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Classification of spanish credit institutions for the purposes of financial supervision

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Abstract

This paper carries out a classification of Spanish financial institutions with the aim of contributing to improving banking supervision. This classification may be used by supervisory authorities, both to act at an early stage on the institutions that present significant risks, and to establish supervisory guidelines as a tool for differentiating the institutions according to their risk, with potential implementation to other financial systems. To perform this classification, a number of economic and financial ratios are calculated using figures from the consolidated financial statements between 2005 and 2012, followed by a factor analysis which provides four dimensions, based on which the k-means analysis is performed, which allows to reach the aim of this paper.

Banking risks, banking supervision, supervisory guidelines, financial system, k-means

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Foreword

The financial crisis that started in the US in 2008 with the collapse of Lehman Brothers, has been the trigger that caused a change in the regulatory systems of financial institutions at an international level. In the case of the Spanish financial system, several laws have been adopted as bailout measures, among which Royal Decree-Law 9/2009 on bank restructuring and strengthening of the resources of credit institutions, whereby the Fund for Orderly Bank Restructuring (hereinafter, "FOBR") is created, whose responsibilities include the granting of assistance to a large number of financial institutions (Unnim, Ibercaja, Catalunya Banc among many others). Another solution chosen by banks has been to undergo restructuring processes, such as the mergers, as in the case of Bankia, a result of a merger of Bancaja, Caja Madrid and other smaller savings banks.

In recent years, there have been numerous studies on the prediction of bankruptcy or insolvency of financial institutions, as well as their classification based on the results. This paper begins with a review of existing literature on the subject, paying particular attention to those studies using factor analysis and k-means, as this is the methodology used herein.

The aim of this study is to establish supervisory guidelines. To this end, a classification of banks and savings banks in the Spanish financial system is carried out based on a set of variables that summarize the economic and financial position of the entities, which are obtained through the factor analysis applied to sixteen ratios derived from information of their consolidated financial statements.

This analysis responds, firstly, to the need to simplify and synthesize the information from different ratios in the underlying factors behind the economic and financial situation of each of the entities and, secondly, to the need of having independent variables, a desirable condition for the implementation of k-means analysis, the technique selected for the classification. The period under study ranges from 2005 to 2012, both inclusive.

From the results obtained by factor analysis and k-means, entities of the Spanish financial system are classified into five groups according to their degree of strength, proving that, in some cases, the reorganization process of the Financial System has suffered from weaknesses, not achieving the objectives that initially would have been desirable.

Review of existing literature

The cluster analysis applied to financial institutions has been used for different purposes, such as their classification according to their credit rating, the prediction of potential bankruptcy situations ("early warning" studies), to identify business models, to obtain benchmarks within each group to evaluate the performance of the entities, and the decrease in bias that occurs when analyzing the variables and indicators at an aggregate level.

For example, Ioannidis et. al. (2009) use the cluster method of k- nearest neighbors, along with other methods, for classifying the creditworthiness of various entities. These groups are useful for the supervisory authorities, as they differentiate the state of institutions, promoting the taking of prudential measures of recovery. Also, Boyacıoglu et. al. (2008), conducted a factor analysis and a k-means cluster following the same methodology as in our study, for predicting the collapse of banks in Turkey.

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For the Chilean financial system, Jara and Oda (2014) performed a hierarchical cluster analysis, depending on the degree of exposure to common risks, with the intention of reducing the bias that occurs when analyzing the variables and indicators at an aggregate level. Coinciding with our paper, Terrones and Vargas (2013) also performed a hierarchical cluster analysis of banks, with the intention of obtaining an alternative supervisory tools, which would allow an improvement in monitoring risk indicators. In line with this work, Dardac and Boitan (2009), also apply the hierarchical cluster analysis to banks, using economic and financial ratios, with the intention of establishing groups to apply an alternative supervisory technique.

In terms of business models Ferstl and Ones (2012) carry out a k-means cluster analysis to determine the characteristics the business models. Cluster analysis has also been used by Villarroya and Monsálvez (2000) to study whether specialization affects the cost efficiency of the institutions, which showed that banks engaged in trading are more cost efficient than investment banks.

Furthermore, using a k-means cluster analysis, Das (2003) obtained a benchmark for the evaluation of hedge fund, using various economic and financial variables. Among other studies that use classification and prediction methods is that of Alam et. al. (2000), which use fuzzy clustering methods and other methods as classification tools for potentially failing banks. Costea (2014) also uses fuzzy c-means clustering to benchmark the financial performance of non-banking financial institutions in Romania. The ratios used are defined in three dimensions: i) capital adequacy; ii) asset quality and iii) profitability.

These methods are not used in our study, due to the greater efficiency of the k-means method, as has been stated by authors such as Ghosh and Dubey (2013), who compare the k-means method with fuzzy clustering, concluding that the clustering of the data occurs with greater efficiency with the k-means method, without neglecting the value of fuzzy clustering to deal with mixed technical information.

Description of census and ratios used

In this paper, unlike many others, rather than using a sample as starting point, a census has been conducted using financial data from banks and saving banks for the period between 2005 and 2012. For data collection purposes the consolidated financial statements of these entities are used. Once the information from each year has been collected, a financial and economic analysis is performed using sixteen ratios.

Defined below are the sixteen financial ratios on which the factor analysis will be applied, obtaining five factors, which are aimed to meet the objectives set.

Solvency 1 (equity / total assets)

This ratio seeks to observe the institution's ability to withstand potential losses or unexpected declines in the value of its assets, without creditors or depositors suffering losses. Equity is identified, according to the definition established in the IASB Framework, with the residual interest in the assets after deducting all liabilities.

Solvency 2 (equity / total liabilities)

With this ratio, the share of equity on the obligations of the institution is obtained. This is another measure of solvency, which explains the percentage of equity over liabilities.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

It represents a measure of leverage and solvency, so that higher values for this ratio imply better solvency and lower leverage.

