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PhD THESIS

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Key issues of operational risk management in the financial sector

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CONTENT

1. BACKGROUND AND EXPLANATION OF THE THEME

My dissertation examines the most important issues of operational risk management in the financial sector. "Operational risk is defined as the risk of loss resulting from inadequate or failed internal processes, people and systems or from external events. This definition includes legal risk, but excludes strategic and reputational risk" (BCBS, 2006, 144. pp).
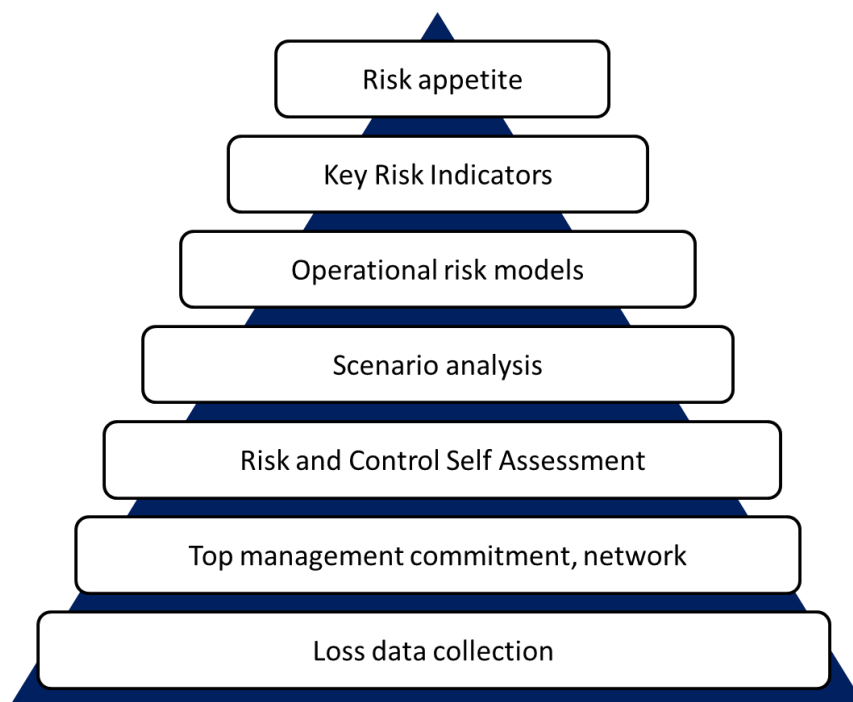
In the European Union, from 2008 – the first years of the crisis – banks are obliged to manage their operational risks and calculate capital on them, so, although this risk has always existed, the history of systematic management is linked to the history of the world economic crisis that begins in 2007/2008. Banks had to develop their systems for identifying, measuring, and managing operational risk, while faced significant challenges in other traditional banking risks as well. Shows the weight of the task, that operational risk became the second most important source of risk of financial institutions right after credit risk and before market risk in terms of the level of capital buffer required by the regulator (EBA, 2017/b). As operational risk is not a bank-specific risk, the results of the research presented here may be worth considering for other sector actors.

I started to research the topic from a scientific point of view in 2014. However, through my work – as a practicing banking professional – I was able to observe and shape the operational risk management processes of the financial sector right from the start.

These processes are summarized in a diagram of the operational risk pyramid (Figure 1), which I compiled on the basis of my experience in the financial sector and the literature research. The pyramid demonstrates the elements and connections of the operational risk management system in a vivid way.

Current dissertation encompasses three researches that focus on different levels of the pyramid and collectively cover the most important issues of the operational risk management system, process and regulation.

Figure 1: Elements of the operational risk management framework (operational risk management pyramid)

Risk appetite

Key Risk Indicators

Operational risk models

Scenario analysis

Risk and Control Self Assessment

Top management commitment, network

Loss data collection

Source: by author

The dissertation begins by reviewing relevant literature and presenting the past, present and potential future of banking operational risk management regulation. Thereafter three separate and from methodological perspective different studies are presented.

The researches summarized in the dissertation will answer the next most important research questions:

- Which country-specific factors have a significant impact on the magnitude and frequency of operational loss events in each country? Research connects to the lowest level of the pyramid (loss data collection) and building block of operational risk models.

