

# BANK CAPITAL, RISK AND PERFORMANCE IN EUROPEAN BANKING: A CASE STUDY ON SEVEN BANKING SECTORS

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## Abstract

The aim of this paper is to evaluate the way in which capital influences profitability of banks and exposure to risk in seven European countries: Austria, Bulgaria, Greece, Italy, Romania, the Netherlands and Hungary. Based on previous studies, we developed a model of simultaneous equations to analyse the relation between capital, risk and performance. The model includes 68 banks and covers the period between 2006 and 2011. In addition, estimations have been made for the three capital ratios (own capital ratio, tier 1 ratio and capital adequacy ratio) for each country included in this study. The obtained results have revealed the existence of a negative relationship between capital and taken risks and a positive relationship between capital and profitability, as well as between risk and profitability.

**Keywords:** capital ratios, risk, profitability, European banks

**JEL Classification:** C33, G21, G28

## 1. Introduction

Capital regulation is one of the most important instruments of ensuring bank prudence and therefore its economic stability. This is why, as a result of recent financial crisis, regulating bodies have adopted new, stricter capital requirements - Basel III Framework. Both for specialized literature, authorities and also for specialists, concerns related to the adoption of new standards have been of utmost importance resulting in a series of empirical studies. However, the effects of adopting new measures of bank capital adequacy are difficult to quantify.

With the introduction of regulated capital, studies have focused on analysing the relationship between capital and risk, capital and profitability or risk and profitability. As one can notice, the relationship between these variables is usually analysed as a pair.

Taking all these aspects into consideration, our study aims to identify the way in which capital ratio influences the profitability of banks and their exposure to risks. Therefore, to assess the existent relationships between capital, risk and profitability, we have developed

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an economic model that analyses simultaneously the existent relationships between these variables. The system of simultaneous equations developed by Shrieves and Dahl (1992) has been used as a starting point. The analysed panel covers 68 banks from countries of the European Union, banks that are subject to the same capital adequacy. Countries included in the study are Austria, Bulgaria, Greece, Italy, Romania, the Netherlands and Hungary and it covers the period from 2006 to 2011.

Another contribution of this study is that it brings new evidence on the relationship among the three variables using a new set of data on European banks. Moreover, estimations have been made for the three capital ratios for each country included in the study. Therefore, this study offers a new insight into the influence of capital ratios on profitability and exposure to risks of banks.

The rest of the paper is structured as follows. Section 2 reviews literature on existing relationships among capital, risk and profitability. Section 3 describes the empirical model which includes a system of simultaneous equations for estimating the links among the three variables. Section 4 presents the empirical results and Section 5 the conclusions.

## 2. Literature Review

The adoption of Basel I Framework has been an important moment in the regulation of the activity of banks. The regulators imposed mandatory capital requirements designed to provide both a cushion during negative economic conditions and a mechanism to prevent banks from excessive risk taking. Thus, specialized literature tried to answer the question whether setting a minimum level would determine banks to reduce their exposure to risks. There are various theories that issue conflicting predictions about the influence of capital on profitability of banks and how banks should adjust their risk.

The results of these studies are contradictory (for example, the studies conducted by Shrieves and Dahl, 1992; Jacques and Nigro, 1997; Aggarwal and Jacques, 2001; Rime, 2001; Matejašák, Teplý and Černohorský, 2009; Jokipii and Milne, 2011).

According to the moral hazard theory, in the light of the capital regulation, banks will be forced to increase their capital and they will react by also increasing the allocation of risky assets.

Applying a system of simultaneous equations, Shrieves and Dahl (1992) have analysed the impact of capital regulation on the decision to take risk of 1800 American banks from 1983 to 1987. The result shows the existence of a positive relation between the changes of own capitals and risk. The positive relation has been also confirmed by studies conducted by Rime (2001) in Switzerland, Matejašák, Teplý and Černohorský (2009) in the USA and the EU-15 indicating that banks that have built up capital have, at the same time, also increased risk.

Shrieves and Dahl (1992) argue that the efficiency of capital regulations based on risk depends on how well the regulations reflect the real exposure of banks to risk, this being connected to a series of assumptions on the unintended effect of minimum capital requirements, regulation costs and manager's risk aversion. Thus, they show that, according to the bank bankruptcy cost avoidance theory, the banks will tend to increase their capital along with the function of the bankruptcy opportunity. Furthermore, according to the proposition of managerial risk aversion theory, in case of bank default, management will increase bank capital to avoid shareholders from suffering losses.

In contrast to these, Jacques and Nigro (1997) found a negative relation between changes in capital and risks. These showed that the introduction of banking capital

regulation in the USA led to high capital ratios and decrease in risk exposure of banks for both capitalized and under-capitalized banks.

The capital buffer theory suggests that banks tend to hold more capital than required as an attempt to avoid market discipline and supervisory intervention. Therefore banks with appropriate capital levels to the minimum capital requirements will increase their capital and lower their risk levels while banks with a large capital buffers will increase their levels of risk along with their capital buffer level.

Recent research conducted by Jokipii and Milne (2011) in some holdings and commercial banks in the US between 1986 and 2006 regarding capital buffers and adjustments for portfolio risks have shown the existence of a positive relation in two directions. Thus, highly capitalized banks adjust the capital reserve and risk in a positive way, while for other banks the result is negative.

The positive relationship between change in capital level and portfolio risk is also supported by agency theory that explains the different risk preferences between owners and managers. Saunders, Strock, and Travlos (1990) suggest an agency problem between managers who also hold capital of the bank and outside investors, who only hold capital without being managers. Bank loan portfolios seem to be less risky when managers own a sufficient fraction of the bank's equity and more risky when banks are controlled by their outside stockholders.

