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Which shocks matter? Relevant challenges for the European banking system

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Risk governance systems and bank outcomes. Are bank-wide initiatives relevant?

Ekaterina Seregina *

Keywords: banking, regulation, policy, governance, risk governance, risk management

Abstract

I study whether risk management system structure relates to banks profitability and stability running the analysis for top EU banks during the post-crisis period (2009-2014). I build on an index of Ellul & Yerramilli (2013) measuring the presence of typical elements of risk governance system and adding a novel component indicating the presence of bank-wide risk management initiatives. I then show in a panel setup that its significantly and positively related to the banks stability using a Z-score measure and profitability using the ROA and ROE metrics. I show those to have importance with results being robust to inclusion of bank-level controls, omitting the largest and smallest banks as well as the top and bottom institutions in terms of capital ratio levels.

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1 Introduction

Failures in bank corporate governance mechanisms are often claimed to have played a key role in the financial crisis. The paper looks at the relation between the EU bank's risk management unit strength and its performance in the post-crisis EU setting. I assess which are the characteristics of banks having strong risk governance. I check whether risk governance elements are related to a firm performance expecting those initiatives to contribute to the institution's stability. Finally, I check whether the results are driven by some other characteristics, i.e. size or capitalization.

Analysis done for crisis period (Aebi et al. (2012), Beltratti & Stulz (2012), Cerasi et al. (2015), Ellul & Yerramilli (2013), Fahlenbrach & Stulz (2009)) demonstrated significant relation between bank risk-taking, performance and selected governance mechanisms, e.g. board size, independence and compensation structure with the analysis done for samples of U.S. banks or for the international bank samples. Aebi et al. (2012) was the first to add into analysis the risk governance components: CRO reporting line (whether (s)he reports to the Board) and activeness of Risk Committee (frequency of meetings). Those were found to be significant for the bank's performance and risk-taking. Ellul & Yerramilli (2013) covered a wider set of metrics. They combined into a single index such characteristics as presence and remuneration status for the Chief Risk Officer (CRO), presence, activeness and expertise of the board level Risk Committee. Resulting index was shown to be negatively related with the realizations of the institutions' tail risk. It was also demonstrated that the reverse relation was not true, i.e. the worst performers in the 1998-99 crisis were not among those who would introduce more risk governance initiatives in the following period).

I measure risk governance strength starting with the index by Ellul & Yerramilli (2013) covering the top governance structure. I add an additional component identifying the presence of enterprise-wide initiatives - a framework of risk appetite, risk elements in the banks' strategy and the prevalence of risk culture (indicated by the description in the annual reports of the initiatives aimed at raising the risk awareness of employees). I refer to the reconstructed version of Ellul & Yerramilli (2013) index as "governance" index and to the new part as "norms" index. Thus current analysis makes the following contributions. I first check whether the US - relevant findings are valid for the European setup. I also check whether bank-wide initiatives matter as much as the governance ones in limiting the banks' risk-taking.

I document the following tendencies for the European market. The strong risk management function is an attribute of larger banks with lower quality loan portfolios. Weaker risk management is an attribute of banks where the roles of CEO and Chairman of the Board are combined. Banks with CEO combining the two roles also tend to be less stable. Larger boards are associated with stronger risk governance, but lower risk norms. Follow-

ing the regulatory changes in 2011 and 2013, there is an upward trend with larger banks introducing the elements of risk system before the official regulation publication in 2013. Smaller banks update their risk systems following the official publication. The level of risk management strength tends to be higher for the larger banks. Overall the increase in the risk governance index was associated with less risk-taking (as measured by the Z-scores) and higher profitability (as measured by ROA and ROE). In particular, an additional risk governance initiative raises the Z-score (the measure I use to measure bank's stability indicating whether institution's ROA is high enough to cover its capital requirements) by 0.135 to 0.179 which is 5.2% to 8.0% of the mean sample value. Profitability (measured by ROA) is affected by the top governance initiatives, not the ones concerning the norms. The impact goes from 0.188 to 0.208 percentage points which is considerable given the mean ROA of 0.05% (though it is less significant given the standard deviation of 0.93).

In the subsample analysis, I make sure that my results hold when excluding the top/bottom banks in terms of size and capital ratios. Results are robust to removing the largest and the smallest institutions in terms of size. The only exception is that the governance index is becoming irrelevant for profitability when the largest institutions are removed. When I remove the better-capitalized institutions (with the highest Tier 1/Assets ratio) norms index loses significance while the governance one stays relevant. On the contrary, the governance index becomes insignificant when worst capitalized banks are omitted from the sample. Together these results suggest that risk governance at the top level is important when the institutions are relatively closer to insolvency while risk norms bring additional stability and profits to those which are already at the relatively stable position.

I repeat the analysis looking into the alternative definitions of the risk governance index. I make sure the results are robust to the binary definition (setting an index to 1 if the value exceeds the sample median in a given year and zero otherwise). I also perform the principal components' analysis for the selected elements and use the first principal component to measure risk governance strength. The results remain robust in both modifications. I then do the following check: instead of manual information collection I use the automated search on the word risk and on the list of the words in general related to an uncertainty measure developed by Tim Lougran (see Loughran & McDonald (2011) for the list of words used). Such a measure would capture the institutions' artificial attention to risk, i.e. an increase in the volume of the report devoted to risks' discussion which is not necessarily supported by some real initiatives behind. When I consider the Z-scores both risk and uncertainty metrics are insignificant for the institution's stability. Similarly, the results are shown for the ROA: the coefficients on risk-norms index substitutes become negative and significant in one of the specifications. This gives an evidence of risk governance elements being important on their own, i.e. a report's risk/uncertainty tone is not related to the outcomes (as opposed to particular

risk governance initiatives detected).

The remainder of the paper is organized as follows. Section 2 covers the relevant literature. Section 3 describes the dataset and provides descriptive statistics. Section 4 presents the results of the empirical analysis. Section 5 gives the robustness checks. Section 6 concludes.

2 Literature and major hypotheses

The paper makes contribution to the strand of literature on corporate governance and firm performance. The issue of governance-performance link was a subject of multiple theoretical and empirical studies. First group reviewed by Shleifer & Vishny (1997) and Baker & Anderson (2010) looked into the relation between governance and performance for the non-banking institutions. The governance features found to be relevant for performance outcomes included the CEO characteristics (age, tenure, education, previous expertise), board structure (i.e. size, expertise, proportions of inside and outside directors, female representation), ownership structure (concentration, government ownership rights, fraction of institutional investors), management compensation schemes (i.e. proportion of variable pay, bonus deferrals and cash/stock proportions), shareholder protection rules as well as the activities of the board committees (i.e. size, expertise of memebers, frequency/length of the meetings).

Given the different nature of banking and non-banking institutions (with banks having higher levels of leverage with reliance on deposit funding, differences in complexity of business models and need to comply with strict regulatory requirements) the governance-performance link is analyzed for them separately. De Haan & Vlahu (2016) reviewed the governance characteristics which were found to be beneficial for the performance. Those included small board, a large proportion of independent directors, the existence of committees (audit, compensation, nomination), anti-takeover provisions, board independence, separation of CEO and Chairman. Fahlenbrach & Stulz (2009) concentrated on CEO compensation schemes and ownership. Having performed the analysis for a sample of European banks they found no evidence of superior results for institutions with stronger CEO incentives. On the contrary, it turned out that institutions with a higher fraction of equity compensation for their CEOs were among the worst performers during the recent financial crisis. Beltratti & Stulz (2012) studied the international sample of banks in July 2007 - December 2008. They showed that institutions with shareholder-friendly boards have on average shown worse performance during the crisis (more risk-taking and greater loan reduction). Worse stock performance during a crisis was shown to be negatively related to board independence and institutional ownership (see Erkens et al. (2012) for an international sample of banks) and positively related to boards financial exper-

tise (Cornet (2010) for a sample of U.S. banks). Cornet (2010) looked into 300 publicly traded U.S. banks and demonstrated that better corporate governance (more independent board, higher pay-for-performance sensitivity, increase in insider ownership) is positively related to performance. Adams & Mehran (2012) provided arguments in favor of board members independence gave that the outsiders are supposed to be better monitors for the management.

Aebi et al. (2012) was one of the first to switch from the broader governance characteristics to the bank-specific area of risk governance. The importance of independent risk management function has been emphasized many times by regulators and policymakers. In fact, the role of risk management in the governance structure is one of the distinct features of financial institutions. Contemporaneously Ellul & Yerramilli (2013) have studied the relation between risk governance and performance for 74 U.S. bank holding companies. They used an index comprising the indicators related to CRO power within the bank as well as the presence and activeness of the risk committee. It was shown that stronger risk governance is positively related to banks operating performance and negatively to the size of tail risk. The current paper is building on that index and after certain amendments assessing whether risk governance is important for a sample of European banks.

This paper extends the previous studies by extending the set of risk governance characteristics under analysis. It looks into the usual measures of risk governance and adds on top the component which is a way to measure the risk norms of the organization. This component adds together the presence in the institution of certain practices ensuring the risk awareness of personnel on multiple levels of an organization. The first element we look at is the presence of a risk appetite statement which usually comprises the set of rules defining the capacity to take the risk and the managers willingness to use it. The second one refers to risk strategy (i.e. whether the institution includes the risk elements into its overall strategy). Finally, we look into what is typically referred to as risk culture which comprises the set of activities to promote the risk awareness in the institution.

The questions to be answered are the following. Firstly, we assess which banks tend to have strong risk governance. We then look into the episodes of regulation tightening and see which institutions adjust to the new standards faster. Next, we assess whether risk governance elements are related to firm performance (we expect these initiatives to contribute to institutions stability). Finally, we check whether any of the banks characteristics strengthen/weaken the link between risk governance and performance.

3 Dataset and descriptive statistics

The analysis is done for 2009-2014 period. The list of banks (shown in Appendix) includes the the largest institutions at the EU level for which I have the information on risk index

and the bank-level controls (99 institutions overall). I use the data on remuneration from Capital IQ and annual reports to get the data on Chief Risk Officer's remuneration (if available). I use publicly available annual, corporate governance and Pillar 3 disclosure reports to obtain the remaining elements of the risk index by Ellul & Yerramilli (2013). I get the data on bank-level controls from SNL Financial.

3.1 Risk Index

First part of my index is similar to one used by Ellul & Yerramilli (2013). I use two binary 0/1 indicators measuring the importance of an executive responsible for risk management at a bank level - Chief Risk Officer (CRO). First one indicates the presence of such a manager in the bank, second determines whether she is in the board of directors. Next two binary 0/1 components are related to the board of directors committee performing the risk oversight (Audit or Risk). First captures its activeness (meeting more frequently than median during the year). Second indicates that the committee is specialized in risk matters (which are separated from the audit and compliance matters). We add to the previously used risk governance measures the elements of what we refer to as risk norms of a bank. Finally I include the data on whether the Chief Risk Officer is in the top-10 executives in the banks. I have two deviations from the original index. It had a component indicating Economics/Finance background for at least on of the Risk committee members. Once I checked that it turned out I would not have any variation in such an index, i.e. all the committees in the banks of my sample would have the adequately skilled member. Secondly I have significant positive correlation between the CRO/CEO remuneration (present in the original index) and the Top-10 remuneration indicator. However, I am not able to retrieve the exact ratio for at least one third of my sample. Thus I stick to the binary top-pay measure in my calculations

The construction of an index to which I refer as "norms" index was done in the following way. I check the reports looking for the three components of a sound risk management system mentioned in the respective guidelines of Bank of International Settlements, OECD, and Financial Stability Board. The first element is the presence of risk appetite statement which usually comprises the set of rules defining the capacity to take the risk (with a well-defined system of risk measures in use) and the managers willingness to use it (i.e. how much risk they are ready to accept given the expected profitability). The second one refers to risk strategy which is defined as the description of the overall and the risk management objectives, actions, and priorities of the risk department with a focus on their implementation in the strategic/tactical plan (1-2 years time horizon). Finally, we look into what is typically referred to as risk culture which comprises the set of activities to promote the risk awareness in the institution and shapes the personnel's decisions on risk-taking. (i.e. reports should specifically mention activities like risk training aimed at

the increase in the risk culture levels).

For the base version of the index, I focused on the instances where relevant initiatives were mentioned in any of the standard reports. Table 1 for the relevant words and wording combinations). Once those words/wording combinations were detected I cross-checked the relevant paragraphs to make sure the instances I detected are in fact referring to risk governance elements I am looking for. To give an example I would make sure that "risk training" would refer to a program in use rather than a plan to launch it in several years. Similarly, I would check that "risk appetite" stands for the set of risk limits relevant for the bank, and not for the "we aim to match the rise in our clients' risk appetite via our product offering".

Evolution of elements over time (Tables 2 and 3) shows the tendency to strengthen the risk governance over time. Most institutions have had a designated risk officer at the beginning of the period or have assigned this role by 2014. Most of the banks (96% of bank-year observations) have a designated risk responsible while fewer institutions keep him/her on the board. Around half sample has a dedicated and/or active committee following the risk issues. Fewer banks have introduced enterprise-wide initiatives. Other elements tended to be introduced throughout the period creating the appropriate variation for the chosen measures.

The baseline analysis is done for the equally weighted index, in the robustness checks section, we confirm that the results hold if we extract the first principal component of the index elements. Table 4 shows the correlations between the index elements. The correlations are mostly positive so that the elements complement each other. The only exception is the negative association between committee dedication and activeness, i.e. if the committee is risk-specific it meets less frequently.

