AN ECONOMETRIC APPROACH OF THE BANKING RISKS – CASE OF CENTRAL AND EST EUROPEAN COUNTRIES

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Abstract
In this paper we analyze the most significant aspects of performance banking on sample banks in Central and East European countries. We started with the aspects of the banking crisis began in 2007 and whose consequences are still felt today both in the EU and USA. Based on the ratios method we tried to capture the extent to which the financial crisis has had a negative impact on the sample banks from Central and East European countries. We also built two regression risks models between overall risk and ROE on the one hand, and between overdue and doubtful loans in total assets ratio and ROA on the other hand. In both cases, liquidity and solvency had an indirect influence over the risks.

Keywords: financial crisis, banking risks, ROA, ROE

JEL classification: F34; G01; G21; G30; M41

1. Introduction

Risk is a permanent feature, inherent in banking institutions. Awareness of this reality, given the financial environment was in a permanent changes (globalization, liberalization of financial markets, financial innovation etc.) and in a highly competitive which improve the banking risk management. Most experts explained the banking risk by credit risk or by liquidity, which came from classical function of banks. This approach has been strongly influenced by the phenomenon of banking risk with its diversification exponential forms. Careful monitoring of the potential risk factors should be

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integrated into the strategy of bank management, relating both to own safety and to the quality of the business environment in which they operate. In this respect, quality of work of any bank may be the cause, but also the effect of generating risks.

In this time, the global crisis is called "risk management era" in banking and in the risk management and is an extremely complex and important task of each bank management. If systemic risk is not properly managed this generates a local crisis (see the case of Lehman Brothers) which goes to a global financial crisis. That is why those analysts believe that the recent financial crisis is a new phenomenon, unprecedented in the world economy. From the moment the real estate credit crunch has turned into a world financial crisis, central banks and governments of developed countries strived to release crediting in order to support the economy, which later gradually came into recession (Bătrâncea, 2009, p. 143-155**).** The banking crisis is a subcategory of the financial crisis consisting in moments of panic, temporary confusion regarding incidents within the financial system. The crisis began in the U.S., but because of deregulation and financial liberalization, this phenomenon has spread to Europe and other continents, having a negative impact on the economy and forcing banks to deal with a difficult situation. After receiving bailouts from the government, some banks were nationalized, others were saved, but in many cases they went bankrupt (Bătrâncea, et al, 2013, p. 16-29**).**

Due to the complexity of the work carried out by the banking institution, which is intermediate in relation savings-investment banking risk implies a complex event with adverse consequences for the bank, and an event can generate unfavorable banking and other adverse events in the chain. Thus, credit risk can be regarded as a conglomeration of adverse events that generate adverse effects for banks and often interrelated, in that they may have common causes and one can generate systematic production and other adverse events.

2. Literature Review

According to literature, the risk is considered to be likelihood or probability of losses not yield expected profit in certain transactions. Thus, the phenomenon of credit risk that occurs as a result of the banking operations and thus causing adverse effects on those activities which damage the quality of the business, the decrease of the profit and record losses and may affect finally

functionality banking institution. In a recent study Berrios and Myrna, analyzed the relationship between credit risk, profitability and liquidity and has concluded that there is a negative relationship between bank deposits and cash flow banks. On the other hand an excessive prudence causes a reduced performance of the financial institution (Berríos and Myrna, 2013, p. 105-118**).**

Björn Simbierowicz and Christian Rauch in a research undertaken for a period between 1998 and 2010 on a sample of commercial banks in the US have analyzed the relationship between two major sources of risk, namely credit risk and liquidity risk and to what extent this link can measure the probability of bank failure. The two researchers concluded that the two sources of risk directly influence the probability of failure of US banks (Simbierowicz and Rauch 2014, p. 242–256**).** Bank risk is uncertainty about the possibilities of collecting value of future earnings or placement (Cociug and Cinic, 2008). And this definition expresses the essence of an adverse event caused by banking business management. Thus the previously reported show that the risk is the chance of an injury, loss, damage, and credit risk is represented by the quantitative expression of the realization of an event that generates loss. The probability of loss is an element that can be determined by statistical and analytical methods. Simplified expression banking risk refers to the present value of all losses or additional expenses that are incurred by a banking institution. Uncertainty in the banking system has increased with the expansion of national and international credit systems, financial markets became more fragile and also default risks specific financial and banking system have multiplied.