The implications of banking capital regulation are complex and not easy to quantify. Therefore, other studies have focused on analysing the link between capital regulation and profitability and between taking risks and profitability.

Profitability may have a positive effect on bank level capital if banks increase their capital through retained earnings rather than through equity issues. The positive relationship between capital and profitability is confirmed by: Berger (1995), Jacques and Nigro (1997), Demirgüç-Kunt and Huizinga (1999). But a rise in capital ratio increases equity and therefore may reduce expected return required by investors from where the negative relationship is obtained.

Molyneux and Thornton (1992) discovered that capital ratio influences performance of banks in a positive way, even though such a relation is limited only to state banks. Berger (1995) analysing the relation between return on own capital and capital ratio in some US banks between 1983–1992 notices a constant positive relation in the 1980s but not at the beginning of the 1990s. On the other hand, Goddard, Molyneux, and Wilson (2004) analysing the growth dynamics and the profitability of the European banking system from 1992 to 1998 notice that banks that maintain a high capitals or current ratio tend to have a relatively low return on capital and slow growth. In Egypt, Naceur and Kandil (2009) analyse effects of capital adequacy for two specific indicators of performance: cost of intermediation and profitability. They show that an increase of capital determines a growth of the intermediation cost and results in higher profitability of assets and capital with effects that are not sustainable on long term. Trujillo-Ponce (2012) examining profitability of banks in Spain, from 1999 to 2009, concludes that higher capitalization had a positive impact on the average return of assets and a negative impact on the average return of capital.

On the other hand, if capital is regarded as expensive due to capital market imperfections and fiscal advantages of debt, banks will have incentives to take more risks

to generate a higher return on equity, the higher the capital. Athanasoglou, Brissimis and Delis (2005) observe that the capital influences the profitability of Greek banks between 1985–2001, but with increasing exposure to credit risk profits are reduced. Comparing performance and risks on 181 big banks of the EU-15 between 1999 and 2004, Iannota, Nocera and Sironi (2007) conclude that state capital banks are less profitable and have a higher degree of risk than banks with other type of ownership.

While the above mentioned studies focused mainly on the relation between capital and risk, capital and profitability or risk and profitability, we notice that there are few studies that underline the relations among the three variables: capital, risk and profitability. Just after the recent financial crisis, researchers have started to be concerned with the analyses of these. The first study was conducted by Kwan and Eisenbeis (1995) that confirms that the three variables are estimated simultaneously. Thus, they show that both efficiency and capital are relevant determining factors in assuming risks and moral hazard. Altunbas, Carbo, Gardener and, Molyneux (2007) found that inefficient European banks own more capital and take lower risks. In the case of cooperative banks, the conclusions show that the capital is inversely proportional to risks and that inefficient banks own lower levels of capital. For commercial banks, the results show a positive relation between risks and capital.

Results obtained by Deelchand and Padgett (2009) on 263 Japanese cooperative banks confirm the belief that risk, capital and inefficiency are estimated simultaneously. These determine the existence of a negative relation between risk and capital showing that inefficient Japanese cooperative banks seem to operate with higher capital and take more risks. Fiordelisi, Marques-Ibanez and Molyneux (2010) analysing 26 EU banks between 1995–2007 find that low levels of efficiency suggest higher future risks but the improvement of bank efficiency tends to consolidate capital levels of banks. Tahir and Mongid (2013) state that in the case of ASEAN banks, the efficiency of banking costs is the basis for bank capital and risk taking. Also, Tan and Floros (2013) evaluated the relation among efficiency, risk and capital for a set of Chinese commercial banks. The results show the existence of a positive relation between risk and efficiency, while the relation between risk (Z-score) and capitalization is negative.

### **3. Data and Methodology**

#### **3.1 Data**

Data for the empirical model on gross domestic product (GDP) and consumer price index (CPI) have been obtained from the Eurostat database and on bank indicators from Bankscope Bureau van Dijk and they cover the period between 2006–2011.

The countries included in the study were: Romania, Austria, Bulgaria, Greece, Italy, the Netherlands and Hungary. The principle that was used for the selection of these countries was the presence of foreign capital in the Romanian banking system. Thus, the first 5 countries with shares in the Romanian banking system were selected for 2011, to which we added Bulgaria for comparability.

Out of these countries, just the first 15 banks were selected depending on the size of their assets. Nevertheless, due to incomplete data, just 68 banks were included in the analysis. These banks include commercial banks, holdings, saving houses, mortgage and cooperative banks.

