

# Risk Management Approaches and Bank Size\*

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*Relying on the database of the European Banking Authority (EBA), the article analyses the relationship between firm size and the selected risk methodology (credit, market and operational risk). Based on the analysis, larger institutions are more inclined to apply more advanced approaches.<sup>1</sup> While this is a favourable trend from a systemic risk perspective, according to statistical tests (Wilcoxon test), there is no evidence that the shift toward more advanced approaches was more intensive in the period between 2008 and 2010 than between 2010 and 2013, even if banks' attention presumably turned to other tasks in an effort to mitigate the consequences of the economic and financial crisis and in consideration of the significant regulatory changes.*

**Journal of Economic Literature (JEL) Classification:** G21, G32

**Keywords:** risk management, banking sector, capital requirement calculation methods

## 1. Introduction

Modern bank regulations and internal considerations have led financial institutions to increasingly focus their attention on risk management. While credit and market risks took centre stage in the 1990s, in the early/mid 2000s operational risk also came into the limelight. It is, therefore, worth exploring the common features of the institutions that apply more advanced risk measurement approaches. Under the Basel II / CRD regulation effective from 1 January 2008 (currently the Basel III / CRR regulation and directive), all financial institutions across the European

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<sup>1</sup> With regard to size, the analysis assumes that a higher share in capital requirements also means larger size. Of course, this assumption maybe limited by the fact that other considerations can also affect systemic risk relevance. This issue is discussed in more detail in the "Conclusions" part.

Union are required to hold capital to guard against various key risks they face. The primary focus of this analysis is on Pillar 1 capital requirements, i.e. the minimum capital requirements for credit risk, market risk and operational risk. Obviously, Pillar 2 capital requirements also address these key risks, but for the purposes of this analysis the term “Pillar 1” is used – in accordance with the database of the European Banking Authority (EBA) on which this paper is based (EBA 2015), because Pillar 1 minimum capital requirements concentrate exclusively on these three key risks (market risk, credit risk and operational risk).

Capital formation is intended to guard against losses faced by deposit holders or the creditors of banks, as all three key risks imply the possibility of incurring certain losses. The literature on risk management defines credit risk as the risk of loss stemming from a borrower’s failure to repay a loan, while market risk is understood as the risk of losses arising from movements in the market prices of financial instruments. Operational risk, in turn, is defined as the risk of losses incurred for inadequate or failed internal processes, people and systems, or from external events.

With respect to all three key risks, the regulator expects the application of adequate capital allocation methods, which may range from fairly simple methods to advanced, model-based approaches. More specifically, the advanced approach is the Internal Model Approach (IMA) for market risk and the Internal Ratings Based Approach (IRB) for credit risk. As regards operational risk, simple methods imply the Basic Indicator Approach (BIA) or The Standardised Approach (TSA), while the Advanced Measurement Approach (AMA) represents the advanced approach. The method selection of credit institutions can be influenced by several factors: the expected reduction of the capital to risk-weighted assets ratio and the commensurate increase in the potential profitability of credit institutions may encourage them to select more advanced approaches. However, the costliness and time-consuming nature of the implementation of more advanced methods, the difficulties involved in obtaining supervisory approval and the possible cycle amplification effect of the chosen approach may deter institutions from the application of more advanced methods. This paper provides an overview of the methods selected at the European level<sup>2</sup> and examines the extent to which firm size may influence risk methods. After a review of the relevant literature, the article presents the method selection for the three key risks, before analysing the trends observed during changeovers to the advanced approaches in 2008–2010 and in 2010–2013.

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<sup>2</sup> Based on the EBA database.

## 2. Review of the relevant literature

Only a few papers address the relationship between institution size and risk management practice in the relevant literature. Although there are a number of analyses (e.g. *BIS 2009a*; *BIS 2009b*) outlining general best practices, they do not offer an explanation of the underlying motives. In an early phase of operational risk management (1998–2001), *Helbok and Wagner (2006)* found that less profitable institutions chose a higher level of disclosure in their operational risk profile and operational risk management practices. According to the authors, the rationale behind this is that highly profitable institutions are less “dependent” on higher transparency, whereas lower capitalised banks expect to improve outsiders’ perception of the institution by more advanced risk management practices and by a higher level of voluntary disclosure. Although *OpRisk & Compliance (2008 and 2009)* presents a database that includes the operational risk management practices and approaches of the largest 100 banks, these articles do not offer a detailed statistical analysis. Earlier research highlighted the positive correlation between the exposure to operational risk loss and firm size (see, for example, *Dahen and Dionne [2010]* or *Na et al. [2005]*). *Homolya (2013)* drew the same conclusion regarding operational risk loss on a Hungarian sample, also adding that institution size and the level of advancement of the applied operational risk approaches correlated positively both on the international and the Hungarian sample.