Solvency 3 (equity / liabilities + memorandum accounts)

This ratio, as the second ratio, seeks to analyze the solvency and leverage of the institution, although, with the difference built in the denominator, on memorandum accounts. These are possible obligations of the institution such as financial guarantees and commitments to purchase among others. The relationship of equity with a greater number of obligations is being calculated.

Solvency 4 (financial liabilities at amortized cost / total assets).

This ratio links the financial liabilities at amortized cost to the total assets of the institution. The most important item in such portfolio are the deposits, in addition to subordinated liabilities and bonds and other debt securities. This ratio is an indicator of the financing structure of the institution which has no speculative nature. The financial liabilities held for trading represent speculative funding. It is assumed that the higher the value of this ratio, the greater obligations the institution will have, resulting in erosion of its solvency.

Gross margin / average total assets (GM/ATA)

This ratio measures gross margin profitability over average total assets. As it is a measure of profitability which does not include amortization, impairment of assets, administrative expenses, and impairment. It is considered that managers will have less liberality to operate.

Liquidity 1 (credit investment / total assets)

This ratio measures the share of the loans of the institution over total assets, that is, the percentage of the total investment that is subject to credit risk. Also financial instruments that are not traded in active markets. It is assumed that the higher this ratio, the lower the institution's liquidity will be, as the resources taken by the institution are invested in long-term loans.

Liquidity 2 (Loans / total assets)

This ratio represents the investment in loans of the institution, which may be present in three portfolios: i) credit portfolio; ii) the trading portfolio; and iii) other financial assets through loss in earnings.

Through the classification of these portfolios the institution points out the management objectives. In the credit portfolio, the largest in size, the goal is the recovery of long-term investment through cash flows. The fact that long-term resources are compromised plays against liquidity. The trading portfolio, which is smaller in size, aims at short-term sale of securities thereof; and the other financial assets portfolio with changes in profits and losses, seeks to either eliminate accounting mismatches or is related to other fair value liabilities.

Liquidity 3 (total deposits / total loans)

This ratio, which represents the percentage of the bank deposits that account for the total of loans received, aims to be an expression of the extent to which deposits fund loans to customers. It is assumed that a higher value of this ratio implies greater liquidity, as the institution would have more stable funding. Retail deposits, as they are covered to a high percentage by the Deposit Guarantee Fund, give stability to this source of funding.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Higher values also mean a smaller proportion of resources committed to long-term investments such as loans, representing increased liquidity.

Liquidity 4 (available-for-sale financial assets / total assets)

This ratio expresses the proportion that available-for-sale assets represent on total assets. The portfolio of available-for-sale assets includes debt and equity instruments, that have not been rated in other portfolios. In the case of debt instruments, they are usually traded in liquid markets, and the institution is not required to hold them to maturity. Equity instruments are supposed to be available-for-sale in the market. Therefore, this portfolio on total assets represents as a measure to assess the liquidity of the institution.

Profitability 1 (profit/loss for the period total average assets)

This ratio measures the ability of bank management to generate returns using their real and financial resources, that is, including both operating expenses and net interest income. It would be a measure of the quality of management, and would correspond to the profitability ROA.

Profitability 2 (operating profit / total average assets)

This measure of profitability is obtained from a result in which no impairments of goodwill, property, plant and equipment, property investment, shares, profit and loss of non-current assets are included, or from the results of interrupted operations according to the Bank of Spain (Circular 4/2004 of 22 December).

This measure excludes the results that are less related to the financial activity of the institution. It is a profitability measure which is more focused on the recurring business of the institution.

Size 1 (logarithm of assets)

The logarithm of assets is taken as a measure of size, making a change of scale through the logarithm. Size is an important variable for institutions to determine their economies of scale and greater possibilities when it comes to risk diversification. Furthermore, a larger size of the institution will bring it closer to "too big to fail" problem which generates a moral hazard.

Size 2 (Logarithm of interest income)

The logarithm of assets is taken as a measure of size, making a change of scale through the logarithm. It should be borne in mind that this indicator addresses the size of turnover, but focusing on interest income.

Operating costs / operating income (OC / OI)

This ratio is intended to approximate a measurement of the efficiency of the institution, considering that higher value ratios imply lower efficiency In the "operating costs" component, in compliance with the Bank of Spain (Circular 4/2004 of 22 December), interest receivable and similar charges, commissions paid, administrative expenses and amortization are found. For "operating income", interest receivable and similar income and commissions received are taken, also according to the Bank of Spain (Circular 4/2004 of 22 December).

Annex 1 displays the table with descriptive statistics of the ratios defined on a yearly basis and on the type of institution.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Empirical results

Factor analysis seeks factors that explain most of the common variance. In this case, new "dummy variables" are calculated, which, while not observable, represent a linear combination of real variables and collect most of the relevant information of the latter. Appendix 2 contains the correlation matrix of the ratios.

Kaiser-Meyer-Olkin measure of sampling adequacy		0.705
Bartlett's test of sphericity	Approx. Chi-square	9,315.945
	Df	91
	Sig.	0.000

Table 1 KMO measure and Bartlett's test of sphericity

Table 1 and table 2 display KMO statistics (Kaiser, 1970 and 1974) Bartlett's test of sphericity (Bartlett, 1950). As it can be observed, the KMO indicates an acceptable adequacy of the data to the factor model. Moreover, the sphericity test is acceptable, given that a high value of the Chi-square (or equivalently a determining low correlation matrix) is obtained, which means that there are high correlations between variables.

Variables	PARTIAL KMO
Solvency 1	0.777
Solvency 2	0.674
Solvency 3	0.737
OC/OI	0.620
Size 1	0.650
Liquidity 1	0.672
Liquidity 4	0.824
Solvency 4	0.804
GM/ATA	0.707
Profitability 2	0.698
Size 2	0.675
Liquidity 3	0.774
Liquidity 2	0.778
Profitability 1	0.604

Table 2 Partial KMO

Table 2 (cont.)