**Table 1 | Descriptive Statistics**

	year	RISK	CAR	E/A	TIER 1	ROAA	NIM	CIR	In Assets	NPL	PLL
<b>Mean</b>	2006	0.66	13.91	8.73	11.04	1.18	3.55	61.07	16.03	4.61	0.45
	2007	0.67	12.89	8.42	10.19	1.31	3.45	59.37	16.29	4.32	0.49
	2008	0.68	13.82	8.97	11.18	0.97	3.49	65.72	16.42	4.70	0.74
	2009	0.64	15.76	9.93	13.35	0.34	3.21	61.64	16.43	7.77	1.48
	2010	0.64	15.82	10.09	13.56	3.06	3.25	62.38	16.43	10.57	1.69
	2011	0.65	14.95	9.52	12.59	-1.22	3.08	68.04	16.42	13.56	2.08
<b>Median</b>	2006	0.67	12.32	7.85	9.00	0.98	3.12	60.92	16.00	2.67	0.35
	2007	0.68	12.17	7.85	9.20	1.08	2.94	58.72	16.18	2.90	0.40
	2008	0.68	12.32	7.54	9.15	0.86	3.03	62.40	16.34	3.20	0.53
	2009	0.68	13.34	8.63	10.55	0.36	2.85	56.57	16.25	6.56	1.24
	2010	0.66	13.33	8.69	10.90	0.51	2.92	58.34	16.27	8.93	1.16
	2011	0.67	13.69	7.83	10.95	0.14	2.89	59.87	16.23	11.13	1.23
<b>Min</b>	2006	0.15	5.89	1.82	4.09	-2.15	0.36	20.89	10.94	0.00	-1.16
	2007	0.22	7.04	2.04	5.34	-1.07	0.28	22.74	11.69	0.00	-0.70
	2008	0.17	4.5	1.39	3.4	-1.72	0.34	22.37	12.31	0.02	-0.13
	2009	0.17	9.17	2.19	6.9	-3.67	0.34	16.25	12.83	0.03	0.00
	2010	0.17	9.1	2.33	6.7	-9.03	0.29	14.47	12.86	0.04	-0.01
	2011	0.14	-5	-3.93	-6	-21.1	0.2	14.35	12.76	0.03	0.01
<b>Max</b>	2006	1.32	33.01	35.48	34.22	6.53	9.7	100.5	20.71	51.45	2.96
	2007	1.31	37.94	23.06	30.67	9.79	9.04	113.25	20.75	58.46	2.52
	2008	1.21	58.67	53.82	58.67	5.82	8.92	322.41	20.77	51.00	2.94
	2009	1	90.37	68.93	90.37	2.33	7.82	323.37	20.65	63.86	5.42
	2010	1.05	65.66	48.19	65.66	22.62	7.51	326.85	20.65	45.45	9.86
	2011	1.27	59.78	54.68	59.78	2.22	7.26	346.19	20.68	51.67	13.95

Source: author's calculations

## 3.2 Methodology

As we have seen, the specialized literature analyses in pairs the variables under discussion: the capital, profitability and risk. This study starts from the idea that simultaneous equations developed by Shrives and Dahl (1992) which analyse the relation between

the level of capital and risk. Contrary to this approach, we will extend the model in order to analyse simultaneously the three variables: the capital, profitability and risk.

$$\Delta PROF_{i,t} = a_0 + a_1 \Delta CAP_{i,t} + a_2 PROF_{i,t-1} + a_3 \Delta RISK_{i,t} + a_4 NIM_{i,t} + a_5 GDP + a_6 CPI + a_7 CIR_{i,t} + a_8 \ln Assets_{i,t} + \varepsilon_1 \quad (1)$$

$$\Delta RISK_{i,t} = b_0 + b_1 \Delta PROF_{i,t} + b_2 \Delta CAP_{i,t} + b_3 RISK_{i,t-1} + b_4 NPL_{i,t} + b_5 LLP + b_6 \ln Assets_{i,t} + \varepsilon_2 \quad (2)$$

$$\Delta CAP_{i,t} = c_0 + c_1 \Delta PROF_{i,t} + c_2 \Delta RISK_{i,t} + c_3 CAP_{i,t-1} + c_4 NPL_{i,t} + c_5 LLP + c_6 \ln Assets_{i,t} + \varepsilon_3 \quad (3)$$

where subscripts  $i, t$  denote bank  $i$ , and year  $t$ .

### 3.2.1 Dependent variables

*Capital (CAP)*: capital is represented by capital ratios subject to bank regulation: own capital ratio / first degree own capital ratio / capital adequacy of capital.

*Risk (RISK)*: Defining bank risk is difficult, specialized literature offers a set of alternatives, all are subject to criticism. In this study, we opted for a relation between risk-weighted assets and total assets. This measure of risk is used in the studies of Shrieves and Dahl (1992), Jacques and Nigro (1997), Aggarwal and Jacques (2001), as well as by regulating bodies in compiling guidelines in capital.

*Profitability (PROF)*: The most common measure of bank performance is profitability, generally expressed by ROA and ROE. Our study using RO(A)A takes into account that banks struggle to improve their profitability in order to raise capital.

### 3.2.2 Selection of variables specific to banks

*Bank size (in assets)*: is given by the value of assets, our study uses as an indicator natural logarithms of total assets.

This variable is important as the assets are closely connected to capital. A bank with a huge level of assets can easily diversify its portfolio and, therefore, reduce its risk exposure. Also, this variable covers the size of savings and diseconomies of scale.

*Net interest margin (NIM)*: expresses the ability of a bank to cover the costs of intermediation. A low margin can reflect high expenses with interests due to dependency on short-term liabilities and a prudent attitude of bank resulting in lower interest income. A high value of this indicator can be a result if there is a significant spread of interest between bonus interest of attracted resources and the interest on loans. Also, a high net interest margin can be the result of an increased volume of given loans, reflected in a higher share of interest income. In this case, we can assume that banks adopt a risky behaviour.

*Provisions for loan losses (LLP)*: This indicator can also be used as a proxy for the quality of assets. Provisions are used to cover recorded or anticipated losses. If loss increases, banks will have to allocate additional capital to reduce risk exposure.

*Non-performing loans ratio (NPL)*: NPL ratio in total loans reflects the quality of loan portfolio in bank balance expressing at the same time bank's ability to distribute risks and recover outstanding loans.

*Cost/Income Ratio (CIR)*: Ratio of operating expenses to operating income expresses the ability of banks to control operating costs being an indicator that measures the quality management. The lower the values of CIR, the higher the banks efficiency.