## 3. Data and methodology

This study relies on data included in the database of the European Banking Authority (*EBA 2015*).<sup>3</sup> The database includes separate spreadsheets for individual years (currently for the period of 2007–2013), for the following data types: core statistical data, credit risk, operational risk, market risk data, and supervisory actions and measures. The main descriptive data of the database are presented in *Table 1* below. Data for 2007 cannot be evaluated yet as the changeover to Basel II regulations was optional at the time. The topic could be investigated more easily with access to more detailed databases (credit institution level data), but the relevant databases (e.g. SNL, S&P Capital IQ) do not contain information which would lend itself to systematic analysis for the method selection. Consequently, future research should be based on an independently compiled database derived from annual reports. For lack of more detailed data, this study concentrates on systemic-level trends.

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<sup>3</sup> The database covers 31 European countries (member states of the European Economic Area (EEA), which is in the scope of the CRD/CRR regulation), of which 28 are EU Member States, and the remaining three comprise: Norway, Iceland, Liechtenstein.

<b>Table 1</b>			
<b>Descriptive statistics of the supervisory disclosure database of EBA</b>			
<b>Descriptive statistics</b>	<b>2008</b>	<b>2010</b>	<b>2013</b>
Total assets (mn €)	45 309 818	42 444 016	42 074 134
Total GDP (mn €)	11 502 644	12 706 891	13 019 818
Number of institutions	7 134	6900	6 580
Total capital requirements (mn €)	1 428 664	1 291 324	1 159 049
Total capital (mn €)	3 836 448	3 930 917	4 038 221
Tier 1 capital (mn €)	2 943 868	3 325 189	3 597 567
Tier 2 capital (mn €)	1 122 282	750 888	442 136
CAR (%)	21.50%	24.40%	27.90%
Total asset/ GDP (%)	394%	334%	323%
<i>Source: EBA (own calculation)</i>			

As shown in *Table 1*, banks' balance sheets contracted significantly between 2008 and 2013 as a result of the institutions' deleveraging efforts, which was accompanied by an improvement both in capital adequacy and in the quality of capital (i.e. a shift to Tier 1 capital) across the European banking sector.

Although data are also disclosed by investment firms, since they represent a lesser weight compared to financial intermediation as a whole, this analysis focuses on the data supplied by credit institutions. In the coming chapters simple descriptive statistics and visual inspections are used to analyse the methodological changeovers observed in 2008–2010 and 2010–2013. This is followed by the presentation of a number of statistical tests (sign test, Wilcoxon signed-rank test of the relevant samples). Finally, it is important to note that the quality of the EBA data falls short of expectations. The database required a great deal of data cleansing<sup>4</sup> before a dataset suitable for adequate analysis was produced.

#### 4. Results

The aggregate result demonstrates that the dominant part of the total capital requirement is the portion earmarked for credit risks. This is consistent with the primary objective of the banking sector, which is to mediate between savings and borrowings (*Table 2*). At the same time, in terms of general trends, the capital allocation for market risk has increased somewhat since 2008. On the one hand, this trend may be related to active market and investment services activity, which

<sup>4</sup> In the context of data cleansing, firstly, discrepancies in magnitude we corrected (e.g. where 20 was shown instead of 20 per cent). Secondly, we checked outliers in the time series and thirdly, where ratios did not add up to 100 per cent when they should have, we scaled the figures up to 100 per cent to ensure consistency.

picked up once again following a trough during the 2008 crisis; on the other hand, it may also reflect increased market volatility.