Variable	Communality
Solvency 1	0.933
Solvency 2	0.942
Solvency 3	0.896
OA/OP	0.449
Size 1	0.950
Liquidity 1	0.917
Liquidity 4	0.588
Solvency 4	0.671
GM/TAA	0.618
Profitability 2	0.912
Size 2	0.938
Liquidity 3	0.811
Liquidity 2	0.867
Profitability 1	0.843

Table 3 Communalities

Table 3 contains the communalities obtained by the factor model. In general, as the table shows, the variables are adequately explained by the model with an average communality of 80.95%, where 10 of the 14 original variables have communalities higher than 80%.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

The square of a factor loading indicates the proportion of variance explained by a factor in a particular variable. The sum of the squares of the weights of any column of the factor matrix is what we call eigenvalues, these indicate the total amount of variance which explains that factor for the variables considered as a group.

The factor loadings can have a maximum value of 1, so the maximum value that the eigenvalue can achieve equals the number of variables.

If we divide the eigenvalue by the number of variables, we obtain the proportion of the variance of the variables that explains the factor.

Factor	Initial eigenvalues			Sum of square saturations of the extraction			Sum of square saturations of the rotation		
	Total	Variance %	Accum. %	Total	Variance %	Accum. %	Total	Variance %	Accum. %
1	4.933	35.238	35.238	4.933	35.238	35.238	4.030	28.784	28.784
2	3.128	22.342	57.579	3.128	22.342	57.579	2.984	21.318	50.101
3	2.008	14.342	71.921	2.008	14.342	71.921	2.287	16.338	66.439
4	1.265	9.034	80.955	1.265	9.034	80.955	2.032	14.516	80.955
5	.734	5.246	86.201						
6	.652	4.658	90.859						
7	.464	3.317	94.176						
8	.384	2.741	96.916						
9	.190	1.360	98.276						
10	.094	.669	98.945						
11	.077	.551	99.496						
12	.039	.281	99.777						
13	.026	.187	99.964						
14	.005	.036	100.000						

Table 4 Variances explained

Table 4 shows the variance explained and the percentage represented by each of the factors displayed.

As it can be seen, four factors obtained eigenvalues greater than one (that is, each of these factors accounts for more variance than the original variable). It was decided to extract four factors, thus explaining 80.955% of the variance.

The factor matrix indicates the relationship between the factors and variables. However, the interpretation of the factors it is often difficult from the factor matrix. Frequently, several variables present high factor coefficients in more than one factor, when what matters is that most of its variability is explained by a single factor. This leads to the development of a simple structure, according to which variables must saturate in a single factor, that is, their factor coefficients have to be high in one factor and low in the rest.

If we seek to simplify the factor structure we have to proceed to rotation. Rotation involves rotating factor axes so that they approximate the original variables. The aim is to facilitate the interpretation of the factor matrix, forcing more variables to define in a latent dimension, in preference to others. Thus, a greater differentiation among factors is achieved, obtained better defined profiles. Upon rotation, the number of factors remains as the percentage of total variance, explained by the original model and the communality of the variables. What varies is the composition of the factors when the factor coefficients of each variable in each factor changes. This also alters the proportion of variability explained by each factor. Variance is distributed between all the factors during rotation (see Table 4).

Among the various existing procedures, the Varimax method was used (Kaiser, 1958), which aims to simplify the factor structure by maximizing the variance of the squared factor coefficients for each factor. The factors finally obtained remain independent.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

	Component			
	1	2	3	4
Solvency 2	.923			
Solvency 1	.906			
Solvency 3	.896			
Solvency 4	-.792			
GM/TAA	.688			
Liquidity 1		.917		
Liquidity 2		.905		
Liquidity 3		-.818		
Liquidity 4		-.754		
Size 1			-.937	
Size 2			-.919	
Profitability 2				.894
Profitability 1				.871
OC/OI				-.578

Table 5 Matrix of rotated components

Table 5 displays the matrix of rotated components, representing the structural factor. By comparing the relative saturations of each factor, it can be seen that a change in the percentage of variance explained by each factor takes place, further changing the more successful rotation becomes (see the last three columns of Table 4). In our case, it decreases the percentage of variation of the first and second factor, and increases the percentage of variation of the third and fourth factor. This implies a success in the Varimax rotation.

Interpretation of factors

a) The first factor is highly correlated with the "Solvency 1" ratio (equity / total assets), "Solvency 2" ratio (equity / total liabilities), "Solvency 3" ratio (equity / liabilities + memorandum accounts), "Solvency 4" (financial liabilities at amortized cost / total assets) and the Gross Margin variable between Average Total Assets. This factor represents the "SOLVENCY" of the institutions. According to the results, it can be seen that a greater solvency is positively related to a higher gross margin on average total assets.

Gross margin on total assets saturates with solvency, while the operating income between total assets saturates with the rest of returns, both economic and financial. This fact leads us to believe that greater solvency is related to higher net interest income, which is the largest component within gross margin, thus it could be argued that the most solvent institutions have lower costs. This fact can be primarily attributed to a lower liability on equity for the most solvent institutions. Secondly, lower funding costs due to the lower risk perceived by the markets.

Moreover, the gross margin between the average total assets saturates with solvency. Institutions with greater solvency achieve a higher interest margins and net income from financial operations. These components are included in the gross margin. This is attributed to the fact that greater solvency implies higher net interest income due to lower cost of funding. Income from financial operations may be better than for less solvent institutions. This may be because the most solvent institutions have fewer problems in obtaining liquidity without having to make sales at low prices, thus harming the results from financial operations.

