Microeconomic determinants of losses in financial institutions during the crisis

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Abstract

In this study we try to explain the inclusion of banks in the WDCI list proposed by Bloomberg. This list collects a group of more than 100 banking institutions which, during the crisis, suffered losses. We explain the probability of being part of the list (to suffer severe or highly severe losses) by their structure and performance. These aspects are represented by 4 variables: ROA, tier1 ratio, number of employees and total assets, referred to the two years preceding the crisis, of a larger sample of more than 400 banks comprehending the banks in and outside the list. By considering the heterogeneity among the banks of the list, an explanation of the probability of highly sever losses is offered by considering the previous variables with the addition of interbanking assets. By using a probit model we find a confirmation of the new rules, inspired by the Basel 3 Accord and by the Financial Stability Board, requiring a solid patrimonial structure, in particular for the "too big to fail" financial institutions, accompanied by a medium return in order to assure a low probability to suffer losses.

Keywords: Bank, Tier1, financial crisis, losses

Jel classification: G21, G01

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Introduction

The recent financial crisis caused unprecedented losses with its shock, which was apparent only into the crisis. The bank sector was particularly menaced with large write-downs on risky mortgage related positions. Infact since the beginning of the financial crisis (second quarter of 2007) to the spring of 2011, worldwide banks firms credit losses and write downs were $1.5 trillion. A large heterogeneity in losses distribution can be observed (Tab.1 and Tab.2) with a primacy of North America in the worldwide context and of UK banks in Europe. This fact seems to claim a certain role for cultural factors in affecting banking strategies and vulnerability.

Table 1. Write downs and Credit losses by Continents (Q2 2007-May 2011)

	Losses ($ billions)	Number of banks
North America	801,1	34
Europe°	657,2	60
Asia	41,6	11
Worldwide°°	*1501,9*	*107*

Source: Bloomberg WDCI.
Notes: ° Europe includes the following countries banks: UK, Germany, France, Italy, Spain, Austria, the Netherlands, Denmark, Ireland, Greece, Belgium, Sweden, Switzerland, Norway. Worldwide°° includes also Island and Israel

Table 2. Credit losses and Write downs inside Europe (Q2 2007-May 2011)

	Losses ($ billions)	Number of banks
UK	211,2	9
Germany	115	16
Switzerland	82	2
France	62,4	5
Belgium-the Netherlands	57,2	7
Spain	39,4	3
Italy*	37,5	4
Ireland	24,2	3
Denmark	10,6	3
Greece	9,3	4
Austria	5,1	2
Norway	2,8	1
Sweden	0,5	1
Europe	*657,2*	*60*

Source: Bloomberg WDCI.
Notes: *Italy includes HVB.

All this uncovers the limits of the bank provisioning process in order to cope with worse-than-expected economic conditions, and raises concerns about bank capitalization, especially among the largest institutions. The individual prudent action of all firms had the unintentional effect of creating systemic problems. Infact banks manage their leverage in a procyclical manner so that it de-

creases during boom period while it increases during recession, because of the use of collateralized borrowing and lending (D'Hulster, 2009). This pushed for proposals for countercyclical capital requirements and loan loss provisions that would be higher in good times and lower in bad times. Capital is infact a safeguard against uncertainty as testified by the stress test for adverse economic and financial market conditions, applied to the 19 largest bank holding companies in the spring of 2009 (see Board of Governors 2009). As well-capitalized banks face lower costs of going bankrupt and of suffering losses, we try to look for the main factors of losses by analyzing the structure of the banks who suffered more.

1. Banks differences in losses

Our analysis is based on a sample of 543 banking institutions: 44 banks with write-downs and credit losses from the onset of the Great Crisis (the second quarter 2007) to May 2011, registered in a list published by Bloomberg (WDCI) [1] and the others from Bloomberg database.

The sample so structured has a worldwide coverage (Tab.3) and the characteristics of the banks are summed up in table 4.

