The Role of Regulatory Pressure in Banks' Capital and Risk Decisions

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Capital regulation represents the core of prudential regulation in banking. Despite the aim of the regulators to have a safer and more robust banking industry, the effects of capital regulation on banks' capital and risk decisions appear ambiguous. The paper analyses the relationship between capital and risk changes and the impact of regulatory pressure for a sample of European banks during the period 2006–2010, which encompasses the start of the latest financial crisis. Results highlight that banks tend to adopt a different behaviour depending on the capital ratio considered, supporting the so-called 'gamble for resurrection' hypothesis. Evidence supports the rethinking of the regulatory framework, especially with reference to higher and stricter capital requirements.

Key Words: bank, capital, risk, regulation, Tier 1

INTRODUCTION

Capital regulation aims at ensuring that banks hold a level of capital consistent with their risk exposure, and their decisions on capital change as their risk position is modified by endogenous or exogenous factors. Nevertheless, if not correctly designed, capital requirements might produce unwanted effects because of moral hazard and asymmetry of information which lead banks to excessive risk taking (Kahane 1977; Koehn and Santomero 1980; Kim and Santomero 1988; Gennotte and Pyle 1991). Understanding the link between regulation and banks' decision is of utmost importance because it might help policy makers to adjust capital regulations. This issue is particularly relevant in the European area where countries are subject to common general regulation which nevertheless is applied on country basis through national supervisory authorities, potentially generating an uneven playing field. Understanding how Eu-

ropean banks react to capital regulation, is a key point in the framework of the banking and market union.

The latest crisis stimulated further discussion and brought to the revision of the prudential framework, as well as the introduction of
[6] additional measures to control bank risk taking that led to a new set of rules under the name of Basel III.

This study tries to answer to the following question: what was the role of regulatory framework in determining changes in capital ratios and in risk exposure during the crisis? In order to answer this research question, balance sheet data for a sample of 1,442 European banks from 2006 to 2010 are analysed. This study contributes to the existing literature providing updated evidence on the behaviour of European banks in light of the implementation of the third version of the Basel Accord, which although strengthening and modifying the Basel II framework, relies on the same assumptions on banks behaviour. The paper is organised as follows: section 2 reviews the main empirical contributions on the topic and presents the model; section 3 describes the sample; the fourth section discusses the results; the last section draws the conclusions.

CAPITAL AND RISK DECISIONS

The literature on bank capital is extensive and the effects of capital requirements have been studied thoroughly. Theories argue that capital regulation can lead to excessive risk taking if capital requirements are not correctly designed (Kahane 1977; Koehn and Santomero 1980; Kim and Santomero 1988; Gennotte and Pyle 1991) and empirical studies have investigated banks' behaviour to provide evidence on the effects of regulation, but results remain ambiguous.

Changes in capital and risk are modelled in this study using a simultaneous equation framework (Shrieves and Dahl 1992; Jacques and Nigro 1997). According to this setting, banks have a desired (optimal) level of capital and risk, which cannot be observed. Changes in capital and risk are assumed to represent adjustments toward these optimal levels that depend on exogenous factors such as regulation, economic cycle and other variables, e.g. size, level of liquid assets and profitability.

In general, capital and risk changes appear to be severely affected by the banks' ex-ante capital level. A number of studies find that low capitalised banks tend to increase risk when facing a drop in capital ratio, taking the 'gamble for resurrection' and increasing the probability of default (Calem and Rob 1999; Godlewski 2005; Iwatsubo 2005; Camara, Lepetit, and Tarazi 2013). [7]

Results become even more varied when considering the quality of capital: banks' decisions vary according to the capital ratio considered, i.e. total regulatory capital, Tier 1 capital, or equity (Kleff and Weber 2003; Hussain and Hassan 2005; Memmel and Raupach 2010; Camara, Lepetit, and Tarazi 2013).