It is worth stressing that the gross margin between average total assets does not saturate with other profitability measures. The reason behind this may be that, for the calculation of the other profitability measures, the operating profit is used. This result includes more discretionary measures for senior management such as provisions to allowances, impairments, amortization and administrative expenses.

b) The second factor is constituted by the "Liquidity 1" ratio (credit investment among total assets), "Liquidity 2" ratio (Loans / total assets), "Liquidity 3" (Total deposits / total loans) and "Liquidity 4" (Available-for-sale financial assets between the total assets). This factor represents the dimension of "Liquidity" in the institutions.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Regarding this factor, which is representative of liquidity, it can be observed that increased credit investment as well as a greater amount from other loans not classified as credit investment on total assets have a negative impact on liquidity, while a higher proportion of deposits on loans, plays in favor of liquidity.

Furthermore, in relation to the "Liquidity 2" ratio defined as "the total deposits among the total loans," we could argue that a higher level of deposits implies a more stable funding due to the existence of the deposit guarantee fund. One of the problems of the crisis in the savings banks was the evaporation of short-term funding sources, given that they presented wholesale funding sources. Secondly, fewer loans means less long-term committed resources, which implies more liquid assets. This is intended to minimize the risk of non-renewal of financing sources.

The "Liquidity 3" ratio defined as "Available-for-sale financial assets between the total assets", positively saturates with "Liquidity 2", as it is assumed that many of the instruments of this portfolio can be converted into liquid and therefore represent a way to obtain liquidity.

c) The third factor is constituted by Size 1, measured as the logarithm of assets, and Size 2, measured as interest income, plus the net equity between reserves ratio. This factor would represent the dimension of "SIZE" in the institutions.

d) The fourth factor is constituted by "Profitability 1" (profit/loss for the period total average assets), "Profitability 2" (operating profit / total average assets) and the ratio of operating costs between operating profits. This factor represents the dimension of "PROFITABILITY" in the institutions.

The ratio of operating costs between operating profit, correlates negatively with the "Profitability 1" and "Profitability 2". This is due to the fact that inefficiency affects profitability in a negative way.

Once the factors are obtained the k-means analysis is carried out ((MacQueen, 1967) and (Forguey, 1965)). It is a case clustering method to assign cases to a fixed number of clusters whose characteristics are unknown, based on a set of variables.

In our case, the factors obtained through factor analysis are used. K-means analysis is based on the distance between the cases in a set of variables (the factors). The first step is to select the K cases farthest from each other; in our analysis five clusters are set. Next, each case is assigned to the nearest center and the centroids are updated as new cases are incorporated. Therefore, it is an iterative process, in which, through iterations, shifts in the centers can be occur, which will be increasingly smaller. K-means analysis uses Euclidean distance to measure the distance between cases.

The Anova Table shows how the variables that better help differentiate the clusters are solvency and liquidity.

	Cluster		Error		F	Sig.
	Mean square	df	Mean square	df		
SOLVENCY	77.287	4	.426	532	181.247	.000
LIQUIDITY	77.182	4	.427	532	180.669	.000
SIZE	62.602	4	.537	532	116.616	.000
PROFITABILITY	68.655	4	.491	532	139.738	.000

Table 6 Anova Table

The table 7 with final centers are of great interest, as it features the groups' characteristics. Annex 3 also shows a table of each group's average equivalent ratios. Finally, Annex 4 shows the distribution of the number of institutions in each group by year and by type of institution.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

	CLUSTER				
	1	2	3	4	5
SOLVENCY	3.31852	-.11404	-.15872	0.39771	-0.25761
LIQUIDITY	0.30333	-0.22337	-0.09989	-3.44381	0.54441
SIZE	0.43530	-0.17872	-0.60025	1.22512	0.77877
PROFITABILITY	0.51014	-3.48323	0.20618	-0.1863	0.02273

Table 7 Table with final centers

Interpretation of clusters

Clusters are arranged according to the level of strength of the institutions, forming five groups which are presented below:

Healthy asset and financial services institutions (corresponds to group 1)

This cluster brings together institutions with great solvency, low liquidity, not very large in size and with high profitability.

Although it is a group of institutions that share the aforementioned characteristics, it should be noted that this represents few institutions which are mainly dedicated to assets and financial services and to support other institutions. They are mainly comprised of banks, for instance, Allfunds Bank, Privat Bank Degroof in 2008 and 2009, and Banca March. The first institution is specialized in helping others to access architecture investment funds in a more secure and efficient way. The second entity is a bank specialized in asset management.

Not so healthy asset and financial services institutions (correspond to group 4)

A cluster of institutions whose solvency is slightly above average, with good liquidity, very small in size, and poor profitability. Institutions such as the Spanish Confederation of Savings Banks (CECA) stand out in this group, which provided support services to the associated savings banks, although it should clarified that away from the cluster center.

Also property management institutions such as Banco de Alcalá, a bank property management bank, and Fibanc, a bank that belongs to the Italian Banco Mediolanum, also specialized in assets and financial services, and Banco de Madrid.

Institutions bailed-out by Europe (correspond to group 2)

This cluster groups institutions with a below average solvency, above average liquidity, large institutions, and well below average profitability.

This group includes the institutions with which the FOBR used 36.968 million euros of the 100,000 million credit from financial assistance requested to Europe. The effects of restructuring are also represented motivated by the Royal Decree-Law 2/2012 of February 3 and the Royal Decree-Law 18/2012 of May 11 which caused a large increase in provisions. There was a default in own resources in terms of regulation and public financial support became necessary. It is worth noting that the only bailed-out banks were subsidiaries of savings banks.

Doubtful institutions (correspond to group 3).

This cluster groups institutions with a solvency below average, liquidity slightly above average, very large institutions, and above average profitability.

This group gathers a large number of institutions, mostly intervened savings banks, grouped with the country's large institutions such as BBVA, Banco Santander and Caixa-Bank. This situation must be clarified as institutions such as BBVA and Santander are shifting away from the cluster center as we move from 2005 to 2012. In most cases, savings banks are close to the cluster center.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

This cluster contains both institutions which survived as banks and savings banks that had to be bailed-out with public money injections. At this point, the governance structure of saving banks which complicated good corporate governance practices must be taken into account, as well as restrictions on the savings banks to obtain first-class resources, without withholding benefits. Therefore, savings banks resorted to a high degree of wholesale funding, being an unstable source in lack of liquidity situations. Another problem with savings banks that was pointed put is the lack of diversification and their high exposure to the property sector.

