Abstract

In this paper we attempt to identify the characteristics of banks that are most likely to be at the origin of a banking crisis following a financial liberalization (FL) process. We do this analysis in response to the observed fact that FL processes arse often followed by banking crisis that cost taxpayers large amounts of resources in rescue operations. To accomplish this objective we identify a sample of "failed" and "healthy" banks following a FL and then compare their financial data at the onset of FL. We also attempt to identify to what extent the quality of the loan portfolio and the management and risk-taking practices of banks affect the outcome. The results are surprisingly robust and they mean that it may be possible to identify with an anticipation of at least 4 years the banks that could be responsible for an eventual banking crisis! Further, both quality of loans and management and risk-taking practices play a role. The results suggest that banks that are more conservative and thus those that are less likely to incur in moral hazard, or are more capable of absorbing important macro shocks given their capitalization, are the ones that are more likely to remain solvent. The study is based on a sample of 82 banks from Greece, Indonesia, Korea, Malaysia, Mexico, Thailand and Taiwan.

From Financial Liberalization to Banking Failure: Starting on the Wrong Foot?[1]

Klaus P. Fischer and Houcem Smaoui*

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From Financial Liberalization to Banking Failure: Starting on the Wrong Foot?

"Unruly blasts wait on the tender spring;
Unwholesome weeds take root with precious flowers..."
The Rape of Lucrece, William Shakespeare (1593)

1 Introduction

The roots of banking crisis (BC) are usually deep and sometimes ugly and the victims are not bank shareholders or depositors, but taxpayers. Financial liberalizations (FL), with the expanded world of opportunities they offer to banks, lead to BC that cost taxpayers large amounts of money. Sometimes, the sums involved are mind-boggling compared to which, the "infamous" United States Savings and Loan Association (S&LA) debacle cost of 3.5% of GNP in the late 1980's, is just a very mild case.

During the 1980's, over 25 emerging markets undertook extensive reorganizations of their financial institutions sometimes at very large costs to society. Judging by the scale of the BC observed in the last five years, the 1990's may well beat this record at a staggering cost to taxpayers. As of 1996 estimates, the recent Mexican crisis will cost taxpayers in the long run a minimum of 15% of GNP (spread over many years) to rescue their banks. The money is being used to cover losses in the bank's loan portfolios and foreign exchange denominated liabilities, following the peso depreciation of 1994-1995. This sum is five times the per year expenses in health and education by Mexico (2.8% of GNP). As was the case in the Unites States' S&LA debacle, it will take years before the final bill laid at taxpayers' feet will be known. Most likely it will be larger than current estimates. The cost of a similar crisis in Venezuela in 1994 is of over 15% of GNP, about trice the health and education spending (6.3% of GNP). As of Mai 1996, an incipient Brazilian BC (including private and state-owned banks) will cost the public purse a minimum of 4.5% of the GNP. We could provide more examples of equally dramatic character dating back to the 1970 's.[1] In almost all these cases, the BC happened after the implementation of a major liberalization program of the financial sector, a "financial liberalization". Kaminsky and Reinhart [23] report that in18 out of 25 banking crisis surveyed, the financial sector had been liberalized some time during the previous five years.

In most emerging markets banks enjoy an explicit or implicit guarantee that covers depositors. In the Mexican case depositors eventually gained access to all of their deposits although an explicit deposit insurance scheme did not exist . However, it would be naive to think that a bank rescue operation saves the (entire) value of

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[1]Caprio and Kligebiel[4] provide estimates of the cost of several banking crisis: among these are the crisis of Bulgaria 14% of GNP, Finland, 8% of GNP, Hungary 10% of GNP, Mexico 12-15% of GNP, Norway 4% of GNP, Spain 17% of GNP, Sweeden 6% of GNP, Venezuela 18% of GNP. According to these authors, in three cases (Argentina, Chile and Côte d' Ivoir) the losses exceeded 25% of GNP. Honohan [20] estimates that since 1980, the crisis resolution costs of banking crises in all developing countries and ex-socialist economies amounts to a quarter of a trillion dollars!

deposits, even when the conjectural government guarantees covers 100% of deposits. The reason is simply, as Rojas-Suarez and Weisbrod [34] have noted, that if they do not loose their deposit by direct confiscation, they loose it through an inflation tax. The difference is only that in the second case non-depositors share in the losses that are born by the entire society.

The simplest possible definition of FL is removal of *nancial repression* (FR). FR consists of a set of restrictions on market competition that yields a protected environment for financial intermediaries. The most common restrictions are: 1. Guaranteed intermediation margin through fixation of lending and deposit rates or direct subsidy programs (see for example Gibson and Tsakalotos [16]); 2. Controls on international capital flows and foreign competition; 3. Barriers to exit for financial intermediaries often accompanied by unlimited (conjectural) deposit insurance; 4. Barriers to exit for major industrial clients of financial intermediaries, i.e. conjectural loan insurance for the largest loans in the portfolio; 5. Guaranteed business activity through government funded credit allocation programs to key economic sectors. A FL program consists of the simultaneous removal of all or part of these restrictions. Of all restriction, the one that is central to FR is control on interest rates and credit allocation. Therefore, as Galvis [14] and Chavez *et al.* [5] [2] we take relaxation or lifting of controls on interest rates as the central event of FL.