- What kind of information do banks publish on their operational risk management system? Which financial and corporate governance factors are related to content and quality of published information? The research examines all elements of the pyramid.

- To what extent is the risk appetite framework – the most advanced element of the bank's operational risk management system – in the practice of Hungarian banks found? What challenges do bank experts see regarding the implementation of this framework? The research focuses on the last building stone of the pyramid, the risk appetite.

2. METHODS AND DATA USED

The dissertation is based on three different research using different methodologies, which together cover the entire operational risk management framework and provide deeper insights into some of its elements.

2.1. ANALYSING THE COUNTRY LEVEL FACTORS OF OPERATIONAL LOSSES

The frequency and severity of operational losses differ across countries, sectors and corporate entity types. The causes of differences and the factors influencing the magnitude and frequency of loss events have been investigated by several earlier researches.

During our research we replicated the analysis of Li and Moosa (2015) covering more loss events (6.199 versus 4388) in more countries (92 versus 53) in a more recent period (2008-2016 versus 1975-2008) using all published operational loss events (SAS Global database versus Fitch First database).

Then, based on the results, we build our own model and introduce the freedom of press as an additional factor.

We used SAS OpRisk Global database which is the world's most comprehensive and most accurate repository of information containing publicly reported operational losses exceeding 100,000 US dollar with the degree of detail that is consistent with the Basel definition and regulations (BCBS, 2004).

The following indicators were included in the model as explanatory variables:

- The World Bank's indicator of good governance: „The Worldwide Governance Indicators (WGI)"

- GDP (at 2016 value)
- GNI/capita (at 2016 value)

- Legal system (French, English, German és Scandinavian)

- Region (USA, Africa, Canada, China, East Asia, Europa, Middle East, Australia and Oceania, Latin-America, UK, Ex-soviet states except Baltic states, Japan)

- Press Freedom Index, which is published yearly by Riporters without Borders (RFS) for 180 countries.

In terms of methodology, the former model is reproduced by OLS regression, while the new model is run by panel regression.

2.2. CONTENT ANALYSIS OF BANKS' RISK DISCLOSURES IN THE FOUR VISEGRAD COUNTRIES

Second research follows the content analysis approach applied by Zeghal and Aoun (2016). We analyse the Pillar 3 and annual reports of the largest and most developed twenty six banks (which covers 65-83,5% of the market based on total assets) in the Czech Republic, Hungary, Poland and Slovakia, in the so called Visegrad countries (V4), in the period of 2008-2016. We focus on operational risk, the second largest component representing 10% to 15% of bank regulatory capital.

This method is content analysis, a subjective, and at the same time scientific, research methodology for examining documents. This methodology ensures systematic classification of our research questions, and supports our study empirically and methodologically. (Zhang and Wildemuth 2005). Content analysis is widely used for literature reviews and for forming measurable indexes from a text.

In the application of the methodology, the assessment was based on two aspects: focusing on the content elements and assessing the quality of the report.

Relating to the aspect of content we examined the reports based on 23 questions, assigned to five categories. If a question was answered in the report, the attributed code took 1 for the specific year and 0 if otherwise.

Following the summary of the code values, based on the American method, we calculated the OpRisk Disclosure Index (ODI) relating to the content aspects of the report, as can be seen below:

$$\textbf{ODI} = \frac{\sum_{i=1}^{n} Si}{23} \qquad\qquad (1)$$

where S_i is the code attributed to each item which takes 1 if the item is disclosed and 0 if otherwise; n is the number of questions, that is 23.

We examined the reports' quality in 11 questions. As with content reviews, we calculated the OpRisk Quality Index (OQI) relating to the quality aspects of the reports based on Zeghal and

Aoun article (2016). Depending on the level of compliance, code values moved between 0 and 3. For quality aspects, annual reports were not included in the study, only the transparency and availability of risk reports were analyzed. While the content of the annual report may supplement the information in the risk report, the quality of the reports can only be verified independently. OpRisk Quality Index (OQI) was calculated from the points as follows:

$$\text{OQI} = \frac{\sum_{i=1}^{n} Si}{33} \tag{2}$$

where S_i is the code attributed to each item which takes 1 if the item is disclosed in a general statement, 2 if the item is disclosed in a specific statement, 3 if the item is disclosed in a specific statement containing quantitative and qualitative details, and 0 if otherwise; n is the number of questions; and 33 is the maximum weighted score for all the items in the index.