Hence, this analysis focuses on three formulations of capital (CAP) to enable a possible comparison of results. Firstly, CAP is interpreted as the total regulatory capital ratio (trCR). This ratio is obtained by the level of capital to risk weighted assets and has a direct relationship with regulatory provisions. Secondly, Tier 1 regulatory capital ratio (t1CR) is included in the analysis as additional measure for the highest quality part of regulatory capital. Lastly, equity to total assets (ETA) is considered. This ratio does not consider risk weighting and might provide different indications. Equity to total assets is a common indicator used by markets to evaluate the capitalisation of firms and does not respond to regulatory provisions. Moreover, it is easy to compute, it has coherence between numerator and denominator, as both are computed using the same rules and has a relationship with leverage.

Risk is measured as the ratio of risk weighted assets to total assets (RWA/TA), in line with the notion of risk formulated by prudential regulation.

Banks decisions are influenced by regulation. In fact, they have to comply with a minimum capital ratio, but they can decide on how much capital to hold above the minimum. Banks with a high capital ratio are considered to be less subject to regulatory pressure, as they hold a buffer sufficient to absorb eventual shocks. On the contrary, banks with a low capital ratio will be subject to more regulatory pressure: on the one hand their capital ratios are likely to be more stressed during downturns and on the other, in case reg-

ulation becomes stricter, they would have to strengthen the capital base or limit their exposure to risk, in order to reach the new regulatory minimum. In general, when banks face an increased regulatory pressure, they tend to adjust their capital ratio by increasing capital
[8] and decreasing risk, in line with the regulatory objective (Shrieves and Dahl 1992; Jacques and Nigro 1997; Matejašák, Teplý, and Černohorský 2009) although contrasting evidence is provided by Heid, Porath, and Stolz (2003) and Van Roy (2005). In this study we define regulatory pressure as in Alexandre and Bouaiss (2009): REG1 represents the difference between the bank's capital ratio and the minimum capital ratio, which is 8%, and REG2 is defined as the product of REG1 and the level of the capital ratio at the beginning of the period (CAP_{t-1}) and expresses the speed at which banks adjust their capital.

Banks' characteristics are also likely to affect banks' decisions. Bank size can have a positive or a negative contribution. A positive relationship with bank capital may exist because larger banks tend to be also more complex and this exacerbates the asymmetry of information (Gropp and Heider 2010). On the other hand, size can have a negative impact on capital buffers. Larger banks have an easier access to capital markets (Ahmad, Ariff, and Skylly 2009) and may have greater flexibility in funding themselves to increase their capital ratios, using for instance hybrid instruments or subordinated debt (Heid, Porath, and Stolz 2003). However, the sign and impact of size is likely to depend on the specialisation: for instance savings and cooperative banks face more restrictions in raising capital (Kleff and Weber 2003). The negative sign might also be related to the 'too big to fail' issue: larger banks may hold less capital because they rely on public intervention in case of distress.

When controlling the impact of size on risk, a positive or a negative sign is expected. In the latter case, a diversification effect would prevail (Lindquist 2004; Van Roy 2005), however, literature finds controversial results.

Liquidity (LIQ) is able to influence both, capital and risk decisions (Allen and Gale 2004; Jokipii and Milne 2011; Athanasoglou 2011), but the expected sign is ambiguous. Liquidity (LIQ) is defined

as liquid assets to customers and short term funding (Athanasoglou 2011). Profitability can impact capital decisions as profitable banks may in fact increase their capital through retained earnings (Kwan and Eisenbeis 1997; Rime 2001; Van Roy 2005; Matejašák, Teplý, and Černohorský 2009). ROA is included in the model, as in previous studies, to account for the profitability of the bank, as well as the ratio of net interest income to total asset (NII/TA). [9]

As underlined by Altunbas et al. (2007), efficiency is a relevant factor when analysing the relationship between decisions on capital and risk. The cost to income ratio is here considered a simple indicator for efficiency (EFF).

Finally, the rate of GDP growth (GDP) is included in order to check for specific country features, which can affect capital and risk decisions by banks (Lindquist 2004; Van Roy 2005). Capital requirements as stated in Basel I and Basel II have a procyclical behaviour. In fact, when the economic cycle deteriorates, losses increases and the level of capital needed to satisfy capital requirements increases as well. However, it can be difficult for banks to raise capital during economic downturns, as it becomes even scarcer and more costly. Banks could therefore be forced to decrease risky assets, e.g. reducing the amount of loans destined to the real economy. The opposite can happen during economic booms.

