

Predicting Banking Distress in European Countries

Ahlem-Selma MESSAI

Business School of Tunis
Manouba University,
Tunis, Tunisia
asm_j@hotmail.fr

Fathi JOUINI

Faculty of economic and management sciences of Sousse
University of Sousse,
Sousse, Tunisia
fathi.jouini@fdseps.rnu.tn

ABSTRACT

This paper seeks to investigate internal and external factors with relation to regulations in order to predict difficulties which the banks are exposed. The sample consists of 368 banks in 8 European countries for the period 2004-2007. The model was built primarily only on a set of ratios constituting the CAMEL rating system (Capital adequacy, Asset quality, Management quality, Earnings ability, Liquidity position). Secondly, we added the variables related to the regulatory environment. The application of the method panel logit shows that financial ratios relating to the rating system (CAMEL) are correlated with the likelihood of problems measured by binary variables. The probability of occurrence of problems in these banks is positively correlated with the presence of an explicit system of deposit insurance and negatively correlated with the presence of auditors who provide information to regulators in the event of illegal activities committed by managers. The ability to prosecute these regulators for their actions has a negative effect on the probability of distress. The role of the Central Bank in monitoring activity is also very important to maintain system's stability.

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regulation, CAMEL, banking distress, deposit insurance.

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Introduction

The current crisis which has started since about 2008 has taken a set of considering the events it has induced incite to give special attention to the pertinence of regulations in the inside as well as in the outside of institutional organization such as banks. The accession of dysfunction incites to challenge classic methods usually used to predict the factors which constitute some of the causes of crisis inducing high costs to be avoided. More generally, the main questions we can make are concerned with the fact if the procedures which are adopted by some authorities take into account the special state of bank institutions when making decisions to enforce regulations? Is it possible that classic plans, such as the conventional device, the deposit insurance, the external auditors, and the lender of last resort, incite to increase the exposition of financial institutions to greater risk?

The primacy of recessions and scandals which have gone with the rapid spreading of tension in the international level leads to conclude that the progress realized in the in smoothing the vulnerability remains insufficient and inadequate. Considering these questions this paper seeks to reconsider the question about the early warning systems (hereafter EWS) which allow to identify the banks likely to be object of distress and failure. Secondly it permits to take necessary steps likely possible to solve the problem of dysfunction before it occurs.

The specificity of this study compared to previous one is that it links the stability of financial institutions to standard norms usually applied in international level. These norms includes among others techniques of internal analysis (Ratios) as well as institutional mechanisms which are able to give response to correction of asymmetric information worries and that of hazard moral (regulation variables). In this line, it will be important to give the large sample of banks to use methods already used in order to analyze the positions of financial institutions before the crises. Results are in conformity the idea that standard tools to predict in an irrevocably ways the distress. Once there are institutional ones, the dispositions usually used leads sometimes to exacerbate the moral hazard problems. This phenomenon which is more likely to appear in economies with good risk management is realized through a large diversification followed by a high centralization of assets. Organizations largely known as systematic (that with large size) are consequently at the forefront of public attention. This study seeks to detect early difficulties and not failures to allow political and monetary authorities to have enough time to take the appropriate

corrective measures and fill gaps that might disrupt the normal functioning of banks. In fact, we tried to make a synthesis between the various previous studies.

The objective of this study is to determine the integration effects of variables related to the regulatory environment, not just the effect of accounting ratios of bank distress. The integration of these variables can provide insight on improving supervision system.

The remainder of this paper is organized as follow: the first section presents the literature review and the previous empirical findings about the prediction of failures. The second describes data and methodology. Results and discussions are presented in the third section. Finally, the section 4 concludes.

Literature review

Following the multiple economic crises literature gives more attention to the prediction of bank failures. This approach presents great importance in real economy since it allows to judge the effectiveness of the process of regulations revised for many times spanning the last decades. Since the study of Sinkey (1975), numerous authors developed several techniques to predict the failure of financial institutions. This author has used multivariable discriminative analysis considering a sample of 220 American banks. About a half of these banks have been object of failure during the 1969-1972 period. Among the one hundred variables he used only ten which have presented a significant effect especially that related to the specificity of banks.