<b>Table 2</b>			
<b>Distribution of own fund requirements under Pillar 1 – European average (unweighted)</b>			
	<b>2008</b>	<b>2010</b>	<b>2013</b>
Market risk part	3.00%	3.20%	3.30%
Operational risk part	7.60%	8.70%	9.50%
Credit risk part	89.50%	88.10%	87.20%

*Source: EBA (own calculation)*

As shown by *Table 3*, the internal model-based approach cannot be considered dominant for any of the three key risk types, neither in terms of institution number nor solvency capital requirements. However, its share based on own funds requirements is higher than its share based by number for all three risk types, which suggests that larger institutions are more inclined to apply more advanced methods. As regards market risk, the higher share of the more advanced approach can be attributed to the duration of its application, which is longer than in the case of credit risk and operational risk as the advanced method was available as early as Basel I in the case of market risk. This, however, should not be considered the primary reason in itself. The real appeal of market risk approaches may lay in the fact that in the case of this risk type, model calculations are supported by high-quality, publicly available market time series and a standardised pricing approach and hence they are associated with distributions that can be adequately estimated by Value at Risk (VaR) models. Application of the advanced Internal Model Approach (IMA) for market risk declined between 2008 and 2010, presumably in response to the crisis-related default or restructuring of certain institutions which had previously applied advanced measurement approaches (e.g. Lehman Brothers, Dexia, Fortis). Headline numbers indicate that the switch to more advanced methods was far more pronounced between 2008 and 2010 than between 2010 and 2013 (change in own funds requirement percentage share: +5.9 percentage points vs. +3.1 percentage points for credit risk; +9.5 percentage points vs. +4.2 percentage points for operational risk). At the same time, it should be noted that a more detailed, country-level analysis would be needed for testing the relationship on a more robust statistical basis. The sub-chapters below include a more detailed analysis of these relationships for each risk type, in certain cases, broken down by country. Importantly, the analysis is essentially based on the assumption that a higher own funds requirements percentage share of a given approach points to a larger size proportion as well, although this assumption might be weakened by the fact that the capital requirement share may also be distorted by special factors (e.g. the special nature of the activity or the higher exposure of special institutions to certain risk categories).

**Table 3**  
**Distribution of the selected capital requirement calculation approach by number and by level of own funds requirements (unweighted averages)**

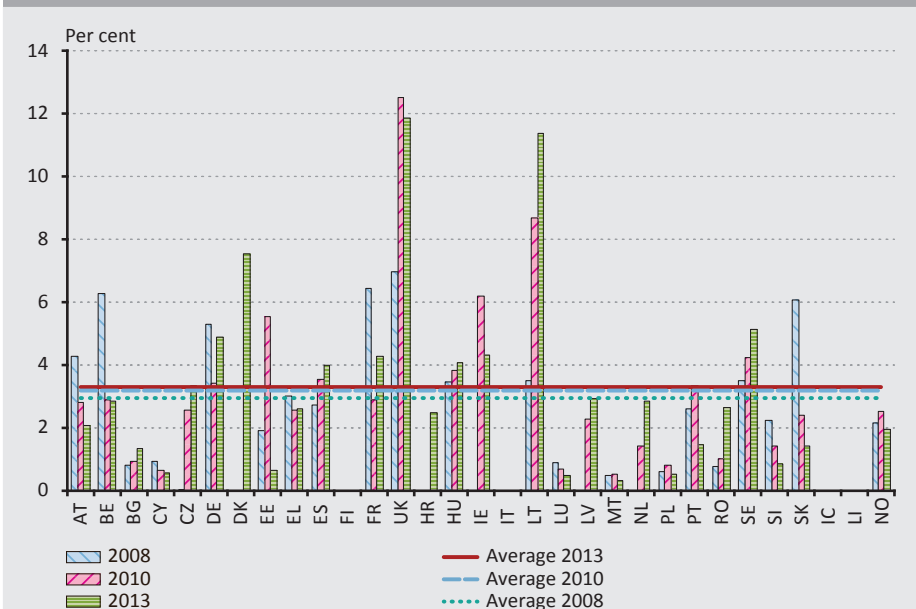
Method choice		2008	2010	2013
Market risk IMA	By number	31%	23%	19%
	By own fund req.	34%	27%	32%
Credit risk IRB	By number	13%	12%	13%
	By own fund req.	30%	35%	39%
Operational Risk AMA	By number	5%	6%	6%
	By own fund req.	8%	18%	22%

Source: EBA (own calculation)