The relationship between changes in capital and in risk in this study is represented by the following equations:

$$\begin{aligned}\Delta \mathrm{CAP}_{j,t} = {} & a_0 + a_1 \mathrm{SIZE}_{j,t} + a_2 \mathrm{LIQ}_{j,t} + a_3 \mathrm{ROA}_{j,t} \\ & + a_4 \mathrm{EFF}_{j,t} + a_5 \mathrm{GDP}_{j,t-1} + a_6 \mathrm{CAP}_{j,t-1} \\ & + a_7 \mathrm{RISK}_{j,t} + a_8 \mathrm{REG2}_{j,t} + \mathrm{E}_{j,t} \qquad (1) \\ \Delta \mathrm{RISK}_{j,t} = {} & b_0 + b_1 \mathrm{SIZE}_{j,t} + b_2 \mathrm{LIQ}_{j,t} + b_3 \mathrm{EFF}_{j,t} \\ & + b_4 \mathrm{GDP}_{j,t-1} + b_5 \mathrm{RISK}_{j,t-1} + b_6 \mathrm{CAP}_{j,t} \\ & + b_7 \mathrm{REG1}_{j,t} + b_8 \mathrm{REG2}_{j,t} + \mathrm{S}_{j,t} \qquad (2)\end{aligned}$$

The model shows endogeneity problems, because changes in capital and risk are interrelated and they show up on both equations, as also confirmed by the Hausman test. To deal with endogeneity,

the study applies a GMM approach. Lagged values of capital and risk are used as instruments for changes in capital and risk, as suggested and implemented by previous literature. Additionally, an Arellano-Bover/Blundell-Bond estimation is employed to check the robust-
[10] ness of the results. The estimator is specifically designed for panel with a low number of time-series observations and a high number of groups and is particularly suitable in case of persistent data (Arellano and Bover 1995; Blundell and Bond 1998).

SAMPLE DESCRIPTION

The sample is constituted by European commercial, savings and cooperative banks. Balance sheet information is obtained from Bankscope for the period from 2006 to 2010. This time span enables to have homogeneity in the data, as all the banks apply the same accounting rules starting in 2006, and helps to focus on banks' decisions during the financial crisis. Besides, ending in 2010, it excludes the most dramatic times of the European sovereign debt crisis, which might have further modified banks behaviour. Additionally, focusing on this period helps excluding the amendments made after the European Banking Authority (EBA) recommendations to raise Core Tier 1 capital to 9% in 2011, as well as the choices made under the supervisory monitoring of the leverage ratio and the observation period of the liquidity ratios, which started in 2011 (European Banking Authority 2011).

Banks with assets and total regulatory capital ratio values available for less than four consecutive years and banks with a capital ratio higher than 100% are eliminated from the sample.

The resulting sample is made of 1,442 banks: 513 are commercial banks, 683 are cooperative banks and the remaining 246 are savings banks (table 1). More than half of the banks in the sample are from Western European countries (1,102). To be more specific, almost 37% of the banks in the sample are Italian banks, but their weight on the sample in terms of total assets (as at 2010) is limited (8.91%) if compared for instance to French banks. There are few of the latter (1.46% of the banks in the sample), but represent more than 25% of total assets. The same holds for banks from the United Kingdom