Table 1: Wording search for the "risk norms" measure and robustness checks

Risk appetite	risk appetite, appetite for risk, intolerance to risk, tolerance to risk, risk bearing capacity, risk capacity, risk limit*
Risk strategy	risk management strategy, risk strategy
Risk culture	control culture, risk awareness, risk culture, risk norms, risk training

Table 2: Evolution of risk index components over years

Year	CRO	CRO in Board	CRO/CEO salary	CRO in Top 10	Dedic. committee	Act. Com.
Overall sample	0.96	0.36	0.56	0.39	0.45	0.52
2009	0.96	0.36	0.56	0.32	0.33	0.53
2010	0.96	0.34	0.59	0.35	0.39	0.50
2011	0.96	0.34	0.55	0.35	0.42	0.48
2012	0.96	0.34	0.55	0.39	0.45	0.51
2013	0.98	0.38	0.56	0.43	0.48	0.57
2014	0.98	0.40	0.56	0.46	0.61	0.53

Table 3: Evolution of risk index components over years

Year	Risk Appetite	Risk Strategy	Risk culture
Overall sample	0.80	0.74	0.51
2009	0.64	0.63	0.36
2010	0.74	0.70	0.41
2011	0.78	0.71	0.46
2012	0.83	0.74	0.53
2013	0.87	0.77	0.59
2014	0.94	0.88	0.68

Table 4: Correlation between index elements

	CRO	In board	Dedic. com.	Active com.	CRO/CEO salary	CRO - top 10 paid	Risk Appetite	Risk Strategy	Risk Culture
CRO	1								
In board	0.099	1							
Dedic. committee	0.129*	0.294***	1						
Active committee	-0.011	-0.155**	-0.196***	1					
CRO/CEO salary	0.009	0.349***	0.231***	-0.231***	1				
CRO - top 10 paid	-0.053	0.419***	0.190***	-0.027	0.312***	1			
Risk Appetite	0.331***	0.113*	0.185***	-0.028	0.189***	0.153**	1		
Risk Strategy	0.106*	0.270***	0.214***	0.070	0.0799	0.082	0.150**	1	
Risk Culture	0.128*	-0.079	0.164**	0.036	-0.055	0.104	0.193***	-0.098	1

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The baseline analysis is done for the equally weighted index, in the robustness checks section I confirm that the results hold if we extract the first principal component of the index elements.

3.2 Outcome variables

The baseline indicator of bank risk-taking used in the analysis is a z-score. It associates the amount of risk taken by the bank with the probability that a bank becomes insolvent, i.e. doesnt have enough equity to cover its losses (E¡-). With an assumption of a normal distribution of profits the inverse probability of insolvency the inverse of insolvency probability is defined as: $P = \frac{\frac{E}{A}+\mu_{ROA}}{\sigma_{ROA}}$

where ROA=(Net income)/Assets is the return on assets and E/A stands for the equity to assets ratio. A high z-score implies a lower chance of turning insolvent. There is no consensus on which is the best way to construct the time-varying z-scores for panel analysis. We use the approach which Le Petit and Strobel (2013) found to be superior when comparing the alternatives present in the literature suggests using the current value of equity to assets ratio together with the mean and standard deviation of ROA computed using the whole sample of available data. Given the high skewness of this measure, a natural logarithm of the resulting z-scores is used for the regression analysis (we would further refer to the transformed indicator as z-score for simplicity). The data for computations were obtained from SNL Financial. I also employ ROA as a measure of banks' profitability. Those two indicators give me an option to check whether risk governance strengthening makes the bank more stable and whether stability is achieved at a cost of lower profitability. Table 5 shows the descriptive statistics.

Table 5: Descriptive statistics for outcome variables

Variable	Mean	SD	min	p25	p50	p75	max
Z-score	2.60	1.04	-0.74	2.10	2.74	3.29	4.56
ROA	0.05	0.93	-3.71	0.02	0.23	0.48	1.65
ROE	-0.01	0.21	-1.04	0.01	0.04	0.08	0.23

3.3 Bank level controls

I use the indicator of banks size (measured by the logarithm of assets), capitalization (Tier 1 / Assets), portfolio quality (ratio of non-performing loans to assets), funding structure (fraction of non-customer deposits), operating income growth and diversity of income sources defined as:

$$Diversity = |\frac{1-(netinterestincome-otherincome)}{operatingincome}| \quad (1)$$

I add the characteristics of banks corporate governance system such as board size, the proportion of independent directors, separation of CEO and Chairman roles and the changes of CEO during the sample period. I control for large restructuring by adding a dummy for banks experiencing more than 20% growth in their assets. We also make sure that the institutions in the sample are indeed deposit-taking and restrict deposits to assets ratio to 20%. As a result, I evaluate how big is a proportion of non-traditional banking income for each of the institutions in our sample. I use the logarithm of assets and the logarithm of NPL ratio to get a more appropriate measure which does not suffer from large outliers. Table 6 presents the descriptive statistics for control variables and 7 shows the statistics for groups with high and low levels of risk index (defined as RMI above/below the median). We have a sample of large banks with a mean asset size of 277bn, Tier 1/Assets ratio of 6%, relatively high NPL ratios for certain institutions (mean proportion of 6% while the maximum is reaching 25%). The sample is also quite diverse in terms of deposit types with certain institutions relying heavily on non-customer deposits. Board size varies from 6 to 48 directors with a mean value of 18.

Table 6: Descriptive statistics for control variables

Variable	Mean	SD	min	p25	p50	p75	max
Assets (bn. euro)	277.7	445.3	1.39	37.41	96.97	2471	2516
Tier 1/Assets	0.06	0.02	0.02	0.04	0.05	0.07	0.12
NPLs/Assets	0.06	0.06	0.00	0.02	0.03	0.07	0.25
Income source diversity	0.33	0.21	-0.51	0.25	0.35	0.45	0.80
Funding fragility	0.35	0.23	0.01	0.19	0.31	0.46	0.98
Operating income growth	0.01	0.29	-1.03	-0.07	0.02	0.10	0.90
Board size	17.93	7.76	6	12	16	21	48
Board independence	0.50	0.21	0.12	0.33	0.52	0.67	0.89
CEO/Chairman separation	0.51	0.50					
CEO change	0.16	0.37					

4 Risk governance and bank characteristics

I start with an analysis relating the risk governance strength to the bank-level characteristics. Tablle 8 presents the panel estimation results of the following specification.

$RiskIndex_{i,t} = \alpha + \beta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$

I first run the fixed effects regressions controlling for bank balance sheet and income statement characteristics (specifications 1, 3 and 5). I then add the set of corporate governance indicators to see whether the estimates remain relevant (specifications 2, 4, 6). Control variables are lagged one year with respect to the risk index measure. Standard

Table 7: Descriptive statistics for the bank level variables by value of risk index

Variable		2011	2012	2013	2014	Overall
Assets	Low index	242.7	228.1	217.2	202.3	242.7
	High index	422.6	388.6	424.9	436.0	422.6
	Difference	-179.87	-160.52	-207.75*	-233.69*	-179.87
Tier 1 capital / Assets	Low index	0.05	0.05	0.06	0.06	0.06
	High index	0.05	0.05	0.06	0.06	0.05
	Difference	0.00	0.00	0.01	0.00	0.00
NPL/Assets	Low index	0.05	0.06	0.08	0.08	0.06
	High index	0.05	0.06	0.07	0.07	0.06
	Difference	-0.01	0.00	0.01	0.01	0.01
Funding fragility	Low index	0.39	0.42	0.35	0.37	0.37
	High index	0.35	0.30	0.32	0.29	0.33
	Difference	0.04	0.12**	0.03	0.07	0.04*
Diversity of income sources	Low index	0.74	0.67	0.82	0.92	0.79
	High index	0.78	0.80	0.82	0.67	0.74
	Difference	-0.03	-0.13	0.00	0.25**	0.05
Operating income growth	Low index	-0.03	-0.01	0.01	0.03	0.02
	High index	-0.10	0.07	0.07	-0.06	-0.01
	Difference	0.07	-0.08	-0.06	0.08	0.02
Board Size	Low index	16.02	15.46	16.57	16.19	16.53
	High index	20.85	20.33	19.57	18.51	20.19
	Difference	-4.83**	-4.86**	-3.00	-2.33	-3.65***
Board Independence	Low index	0.48	0.50	0.51	0.51	0.49
	High index	0.53	0.53	0.54	0.53	0.53
	Difference	-0.06	-0.03	-0.03	-0.02	-0.04*
CEO/ Chairman combination	Low index	0.49	0.45	0.44	0.42	0.47
	High index	0.55	0.55	0.54	0.49	0.54
	Difference	-0.06	-0.10	-0.10	-0.07	-0.08
CEO change	Low index	0.22	0.21	0.10	0.16	0.18
	High index	0.10	0.26	0.21	0.08	0.17
	Difference	0.12	-0.05	-0.12	0.08	0.00

errors are clustered at the bank level. I obtain the following results. Stronger governance is associated with larger size and worse portfolio quality. Larger boards tend to adopt more elements of risk governance at the board level and less enterprise-wide measures. Splitting the roles of chief executive and board of directors chairman is associated with more risk governance elements adopted. Finally, large restructuring (measured by large asset changes) is associated with more risk governance measures adopted.

Table 8: Risk governance and bank characteristics in 2009-14

Specification	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	Total index	Total index	Gov. index	Gov. index	Norms index	Norms index
Size	1.247**	1.184**	0.665**	0.541	0.582**	0.643**
	(0.489)	(0.546)	(0.322)	(0.380)	(0.288)	(0.304)
Tier 1/Assets	-5.265	-4.039	-1.497	-0.680	-3.768	-3.359
	(5.649)	(5.814)	(3.247)	(3.397)	(3.726)	(3.308)
NPL/Assets	4.010**	2.683	1.002	0.832	3.009**	1.851
	(1.532)	(1.675)	(1.174)	(1.128)	(1.266)	(1.341)
Income diversity	-0.084	-0.101	-0.066	-0.084	-0.018	-0.016
	(0.108)	(0.122)	(0.072)	(0.081)	(0.070)	(0.084)
Funding fragility	-0.660	-0.917	-0.696	-0.668	0.036	-0.249
	(0.611)	(0.696)	(0.427)	(0.465)	(0.411)	(0.416)
Oper. inc. growth	0.077	0.046	0.060	-0.033	0.017	0.079
	(0.077)	(0.083)	(0.068)	(0.053)	(0.047)	(0.074)
Board size		-0.303		0.532*		-0.836***
		(0.384)		(0.281)		(0.246)
Board independence		1.057**		0.509		0.548
		(0.508)		(0.368)		0.361)
CEO/Chairman combination		-1.015***		-0.471***		-0.544***
		(0.214)		(0.153)		(0.191)
Change of CEO		-0.080		-0.104		0.025
		(0.107)		(0.077)		(0.074)
Large restructuring		0.411**		0.234		0.178
	(0.189)		(0.150)		(0.172)	
Year FE	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES

The table shows the estimates of β from $RiskIndex_{i,t} = \alpha + \beta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$
Standard errors are clustered at a bank level and shown in parentheses
*** - p<0.01, ** - p<0.05, * - p<0.1

5 Risk governance and performance

5.1 Baseline regressions

Moving to the performance evaluation we estimate the following specification:

$$Performance_{i,t} = \alpha + \beta RiskIndex_{i,t-1} + \theta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$$

δ_t stands for the time fixed effect, γ_i goes for the bank fixed effect. The main performance indicator considered is Z-score measuring the banks stability (i.e. distance to default). Specifications (1), (3), (5) and (7) consider the balance sheet and income statement characteristics as controls. Specifications (2), (4), (6) and (8) add the corporate governance controls.. Control variables are lagged one year with respect to the performance measure. Standard errors are clustered at the bank level. Table 14 shows the relevant outcomes for specifications including the overall index as well as the ones separating the two components.

Panel A shows that risk elements matter for bank stability. I.e. institutions increasing

the strength of risk management unit tend to be farther from the default. This holds both when the elements are assessed as a sum and when the sub-indices are considered separately. The result is also economically significant: an additional risk governance initiative raises the Z-SCORE by 0.135 to 0.179 which is 5.2% to 8.0% of the mean sample value. Panel B demonstrates the ROA outcomes. Profitability is affected by the top governance initiatives, not the ones concerning the norms. The impact goes from 0.188 to 0.208 percentage point which is considerable given the mean ROA of 0.05%. Panel C shows the results for the ROE metric.

Table 9: Risk governance and bank outcomes

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Risk governance and stability								
Total index (lagged 1Y)	0.098**	0.123***						
	(0.040)	(0.041)						
Governance Index (lagged 1Y)			0.068	0.092*	0.078	0.104**		
			(0.053)	(0.053)	(0.053)	(0.052)		
Norms Index (lagged 1Y)			0.134*	0.158**			0.087	0.123*
			(0.075)	(0.078)			(0.068)	(0.071)
Panel B. Risk governance and ROA								
Total index (lagged 1Y)	0.195***	0.188***						
	(0.057)	(0.056)						
Governance index (lagged 1Y)			0.208**	0.203**	0.226**	0.220**		
			(0.092)	(0.102)	(0.090)	(0.010)		
Norms index (lagged 1Y)			0.181	0.172			0.137	0.157
			(0.112)	(0.116)			(0.096)	(0.104)
Panel C. Risk governance and ROE								
Total index	0.029***	0.026***						
	(0.010)	(0.010)						
Governance index			0.024*	0.024*	0.027**	0.027**		
			(0.012)	(0.013)	(0.012)	(0.012)		
Norms index			0.035*	0.027			0.028	0.024
			(0.020)	(0.021)			(0.019)	(0.021)
Financial controls	YES	YES	YES	YES	YES	YES	YES	YES
Governance controls	NO	YES	NO	YES	NO	YES	NO	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES	YES	YES

Panel A shows the estimates of β from $Z - score_{i,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$
Panel B shows the estimates of β from $ROA_{i,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$
Panel C shows the estimates of β from $ROE_{i,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$
Standard errors are clustered at a bank level and shown in parentheses , *** - p<0.01, ** - p<0.05, * - p<0.1

An important point to make concerns the endogeneity concerns. Time invariant factors which would influence both the choice of risk governance strength and the performance oucome are captured by the bank fixed effects. Further, I make additional checks including the country-year fixed effects or size-year fixed effects (capturing the important factors affecting banks of similar size group or jurisdiction in a given time period). Finally, I employ the Arellano-Bond estimation procedure to tackle the potential reverse causality

issues. However, should the banks be responding to the worsened performance they would do so by strengthening the risk system which would push the β estimates downwards. Thus if anything such a concern would make the results obtained in the baseline estimation stronger.