*Factors of macroeconomic determinants*: to capture the effect of macroeconomic environment on banks, we have used the annual growth ratio of the gross national product from each country (GDP), as well as the inflation ratio for each country measured by means of consumer price index (CPI).

It is considered that during economic growth the demand for loans grows and therefore the profit of banks grows. The level of non-performing loans decreases during this period and lending criteria are more relaxed.

Also, high rates of inflation are associated with high interest rates and, therefore, with higher income. If banks do not react to inflation and do not adjust their interest rates then profitability may take a downturn.

## 4. Empirical Results

Estimation of the model was carried out by means of system fit package available in R using SUR estimation, developed by Zellner (1962). The method analyses a system of simultaneous equations between capital, risk and profitability. Equations are estimated using the three capital ratios (own capital ratio, tier 1 ratio and capital adequacy ratio) obtaining sets of results for each equation.

The results of profitability (Equation (1)) at the country level for the three types of capital ratios are presented in the Table 2 and 3.

Analysing the variables of the equation for each country, we can see that capital has a significant impact on the profitability of banks in case of Hungary, the Netherlands and Greece measured by ROAA (*i.e.* return on average assets). Also in case of Romania, it is positive for own capital ratio and the capital adequacy but it is insignificant statistically. These results are similar to those of Berger (1995), Athanasoglou, Brissimis and Delis (2005) and Staikouras and Wood (2004). According to Barrell, Davis, Fic and Karim (2011), a positive impact on bank performance underlines the benefits of high level of bank regulation.

The positive relationship between capital and profitability is not surprising and implies that high profitability may drive higher capital ratios since profits are a source of capital.

In case of Austria, the relation is significantly negative for all three capital ratios. Negative relations mean that banks consider the current capital being higher than the optimal, therefore any increase of bank capital should result in a negative return.

In case of Bulgaria and Italy, the results are mixed meaning that the relation is a positive in case of capital adequacy ratio and own capital ratio, and inverse for the other ratio.

Regarding the relation between profitability and risk, we observe that in case of Romania, the relation is positive and statistically significant for all three capital ratios. This result indicates the fact that Romanian banks take risks in order to generate profit. Also, in case of Hungary and Bulgaria, we observe a positive relation contrary to Austria, Greece and Italy, where the relation is negative but generally statistically insignificant. The positive relation is consistent with Saunders, Strock, and Travlos (1990) and

Altunbas, Carbo, Gardener and, Molyneux (2007) who found a positive relation between the efficiency of the banks and their risk. In case of Austria, Greece and Italy who have a matured banking market, the negative results can be related to market structure, which refers to the degree of market concentration. Thus, profitability is determined by capital and size meaning that more capital is required.

**Table 2 | Estimating Profitability Equation at the Country Level**

Dependent Variable $\Delta$ PROF													
		Hungary			Netherlands			Bulgaria			Austria		
Variable	Coefficient	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR
constant	$a_0$	0.931	2.563	3.320	-0.173	0.024	-0.066	-1.912	-1.049	-1.950	2.267	2.840	3,755
	std.error	4.470	4.257	4.320	0.711	0.946	1.138	2.718	2.337	2.704	2.603	2.517	2,614
$\Delta$ CAP <sub>it</sub>	$a_1$	0.209	0.087 <sup>*</sup>	0.112 <sup>*</sup>	0.694 <sup>***</sup>	0.302 <sup>***</sup>	0.221 <sup>***</sup>	-0.052	-0.205 <sup>***</sup>	0.008	-0.013	-0.158 <sup>***</sup>	-0,209 <sup>***</sup>
	std.error	0.177	0.045	0.062	0.085	0.051	0.058	0.067	0.054	0.048	0.155	0.091	0,107
PROF <sub>it-1</sub>	$a_2$	-0.287	-0.298	-0.332	-0.303 <sup>***</sup>	-0.127	-0.213	-0.660 <sup>***</sup>	-0.679 <sup>***</sup>	-0.635 <sup>***</sup>	-0.827 <sup>***</sup>	-0.877 <sup>***</sup>	-0,892 <sup>***</sup>
	std.error	0.207	0.203	0.212	0.136	0.172	0.215	0.127	0.104	0.119	0.142	0.138	0,139
$\Delta$ RISK <sub>it</sub>	$a_3$	0.594	1.774	2.001	-3.051 <sup>***</sup>	1.638	1.801	2.319 <sup>***</sup>	0.845	2.090	-0.559	-0.841	-2,549 <sup>***</sup>
	std.error	1.337	1.384	1.436	0.771	1.071	1.350	1.201	1.068	1.297	0.953	0.929	1,320
NIM <sub>it</sub>	$a_4$	0.112	0.165	0.180	0.070	0.052	0.067	0.045	-0.128	0.074	0.208	0.236 <sup>*</sup>	0,250 <sup>*</sup>
	std.error	0.171	0.170	0.173	0.050	0.066	0.079	0.126	0.115	0.121	0.145	0.137	0,138
GDP	$a_5$	-0.012	-0.036	-0.025	0.041	0.045	0.022	0.075 <sup>**</sup>	0.012	0.084 <sup>**</sup>	0.095	0.062	0,064
	std.error	0.057	0.056	0.056	0.025	0.032	0.040	0.037	0.035	0.035	0.062	0.063	0,064
CPI	$a_6$	0.332 <sup>**</sup>	0.360 <sup>***</sup>	0.335 <sup>**</sup>	-0.077 <sup>***</sup>	-0.276 <sup>***</sup>	-0.159	0.009	0.050	0.005	-0.067	-0.085	-0,143
	std.error	0.148	0.147	0.146	0.103	0.127	0.167	0.046	0.040	0.046	0.166	0.144	0,152
CIR <sub>it</sub>	$a_7$	-0.025	-0.044 <sup>*</sup>	-0.038	0.000 <sup>*</sup>	0.001	-0.002	-0.014	-0.029 <sup>***</sup>	-0.011	-0.009 <sup>***</sup>	-0.009 <sup>***</sup>	-0,009 <sup>***</sup>
	std.error	0.027	0.022	0.022	0.004	0.006	0.007	0.013	0.011	0.011	0.002	0.002	0,002
Ln Assets <sub>it</sub>	$a_8$	-0.123	-0.185	-0.241	0.003	0.000	0.013	0.210	0.260 <sup>**</sup>	0.189	-0.101	-0.127	-0,174
	std.error	0.294	0.287	0.293	0.038	0.051	0.061	0.163	0.142	0.164	0.151	0.146	0,150
Observations		35	35	35	45	45	45	55	55	55	45	45	45
R-squared		0.265	0.282	0.268	0.686	0.442	0.198	0.640	0.727	0.642	0.701	0.715	0.695
Adjusted R-squared		0.014	0.008	0.011	0.605	0.299	0.009	0.560	0.666	0.563	0.587	0.607	0.579
McElroy-R2 (system)		0.306	0.482	0.557	0.737	0.755	0.832	0.567	0.655	0.730	0.624	0.687	0.881