TABLE 1 Description of the Sample by Country

(1)	(2)	(3)	(4)	(5)	(6)	(7)
1	Albania	EE	3	0.21%	2,511,074	0.01%
2	Andorra	WE	1	0.07%	5,200,000	0.01%
3	Austria	WE	17	1.18%	556,619,900	1.54%
4	Belarus	EE	12	0.83%	24,560,047	0.07%
5	Belgium	WE	8	0.55%	1,108,900,000	3.06%
6	Bosnia-Herzegovina	EE	7	0.49%	2,543,303	0.01%
7	Bulgaria	EE	13	0.90%	24,768,523	0.07%
8	Croatia	EE	19	1.32%	41,303,234	0.11%
9	Cyprus	WE	6	0.42%	56,242,000	0.16%
10	Czech Republic	EE	11	0.76%	116,200,000	0.32%
11	Denmark	WE	69	4.79%	856,039,971	2.36%
12	Estonia	EE	5	0.35%	714,925	0.00%
13	Finland	WE	5	0.35%	436,652,800	1.21%
14	France	WE	21	1.46%	9,227,700,000	25.48%
15	Germany	WE	274	19.00%	4,072,687,100	11.25%
16	Greece	WE	16	1.11%	456,284,800	1.26%
17	Hungary	EE	6	0.42%	73,800,000	0.20%
18	Ireland	WE	7	0.49%	540,300,000	1.49%
19	Italy	WE	531	36.82%	3,227,093,820	8.91%
20	Latvia	EE	14	0.97%	20,397,889	0.06%
21	Lithuania	EE	8	0.55%	20,851,623	0.06%
22	Luxembourg	WE	8	0.55%	196,000,000	0.54%
23	Macedonia (FYROM)	EE	7	0.49%	2,757,907	0.01%
24	Malta	WE	2	0.14%	6,486,620	0.02%
25	Moldova	WE	3	0.21%	645,185	0.00%
26	Montenegro	EE	2	0.14%	526,000	0.00%
27	Netherlands	WE	18	1.25%	1,959,329,100	5.41%
28	Norway	EE	99	6.87%	413,186,849	1.14%
29	Poland	EE	18	1.25%	194,308,158	0.54%
30	Portugal	EE	10	0.69%	364,500,000	1.01%
31	Romania	EE	12	0.83%	51,063,816	0.14%
32	Russian Federation	EE	43	2.98%	580,295,637	1.60%
33	Serbia	EE	8	0.55%	5,906,559	0.02%
34	Slovakia	EE	6	0.42%	36,484,600	0.10%

[11]

Continued on the next page

TABLE 1 *Continued from the previous page*

(1)	(2)	(3)	(4)	(5)	(6)	(7)
35	Slovenia	EE	14	0.97%	45,095,600	0.12%
36	Spain	WE	52	3.61%	2,805,100,000	7.75%
37	Sweden	WE	13	0.90%	689,690,830	1.90%
38	Switzerland	WE	7	0.49%	2,059,171,011	5.69%
39	Turkey	WE	17	1.18%	380,102,354	1.05%
40	Ukraine	EE	23	1.60%	34,054,751	0.09%
41	United Kingdom	WE	27	1.87%	5,513,980,033	15.23%
	Total		1,442	100.00%	36,210,056,019	100.00%
		EE	340	23.58%		
		WE	1,102	76.42%		

NOTES Column headings are as follows: (1) number, (2) country, (3) Eastern/Western Europe, (4) number, (5) percentage, (6) total assets as of December 2010, (7) percentage. Elaboration from Bankscope.

[12]

that weight for more than 15% in terms of assets. German banks are numerous and their total assets represent 11.25%, but also in this case, there are few large banks and many small banks.

Summary descriptive statistics of the sample are presented in table 2. The average value of total assets over the time period analysed is around 26 billion Euros. The average total regulatory capital ratio (a.trCR) over the period 2006–2010 is around 16.19%, well above the minimum required by the regulation. The median for trCR is slightly lower than the mean (table 2). Most of the banks in the sample therefore seem to be well capitalised in terms of total regulatory capital ratio (table 3). The average Tier 1 regulatory capital ratio is 14.45% for the whole sample.

Table 4 summarises the evolution of the capital ratios in the time period considered, using three different variables: total regulatory capital ratio (trCR), Tier 1 regulatory capital ratio (t1CR) and equity to total assets (ETA).

RESULTS

GMM provides results summarised in table 5. Looking at the capital equations, capital and risk show a statistical significant relationship,

TABLE 2 Descriptive statistics

Variable	Obs	Mean	Std. dev.	Min	Max
Total Assets	6,969	26,200*	145,000*	3,215	2,200,000*
t1CR	5,023	14.45	7.80	0.13	97.29
trCR	6,606	16.19	7.18	0.13	99.20
ETA	6,969	9.94	5.40	−0.47	93.54
CapTA	4,000	9.77	4.87	0.75	77.93
ROAA	6,965	0.62	1.40	−22.44	21.20
NII/av.TA	6,881	3.06	1.64	−0.73	25.41
Cost/Income	6,947	65.87	24.14	1.92	731.21

NOTES * × 1000. Figures in thousand Euros for Total assets and in percentage for the other variables. Elaboration from Bankscope.