Individual bank insolvencies are bound to occur, specially in an environment of deep macroeconomic and institutional changes. Often, banks enter into a FL process with a large portfolio of unperforming assets already in their books. For these banks, FL and the effects it typically has on interest rate and solvency of business firms[3], is unlikely to improve the quality of their portfolio. However, system-wide BC are to be avoided. The reasons are multiple, but one stands out. Bank insolvencies are prone to degenerate into bank runs. Depositors, unsure of the meaning of insolvency of some banks on the solidity of the other banks and the whole payment system, may under these conditiions initiate a bank run.[4] Further, if FL has been carried out with any success, it is likely that the assets managed by the banking system has increased substantially, possibly recapturing some of the financial resources that had escaped the country under FR [18]. An erosion of confidence in the financial system can provoque a rapid outflow of capital and a crisis in foreign exchange markets. As [17] have remarked, the financial strain provoqued by a banking crisis can generate a string of other negative externalities for the rest of the economy including erosion of fiscal prudency, pushing authorities toward less benign ways of financing deficit, lower availability and highten de cost of bank credit undermining the real economy

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[2] This author goes as far as stating 'FL is the elimination of FR, that is, increase of interest rates to an efficient equilibrium level that promotes optimal saving rates and avoids misalocation of real and financial resources.'

[3] See Chavez *et al.* [5] and Fischer *et al.* [13] for a detailled description of the risks to non-financial sectors business of a FL.

[4] An exelent historical review of the bank run literature is provided by Hasan and Dwyer [19] Park [32]. Aharony and Swary [1] provide a lucid insight into the informatio-based contagion effects behind bank runs. As a dramatic case of bank run take the Argentina's "tequila hangover" of 1994-95. In this country, in response to the Mexican crisis of end of 1994, nearly 20% of the deposit base of the country was withdrawn by investors in the lapse of less than three months.

and difficulties in controling monetary targets.

Given the importance of avoiding BC following FL, how can this be done? The question is not a new one and has been treated in the literature under different approaches. One traditional way has been to study the best possible "sequencing" of macroeconomic measures that will minimize the possibility of landing in a BC. The literature associated with this approach is quite extensive and has been supported by some "heavy-weight" researchers (such as McKinnon [29]) and by researchers of the International Monetary Fund (IMF). Examples of works along this line are Sundararajan [35], Galbis [15], Mansell [26], Cole and Slade [6], Johnston ([22], [21]), Villanueva and Ma [37]. The central proposition of this literature is that macroeconomic stability is a prerequisite for a successful structural adjustment and that fiscal deficit must be under control before engaging in financial sector reforms. And for the latter, the preferred sequence is to first liberalize internal financial markets before eliminating controls on international capital flows.

More recently, and partly due to the insufficiency of macroeconomic factors to explain BC, some emphasis has been given to the regulatory and supervisory framework that must be in place before launching the liberalization of the banking sector. Prudential supervision, so the argument goes, is one of the critical components that were often ignored in FL processes (see e.g. Johnston [21]). This aspect became much more important in the literature of optimal sequencing of later years, like in Sundararajan [35]. This new literature axes its argument on the increased opportunities of risk taking available to banks following FL and the need for tighter banking supervision practices. This is particularly important if FL is accompanied by the introduction or subsistence of an explicit or conjectural deposit insurance scheme at fixed rates.

One third approach, closely associated to the previous, is to look into performance measures of banks at the moment of FL. Then see if it is possible to identify those banks that are most likely to fail one the FL process is up and running. To our knowledge, no research exists on this particular approach. The idea is to focus attention from the beginning of the FL process on those banks that, given a set of performance measures, can be considered the most likely to run into difficulties later. The control and monitoring can thus be concentrated on this subset of banks. The latter is the approach taken in this paper.

The remainder of the paper is organized as follows. In section 2 we discuss the roots of bank insolvency; in section 3 we present the procedure for sample preparation and sources of data; in section 4 we introduce the statistical methodology; and finally in sections 5 and 6 we present results and conclusions. An appendix with some relevant information has also been added.

2   The roots of bank insolvency

What *causes* bank failure is subject of a intense debate. Benston and Kaufman (B&K) [3] present a thorough analysis of the main arguments and empirical analysis associated to this debate in the context of the United States. According to B&K, the

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four "causes "of banking crisis in that country, as debated in the literature, are: (1) excessive expansion of bank credit preceding the crisis; (2) asymmetric information resulting in the inability of depositors to value bank assets accurately; (3) shocks originating outside of the banking system, independent of the financial conditions of banks that either cause depositors to change their liquidity preference or cause reduction in bank reserves; and (4) institutional and legal restrictions that weaken banks, making them unnecessarily prone to failure. The empirical evidence reported by B&K appears, globally, to be consistent with the strand of the asymmetric-information hypothesis which caused depositors to run on banks when adverse economic conditions leads them to doubt the value of banking assets. The evidence also supports the hypothesis that banks were rendered more likely to fail when adverse shocks were experienced because of restriction of risk diversification and systemic weaknesses.