Source: author's calculations (significance of 99%, 95%, 90% is indicated by \*\*\*/\*\*/\*)

Net interest margin has a negative relation in case of Romania and Greece, contrary to other countries which have a positive relation. This means that the two countries have reduced significantly their margins, thus the ability of banks to earn net interest income with their interest-earning assets and their ability to generate profit with their total assets have been decreasing.

**Table 3 | Estimating Profitability Equation at the Country Level**

Dependent Variable $\Delta$ PROF										
		Greece			Romania			Italy		
Variable	Coefficient	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR
constant	$a_0$	0.070	1.125	1.038	20.216	22.645	21.114	2.550 <sup>*</sup>	1.968	2.119
	std.error	5.843	5.677	5.712	27.618	26.566	26.278	1.308	1.390	1.373
$\Delta CAP_{it}$	$a_1$	0.292 <sup>***</sup>	0.284 <sup>***</sup>	0.275 <sup>***</sup>	0.081	-0.050	0.246	0.161 <sup>***</sup>	-0.127 <sup>**</sup>	-0.159 <sup>**</sup>
	std.error	0.093	0.079	0.079	0.379	0.239	0.239	0.057	0.065	0.060
PROF <sub>it-1</sub>	$a_2$	-0.083	-0.096	-0.091	-1.359 <sup>***</sup>	-1.350 <sup>***</sup>	-1.358 <sup>***</sup>	-0.113	-0.243	-0.279
	std.error	0.281	0.277	0.279	0.140	0.135	0.137	0.173	0.186	0.188
$\Delta RISK_{it}$	$a_3$	-7.160 <sup>**</sup>	-2.133	-1.707	16.989 <sup>**</sup>	16.383 <sup>*</sup>	20.743 <sup>**</sup>	-0.971	-0.302	-0.195
	std.error	2.679	2.738	2.778	7.961	8.518	8.496	0.901	0.926	0.911
NIM <sub>it</sub>	$a_4$	-1.217	-1.116	-1.066	-0.425	-0.339	-0.385	-0.029	0.065	0.048
	std.error	0.732	0.722	0.726	0.773	0.772	0.773	0.091	0.091	0.090
GDP	$a_5$	0.495 <sup>***</sup>	0.452 <sup>***</sup>	0.473 <sup>***</sup>	-0.252	-0.246	-0.211	0.056 <sup>*</sup>	0.042	0.031
	std.error	0.107	0.107	0.107	0.202	0.202	0.209	0.028	0.031	0.032
CPI	$a_6$	0.344	0.324	0.268	0.469	0.494	0.338	-0.161 <sup>**</sup>	-0.189 <sup>**</sup>	-0.144 <sup>*</sup>
	std.error	0.313	0.308	0.310	1.021	1.009	1.065	0.079	0.083	0.083
CIR <sub>it</sub>	$a_7$	-0.039	-0.036	-0.035	-0.106	-0.116	-0.104	-0.002	-0.001	-0.001
	std.error	0.039	0.039	0.039	0.095	0.090	0.091	0.002	0.002	0.002
Ln Assets <sub>it</sub>	$a_8$	0.264	0.170	0.177	-0.534	-0.695	-0.563	-0.117	-0.092	-0.102
	std.error	0.262	0.250	0.252	1.433	1.350	1.343	0.070	0.074	0.073
Observations		50	50	50	57	56	57	50	50	50
R-squared		0.516	0.511	0.509	0.721	0.719	0.726	0.328	0.240	0.226
Adjusted R-squared		0.422	0.416	0.414	0.673	0.671	0.679	0.197	0.091	0.075
McElroy-R2 (system)		0.582	0.723	0.731	0.589	0.618	0.699	0.318	0.303	0.422

Source: author's calculations (significance of 99%, 95%, 90% is indicated by \*\*\*/\*\*/\*)

Regarding the two macroeconomic variables used, namely, the annual growth ratio of GDP and the rate of inflation measured by CPI, we notice that the relation between profitability and the annual growth ratio of GDP is negative in Romania, while the inflation relation is positive. We find the same relation in case of Greece, while in case of the Netherlands, Austria and Italy we find an inverse relation, that is negative for inflation and positive for the annual growth ratio of GDP. In case of Bulgaria and Greece, the relation is positive for both variables. Inflation rate and GDP growth rate affect the bank profitability depending on economic conditions prevailing in that country. In case of the Netherlands, Austria and Italy having a matured financial market the positive relation shows that rapid economic growth increases profitability. This result is consistent with the results of previous research (Demirgüç-Kunt and Huizinga, 1999). Also, a negative

relation between inflation and profitability means that the banks that have not anticipated inflation would not adjust rates timely, and the overhead costs would rise quicker than the inflation resulting in poor profits.