Institutional protection schemes (IPS) are also included, also know as cold mergers. They were created with the objective of mutualizing the results, solvency and liquidity, intended to guarantee solvency and liquidity through IPS, allowing each savings bank to maintain its identity and legal status. To prevent that the creation of new institutions was only aimed at obtaining funding from the FOBR, the(Royal Decree-Law 6/2008 of October 10) established that there must be willingness to perpetuate the IPS in time. A period of 10 years was agreed by all institutions making up the IPS, duly notifying within a period of two years to leave the IPS.

Thus, savings bank present in this group in which banks are located, required a considerable amount of aid, while banks, having a more flexible financing structures to raise capital, survived better.

More doubtful institutions (correspond to group 5)

This cluster gathers institutions with a solvency well below average, with very poor liquidity, not very large in size and with average profitability.

In this group, institutions such as Caja Ontivent and Caja Pollensa stand out, these are the only two institutions that still function as savings banks in Spain. Various foreign bank branches as Citibank, Deutsche Bank and Lloyds Bank are also present, due to the aid received in their countries of origin. Many small banks are also included, such as Bankoa, a small bank of Basque origin focused on the industry sector that was acquired before the crisis by the French bank Credit Agricole; and some savings banks until 2009 as Caja Jaén, Caja Ávila and Caja Manlleu, involved in mergers in 2009. It could be argued that, in this group, savings banks are scarce, with a strong presence of small and foreign banks.

Set of clusters analysis

It is observed that property management institutions do not experience problems due to not having a real estate portfolio “Group 1" and "Group 4”. Furthermore, it is observed that institutions that have been bailed-out by Europe "Group 2”, are institutions that have large real estate portfolios and institutions that are savings banks except for two banks that are subsidiaries of savings banks. This aspect suggests management problems on savings banks, where the two only subsidiary banks showed signs of serious trouble.

Moreover, the cluster of doubtful institutions “Group 3" (289 cases), in which a large number of institutions is concentrated (most savings banks with the IPS formed by them), did not lead to excellent results. The economic sense of this scheme may be raised, and its usefulness in the restructuring process of the Spanish financial system. It was intended to cover fund solvency problems with others in better shape, but as it happened many IPS and mergers had to be rescued and nationalized.

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

Therefore, a recapitalization as it has been done in other countries, institution by institution, in an accelerated manner, would have prevented the problem from worsening. Some relevant cases due to high cost are Catalunya Caixa (merger) and Bankia (IPS).

Another issue worth noting is how institutions belonging to doubtful institutions "group 3" (with a solvency below average) have to be bailed-out. This may be due to delayed recognition of credit impairment. This raises the issue of the convenience of the system of provisions based on incurred losses. The new IFRS 9 system reflects the expected loss as a method to record credit impairment, one of the objectives being to avoid delaying the recognition of credit impairment. The delay in the recognition of delinquency could also be due to refinancing; this practice is positive when seeking to achieve a viable future for the company. However, according to the IMF, in was widely used in Spain to delay losses, thus the royal decrees on provisions were enacted.
The Bank of Spain also modifies the Circular 4/2004 of December 22 of the Bank of Spain with the Circular 2/2012 of February 29 of the Bank of Spain in its content regarding provisions and specially the Circular 6/2012 of September 27 of the Bank of Spain, which calls for banks to record in the financial statements the refinanced amounts.

In the group ‘more doubtful institutions’ "Group 5" (180 cases) those savings banks that survived the crisis are located, Caja Ontivent and Caja Pollensa, whose distinguishing feature coincides with that of German savings banks, the fact that they did not experience growth outside their regional areas.

Conclusions

In this study, we have analyzed the annual accounts of banks and savings banks in the Spanish financial system in the time interval between 2005 and 2012. To do this, we used a series of financial ratios on which a factor analysis has been applied, intended to reduce the number of dimensions and obtaining the latent structure of the data.

The dimensions obtained were as follows: Solvency (Factor 1) Liquidity (Factor 2), Size (Factor 4) and Profitability (Factor 4).

Through factor analysis it can be observed how economic profitability is positively related to solvency, suggesting its utility to fix the remuneration of executives, rather than financial profitability.

Once these five dimensions were obtained, a k-means analysis on financial institutions was applied, obtaining five groups which were named: Healthy asset and financial services institutions (Group 1), Not so healthy asset and financial services institutions (Group 4), Institutions bailed-out by Europe (Group 2), Doubtful institutions (Group 3), and More doubtful institutions (Group 5), with solvency and liquidity being the dimensions that create the most differences among the groups.

In the group of institutions with healthy heritage services, small institutions with great solvency, high profitability, and little liquidity are gathered. This group has a reduced number of institutions dedicated to wealth management and investment fund placement.

The group of institutions of less healthy heritage services gathers small institutions that have a solvency slightly above average, good liquidity, but with poor profitability.

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In this group there are very few entities, which highlights the ECSC, an organization that provides services to the savings banks and subsidiaries of foreign banks engaged in wealth management.

In the group of institutions rescued by Europe, institutions with a solvency below average cluster are gathered. They are large institutions with good liquidity and a very bad performance. This group includes institutions that have received a bailout from Europe. They are institutions that had large real estate portfolios, being savings banks, except for only two banks that are subsidiaries of savings banks. This aspect suggests management problems on savings banks, where the two only subsidiary banks showed signs of serious trouble.

The restructuring of the financial system through the IPS and mergers is questioned as some of the participating institutions have been rescued by Europe. This fact arises the question that perhaps, as in the case of Bankia and Caixa Catalunya, a quick institution by institution resolution might have avoided the problem which originated through grouping with other institutions which, in turn, had solvency problems.