In the context of most FL processes it is possible to find the four ingredients that contribute to banking failures and BC. Student of FL processes have often found one additional factor that appears to influence heavily the quality of bank assets. This factor is associated with the ownership linkages that often exist in emerging markets between financial sector enterprises (banks) and industrial enterprises. In cases in which these linkages exist or their effects are not strictly regulated and monitored, banks tend to overconcentrate their loan portfolio in a small group of related enterprises, with credit risk controls that are unreliable.[5].

Of these ingredients, some are effective for the whole banking system thus affecting each and every bank in the system. This would be the case for institutional and legal restrictions and to a large extent the information asymmetry with the resulting inability of depositors to value bank assets and bank solvency.[6] Others, mostly shocks from outside of the banking system, may affect the banking system as a whole or a particular subset of banks. The latter would be the case if banks tend to concentrate their loan portfolios in some regions or industrial sectors.

A third category of factors have a bank specific character. This includes the bank management practices of individual banks, including asset expansion policies and affiliated-company financing practices. These practices can make an important difference of how banks will seize the opportunities offered by FL in terms of deregulation of markets, elimination of restrictions on banking practices, ability to create new products, etc. FL, with a backdrop of explicit or conjectural deposit guarantees, offers a unique opportunity to engage in expansion policies, asset liability management practices that increase moral hazard.

The differences in probability of insolvency between banks in a particular economy

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[5]In some cases, for example Chile, the banking crisis has been strongly linked to this practice of afiliated company lending practices. A detailled description of this phenomena in this country is given by Cortes-Douglas [8]. Galbis [14] undertakes a an interesting analysisi of the problems associated with a FL process when these links between the industrial and financial sectors (called "groups") exist.

[6]It could perhaps be argued that banks listed in local exchanges disclose more information to the public than do closely held banks. Thus, depositors would be better able to asses the value of bank assets in the former case. However, it is very unlikely that the relatively low level of detail of information required by most exchanges is sufficient to make an important difference in the assessment of asset values.

undergoing FL rests thus on two main components: 1) on the risk taking and bank management practices of bank owners/managers before and during the FL process; 2) on the quality of the loan portfolio at the onset of the FL process. The latter will, in large measure also be influenced by the risk-taking practices of banks before the FL. These two bank-specific components can be assessed by comparing a group of indicative financial ratios that measure both management practices and the quality of the bank portfolio at the moment of the initiation of the FL process.

3 Data

3.1 Source and Selection Procedure

Our sample includes countries in which only individual banks (e.g. Malaysia) faced difficulties and thus did not present an environment of system-wide BC. Other countries, notably Mexico, were subject to a massive system wide BC, in which a substantial portion of the aggregated banking assets where considered insolvent and several banks faced simultaneously liquidity problems. The number of countries covered and the number of observations in each country that could be included in the sample was externally limited in two ways: first, by the countries for which individual bank accounting data was available and the period covered; second, by the period in which the FL occurred and the need to allow for a reasonable time for the FL process to run its course. There are FL-cum-BC event that have occurred but were not included because data was not available at the time of the event. Most notable the Latin American "southern cone" (Argentina, Chile and Uruguay) first-wave BC of the early 1980's could not be included for that reason[7]. No individual bank data was available for that time. In other cases, data was available but the event FL-cum-BC is too recent to be reflected in the data (e.g. Venezuela).

Overall de bank selection procedure followed these steps:

(a) Our original sample included 9 countries (Greece, Indonesia, Korea, Malaysia, Mexico, Portugal, Thailand and Taiwan and Turkey). These are countries that experienced FL not earlier than 1980-85 and not later than 1992 and for which data was likely to be available. For these countries we searched all accounting data for their banking system available in the database Disclosure Emerging Markets, PACAP and Mexico's "Comision Nacional Bancaria."

(b) For each country we identified the FL event. That is, the date in which interest rates and credit controls were eliminated. In the case of Indonesia we accepted two dates: 1983 and 1988. We considered the reforms of 1988 as another important FL event although interest rates and credit controls

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[7]These cases are reported with some detail by Diaz-Alejandro[11], Johnston [21] and Cortes-Douglas [8] among others.

had been eliminated in 1983. [8]. In the case of Thailand we also accepted two FL events, the relaxation of controls of 1980 and the elimination of controls of 1990.