Altman (1977) developed a system for identifying serious financial problems in savings and loan associations. He used 25 ratios representing liquidity, asset quality, capital adequacy and earnings. Only 12 variables can explain the banking failure. Pantalone and Platt (1987) proposed a model integrating relative ratios of the CAMEL rating system.

They used a sample of 113 failed banks and 226 non-failed over the period of the early 80s. Using the logit method, the significant variables are representative of profitability, management quality, leverage, diversification and economic environment.

Thomson (1991) examined the bank failures that occurred in the United States during the 1980s. He used 16 variables. Unlike other studies, he included variables related to economic conditions in domestic markets banks.

Variables specific to the banking sector ratios were calculated from the balance sheet and income statement and represented capital adequacy, the risk of the loan portfolio, risk management, liquidity and income. The result shows that the probability that a bank will fail is a function of variables related to its solvency. Economic conditions in the markets where a bank operates also appear to affect the probability of bank failure as much as four years before the failure date.

Barr and Siems (1997) proposed a model for early warning of bank difficulties, whose aim is to realize the difficulties two years prior to insolvency. The explanatory variables included are representative of the CAMEL rating system plus a variable to capture local economic condition, quality management has been approximated using technical efficiency, derived from the nonparametric DEA (Data Envelopment Analysis) methodology. The result indicates that management is, indeed, important to the successful operation of a bank.

Capelle-Blanchard and Chauveau(2004) used the same methodology for the main European commercial banks from 1993 to 2000 and have examined the potential contribution to bank supervision of a model designed to include an off-site proxy of the management quality based only on publicly available financial information. The relevance of their EWS depends to some extent on its accuracy in predicting which banks will have their solvency degraded. They show that proxies for CAMELS (S: Sensitivity to market risk) do a good job for identifying the banks that are likely to have their solvency degraded in the future.

Gonzalez-Hermosillo (1999) examined the bank failures in the U.S., Mexico and Colombia, which took place in the 1980s and 1990s. She used the macroeconomics and microeconomics variables. The result shows that a low capital equity and reserves coverage of problem loan ratio is a leading indicator of bank distress, signaling a high likelihood of near term failure. Doganay et al., (2006) developed warning systems to predict bank failures, for at least three years before the date of bankruptcy. Using a sample of 42 banks in which 19 have been object of failures during the period 1997-2000 and considering twenty seven ratios, the authors conclude that logit model are the most appropriate to predict bankruptcy. Testing the same model for a sample of 906 institutions in which 319 have supported failures spanning the

period from 1980 to 1984, Barth et al., (1985) found that the composition of the loan portfolio, the capital ratio and the income structure affect significantly the bank failures. Godlewski (2003) integrated CAMEL variables in the specific case of emerging countries over the 1999-2000 period. The sample includes 1853 banks from Asia, Latin America and some Central and Eastern Europe countries with 270 of them are failed banks. Using the logit model, the author concludes the probability of bankruptcy is negatively correlated to the variables he used in his model. To investigate the same phenomenon for the cases of Japanese and Indonesian banks Montgomery et al., (2005) Introduce 18 financial ratios considering information in balance sheets and income statements.

Similarly, Konstandina (2006) identified for the case of Russia six macroeconomic factors and thirteen other specific explanatory variables related to banks to predict their failure. The author attributes specifically the increase in bankruptcy to the raise in bad loans and to the purchase of treasury bills. The use of a proportional hazard models have enabled her to identify the factors that are able to slow down the risk of bank in a period of financial crisis. Similarly to what have been theoretically predicted, the author confirms the result according to which the first banks exposed to bankruptcy risk are less efficient.

Considering 134 banks from sample composed of 11 European countries Naouar (2007) found that variables measuring the regulatory, institutional and legal environments such as set in La Porta et al., (1998) and given in the World Bank reports constitute the most influential since they impact the process of risk taking. This confirms largely the fact that this factors are not without effects. The same results are shown in Abdennour et al., (2008). The use of an early warning system for banking problems based on accounting ratios and factors related to regulatory, institutional and legal environment has been with great importance for financial institutions in emerging countries. In this line, Badjio (2009) proposed application for the countries of Central Africa. He introduced variables representing the CAMEL rating system and taking into account the management style of banks in the Central African Economic and Monetary Community. Three variables have been statistically significant which are ratios measuring (Equity / Total loans), (Total Deposits / Total Assets) and (Total operating income / Total assets). The first has a negative effect while the two others have a positive influence on the dependent variable of his model. Giovanis (2010) developed a model of EWS of distress using a logistic regression and an Adaptive Neuro-Fuzzy Inference System (ANFIS). He adopted the same procedure in Gentry et al, (1985) to specify whether or not the company has been through some financial distress. In-