### 4.1. Market risk

As mentioned above, based on unweighted average, the share of capital allocation for market risk was 3 per cent in 2008 and 3.3 per cent in 2013. Higher percentages were only observed in certain countries. In the United Kingdom, for example, the larger share can be explained by the depth of financial markets and banks' strong presence in such markets, while the relatively high share recorded in Lithuania

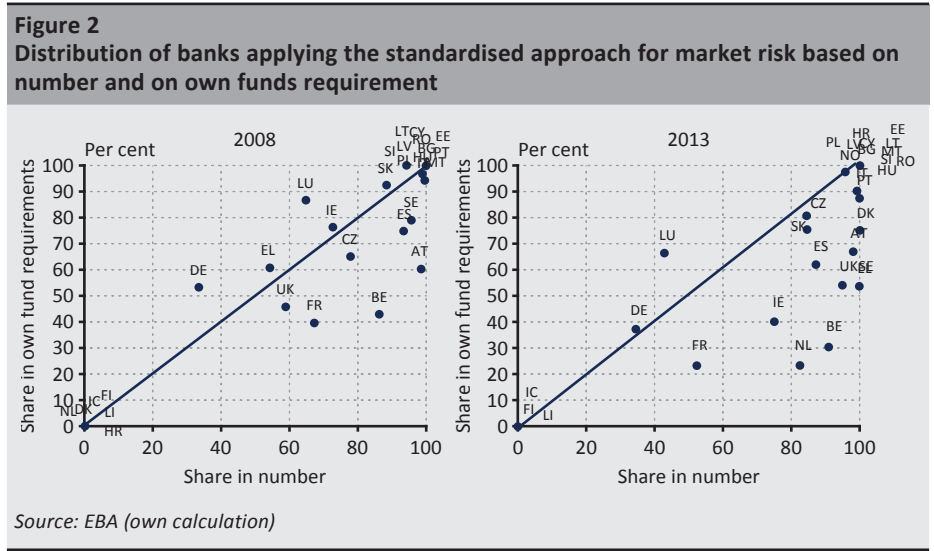
**Figure 1**  
**Ratio of own funds requirements for market risk to total own funds requirements (%)**



Source: EBA (own calculation)

appears to contradict our assumption and the outlier might merely stem from the data quality of the EBA database. In the Hungarian banking sector, the percentage of capital requirements for market risk exceeded the average recorded for the 31 European countries (EEA Member states, which are in the scope of CRD/CRR regulation) of the EBA database in all three years (at 4.1 per cent in 2013).

As shown in *Figure 2*, most banks applied the standardised approach in capital allocation for market risk. In many countries, the standardised approach was applied exclusively in 2013: in addition to Hungary, this was the case in Bulgaria, Cyprus, Denmark, Estonia, Latvia, Lithuania, Malta, Poland, and Slovenia, for example. Based on own funds requirements, the share of banks using the standardised approach falls short of the number-based percentage, which suggests that banks relying on the Internal Model Approach (IMA) are larger in size (with larger exposures to market risk). Starting from 2008, a diverging movement can be observed: application of the standardised approach increased in certain countries and declined in others. With respect to the exclusive use of the standardised approach in Hungary, it should be mentioned that in its recent presentation for bank risk managers, the MNB indicated, as a lesson learnt from the SREP reviews, that a more broad-based application of the Pillar 1 advanced market risk measurement approach would be desirable.<sup>5</sup>