(c) We distinguish two types of banks. The banks that succeeded to go through a period of maximum 10 years following FL without troubles and those that did not. For example, Turkey had its FL in 1982. Thus we researched through 1992. The first group of banks we call the "healthy" banks sample. The other group of banks, those that faced difficulties during the process of FL, was named the "failed" banks sample. Under "failed" banks we included banks that:

1. benefitted from Central bank or government "support" (to be specified below) within a period of maximum 10 years following FL;

2. the banks for which the press informed they were subject to solvency or liquidity problems (most likely these banks received support from the government/Central Bank but the press was not sufficiently explicit about it);

3. banks that went bankrupt or were liquidated within a period of maximum 10 years following FL.

(a) The reason why we do not limit our sample of "failed" banks to banks that became insolvent and were liquidated, is the following. In most emerging markets only very occasionally do banks actually fail, and if they do it is usually a small regional banks. Very rarely is ti possible to observe a major national bank that fails[9] In most cases an explicit or conjectural insurance system exists. Thus, banks that become technically insolvent are typically salvaged by the authorities. The types of "support" considered to include a bank in the category of "failed" are the following[10]:

1. *Bailout/Open-bank assistance* The insurer assumes the totality of the losses through loans and/or transfers and keeps the operating and ownership structure intact. The assistance is provided in the form of injection of equity capital, purchase of convertible bonds, purchase or guarantee of non performing assets etc. Creditors/depositors and shareholders may be asked to bear some of the losses. In some cases

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[8]In October of 1988 Indonesia undertook a second and deeper wave of deregulation of the banking system, called the PAKTO, that dramatically lowered entry barriers to financial intermediaries. The main drive was to encourage new domestic and foreign entrants. Prudential regulation was strengthened and new capital adequacy standards were introduced. In December, a new set of reforms, called the PAKDES, focused on stimulating the capital markets and other non-banking financial insitutions. A detailed description of the reforms undertaken by Indonesia and other asian countries from the 1970's through 1995 is available in Dinh [12].

[9]One could argue that in most emerging markets there exists an enhanced version of the "too big to fail" doctrine that has been so hotly debated in the United States (see e.g. O'hara and Shaw [30], Cook [7])

[10]This is an adaptation of the classification proposed by Dewatripont and Tyrole [10].

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other banks may be asked to contribute. Bank control remains in the hands of the old owners but may be accompanied with concessions from management/owners.

2. *Nationalization/Bridge bank.* The government assumes the ownership of the bank who also bears the totality of the losses. The government assumes the full cost of putting the bank in order and to meet all regulatory requirements including legal capital requirements, if they exist.[11]

3. *Assisted merger.* The insurer only assumes to cover losses up to the point where new investors become interested in acquiring the bank. Under assisted mergers the insurer agrees to income maintenance paying the acquiring institution a difference between earnings on assets of failed institution and cost of funds. This is possibly the lowest cost option of rescue operation short of liquidating the bank.[12]

4. *Purchase and assumption (P&A).* The government only assumes to cover losses and completely eliminate bad assets. The insurer makes a cash payment or else purchases some of the bank's bad assets at an inflated price. Then it seeks to sell the bank to new investors/acquirer. This procedure in effect circumvents the upper limit of deposits on which deposit insurance applies.[13] This form will be preferred by potential investors when the quality of the assets of the failed bank are too difficult to assess as to put a price-tag to these assets. This is an alternative that became very popular during the United States 1985-90 BC.

(a) The classification of banks into "failed" or "healthy" was done by researching all available published information to which we had access. The database used for this exercise was LEXIS/NEXIS. This is a computer-based remote access database that includes thousands of publications world-wide. We researched all information about the banks for a period of maximum 10 years following the FL event. Banks for which we could obtain no

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[11] In the United States, for a federally chartered bank, the technical expression is "a federally chartered bridge bank (FCBB) " that is operated by the FDIC. To become a FCBB the process involves the action of as many as three agencies: the charering agency (the Office of the Comptroller of the Currency, OCC), the FDIC, and the Federal Reserve (Fed). To make a failure effective the Fed ususally calls in its discount window loans. As the bank is unable to make this payment the OCC declares the bank insolvent and appoints the FDIC as receiver. For more details about the American closure procedure see [36].

[12] Following the Mexican crisis several banks were partially sold to *foreign,* mostly Canadian, hands. The Banc of Montreal took a stake of 15% of Bancomer, the second largest financial services group. Another Canadian bank, Bank of Nova Scotia, increased its stake in Grupo Financiero Inverlat, which had been taken over by the Mexican Bank regulators in 1995. In May 1995, the Spanish banking group Banco Bilbao Vizcaya bought 70% of Grupo Financiero Probursa. Obviously, such a development beggs the question of desirability of an important share of the banking sector going to foreign hands.

