while institutional ones, such as dummies for central bank independence, explicit deposit insurance and a financial liberalization, are contemporaneous. They established that only one macroeconomic variable, namely declining stock prices, is significant at the 10% level while the institutional dummies for central bank independence and financial liberalization appear robust at the 5% level. On the whole, the model has moderate explanatory power and correctly predicts the 40% of crisis episodes, which is quite lower than the performance of our model.

In their turn, *Kunt & Detragiache [10]&[11]* tested many variations of their baseline model, presented in the section with contemporaneous values, trying to develop an efficient warning system for banking crises. In short, they established that the ratio of private credit/GDP is not significant at time 0 but appears significant at the 10% level, when lagged by two years and all other macroeconomic variables enter with contemporaneous values. Looking at the statistical side, the model χ^2 is robust at the 1% level and the percentage of crises predicted correctly ranges from 56% to 63% and when extending to the whole sample from 76% to 78%. Again, this model does not seem to reach the impressive prediction performance of our own.

Finally, *Eichengreen and Arteta [15]* use a wide variety of variables with lagged values by one year and found that domestic credit booms and the ratio of M2/reserves appear are quite significant. Moreover, their model demonstrated a moderate explanatory power as the pseydo-R^2 ranges from 16,3 to 23,1, clearly lower than the one in our model. The role of lending booms, as a proxy for financial liberalization, is also found in *Kaminsky and Reinhart [9]*. More specifically, their study used monthly data and concluded that this financial liberalization dummy is a leading indicator of banking crisis.

In conclusion, it is the first time that variables concerning the international liquidity and the Stockmarket capitalization are reported as reliable leading indicators of an oncoming banking crisis with such an impressive prediction performance reaching the 90% of crises episodes or the 99% of all the in-sample observations.

7. CONCLUSION

The recent proliferation of systemic banking sector crises accompanied in many cases with severe economic disruption has prompted a call for improving the monitoring capabilities of the policymakers. As part of this effort, this thesis examined whether a period of premature financial liberalization tends to increase the likelihood of a banking crisis. Actually, this study has a twofold research goal. The link between the independent and the explanatory variables was assessed explored both on a simultaneous basis, indicating a possible causal link, and on a lagged one, searching for an efficient warning system. This is hardly surprising as the primary concern in the field of financial crises is their prevention, or at least their timely prediction.

In order to capture this link, we focused on a sample banking crises of the period 1978-2000, regressing the probability of the event of a crisis Pr (y_i=1) with the values of 7 independent variables, meaning the 6 indices of financial repression and one index of international liquidity with a discrete probit model. Essentially, we defined the financial liberalization as the reduction of financial repression, arguing that a potential shift towards financial liberalization would be reflected in the overshooting of these variables, which included the 1/ Reserve ratio, the real interest-rate, the ratios of Deposit Banks' Assets/Total Bank Assets, Private Credit/Total Domestic Credit, M3/GDP, Stockmarket Capitalization/GDP and US M3/GDP.

As we have already mentioned, the link between financial liberalization and the event of a banking crisis has been already tested in previous studies with the inclusion of only one relevant dummy in a large set of other macroeconomic and institutional explanatory variables. Therefore, this is the first study focusing exclusively on the role of financial liberalization with the use of 6 real indices all measuring this factor. Another basic feature of this study is the use of monthly data, based on the specification of the starting month of the crises in the sample provided by the study of *Kaminsky and Reinhart [9]*.

Although this was decided in order to obtain a better understanding of the dynamics of each crisis and a higher predictive performance of the model, it entailed a significant cost in terms of data availability. Initially, the country sample was limited to 19 countries as it was impossible to obtain any historic data for the older banking crises like Uruguay 1981 and Peru 1983. Similarly, the variable of Stockmarket turned out to be quite problematic, as there is no available monthly capitalization data for most crises of the 1970s and the 1980s. In order to

avoid removing these crises from the sample altogether, we decided to adjust the model accordingly, exploring 2 different specifications of the original model. The narrow one excluded the Stockmarket variable, encompassing all 19 countries, and the broad one included all 7 variables but with the limited sample of 10 countries. In fact, the results revealed that this adjustment was quite necessary as the limited sample of the 10 countries was more uniform with a view to their time, all after 1988, and their origin. Inevitably, all the models under the broad specification produced the most robust results in terms of their explanatory power and their predictive accuracy. Moreover, the variable in question, concerning the Stockmarket capitalization as a share of the GDP, consisted the one of the two statistically significant variables in the lagged model and thus, was indispensable to the regression.

As we have already mentioned, we reported results for both contemporaneous and lagged values with quite positive results consistent with the relevant bibliography. In the first case, the estimated model confirmed the theory that bank insolvency reveals imprudent management and non-compliance with the existing regulation as indicated by the surge in bank assets and the depletion of reserve ratios accordingly. Moreover, the relative significance of an increase in the ratios of Private Credit/Total Credit or of M3/GDP, depending on the choice of the broad or the narrow model, completes the image of an overheated financial system at the brink of collapse. As we stressed, the contemporaneous models, obtained satisfactory classification accuracy with the broad model reaching the 90% of crises episodes.

The search for a reliable lagged model was quite hard as the performance of the most likely candidate, meaning the model with values lagged by one period or 3 months, were rather disappointing in all aspects. Nevertheless, they are reported, indicating that there is a rather significant increase primarily in domestic liquidity and to a lesser extent in international liquidity, private credit and real interest rates at a point of 3 months before the onset of the crisis.

Therefore, it came as a pleasant surprise to find that when independent variables entered the broad model with values lagged by 4 periods or 1 year consist such a reliable warning system of banking crises. The reasoning behind the output is quite straightforward. One year before the onset of the crises, there is an increase in international liquidity, as proxied by the ratio of U.S. M3/GDP, and a simultaneous rise in the domestic Stockmarket capitalization. Essentially, the fall in U.S. interest rates urged foreign capitals to economies with higher returns in the form either of real interest rates or of Stockmarket returns like the ones in our sample. Probably, this event signals the start of the pre-crisis period of the financial overheating, lasting one year and resulting in the collapse of the banking system.

On the whole, it can be argued that these two variables, especially the U.S. M3/GDP, consist quite reliable leading indicators of future banking distress as they manage to predict correctly the 90% of the banking crises. This is a very positive finding especially in the quite difficult area of predicting financial crises. Of course, it is subject to the limitations of the choice of

data and sample as any empirical research. Nevertheless, this study can consist the start of a more systematic effort to analyze the impacts of a period of financial liberalization to the whole financial system and even more to the banking sector.