stitutions that distribute a few dividends may be having financial difficulties. Using a sample of 179 financial institutions from Taiwan Security Exchange (TSE) during the period 2002-2008, the author concluded, finally, that the Neuro-Fuzzy Inference system constitutes the most appropriate tool for financial risk management and for decision making in the Central Bank.

Besides the financial ratios some researchers have used macroeconomic variables. Banks are strongly influenced by contractions that the economy experiences over time. Banking distress is highly influenced by a number of macro variables. Among the variables, there are: interest rate, inflation, real GDP growth, output downturns, adverse terms of trade shocks, credit expansion, market pressure and losses of foreign exchange. These macro variables influence the functioning of financial and economic systems as a whole (Demirguc-Kunt and Detragiache 1998, 2000; Hutchison and McDill, 1999; Hutchison, 2002; Domac and Mertinez-Peria, 2000; Frankel Langrin, 2001; Hefferman, 1996; Borovikova , 2000; Yilmaz, 2003 ; Gungel, 2008). The use of the macroeconomic variables will not be the object of our search. Our principal objective of this study is to determine the integration effects of variables in the regulatory environment, not just the effect of accounting ratios of bank distress.

Data and methodology

The sample:

Our sample consists of European banks. The choice of these countries is motivated by the number of bank defaults in these countries. It is very important in recent years. Many European banks were hit by the 2008 crisis, as U.S. banks but to a lesser degree. Banks do not seem to remember the lessons of past crises. Some countries in our sample have been hit by a crisis of indebtedness. Indeed, the Greek state has destroyed the entire financial and monetary European system.

Recognizing the principle of “Too Big To Fail”, we select only big sized banks. We adopt this selection since the large banks are behind the latest crisis. Once they benefit from an implicit insurance against bankruptcy these banks increase their risky activities. So, to improve their profitability they are tempted to take more risk. The

data used was from the BankScope database. It includes balance sheets and income statements of the selected banks.

This information helps to build a set of ratios constituting the CAMEL rating system. The pretreatment of the data gave a sample of 368 banks in eight European countries.

Initially, a total asset was used as a criterion for exclusion of small banks. This technique was already applied by Godlewski (2004). The size of those banks is below the fifth percentile. So to integrate the counterparty risk, we selected the financial institutions that provide more credit. i.e banks whose total loans / assets ratio is greater than 32, 88% (the fifth percentile is eliminated).

A commercial bank is characterized by a high level of deposits. For this reason we opted for banks with high levels of deposits. The elimination of the fifth percentile can retain the institutions whose total deposits/ total assets is greater than 45,83% .

The incentives to undertake excessive risk come mainly from the banking regulation, and then two sources were used. The first comes from the study of Barth et al.,(2001) made to the World Bank and the second made by Demirgüç-Kunt and Detragiache, (2008). In the first study, the data collected from several surveys have been subdivided into ten sub-bases. Each one focuses on one aspect of standardization activity and prudential supervision: supervision of capital, the adoption of a system of deposit insurance, market discipline, the transparency of the banking market, ownership structure, liquidity and management of monitoring committees. The second study identifies factors that influence decisions about financial security of a country. It uses a comprehensive data covering 180 countries over the period 1960-2003. This analysis focuses on how institutional factors influence the adoption of a system of deposit insurance. The majority of this data is qualitative (often binary).

The variables:

Within the model, we attempt to explain the dependent variable (Y) which presents the probability of distress:

$$\text{prob} \{Y_i = 1\} = \frac{1}{1 + e^{-\alpha_i - \beta X_i}}$$

$Y_{i,t}$ is the binary dependent variable latent bank (i) at the period (t) i:

the number of banks from 1 to 368;

$X_{i,t}$ is the explanatory variable of bank (i) at (t).

t : is the study period from 2004 to 2007.

α : the constant

β_1 : the coefficient of explanatory variable X_1 .