6 Robustness checks

6.1 Subsamples analysis

Risk governance mechanisms (especially those related to organizational structure) are likely to be related to the traditional corporate governance mechanisms which were proven to matter for firms performance in the corporate governance literature. One important difference between the U.S. and EU is related to the structure of the board of directors. While U.S. banks typically have a 1-level board, some of the European banks have two levels executive board and supervisory board. Similarly (as demonstrated in the analysis above) the results might be driven by banks size and capitalization. Here I repeat the previous panel estimation excluding the top/bottom banks by size (columns 1 and 2), Tier 1/Assets ratio (columns 3 and 4) or splitting them with respect to their governance structure (columns 5 and 6). Table 10 shows the outcomes. Results are robust to removing the largest and the smallest institutions with the only exception of governance index becoming irrelevant for profitability when the top institutions are removed. When I remove the institutions with the highest Tier 1/Assets ratio Norms index loses significance while Governance one stays relevant. On the contrary, the Governance index becomes insignificant when worst capitalized banks are dropped from the sample. Together those results suggest the risk governance at the top level to be important when the institutions are relatively closer to insolvency while risk norms bring additional stability and profits to those which are already at the relatively stable position. Finally, my results are robust to the sample being restricted to banks with a 1-level board structure (Board or Executive Board only). At the same banks having two levels of top governance structure (Executive and Supervisory Board) seem not to benefit from the additional risk governance initiatives. The latest set of results though has to be seen with caution given that the sample size is halved in both cases.

Table 10: Subsample analysis

Panel A - results for the Z-SCORES

	Excl. 20% biggest	Excl. 20% smallest	Excl. 20% high cap.	Excl. 20% low cap.	1-tier board	2-tier board
Total index (lagged 1Y)	0.213***	0.176***	0.144**	0.126**	0.253***	0.077
	(0.065)	(0.065)	(0.066)	(0.060)	(0.069)	(0.050)
Governance index (lagged 1Y)	0.169**	0.130*	0.137*	0.043	0.307***	0.058
	(0.084)	(0.077)	(0.074)	(0.068)	(0.097)	(0.075)
Norms index (lagged 1Y)	0.269*	0.226*	0.150	0.209*	0.197	0.103
	(0.137)	(0.123)	(0.102)	(0.115)	(0.146)	(0.080)

Panel B - results for ROA

	Excl. 20% biggest	Excl. 20% smallest	Excl. 20% high cap.	Excl. 20% low cap.	1-tier board	2-tier board
Total index (lagged 1Y)	0.235***	0.223***	0.152**	0.134**	0.231***	0.094
	(0.066)	(0.074)	(0.070)	(0.065)	(0.085)	(0.067)
Governance index (lagged 1Y)	0.206	0.196*	0.225**	0.048	0.379**	0.028
	(0.124)	(0.113)	(0.094)	(0.126)	(0.144)	(0.132)
Norms index (lagged 1Y)	0.271*	0.250*	0.085	0.219**	0.0881	0.184*
	(0.160)	(0.135)	(0.093)	(0.103)	(0.201)	(0.094)

Panel C - results for ROE

	Excl. 20% biggest	Excl. 20% smallest	Excl. 20% high cap.	Excl. 20% low cap.	1-tier board	2-tier board
Total index (lagged 1Y)	0.235***	0.223***	0.152**	0.134**	0.231***	0.094
	(0.066)	(0.074)	(0.070)	(0.065)	(0.085)	(0.067)
Governance index (lagged 1Y)	0.206	0.196*	0.225**	0.048	0.379**	0.028
	(0.124)	(0.113)	(0.094)	(0.126)	(0.144)	(0.132)
Norms index (lagged 1Y)	0.271*	0.250*	0.085	0.219**	0.0881	0.184*
	(0.160)	(0.135)	(0.093)	(0.103)	(0.201)	(0.094)
Observations	284	290	279	306	200	168
R-squared	0.852	0.856	0.875	0.861	0.834	0.930
Year FE	YES	YES	YES	YES	YES	YES
Bank FE	YES	YES	YES	YES	YES	YES

Panel A shows the estimates of β from $Z - score_{i,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$

Panel B shows the estimates of β from $ROA_{i,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$ Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6.2 Alternative index definitions

I check whether the results hold if we redefine the index. First of all, I use the binary variable (high index) set to one if the index exceeds the cross-sectional median in a given year and zero otherwise. Alternatively, Instead of equal weighting, I perform the estimation with a principal components analysis scheme. In this way, the appropriate weights are determined by the data points rather than the subjective weights assignment. I use the first principal component of the index components. Repeating the estimations for the Z-scores we confirm the initial findings: higher risk index level is associated with a greater financial stability. As before we have a one-year lag for the control variables and cluster standard errors at the bank level. Results are shown in Table 11.

Table 11: Alternative index definitions

	(1)	(2)	(3)	(4)
High Index	0.128*	0.203**		
	(0.076)	(0.079)		
Index (principal components)			0.065*	0.097**
			(0.039)	(0.043)
Financial controls	YES	YES	YES	YES
Governance controls	NO	YES	NO	YES
Bank and Year FE	YES	YES	YES	YES

The table shows the estimates of β from $RiskIndex_{i,t} = \alpha + \beta Controls_{i,t-1} + \gamma_i + \delta_t + \epsilon_{i,t}$
Standard errors are clustered at a bank level and shown in parentheses
*** - p<0.01, ** - p<0.05, * - p<0.1

To do a further robustness check and check that my analysis does not simply capture the general rise in discussions of risk issues following the crisis period I use two alternative text measures. I first count the mentioning of the word "risk" in the same series of documents as before (scaled by the overall text length). I then use the uncertainty list developped by Tim Lougran (see Loughran & McDonald (2011)) to look for a wider set of words which would again capture the generic tone of the reports, but not focus on the risk initiatives. Selected words from the dictionary are shown in Table 17. Results of regressing Z-scores, ROA and ROE on Risk Governance index, alternative indices and the previously used sets of controls are shown in Table 13

Results are the following. When I consider the Z-scores both risk and uncertainty metrics are insignificant for institution's stability measure. Thus automatic detection of the related terms in the report's text does not detect the attention to risk. Similar results are shown for the ROA: the coefficients on risk-norms index substitutes become negative and significant in one of the specifications. Thus a report's tone detected by our measures is likely to reflect poor performance rather than measure the "risk norms".

Table 12: Loughran uncertainty list

C: cautious*, clarification*, conceivabl*, conditional, confus*, contingen*, could, crossroad*
I: imprecis*, improbab*, incomplete*, indefinite, indetermin*, inexact*, instabilit*, intangibl*
R: - risk* random*, reassess*, recalculat*, reconsider*, reexamin*, reinterpret*, revise*, roughly, rumors
S: - seems, seldom*, sometime*, somewhat, somewhere, speculat*, sporadic*, sudden*, suggest*, susceptibility
U: - uncertain*, unclear, undecided, undefined, undesignated, undetectable, undetermin*, undocumented, unexpect*, unforecasted, unforeseen

Table 13: Alternative definitions for "risk norms"

Panel A - results for the risk count						
	Z-score	Z - score	ROA	ROA	ROE	ROE
Governance index (lagged 1 year)	0.058	0.092	0.152***	0.135**	0.035**	0.037**
	(0.060)	(0.061)	(0.052)	(0.058)	(0.014)	(0.014)
Risk measure (lagged 1Y)	-0.047	0.026	-0.130	-0.304	-0.019	-0.033
	(0.149)	(0.140)	(0.212)	(0.205)	(0.046)	(0.048)
Panel B - results for the uncertainty list						
	Z-score	Z - score	ROA	ROA	ROE	ROE
Governance index (lagged 1Y)	0.032	0.067	0.149***	0.132**	0.034**	0.036**
	(0.056)	(0.057)	(0.051)	(0.056)	(0.014)	(0.014)
Uncertainty measure (lagged 1Y)	-0.083	-0.009	-0.178	-0.295*	-0.019	-0.030
	(0.111)	(0.109)	(0.158)	(0.172)	(0.033)	(0.038)
Financial controls	YES	YES	YES	YES	YES	YES
Governance controls	YES	YES	YES	YES	YES	YES
Year and Bank FE	YES	YES	YES	YES	YES	YES

Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

6.3 Alternative fixed effects

In current section I take into account that large banks might be subject to different shocks, i.e. certain regulations are targeting large banks with more lax rules for the smaller institutions. Hence I split the banks into five quintiles and perform the estimation with size-year fixed effects. Alternatively some countries transpose regulations earlier than the other, thus it is reasonable to perform an estimation with country-year fixed effects. Here we notice that the total and "norms" indices stay significant for the Z-scores, while governance index preserves significance once profitabiity is concerned.

Table 14: Risk governance and bank outcomes - alternative FE

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Risk governance and stability								
Total index (lagged 1Y)	0.129*				0.118			
	(0.072)				(0.078)			
Governance index (lagged 1Y)		0.046	0.061			0.053	0.038	
		(0.094)	(0.099)			(0.096)	(0.109)	
Norms index (lagged 1Y)		0.282**		0.326***		0.287**		0.324***
		(0.108)		(0.104)		(0.111)		(0.111)
Financial controls	YES	YES	YES	YES	YES	YES	YES	YES
Governance controls	YES	YES	YES	YES	YES	YES	YES	YES
Size-Year FE	YES	YES	YES	YES	NO	NO	NO	NO
Country-Year FE	NO	NO	NO	NO	YES	YES	YES	YES
Panel B. Risk governance and ROA								
Total index (lagged 1Y)	0.074*				0.081**			
	(0.039)				(0.039)			
Governance index (lagged 1Y)		0.098**	0.099**			0.091*	0.092*	
		(0.046)	(0.046)			(0.047)	(0.047)	
Norms index (lagged 1 year)		0.030		0.034		0.062		0.041
		(0.073)		(0.065)		(0.068)		(0.066)
Financial controls	YES	YES	YES	YES	YES	YES	YES	YES
Governance controls	YES	YES	YES	YES	YES	YES	YES	YES
Size-Year FE	YES	YES	YES	YES	NO	NO	NO	NO
Country-Year FE	NO	NO	NO	NO	YES	YES	YES	YES
Panel C. Risk governance and ROE								
Total index (lagged 1Y)	0.026***				0.024***			
	(0.009)				(0.009)			
Governance Index (lagged 1Y)	0.023**	0.025**			0.017*	0.018*		
		(0.011)	(0.012)			(0.010)	(0.010)	
Norms Index (lagged 1Y)		0.031		-0.001		0.038**		0.033**
		(0.020)		(0.011)		(0.018)		(0.016)
Financial controls	YES	YES	YES	YES	YES	YES	YES	YES
Governance controls	YES	YES	YES	YES	YES	YES	YES	YES
Size-Year FE	YES	YES	YES	YES	NO	NO	NO	NO
Country-Year FE	NO	NO	NO	NO	YES	YES	YES	YES

Panel A shows the estimates of β from $Z - score_{i,x,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_{xt} + \epsilon_{i,t}$

Panel B shows the estimates of β from $ROA_{i,x,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_{xt} + \epsilon_{i,t}$

Panel C shows the estimates of β from $ROE_{i,x,t} = \alpha + \beta RiskIndex_{i,t} + \theta Controls_{i,t-1} + \gamma_{xt} + \epsilon_{i,t}$

x stands for the size group or country group, standard errors are clustered at a bank level and shown in parentheses, *** - p<0.01, ** - p<0.05, * - p<0.1

7 GMM regressions

To alleviate the concern that risk governance changes might be endogenously driven by the poor bank performance I perform the panel-GMM estimation using the following specification:

$$Performance_{i,t} = \alpha + \mu Performance_{i,t-1} + \beta RiskIndex_{i,t-1} + \theta Controls_{i,t-1} + \delta_t + \epsilon_{i,t}$$

As before my specification includes as explanatory variables the lagged values of the risk index and bank-level controls as well as the time fixed effects. The specification is augmented by the lagged value of performance indicator and a set of year fixed effects. I use the lagged values of my outcomes and controls starting from year 2 and backward as the instruments. I run the separate regressions including bank balance sheet and income statement controls first (specifications (1), (3), (5) and (7)). I then add the corporate governance controls and see whether the indicators showing the risk governance strength still matter(specifications (2), (4), (6) and (8)). Control variables are lagged one year with respect to the performance measure. Standard errors are clustered at the bank level. Table 15 shows the relevant outcomes for specifications including the overall index as well as the ones separating the two components. As we can see the results are preserved for the banks' stability (Z-scores) while the profitability stays unaffected except for the reserved positive relation between ROE and "norms index".

Table 15: Risk governance and bank outcomes - GMM results

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A. Risk governance and stability								
Z-score (lagged 1Y)	0.344***	0.326***	0.462***	0.485***	0.396***	0.322***	0.322***	0.256**
	(0.101)	(0.112)	(0.118)	(0.139)	(0.111)	(0.116)	(0.112)	(0.114)
Total index (lagged 1Y)	0.191***	0.225***						
	(0.069)	(0.076)						
Governance index (lagged 1Y)			0.320**	0.392**			0.251*	0.215
			(0.135)	(0.158)			(0.133)	(0.137)
Norms index (lagged 1Y)					0.155	0.226**	0.164	0.232**
					(0.099)	(0.101)	(0.112)	(0.103)
Financial controls	YES	YES	YES	YES	YES	YES	YES	YES
Governance controls	NO	YES	NO	YES	NO	YES	NO	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Panel B. Risk governance and ROA								
ROA (lagged 1Y)	0.378***	0.400***	0.379***	0.403***	0.389***	0.391***	0.372***	0.385***
	(0.102)	(0.111)	(0.100)	(0.110)	(0.099)	(0.105)	(0.103)	(0.111)
Total index (lagged 1Y)	0.095	0.124						
	(0.150)	(0.156)						
Governance index (lagged 1Y)			0.272	0.297			0.305	0.277
			(0.249)	(0.265)			(0.256)	(0.265)
Norms index (lagged 1Y)					0.072	0.105	-0.067	0.025
					(0.181)	(0.185)	(0.208)	(0.200)
Financial controls	YES	YES	YES	YES	YES	YES	YES	YES
Governance controls	NO	YES	NO	YES	NO	YES	NO	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES
Panel C. Risk governance and ROE								
ROE (lagged 1Y)	0.363***	0.337***	0.409***	0.404***	0.358***	0.307***	0.341***	0.318***
	(0.103)	(0.108)	(0.101)	(0.109)	(0.098)	(0.101)	(0.105)	(0.111)
Total index (lagged 1Y)	0.025	0.036						
	(0.034)	(0.035)						
Governance Index (lagged 1Y)			-0.012	-0.021			-0.031	-0.045
			(0.059)	(0.061)			(0.060)	(0.062)
Norms Index (lagged 1Y)					0.062	0.086**	0.079	0.105**
					(0.043)	(0.043)	(0.053)	(0.049)
Financial controls	YES	YES	YES	YES	YES	YES	YES	YES
Governance controls	NO	YES	NO	YES	NO	YES	NO	YES
Year FE	YES	YES	YES	YES	YES	YES	YES	YES

The table shows the estimates of β from $Performance_{i,t} = \alpha + \mu Performance_{i,t-1} + \beta RiskIndex_{i,t-1} + \theta Controls_{i,t-1} + \gamma_c + \delta_t + \epsilon_{i,t}$

$Performance_{i,c,t}$ stands for the Z-score, ROA or ROE

Standard errors are clustered at a bank level and shown in parentheses

*** - p<0.01, ** - p<0.05, * - p<0.1

8 Conclusions and directions for future research

I have performed the analysis of relation between the risk governance elements and performance of financial institutions during the 2009-14 period. Making comparisons to the U.S. setting we noticed the following. European financial institutions tended to strengthen their risk management arms following the crisis period similarly to their U.S. counterparties. Larger institutions were faster to implement the new practices (consistently with higher regulatory pressure and the tendency to follow the peer banks). However, the changes mattered at the individual level: introduction of new practices was associated with an increase the institution‘s stability measured by the z-scores and is positively associated with the measures of banks profitability (return on assets, return on equity) though in this case only the governance elements remain significant. Further analysis could consider new components (e.g. usage of advanced risk models) adding variablity to index levels and replacing the components which became relevant for the whole sample throughout the analysis.