Heightened risks are the main cause of the main problems faced by banking institutions, proven experience. This situation is explained by the fact that the future evolution of the value of assets and liabilities of costs cannot be predicted accurately because they depend on macroeconomic factors: inflation, gross domestic product, however, and monetary policy. Banks may be unable to refinance short-term liabilities in case of solvency concerns. To manage this risk, banks can accumulate a buffer of liquid assets, or strengthen transparency to communicate solvency. While a liquidity buffer provides complete insurance against small shocks, transparency covers also large shocks but imperfectly. Due to leverage, an unregulated bank may choose insufficient liquidity buffers and transparency. The regulatory response is constrained: while liquidity buffers can be imposed, transparency is not

verifiable. Moreover, liquidity requirements can compromise banks' transparency choices, and increase refinancing risk. To be effective, liquidity requirements should be complemented by measures that increase bank incentives to adopt transparency (Ratnovski, 2013, p. 422–439). An important cause of the current financial crisis can be identified on the one hand in the absence of regulation in the banking (financial) system of the United States, on the other hand, in the decrease in reference interest by FED after the terrorist attack from 09.11.2001, in order to create liquidity in the banking system and to protect numerous financial institutions entering the payment inability (Bătrâncea, et al, 2009, p. 58-64, Bătrâncea, 2006**).**

In literature there are other approaches to the causes underlying the problems facing banks, especially in times of crisis, and some of them consider that the risks depend on variations in the level of income set and expenditures covered from them. The main sources of income consist of interest on investments made, and the main expense is the interest that must be honored on deposits. Since, risk management is an important goal of financial management, it is important to learn how prepayment risk pertains to bank performance. The results of Fayman and He suggest that prepayment risk may significantly impact return on loans, return on equity and real estate loans to total loans ratios of various commercial banks (Fayman and He, 2011, p. 26-40). Liquidity production is a central function of banks. High leverage is optimal for banks in a model that has just enough frictions for banks to have a meaningful role in liquid-claim production. A recent model explains why banks have higher leverage than most operating firms, why risk management is central to banks′ operating policies, why bank leverage increased over the last 150 years or so, and why leverage limits for regulated banks impede their ability to compete with unregulated shadow banks (DeAngelo and Stulz, 2015, p. 219-236).

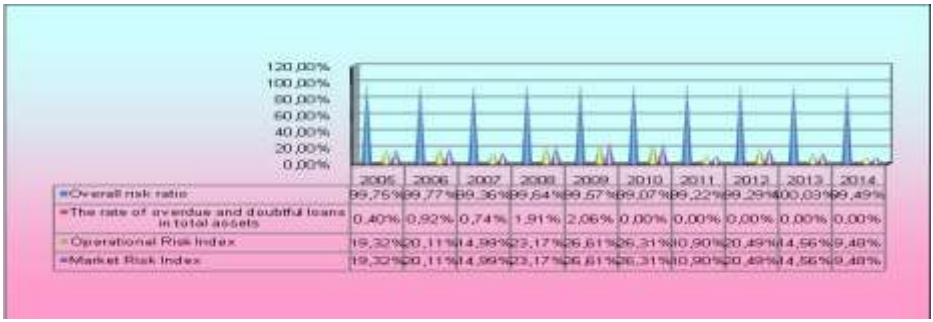
Bankruptcy prediction models are generally known as modalities of the "dangers" of financial entities. In financial theory are three types of assessment addressed the financial issues namely univariate analysis, multivariate analysis and logit analysis (Bătrâncea, et al, 2013, p. 18-30**)**. Credit risk measurement remains a critical field of top priority in banking finance, directly implicated in the recent global financial crisis. In their paper some authors examine the dynamic linkages between credit risk migration due to rating shifts and prevailing macroeconomic conditions, reflected in alternative business cycle states (Gavalas and Syriopoulos, 2014, p. 122-143).

Another article analyzes instruments of prudentia1 regulation of banking activities, provides a comparative analysis of their effectiveness, and also suggests the use of the discussed instruments by bodies of monetary policy, depending on the institutional conditions (Mansurov, 2013, p. 54-59). Other theories claim that the main cause of banking risks is macroeconomic factors whose changes are difficult to predict. The most common cause financial losses and insolvency is given the difficulty to cope with events that may occur but cannot be provided. Thus, we consider the risk; intensity and size are given ways exercised to cover the loss, market conditions and the complexity of instruments that lies behind the loss.