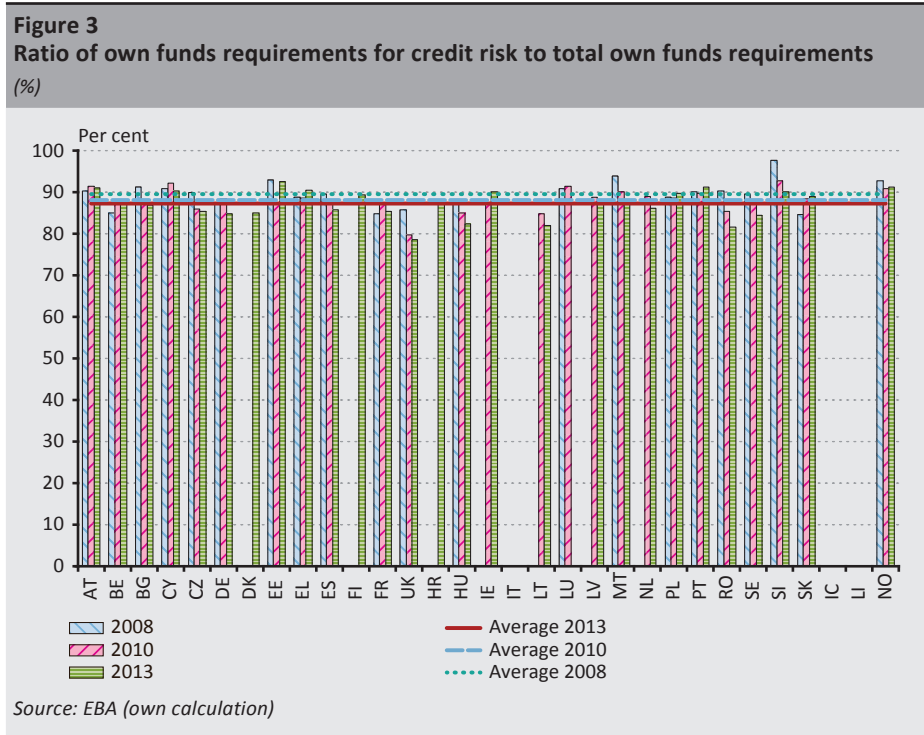


**4.2. Credit risk**

As indicated above, credit risk represents a dominant share in the capital requirement. Its unweighted average share was 89.5 per cent in 2008, 88.1 per cent in 2010 and 87.2 per cent in 2013. Individual countries do not exhibit significant

<sup>5</sup> PRMIA presentation – Old and new supervisory instruments of the central bank – SREP findings, expected methodological changes and the new instruments of the central bank, Budapest, 23 April 2015.

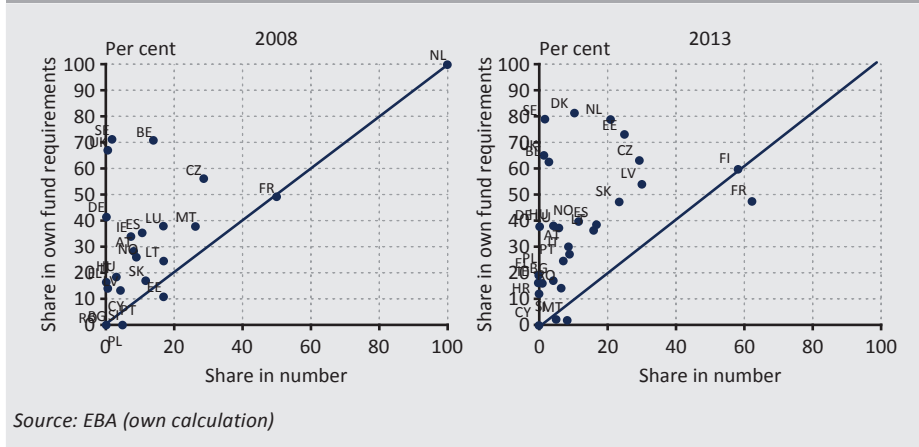
dispersion in this regard (Figure 3). In the Hungarian banking sector, the percentage share of own funds requirements for credit risk fell short of the European average of the EBA database in the review period.



Most banks apply the standardised STA approach for credit risk, both in terms of number and size (capital requirement). Between 2008 and 2013, application of the Internal Ratings Based Approach (IRB) increased: (percentage by number: -12.7% in 2008, -11.5% in 2010, -12.7% in 2013; percentage by own funds requirement: -30% in 2008, -35% in 2010, -39% in 2013): diverging (up and down) movements could be observed during the period, and it appears that changeover to the IRB approach decelerated somewhat between 2010 and 2013. Based on own funds requirements, the ratio of banks applying the IRB approach is higher than based on number, which points to the larger size of more advanced IRB banks. Similarly, in the Hungarian banking sector the own funds based share of banks using the IRB approach exceeds the number based share; at the same time, however, in the Hungarian banking sector the percentage of banks applying the IRB approach rose continuously in the review period of 2008–2013 (percentage by number: 1% in 2008 and 4% in 2013; percentage by own funds requirement: 2008: 14%, 2013: 38%). Obviously, these proportions can be also influenced by other factors. For instance, countries with a more extensive lending history may have a stronger background for more advanced credit risk approaches.