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A List of institutions under analysis

	Bank	Country
1	Aareal Bank AG	Germany
2	ABLV Bank	Latvia
3	ABN AMRO Bank N.V.	Netherlands
4	Allied Irish Banks plc	Ireland
5	Alpha Bank	Greece
6	AXA Bank Europe SA	Belgium
7	Banca Carige S.P.A. - Cassa di Risparmio di Genova e Imperia	Italy
8	Banca Monte dei Paschi di Siena S.p.A.	Italy
9	Banca Piccolo Credito Valtellinese	Italy
10	Banca Popolare Dell'Emilia Romagna - Societ Cooperativa	Italy
11	Banca Popolare Di Milano - Societ Cooperativa	Italy
12	Banco Bilbao Vizcaya Argentaria	Spain
13	Banco BPI	Portugal
14	Banco Comercial Portugus	Portugal
15	Banco de Sabadell	Spain
16	Banco Financiero y de Ahorros Spain	
17	Banco Mare Nostrum	Spain
18	Banco Popolare - Societ Cooperativa	Italy
19	Banco Popular Espaol	Spain
20	Banco Santander	Spain
21	BANK BPH SA	Poland
22	BANK HANDLOWY W WARSZAWIE SA	Poland
23	Bank Nederlandse Gemeenten N.V.	Netherlands
24	Bank of Cyprus Public Company Ltd	Cyprus
25	Bank of Valletta plc	Malta
26	Bankinter	Spain
27	Banque PSA Finance	France
28	Barclays plc	United Kingdom
29	BAWAG P.S.K.	Austria
30	Bayerische Landesbank	Germany
31	Belfius Banque SA	Belgium
32	BNP Paribas	France
33	Caixa Geral de Depsitos	Portugal
34	Caja de Ahorros y M.P. de Zaragoza	Spain
35	Cajas Rurales Unidas	Spain
36	Co-operative Central Bank Ltd	Cyprus
37	Commerzbank AG	Germany
38	Coperatieve Centrale Raiffeisen-Boerenleenbank	Netherlands

39	Credito Emiliano S.p.A.	Italy
40	Danske Bank	Denmark
41	DekaBank Deutsche Girozentrale	Germany
42	Deutsche Apotheker- und rztebank eG	Germany
43	Deutsche Bank AG	Germany
44	Dexia NV*	Belgium
45	DNB Bank Group	Norway
46	DZ Bank AG	Germany
47	Erste Group Bank AG	Austria
48	Eurobank Ergasias	Greece
49	GETIN NOBLE BANK SA	Poland
50	Groupe BPCE	France
51	Groupe Crdit Agricole	France
52	Groupe Crdit Mutuel	France
53	HASPA Finanzholding	Germany
54	Hellenic Bank Public Company Ltd	Cyprus
55	HSBC Holdings plc	United Kingdom
56	HSH Nordbank AG	Germany
57	IKB Deutsche Industriebank AG	Germany
58	ING Bank N.V.	Netherlands
59	Intesa Sanpaolo S.p.A.	Italy
60	Jyske Bank	Denmark
61	KBC Group NV	Belgium
62	KfW IPEX-Bank GmbH	Germany
63	Kutxabank	Spain
64	La Banque Postale	France
65	Landesbank Baden-Wrttemberg	Germany
66	Landesbank Hessen-Thringen	Germany
67	Landwirtschaftliche Rentenbank	Germany
68	Liberbank	Austria
69	Lloyds Banking Group plc	United Kingdom
70	Mediobanca - Banca di Credito Finanziario S.p.A.	Italy
71	Mnchener Hypothekenbank eG	Germany
72	National Bank of Greece	Greece
73	Nederlandse Waterschapsbank N.V.	Netherlands
74	Norddeutsche Landesbank-Girozentrale	Germany
75	Nordea Bank AB (publ)	Sweden
76	Nova Kreditna Banka Maribor d.d.	Slovenia
77	Nova Ljubljanska banka d. d.	Slovenia
78	NRW.Bank	Germany
79	OP-Pohjola Group	Finland

80	sterreichische Volksbanken-AG	Austria
81	OTP Bank Ltd	Hungary
82	Permanent tsb plc.	Ireland
83	Piraeus Bank	Greece
84	POWSZECHNA KASA OSZCZEDNOSCI	Poland
85	Raiffeisen Zentralbank sterreich AG	Austria
86	Raiffeisenlandesbank Niedersterreich-Wien AG	Austria
87	Raiffeisenlandesbank Obersterreich AG	Austria
88	Royal Bank of Scotland Group plc	United Kingdom
89	SID - Slovenska izvozna in razvojna banka	Slovenia
90	Skandinaviska Enskilda Banken AB (publ) (SEB)	Sweden
91	SNS Bank N.V.	Netherlands
92	Socit Gnrale	France
93	Svenska Handelsbanken AB (publ)	Sweden
94	Swedbank AB (publ)	Sweden
95	Sydbank	Denmark
96	The Governor and Company of the Bank of Ireland	Ireland
97	UniCredit S.p.A.	Italy
98	Unione Di Banche Italiane Societ Cooperativa Per Azioni	Italy
99	Volkswagen Financial Services AG	Germany

The battle over bankers' bonuses: relevant impact or a mountain out of a molehill.

Ekaterina Seregina *

Abstract

I study market reaction to the tightening of remuneration rules for a sample of European banks. I cover 15 events in the post-crisis period including the most controversial announcement - agreement on a 100% cap for the variable-to-fixed remuneration ratio. My results suggest that investors expect the new rules to reduce banks' risk-taking: CDS spreads go down for an overall of -2.8% across the [-1, 1] windows[1]. At the same time, I document a fall in market capitalization for multiple events with more severe outcomes for the "high-bonus" group showing a total of 8% reduction in value in the weeks following the bonus cap-related announcements. A 1-year horizon analysis shows the lower levels of individual (CDS spreads, stock market volatility) and systemic (SRISK) risk-taking for the "high-bonus banks". Thus the battle over bonuses has ended with an outcome favorable for the longer-term investors: affected banks demonstrated lower levels of risk indicators with no inferior profitability outcomes.

Keywords: banking, regulation, governance, remuneration, bonus, synthetic controls

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[1]And more so once the wider event windows are concerned

1 Introduction

Excessive variable pay is often mentioned in a set of factors leading to excessive risk-taking in the banking sector. The recent crisis has triggered a wave of active protests against the excessive pay and increased regulatory attention to banks' remuneration packages. Following the crisis various regulatory initiatives in the European Union aimed at restructuring the bankers' salary packages. I look into those rules starting from the release of the draft version of Capital Requirements Directive IV (CRD IV) in February 2010 and following up to the final guidelines on remuneration policies published by the European Banking Association in December 2015.

Importance and desirability of performance-related compensation is a subject of multiple studies[2] with major contributions being theoretical given the scarcity of exogenous shocks to remuneration structure. Post-crisis regulatory changes in the EU which I used for my analysis provided a new opportunity to study the bonus-performance link.

The aim of my paper is twofold. I apply the event study approach to see whether market participants consider the remuneration restrictions to be creditworthiness and/or value enhancing for banks. I then check whether new rules affect the banks' individual and systemic risk indicators on a 1-year horizon following the regulations to see whether investors' initial reactions are consistent with banks' subsequent performance.

Major results are the following. Stock market investors consider the new rules burdensome (with compliance costs and potential profitability losses outweighing the reduction of short-termism and risk-taking) and the value reduction is significantly larger for the "high-bonus" banks. CDS investors favor the rules bringing the spreads (and thus the funding costs) down, with no sizeable differences between "high-bonus" banks and the rest of the sample.

As indicated above, I am interested in identifying whether the regulation affected more the group of banks putting more emphasis on the variable part of the compensation scheme prior to the regulatory announcements. To split the banks into affected and non-affected groups I use the quantitative threshold from the bonus cap rule - major and most controversial post-crisis regulatory innovation[3]. This rule limited the variable compensation to 100% of the fixed salary with a possibility to increase the threshold to 200% upon shareholders' approval. I use a 100% threshold at the CEO level differently from the contemporaneous studies of Kleymenova & Tuna (2017) and Colonnello et al. (2018) who use a 200% and 250% cuts. I choose 100% to keep the groups of affected and non-affected banks more comparable in terms of observable characteristics. The lower threshold is also plausible when the analysis is done for the non-bonus regulatory announcements: insti-

[2]Edmans et al. (2017) provide the most recent survey of relevant literature

[3]see e.g. "Bankers look for ways round bonus clawbacks" (Financial Times, 26 June 2015) and "Britain loses battle over EU bank bonus caps" (Reuters)

tutions with considerable bonus shares are also the ones having to adjust more following the guidance from the regulators regarding remuneration deferrals, splits between cash and stock compensation and compulsory disclosure of the compensation system details.

Events covered by my analysis listed in Table 11 in the Appendix include the major regulatory announcements related to the Capital Requirements Directive IV - draft publication (February 2010), approval by the EU Parliament (April 2013) and official publication (June 2013). Those publications included the major innovations in the sphere of remuneration regulations. However, they also introduced a set of non-remuneration rules (related to capital instruments eligibility, capital buffers, disclosure and liquidity rules). Those make it harder to attribute the abnormal market performance to expected changes in the banks' compensation systems only. Hence I proceed by looking at the set of regulatory announcements which specifically targeted remuneration systems and were released in the post-crisis period starting October 2010 and ending in July 2015.[4] The reactions to those provide a more precise measure of investors' attitude to remuneration rules per se, not the overall regulatory package.

Significant (and sizeable) stock market reactions occur in anticipation of CRD IV publication (-1.7%), a week before the first European Parliament discussion of bonus caps (-2.5%), in the 3 days around bonus caps' approval (-2.1%) and in two weeks following the release of detailed identified staff definition (-3.9%). CDS investors on the contrary favor the remuneration rules: spreads are reduced both at 3 days around the announcement and in the subsequent weeks for 10 out of 15 events considered: simple aggregation of significant results for the [-1;1] windows gives a -2.8% spreads' reduction which is magnified once the longer time periods are concerned (i.e. post-crisis guidelines' revision brings a -7.3%, the first discussion of bonus caps - -5.7% in the two weeks following the events). However, the bonus cap rules produce a 3.9% rise in spreads which is not game-changing once the overall series of announcements are considered, but signals that the costs associated with limiting bankers' incentives are outweighing the potential reduction in risk-taking behavior.

The cross-sectional analysis uncovers that the "high-bonus" group deviates from the full sample only when the stock markets are concerned. This group shows a $+3.6\%$ difference accumulated in two weeks following the parliament approval and $+3.1\%$ accumulated over two weeks before the official publication of the CRD IV. Taken alone those events would suggest investors are welcoming the regulatory strengthening. However, same group of banks shows inferior performance in the weeks following the release of post-crisis remuneration rules (-3%), their official approval (-2.4%), the bonus cap agreement (-2.2%), revision of the identified staff definition (-1.3%) and the guidelines on the discount rates

[4]Those include the remuneration-specific announcements - bonus cap for material risk takers (first discussion and approval), revisions of remuneration guidelines (4 events), clarifications of the bonus rule in terms of personnel concerned and ratios' computation (6 events).

for deferred remuneration parts (-2.1%). These results confirm the necessity of looking into the more technical announcements: while welcoming the multiple provision regulations investors penalize the affected banks following the bonus-specific announcements. CDS investors tend to pay less attention to individual banks and more to the overall rules' content: only in few cases the changes for the "high-bonus" banks are significantly different from the ones exhibited by the rest of the sample and the most significant difference is associated with major regulatory change (-3.4% difference in two weeks following the Parliament approval of CRD IV) rather than with technical update ($-.022*$ before the final guidelines on remuneration policies are released).

Longer term analysis allows to judge whether the short-term reactions are consistent with the post-regulation risk outcomes on a 1-year horizon. I use CDS spreads and stock market returns' volatility as individual risk indicators. I switch to cCoVaR (Adrian & Brunnermeier (2016)) and SRISK (Acharya et al. (2017)) to assess the systemic risk changes. I employ the synthetic control methodology matching affected institutions to artificial units constructed in a way to match the bank-level characteristics and the pre-treatment trends of outcome variables. Such an approach also allows to make the best use of a limited sample - a combination of control units serves better than a unique matching unit. I use three options for the "treatment" dates: January 2011 as a unique date for all the banks when CRD III with the first post crisis amendments to remuneration regulations became effective; February 2013 marking the timing of official bonus cap announcement and the official CRD IV effective date - January 2014.