$Y_{it} = 1$ if the bank is undercapitalized

$Y_{it} = 0$ if the bank is well capitalized.

So to distinguish between a healthy bank and another in difficulty, we used the binary values 0 and 1.

A distressed bank = 1.

A healthy bank = 0.

Researchers often use the Tier (1) capital ratio, which is equal to 4%, or the ratio of capital Tier 1 + Tier 2, which is equal to 8% as a threshold to distinguish between the two states. As part of this work, we refer to the works of Estrella et al., (2000) and Abdennour et al., (2008), taking 5.5% as an indicator. This proxy is considered a good indicator to detect early the first signs of banking fragility. Indeed, a bank whose capital ratio is above 5.5% is a healthier bank than a bank whose capital ratio is below 5.5% is considered in difficulties.

Presentation of the explanatory variables:

Our model includes two types of variables to predict the banking distress which are CAMEL variables and those related to regulatory environments.

Everywhere in the world, the systems of supervision try to evaluate the situation of banks through a set of financial ratios. Compared to other monitoring systems (PATROL in Italy, SAAB in France, BAKIS in Germany), CAMEL seems the easiest and the quickest to establish. It includes the most important indicators of fragility covering risks related to the capital adequacy, the asset quality, the profitability and the liquidity position. Moreover, the treatment of fragility using other systems can be made case by case, which generates a late prediction of problems. In addition, in the operating framework, they seem more costly than the CAMEL, so they present different disadvantages to the regulator. The CAMEL reveals financial information extracted from balance sheet and income statement of the bank. Calculated ratios

can explain the situation of banks. The acronym CAMEL combines the following five criteria: the capital adequacy (C), the asset quality (A), the management quality (M), the earnings ability (E), and the liquidity position (L).

Each indicator is approximated by one or several financial ratios. In this study, two ratios were used to explain each criterion by the acronym CAMEL. The choice of these ratios is based on them which are most relevant to the studied topic. Table 1 presents all ratios we used in our model as well as their expected signs.

The first two ratios (R1 and R2) indicate the adequacy of capital to the total loans. The ratio equity / total assets (R1) evaluates the ability of banks to assume their obligations to absorb unexpected losses and to absorb shocks. The second ratio, Equity / Total loans, is considered as a buffer to absorb potential losses (Godlewski, 2004). It measures the hedge funds against credit risk. These first two ratios affect negatively the probability of default. The quality of the assets, as approximated by R3 and R4 ratios, affects positively the probability of being undercapitalized.

Table 1. List of CAMEL's variables

Ratios	Variables	CAMEL	Expected sign
R1	Equity / Total Assets	C	-
R2	Equity/ Total Loans	C	-
R3	Net loans / Total Assets	A	+
R4	Total Other earnings / Total Assets	A	+
R5	Personnel expenses / Total operating expenses	M	-
R6	Total operating income/ Total Assets	M	-
R7	Net income/ Equity (ROE)	E	+/-
R8	Net income / Total Assets(ROA)	E	+/-
R9	Total Deposits / Total Assets	L	+/-
R10	Total Deposits / Total liabilities	L	+/-

The ratio Net Loans/Total Assets explains the importance given to loans. Indeed, the core business of banks is granting credits. This is, however, a risky activity increasing normally the likelihood of difficulty. The ratio of Total Other Operating Income / Total Assets measures the share of income generated outside the activity of the banking intermediation. It has a positive effect on the probability of default. Indeed, banks with investments in other projects (often high risk) present a significant probability to be in difficulty.

Management quality is assessed by the ratios Personnel expenses / Total Operating Expenses (R5) and Total Operating income / Total Assets (R6). Indeed, the effectiveness of managing risk increases with the consideration of the needs of staff (personnel costs while positively affecting the quality of management). Moreover, the probability of presence of problems in credit institutions is negatively correlated with the proportion of personnel costs of total operating expenses. The banks are undercapitalized characterized by low profitability. This profitability is measured by the ratios R7 and R8. The ratio Net income / Equity allows shareholders to monitor the returns earned on their investments, it is a guarantee of a sustainable solvency. According to the CAMEL model, this ratio allows to assess the level of profits relative to the capital invested. The ratio Net income/ Total Assets, measures the rate of return on average total assets held by the institution. This is an indicator of overall profitability.