**Figure 4**  
**Distribution of banks applying the Internal Ratings Based Approach for credit risk based on number and on own funds requirement**

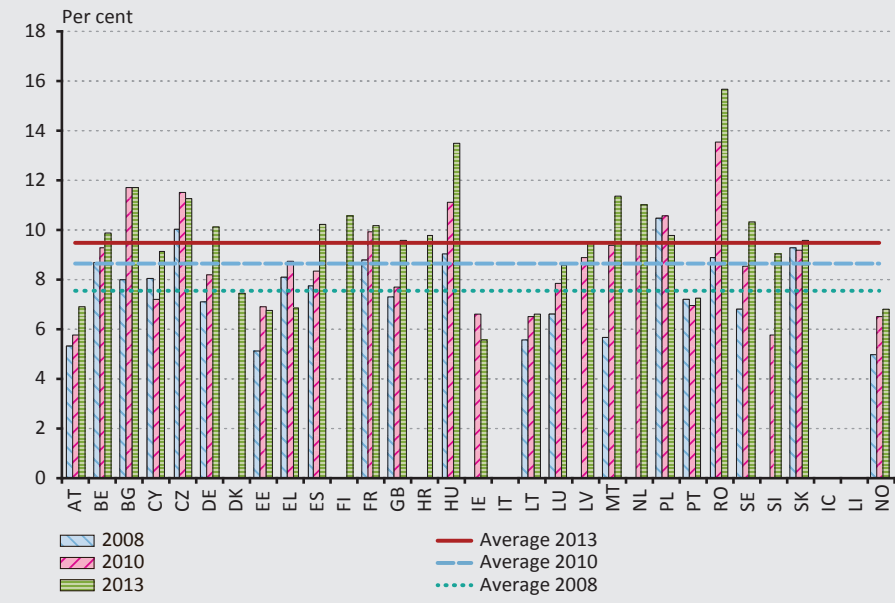


### 4.3. Operational risk

Based on the unweighted average, the share of operational risk in capital requirements amounted to 7.6 per cent in 2008 and 9.5 per cent in 2013. The dispersion in the ratio of capital requirements for operational risk to total capital requirements is smaller than observed in the case of market risk. The higher ratio observed in Central European countries (including Hungary) can be attributed to the need to prepare for higher risk with higher income, which, in turn, has an impact on capital requirements as the basis of capital requirements is gross income in the case of more basic methods (which can be roughly defined as income before impairments and amortisation). Moreover, for operational risk the calculation is based on the average gross income of the last three years; therefore, any decline in gross income only materialises gradually. By contrast, in the case of credit risk, actual exposure is considered and thus changes materialise immediately.

Application of the Advanced Measurement Approach increased only gradually in the review period. The expansion, however, was more subdued in the 2010–2013 period than between 2008 and 2010. According to 2013 data, in terms of the number of institutions, the majority of banks apply BIA, i.e. the simplest approach (BIA: 72%, TSA: 23%, AMA: 7%), while in terms of capital requirements, most banks rely on the standardised approach (BIA: 28%, TSA: 50%, AMA: 23%). There was a clear shift towards the more advanced AMA approach (percentage share based on the number of institutions: 2008: 4.8%, 2010: 5.8%, 2013: 6.4%; percentage share based on capital requirements: 2008: 8.1%, 2010: 17.7%, 2013: 21.9%). Moreover, as the ratio of banks applying the advanced AMA approach is higher on the basis of capital requirements than based on number, we may conclude that banks relying