Approval of bonus cuts in February 2013 was followed by a short period of lower SRISK realisation for the "above 100%" banks (with differences of up to 0.13 or 1.6% of the sample mean). In this case the threshold selection mattered since "above 200%" banks have shown a significantly lower level of SRISK for a year following the announcement (up to 0.4 difference or about 4.8% of the sample mean for 2012-2014 time period). At the same time the individual risk indicators (i.e. CDS spreads and stock returns' volatility) were not in any way affected by the regulatory intervention.

Finally, official effective date was not anyhow special for the high bonus banks: neither estimation around January 2014 nor (an unreported) analysis around the country-specific effective dates has shown persistent and sizeable differences in terms of risk indicators for the "high-bonus" banks.

Affected group of banks has shown lower individual risk levels (in terms of CDS and stock market volatility) when compared to the synthetic control following the 2011 regulatory intervention and the February 2013 bonus cap introduction. In addition, following the caps' approval the banks with high bonus levels have shown a significantly lower levels of systemic risk (with more sizeable difference in case of the "above 200%" group). Importantly the results stayed valid when I limited the analysis to a group of banks under Financial Stability Board (FSB) jurisdiction. Those were subject to an additional set of

rules starting 2011, thus it was important to confirm the results by comparing an FSB "high-bonus" group to the FSB control group.

My paper contributes to several literature strands. First of all it complements a series of event studies around the major regulatory changes: Acharya, Anginer & Warburton (2016) assessing the impact of implicit government guarantees, Moenninghoff et al. (2015) looking at the consequences of G-SIIBs announcements, Neretina et al. (2015) analyzing the relevance of stress-testing announcements, Schäfer et al. (2015*b*) evaluating the impact of bail-in announcements and Schäfer et al. (2015*a*) looking at of major regulatory reforms in Germany, Switzerland, United Kingdom and the USA, Acharya, Anginer & Warburton (2016) looking at the impact of Long-Term Refinancing Operations and the Outright Monetary Transactions program. The closest study is Kleymenova & Tuna (2017) focusing on market reactions to the UK Remuneration Code. They document positive returns in response to the Code and negative response to the EU bonus cap regulation which is consistent with the results of the current study.

The second set of relevant studies assesses the longer-term relation between remuneration structure and performance outcomes during the turbulence periods. Relating the crisis performance measures to pre-crisis bonus levels allows to identify whether bonuses were in fact "responsible" for the poor performance of banks. The contributions here include Beltratti & Stulz (2012) and Fahlenbrach & Stulz (2009) demonstrating that high-bonus banks were not exhibiting worse performance with respect to those with a higher proportion of fixed compensation. The current study shows that restricting the bonuses was associated with lower risk outcomes upon announcement, hence the debated rule was in fact restricting the ris-taking activity for a target group.

A recent study of Cerasi et al. (2017) looked into the compensation packages for bank Chief Executive Officers (CEOs) and checked whether those changed following the FSB guidelines on sound compensation. They indeed find more relevant changes for banks in jurisdictions under the FSB rules and show that CEO variable payments became more dependent on the risk generated rather than on the short-term profits. Current paper differs from their analysis by giving a closer look to the market-based outcomes. However, lower profitability targets for CEOs are compatible with the negative stock market reactions which I find in the stock markets (in such case investors would be unwilling to give up the income stream for the sake of lower risk). As mentioned above, in my robustness check I make sure that my findings for the FSB sample are compatible with the full sample ones.

Colonnello et al. (2018) is to the best of my knowledge the only paper comparing the EU remuneration regulation impact relying on the variable-to-fixed ratio criterion (they use a 250% threshold). They focus on dismissals before and after implementation date and document more frequent dismissals following the regulation. The results, however, do not hold once the good-performing executives are concerned. My paper is different in

terms of outcomes analyzed, I also using a more lax threshold which still captures the exposure to a new regulation, but also allows to obtain a better balance between the affected and unaffected samples in terms of the covariates and the pre-treatment levels of outcome variables.

To sum up, my paper makes the following contributions. It identifies the affected institutions basing on a quantitative criterion broad enough to capture the relevance of non-cap provisions. It covers more technical announcements to uncover and reaction to the caps. It also uncovers that detailed remuneration setting rules are more important for stock market investors with major (negative) reactions observed following the "first" publications of a kind (CRD IV draft, first release of bonus cap rule and first guidelines on the categories of personnel concerned) rather than the whole set of clarifying announcements. In addition, the paper is the first to look at a broader spectrum of indicators reflecting the banks' systemicity and document the risk reduction with outcome variables reflecting both individual and systemic risk levels.

The rest of the paper is structured as follows. Section 2 discusses the literature in more detail, Section 3 provides a literature review, Section 4 describes the dataset in use and provides descriptive statistics, Section 5 shows the empirical results. Section 6 briefly discusses the robustness checks. The last section concludes. Appendices contain the details on the relevant regulatory changes, a sample of institutions and the full results of the robustness checks.

2 Related Literature

The paper contributes to the two major strands of literature. First one examines a series of regulatory changes which occurred after the 2007-08 financial crisis. Event study analysis covering broad country-level reforms was done by Schäfer et al. (2015*a*). Focusing on major legislative changes in Germany, Switzerland, United Kingdom, and the USA they found significant reactions in terms of stock market returns and CDS spreads with results differing by type of banks (investment vs non-investment), bank size (systemically important vs non-systemically important) and bank stability (high vs low z-scores). Acharya, Anginer & Warburton (2016) assessed whether implicit government guarantees in the U.S. were considered credible and priced by the market participants. Looking at the relation between the banks' bond spreads and their risk profiles they find a weaker risk-spread relationship for largest institutions. Event study analysis around the collapse of Lehman Brothers, the rescue of Bear Stearns, the adoption of TARP has uncovered a stronger impact on largest institutions following the events lowering and increasing the guarantee expectations. Neretina et al. (2015) looked into the impact of stress testing announcements (methodologies and results) and found them to be relevant for CDS spreads and

betas with no significant impact on the stock market returns. Moenninghoff et al. (2015) looked into the impact of the announcements regarding Global Systemically Important banks (G-SIBs). Relevant regulations negatively affected the value of the targeted group of banks consistently with the presence of additional regulatory burden. The announcement of the G-SIBs identity was associated with an offsetting positive reaction since the G-SIBs designation is associated with implicit government guarantees in case of failure. A subsequent study of Schäfer et al. (2015*b*) looked into the bail-in cases which lowered the markets expectations for bailouts once the bail-in precedents were established. The markets reaction differed depending on the type of bail-in event (junior vs senior) bank group (GSIB-s vs non-GSIB-s, GIIPS vs non-GIIPS origin) and country's fiscal capacity to perform the bailout procedure. Carletti et al. (2016) looked into the impact of new collective actions clauses in European bonds contracts and found significant reaction for the CDS market.

The second related field includes the work analyzing the determinants of executive compensation outcomes. Edmans et al. (2017) provide the most recent review of relevant theoretical and empirical literature and list three major forces influencing the pay structure of the top executives. First one is related to shareholders aiming at retaining the best executives in the competitive labor market with the goal of profit maximization. Second relates to executives' power to set their pay packages aiming at the rent extraction. Finally, the authors acknowledge the importance of institutional forces including the major regulatory changes one of which is exploited in the current study.

Certain contemporaneous studies perform the analysis for bonus regulations. Kleymenova & Tuna (2017) focus on market reactions to the UK Remuneration Code. They document positive returns in response to the Code and negative response to the EU bonus cap regulation. Importantly UK code introduced the rules for bonus deferrals, but the limits for the variable to fixed ratios were set only in the CRD IV. Given that I identify the affected banks according to the quantitative threshold it seems plausible to keep UK banks in the analysis. However, the deferrals might play an important role as well, hence I provide the results for a non-UK sample together with the main results. Cerasi et al. (2017) look into the compensation packages for bank Chief Executive Officers (CEOs) and check whether those changed following the Financial Stability Board (FSB) guidelines on sound compensation. They indeed find more relevant changes for banks in jurisdictions under the FSB rules and show that CEO variable payments became more dependent on the risk generated rather than on the short-term profits. Current paper differs from their analysis by giving a closer look at the market outcomes. I also cover a wider set of announcements and use a narrower definition of the "affected" group.

Colonnello et al. (2018) is to the best of my knowledge the only paper explicitly looking at the variable-to-fixed ratios. They analyze the executive turnover post-EU regulation and show that good-performing executives are not more likely to leave banks after the

cap introduction. Yet, they document more frequent dismissals. They use the maximum possible ratio of 250% to identify the "treated" directors and banks and get a limited number of "treatment" cases. This approach is potentially suitable for the analysis of directors' mobility, but might be too narrow to study the other relevant consequences of the regulation. The 100% threshold used in the current analysis allows to identify the group of banks affected by both quantitative threshold and the rest of remuneration related rules (remuneration deferrals, splits between cash and stock compensation and compulsory disclosure of the compensation system details) and gives a group of institutions which is large enough for making meaningful comparisons with the non-affected institutions. Another distinguishing feature of the current study with respect to theirs is in choosing the date in which the rules become effective. In Colonnello et al. (2018) there is a unique "effective" date with no attention to more narrowly focused announcements and country-specific implementation schedules covered by my study.

To sum up, the current analysis makes the following contributions. It identifies the affected institutions basing on a quantitative criterion which is broad enough to capture the relevance of non-cap provisions and form a sample large enough for a meaningful analysis. It covers short-term and long-term outcomes thus capturing investors' reactions and bank risk levels following the implementation. Finally, it performs the analysis around the series of regulatory announcements and covers both the timing suggested by the major regulatory document and the country-specific transposition rules.

3 Dataset and descriptive statistics

3.1 Variable-to-fixed ratios

My analysis is done for a sample of large European banks for which the remuneration data is available (Appendix B shows the list of banks included). The major part of the analysis relies on institutions for which the stock market/CDS data is available leaving us with a total of 81/37 banks which have both market data and remuneration information. The resulting list is split into subsamples according to the 2013 ratio of variable-to-fixed remuneration ratios computed relying on the data from Capital IQ. Similarly to Cerasi et al. (2017) I compute the fixed component as Salary + Other. I then obtain the variable portion as Cash Compensation + Non-cash compensation - Salary - Other.

I assign the banks to the treated group in case the 100% threshold is binding at the CEO level. Though the regulation touched upon a large group of employees I consider the CEO information to be indicative of the bank's bonus policy and thus compare the post-regulatory outcomes for affected and non-affected banks basing on the CEO variable-to-fixed ratio prior to the regulatory announcements. I use the maximum ratios for 2010/2011

and 2013/2014 periods.[5] When making a cross-check with the annual and remuneration reports my approach produces discrepancies between the database and the exact reported values. However, the assignment to the "above 100%" category remains valid. Taking these discrepancies into account I stick to the binary treatment indicator (1 if the bank belongs to the "above 100%" category and 0 otherwise) for my analysis.

Table 1 shows the statistics for the two remuneration ratios. 2011 ratios range from 0 to 336% with a mean of 51% largely driven by the extreme ratios in the right tail of the distribution. 2013 ratios are slightly higher despite the 2011 European remuneration guidelines asking for an appropriate balance and range from 0% to 475%. Mean of 62% is again driven by the large outliers (median stands at 13% only). This shows that only a clear threshold announced in February 2013 could trigger the reduction of variable-to-fixed ratios.

Table 1: Descriptive statistics for variable-to-fixed remuneration ratios

2011 variable-to-fixed ratio

Variable	No. of banks	Mean	St. Deviation	Min	P25	P50	P75	Max
Ratio>100%	25	2.10	0.82	1.06	1.44	1.97	3.11	3.36
Ratio<100%	126	0.19	0.27	0.00	0.00	0.00	0.30	0.97
Overall sample	151	0.51	0.82	0.00	0.00	0.12	0.63	3.36

2013 variable-to-fixed ratio

Variable	No. of banks	Mean	St. Deviation	Min	P25	P50	P75	Max
Ratio>100%	31	2.25	1.21	1.01	1.28	1.75	2.91	4.75
Ratio<100%	121	0.20	0.28	0.00	0.00	0.01	0.39	0.97
Overall sample	152	0.62	1.02	0.00	0.00	0.13	0.78	4.75

3.2 Outcome variables

I use the Datastream data on the stock market returns and CDS spreads for the event studies. I use the following indicators as outcome variables in the longer term analysis[6]:

- monthly average level of CDS spreads reflecting the price of hedging against a bank's credit risk realization
- cCoVaR (see Adrian & Brunnermeier (2016)) showing the decline in the market capitalization given the problematic state of the particular bank (movement from a 95% quantile of returns' to the median)

[5] In this way, I tackle the potential delays in implementation across countries and the several cases of newly appointed CEOs for which the variable-to-fixed results are typically distorted.

[6] taking the values in logs where it is necessary to avoid the right skewness of the metric)

- SRISK (see Acharya et al. (2017)) reflecting the bank's capital shortage in case of realization of system-wide shocks and scaled by market capitalization to ensure cross-sectional comparability

- Long Run Marginal Expected Shortfall (LRMES) (see Acharya et al. (2017)) indicating the bank's tail risk (fall of stock prices given the 40% decline in the market index)

- stock market returns' volatility

Tables 2 shows the descriptive statistics for the outcomes of the affected and non-affected banks[7].

Here we see no striking differences across periods with high-bonus group exhibiting the higher levels of systemic risk indicators. To give an example, the average capital shortfall expected following a 40% fall in the market would be associated with a capital shortfall accounting for the 121% of the market capitalization for the high bonus banks. The similar metric for the low-bonus banks would be 93%.