Table 3. Geographical repartition of the sample

	Banks in the list	Banks outside the list
North America	23	337
Europe	15	46
Asia	6	89
Worldwide	44	499*

Sources: Bloomberg and Bloomberg WDCI

* Worldwide includes also Central and South American Countries, Israel and Jamaica.

On the base of the geographical coverage and the interest in banks characteristics, our paper extends the strand of literature[2] which connects banks performance to banks characteristics. Infact our main target is to try:

1- to explain the probability to be a bank in the list published by Bloomberg;
2- to catch the differences among the banks in the list, in term of write downs, by calculating the probability to be part of a certain partition.

[1] This source is quite interesting and it offers a complete statistics on the write downs and credit losses by individual banks from December 2007 ahead.

[2] Other strands explain the performance through country specific characteristics (Beck and Levine,2004; Levine, 2004; Stulz and Williamson,2003), market structure (Berger,1995; Bergerand Humphrey,1997; Bikker and Haaf, 2002; Goddard et al., 2001; Molyneux et al.,1996) and macroeconomic conditions (Arpa et al., 2001; Bikker and Hu, 2002)

Table 4. Characteristics of the banks in the sample

	Banks in the list			Banks outside the list		
	Max.	Min.	Mean	Max.	Min.	Mean
ROA	3.4	-0.07	1.0	14.6	-3.2	1.34
Number of employees	313000	963	50098	91320	24	2563
Total assets (Millions $)	1703162	9956	473874	399507	104	10768
Interbanking assets (Millions $)	291090	0	39418	33215	0	825
Tier 1 capital ratio	14.7	5.94	8.65	34.49	2.42	12.18

Sources: Bloomberg and Bloomberg WDCI
Notes: the values are the simple mean of the 2005-2006 quarterly data.

Many could be the combinations of structural-variables to take under consideration, but our final choice, even guided by literature, is the following:

1. internal determinants of performance:
   -return on assets (ROA),
   -tier 1 ratio,
   -interbanking assets
2. internal determinants of structure/size:
   -total assets,
   -number of employees, in order to catch organization difficulties connected to the dimension from a human capital prospective.

All these data are taken from Bloomberg database. The values we use as regressors are the simple mean of the 2005-2006 quarterly data, the two years before the onset of the crisis.
In this way the profitability, the leverage and the dimensional aspect of the bank are under analysis[3].
By considering the variables one by one, we observe that ROA represents the level of profitability (Golin, 2001) and it appears inversely related to proportion of loan loss provisions, by following Staikouras and Wood (2003), as well as that banks with greater levels of equity are relatively more profitable.
Tier 1 ratio detects the ability to absorb losses[4], the higher it is the better is the position of a bank. Excessive leverage by banks is widely believed to have contributed to the global financial crisis (FSB 2009; FSA 2009). Well-capitalized banks face lower costs of going bankrupt and of suffering losses by reducing their costs of funding.

[3] All these information can be found on Bloomberg site.
[4] On the base of regulatory standards tier 1 capital ought be equal, on the base of Basel II, at least 4% with Basel III instead the requirement increases to at least 6% (in particular the ratio will be set at 4.5% from 1 January 2013, 5.5% from 1 January 2014 and 6% from 1 January 2015).

The size, represented by total assets, is an important aspect as highlighted in banks performance literature. It represents the level of potential economies[5] to be used. These potential economies can assume two forms: economies of scale, through the reduction of costs, and scope economies, through the access to markets with size limits access, through a better diversification of products and loans (Kosmidou et al., 2006, Barros et al., 2007). The second dimension of the size, the number of employees, has the role of taking into account the fact that the risk of loss can result even from inadequate or failed internal processes, people and systems, as expressed by the Basel Committee on Banking Supervision (BCBS). Chernobai et al. (2008) seem to confirm the relevance of the number of employees as one of the determinants of operational risk, by founding a significant and a concave relation between operational risk and the human factor.