[13] By this "no general creditor incurs any loss ", as outlined in *Deposti Insurance in a Changing Environment,* FDIC, Washington, D.C. 1983.

information that would reveal unambiguously the status of "healthy" or "failed" were eliminated. The consequence of this is of course a reduction of our sample size.[14] However we chose not to do this to avoid type II error in the preparation of the sample. We eliminated Portugal because we could not identify unambiguously the existence of banks that had run into troubles. Turkey was eliminated due to absence of accounting data. We present the resulting sample in Table 1

<div align="center">Table 1</div>

Country	Date of FL	Healthy Banks	Failed Banks	Banks Used
Greece	1987	5	3	8
Indonesia	1983 and 1988	10	2	12
Korea	1989	3	4	7
Malaysia	1978 and 1991	10	2	12
Mexico	1988	5	14	19
Portugal	1991	9 (not used)	0	0
Taiwan	1985	9	1	10
Thailand	1980 and 1990	10	4	14
Turkey	1982	8 (not used)	2 (not used)[15]	0
TOTAL		**52**	**30**	**82**

The complete list of banks used in the study is presented in Table A2 in the appendix.

3.2 Financial Ratios

We obtained data for eight categories of ratios totaling eighteen financial ratios. The ratios we used are standard in Early Warning System (EWS) literature (e.g. [36], [9], [31], [25], [28], [2]) and CAMEL methodology (e.g. [33]). We present the exact specification of the ratios we use in Table A1 in the appendix. The categories of ratios used are the following: quality of loan portfolio, profitability, capital adequacy, liquidity risk, growth, efficiency, interest rate risk and charter value.[16] Of these categories of ratios the first one allows us to evaluate the possible effect of the quality of the loan portfolio on solvency. All other categories provide an indication about the management, asset expansion and risk-taking practices of banks. For each ratio we took two years of observations, the one corresponding to the year of FL and one for the previous year.

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[14] We could have used the more lax criteria of classifying banks for which there were no news that would reveal their status as "failed," as "healthy."

[15] The observations for this country were not used as the data at the date of FL for the failed banks was not available.

[16] The charter value ratios are less standard in EWS and CAMEL literature. However, the case has been made (see e.g. Keeley [24] and Marcus [27]) that bank risk taking, particularly moral hazard, can be strongly influenced by charter value. Of the two measures used there, the first is a rather unusual one. It was proposed byRojas-Suarez and Weisbrod [34], The second is a standard measure of charter value in the literature.

Unfortunately we were not able to compute all these ratios for all banks in the sample. Thus, some were not used in some of the statistical tests. Which ratios were used specifically become evident from the tables of results.

In Table 2 we present summary statistics for the ratios used.

Table 3
Summary Statistics

Ratio	Mean		Variance		Skewness		Kurtosis	
	F	H	F	H	F	H	F	H
ROA	0.305	0.159	0.489	0.226	2.424	3.153	4.70	9.096
ROE	0.168	0.085	0.018	0.012	0.431	0.567	-1.211	12.814
OPTA	0.019	0.013	0.0002	0.0003	1.893	2.98	3.472	8.76
OPCE	14.741	6.09	1452.2	350.9	3.909	3.412	16.83	11.24
CATA	0.571	0.789	2.080	1.587	5.142	3.808	10.349	19.93
RTTA	0.014	0.016	0.0001	0.0005	1.672	0.333	3.476	4.082
LTCE	1013.64	753.47	4362238	10756178	2.331	6.58	5.224	46.304
TDCE	1470.41	859.231	2745.56	1224.89	1.505	-7.646	0.658	57.43
PLLLT	2.241	0.678	148.05	0.133	7.241	1.268	52.609	2.030
NLLLT	2.055	0.931	0.32	0.141	0.108	2.407	-0.466	6.781
LTTA	0.587	0.622	0.03	0.035	-0.23	-0.614	-0.753	0.159
CHTA	0.09	0.109	0.005	0.0044	1.451	0.689	2.396	-0.151
GOWTH	0.555	0.526	0.298	0.0956	1.068	-0.628	-0.508	2.33
OEOI	15.957	9.204	1497.72	107.97	4.827	-4.261	26.42	34.26
TAEMP	502.49	486.89	687171	544159	-1.252	1.135	9.054	-0.519
GAP	-0.263	-0.522	0.151	0.094	-0.168	2.144	-1.528	6.163
CHTD	0.191	0.196	0.02	0.069	2.488	3.978	10.305	19.854
PB	1.270	1.636	1.152	1.109	1.707	0.759	2.424	-0.058

At this point we will not comment on these statistics. We note however the need to use non-parametric tests to perform comparison of ratios. As the statistics reveal, often these ratios present strong leptokurtosis and skewness biases.

4 Statistical Methodology

The statistical methodology used is rather straight forward. It consisted of two separate tests:

1. We performed a non-parametric test of Wilcoxon, also known under the name of *Mann & Withney U Test*. This is one of the most robust and popular non-parametric tests on a two sample situation. The test allows us to seek the rejection of the hypothesis that the financial ratio in question are identical for the "failed" and "healthy" samples. This test was performed on all ratios of

interest in the eight categories. The standard practice in this type of situations is to rank all observations by value. Then, if the sum of the ranks of one sample differs significantly from that of the other sample, there exist a significant difference in the placement of both samples.[17] In our case this means that we combine, for each ratio, the values obtained for the two samples and rank them. The next step is then to verify whether the sum of ranks of the "failed" sample and the "healthy" sample equals the respective expected value or theoretical sum of ranks. This is the sum of ranks that would exist if both samples came from the same population. This is repeated for each financial ratio. The test statistic is a *Z-test.* For samples of our size the critical value for a 0.05 confidence level is 1.96.