Table 2: Descriptive statistics for outcome variables

Ratio > 100%	2009-2011					2012-2014				
Variable	Mean	St. Dev.	Min	P50	Max	Mean	St. Dev.	Min	P50	Max
Stock returns	-0.00	0.03	-0.30	-0.00	0.24	0.00	0.02	-0.23	0.00	0.25
CDS returns	0.00	0.04	-0.23	0.00	0.19	-0.00	0.03	-0.23	0.00	0.19
CDS (log)	4.97	0.52	4.02	4.89	6.71	5.01	0.61	3.86	4.99	6.66
cCoVaR	0.17	0.10	0.00	0.16	0.37	0.12	0.06	-0.01	0.12	0.31
SRISK (log)	9.49	1.88	6.91	10.25	12.13	9.51	1.75	6.91	10.2	11.96
Returns' volatility	-4.10	0.87	-6.75	-4.25	-1.72	-4.72	0.67	-6.70	-4.77	-1.95

Ratio < 100%	2009-2011					2012-2014				
Variable	Mean	St. Dev.	Min	P50	Max	Mean	St. Dev.	Min	P50	Max
Stock returns	-0.00	0.03	-0.30	-0.00	0.32	0.00	0.03	-0.41	0.00	0.41
CDS returns	0.00	0.04	-0.23	0.00	0.19	-0.00	0.02	-0.23	0.00	0.19
CDS (log)	5.2	0.77	3.88	5.06	7.45	5.28	0.87	3.46	5.17	7.45
cCoVaR	0.10	0.10	-0.04	0.08	0.37	0.09	0.07	-0.04	0.08	0.29
SRISK (log)	8.26	1.31	6.91	8.07	11.98	8.25	1.27	6.91	8.00	11.75
Returns' volatility	-4.38	1.11	-6.75	-4.35	-1.72	-4.69	1.12	-6.75	-4.65	-1.72

[7]I use logs of CDS level, SRISK level and returns' volatility to tackle the right skewness of the variables

3.3 Controls

I merge the data on outcome variables with a set of bank level controls including size (total assets), capital ratio (Tier 1 capital to total assets), proportion of non-performing loans (NPL/Assets), share of deposits in total assets and a measure of income diversity[8] evaluating how big is the proportion of non-traditional banking income. The motivation for such a choice of controls is the following. Size of an institution typically affects the existing advances in the sphere of governance rules (large banks might be following the best practices of foreign banks and thus be partly compliant at the time the rules are introduced in the EU) and the compliance costs (some rules are harder to implement for larger organizations). Capital ratios reflect whether the CRD IV rules for capital ratios are likely to be binding (lower capital would bring a greater need of adjustments). NPL ratios might indicate the need for adjustments (i.e. investors might welcome more the regulations for the more troubled banks). Finally income diversity would be a metric reflecting a proportion of non-traditional banking business (i.e. asset management, investment advisory, etc.) which typically determines the risk-taking options and influences the exposure to non-credit risks (i.e. interest rate, market and counterparty credit) which saw an increase in requirements as part of the CRD IV initiative.

Table 3 presents the descriptive statistics. Here I document the larger size and diversity of income sources for the high bonus banks which also exhibit lower levels of NPLs. The differences are confirmed via the t-tests shown in Table 4. High-bonus banks are significantly larger, have lower capital ratio, higher diversity of income sources and higher liquidity ratios. Since I aim at isolating the impact of remuneration rules controlling for the above-mentioned characteristics is important in the event study analysis. The longer term analysis uses matching on those to construct the appropriate control group for the high-bonus banks.

4 Empirical analysis - event study

4.1 Methodology

Baseline analysis for the stock and CDS markets is performed using a 1-factor model:

$$r_{jt} = \alpha + \beta_j r_{mt} + \epsilon_{jt} \tag{2}$$

r_{mt} stands for the MSCI Europe returns in case of the stock market and return on

[8]
$$divers = |\frac{1 - (NetInterestIncome - OtherIncome)}{OperatingIncome}| \tag{1}$$

Table 3: Descriptive statistics for control variables

Variable	Mean	St. Dev.	Min	P25	P50	P75	Max
Ratio > 100%							
Assets (bn euro)	735.8	720.6	6.68	38.31	582.7	1214.2	2175.7
Tier 1/Assets	0.05	0.03	0.00	0.04	0.05	0.06	0.12
NPLs/Assets	0.03	0.04	0.00	0.00	0.02	0.05	0.17
Deposits/Assets	0.41	0.15	0.00	0.29	0.41	0.53	0.75
Income diversity	0.53	0.20	0.06	0.41	0.51	0.68	0.96
Liquidity ratio	0.45	0.19	0.11	0.27	0.50	0.59	0.89
Ratio < 100%							
Assets (bn euro)	178.3	296.4	3.38	20.21	61.76	218.9	1907.1
Tier 1/Assets	0.06	0.02	-0.04	0.05	0.06	0.07	0.16
NPLs/Assets	0.06	0.09	0.00	0.01	0.03	0.07	1.25
Deposits/Assets	0.49	0.20	0.00	0.39	0.53	0.61	0.95
Income diversity	0.40	0.16	0.00	0.28	0.40	0.52	0.87
Liquidity ratio	0.28	0.15	0.06	0.17	0.25	0.35	0.98

Table 4: T-tests for major characteristics (unaffected - affected)

Variable	Size	Tier 1/Assets	NPL/Assets	Deposits/assets	Income diversity	Liquidity ratio
	-1.267***	0.008***	0.030	0.073***	-0.135**	-0.171***
	[-10.07]	[4.66]	[7.45]	[5.69]	[-9.08]	[-13.16]

t-stats in parentheses

*** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

the average of industry level CDS indices.[9] In both cases market model is estimated from -250 to -30 days preceding the event (for each event I exclude from the estimation sample the days of overlap with other relevant events).

Abnormal returns (AR) are computed as

$$AR_{jt} = r_{jt} - \hat{\alpha} - \hat{\beta}_j r_{mt}^{cds} \tag{3}$$

for the CDS returns

Cumulative abnormal returns (CAR) are computed as:

$$CAR_{jt} = \sum_{t=k_1}^{k_2} \frac{1}{N} (\sum_{j=1}^{N} AR_{jt}) \tag{4}$$

I use a variety of event windows. [-1; 1] captures the immediate markets' reaction

[9]the data is obtained from Datastream and includes the 5 year CDS indices for auto manufacturing, banks, beverages, cables chemicals, construction, consumer goods, electricity andpower, energy, leisure, manufacturing, metals and mining, oil and gas, other financials, other services, other utilities, service companies, telecoms, transportation

while [-10; -2] , [-5; -2], [2; 5] and [2; 10] allow to capture the potential anticipation effects and/or pre-event information releases (likely for the major events) and the delayed markets' reaction (likely for more technical publications). I evaluate the significance using the Kolari & Pynnönen (2010) ADJ-BMP t-statistic.

Following the computation of cumulative abnormal returns I estimate the cross sectional models regressing the abnormal returns on the binary variable $Affect_{100,j}$ (taking the value of one if a bank has bonus ratio exceeding 100% and zero otherwise), the set of bank-level controls and the dummy variable taking the value of one in case the bank is under government support program around the introduction of new regulations: such banks are fundamentally different from the remaining group as they were prohibited from paying any bonuses as a condition ofobtaining state support.

$$CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt} \tag{5}$$

I include the following controls to capture characteristics which are relevant for the institutions' outcomes: size (logarithm of assets), capitalization (Tier 1/Assets ratio), fraction of deposit funding (Deposit/Assets ratio), loan portfolio quality (NPL/Assets ratio) and the measure of income diversification showing the proportion of non-traditional banking income. I use the controls lagged one year with respect to the event date. As a robustness check (reported in the Appendix) I also include the specification in which $Affect_{100,j}$ is replaced by $Affect_{200,j}$ (taking the value of one if a bank has bonus ratio exceeding 200% and zero otherwise) given the banks' option to increase the threshold to 200% upon shareholders' approval. However, the non-cap provisions are relevant for all banks with considerable bonus shares hence I keep 100% as a threshold in the baseline analysis.

4.2 Events covered

Table 11 lists the events covered by the analysis. First group (events 1-3) contains the major regulatory announcements related to the Capital Requirements Directive IV - draft publication (February 2010), approval by the EU Parliament (April 2013) and official publication (June 2013). Those publications are important given that they included the major innovations in sphere of remuneration regulations. However, they also introduced a set of non-remuneration rules (related to capital instruments eligibility, capital buffers, disclosure and liquidity rules). Those make it harder to attribute the abnormal market performance to expected changes in the banks compensation systems only. Hence I complement my analysis looking at the set of regulatory announcements (events 4-15) which specifically targeted remuneration systems and were released in the post crisis period

(starting October 2010 and ending in July 2015). The most controversial of them[10] - bonus cap for material risk takers approved in February 2013 - has set a 100%[11] threshold for the ratio between the variable and fixed components of the material risk takers' salary. Other regulations I consider include the revisions of overall remuneration guidelines (4 events) and the clarifications of the bonus rule in terms of personnel concerned and ratios' computation (6 events).

4.3 Results

First set of results is related to three major regulatory announcements. Panel A of Table 5 shows the average cumulative abnormal returns (CARs) in the stock markets. Overall sample exhibits 0.8% returns around the draft publication, while the following announcements generate significant, but relatively small returns of -0.2% to 0.0%. High bonus group shows several instances of higher abnormal returns

Further significant stock market reaction is observed around the bonus cap announcements: -2.5% in a week before the bonus cap discussion by the European Parliament and a -2.1% drop in the 3 days around approval of the cap. Negative returns of -3.9% were realized in two weeks following the release of detailed identified staff definition.

Cross-sectional analysis results are shown in Panel B. Here we notice the significantly higher stock market returns for a group with higher bonus levels: $+3.6\%$ difference accumulated in two weeks following the parliament approval and $+3.1\%$ accumulated over two weeks before the official publication of the CRD IV. As for the more narrowly focused rules, I find multiple cases of significant and negative differences in realized abnormal returns between the affected and non-affected banks and those differences are consistent in sign and significance for the two possible thresholds of 100% and '200%. I discuss here the result for the "above 100%" group ("above 200%" group's results shown in the Appendix are consistent in terms of sign and significance, and typically become larger in absolute terms).

"Above 100%" group exhibits inferior performance in the weeks following the following rules' releases: post-crisis remuneration rules (-3%), their official approval (-2.4%), the bonus cap agreement (-2.2%), revision of the identified staff definition (-1.3%) and the guidelines on the discount rates for deferred remuneration parts (-2.1%).

Revision of identifed staff rules turned out to be the most controversial event preceded by large positive returns for the high-bonus group but followed by a period of

[10]The bonus cap rule gave rise to multiple protests and controversy and can thus be considered unexpected for the market participants (see e.g. "Bankers look for ways round bonus clawbacks" at https://www.ft.com/content/6e9d784a-1b2f-11e5-8201-cbdb03d71480, "Chance for bankers to dodge Europe bonus caps" and "Britain loses battle over EU bank bonus caps" at https://uk.reuters.com/article/banks-bonuses-europe-idUKL5N0CJ26920130327)

[11]200% upon shareholders' approval

negative difference with the rest of the sample. I suggest the following explanation: the clarification of the rule and exemption options was beneficial (and bringing positive returns) for the institutions concerned (as it revealed the scope of adjustments needed) but the resulting personnel coverage was wider than the one initially stipulated (and hence triggered negative returns for the "above 200%" category). Overall the stock market reaction accumulated in 4 weeks' period around the release would amount to 9.3% for the "above 100%" group. Positive returns' differential is also seen in the week following the final remuneration guidelines release: 1% indicating the market's positive attitude towards the uncertainty resolution (with no further tightening clauses were included in that document).

Table 5: Stock market reaction

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.022	.008	.008***	-.001	.001
2. European parliament approval of CRD IV	.034	.011	.001***	.003	.014
3. Official publication of CRD IV	-.016	-.001	-.017***	-.011	-.039
4. Public consultation - guidelines on remuneration policies	.019	.014	.005	-.003	.003
5. Guidelines on remuneration policies and practices	.010	-.005	-.001	-.013	-.028
6. "Within reach" agreement on bonus caps	-.011	-.025**	.015	.007	.012
7. Agreement on bonus caps	-.023	-.013	-.021*	-.024	-.030
8. Identified staff definition	.054	.029	-.043	-.009	.002
9. Revised identified staff definition	.010	.006	-.003	-.009	-.012
10. Standards on variable instruments	.006	.001	-.008	.000	.008
11. Guidelines on the applicable discount rate	-.020	-.024**	-.001	.028**	.010
12.Technical standards on identified staff	.027	.011	.011	-.024***	-.039***
13. Consultation on guidelines on remuneration policies	.016	-.013	.003	.009	.002
14. Correction to identified staff rules	-.013	.008	.004	.013	.003
15. Final guidelines on remuneration policies	-.018	.008	.018	-.006	-.006
Panel B - significance of "above 100%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.041	.026	-.007	.031*	.029
2. European parliament approval of CRD IV	-.008	.023**	.000	.017	.036**
3. Official publication of CRD IV	.031**	.033**	.006	.014	-.001
4. Public consultation - guidelines on remuneration policies	-.009	-.016**	-.006	-.010	-.030**
5. Guidelines on remuneration policies and practices	.009	.014	-.004	-.024*	-.014
6. "Within reach" agreement on bonus caps	.016	.016	-.010	-.007	-.011
7. Agreement on bonus caps	.001	-.008	-.008	-.022**	-.018
8. Identified staff definition	.093**	.050**	-.025	-.011	-.025
9. Revised identified staff definition	-.007	-.004	-.007	-.013*	-.007
10.Technical standards on variable instruments	-.015	-.000	-.003	.013	.033
11. Guidelines on the applicable discount rate	-.029*	-.008	.006	-.021*	-.015
12.Technical standards on identified staff	-.028*	-.021**	-.002	-.001	.011
13. Consultation on guidelines on remuneration policies	.027**	.001	.010	-.008	-.024
14. Correction to identified staff rules	-.004	.003	.006	.002	.005
15. Final guidelines on remuneration policies	-.007	.003	.004	.010*	.011
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a 1-factor model with MSCI Europe as a reference index. Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_k Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$ with lagged controls including size, capital ratio, proportion of NPLs, income diversification, deposits/assets ratio, liquidity ratio and government support indicator

*** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

Table 6 shows the results for CDS spreads. Overall strengthening of bonus rules could cause lower riskiness (which would cause the decline in spreads), but also mean lower profitability and the increase in compliance costs (associated with rises in spreads). Most significant changes in case of major announcements are brought by the draft publication: an overall +2.1% raise from two weeks prior to the release till 3 days around the announcement. Other two events are accompanied by the changes by the relatively moderate change: +0.6% following the EU Parliament approval and −0.1% for the official

publication. Most significant spread-reducing events include the post-crisis guideines' revision (-7.3% in two weeks around the announcement), first discussion of bonus caps (-5.7% in the two weeks following the event) and the final guidelines on remuneration systems (-4.5%). Multiple events related to the identified staff rules while being controversial again brings an overall -2.5% spread change two weeks around the first definition release and further reductions of -3.5% 3 days around the release of technical standards and -9.3% a week before their revision. The official bonus cap announcement produces the 3.9% spreads' rise 3 days around the event which is not game-changing once the overall series of announcements is considered, but signals that the costs associated with limiting bankers' incentives are outweighting the potential reduction in risk-taking behaviour. The results suggest the investors are favoring the remuneration rules in general as the sample exhibits spreads' reduction both at the time around the announcement and in the subsequent weeks for 10 out of 15 events considered (simple summation of significant results for the [-1;1] windows gives a -2.8% spreads' reduction which is magnified once the longer time periods are concerned). However, major rules and the controversial bonus cap approval are considered burdensome for the banks.