Finally, the relation between profitability and cost efficiency is negative for all analysed countries. Poor expenses management is the main contributor to poor profitability. The result is in line with the study of Kosmidou, Pasiouras, Doumpos and Zopounidis (2006), Pasiouras and Kosmidou (2007), Trujilo-Ponce (2012).

And also the size of bank measured by means of the volume of assets has different results. Thus, for Hungary, Austria, Romania and Italy the relation is negative being in line with the results of Naceur (2003). The result can be explained by economies of scale. For the Netherlands, Bulgaria and Greece, the relation is positive, similar to the results of Iannotta, Nocera, and Sironi (2007). The results of the risk (Equation (2)) by country for all three types of capital ratios are presented in the Table 4 and Table 5.

**Table 4 | Estimating Risk Equation at the Country Level**

Dependent Variable $\Delta$ RISK													
		Hungary			Netherlands			Bulgaria			Austria		
Variable	Coefficient	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR
constant	$b_0$	0.046	0.147	0.011	0.110	0.199	0.137	0.131	0.087	0.017	0.272	0.407	0.802**
	std.error	0.551	0.524	0.513	0.166	0.168	0.166	0.193	0.187	0.181	0.441	0.446	0.377
$\Delta \text{ PROF}_{it}$	$b_1$	0.040	0.064	0.070	-0.101***	0.060**	0.040*	-0.007	-0.023	-0.018	-0.017	-0.006	0.007
	std.error	0.054	0.047	0.046	0.030	0.025	0.022	0.013	0.014	0.013	0.022	0.020	0.017
$\Delta \text{ CAP}_{it}$	$b_2$	-0.001	-0.012*	-0.019**	0.098***	-0.034***	-0.029***	-0.002	-0.011**	-0.018***	0.012	-0.017	-0.053***
	std.error	0.021	0.006	0.008	0.025	0.010	0.007	0.006	0.005	0.004	0.020	0.013	0.010
$\Delta \text{ RISK}_{it-1}$	$b_3$	-0.371**	-0.326**	-0.279**	-0.142*	-0.172	-0.136*	-0.357***	-0.352***	-0.290***	-0.409***	-0.416***	-0.227***
	std.error	0.135	0.130	0.129	0.080	0.081	0.078	0.091	0.088	0.082	0.096	0.094	0.078
$\text{NPL}_{it}$	$b_4$	-0.002	-0.005	-0.007	0.009	-0.010**	-0.009	-0.008***	-0.007**	-0.007**	0.002	0.002	0.006
	std.error	0.007	0.006	0.006	0.009	0.009	0.009	0.003	0.003	0.003	0.005	0.005	0.004
$\text{LLP}_{it}$	$b_5$	0.068	0.083*	0.083*	0.019	0.044	0.035	0.005	0.007	-0.003	0.001	0.031	0.092**
	std.error	0.056	0.048	0.047	0.033	0.034	0.033	0.017	0.016	0.016	0.039	0.039	0.033
$\text{Ln Assets}_{it}$	$b_6$	0.008	0.001	0.008	-0.006	-0.005	-0.003	0.014	0.015	0.018	-0.002	-0.010	-0.042*
	std.error	0.036	0.035	0.034	0.008	0.008	0.008	0.015	0.015	0.014	0.025	0.025	0.022
Observations		35	35	35	45	45	45	55	55	55	45	45	45
R-squared		0.287	0.339	0.349	0.225	0.208	0.185	0.502	0.548	0.549	0.444	0.464	0.588
Adjusted R-squared		0.101	0.167	0.179	0.084	0.064	0.037	0.423	0.477	0.478	0.299	0.324	0.481

Source: author's calculations (significance of 99%, 95%, 90% is indicated by \*\*\*/\*\*/\*)

Variables of risk equation show that capital has a significantly negative impact in most analysed cases. So, growth of one per cent of the capital adequacy ratio leads in case of Romania to a decrease by 0.01 of risk-weighted assets to total assets. This could

mean that banks maintain the same capital decreasing risky assets in order to fulfill the minimum capital requirements or they diversify their product and services portfolio.

Another explanation as suggested by Shrieves and Dahl (1992) is that a negative relationship may exist between capital and risk adjustments if banks seek to exploit the deposit insurance subsidy.

Profitability has a positive relation but it is insignificant in case of Romania, Hungary and the Netherlands and negative in case of Bulgaria, Austria, Greece and Italy.

Regarding non-performing loans ratio, in case of Romania we have not found a connection, while the provisions for non-performing loans have a negative relation, statistically significant only in case of own capital. In general, the two variables have no significant relations. Hungary and Italy are exceptions with a negatively significant relation in case of non-performing loans and Hungary and Italy have a significant positive relation in case of provisions for non-performing loans.