2. Method and Results

Banking risk management aims, through its system of identification, evaluation, analysis and control to diminish the negative influences of risk factors in the planning phase also to minimizing the losses during the execution of the strategic plan assumed. Credit risk analysis is done on two fundamental components: the amount of credit risk and credit risk quality. The first element is the balance of the loan granted at a time to a debtor or the amount of money that has returned to the debtor at some point, the total amount of credit granted. Credit risk quality lies, on the one hand, from the debtor possibility to enter into default, and on the other hand from the debtor guarantees in order to reduce the credit risk. Therefore, the bank guarantees reduce the credit risk and reflect the bank's ability to negotiate with the customer. In same time the credit risk can be reduced by improving the quality and /or the customer reputation, features which resulted in the customer activities. In our research we used the indexes method, ratio method and the regression using the R-studio econometric programs. Fist, we present the evolution of the credit risk and then the econometric models. The evolution of credit risk indicators is shown below.

Figure 1 Evolution of risk indicators



	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Overall risk ratio	89,76%	89,77%	89,36%	89,64%	89,57%	89,07%	89,22%	89,29%	100,03%	99,49%
The rate of overdue and doubtful loans in total assets	0,40%	0,92%	0,74%	1,91%	2,06%	0,00%	0,00%	0,00%	0,00%	0,00%
Operational Risk Index	19,32%	20,11%	14,99%	23,17%	26,61%	26,31%	10,90%	20,49%	14,56%	9,48%
Market Risk Index	19,32%	20,11%	14,99%	23,17%	26,61%	26,31%	10,90%	20,49%	14,56%	9,48%

Source: Authors' calculus

The above data shows that compared to the general risk, index operational risk has a significant weight and an upward trend from year to year until 2010, followed a downward curve, but overall records a halving of values compared to the base year, 2005. The rate of overdue and doubtful loans in total assets recorded an oscillating trend from year to year until 2008(then is zero), and the market risk index has the same values comparing with the other risks mentioned.

As can be seen the overall risk ratio is the ratio between total assets and net exposure (including off-balance sheet assets). Net exposure is determined by aggregating the total risk-weighted assets and liabilities - off-balance sheet items. The indicator overdue and doubtful loans are those loans whose repayment is uncertain, based on existing conditions and safeguards. Assets are unprotected or minimally protected realizable value of their collateral. We used the research conducted and operational risk index is determined by dividing the funds allocated for operational risk (12% of total revenue) Tier 1 funds (share capital, reserves, share premium, profit etc.).

Market risk index also is another measure of risk by dividing Tier 2 extra (subordinated debt) to net exposure. On the other hand the management of liquidity risk is an indicator that underpins confidence in the banking system as banks are credit institutions heavily indebted as the ratio of assets to Tier 1.

Lastly, we find that interest rate risk is determined by dividing the assets sensitive to changes in interest rates (loans and advances to customers and receivables to credit institutions) in liabilities sensitive to changes in interest (debt to credit institutions at sight, liabilities to customers on demand).

Figure 2 The evolution of management of liquidity risk and interest rate risk

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
The interest risk ratio	2,71	2,78	4,66	5,04	5,11	6,20	6,47	5,08	6,69	3,45
Liquidity risk management	0,24	11,64	10,19	9,18	9,89	10,91	7,82	9,01	7,65	7,30

Source: Authors' calculus

Regarding the management of liquidity risk we observe that the ratio increases until 2006 then decreases until 2014, on the one hand and the interest rate risk increases until 2013. This means that the banks reduced the liquidity risk by decisions, and on the other hand we observe that the interest risk increased taking into account the end of the financial crisis period. Traditionally the risk can be measured by the interest rate and by the difference between the assets and the liabilities which are sensitive to interest rate. The most advanced methods to manage the interest rate risk used in banking practice include measuring gap's (GAP's) at different maturities, measurement dynamic gap on the basis of estimates of reinvestment and rates, the time measurement assets, the liabilities and the off-balance bank. In addition, in the gap analyze, many banks use the model of duration gap (Duration), which is a more advanced methods for managing the interest rate risk and. This model focuses on the net interest or capital market value and is based by synchronize the cash-flow inflow and the cash outflow. In order to identify the causes of banks' solvency we chose a sample of banks. So we analyzed the models of RGR (Overall risk ratio) and RCI (The overdue and

doubtful loans in total assets ratio) to identify the factors which influence the banking risks. In the econometric modeling, we used RStudio programs.