Panels B demonstrates the cross-sectional results. Only in few cases the changes for the "high-bonus" banks are significantly different from the ones exhibited by the rest of the sample (-3.4% difference in two weeks following the Parliament approval of CRD IV, -0.09% around the identified staff rules' revision and $-.022*$ before the final guidelines on remuneration policies are released). Taking into account the small sample size I've performed an additional calculation for a simplified specification including only the "above 100%" ("above 200%") indicators and the flag of government support (results are available upon request). The results stayed unaffected signalling less attention to individual banks and more to the overall rules' content in case of the CDS investors.

Table 6: CDS market reaction

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.041**	.030***	-.020***	-.026	-.040
2. European parliament approval of CRD IV	.008	.024	.006***	-.016	-.021
3. Official publication of CRD IV	.037	.001	-.001***	.020	.015
4. Public consultation - guidelines on remuneration policies	-.039	-.045**	-.013***	-.028*	-.022
5. Guidelines on remuneration policies and practices	.018	.009	.018***	.015	.057*
6. "Within reach" agreement on bonus caps	-.035*	-.005	.002***	-.036**	-.057***
7. Agreement on bonus caps	.002	-.007	.039***	-.022	-.016
8. Identified staff definition	.000	-.032**	-.025***	.034*	.039
9. Revised identified staff definition	.010	-.014	-.004***	.001	-.007
10.Technical standards on variable remuneration instruments	-.012	-.011	.014***	.004	.018
11. Guidelines on the applicable discount rate	.005	.014	-.005***	-.032	-.069*
12.Technical standards on identified staff	.014	.015	-.035***	-.004	-.016
13. Consultation on guidelines on remuneration policies	-.031	-.023	.005***	.002	.019
14. Correction to identified staff rules	-.054	-.093*	-.005***	-.033	-.037
15. Final guidelines on remuneration policies	.035	.003	-.019***	-.041***	-.026*
Panel B - significance of "above 100%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.041	-.014	-.012	.023	.018
2. European parliament approval of CRD IV	.019	.012	.006	-.010	-.034*
3. Official publication of CRD IV	-.017	-.006	-.005	-.017	.017
4. Public consultation - guidelines on remuneration policies	-.006	.010	.007	.018	-.011
5. Guidelines on remuneration policies and practices	.017	.021	-.000	.010	-.016
6. "Within reach" agreement on bonus caps	.016	.018	-.005	.010	.017
7. Agreement on bonus caps	-.013	-.017	-.000	.008	.020
8. Identified staff definition	-.000	.002	.018	-.003	.016
9. Revised identified staff definition	-.011	-.009	-.009*	-.011	-.018
10.Technical standards on variable instruments	-.018	.001	.006	-.001	.026
11. Guidelines on the applicable discount rate	.006	.001	-.004	.050**	.036
12.Technical standards on identified staff	.007	-.011	.002	.027	-.016
13. Consultation on guidelines on remuneration policies	.008	-.010	-.027	-.034	-.015
14. Correction to identified staff rules	-.021	.050	.015	.013	.032
15. Final guidelines on remuneration policies	.004	-.022*	.029	-.006	.010
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a 1-factor model with an average of industry level CDS indices used as a market index. Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$ with lagged controls including size, capital ratio, proportion of NPLs, income diversification, deposits/assets ratio, liquidity ratio and government support indicator
*** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

5 Synthetic controls analysis

In this section I look at the monthly basis outcomes for the full sample of banks using a synthetic control analysis.[12] The approach introduced by Abadie & Gardeazabal (2003) and Abadie et al. (2015) is typically used for small sample case studies and fits to my

[12]Appendix D gives the details on the methodology

case of few treated units and a limited number of control units.[13] Gobillon & Magnac (2016) provide evidence in favor of the method in small samples when comparing it to a standard difference-in-difference setup.

I do the analysis around the three different dates: January 2011 when the new (CRD III) governance rules were introduced, February 2013 when the cap rules were approved and January 2014 when the bonus rules were set to get binding according to the CRD IV timeline[14], February 2013 when the bonus cap was officially approved. I look into the data 12 month before and 12 months after the relevant point in time and match the outcomes using the same set of controls which I employed in the event study analysis: size, capital ratio, proportion of NPLs, measure of income diversification, deposits/assets ratio, liquidity ratio and government support indicator. The outcome variables include CDS spreads and stock market volatility (both in logs) and two indicators of systemic risk - SRISK and cCoVaR.

Table 7 present the differences in outcomes for a group of affected units and the group of synthetic controls. I report both the comparison between the group of "above 100%" banks as compared to the rest of the sample and the results shown by the "above 200%" group of banks. Resulting difference in a post-treatment trend for treated and synthetic units is interpreted as intervention impact. Assigning the status of treated to each of the control group's units it is possible to make an inference on the impact significance for truly affected units. The p-value (assuming N units with the first being the treated one) is obtained using the following formula[15]:

Significance of results is determined using the p-value criterion.

$$p - value = \frac{\sum_{j=2}^{N} 1[RMSPE_j \geq RMSPE_1]}{N} \tag{6}$$

$$RMSPE_j = \frac{\sum_{t=T_0+1}^{T} \frac{Y_{j,t} - \hat{Y_{j,t}^N}}{T - T_0}}{\sum_{t=1}^{T_0} \frac{Y_{j,t} - \hat{Y_{j,t}^N}}{T_0}} \tag{7}$$

[13] As emphasized in Abadie et al. (2015) "a combination of comparison units (synthetic control) often does a better job of reproducing the characteristics of the unit or units representing the case of interest than any single comparison unit alone". In fact my treatment group is limited by the banks relying on high bonuses while control group is constrained by the availability of market data.

[14] in an unreported robustness check (available upon request) I perform the estimation for a set of country-specific dates marking the transposition of new remunerational laws into the country-level legislations. The results are consistent with those shown following January 2014

[15] The estimate can be used to make inferences assuming the intervention is randomized conditional on observables (including the trend of the outcome variable). However even if the randomness of treatment assignment is arguable, the fraction still demonstrates the probability of obtaining a given impact estimate when the intervention is reassigned at random.

Initial 2011 change in remuneration guidelines is followed by a period of lower CDS spread levels (0.12 to 0.16 lower spreads constituting around 3% of sample mean) and lower stock market volatility (0.21 lower volatility constituting around 5% of the sample mean value in absolute terms) demonstrated by the group of affected banks. At the same time affected group started to exhibit higher levels of systemic risk: up to 0.03 difference (25% of its sample mean for the period) for cCoVaR and up to 0.13 difference for SRISK (1.5% of the standard deviation for the period). Results are consistent for "above 200%" banks in terms of sign and significance.

Approval of bonus cuts in February 2013 was followed by a short period of lower SRISK realization for the "above 100%" banks (with differences of up to 0.13 or 1.6% of the sample mean). In this case, the threshold selection mattered since "above 200%" banks have shown a significantly lower level of SRISK for a year following the announcement (up to 0.4 difference or about 4.8% of the sample mean for 2012-2014 time period). At the same time, the individual risk indicators (i.e. CDS spreads and stock returns' volatility) were not in any way affected by the regulatory intervention.

Finally, the official effective date was not anyhow special for the high bonus banks: neither estimation around January 2014 nor (an unreported) analysis around the country-specific effective dates have shown persistent and sizeable differences in terms of risk indicators for the "high-bonus" banks.

Table 7: Synthetic controls - results

100% group	January 2011				February 2013				January 2014			
	CDS (log)	CoVaR	SRISK(log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)
month 1	-0.10	0.00	0.05***	0.09	-0.02	-0.01	-0.09*	-0.12	-0.02	0.00**	0.09	-0.02
month 2	-0.16***	0.00	0.00***	-0.12	-0.01	0.00	-0.13*	-0.07	-0.03	0.00**	0.14	0.11
month 3	-0.14***	0.00	0.00	0.03	0.00	0.00	-0.17	-0.11	-0.01	0.00**	0.18*	0.07
month 4	-0.12***	0.00*	-0.03	0.02	-0.02	-0.01	-0.06	0.00	0.00	0.00	0.13	0.01
month 5	-0.13***	0.00	-0.01	-0.21**	0.02	-0.01	-0.08	-0.13	0.00	0.00	0.10	-0.06
month 6	-0.12**	0.00	-0.05	-0.18*	0.00	0.00	-0.07	-0.09	-0.02	0.00	0.13	-0.01
month 7	-0.13	0.00	0.00***	-0.18*	-0.04	-0.01	-0.13	-0.07	0.00	0.00	0.08	-0.17
month 8	-0.11	0.00	0.03***	-0.16	-0.09	0.00	-0.12	-0.06	-0.01	0.01	0.11	-0.04
month 9	-0.07	0.02***	0.12***	-0.01	-0.06	0.00	-0.12	-0.04	-0.02	0.01	0.10	-0.07
month 10	-0.05	0.03***	0.13***	0.06	-0.07	-0.01	-0.13	0.08	-0.04	0.01*	0.18	-0.01
month 11	-0.01	0.03***	0.13***	0.09	-0.08	-0.01	-0.15	0.01	-0.04	0.01*	0.21	0.12
month 12	-0.04	0.02***	0.11***	0.02	-0.09	-0.01	-0.12	-0.08*	-0.05	0.01*	0.20	-0.02

200% group	January 2011				February 2013				January 2014			
	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)
month 1	-0.09**	0.00	-0.02	0.09	0.02	0.00	-0.21**	-0.11	0.00	0.00*	0.07	-0.03
month 2	-0.07	0.00	-0.07	-0.12*	0.04	0.00	-0.30**	-0.01	0.02	0.00	0.15	0.16**
month 3	-0.08*	0.00	-0.02	0.03	0.00*	0.00	-0.46***	-0.09	0.02	0.00	0.23	0.11
month 4	-0.05	0.00	-0.06	0.02	-0.02**	-0.01	-0.27***	0.01	0.02	0.00	0.12	0.01
month 5	-0.09*	0.00	-0.05	-0.21*	0.09	-0.01	-0.31***	-0.09	0.01	0.00	0.12	-0.05
month 6	-0.07	0.00	-0.10	-0.18**	0.06	0.00	-0.25***	-0.07	-0.04	0.00	0.16	0.01
month 7	-0.11*	0.00	-0.04	-0.18***	0.04	-0.01	-0.37***	-0.03	-0.06	0.00	0.12	-0.15
month 8	-0.15**	0.00	0.02	-0.16	0.00	0.00	-0.36***	-0.01	-0.05	0.01	0.04	-0.02
month 9	-0.12	0.02	0.22***	-0.01	0.02	0.00	-0.28***	0.00	-0.03	0.01	0.07	-0.04
month 10	-0.06	0.03*	0.30***	0.06*	0.03	-0.01	-0.39***	0.12	-0.06	0.01	0.20	0.01
month 11	-0.04	0.03	0.27***	0.09	0.00	-0.01	-0.40**	0.04	-0.08	0.01	0.19	0.18
month 12	-0.03	0.02	0.23***	0.02	-0.02	-0.01	-0.31	-0.07*	-0.14	0.01	0.20	0.01

The table shows the difference in outcomes between the affected group and the constructed synthetic controls; *** p-value < 0.01, ** $0.01 <$ p-value < 0.05, * $0.05 <$ p-value < 0.1

P-value (assuming N units with the first being the treated one) is obtained as $\frac{\sum_{j=2}^{N} 1[RMSPE_j \geq RMSPE_1]}{N}$, $RMSPE_j = \frac{\sum_{t=T_0+1}^{T} \frac{Y_{j,t} - Y_{j,t}^N}{T - T_0}}{\sum_{t=1}^{T_0} \frac{Y_{j,t} - Y_{j,t}^N}{T_0}}$

6 Robustness checks

6.1 Event study

I perform the following robustness checks. I repeat the analysis for the stock market using the Fama-French market factor (covering the traded European institutions) for abnormal returns' computation. Next, I repeat the analysis omitting the UK banks from the sample. UK remuneration code has introduced the rules for bonus deferrals, but the limits for variable to fixed ratios were set only in the CRD IV. Hence I exclude the banks which could be more "prepared" to regulatory innovations but leave them for the baseline tests as 80.4% of the high earners are based in the UK[16] and the quantitative variable-to-fixed threshold was never part of any UK regulation. If investors have already incorporated the new remuneration rules information into the UK banks' stock prices removing those banks from the sample would make the results sharper.

The similar check looks into the FSB jurisdiction banks which have become subject to the set of rules coming from the transposition into national regulations for FSB Principles for Sound Compensation practices. Those rules included among others the recommendations to have an independent board and supervisory oversight of the process, the rules for bonus deferrals and certain disclosure requirements. Thus such a check allows to see the "bonus cap" reaction under condition of the bank being already subject to a set of salary-related rules.

Tables 8 and 9 show the results for two bonus related announcements and the technical definition for personnel subject to thresholds. Appendix C shows the full set of results.

The stock market results do not depend on the choice of market index: Fama French estimation renders insignificant the negative returns shown prior to the first discussion on bonus caps, but the sample still demonstrates the loss in value upon the approval of caps and the release on the identified staff definition (with more losses for the "high-bonus banks"). Similarly, the abnormal returns are not affected in terms of size and significance once the non-UK sample is considered. Same is true when I consider the full sample of FSB-jurisdiction banks. The only difference is demonstrated by the "high-bonus" institutions: they demonstrate a significant and negative deviation from the other FSB banks following the very first discussion on bonus caps but show no abnormal returns following the instructions on the affected personnel. CDS market results are also consistent in terms of sign and significance with only considerable deviation observed for a non-UK sample. Cross-sectional analysis results in significant reduction of spreads for the "high-bonus" institutions following the bonus cap approval and in anticipation of identified staff rules.