**Table 5 | Estimating Risk Equation at the Country Level**

Dependent Variable $\Delta$ RISK										
		Greece			Romania			Italy		
Variable	Coefficient	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR
constant	$b_0$	0.600***	0.839***	0.826***	0.343	0.324	0.258	0.085	0.084	0.113
	std.error	0.224	0.233	0.232	0.239	0.234	0.229	0.234	0.236	0.239
$\Delta$ PROF <sub>it</sub>	$b_1$	-0.015*	-0.001	0.000	0.002	0.002	0.002	-0.017	0.000	-0.005
	std.error	0.009	0.009	0.009	0.001	0.001	0.001	0.024	0.022	0.023
$\Delta$ CAP <sub>it</sub>	$b_2$	0.015***	-0.007	-0.008	0.004	-0.007**	-0.010***	0.018*	-0.011	-0.014
	std.error	0.005	0.005	0.004	0.005	0.003	0.003	0.009	0.009	0.008
$\Delta$ RISK <sub>it-1</sub>	$b_3$	-0.658***	-0.588***	-0.564***	-0.493	-0.413***	-0.409***	-0.151**	-0.206***	-0.219***
	std.error	0.158	0.177	0.178	0.109	0.111	0.104	0.072	0.075	0.079
NPL <sub>it</sub>	$b_4$	-0.001	-0.002	-0.002	0.000	0.000	0.000	-0.006*	-0.007**	-0.007**
	std.error	0.003	0.003	0.003	0.001	0.001	0.001	0.003	0.003	0.003
LLP <sub>it</sub>	$b_5$	0.010	0.016	0.016	-0.019*	-0.014	-0.004	0.099	0.150**	0.147**
	std.error	0.011	0.011	0.011	0.011	0.010	0.010	0.068	0.068	0.068
Ln Assets <sub>it</sub>	$b_6$	-0.009	-0.026**	-0.026**	0.002	-0.001	0.002	-0.002	-0.001	-0.001
	std.error	0.010	0.010	0.010	0.015	0.015	0.015	0.012	0.013	0.013
Observations		50	50	50	57	56	57	50	50	50
R-squared		0.393	0.295	0.292	0.366	0.384	0.401	0.196	0.192	0.194
Adjusted R-squared		0.308	0.196	0.193	0.288	0.308	0.327	0.084	0.079	0.082

Source: author's calculations (significance of 99%, 95%, 90% is indicated by \*\*\*/\*\*/\*)

The size of the bank shows an insignificant positive relation in case of Hungary, Bulgaria and Romania and a negative one in case of the Netherlands, Austria, Greece and Italy. The negative relation between size and risk suggests that higher equity banks take

on lower levels of risk. Also, this can be justified by diversification as it is assumed that big banks will have lower risks being able to have diversified portfolios.

Results of the Equation 3 of capital changes for all three types of capital ratios are presented in the Table 6 and 7.

The measured impact on profitability is positive for Austria and statistically significant for Hungary, the Netherlands and Greece. In case of Romania, it is negative. The same is found in case of Bulgaria and Italy, though insignificant statistically.

As we have expected, the relation between capital and risk is significantly negative statistically for all the countries, except for Italy, in case of own capital ratio and tier 1 ratio, which means banks that take a high risk also have high capital.

Regarding the relation between capital and the quality of assets, we observe a significant positive relation for LLP in case of Romania and Austria. NPL has also a positive relation in case of Romania together with Bulgaria and Austria.

**Table 6 | Estimating Capital Equation at the Country Level**

Dependent Variable $\Delta CAP$										
		Greece			Romania			Italy		
Variable	Coefficient	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR
constant	$c_0$	9.177	13.495	15.747	15.471	6.342	11.861	4.382	2.296	0.757
	std.error	8.447	9.189	9.484	10.551	10.877	8.537	3.808	4.432	4.250
$\Delta PROF_{i,t}$	$c_1$	0.922***	0.855***	0.830***	-0.015	-0.001	0.010	-0.865**	-1.200***	-1.311**
	std.error	0.308	0.304	0.301	0.047	0.050	0.041	0.372	0.426	0.429
$\Delta RISK_{i,t}$	$c_2$	-4.073	-11.300**	-11.610**	-11.083**	-13.461**	-12.291***	0.592	0.798	-0.633
	std.error	4.537	4.498	4.485	4.688	5.289	4.169	2.361	2.814	2.847
$CAP_{i,t-1}$	$c_3$	0.009	-0.032	-0.061	-0.695***	-0.270*	-0.526***	-0.274***	-0.160	-0.057
	std.error	0.102	0.094	0.102	0.202	0.152	0.106	0.073	0.123	0.100
$NPL_{i,t}$	$c_4$	-0.003	-0.008	-0.021	0.007	-0.008	0.030	-0.081	-0.011	0.000
	std.error	0.115	0.111	0.110	0.039	0.042	0.035	0.050	0.053	0.053
$LLP_{i,t}$	$c_5$	0.282	0.239	0.251	1.137***	1.096**	0.599*	1.131	-0.799	-0.464
	std.error	0.366	0.357	0.356	0.402	0.449	0.355	0.969	1.005	0.994
$\ln Assets_{i,t}$	$c_6$	-0.524	-0.745	-0.848*	-0.730	-0.359	-0.355	-0.115	-0.017	0.013
	std.error	0.458	0.490	0.495	0.636	0.671	0.529	0.207	0.234	0.239
Observations		50	50	50	57	56	57	50	50	50
R-squared		0.260	0.256	0.259	0.381	0.279	0.506	0.327	0.103	0.061
Adjusted R-squared		0.156	0.152	0.156	0.305	0.191	0.446	0.234	0.022	0.070

Source: author's calculations (significance of 99%, 95%, 90% is indicated by \*\*\*/\*\*/\*)

Loan losses have a positive effect on capital because if losses increase, banks will increase regulatory capital to reduce the risk (Athanasoglou, 2011). On the other hand, loan loss provisions lower a nominal amount of the risk-weighted assets and therefore it is expected to negatively affect bank risk.