2. We estimated a Logit regression model on the sample of "healthy" (0) and "failed" (1) banks with the dichotomous variable as dependent variable and a reduced set of financial ratios as explanatory variables. This test, allows us to identify the subset of explanatory variables that explain best one or the other outcome with explicit consideration of interaction between variables. It also allows us to compute probabilities associated with an outcome for each member of the sample.

These are standard statistical procedures and, fto save space, we simply refer the reader to any statistics textbook for an exact specification and more detailed description of the same.

5 Results

We present results in the same order that we presented the tests.

5.1 Wilcoxon Non-Parametric Test.

In Table 3 we present the results of the non-parametric rank test. The table is rather large, thus we have placed it at the end of the article. This table should be interpreted is as follows. Compare columns 2 ($\sum$) and 3 ($\sum$ under H_0). These two columns represent the actual sum of ranks and the sum of ranks that should be found if the two samples came from the same population, respectively. When the hypothesis is rejected these columns should be approximately equal. This is so because the actual sum of ranks equals approximately the expected sum of ranks when the null hypothesis of no difference holds. However, when columns 2 and 3 differ substantially for both samples (and when the difference for one sample is important the same will happen to the other sample) then the interpretation is that the actual sum of ranks is not approximately equal to the expected sum of ranks under the null hypothesis. How different these sums of ranks are is measured by the computed

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[17]The rank is considered to be preferable to the actual values for several reasons associated with the probabilistic properties of ordinal values.

$Z - statistic$. This value is also function of the standard error of ranks. The last two columns are not strictly necessary but they provide the $P - value$ associated to the statistic and the decision. In general a $Z - statistic$ larger than 1.96 implies that there exist a statistically significantly difference between the two samples for the ratio in question with a significance level of 0.05.

The results displayed in Table 3 are amazingly robust. In almost all categories/ratios the test suggests a difference in values for "failed" and "healthy" banks in the expected direction. Even for the category of charter value there is a ratio that passes the 0.1 confidence level barrier. More specifically, for each category of ratio what this test implies is the following (see also Table 2 with general statistics):

- *pro tability,* "failed" banks are consistently more profitable than "healthy" banks across all ratios. In three out of four measures "failed" are twice as profitable than "healthy" banks. This is perhaps a quite inexpected result. However it is perfectly consistent with a picture of "failed" banks that operate in a much more aggresive manner;

- *capital adequacy,* "failed" banks are consistently under-capitalized, however measured, when compared to "healthy" ones. Clearly, banks with a better capitalization will be able to absorb with less difficulties the macro shocks that are likely to occur during the FL process;

- *quality of loan portfolio,* "failed" banks start the FL process with a loan portfolio of less quality than "healthy" ones. As with profitability the indicators are twice as large for "failed" banks than for "healthy" banks. This implies that the quality of the loan portfolio at the onset of the FL process is an important determinant of bank solvency;

- *liquidity risk,* "failed" banks operate with lower liquidity ratios than "healthy" ones;

- *growth,* if one accepts a confidence limit of 0.1, then "failed" banks display a higher growth rate than "healthy" ones;

- *efficiency,* surprisingly "failed" banks operate with higher efficiency than "healthy" ones;

- *interest rate risk,* the interest rate risk exposure, as measured by the GAP of "failed" banks is larger than that of "healthy" banks. It is interesting to note that both samples display negative GAP measures, but that this negative Gap ratio is larger for the "healthy" sample than for the "failed" sample. On eof the possible interpretations of this result is that "failed" banks hold a more important portion of their assets in the form of short-term interest-rate sensitive assets. In a context of FR this could be considered an aggresive strategie of asset management.

- *charter value,* as expected, "failed" banks display a lower charter value than "healthy" ones, implying that the former may be more prone to engage in moral hazard than the "healthy" banks.[18]

The analysis of these ratios suggest that both types of ratios, those measuring loan porfolio quality and those reflecting management and risk-taking practices, are signifficantly different for the two samples, suggesting that they both play a role in determining the eventual solvency of the bank.

5.2 Logit Regression.

To execute the Logit regression we used a reduced number of financial ratios. The use of the complete set of 18 financial ratios would have yielded a too small number of degrees of freedom for a meaningful interpretation of results. Unfortunately, one set of ratios we were forced to eliminate was the ones measuring quality of loan portfolio (PLLLT and NLLLT). This limits the usefulness of the test.[19] However, we can still test whether management risk-taking practices, i.e. moral hazard, plays an important role in eventual insolvency. We present the ratios used in this "complete model" and the values of the coefficients estimated via a maximum likelihood function in Table 4. We remind the reader that the dependent variable is the revealed state of the bank "healthy" (0) and "failed" (1).