The large level of deposits in total assets and total liabilities, measured respectively by R9 and R10 can have positive or negative effects on the likelihood of difficulty of the banks. The increase in deposits is an indicator of liquidity's availability. Thus, the bank can meet its commitments. In case of bank runs, the rush of depositors at the counters increases the distress probability. The regulatory environment variables and assumptions with CAMEL's variables, we also incorporated the external determinants of default, which are more particularly variables related to the regulatory environment. These estimated variables (binary variables), allow regulators to act in the interest of the bank has a serious trouble (the possibility of prosecution of supervisors for their acts, auditors inform the supervisors of illegal activities committed by managers, monitoring function is performed by the Central

Bank and the existence of an insurance deposit system). So, we formulated the following hypotheses:

H₁: When the auditors inform the supervisors about illegal activities through the audit report, the supervisors can then take appropriate disciplinary actions and can ensure system stability.

H₂: The presence of an insurance deposit system can prevent bank runs and can ensure stability.

H₃: The possibility of prosecution of supervisors for their acts, reduces the likelihood of distress.

H₄: The system stability can be maintained when the oversight function is delegated to the Central Bank.

Goodhart, (2008) used several regulatory variables mentioned in recent studies as factors that explain the failure of the system. Among these elements we can evoke:

1. Deposit insurance system;
2. Insolvency of the bank, and effectiveness “prompt corrective action”;
3. Money market operations performed by Central Banks.

Indeed, when the Central Bank oversight decreases the probability of being under-capitalized.

First, the introduction of a deposit insurance fund protects depositors. It can reduce the excess of banking risk that no longer generates significant revenues to indicate a good performance to its customers and thus avoid liquidity problems. In most cases, all deposits are not covered and therefore a minimum of market discipline on the part of depositors are insured. This encourages banks to take more risks.

Table 2. Variables of regulatory environment

Dummy	Variables	Définition	Auteurs
D ₁	regulatory discipline (-)	=1when the auditors report fraud or abuse committed by the leaders to supervisors =0 otherwise	Barth and al (2001) Godlewski(2003), Abdennour and al (2008)
D ₂	Deposit insurance (+/-)	=1 in the presence of a system of explicit deposit insurance =0 otherwise	Barth et al (2001) Godlewski(2003), Demirgüç-Kunt.A and Detragiache. E (2008), Naouar(2007) Abdennour and al (2008)
D ₃	Responsibility of supervisors (+/-)	=1 in the case of prosecution of supervisors for their actions. =0 otherwise	Barth and al (2001) Godlewski(2003), Naouar(2007) Abdennour and al (2008)
D ₄	Role of CB in monitoring (+/-)	=1 if the Central Bank has the task of monitoring and supervision =0 if the control and the supervision are carried out by another independent institution.	Barth and al (2001) Abdennour and al (2008)

Regarding the variable of the insurance deposits, we note that all the countries (eight countries) have an explicit system of deposit insurance. Therefore it is difficult to estimate the impact of this variable on the bank situation. For this reason, we follow the reasoning proposed by Demirguc-Kunt and Detragiache (2008) by integrating the determinants of the deposit insurance system.

DemirgüçKunt and Detragiache (2008) compile eight characteristics of deposit insurance. These are: The coverage ratio, insurance of foreign deposits, the coverage of interbank deposits, the existence of an insurer, the payment of coverage, premiums are adjusted for risk, the administration of the premium (for the state or the private sector), and membership is voluntary or mandatory.

Based on this study, we approximated the variable relating to the existence of a deposit insurance system and its determinants by using the principal component analysis (PCA).

Table3. Determinants of deposit insurance

Factor	Variables	Measure	Author
F	Foreign deposit insurance (D5) (+/-)	1 if there exists 0 otherwise	Demirgüç-Kunt et al. (2008)
	Co-insurance (D6) (+/-)	1 if there exists 0 otherwise	
	Interbank deposit insurance (D7) (+/-)	1 if there exists 0 otherwise	
	The premium risk-adjusted (D8) (+/-)	1 if exists 0 otherwise	
	Funding for the premium (D9) (+/-)	0 by the bank only 1 by the state and the bank together	
	Administration of the guarantee fund (D10) (+/-)	0 public 1 private	

Analysis and interpretation of results:

To test a model for detecting banking distress, it is useful to make these three tasks:

- The determination of correlations between the dependent variable and different ratios.