**Figure 5**  
**Ratio of own funds requirements for operational risk to total own funds requirements**  
 (%)

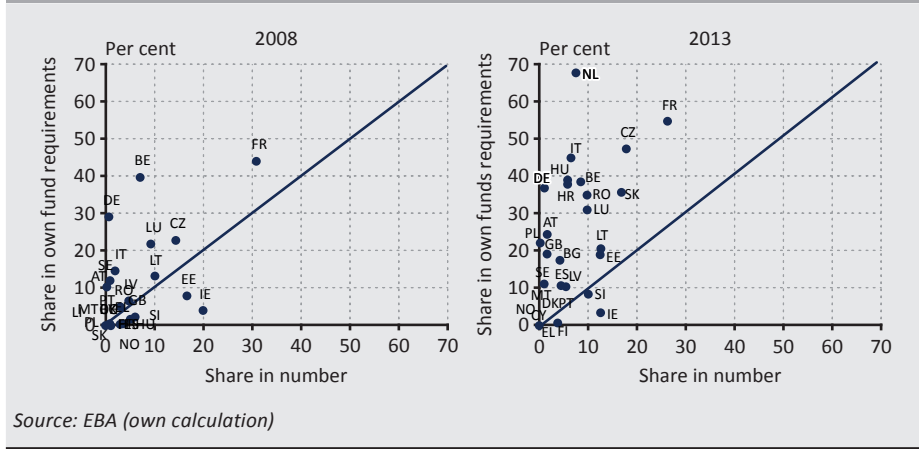


Source: EBA (own calculation)

on the advanced AMA approach are larger. Between 2010 and 2013, changeover to the AMA approach slowed. Similarly, in the Hungarian banking sector, the own funds based share of banks using the AMA approach exceeds the number based share. However, in line with the average EU trend, the percentage of banks applying the AMA approach also rose continuously in the Hungarian banking sector until it exceeded the level of the EU average (percentage by number: 2008: 1%, 2013: 6%; percentage by own funds requirement: 2008: 0%, 2013: 38%) (Figure 6). Obviously, these proportions can also be influenced by other factors. For instance, countries with more extensive operational risk databases may have a stronger background for more advanced operational risk approaches.

As mentioned above in Part 2, during the review of the literature, *Dahen and Dionne (2010)*, *Na et al. (2005)* and *Homolya (2013)* provide an overview of the positive correlation between bank size and operational risks (larger institutions face higher operational risk loss exposures, which is essentially driven by frequency). In consideration of the potentially higher operational risk loss exposure of larger institutions, it is particularly relevant to determine whether or not larger institutions select more advanced approaches.

**Figure 6**  
**Distribution of banks applying the Advanced Measurement Approach (AMA) for operational risk based on number and on own funds requirement**



**4.4. Statistical testing of the methodological changeover between 2008 and 2013 and testing of the deceleration in changeover by comparing the periods of 2008–2010 and 2010–2013**

This sub-chapter tests the hypothesis according to which the higher share of institutions applying the advanced method in 2013 compared to 2008 was statistically significant. In addition, the analysis is also intended to investigate whether or not the switch to the advanced approach decelerated after 2010. For the purposes of statistical testing, in addition to the Wilcoxon signed-rank test, the sign tests of the related samples – as included in the SPSS statistical programme package – are also applied. The null hypothesis used in these tests is that the median of the differences is 0.

Nearly the entire EU sample was suitable for testing (a total of 24 countries after having discarded those with inadequate/insufficient time series: DK, FI, NL, LI, IC, NO, HR), and a separate sample was compiled from Central and Eastern European (CEE) countries (10 countries). The Pillar 1 application of the advanced market risk approach is less widespread in CEE countries compared to the European average, but the difference is only marginal in the case of credit risk and operational risk (Table 4).

In the case of credit risk and market risk, there was a clear difference between 2013 and 2008 with respect to the share of credit institutions using the advanced method (with a statistically significant rise observed in 2013); by contrast, there was no significant difference for market risk (Table 5). However, testing the change in the percentage of users of the advanced approach between 2008 and 2010 and between 2010 and 2013 reveals that the difference is statistically negligible. As demonstrated by Table 6, there was no evidence that the switchover to more advanced approaches slowed down significantly after 2010.

**Table 4**  
**Percentage of banks applying the advanced method in Central and Eastern European (CEE) countries**

CEE average	by type	MarkRisk IMA average	CreRisk IRB average	OpRisk AMA average
2013	By number	2.80%	13.11%	9.10%
	By own fund req.	3.95%	33.94%	26.53%
2010	By number	3.60%	11.13%	7.73%
	By own fund req.	1.60%	25.69%	16.79%
2008	By number	4.11%	7.60%	4.92%
	By own fund req.	4.59%	12.36%	5.24%

Source: EBA (own calculation)