The abrupt passage of institutions from the group of doubtful institutions to the group of institutions bailed-out by Europe, as those institutions were having huge losses, raises the problem of delayed recognition of losses through impairment on loans and the possible use of refinancing. These facts may have caused a delay in the recognition of delinquency in the system, something that the royal decrees on provisions aimed to amend, together with the planned change in the systems of provisions at an international level.

The group of doubtful institutions gathers a large number of institutions that have a solvency below average and are large institutions whose liquidity is slightly above average. This group contains the bulk of the savings banks and large banks (although farther from the center of the cluster). It should be stressed that lower solvency implies an increase in liquidity, since an increase in the latter is quicker in times of crisis. The lower solvency of these institutions is also of note, coinciding with a larger size, which can be explained by the implicit support of the State for the large institutions.

The group of more doubtful institutions gathers those with worst solvency than those from the group of doubtful institutions. It shows small institutions with poor liquidity, but with average profitability. Within this group there are two savings banks worth noting, the only ones that have survived: Caja Ontivent and Caja Pollensa, whose distinguishing feature coincides with that of German savings banks, the fact that they did not experience growth outside their regional areas. Small banks and foreign banks are also present, the latter receiving aid from their countries of origin.

YEARLY AVERAGE RATIO

Year		Solvency1 (E/TA)	Solvency2 (E/TL)	Solvency3 (E/TLO+ OA)	Solvency4 (FLAC/TA)	GM/TAA	Liquidity 1 (CI/TA)	Liquidity 2 (L/TA)	Liquidity 3 (TD/TLO)	Liquidity 4 AFSFA/TA	Profitab. 1 (INP/ TAA)	Profitab. 2 EM/TAA	OC/OI	Size 1 (Active logs)	Size 2 (IT logs)
2005	Average	0.0871	0.1008	0.0817	0.8503	0.0364	0.7996	0.7595	0.9758	0.0876	0.0082	0.0092	0.5916	6.8235	5.2994
	N	77	77	77	77	77	77	77	77	77	77	77	77	77	77
	Standard dev.	0.0212	0.1292	0.1267	0.1441	0.0685	0.0099	0.0108	0.1110	0.7279	0.7573	0.0212	0.1292	0.1267	75725 939688 7549
2006	Average	0.0366	0.0184	0.7697	0.9383	0.0834	0.0097	0.0114	0.6303	6.8801	5.4052	0.0366	0.0184	0.7697	0.9383
	N	78	78	78	78	78	78	78	78	78	78	78	78	78	78
	Standard dev.	0.0257	0.0781	0.1197	0.1566	0.0643	0.0105	0.0112	0.1185	0.7473	0.7614	0.0257	0.0781	0.1197	0.1566
2007	Average	0.0364	0.0886	0.7692	0.9490	0.0947	0.0094	0.0109	0.6783	6.9473	5.5818	0.0364	0.0886	0.7692	0.9490
	N	75	75	75	75	75	75	75	75	75	75	75	75	75	75
	Standard dev.	0.0276	0.0909	0.1286	0.2245	0.0626	0.0068	0.0078	0.0875	0.7672	0.7743	0.0276	0.0909	0.1286	0.2245
2008	Average	0.0322	0.7845	0.7819	1.0163	0.0968	0.0047	0.0041	0.7928	6.9601	5.6535	0.0322	0.7845	0.7819	1.0163
	N	76	76	76	76	76	76	76	76	76	76	76	76	76	76
	Standard dev.	0.0226	0.1109	0.0956	0.1847	0.0696	0.0073	0.0091	0.1310	0.7696	0.7846	0.0226	0.1109	0.0956	0.1847

YEARLY AVERAGE RATIO (CONT.)

Year		Solvency1 (E/TA)	Solvency2 (E/TL)	Solvency3 (E/TLO+ OA)	Solvency4 (FLAC/TA)	GM/TAA	Liquidity 1 (CI/TA)	Liquidity 2 (L/TA)	Liquidity 3 (TD/TLO)	Liquidity 4 AFSFA/TA	Profitab. 1 (INP/ TAA)	Profitab. 2 EM/TAA	OC/OI	Size 1 (Active logs)	Size 2 (IT logs)
2009	Average	0.0333	0.7625	0.7502	1.0439	0.0977	0.0022	0.0047	0.7383	6.9506	5.4951	0.0333	0.7625	0.7502	1.0439
	N	77	77	77	77	77	77	77	77	77	77	77	77	77	77
	Standard dev.	0.0248	0.1255	0.1128	0.2277	0.0759	0.0093	0.0111	0.1962	0.7921	0.8633	0.0248	0.1255	0.1128	0.2277
2010	Average	0.0336	0.7477	0.7366	1.0810	0.0971	0.0002	0.0022	0.7704	6.9550	5.2213	0.0336	0.7477	0.7366	1.0810
	N	48	48	48	48	48	48	48	48	48	48	48	48	48	48
	Standard dev.	0.0352	0.1568	0.1507	0.3214	0.1026	0.0179	0.0207	0.2899	0.9859	1.0576	0.0352	0.1568	0.1507	0.3214
2011	Average	0.0326	0.7199	0.7048	1.2270	0.1016	-0.0008	0.0008	0.8800	7.0580	5.5125	0.0326	0.7199	0.7048	1.2270
	N	55	55	55	55	55	55	55	55	55	55	55	55	55	55
	Standard dev.	0.0347	0.1750	0.1775	0.7158	0.1183	0.0179	0.0249	0.3883	1.0103	1.0737	0.0347	0.1750	0.1775	0.7158
2012	Average	0.0332	0.6602	0.6518	1.4617	0.1143	-0.0206	-0.0143	0.7551	6.9837	5.4296	0.0332	0.6602	0.6518	1.4617
	N	51	51	51	51	51	51	51	51	51	51	51	51	51	51
	Standard dev.	0.0291	0.2212	0.2163	1.0055	0.1550	0.0447	0.0386	0.2195	1.0567	1.1258	0.0291	0.2212	0.2163	1.0055
Total	Average	0.0345	0.7701	0.7463	1.0634	0.0955	0.0029	0.0047	0.7199	6.9376	5.4596	0.0345	0.7701	0.7463	1.0634
	N	537	537	537	537	537	537	537	537	537	537	537	537	537	537
	Standard dev.	0.0271	0.1425	0.1436	0.4517	0.0891	0.0193	0.0190	0.2174	0.8396	0.8881	0.0271	0.1425	0.1436	0.4517