[13]

TABLE 3 Distribution of Banks According to the Average trCR

Average trCR	No. of banks
< 8%	5
8% ≤ a.trCR < 10.5%	104
10.5% ≤ a.trCR < 20%	1094
a.trCR ≥ 20%	239

NOTES Elaboration from Bankscope.

TABLE 4 Evolution of Capital Ratios

Year	trCR	t1CR	ETA
2006	16.6	14.75	10.35
2007	15.77	14.10	10.14
2008	15.82	14.05	9.72
2009	16.46	14.79	9.90
2010	16.47	14.66	9.51

NOTES trCR – total regulatory capital ratio; t1CR – Tier 1 capital ratio; ETA – equity to total assets. Figures in percentage. Elaboration from Bankscope.

even if the level of the coefficient is low: the relationship with trCR is positive, while it has a negative significant impact on changes in ETA and t1CR. This might suggest that banks in the sample tend to increase their overall capital ratio (trCR) when risk increases, but they have the opposite behaviour if they have to adjust their capital level in terms of ETA and t1CR, which express the highest quality components of capital. The net increase could be therefore the result of an increase in the lowest quality instruments, such as Tier 2 and Tier 3, which are not destined to absorb losses in a going concern basis, but only in a gone concern framework, as clarified by the latest regulatory instructions. The behaviour of banks seems to reflect

TABLE 5 GMM for Capital Equations

Variable	dcap = dtrCR		dcap = dETA		dcap = dt1CR	
	1.1	1.2	2.1	2.2	3.1	3.2
CONST	15.572***	16.022***	5.828***	5.798***	12.384***	12.587***
[14] SIZE	−0.286***	−0.248***	−0.182***	−0.175***	−0.361***	−0.343***
LIQ	0.012***	0.011***	0.000	0.000	0.004	0.003
ROA	0.071	0.063	0.217***	0.216***	0.215***	0.213***
GDP	−0.079***	−0.084***	−0.022*	−0.023*	−0.089***	−0.093***
EFF	−0.013**	−0.012**	−0.016***	−0.016***	−0.009**	−0.008**
REG2	0.018***	0.019***	0.002***	0.002***	0.012***	0.013***
CAP_{t-1}	−0.875***	−0.937***	−0.267***	−0.270***	−0.622***	−0.649***
DRISK	0.001***	0.002***	−0.003***	−0.002***	−0.002***	−0.001***
AD		−2.782***		−0.412***		−1.714***
UND		−4.228***		−0.713		−2.864***
R^2	0.465	0.424	0.755	0.752	0.603	0.582
Obs.	3250	3250	3250	3250	3159	3159

NOTES ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level. R^2 is calculated as the square of the correlation between the observed and the predicted, the latter calculated on the sample. J-Stat is not applicable in this case as the equations are exactly identified.

the possibility to choose between various instruments included in the capital base to increase their capital ratio. Moreover, since capital ratios depend both on the capital level and on risk weighted assets, banks have a possibility to modify their regulatory capital ratio through changes in the numerator or in the denominator and the choice between the two might depend on economic convenience.

The value of capital in $t-1$ shows a negative significant relationship with changes in t. Banks with high capital ratios tend to decrease their capital ratio in the next period. The impact is stronger for the regulatory capital ratio (trCR). This could indicate that banks try to increase risk while maintaining the same level of capital in order to optimise the use and the cost of the latter. However, if the peculiarity of the time period is taken into consideration, this relationship could be the result of an increased riskiness of assets and a decrease in the capital base. These effects might produce a decrease in

the capital ratio in the next period (as the numerator diminishes and the denominator increases). Moreover, as already discussed, banks must comply with the minimum of 8% capital ratio, therefore banks close to the minimum might have less space to decrease capital ratios if compared with banks that have a very high capital ratio. [15]

Regulatory pressure modelled as REG2 has a positive and significant impact on all the specifications. REG2 represents the speed of adjustment of capital ratios. It is not surprising that the effect is higher for regulatory capital ratios, as these are the variables considered by the supervisory authorities. It is reasonable to believe that REG2 will be lower for banks far from the minimum and higher for banks approaching the minimum.