Subsequently, the available indexes were analyzed using the following quantitative analysis methods:

- Panel regression

The following hypotheses were set during panel regression:

H1: The content and the quality of OpRisk disclosure by the V4 largest banks have improved and become more sophisticated in the period of 2008-2016.

H2: The content and the quality of OpRisk disclosure by the V4 largest banks are positively correlated with the implementation of AMA.

H3: The content and the quality of OpRisk disclosure by the V4 largest banks are positively correlated with bank size (natural logarithm of total assets).

H4: The content and the quality of OpRisk disclosure by the V4 largest banks are correlated with the level of equity-to-assets ratio.

H5: The content and the quality of OpRisk disclosure by the V4 largest banks are correlated with profitability.

H6a: The content and the quality of OpRisk disclosure by the V4 largest banks are negatively correlated with board size.

H6b: The content and the quality of OpRisk disclosure by the V4 largest banks are negatively correlated with duality between the roles of CEO and of the chairman of the board.

H6c: The content and the quality of OpRisk disclosure by the V4 largest banks are positively correlated with the proportion of independent non-executive directors.

- Cluster analysis

During the cluster analysis the twenty-six banks examined were grouped based on ODI, which measures the content of the reports, the OQI indicator determining the quality of the report, the total assets indicating the size of the bank and the ROA showing the bank's profitability. We use two methodologies for cluster analysis: hierarchical and K-cluster analysis.

- Multi-dimensional scaling

The multi-dimensional scaling methodology provides the opportunity to display twenty-six selected banks along multiple factors, but in two dimensions. Our variables on which we have performed scaling are the followings: ODI and OQI indicators, which measure the quality and content of the report, total assets, total equity, net income, equity/total assets ratio and ROA.

2.3. RISK APPETITE FRAMEWORK – QUALITATIVE SURVEY IN THE DOMESTIC BANKING SECTOR

The FSB (2013) defines the RAF so: "The overall approach, including policies, processes, controls, and systems through which risk appetite is established, communicated, and monitored. It includes a risk appetite statement, risk limits, and an outline of the roles and responsibilities of those overseeing the implementation and monitoring of the RAF. The RAF should consider material risks to the financial institution, as well as to the institution's reputation vis-à-vis policyholders, depositors, investors and customers. The RAF aligns with the institution's strategy." (FSB 2013:2).

The research presented in the dissertation consists of two stages:

I. stage (interviews)

During the first stage – in Spring 2016 – we conducted a structured survey at a domestic big bank, based on 1-1,5 hour interviews. Our aim was to gauge the bank's risk culture and attitude towards risk appetite. Because of this we placed great emphasis on the respondents' professional background and position.

Research question: What does risk appetite mean to the different departments of the bank, considering the types of risk the given department handles and the foreseeable variation of these risks in the coming 1-2 years?

II. <u>stage (on-line questionnaires)</u>

Networking for the second stage, which involved online questionnaires, occurred through two channels. Firstly we targeted the 9 largest Hungarian banks based on balance sheet. We could send the questionnaire to their risk management directors, through personal contact, using email.

Our other channel was the IIA Hungary, the members of which are internal bank and company auditors. We approached 120 people through this channel, meaning 45 institutions. These 45 include the 9 big banks, which we chose and approached separately as well.

Research question: How do members of the Hungarian financial sector interpret risk appetite, and what does it mean to them in practice?

In our analysis we could rely on the data of 13 interviews, 3 detailed questionnaires and 20 online questionnaires.

3. RESULTS OF THE DISSERTATION

The study of the regulation and its possible directions and the literature review produced the following results:

1. The primary purpose of identifying and assessing risks remains to determine the capital requirement corresponding to the institution's risk profile. While maintaining this goal the regulator's expectation is getting stronger and stronger towards the financial institutions to make serious efforts for risk reduction and prevention. At the same time, the regulator forces the operational risk management organization to assess, evaluate and test the operation of internal controls.