Our choice of variables seems also to follow the results of Chernobai et al. (2008), who, by studying 159 U.S. financial institutions from 1980 to 2003, noticed that frequent losses can be connected to financial constraints, expressed by higher leverage and equity volatility and lower market-to-book ratio, accompanied by high profitability and number of employees.

By using the same variables, we try to investigate if they can help explain the difference in the losses suffered by banks during the crisis.

1.1 Bank's structure and performance as determinants of inter banks differences in losses

We define the variable y, a dummy variable, coded "1" for banks in the list or "0", for the opposite case, and x_i with i=1-5 the set of explanatory variables given by structural and performance variables. The probability function of y conditional on all the regressors is specified by a probit model. To be in the list implies to suffer losses which is a latent variable y^* generated by a regression

$y^*= \alpha+\beta X_i+\varepsilon$

where α is a constant , x_i represents the covariates and ε is a normally distributed random term.

So the probability of being in the list can be expressed as:

$$y = \begin{cases} 0 \ otherwise \\ 1 \ if \ y^* > 0 \ i.e \ \varepsilon_i < \alpha + \beta X_i. \end{cases}$$

$Pr(y=1|x_i)=Pr(\varepsilon_i<\alpha+\beta X_i)=\Phi(\alpha+\beta X_i)$

[5] The evidence is not certain as a strand of literature is in favor of a positive connection of bank size and economies of scale in case of large banks (European Commission, 1997; Berger and Humphrey, 1997; Altunbas et al., 2001), while another strand supports the idea that just small banks are positively influenced by the size while large one are negative influenced (Vander Vennet, 1998; Pallage, 1991)

where Pr is for the probability while Φ is the Cumulative Distribution Function (CDF) of the standard normal distribution.

Table 5 shows the first probit regression. As shown in the table, all the regressors are statistically significant and with the expected signs. Infact a negative sign for tier1 ratio implies that augmenting the tier1 ratio reduces the probability of being included in the list while positive signs of ROA and total assets imply that the larger the return on capital and the total assets the higher the probability to be in the list. By looking at the marginal effects (Tab.5), we observe, at mean values of tier 1 ratio (11.8), ROA (1.23) and total assets (50037), that the probability to be in the list would have been equal to 0.032. By repeating the analysis (Tab.5) doubling the values of ROA (2.5) and total assets (100000) and reducing the tier 1 (5.9), the same probability becomes larger and equal to 0.68.

Table 5. Probit Model on the full sample with three regressors

Dependent variable: WDCI1. Pseudo R^2: 0.6421
Total number of banks: 459; number of WDCI banks: 41.
LR chi2 = 177.42, Prob > chi2 = 0.0000

Regressors	Coefficients	Standard error	Z	Prob. > |Z|
Tier 1	-0.1958658	0.0714	-2.74	0.006
ROA	0.4296135	0.2050	2.09	0.036
Tot. Assets	0.0000118	1.71e-06	6.88	0.000
Constant	-0.6418107	0.6362	-1.01	0.313

Marginal effect on regressors mean values: tier 1=11.8, ROA=1.23, tot assets=50037
y = Pr (WDCI1 = 1) = 0.0319

	dy/dx	Standard error	Z	Prob. > |Z|
Tier 1	-0.0140404	0.00365	-3.85	0.000
ROA	0.0307963	0.0138	2.23	0.026
Tot assets	8.44e-07	0.0000	2.26	0.024

Marginal effect for the following values for regressors: Tier 1= 5.9, ROA=2.5, Tot assets=100000
y = Pr (WDCI1 = 1) = 0.6752

Tier 1	-0.0704698	0.01597	-4.41	0.000
ROA	0.1545691	0.04932	3.13	0.002
Tot assets	4.24e-06	0.00000	4.00	0.000

We repeat then the study (Tab.6) by adding a new regressor, representative of the largeness or complexity of the banks organizations: the number of employees.