Size has a negative coefficient for all the definitions of capital ratio and it is always statistically different from zero. The results support the theories maintaining that larger banks tend to hold lower capital ratios, as they can more easily raise capital in the market. This negative relationship could also be attributed to the moral hazard deriving from the 'too big to fail' status, as larger banks might hold a lower level of capital, relying on the eventual bail out by the government in case of bankrupt. The magnitude of the coefficients varies depending on the type of capital ratio considered. The value of the coefficient is in fact larger for regulatory capital ratios (trCR and t1CR) while it is in general smaller for changes equity to total assets (ETA). Overall, results are in line with previous research.

Liquidity shows a positive sign: more liquid banks tend to increase their capital base. The contribution of the variable appears statistically significant but small, with a coefficient that is around 1% when considering changes in trCR; it is even smaller in size and not significant when considering the other capital ratios. The limited size and significance of the contribution of liquidity could depend on the period analysed. In fact, during the crisis, financial intermediaries tended to retain their liquidity because of the uncertain evolution of events and doubts on the solvency of other institutions.

Return on assets (ROA) generally has a positive impact on changes in capital. The coefficient is statistically significant when capital is measured as t1CR and as ETA. The literature suggests that this

positive relationship derives from the possibility to use earnings to strengthen the capital base (Berger 1995). Apparently, also banks in the sample tend to increase their capital thanks to retained earnings.

[16] Efficiency computed as cost to income ratio has in general a weak negative sign when changes in capital ratios are considered. More efficient banks, therefore seem to operate with a lower capital ratio and this supports the theory that regulators might allow more efficient banks to operate with less restrictions on their leverage. GDP growth has a negative impact on changes in capital ratios. The effect is stronger for trCR and t1CR. Banks located in countries with slower growth tend to increase their capital ratios more, everything else equal. The negative relationship could be influenced by the request to strengthen the capital base made both by markets and regulators, after the bust of crisis. The coefficient appears small and therefore the economic situation of countries seems to contribute, but with a limited strength, as it is reasonable to assume that banks that operate internationally do not take into account only their home country economy but also the ones of the various countries where they operate. Moreover, since the investigation does not include the whole business cycle, it has to be interpreted with care.

In specification 2, the three models include two additional dummy variables describing the level of capital. AD is equal to one for banks which are adequately capitalised, while UND is a dummy variable to isolate undercapitalised banks.[1]

The dummy variable for well capitalised banks (WELL) is not included in the model, as these banks are taken as a basis for the analysis. The relationship with changes in trCR and in t1CR is negative and significant. Adequately capitalised and undercapitalised banks with high risk levels tend to decrease their regulatory capital more than well capitalised banks. While this could be a surprising result, it might be related to the risk equation and to the 'gamble for resurrection' hypothesis. The period analysed (2006–2010) encompasses the last financial crisis: undercapitalised banks might have suffered losses due to the financial downturn and this could have been trans-

TABLE 6 GMM for Risk Equations

Variable	trCR	trCR	ETA	ETA	t1CR	t1CR
CONST	1.426***	1.429***	1.250***	1.240*	1.485***	1.489***
SIZE	−0.037***	−0.038***	−0.028***	−0.029***	−0.040***	−0.040***
LIQ	−0.001**	−0.001*	−0.001	−0.001	−0.001*	−0.001*
GDP	0.004***	0.004***	0.004**	0.004***	0.004***	0.004***
EFF	−0.001***	−0.001***	−0.002***	−0.002***	−0.001***	−0.001***
REG1	−0.017***	−0.017***	0.010**	0.013***	−0.021***	−0.021***
REG2	0.000***	0.000***	0.000***	−0.001***	0.000***	0.000***
$RISK_{t-1}$	0.000*	0.000*	0.000***	0.000	0.000	0.000
dtrCR	0.002	0.002				
DETA			−0.089***	−0.091***		
dt1CR					0.007	0.007***
AD		−0.004		0.070***		−0.009
UND		−0.079**		0.036		−0.094
R^2	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Obs.	3250	3250	3250	3250	3159	3159

[17]

NOTES drisk = d(rwa/ta). ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level. R^2 is calculated as the square of the correlation between the observed and the predicted, the latter calculated on the sample. J-Stat is not applicable in this case as the equations are exactly identified.

lated into a further decrease of the capital base, both in terms of regulatory capital and in terms of equity to total assets ratio. Additionally, most of the banks suffered an increase in the riskiness of their asset portfolio.