2. There are some new risk categories within operational risks which receive special attention from the regulator. They include model risk, conduct risk, outsourcing risk and reputational risk. The latter is not deemed to be a part of operational risk under the Basel II definition, but during its audits of banks the regulator nevertheless deals with reputational risk in the context of operational risks, treating it as a consequential risk of these.

3. The destruction of reputational risk as a consequence of operational risk can be a multiple of the original loss. (Eckert and Gatzert, 2017). Therefore events may occur where the regulatory capital is not sufficient to cover losses. The regulation of

operational risk cannot be satisfied only with rules for capital calculation, but should be supplemented by continuous monitoring of the framework, by issuing bans and recommendations.

After processing the three empirical studies, we can present the following results::

4. Analyzing country-specific factors affecting operational risks at first we investigated the same regression model for all industries as in (Li and Moosa; 2015) on our own database.

$$LOSS_i = \alpha + \beta \ln GDP_i + \varphi GOV_i + \gamma \ln GNI_i + \sum_j \delta_{i,j} LES_{ij} + \sum_j \lambda_{i,j} REG_{ij} + \varepsilon_i \quad (1)$$

where $LOSS_i$ can be the frequency or the severity of operational losses in the ith country in a year; GOV_i is the aggregate governance index (a higher value means better governance); GNI_i is the GNI per capita, and LES and REG are dummy variables for the legal system and the geographical region.

We found that the same composite indicator of good governance GOV and the living standard GNI per capita are not significant explanatory variables any more. Moreover, the most important significant control variable is the geographical region which strengthens the idea that countries are very different in operational risk but these differences remain completely unexplained, see Table 1.

Table 1: Regression output for the model of Li and Moosa (2015), 2008-2016

Factors		Total loss		Frequency		Severity	
		Coefficient	Sign.	Coefficient	Sign.	Coefficient	Sign.
Logarithm of GDP		0.7324	0.000 ***	0.3477	0.000 ***	0.4202	0.000 ***
Governance Indicators		-0.0089	0.695	-0.0150	0.122	0.0016	0.924
Logarithm of GNI per capita		-0.1333	0.113	-0.0314	0.380	-0.0994	0.108
Legal system	French system (civil law)	Reference					
	English system (common law)	0.4449	0.020 *	0.3479	0.000 ***	0.2218	0,114
	German system	0.1468	0.491	-0.0073	0.936	0.1774	0,258
	Scandinavian system	-0.3028	0.396	-0.1244	0.414	-0.1345	0,609
Region	United States	Reference					
	Africa	-3.8444	0.000 ***	-2.6017	0.000 ***	-0.8042	0,140
	Canada	-2.9045	0.002 *	-2.2014	0.000 ***	-0.4446	0,508
	China	-2.8706	0.002 *	-2.7633	0.000 ***	0.2407	0,729
	East Asia	-3.6327	0.000 ***	-2.5884	0.000 ***	-0.5648	0,283
	Europe	-3.5711	0.000 ***	-2.5718	0.000 ***	-0.5660	0,279
	Middle East	-4.3483	0.000 ***	-2.9566	0.000 ***	-0.9921	0,069 †
	Australia and Oceania	-2.8321	0.000 ***	-2.1406	0.000 ***	-0.3144	0,583
	Latin America	-3.6261	0.000 ***	-2.6797	0.000 ***	-0.5393	0,312
	United Kingdom	-1.1560	0.203	-1.3818	0.000 ***	0.3977	0,551
	Ex-soviet states except Baltic states	-3.4743	0.000 ***	-2.4296	0.000 ***	-0.6329	0,266
	Japan	-4.0755	0.000 ***	-2.8630	0.000 ***	-0.8467	0,220
_cons		-2.3073	0.058 †	-0.5108	0.324	-2.4543	0.006 *
R^2			0.390		0.474		0.251

*† p<0.1;   * p<0.05;   ** p<0.001;   *** p<0.0001*

Source: SAS OpRisk Global

Remarks: Legal system and region were dummy variables. Countries were divided into four categories according to their legal system, the basis (LES0) is the French system (civil law), LES1 is the English Anglo-saxon system (common law), LES2 is the German system, and LES3 is the Scandinavian system. The basis of regions (REG0) was US.