By considering the results of the estimation, we find that even this coefficient is statistically significant and with the positive expected sign while the variable representative of the performance, ROA,

loses the significance. Again it emerges (Tab.6) that by augmenting the performance and enlarging the dimension of the structure the probability of losses increases from 0.023 to 0.973.

This result confirms what previously found: large banks in terms of number of employees and total assets, with a pressure in term of profitability, are the most exposed to losses.

Table 6. Probit model on the full sample with four regressors

Dependent variable: WDCI1. Pseudo R2: 0.6566
Total number of banks: 432; number of WDCI banks: 39
LR chi2 = 172, Prob > chi2 = 0.0000

Regressors	Coefficients	Standard error	Z	Prob. > |Z|
Tier 1	-0.227	0.078	-2.93	0.003
ROA	0.390	0.261	1.49	0.135
Tot. Assets	6.87e-06	2.52e-06	2.73	0.006
Num.employ.	0.0000392	0.000	2.57	0.010
Constant	-0.349	0.680	-0.51	0.608
Marginal effect on regressors mean values: Tier 1=11.8, ROA=1.21, Tot assets=50697, Num employ=6318 y = Pr (WDCI1 = 1) = 0.0236				
	dy/dx	Standard error	Z	Prob. > |Z|
Tier 1	-0.013	0.004	-3.28	0.001
ROA	0.022	0.014	1.53	0.126
Total assets	3.82e-07	0.000	1.43	0.153
Num.employ.	2.18e-06	0.000	1.84	0.066
Marginal effect for the following values for regressors: Tier 1= 5.9, ROA=2.5, Tot assets=100000 and Num employ.=50000. y = Pr (WDCI1 = 1) = 0.9732				
Tier 1	-0.014	0.017	-0.80	0.422
ROA	0.024	0.031	0.78	0.434
Tot. assets	4.25e-07	0.000	0.61	0.544
Num.employ.	2.42e-06	0.000	0.83	0.408

This result also confirms the prescription of Basel 3 agreement which points special attention to large institutions.

1.2 Bank's structure and performance as determinants of intra banks differences in losses

If the previous analysis is a guide in understanding why during the same phenomenon there appears a different reaction among banks, by looking at the characteristics of the banks in the list, it becomes necessary to discover which are the causes of a so big heterogeneity in losses. We repeat then the analysis by using this new sample, 44 banks in the list, partitioned, on the base of the severity of loss, through a new dummy which assumes value "1" or "0", if the losses are higher or lower than 9 mil-

lion[6] respectively. We try to understand here the factors discriminating the intensity of losses. A new probit model is then estimated by using the same regressors we used to explain the inclusion in the list. In this case our target is then to study the effect of the above mentioned regressors over the probability of loss over 9 million.

Only one regressor (Tab.7), total assets, is now statistically significant and with the expected sign. A confirmation of the role of performance and structure is found even for losses larger than 9 million. Infact by increasing the dimension and the level of performance, with the tier1 ratio at the Basel III level, the probability increases sensibly, becoming nearly 0.94.

Table 7. Probability on WDCI banks list with over 9 millions losses – 1

Dependent variable: WDCI2. Pseudo R^2: 0.2533
WDCI banks: 41
LR chi2 = 14.34, Prob > chi2 = 0.0025

Regressors	Coefficient	Standard error	Z	Prob. > |Z|
Tier 1	-0.069	0.147	-0.47	0.641
ROA	0.539	0.432	1.25	0.212
Tot. Assets	1.93e-06	6.03e-07	3.21	0.001
Constant	-0.893	1.185	-0.75	0.451
Marginal effect on regressors mean values : Tier 1=8.6, Roa=1.06, Tot assets=453687				
y = Pr (WDCI1 = 1) = 0.4825				
	dy/dx	Standard error	Z	Prob. > |Z|
Tier 1	-0.027	0.059	-0.47	0.641
Roa	0.215	0.172	1.25	0.213
Total assets	7.71e-07	0.000	3.19	0.001
Marginal effect on the following values: Tier 1= 5.9, Roa=2.5, Tot assets=500000				
y = Pr (WDCI1 = 1) = 0.9407				
Tier 1	-0.016	0.025	-0.64	0.519
Roa	0.128	0.054	2.40	0.017
Tot. Assets	4.60e-07	0.000	1.11	0.269