- Logit regression on CAMEL variables.
- Logit regression on CAMEL variables and factors that explain the regulatory environment.

According to t-test for independent sample, we note that healthy banks have higher solvency ratio and hedge ratio of loans by equity. Distressed banks have the following characteristics:

- These banks have a low capital ratio.
- They cannot cover all loans.
- They have also several related activities,
- less personal expenses and
- A weak economic profitability.

Table 4. T-Test for independent sample

Ratios	Mean Distressed banks	Mean Healthy banks	The student's t
R1 Equity / Total Assets	0.037366	0.092207	-31,339***
R2 Equity / Total Loans	0.078390	0.155895	-15,695***
R3 Net loans/ Total Assets	0.561438	0.639403	-7,687***
R4 Total other operating income / Total Assets	0.390487	0.301731	9, 113***
R5 Personnel expenses/ Total operating expenses	0.478710	0.492294	-2,129**
R6 Total operating income / Total assets	0.020373	0.037457	-13,703***
R7 Net income/ equity (ROE)	0.112839	0.085162	5,184***
R8 Net income / Total Assets(ROA)	0.003974	0.008146	-10, 465***
R9 Total Deposits / Total Assets	0.730666	0.726927	0, 347
R10 Total Deposits / Total liabilities	0.760226	0.802188	-3,692***

Significant at the level of: (***) 1%, (**) 5% or (*) 10%.

Indeed, in the presence of difficulties probability, a bank has a risk of insolvency and a low level of coverage of loans. This is explained by the negative and significant difference of the first two ratios. Concerning profitability (presented by the ratios R7 and R8) two cases may exist: the bank that has a probability of default generates a low profitability. Or, the bank seeks by all way to realize more revenues and therefore take more risks. Since profitability is an increasing function of risk (a positive mean difference indicated by the ratioR7). Moreover, an increase in profitability increases the excess risk and potential distress.

Correlation

The correlation between the explanatory variables and the dependent variable is presented in the table below. The majority of the explanatory variables have expected signs.

Table 5. The correlation between dependent variable et independents variables

		corrélation	T student
R1	Equity / Total Assets	-0.772876	-46.69796***
R2	Equity / Total loans	-0.563211	-26.13278***
R3	Net loans/ Total Assets	-0.217567	-8.546381***
R4	Total other operating income / Total Assets	0.253322	10.03998***
R5	Personnel expenses/ Total operating expenses	-0.058349	-2.240956**
R6	Total operating income / Total Assets	-0.450022	-19.32112***
R7	Net income / Equity (ROE)	0.143175	5.546553***
R8	Net income / Total Assets(ROA)	-0.355255	-14.57115***
R9	Total Deposits / Total Assets	0.070277	2.701125***
R10	Total Deposits / Total liabilities	-0.071572	-2.751183***

Significant at the level of: (***) 1%, (**) 5% or (*) 10%.

The correlation test shows that there is a strong relationship between the approximate ratio of the solvency position and banking problems. This is the similar case of management quality approximated by the ratio (Total Operating Income /Total Assets) and the ability to realize revenues represented by profitability (Net Income / Total Assets).

Logit model application:

This study covers a period exceeding one year. The econometric method used is the Logit Panel. Indeed, when using panel data, incorporating a fixed effect in an empirical model representing the individual effect of each bank assumes that the dependent variable can vary according to institutions independently of all the explanatory variables in the regression. Nevertheless, the use of fixed effect can lead to undesirable results when the estimation period is short (eg. only two years). Moreover, when the explanatory variable does not vary with time (eg. regulatory variables) we use the random effect. About the estimated qualitative Logit model, the fact, integrating a fixed effect requires exclusion from the sample of all establishments which have not had problems (well-capitalized banks). However, it is preferable to use a

random effects model since the use of this technique involves the loss of a significant amount of information (Demirguç-Kunt and Detragiache, 1998).