As a robustness check, the variable for the profitability (ROA) is substituted with net interest income to total assets (NII/TA). Coefficients generally keep the same sign, size and statistical significance in all the specifications of the model.[2]

Risk equations are now considered (table 6). Overall, results highlight a weak relationship between explanatory variables and changes in risk related to total assets.[3]

Changes in RISK are negatively influenced by size, consistently with the diversification hypothesis. Larger banks can diversify their assets better and therefore they can pursue a decrease in the overall

level of risk. Liquidity has a weak negative effect on risk decisions. The same type of relationship holds for efficiency.

GDP growth has a positive and significant sign: banks located in countries with a high GDP growth tend to take on a higher level of
[18] risk. During booms, banks seem to have a less prudent behaviour to exploit profit opportunities.

Regulatory pressure measured as REG1 has a negative and significant coefficient for the two regulatory capital ratios (trCR and t1CR). If a bank has a high level of REG1 (meaning that the difference between its trCR and the regulatory minimum is positive), everything else equal, it will tend to pursue a decrease in risk. On the contrary, banks with a low REG1, which are undercapitalised or adequately capitalised, will pursue an increase in risk. This again supports the 'gamble for resurrection' hypothesis. REG2 express the speed of adjustment. The sign is generally positive across capital ratio definition. However, the impact is really small and its contribution to decisions on risk seems to be negligible.

The impact of changes in capital ratio on decisions on risk seems statistically significant only when considering capital as ETA and as t1CR, but controlling also for the ex ante level of capital. In the first case the relationship is negative, while in the second it is positive. Therefore, for changes in ETA and RISK, a two way negative relationship seems to hold. The same cannot be said for the other capital ratios.

As robustness check, given the structure of the data and of the model, an Arellano-Bover/Blundell-Bond model is also tested. Estimations provide overall similar results (table 7). With reference to the capital equations, signs and statistical significance appear similar to what obtained with GMM, but for a size, which takes a positive significant sign in several specifications. Considering the relationships between capital and risk, changes in risk now positively affect changes in capital also for eta and t1cr. Besides, only for eta, past levels of capital ratios (eta_{t-1}) take a positive sign.

Turning to risk equations, the only relevant differences appear to be the change in sign of past levels of risk, although not significant, and of liquidity coefficient (table 8). The latter takes a different sign

TABLE 7 Results for Capital Equations with Arellano-Bover/Blundell-Bond Regressions

Variable	dcap = dtrCR		dcap = dETA		dcap = dt1CR		
	a.1	a.2	b.1	b.2	c.1	c.2	
CONST	14.093***	14.882***	13.324***	9.889***	17.866***	17.933***	[19]
SIZE	0.392***	0.435***	−0.448***	−0.191**	−0.002	0.160*	
LIQ	0.006*	0.005*	0.001	0.004	0.006**	0.004	
ROA	0.038	0.038	0.181***	0.187***	0.153***	0.147***	
GDP	−0.084***	−0.079***	−0.014*	−0.008	−0.074***	−0.065***	
EFF	−0.014***	−0.140***	−0.016***	−0.014***	−0.013***	−0.014***	
REG2	0.024***	.025***	0.002***	0.003***	0.024***	0.025***	
CAP_{t-1}	−0.44***	−0.491***	0.370***	0.300***	−0.050***	−0.571***	
DRISK	0.005***	0.006***	0.000	0.001	0.004*	0.004**	
AD		−9.222***		5.555**		−15.934***	
UND		9.235		−113.728***		12.639	
R^2	0.014	0.014	0.06	0.009	0.016	0.012	
Obs.	3250	3250	3250	3250	3159	3159	

NOTES ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level. R^2 is calculated as the square of the correlation between the observed and the predicted, the latter calculated on the sample.

with significant, but very low coefficient for changes in t1CR. Finally, UND for undercapitalised banks takes a positive instead of a negative sign in all the specifications, suggesting that risk increases more in undercapitalised banks than in other banks.