A. The model of RGR(Overall risk ratio)

We will analyze the relationship between RGR and other 7 independent variables. We suppose that the model shows a strong linear connection as follows:

- ROE represents Return on equity;
- ROA represents Return on assets;
- RLI represents Quick ratio;
- KFP represents Long term funds to Long term assets;
- RAD represents Loans to Deposits;
- IS1 represents Solvency Index 1;
- IS2 represents Solvency index 2.

a) Build the linear model:

```
> MODEL_RGR=lm (RGR~ROE +ROA+RLI +KFP+RAD+IS1 +IS2)
> Summary (MODEL_RGR)

Call:
Lm (formula = RGR ~ ROE + ROA + RLI + KFP + RAD + IS1 + IS2)

Residuals:
   Min     1Q Median     3Q    Max
-18.649 -3.406 -1.103  2.266 72.083
Approximately 72% of residuals are in [-3.406, 2.266]

Coefficients:
            Estimate Std. Error t value Pr (>|t|)
(Intercept) 90.69016   12.36025   7.337 2.52e-09 ***
ROE         -0.08862    0.24557 -0.361   0.7198
ROA          1.35666    1.25876   1.078   0.2866
RLI         -0.04337    0.03467 -1.251   0.2172
KFP         -0.03172    0.05935 -0.535   0.5955
RAD          0.05452    0.09501   0.574   0.5688
IS1         -0.26265    0.13812 -1.902   0.0634.
IS2          0.16180    0.28162   0.575   0.5684
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```

Residual standard error: 11.9 on 47 degrees of freedom
(11 observations deleted due to missingness)
Multiple R-squared: 0.2921, Adjusted R-squared: 0.1866
F-statistic: 2.77 on 7 and 47 DF, p-value: 0.01702
We test the model with ANOVAs:
> anova (MODEL_RGR)
Analysis of Variance Table

Response: RGR

	Df	Sum Sq	Mean Sq	F value	Pr (>F)	
ROE	1	1006.9	1006.93	7.1116	0.01047	*
ROA	1	572.4	572.43	4.0428	0.05012	.
RLI	1	201.0	200.96	1.4193	0.23950	
KFP	1	90.5	90.52	0.6393	0.42799	
RAD	1	81.1	81.09	0.5727	0.45295	
IS1	1	746.8	746.85	5.2747	0.02614	*
IS2	1	46.7	46.73	0.3301	0.56836	
Residuals	47	6654.7	141.59			

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

ANOVA analysis emphasizes that RLI, KFP, RAD and IS2 coefficients are not significant. So we remove these independent variables from the model.

The new RGR model will be:
> MODEL_RGR=lm (RGR~ROE +ROA+IS1)
> summary (MODEL_RGR)

Call:
lm (formula = RGR ~ ROE + ROA + IS1)

Residuals:

Min	1Q	Median	3Q	Max
-17.641	-3.817	-0.115	2.130	71.747

Approximately 71,74% of residuals are in [-3.817, 2.130]

The Coefficients of the model:

	Estimate	Std. Error	t value	Pr (>|t|)

```
(Intercept) 88.06799    3.41742 25.770   <2e-16 ***
ROE         -0.17667    0.20877 -0.846   0.4014
ROA          2.26216    0.89562   2.526   0.0147 *
IS1         -0.21436    0.08545 -2.509   0.0153 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 11.68 on 51 degrees of freedom
  (11 observations deleted due to missingness)
Multiple R-squared:  0.2594,          Adjusted R-squared:  0.2158
F-statistic: 5.954 on 3 and 51 DF, p-value: 0.001463

> anova(MODEL_RGR)
Analysis of Variance Table

Response: RGR
          Df Sum Sq Mean Sq F value Pr (>F)
ROE        1 1006.9 1006.93 7.3764 0.00900 **
ROA        1 572.4 572.43 4.1934 0.04575 *
IS1        1 859.0 859.05 6.2931 0.01534 *
Residuals 51 6961.8 136.51
```

Conclusion: Both lm and ANOVAs functions show us that the model is significant:

The model of RGR is:

RGR= 88.06799 - 0.17667 ROE+ 2.26216 ROA -0.21436 IS1

For a change of 1 unit of ROE, RGR changes by -0.17667.

For a change of 1 unit of ROA, RGR changes by 2.26216.

For a change of 1 unit of IS1, RGR changes by -021436.

For a change of 1 unit of ROE, ROA and IS1, RGR changes by 1,87113.

For ROE =0, ROA=0 and IS1 =0 RGR = 88.06799 (no action from ROE, ROA and IS1)

B. The model of RCI (The overdue and doubtful loans in total assets ratio)

The statistic analysis shows that between IS1 (solvency index 1) as dependent variable on the one hand and the independent variables ROA

(Return on assets), KFP (Long term funds to Long term assets) and IS2 (Solvency index 2) is a strong linear connection as follows.

a) Build the linear model:

```
> summary (MODEL_RCI)

Call:
lm (formula = RCI ~ ROE + ROA + RLI + KFP + RAD + IS1 + IS2)