The use of the bivariate correlation between the explanatory variables shows the presence of dependence between certain variables. Then they were tested separately seeking the most significant outcome. Indeed, indicators are classified by their degree of relevance for explaining the deterioration in the ratio capital of banks. In addition, each ratio must pass through a sieve of introduction or elimination depending on his individual contribution to explaining the dependent variable. The dependence between the ratios retained must be low (see the Pearson correlation for independent variables). In fact, among the 10 ratios only five ratios were selected to avoid the problem of multicollinearity.

Table 6. Pearson correlations for independent variables

	R2	R4	R 6	R8	R10
R2	1.000000				
R4	0.310776	1.000000			
	(12.53606)				
R6	0.344680	-0.298530	1.000000		
	(14.07790)	(-11.99269)			
R8	0.374857	-0.165892	0.464892	1.000000	
	(15.50263)	(-6.449770)	(20.13204)		
R10	0.284409	0.228212	-0.030003	-0.112675	1.000000
	(11.37413)	(8.986933)	(-1.150869)	(-4.347731)	

Value in parentheses is the t-student

The estimation results of models are presented in the table below. First, we test the Logit model (model 1), where it was built only from the five CAMEL variables. Then, in the second model, we add variables related to the regulatory environment except the variable relating to the existence of a deposit insurance system (D2). The latter is subsequently added at the third model after the application of the principal component analysis (PCA).

By estimating these three models were found almost the same expected signs. The main activity of the bank is granting of credits. The ratio R2 (Equity / Total Loans) is the rate of recovery of loans granted by the equity. This ratio is one of the best indicators of banking problems. It has negative consequences on the likelihood of having problems of bank failures. Indeed, when this variable is high, the bank has enough funds to withstand difficultie

Table 7. Results for the Logit model application

Variables	Model 1	Model 2	Model 3
R2 Equity/ Total loans	-1.249984 ***	-1.089388***	-1.111983***
R4 Total other operating income / Total Assets	0.486333***	0.3536902***	0.4349359***
R6 Total operating income / Total Assets	-.0227529***	-0.019039***	-0.026969***
R8 Net Income / Total Assets	-0.288018***	-0.2373362*	-0.371062***
R10 Total Deposits / Total liabilities	0.0419052	-0.139140***	-0.14169***
D1 Audit		-15.54379***	-11.41524***
D2 Deposit insurance		-	2.853437*
D3 Responsibility of supervisors		-14.05587***	-12.14776***
D4 Role of CB		-4.414858**	-10.3024***
C Constant	-5.511353	27.6227***	24.10395***
Wald chi2(5)	285.01	438.76	767.62
Likelihood ratio test	401.81	107.34	104.62
AIC	404.134	375.644	374.925
BIC	441.195	428.588	433.163
Number of observations	1472	1472	1472

Significant at the level of: (***) 1%, (**) 5% or (*) 10%.

The asset quality of the credit institution by the ratio R4 (Total Other operating Income / Total Assets) is significant and affects the probability of being in trouble positively. A high level of this ratio can be seen as a signal of presence of difficulty in banks.

Management quality represented by the ratio R6 (Total Operating income / Total Assets) is statistically significant and negatively correlated with the probability of default. The economic profitability of the bank (Earning / Total Assets) has an expected negative sign and it is significant at 1%. Most often under-capitalized banks have low profitability. The liquidity is approximated by R10 (Total Deposits / Total Liabilities) and is a positive sign. By this standard, a troubled bank is a bank that has a high proportion of deposits. Following a bank run, depositors rush to withdraw deposits for counters because they are worried about the health of their banks. During the first estimate (model1), this variable appears insignificant. On these variables prescribed type, it was seen that after applying the first model we found significant results with the exception of R10.

Following the introduction of variables related to the regulatory environment by estimating the second model, there was improvement in the quality of the model (D1 (Audit), D3 (Responsibility of supervisors) and D4 (Role of Central Bank) as proposed by Barth et al. (2001). This improvement is justified econometrically by smaller values of AIC and BIC criteria from the first estimated model and the degree of significance. The coefficients for the new variables have negative signs and are significant at 5%. If we compare the results of this second model to those of the first, it shows that the ratio (R10) became significant with a negative sign. This can be explained by the presence of an explicit deposit insurance system in these eight countries. Indeed, in the presence of these systems, depositors are protected in case of bank failure. Depositors have no need to remove their funds deposited with banks. Therefore, this guarantee of deposits may limit the bank runs.