We then created our own empirical model including the Freedom of the Press index. The basic equation of the new model variations is the following:

$$lnLOSS_i = \alpha + \beta ln\,GDP_i + \varphi GOV_i + \gamma ln\,GNI_i + \theta PRESS_i + \varepsilon_i \qquad (2)$$

where $LOSS_i$ can be the frequency or the severity of operational losses in the ith country in a year; GOV_i is the aggregate governance index (a higher value means better governance); GNI_i is the GNI per capita, and $PRESS_i$ is the Freedom of Press index of the ith country. Based on this model, we have run three model variations. In the first we took into account all the explanatory variables, in the second we omitted the government indicator and in the third the freedom of the press index.

The results are shown in the following table:

Table 2: OLS regression output for logarithm of total loss and logarithm of frequency in all industries, 2008-2016

Variables	Logarithm of Total loss			Logarithm of Frequency		
	Coefficient			Coefficient		
Logarithm of GDP	0,865 ***	0,854 ***	0,816***	0,415 ***	0,407 ***	0,388 ***
Governance Indicators	-0,028	-	0,017	-0,019 †	-	0,005
Press Index	0,015 *	0,012 *	-	0,008 ***	0,006 *	-
Logarithm of GNI per capita	-0,157 *	-0,208 *	-0,157 *	-0,08 *	-0,115 ***	-0,08 *
const	-6,697 ***	-6,229 ***	-6,574***	-3,121 ***	-2,801 ***	-3,054 ***
R2	0,337	0,336	0,329	0,356	0,353	0,344

Variables	Logarithm of Severity		
	Coefficient		
Logarithm of GDP	0,079 *	0,084 ***	0,084 ***
Governance Indicators	0,012	-	0,008
Press Index	-0,001	0,000	-
Logarithm of GNI per capita	-0,042	-0,021	-0,042
const	-0,096	-0,287	-0,107
R2	0,021	0,020	0,021

*† $p<0.1$;   * $p<0.05$;   ** $p<0.001$;   *** $p<0.0001$*

Source: SAS OpRisk Global

Our results suggest that when modelling operational losses (total loss, frequency and severity), governance indicators have very poor explanatory power in all model variation. Increasing in the standard of living has an inverse effect on the loss frequency, meaning that in countries with a higher standard of living we can expect fewer operational loss events. GDP matters in all settings as expected in all model variation. Our new variable, the Freedom of Press Index is significant in terms of total loss and frequency which means as we can anticipate that in a country where the press is not free (ie higher index value), the number of published loss events will be significantly lower. Not because investing in such a country is less risky, but because loss events do not come to light. Not surprisingly, the freedom of press has an explicit effect on total loss and loss frequency (the number of reported loss events), but not significant related to loss severity. Once the event is published, the size of the loss (severity) is not affected by the freedom of press. Models that investigate total loss and frequency as dependent variables are much better (30-35% R2 indicator), than our model for severity, which is in line with findings in the literature that models built for frequency have stronger explanatory power than models built for individual loss events. (Homolya, 2012).

The same model was run only for financial sector data and we got very similar results.

The conclusion behind the figures is that in countries with low press freedom,

- where the media is under economic, political, religious and other influence,

- where the infrastructure to support the appearance of news is of low quality,
- where the news release process is not transparent,
- where journalists and reporters are exposed to atrocities,

there the sensitive operational loss events such as internal and external fraud, process and human error, corruption, conduct risk, etc. cannot be released, so we cannot find them in loss database. Thus, when we analyse loss data, these countries – wrongly – seem less risky.

It follows that in the case of modelling on public databases, we have to pay attention to eliminating the distorting effects and correct our data by incorporating the press freedom or similar controlling variable.

5. Our research on the risk report of Hungarian, Check, Slovak and Polish banks shows, that however, although operational risk disclosures have become more informative since 2008 (we accept H1), much relevant information remains unknown for external stakeholders. Our conclusion is that many banks provide primarily high-level statements instead of providing practical information. Major incidents, structure of operational risk exposure, trends and challenges are rather neglected in risk disclosures.