Residuals:
   Min     1Q  Median     3Q    Max
-10.387 -4.448 -1.331   3.107 24.945

Coefficients:
            Estimate Std. Error t value Pr (>|t|)
(Intercept) 15.457618   6.967264   2.219 0.03138 *
ROE         -0.251366   0.138425 -1.816 0.07577.
ROA          1.577064   0.709540   2.223 0.03109 *
RLI         -0.063840   0.019544 -3.266 0.00204 **
KFP         -0.017356   0.033453 -0.519 0.60632
RAD          0.007863   0.053557   0.147 0.88391
IS1         -0.001192   0.077856 -0.015 0.98785
IS2         -0.054710   0.158745 -0.345 0.73190
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.707 on 47 degrees of freedom
  (11 observations deleted due to missingness)
Multiple R-squared:  0.4129,          Adjusted R-squared:  0.3255
F-statistic: 4.723 on 7 and 47 DF, p-value: 0.0004479

> anova (MODEL_RCI)
Analysis of Variance Table

Response: RCI
          Df Sum Sq Mean Sq F value    Pr (>F)
ROE        1 138.18 138.18 3.0715 0.0861952.
```

```
ROA          1 592.16 592.16 13.1625 0.0007019 ***
RLI          1 705.70 705.70 15.6861 0.0002522 ***
KFP          1  35.66  35.66 0.7927 0.3778325
RAD          1   1.36   1.36 0.0301 0.8629003
IS1          1   8.86   8.86 0.1969 0.6592593
IS2          1   5.34   5.34 0.1188 0.7319041
Residuals 47 2114.47  44.99
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

ANOVA analysis emphasizes that KFP, RAD, IS1 and IS2 coefficients are not significant. So we remove these independent variables from the model.

The new model of RCI:

```
> MODEL_RCI=lm (RCI~ROE +ROA+RLI)
> summary (MODEL_RCI)

Call:
lm (formula = RCI ~ ROE + ROA + RLI)

Residuals:
    Min      1Q  Median      3Q     Max
-9.5154 -4.2832 -0.5026  2.9536 25.8729

Coefficients:
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 12.81484    1.78094   7.196 2.67e-09 ***
ROE         -0.20863    0.11527  -1.810  0.07619 .
ROA          1.47454    0.49603   2.973  0.00450 **
RLI         -0.06308    0.01547  -4.077  0.00016 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 6.516 on 51 degrees of freedom
  (11 observations deleted due to missingness)
Multiple R-squared:  0.3987,          Adjusted R-squared:  0.3633
F-statistic: 11.27 on 3 and 51 DF,  p-value: 8.728e-06
```

b) Testing the model validity

```
> anova(MODEL_RCI)
```

Analysis of Variance Table

Response: RCI

	Df	Sum Sq	Mean Sq	F value	Pr(>F)	
ROE	1	138.18	138.18	3.2541	0.0771513	.
ROA	1	592.16	592.16	13.9449	0.0004755	***
RLI	1	705.70	705.70	16.6185	0.0001602	***
Residuals	51	2165.68	42.46			

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Conclusion: Both lm and anova functions show us that the model is significant:

The model of RCI is:

RCI = 12.81484 - 0.20863 ROE +1.47454 ROA -0.06308 RLI

For a change of 1 unit of ROE, RCI changes by -0,20863 unit.

For a change of 1 unit of ROA, RCI changes by 1,47454 units.

For a change of 1 unit of RLI, RCI changes by -0,06308 unit.

For a change of 1 unit of ROE, ROA and RLI, RCI change by 1,20283 units.

3. Conclusions

Due to the complexity of the work carried out by the banking institution, credit risk implies a complex event with adverse consequences for the bank, and an event unfavorable bank may generate more adverse events in the chain of often interrelated, in that they may have common causes and one can generate systematic production and other adverse events

According to international standards, risk management must consider the following aspects: to be an ongoing strategy organization to translate strategy into tactical objectives and operational, to consider all risks affecting the activities of the credit institution and be integrated into the culture organization.

Having into account the regression model from the above we mention that Overall risk ratio directly depends by the return on equity and indirect depends by return on equity and solvency index 1. On the other hand the overdue and doubtful loans in total assets ratio depend directly by the return on assets and indirect depends by return on equity and quick ratio.

In our opinion, the main objective of banking supervision is improved current system of monitoring and reporting by creating a unified interface capable of providing information in real time about various queries. In the context of developments alerts Romanian banking system, banking supervision is increasingly oriented to analyze the risk profile of the institution, which is performed using rating systems and early warning tests or the type of stress-testing.

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