The results show that the probability of banking distress is reduced when the auditor report to supervisors, by obligation, illegal activities such as fraud or abuse committed in the internal management by bank managers. The operation of the bank may be threatened by the audit check report prepared by the auditor and disciplined when it carry out this carefully and objectively. Hypothesis 1 is then accepted.

This probability is a decreasing function when it is possible to take legal action against the supervisors for their actions (hypothesis 3 is confirmed). This action has the role of early warning of distressed banks in order to encourage them to make adjustments to their capital. Accountability of supervisors creates greater regulatory discipline and makes more efficient the monitoring process. These two variables (D1 and D3) are significant at 1% level.

The coefficient of D4 (sign is negative) shows that the Central Bank plays an active role in monitoring and supervision and has authority to deal with the problems of failure. The exercise of control and supervision of the Central Bank is negatively correlated with the probability of being undercapitalized (This variable is significant at 5%). Hypothesis 4 is then accepted.

To approximate the variable D2, (presence of deposit insurance) a third model using factor analysis (principal component analysis is the procedure followed by Demirgüç-Kunt and Detragiache, 2008). This author examines the determinants of deposit insurance, along with other variables used in his study; he describes the deposit insurance scheme). Using a single factor (F) presenting the three critical variables of a system of deposit insurance (The administration of funds; Coverage of deposits i.e. foreign, co-insur-

ance and interbank; and Financing of the premium) shows that the probability of difficulty increases with the presence of such a guarantee fund. The presence of such a system discourages depositors to monitor their banks because they feel protected.

Therefore, banks do not respect market discipline that motivates them to take more risks. This result is significant only at a threshold of 10%. Hypothesis 2 was therefore rejected. Whatever the model, the probability of having problems and being undercapitalized is negatively correlated with the solvency ratio, quality management, economic profitability approximated by ROA (return on assets) and the share of deposits in liabilities. By cons, this probability is an increasing function of income from other activities.

Furthermore, a bank in distress has the following characteristics:

- A low capital ratio,
- a poor quality of management,
- a low profitability,
- Important revenues from other activities and a small proportion of deposits compared to total liabilities.

Finally, we can conclude from the results that the banking supervision has a significant effect on the detection of potential problems in the credit institutions. The results of our study also indicate that the regulatory environment influence risk taking by financial institutions. The use of an advanced detection system incorporating external variables related to the regulatory environment is very useful for European banks. We found that a bank can resist to the turbulence when it has an explicit insurance system, when the central bank has monitoring power and take disciplinary measures to supervisors for their management.

Conclusion

This paper presented a model for detecting problems that the distressed banks may know.

The sample consists of 368 institutions from eight countries. The analysis showed that financial ratios relating to the rating system for predicting default CAMEL are correlated with the likelihood of problems measured by binary variables.

A bank in distress, which represents specific characteristics, can be summarized as follows: a low ratio of capital, poor management and low profitability. In front of difficulties, banks earn significant revenues from non-traditional activities. This result confirms the idea which concludes that regulation encourages banks to take more risks by circumventing the regulatory framework. Thus, diversification of activities complicates the monitoring system and increases the likelihood of difficulties. The establishment of deposit insurance systems which protects the depositors and makes risk-taking more expensive would further aggravate the moral hazard. So believing they are protected, the banks take more risks. In return, the presence of auditors providing information to regulators in case of rules default reduces potential problems in the banks. Moreover, sanction against negligent managers would be recommended. Similarly, the decreasing relationship between default probability and the role of the Central Bank in monitoring activity demonstrates that this organization plays an important role in maintaining stability and control of credit institutions. Overall, the results of the analysis, given the limitations of the technique have confirmed that a robustness tightening of supervision and control are able to reduce the probability of credit institutions distress. This conclusion might create problems of costs to establish this measure. From another point of view, it is likely to encourage banks to innovate more and harden supervision. Ultimately, we note that this study can be further enriched if one takes into account other types of variables.

Indeed, the predictive power of the model can be improved by adding variables that take into account the macroeconomic environment (inflation, growth rate of GDP, (Wong, 2010)). We can also add variables which describe the state of governance (internal, external) or use artificial intelligence as the adaptive Neuro-Fuzzy inference system (Giovanis, 2010) and artificial neuronal network (Shu and Lin, 2010).

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