6. When analysing ODI and OQI indexes derived from the V4 banks' risk and annual reports, we run panel regression analysis with the following regression models:

$$ODI_{i,t} = \beta_0 + \beta_1 \, lnTotalasset_{i,t} + \beta_2 \, ROA_{i,t} + \beta_3 \, E/A_{i,t} + \beta_4 \, Board\ size_{i,t}$$
$$+ \beta_5 \, Board\ independence_{i,t} + \beta_6 \, CEO_{i,t} + \beta_7 \, AMA_{i,t} + \varepsilon_{i,t} \qquad (3)$$

and

$$OQI_{i,t} = \beta_0 + \beta_1 \, lnTotalasset_{i,t} + \beta_2 \, ROA_{i,t} + \beta_3 \, E/A_{i,t} + \beta_4 \, Board\ size_{i,t}$$
$$+ \beta_5 \, Board\ independence_{i,t} + \beta_6 \, CEO_{i,t} + \beta_7 \, AMA_{i,t} + \varepsilon_{i,t} \qquad (4)$$

where i is the bank and t is the year.

Based on the Hausman test, the fixed effect model is the best method for analyzing both connections. Table 3 shows the results of regression analysis based on equation (3) and (4).

Table 3: Results of regression analysis based on equation (3) and (4)

	Dependent variable: ODI		Dependent variable: OQI	
	Beta	p	Beta	p
CEO	0,0023	0,974	0,1217*	0,004
BoardIndep	-0,0566	0,623	0,0293	0,661
Boardsize	0,0186†	0,052	0,0009	0,878
Equity/Total assets	0,0235**	0,002	0,0168***	0,000
ROA	0,0162	0,444	0,0057	0,646
AMA	0,1674***	0,000	0,0782***	0,000
ln(totalassets)	0,1121*	0,004	0,1057***	0,000
_cons	-0,8678†	0,013	-0,7376***	0,000

*† $p<0.1$;   * $p<0.05$;   ** $p<0.001$;   *** $p<0.0001$*

Source: STATA program

We can conclude that both the content (ODI) and the quality (OQI) of OpRisk disclosure by the V4 largest banks are positively correlated with the implementation of AMA, with bank size (natural logarithm of total assets), and with the level of leverage (equity-to-assets ratio). Three of our hypotheses, H2, H3 and H4, are confirmed by regression models. The results don't indicate connection between disclosure and the ROA of the banks. Therefore, we refute the H5 hypothesis that assumes that the content and the quality of OpRisk disclosure by the V4 largest banks are correlated with profitability. Relating to board structure, we conclude that board size is positively correlated with the content of disclosures, when selecting a confidence interval of 90%. In the case of quality, the board size is not significant. As for the proportion of independent non-executive directors, the coefficient of independence is not significant in the regressions The regression analysis shows that the report quality is better if the CEO and the chairman of the board are the same person, however, there isn't empirical evidence for the connection between the content of the report and the duality between the role of CEO and the chairman of the board. Due to these results, we reject the H6a, H6b and H6c hypotheses.

Figure 2 shows the comparison of the results with the findings in the literature.