ISSN-Print: 2007-1582- ISSN-On line: 2007-3682

AVERAGE RATIO BY TYPE OF INSTITUTION

Institution		Solvency1 (E/TA)	Solvency2 (E/TL)	Solvency3 (E/TLO+OA)	Solvency4 (FLAC/TA)	GM/TAA	Liquidity 1 (CI/TA)	Liquidity 2 (L/TA)	Liquidity 3 (TD/TLO)	Liquidity 4 AFSFA/TA	Profitab. 1 (NPI TAA)	Profitab. 2 EM/TAA	OC/OI	Size 1 (Active logs)	Size 2 (IT logs)
BANK	Average	0.1035	0.1269	0.1049	0.8470	0.0449	0.7836	0.7778	1.0783	0.0792	0.0036	0.0059	0.8143	6.6538	5.1675
	N	243	243	243	243	243	243	243	243	243	243	243	243	243	243
	Standard dev.	0.0820	0.1281	0.1121	0.1320	0.0368	0.1793	0.1701	0.6374	0.1155	0.0200	0.0230	0.2720	0.9797	1.0809
SAVINGS BANK	Average	0.0637	0.0691	0.0580	0.8807	0.0258	0.7589	0.7203	1.0510	0.1091	0.0022	0.0037	0.6418	7.1721	5.7010
	N	294	294	294	294	294	294	294	294	294	294	294	294	294	294
	Standard dev.	0.0286	0.0332	0.0268	0.0810	0.0080	0.1016	0.1111	0.1931	0.0557	0.0187	0.0149	0.1090	0.6121	0.5906
Total	Average	0.0817	0.0953	0.0792	0.8655	0.0345	0.7701	0.7463	1.0634	0.0955	0.0029	0.0047	0.7199	6.9376	5.4596
	N	537	537	537	537	537	537	537	537	537	537	537	537	537	537
	Standard dev.	0.0622	0.0940	0.0813	0.1084	0.0271	0.1425	0.1436	0.4517	0.0891	0.0193	0.0190	0.2174	0.8396	0.8881

CORRELATIONS MATRIX

Ratios		Solvency 1 (E/TA)	Solvency 2 (E/TA)	Solvency 3 E/TL+OA	Solvency 4 FLAC/TA	GM/TA A	Liquidity 1 (CI/TA)	Liquidity 2 (L/TA)	Liquidity 3 (TD/TL)	Liquidity 4 AFSFA/TA	Size 1 (Active logs)	Size 2 (IT logs)	Profitab. 1 (NPI TAA)	Profitab. 2 EM/TAA	OC/OI
Correlation	Solvency1 (E/TA)	1.000	.985	.955	-.582	.675	-.055	-.014	-.062	.080	-.504	-.524	.356	.381	.182
	Solvency2 (E/TL)	.985	1.000	.980	-.585	.685	-.057	-.019	-.082	.058	-.479	-.510	.329	.366	.179
	Solvency3(E/TLO+OA)	.955	.980	1.000	-.560	.595	-.107	-.068	-.043	.100	-.468	-.515	.307	.338	.204
	Solvency4(FLAC/TA)	-.582	-.585	-.560	1.000	-.434	.209	.178	.048	-.008	.137	.172	-.232	-.248	-.107
	GM/TAA	.675	.685	.595	-.434	1.000	.161	.195	-.141	-.156	-.419	-.372	.285	.402	.054
	Liquidity1(CI/TA)	-.055	-.057	-.107	.209	.161	1.000	.884	-.697	-.567	-.135	-.071	.129	.173	-.133
	Liquidity2(L/TA)	-.014	-.019	-.068	.178	.195	.884	1.000	-.670	-.542	-.153	-.082	.132	.164	-.083
	Liquidity3 (TD/TL)	-.062	-.082	-.043	.048	-.141	-.697	-.670	1.000	.459	-.195	-.212	-.178	-.203	.124
	Liquidity4 AFSFA/TA	.080	.058	.100	-.008	-.156	-.567	-.542	.459	1.000	.029	.001	.034	-.012	.000
	Size 1 (Active logs)	-.504	-.479	-.468	.137	-.419	-.135	-.153	-.195	.029	1.000	.962	-.087	-.083	-.237
	Size 2 (Log TI)	-.524	-.510	-.515	.172	-.372	-.071	-.082	-.212	.001	.962	1.000	-.085	-.072	-.282
	Profitability 1(NPITAA)	.356	.329	.307	-.232	.285	.129	.132	-.178	.034	-.087	-.085	1.000	.906	-.191
	Profitability 2 (EM/TAA)	.381	.366	.338	-.248	.402	.173	.164	-.203	-.012	-.083	-.072	.906	1.000	-.289
	OA/NP	.182	.179	.204	-.107	.054	-.133	-.083	.124	.000	-.237	-.282	-.191	-.289	1.000
Sig. (1-tailed)	Solvency1 (E/TA)		.000	.000	.000	.000	.100	.375	.076	.032	.000	.000	.000	.000	.000
	Solvency2 (E/TL)	.000		.000	.000	.000	.096	.333	.028	.090	.000	.000	.000	.000	.000
	Solvency3(E/TLO+OA)	.000	.000		.000	.000	.006	.057	.158	.010	.000	.000	.000	.000	.000
	Solvency4(FLAC/TA)	.000	.000	.000		.000	.000	.000	.133	.431	.001	.000	.000	.000	.007
	GM/TAA	.000	.000	.000	.000		.000	.000	.001	.000	.000	.000	.000	.000	.106
	Liquidity1(CI/TA)	.100	.096	.006	.000	.000		.000	.000	.000	.001	.050	.001	.000	.001
	Liquidity2(L/TA)	.375	.333	.057	.000	.000	.000		.000	.000	.000	.028	.001	.000	.027
	Liquidity3 (TD/TL)	.076	.028	.158	.133	.001	.000	.000		.000	.000	.000	.000	.000	.002
	Liquidity4 AFSFA/TA	.032	.090	.010	.431	.000	.000	.000	.000		.250	.490	.216	.395	.498
	Size 1 (Active logs)	.000	.000	.000	.001	.000	.001	.000	.000	.250		.000	.021	.027	.000
	Size 2 (Log TI)	.000	.000	.000	.000	.000	.050	.028	.000	.490	.000		.024	.049	.000
	Profitability 1(NPITAA)	.000	.000	.000	.000	.000	.001	.001	.000	.216	.021	.024		.000	.000
	Profitability 2 (EM/TAA)	.000	.000	.000	.000	.000	.000	.000	.000	.395	.027	.049	.000		.000
	OC/OI	.000	.000	.000	.007	.106	.001	.027	.002	.498	.000	.000	.000	.000	