**Table 5**  
**Statistical test for the equivalence of the share of advanced approaches in 2008 and 2013**

Shares 2008 vs. 2013 (significance)	Full sample		CEE sample	
	Related sample sign test	Related samples Wilcoxon signed rank test	Related sample sign test	Related samples Wilcoxon signed rank test
MR STA Number based 2008 vs. 2013	0.607	0.363	0.625	0.273
MR STA Own fund requirement based 2008 vs. 2013	0.143	0.022	1.000	0.686
CR IRB Number based 2008 vs. 2013	0.027	0.122	0.039	0.066
CR IRB Own fund requirement based 2008 vs. 2013	0.093	0.024	0.021	0.007
OR AMA Number based 2008 vs. 2013	0.017	0.101	0.021	0.022
OR AMA Own fund requirement based 2008 vs. 2013	0.004	0.000	0.002	0.005
OR AMA Own fund requirement based 2008 vs. 2013	24	24	10	10

Note: Grey background colour indicates a significance level above 95%.  
 Source: EBA (own calculation)

**Table 6**

**Statistical test for the match between the differences in changes in the share of advanced approaches in the periods of 2008–2010 and 2010–2013 (significance)**

Share difference of 2008–2010 vs. 2010–2013 (significance)	Full sample		CEE sample	
	Related sample sign test	Related samples Wilcoxon signed rank test	Related sample sign test	Related samples Wilcoxon signed rank test
MR STA Number based 2008–2010 vs. 2010–2013	1.000	0.820	0.625	0.715
MR STA Own fund requirement based 2008–2010 vs. 2010–2013	0.002	0.006	0.375	0.138
CR IRB Number based 2008–2010 vs. 2010–2013	0.832	0.592	0.754	0.721
CR IRB Own fund requirement based 2008–2010 vs. 2010–2013	1.000	0.784	0.754	0.959
OR AMA Number based 2008–2010 vs. 2010–2013	0.286	0.445	0.344	0.878
OR AMA Own fund requirement based 2008–2010 vs. 2010–2013	0.523	0.263	1.000	0.878
N = sample size	24	24	10	10

*Note: Grey background colour indicates a significance level above 95%.  
Source: EBA (own calculation)*

## 5. Conclusions

The most important finding of this paper is the conclusion that institution size has a significant impact on the selection of the risk method. Indeed, larger institutions facing potentially greater loss exposure tend to be more motivated to apply more advanced approaches, presumably also in consideration of the fixed costs of risk management. From a systemic risk perspective, this is a positive conclusion, as institutions with heightened systemic risk effects should pursue a more thoughtful risk management practice.<sup>6</sup> The changeover to more advanced risk measurement approaches between 2008 and 2010 and between 2010 and 2013 did not exhibit a statistically significant difference in growth rate, even though a substantial deceleration could be intuited from market circumstances and other, significant regulatory changes. Interestingly, until recently regulatory authorities had made

<sup>6</sup> This conclusion, however, could be explored further in view of different other factors that may have an impact on the exposure to systemic risk besides firm size (e.g. in the case of diverging market concentration), such as substitutability and interconnectedness (see, for example, *FSB [2015]*).

great efforts to encourage the use of more sophisticated methods, but apparently, this enthusiasm was smothered by the outbreak of the financial crisis in 2008, as also expressed in a recent speech by *Stefan Ingves (2015)*, Chairman of the Basel Committee on Banking Supervision: “When it comes to addressing the weaknesses in the RWAs framework, we can distinguish between three broad areas. The first of these is policy measures that directly limit the degree of RWA variability. This could be done by placing greater emphasis on standardised measurement approaches. Another way is by limiting the flexibility banks have in determining internal model-based estimates of RWAs”. The author of this paper believes that advanced methods have both benefits and weaknesses. While thoroughly considered changes should be welcome, hopefully the advantages of advanced approaches will not be discarded during the process of rethinking the Basel regulatory framework after Basel III.<sup>7</sup>

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<sup>7</sup> Specific steps have already been taken in this process within the framework of the Basel Committee on Banking Supervision: the “fundamental review”, i.e. a revision to the market risk framework (<http://www.bis.org/bcbs/publ/d352.htm>), was issued nearly concurrently with the finalisation of this article. Moreover, consultative documents were published on Revisions to the Standardised Approach for credit risk in December 2015, and on revisions to the operational risk capital framework to introduce Standardised Measurement Approach (SMA) to replace currently existing approaches in March 2016.

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