Figure 2: Comparison of influencing factors of ODI and OQI indexes derived from risk and annual reports of V4 countries, white signs for the result of the literature, black signs for our own results
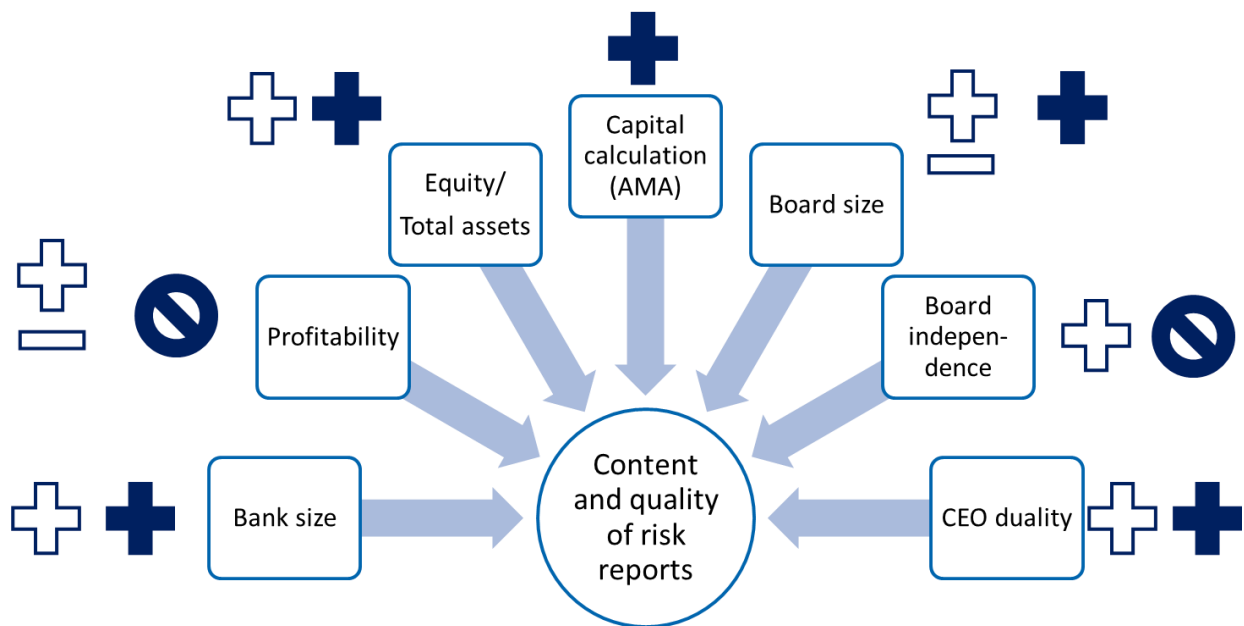
Source: by author

In most cases research on the SAS database has confirmed the findings in the literature. In terms of profitability and independence of the board – unlike the literature – we could not show any correlation with the content and quality of the risk reports. However, the novelty of our research is to include capital calculation methodology into the analysis and to prove its significant positive relationship with risk reports.

7. The following table shows the results of the hierarchical cluster analysis for the twenty-six banks of the V4.

Table 4: Comparing clusters based on hierarchical cluster analysis

1. claster (average)	2. claster (below-average)	3. claster (above-average)
•OTP (HU) •ERSTE (HU) •UCB (HU) •KH (HU) •FHB (HU) •CIB (HU) •BGZ BNP (PL)	•BB (HU) •MKB (HU) •Raiffeisen (HU) •Raiffeisen Cz (CZ) •Tatra (SK) •CSOBas (SK)	•CSOB cz. (CZ) •Ceska Sporitelna (CZ) •Komercni Banka (CZ) •UniCredit (CZ) •SlovenskaSporitelna (SK) •VUB (SK) •PKO (PL) •Pekao (PL) •mBank (PL) •Zachodni (PL) •ING (PL) •Millenium (PL) •Alior (PL)

Source: by author

The results show that there is no Hungarian bank among the banks with above-average reporting quality, and the majority of financial institutions in Poland are among the organisations which publish the highest quality reports.

8. As a result of multidimensional scaling we can represent the twenty-six selected banks in two dimensions. Figure 3 shows the "distance" of each bank after collapsing the examined factors.