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[18] This particular test, in combination with the other ones, could be considered a test, albeit a simple one, of the somewhat controversial theory that banks that display a higher charter value are more inclined to engage in risk enhancing moral hazard activities.

[19] We attempted nonetheless to run a model that would include these ratios. The purpose was to at least an impression about the importance of the quality of the loan portfolio on failure probability. However, the number of usable observations dropped dramatically and the maximum likelihood procedure failed to converge even at very high number of iterations.

Table 4
Logit Regression

General Statistics		
Log Likelihood	-39.42	
Cases Correct[20]	91 out of 108	
Coefficients		
Ratio	Coefficient	$t - statistics$
Constant	-1.454	-0.493
ROA	-260.4	-1.888
ROE	21.40	2.139
OPTA	19.67	1.279
CATA	1.942	1.425
OPCE	-3.722	-0.837
LTCE	-0.037	-0.246
TDCE	-0.044	-0.371
LTTA	3.486	0.955
CHTA	0.802	0.065
OEOI	0.066	1.839
GAP	3.761	2.041
CHTD	-2.951	-0.648

The results of this regression reveals that bank failure is positively related to return on equity (ROE), operating efficiency (OEPO), interest rate risk (GAP), and negatively related to returns on asset (ROA). The number of correctly classified observations is remarcably high. This result confirms the observations made when interpreting the Wilcoxon test, that banks that operated more aggressively were the ones that fell in the category of "failed" banks. A Logit regression that includes as regressors only the ratios that were significant at the 0.10 confidence level in the "complete model" yields the following result:

$$\pi = -1.416 + 15.199 * ROE + -120.9 * ROA + 0.06 * OEOI + 2.42 * GAP$$

where π represents the probability of "failing". We call this the "reduced model." Using this reduced regression would have classified correctly 98 out of 116 observations!

The Logit regression also yields for each observation the probability of being correctly classified (i.e. $P(Y_i = y_i \mid X_i\widehat{\beta}$, where y_i is the actual value of Y_i for observation i). This give a measure of the quality of the prediction. We computed the means of these probabilities for the sample of "failed" and "healthy" banks. We present these values in Table 5.

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[20] Cases correct is the number of observations for which the estimated probability of achieving the observed value is greater than .5, and thus the "predicted value" is the one which occurred. In this paper when we refer to correct classified cases we mean for in-sample cases. The rather small number of observations available to carry out the study did not allow us to keep a subsample for out-of-sample tests of classification correctness.

Table 5
Computed Probabilities of Correct Classification (Mean of Samples)

Model	"Failed"	"Healthy"
Complete Model	0.44	0.75
Reduced Model	0.59	0.78

It is not surprising that it is easier to correctly classify "healthy" banks than "failed" ones given the superior number of observations available for the first sample. Somewhat surprisingly is that the simple "reduced model" performs better in predicting the outcome than the "complete model." A more in-depth analysis with additional information about bank accounts would most likely provide a richer "reduced model" with even larger predictive power than the one presented here.

6 Conclusion

In this paper presents a statistical analysis designed to distinguish, at the onset of a financial liberalization (FL) process those banks that are most likely to be at the origin of a banking crisis a few years later. The analysis is a response to the frequently observed fact that FL often are followed by banking crisis that may cost taxpayers enormous amount of resources in rescue operations. The study is based on a sample of 82 banks from Greece, Indonesia, Korea, Malaysia, Mexico, Thailand and Taiwan.

The purpose of the work is to investigate two questions: 1) whether it is possible to statistically distinguish "failed" banks (which we define as those banks that may require taxpayers money support or may go bankrupt) from "healthy" banks (defined as those banks that will perform well through the FL process). 2) assess to what extent the state of the loan portfolio and/or the management risk-taking practices (moral hazard) at the onset of the FL process, play a dominant role. For the first question, the results are surprisingly robust with most financial ratios used in the study displaying statistically different values for the sample of "failed" and "healthy" banks when using a non-parametric Wilcoxon test. Further a Logit model allows us to correctly classify 84% of in-sample observations. Given that the average delay from the moment of FL to bank insolvency is between four and five years, this means that it may be possible to identify with an anticipation of *at least 4 years* which banks may be the responsible of an eventual banking crisis!

For the second question, difficulties in obtained the data limited our ability to test the alternative hypothesis. However, the evidences suggest that both, the state of the loan portfolio at the onset of FL and the risk-taking practices are important factors in influencing the outcome. The tests allow us to state quite categorically that moral hazard does play an important role in determining bank insolvency. The differences in ratios and the Logit regression suggest that banks that display a more conservative management and risk-taking practices are the ones that are more likely to eventually be revealed as "healthy" banks. As a subsidiary result of this research we also shed some light on the interesting question of the effect of charter value on the behavior of banks. Our data suggest that the banks that display a higher charter

value are those that engage in less risky bank management –i.e. less moral hazard–
and are those that become classified as "healthy" banks.