AVERAGE EQUIVALENT RATIOS TO EACH GROUP

Institution		Solvency1 (E/TA)	Solvency2 (E/TL)	Solvency3 (E/TLO+OA)	Solvency4 (FLAC/TA)	GM/TAA	Liquidity 1 (CI/TA)	Liquidity 2 (L/TA)	Liquidity 3 (TD/TLO)	Liquidity 4 AFSFA/TA	Profitab. 1 (NPI TAA)	Profitab. 2 (EM/TAA)	OC/OI	Size 1 (Active logs)	Size 2 (IT logs)
1	Average	0.2813	0.4093	0.3336	0.5800	0.1008	0.7539	0.7725	0.7727	0.0624	0.0283	0.0324	0.7638	5.8391	4.2004
	N	26	26	26	26	26	26	26	26	26	26	26	26	26	26
	Standard dev.	0.0804	0.1690	0.1762	0.2245	0.0565	0.1652	0.1024	0.2387	0.1041	0.0233	0.0307	0.1992	0.8561	0.9768
2	Average	0.0505	0.0627	0.0538	0.8968	0.0217	0.6730	0.6442	1.3169	0.0849	-0.0645	-0.0577	1.0236	7.0323	5.4455
	N	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Standard dev.	0.0882	0.1102	0.0972	0.0886	0.0188	0.1512	0.1523	0.3063	0.0602	0.0465	0.0279	0.5935	1.0394	1.1349
3	Average	0.0648	0.0704	0.0585	0.8764	0.0259	0.7551	0.7242	0.9874	0.1105	0.0053	0.0063	0.6726	7.4000	6.0088
	N	289	289	289	289	289	289	289	289	289	289	289	289	289	289
	Standard dev.	0.0271	0.0325	0.0259	0.0644	0.0082	0.0859	0.1023	0.1899	0.0515	0.0063	0.0067	0.1243	0.5513	0.5823
4	Average	0.1288	0.1456	0.1366	0.7763	0.0397	0.3302	0.3374	2.6772	0.3053	0.0029	0.0018	0.9299	6.0661	4.3530
	N	21	21	21	21	21	21	21	21	21	21	21	21	21	21
	Standard dev.	0.0738	0.1032	0.0943	0.1661	0.0228	0.1273	0.1211	1.2628	0.2473	0.0125	0.0142	0.3042	0.6196	0.6668

AVERAGE EQUIVALENT RATIOS TO EACH GROUP (CONT.)

Institution		Solvency1 (E/TA)	Solvency2 (E/TL)	Solvency3 (E/TLO+OA)	Solvency4 (FLAC/TA)	GM/TAA	Liquidity 1 (CI/TA)	Liquidity 2 (L/TA)	Liquidity 3 (TD/TLO)	Liquidity 4 AFSFA/TA	Profitab. 1 (NPI TAA)	Profitab. 2 EM/TAA	OC/OI	Size 1 (Active logs)	Size 2 (IT logs)
5	Average	0.0789	0.0878	0.0719	0.8959	0.0395	0.8592	0.8375	1.0095	0.0530	0.0031	0.0057	0.7295	6.3160	4.8905
	N	180	180	180	180	180	180	180	180	180	180	180	180	180	180
	Standard dev.	0.0392	0.0493	0.0415	0.0526	0.0272	0.0878	0.0955	0.1365	0.0570	0.0089	0.0141	0.2037	0.4761	0.5506
Total	Average	0.0817	0.0953	0.0792	0.8655	0.0345	0.7701	0.7463	1.0634	0.0955	0.0029	0.0047	0.7199	6.9376	5.4596
	N	537	537	537	537	537	537	537	537	537	537	537	537	537	537
	Standard dev.	0.0622	0.0940	0.0813	0.1084	0.0271	0.1425	0.1436	0.4517	0.0891	0.0193	0.0190	0.2174	0.8396	0.8881

DISTRIBUTION OF THE NO. OF INSTITUTIONS OF EACH GROUP BY TYPE OF INSTITUTION

		Cluster					Total
		1	2	3	4	5	
INSTITUTION	BANK	26	10	68	18	121	243
	SAVINGS BANK	0	11	221	3	59	294
Total		26	21	289	21	180	537

DISTRIBUTION OF THE NO. OF INSTITUTIONS OF EACH GROUP BY YEAR

		Cluster					Total
		1	2	3	4	5	
Year	2005	5	1	41	0	30	77
	2006	4	0	39	0	35	78
	2007	5	0	45	1	24	75
	2008	3	0	49	0	24	76
	2009	3	1	48	2	23	77
	2010	2	2	23	5	16	48
	2011	2	5	29	5	14	55
	2012	2	12	15	8	14	51
Total		26	21	289	21	180	537

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