Figure 3: Representation of bank by two artifical dimensions
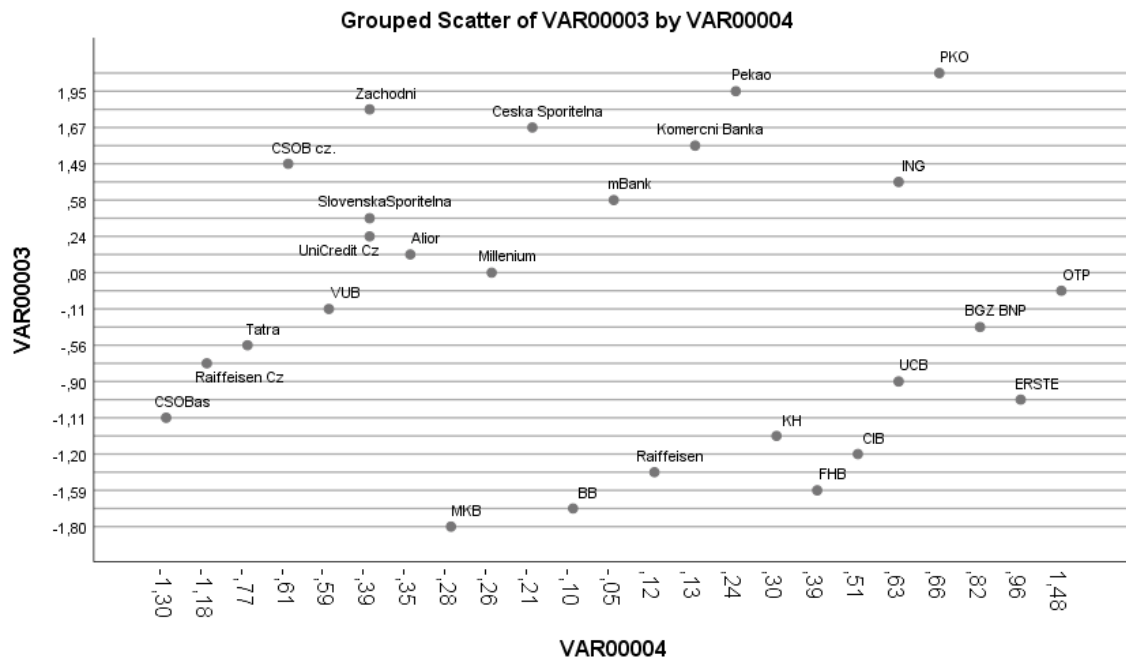
Source: SPSS program

The vertical axis (VAR00003) of the figure measures each of our original variables, while the horizontal axis (VAR00004) negatively correlates with ROA and equity/total assets ratio. So as we move away from the origin on the horizontal axis, we find less profitable and lower-capitalized banks.

Based on the examined aspects the two farthest banks are the CSOB a.s. and PKO Bank. The PKO Bank can be considered as an outlier observation based on its total assets and total equity as well.. The institutions of the Hungarian banking sector are located in the lower right part of the chart; these banks are less profitable and operate with lower equity/total assets ratio.

9. Our research on the risk appetite framework – based on interviews and online questionnaires – concluded with the result that the risk appetite system of the Hungarian financial institution sector was set up, but there are only a few banks where this framework works as an integral part of internal control system. Based on the answers of professionals, all institution considers the implementation of RAF beneficial. The main advantages of implementation can be the transparency of processes' riskiness, increasing risk awareness, diversification of risk taking and clear

management expectations. However there are more obstacles before the implementation. The major obstacles are the implementation of new conceptual frameworks with common content, organisational workload, the lack of data and methodology behind quantification. Another result of our survey is that it is worth starting the development of RAF for the first pillar risks (credit risk, market risk and operational risk), because these are the risk types where banks have well-developed risk management tools and methods that can serve as the basis of risk appetite system. The following table illustrates the appropriate measurement tools for each risk types based on the answers of professionals.

Table 5: Measurement method for each type of risk

	Credit risk	Market risk	Operational risk	Legal/ compliance risk	Liquidity risk	Reputational risk	Country risk	Strategic risk
Risk capital	√√√	√√ √	√√√	√	√√√	-	√√√	√√√
Expected loss (based on self assessment)	√√√	√√	√√√	√√√	√√√	√√	√√	√√√
Non-expected loss (based on self assessment)	√	√	√√	√√	√	√	√	√√
Amount of losses	√√	√√	√√√	√√	√√	√√	√√	√√
Volatility of profit or income	-	√√ √	√	-	√√	-	√	√
Zero tolerance commitments	-	-	√	√√	√	√√√	-	√

Source: by author

At the specific risk types the respondents selected the method with √√√ as the most useful tool for quantification or measurement of risk appetite.

Based on our survey, six criteria for a well-functioning risk management system are the followings:

- supported by methodologies and data
- transparency
- proactive
- consistent with business goals
- built into decision-making processes
- part of daily practice

The results presented in the dissertation contain useful conclusions and recommendations for financial sector, the regulator and other sectors' participants as well.

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