We repeat again the study (Tab.8) by substituting the tier 1 ratio with the interbanking assets[7], to see if the exposition in term of the connections with other banks can be a possible explanation for large losses. Even this new factor is significant and with a positive expected sign. This means that even the position in the interbanking market had a negative effect, creating instability which matured in losses. In this case even the coefficient of the ROA is slightly significant. In part this would confirm the empirical evidence of Furfine (2001) who found that the risk, expressed by the interest paid on federal

[6] This partition divides the list in nearly two half: 22 are the banks with a loss over 9 million while 23 show a loss lower than 9 million.

[7] The literature is not certain on the evaluation of interbanking assets infact , while Allen and Gale (2000) and Freixas et al.(2000) considers interbanking assets as a source of contagion, Rochet and Tirole (1996) and Calomiris, (1998) consider it a source for prudence, as banks are better in evaluating other banks status and so this lending favors less risky behavior.

fund loans, connected to a borrower bank is dependent on the profitability and capital ratio. The marginal analysis, on mean values, shows a probability of a loss over 9 million equal to 0.65.

At the end a new identikit can be now offered for losses over 9 millions: large banks exposed in the interbanking market with a need for high profitability are exposed to highly severe losses.

Table 8. Probability on WDCI banks list with over 9 millions losses – 2

Dependent variable: WDCI2. Pseudo R^2: 0.3279 WDCI banks: 39. LR chi2 = 17.52, Prob > chi2 = 0.0006				
Regressori	Coefficient	Standard error	Z	Prob. > |Z|
ROA	0.815	0.446	1.83	0.068
Total assets	1.44e-06	7.74e-07	1.86	0.063
interbanking assets	0.0000305	0.000	2.08	0.038
Constant	-2.256	0.81317	-2.77	0.006
Marginal effect on regressors mean values : Roa=1.03, Tot assets=405942, Interb. assets=39418 y = Pr (WDCI1 = 1) = 0.6462				
	dy/dx	Standard error	Z	Prob. > |Z|
ROA	0.3030741	0.15618	1.94	0.052
Tot. Assets	5.34e-07	0.00000	1.86	0.063
Interb. Assets	0.0000113	0.00000	2.67	0.007

2. Conclusions

In this study we try to explain the probability of banks to suffer severe or highly severe losses, represented by the inclusion in the WDCI list, proposed by Bloomberg, by their structure and performance. These aspects are represented by 4 variables: ROA, tier1 ratio, number of employees and total assets. Then, by considering the heterogeneity among the banks of the list, an explanation of the probability of the type of losses (severe or highly severe) is offered by using the previous variables with the addition of a new variable: the interbanking assets.

The results of the probit models give us two "identikits" of banks: the first identifies the characteristics of banks included in the WDCI list (suffering severe or highly sever losses) and the second identifies the banks with highly severe losses.

In both cases the dimension of the bank is crucial: a large bank, in terms of number of employees and total assets, with a strong pressure for profitability is vulnerable to losses, a larger bank with a strong pressure for profitability and exposed in the interbanking sector may suffer highly severe losses.

These results confirm the direction of the new rules inspired by the Basel 3 agreement and by the Financial Stability Board, which seem generally in favor of a solid patrimonial structure with an addic-

tion of capitalization for large banks, just to reduce the risk of losses. This interest in the large dimension is absolutely relevant as large banks, in case of fragility and of negative shocks, through their inter-connections, can start a domino effect which can propagate affecting the entire financial system.

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