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Table 3
Results of Wilcoxon Tests

Ratio	$\sum$ (No. of Obs)[21]		$\sum$ under H_0		Std. Err.	Comp. Z	P-value	Decision
	F	H	F	H				
Pro tability								
ROA	4954 (51)	9074 (116)	4284	9744	287,789	2.326	0.02	Reject H_0
ROE	5481 (53)	9397 (119)	4584	10293.5	301,538	2.972	0.003	Reject H_0
OPTA	6122 (56)	10349 (125)	5096	11375	325,831	3.147	0.0016	Reject H_0
OPCE	6184 (56)	10287 (121)	5096	11375	325,832	3.338	0.0008	Reject H_0
Capital adequacy								
CATA	5096 (56)	11375 (125)	6527	9944	325,832	4.390	0.0001	Reject H_0
RTTA	1716 (26)	7061 (106)	1729	7049	174,772	-0.069	0.945	Accept H_0
LTCE	5986 (56)	10485 (125)	5096	11375	325,832	2.730	0.0063	Reject H_0
TDCE	5818 (56)	9758 (120)	4956	10620	314,833	2.736	0.0069	Reject H_0
Loan Portfolio Quality								
PLLLT	2407 (42)	2153 (53)	2016	2544	133,444	2.930	0.003	Reject H_0
NLLLT	601 (10)	65 (26)	481	185	28,311	-4.221	0.0001	Reject H_0
Liquidity Risk								
LTTA	4691 (56)	11780 (125)	5096	11375	325,832	-1.241	0.214	Accept H_0
CHTA	5096 (56)	11375 (125)	5866	10605	325,832	2.362	0.018	Reject H_0
Growth								
GOWTH	4097 (48)	7228 (102)	3624	7701	248,209	1.903	0.056	
Efficiency								
OEOI	2893 (48)	7838 (98)	3528	7203	240,049	-2.643	0.008	Reject H_0
TAEMP	1027 (20)	684 (38)	1121	590	61,124	1.529	0.126	Accept H_0
Interest Rate Risk								
GAP ratio	4007 (42)	7469 (109)	3192	8284	240,806	3.382	0.0009	Reject H_0
Charter Value								
CHTD	4654 (50)	9374 (117)	4200	9828	286,181	1.585	0.113	Accept H_0
PB	698 (16)	5743 (97)	916	5529	121,424	-1.758	0.078	Accept H_0

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[21] We remind the reader that we took two years of observations for each bank, the one corresponding to the FL event and the one for the previous year. Thus the numbers shown below correspond to the double of banks observed.

Appendix
Table A1

De nition of Financial Ratios	
Ratio	**Calculation**
Pro tability	
Return on Assets (ROA)	$\frac{\text{Earnings before taxes}}{\text{Total Assets}}$
Return on Equity (ROE)	$\frac{\text{Earnings before taxes}}{\text{Equity}}$
Operating Profits of Assets (OPTA)	$\frac{\text{Operating Income}}{\text{Total Assets}}$
Operating Profits of Equity (OPCE)	$\frac{\text{Operating Profits}}{\text{Equity}}$
Capital adequacy	
Capital over Assets (CATA)	$\frac{\text{Equity}}{\text{Total Assets}}$
Retained Earnings over Total Assets (RTTA)	$\frac{\text{Retained Earnings}}{\text{Total Assets}}$
Loans over Equity (LTCE)	$\frac{\text{Total Loans}}{\text{Equity}}$
Deposits over Equity (TDCE)	$\frac{\text{Total Deposits}}{\text{Equity}}$
Loan Portfolio Quality	
Reserves over Total Loans (PLLLT)	$\frac{\text{Reserves}}{\text{Total Loans}}$
Loan Losses over Total Loans (NLLLT)	$\frac{\text{Loan Losses}}{\text{Total Loans}}$
Liquidity Risk	
Total Loans over Total Assets (LTTA)	$\frac{\text{Total Loans}}{\text{Total Assets}}$
Liquidity Ratio (CHTA)	$\frac{\text{Liquid Assets}}{\text{Total Assets}}$
Growth	
Growth of Assets (GOWTH)	$\frac{\text{Total Assets}_t - \text{Total Assets}_{t-1}}{\text{Total Assets}_{t-1}}$
Efficiency	
Operating Efficiency (OEOI)	$\frac{\text{Operating Expenses}}{\text{Operating Income}}$
Total Assets over Employees (TAEMP)	$\frac{\text{Total Assets}}{\text{Number of Employees}}$
Interest Rate Risk	
GAP ratio (GAP)	$\frac{\text{Rate Sensitive Assets} - \text{Rate Sensitive Liabilities}}{\text{Total Assets}}$
Charter Value	
Liquid Assets over Deposits (CHTD)	$\frac{\text{Liquid Assets}}{\text{Total Deposits}}$
Market over Book Value (PB)	$\frac{\text{Market Value of Equity}}{\text{Book Value of Equity}}$