The size of the bank has a negative impact in case of Austria, Greece, Romania and Italy, and a positive impact in case of Hungary, the Netherlands and Bulgaria. The negative relation between risk and size is found in countries with a matured banking market and which have easier access to capital markets and therefore they can operate with lower amounts of capital, except Romania, which has to face fierce competition.

**Table 7 | Estimating Capital Equation at the Country Level**

Dependent Variable $\Delta$ CAP													
		Hungary			Netherlands			Bulgaria			Austria		
Variable	Coefficient	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR	E / A	Tier 1 ratio	CAR
constant	$c_0$	-3.091	6.500	3.286	-1.110	-0.580	1.038	-5.237	-5.103	-1.789	10.933*	13.098**	14.195***
	std.error	13.967	12.609	11.192	3.561	3.205	3.526	6.529	6.238	5.961	5.659	5.177	5.632
$\Delta$ PROF <sub>it</sub>	$c_1$	1.990	2.077*	2.590**	1.326***	1.679***	1.638***	-0.821**	-0.973**	-0.530	0.291	0.228	0.230
	std.error	1.168	1.022	0.985	0.449	0.423	0.425	0.397	0.434	0.403	0.257	0.246	0.247
$\Delta$ RISK <sub>it</sub>	$c_2$	-8.982**	-8.376**	-7.926*	-4.643**	-11.486***	-12.146***	-8.533*	-10.441**	-14.169***	-8.091***	-8.131***	-9.220***
	std.error	4.269	4.030	3.845	3.224	3.203	3.056	4.226	4.298	4.018	2.033	1.934	2.022
CAP <sub>it-1</sub>	$c_3$	-0.076	-0.238*	-0.512**	-0.020	-0.007	-0.099	0.001	0.059	-0.195	-0.181	-0.299	-0.114
	std.error	0.375	0.135	0.214	0.121	0.094	0.115	0.138	0.156	0.132	0.169	0.175	0.118
NPL <sub>it</sub>	$c_4$	-0.248	-0.249*	-0.346**	-0.171	-0.157	-0.201	0.024	0.009	-0.062	0.083	0.091	0.103
	std.error	0.148	0.133	0.131	0.179	0.171	0.173	0.096	0.098	0.094	0.073	0.066	0.065
LLP <sub>it</sub>	$c_5$	1.651	1.637	2.357**	0.202	0.110	0.193	-0.363	-0.351	0.033	1.698***	1.597***	1.553***
	std.error	1.257	1.081	1.062	0.666	0.664	0.649	0.537	0.519	0.561	0.465	0.444	0.450
Ln Assets <sub>it</sub>	$c_6$	0.257	-0.222	0.217	0.117	0.083	0.064	0.398	0.348	0.368	-0.634	-0.675**	-0.809**
	std.error	0.981	0.779	0.708	0.179	0.163	0.160	0.498	0.422	0.410	0.353	0.310	0.303
Observations		35	35	35	45	45	45	55	55	55	45	45	45
R-squared		0.254	0.357	0.424	0.301	0.252	0.281	0.212	0.205	0.250	0.630	0.655	0.629
Adjusted R-squared		0.059	0.190	0.274	0.174	0.115	0.150	0.087	0.079	0.132	0.533	0.565	0.532

Source: author's calculations (significance of 99%. 95%. 90% is indicated by \*\*\*/\*\*/\*)

## 5. Conclusion

This paper contributes to specialized literature by the empirical analysis of the influence of capital on profitability of banks and their exposure to risk. We have adopted a model of simultaneous equations, in which capital, risk and profitability are included in dependent variables.

The model has been applied to 68 EU banks (Austria. Bulgaria. Greece. Italy. Romania, the Netherlands and Hungary) for the period from 2006 to 2011. A special contribution has been brought by the measurements for simultaneous equations for the three capital ratios: equity capital ratio, tier 1 ratio and capital adequacy ratio.

The evidence reveals differences between these seven banking sectors, during the sample period. These differences reflect different market conditions.

Our results show there is a negative relation between the capital and the taken risks for all countries. The negative relation between capital and risks, when we consider taking moral risks, means that an increase in the riskiness of bank asset portfolio erodes the bank capital. Therefore, banks would reduce their riskiness in order to increase capital.

Profitability seems to have a significant positive influence on capital in the Netherlands. Greece and Hungary as well as between risk and profitability in the Netherlands. Hungary and Romania.

The positive relation between the capital ratios and profitability leads to the conclusion that banks that generate profit become better capitalized as a result of capital reinvestment and therefore have higher capital. Banks that reduce operational costs and those that expose themselves to higher risks have higher profitability. Thus, the model confirms the assumption that higher risk leads to higher profit. This result is given by the positive relation between risk and profitability.

Referring to Romania, the results show a significantly negative relation between capital and risk. The relation between risk and profitability is positive, while between capital and profitability, it is negative for own capital ratio and tier 1 ratio and positive for capital adequacy. The results show that Romanian banks have a tendency to take more risks to grow profitability. Regarding the relation between capital and profitability, we can assume that less efficient banks in order to fulfill the minimum capital requirement will try to reduce the risk-weighted assets maintaining the same capital and will even diversify their product and services portfolio.

Important policy implications emerge from our empirical results. First, the findings suggest that under different market conditions, capital regulation is an effective supervision tool, our study confirming that an increase in capital requirements seems to generate decreased risk-taking by banks. Second, this result sheds light on how banks could overcome the regulations on capital and emphasizes the critical role of a joint regulation of capital ratios in relation to bank risk-taking behaviour and the influence on bank profitability.

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