CONCLUSIONS

This study investigates the decisions on capital and risk for a wide sample of European banks from 2006 to 2010, focussing on the impact of regulatory pressure. The topic has been deeply analysed by previous literature, however results are still controversial.

The main results suggest that banks tend to have a different behaviour depending on the type of capital ratio analysed. A positive relationship between total regulatory capital ratio and risk seems to exist, but the relationship becomes negative when controlling for changes in Tier 1 capital ratio or equity to total assets, which can be

TABLE 8 Results for risk equations with Arellano-Bover/Blundell-Bond regressions

Variable	trCR	trCR	ETA	ETA	t1CR	t1CR
CONST	2.177***	1.804***	1.735***	1.957***	1.892***	1.315***
SIZE	−0.093***	−0.065***	−0.064***	−0.082***	−0.075***	−0.031***
LIQ	0.000	−0.000	0.000	−0.000	0.000***	0.000
GDP	0.001***	0.002***	0.001***	0.002***	0.002***	0.002***
EFF	−0.000***	−0.000***	−0.000	−0.000	−0.000**	−0.000**
REG1	−0.023***	−0.022***	−0.020***	−0.020***	−0.019***	−0.019***
REG2	0.000***	0.000***	0.000***	0.002***	0.000***	0.000***
$RISK_{t-1}$	−0.000	−0.000	−0.000	−0.000	−0.000	−0.000
dtrCR	0.004***	0.004***				
DETA			0.010***	0.010***		
dt1cr					0.002***	0.002***
AD		−0.403***		−0.275***		−0.746***
UND		4.537**		24.759***		6.476***
R^2	0.017	0.005	0.021	0.003	0.023	0.001
Obs.	3250	3250	3250	3250	3159	3159

NOTES drisk = d(RWA/TA). ***, **, * respectively indicate statistical significance at 1%, 5% and 10% level. R^2 is calculated as the square of the correlation between the observed and the predicted, the latter calculated on the sample.

[20]

considered the ratios capturing the highest quality capital. Regulatory pressure has a relevant impact on banks' decisions, but it does not seem to have the desired effect on low capitalised banks. The aim of the regulation is to induce banks to take risks consistently with their capital base (and vice versa, having a capital base sufficient to compensate for their risk exposure), but low capitalised banks tend to have the opposite behaviour, increasing risk when their capital ratio decreases, approaching the minimum. The results therefore support the so-called 'gamble for resurrection' hypothesis, i.e. banks close to the minimum standards tend to increase their risk exposure in order to benefit from possible profits that in the end could be used to strengthen their capital base. It would be useful to determine a mechanism that enables the supervisor to intervene quickly and promptly in case of a drop in the capital ratio, in order to avoid

that banks with a low level of capital increase their risk in a way that could threaten the stability of the institution and of the whole financial system.

Overall, results support the existence of perverse incentives in banks' behaviour and the inability for the regulation to discipline banks' risk taking effectively. More transparency and a more homogeneous definition of capital as in Basel III can be an effective tool in controlling banks' capital and risk taking behaviour. The findings of this research have relevant policy implication with respect to the European supervisory and regulatory system. The European banking sector is facing the challenges of the financial crisis that especially hit the Euro-Mediterranean countries, which are traditionally more bank-centred and are also severely living the sovereign debt crisis. Given the regulatory revision that requires stricter regulation, it is important to understand the effects of capital requirement on banks' decisions, as the latter can influence their lending behaviour and, as a consequence, the availability of funds to families and firms, hence affecting the economic growth of the area. Constant and further research is needed to deeper investigate the behaviour of banks. [21]

NOTES

1 A bank is considered well capitalised if its average trCR is larger or equal to 10.5%; adequately capitalised if average trCR is equal or larger than 8%; undercapitalised if the average trCR is below the 8% regulatory threshold.
2 Results are omitted.
3 The value of R^2 for RISK is very small. The results should therefore be interpreted with care. It has to be acknowledge, in fact, that R^2 is not the most suitable measure for the goodness of fit in this case, but it has been indicated as other statistics are not applicable. J-stat, for example, can not be calculated because the system of equations is exactly identified.

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