[16] See EBA report on remuneration policies and high earners
https://eba.europa.eu/documents/10180/1720738/EBA+Final+Report+on+High+Earners+2015.pdf

Table 8: Robustness checks - stock market reaction

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1-factor, MSCI					
6. "Within reach" agreement on bonus caps	-.011	-.025**	.015	.007	.012
7. Agreement on bonus caps	-.023	-.013	-.021*	-.024	-.030
12. Technical standards on identified staff	.027	.011	.011	-.024***	-.039***
1-factor, Fama French					
6. "Within reach" agreement on bonus caps	-.008	-.016	.000	.003	.008
7. Agreement on bonus caps	.005	.012**	-.020**	-.013	-.016
12. Technical standards on identified staff	.029	.011	.013	-.019**	-.036***
1-factor, excluding UK banks					
6. "Within reach" agreement on bonus caps	-.010	-.026**	.015	.006	.011
7. Agreement on bonus caps	-.024	-.013	-.021*	-.022	-.027
12. Technical standards on identified staff	.029	.013	.012	-.025***	-.039***
1-factor, FSB banks					
6. "Within reach" agreement on bonus caps	-.015	-.034**	.025*	.021	.019
7. Agreement on bonus caps	-.025	-.008	-.031*	-.019	-.025
12. Technical standards on identified staff	.029	.010	.014	-.022***	-.045**
Panel B - significance of "above 100%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1-factor, MSCI					
6. "Within reach" agreement on bonus caps	.016	.016	-.010	-.007	-.011
7. Agreement on bonus caps	.001	-.008	-.008	-.022**	-.018
12. Technical standards on identified staff	-.028*	-.021**	-.002	-.001	.011
1-factor, Fama French					
6. "Within reach" agreement on bonus caps	.017	.017	-.010	-.007	-.011
7. Agreement on bonus caps	.002	-.007	-.008	-.021**	-.017
12. Technical standards on identified staff	-.027*	-.021**	-.001	-.001	.012
1-factor, excluding UK banks					
6. "Within reach" agreement on bonus caps	.029	.014	-.006	-.003	-.007
7. Agreement on bonus caps	.001	-.017	-.016	-.017*	-.004
12. Technical standards on identified staff	-.028*	-.024**	.002	-.006	.011
1-factor, FSB banks					
6. "Within reach" agreement on bonus caps	.023	.014	-.009	-.020*	-.029*
7. Agreement on bonus caps	.001	-.006	-.003	-.013	.012
12. Technical standards on identified staff	-.018	-.010	-.006	.002	.008
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a 1-factor model, with MSCI Europe or Fama French market factor used as a market index. Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_k Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$ with lagged controls including size, capital ratio, proportion of NPLs, income diversification, deposits/assets ratio, liquidity ratio and government support indicator

*** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

Table 9: Robustness checks - CDS market reaction

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1-factor, full sample					
6. "Within reach" agreement on bonus caps	-.035*	-.005	.002***	-.036**	-.057***
7. Agreement on bonus caps	.002	-.007	.039***	-.022	-.016
12.Technical standards on identified staff	.014	.015	-.035***	-.004	-.016
1-factor, no UK banks					
6. "Within reach" agreement on bonus caps	-.035*	-.008	.002***	-.037**	-.059***
7. Agreement on bonus caps	.001	-.008	.036***	-.021	-.020
12. Technical standards on identified staff	.013	.016	-.038***	-.007	-.017
1-factor, FSB banks					
6. "Within reach" agreement on bonus caps	-.034	-.006	.001***	-.039**	-.059***
7. Agreement on bonus caps	.004	-.006	.037***	-.022	-.024
12. Technical standards on identified staff	.017	.014	-.048***	-.007	-.019
Panel B - significance of "above 100%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1-factor, full sample					
6. "Within reach" agreement on bonus caps	.016	.018	-.005	.010	.017
7. Agreement on bonus caps	-.013	-.017	-.000	.008	.020
12.Technical standards on identified staff	.007	-.011	.002	.027	-.016
1-factor, excluding UK banks					
6. "Within reach" agreement on bonus caps	.029	.014	-.006	-.003	-.007
7. Agreement on bonus caps	.001	-.017	-.016	-.017*	-.004
12. Technical standards on identified staff	-.028*	-.024**	.002	-.006	.011
1-factor, FSB banks					
6. "Within reach" agreement on bonus caps	.029	.040	-.002	-.016	-.023
7. Agreement on bonus caps	-.013	-.018	.015	-.014	.007
12. Technical standards on identified staff	-.014	.002	-.028	.034	.026
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a 1-factor model with an average of industry level CDS indices used as a market index. Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$ with lagged controls including size, capital ratio, proportion of NPLs, income diversification, deposits/assets ratio, liquidity ratio and government support indicator

*** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

6.2 Synthetic controls

In this section I perform the synthetic controls' analysis for an FSB-only sample[17]. Here we find the lower level of CDS spreads and volatility for the affected group in 2011 with with difference being more sizeable than in the baseline case. Individual and systemic risk realisations are also lower for the "high-bonus" group when the cap is officially approved. No difference is observed following the official implementation date.[18]

[17]non-UK sample results available upon request

[18]In the unreported robustness check I look into the country-specific implementation dates instead of the unique date set by the CRD IV provisions. The results stay unchanged in terms of size and significance

Table 10: Synthetic controls, FSB sample - results

100% group	January 2011				February 2013				January 2014			
	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)
month 1	-0.18***	-0.01	0.05	0.14	-0.05**	0.00	-0.09	-0.13*	-0.03	0.00	0.05	-0.10
month 2	-0.24***	0.00	0.01	-0.10**	-0.02*	0.00	-0.12**	-0.12	-0.04*	0.00	0.10	0.04
month 3	-0.20***	0.00	0.02	0.03	0.00	0.00	-0.17*	-0.10	-0.01	0.00	0.16	0.03
month 4	-0.18***	0.00	-0.03	0.05	-0.05*	-0.01	-0.05	-0.01	-0.01	0.00	0.16	-0.01
month 5	-0.20***	0.00	0.00	-0.16**	0.01	-0.01	-0.07	-0.11	0.00	0.00	0.10	-0.10
month 6	-0.20***	0.00	-0.04	-0.19*	-0.02*	0.00	-0.07*	-0.06	-0.03	0.00	0.10	-0.06
month 7	-0.20***	0.00	0.02	-0.16*	-0.07*	-0.01	-0.13***	-0.06	-0.01	0.00	0.08	-0.15
month 8	-0.13	0.00	0.04	-0.09	-0.13**	0.00	-0.12***	-0.05	-0.02	0.00	0.09	-0.06
month 9	-0.07	0.01*	0.14	0.03	-0.11**	0.00	-0.11***	-0.10*	-0.03	0.00	0.13	-0.09
month 10	-0.04	0.02	0.16	0.11	-0.12**	0.00	-0.12***	0.06	-0.04	0.01	0.18	0.04
month 11	-0.02	0.01	0.14	0.16*	-0.13**	-0.01	-0.14***	-0.04	-0.05	0.01	0.21	0.12
month 12	-0.05	0.00	0.12	0.09	-0.13**	-0.01	-0.12**	-0.17**	-0.06	0.01	0.21	0.02

200% group	January 2011				February 2013				January 2014			
	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)
month 1	-0.23**	-0.01	-0.03	-0.02	-0.01**	-0.01	-0.24***	-0.20***	-0.01	0.00	-0.01	-0.17
month 2	-0.24*	0.00	-0.07	-0.27**	0.04*	0.00	-0.31***	-0.13	0.01	0.00	0.07	0.12
month 3	-0.21**	0.00	-0.02	-0.05	0.02***	0.00	-0.47***	-0.22*	0.03	0.00	0.21	0.07
month 4	-0.16	0.00	-0.07	-0.03	-0.04***	-0.01	-0.27***	0.14	0.04	0.00	0.20	-0.12
month 5	-0.21**	0.00	-0.05	-0.24*	0.07**	0.00	-0.31***	0.21*	0.02	0.00	0.14	-0.21*
month 6	-0.21	0.00	-0.11	-0.29**	0.05**	0.00	-0.27***	0.09	-0.04	0.00	0.13	-0.21
month 7	-0.21*	0.00	-0.05	-0.24	0.01**	0.00	-0.38***	0.00	-0.04	0.00	0.12	-0.12
month 8	-0.19	0.00	0.02	-0.22	-0.03**	0.00	-0.36***	0.05	-0.05	0.00	0.06	-0.01
month 9	-0.13	0.01*	0.24	-0.11	-0.02**	0.00	-0.34***	-0.01	-0.02	0.00	0.13	-0.04
month 10	-0.07	0.02	0.26	-0.06	0.00	0.00	-0.43***	0.23**	-0.03	0.01	0.21	0.09
month 11	-0.05	0.01	0.30	0.07	-0.05	0.00	-0.44***	0.05	-0.07	0.01	0.18	-0.04
month 12	-0.06	0.00	0.26	-0.06	-0.05	0.00	-0.38***	-0.23***	-0.12	0.01	0.23	0.02

The table shows the difference in outcomes between the affected group and the constructed synthetic controls; *** p-value < 0.01, ** $0.01 <$ p-value < 0.05, * $0.05 <$ p-value < 0.1

P-value (assuming N units with the first being the treated one) is obtained as $\frac{\sum_{j=2}^{N} 1[RMSPE_j \geq RMSPE_1]}{N}$, $RMSPE_j = \frac{\sum_{t=T_0+1}^{T} \frac{Y_{j,t} - Y_{j,t}^N}{T - T_0}}{\sum_{t=1}^{T_0} \frac{Y_{j,t} - Y_{j,t}^N}{T_0}}$

7 Conclusions

In this paper I analyze the impact of the post-crisis remuneration regulations on the European banking industry. I cover three major regulatory announcements related to the Capital Requirements Directive IV which included remuneration rules as part of a large set of new requirements.

I look into the two waves of the regulations. First one in 2010-11 introduced the requirements for disclosure in the sphere of remuneration and for a balance between the variable and fixed components of the salary. I then look into the CRD IV major innovation - the rule setting an explicit cap for the ratio between variable and fixed components released in February 2013 followed by the revisions of bonuses-related technical standards and remuneration guidelines. In my analysis I cover the short term reactions to the new rules in the stock and CDS markets. I also look into the long-term risk-taking outcomes measured by a set of market-based measures (CDS spreads, SRISK, CoVaR, LRMES and returns' volatility).

Major (pre-crisis) theoretical contributions to the pay-performance links were theoretical and produced two major hypotheses[19]:

- Lower bonuses reduce the risk-taking incentives: managers receiving lower performance-related compensation are less motivated to sacrifice long-term goals for short-term opportunities.
- Reduction in risk-taking is achieved at a cost of lower profitability i.e. due to inefficient changes to banks asset portfolios.

First part of my analysis provides the market's view on those hypotheses. Negative reaction in the stock markets could be explained by expected profit reduction. In this case we would have to deduce that the markets are dominated by the short-term focused investors (risk averse and long-term investors would in fact favor the new rules). In addition given the degree of unertainty around the exact implementation rules the reactions in the stock maket could be determined by the mere welcoming of new information releases or by assessment of rules as being more or less stringent with respect to the initial expectations. The first explanation would push the abnormal returns to a positive side (and more so for the more "affected" banks), thus reinforcing the negative results I obtained. The second would work for the "follow-up" rules rather than for initial bonus cap approval, hence the negative reaction to bonus caps stays valid (and consistent with contemporaneous study of Kleymenova & Tuna (2017)).

The fall in CDS spreads observed after the set of remuneration-related announcements signals the reduced credit risk as perceived by the market participants. It is worth noting

[19] see Thanassoulis (2012), Thanassoulis (2014), Bénabou & Tirole (2016), Acharya, Pagano & Volpin (2016)

however that the stock market reaction is amplified for the targeted "high-bonus" banks while the CDS spreads' fall is valid for the full sample without additional impact for the "high-bonus" group. As for the longer-term outcomes, I find the lower (individual and systemic) risk outcomes for the affected group of banks, though with no evidence of inferior outcomes for profitability (ROA) following the cap introduction.

To sum up, the results indicate that the battle over bonuses was likely supported by investors favoring the short-term profitability over the risk reduction. However, bonus caps have played a risk-limiting role reflected in both - short term investors' expectations (CDS market) and longer-term risk indicators which stayed at lower levels for the affected group of banks when compared to a synthetic control comparable to "high-bonus" institutions in terms of bank-level covariates and pre-treatment outcome variable levels.

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Appendices

A Regulatory Background and Relevant Timeline

Starting from 2009 multiple guidelines and regulations covered the various components of compensation system for the banking industry in the EU. Among all they included the requirements for transparency, variable remuneration shares, deferral periods and the proportion of cash versus non-cash payments. Initial post-crisis adjustments to remuneration regulations were implemented within the Capital Requirements Directive III (CRD III) which emphasized the need for governance system, risk alignment and transparency in remuneration. As part of its implementation the Commission of European Banking Supervisors has approved and published the Guidelines on Remuneration Policies and practices on December 10^{th} 2010 emphasizing the need for a balance between the variable and fixed components of the salary. The Directive itself became effective from January 1^{st} 2011.

Next large EU-level reform of managerial remuneration practices was implemented within the Capital Requirements Directive (CRD IV). Preliminary draft issued in 2010 stipulated the need for better disclosure of remuneration practices. In particular it required the financial institutions to disclose among others the following details of the compensation system:

- remuneration committee composition, external consultants, the role of the relevant stakeholders;
- pay-performance linkages, performance measurement and risk adjustment criteria
- deferral policy and vesting criteria
- the main parameters and rationale for the variable remuneration scheme
- remuneration, broken down by business area; by senior management and members of staff whose actions have a material impact on the risk profile of the institution;
- the split into fixed and variable components, the number of beneficiaries; amounts of variable remuneration, split into cash, shares, share-linked instruments; amounts of outstanding deferred remuneration, split into vested and unvested portions;
- deferred remuneration awarded during the financial year;
- number of individuals being remunerated EUR 1 million/more, broken down into pay bands of EUR 500 000.

In February 2013 it was revealed that the regulation would be complemented by the additional rule setting a cap for the ratio between variable and fixed components (referred to as the bonus cap further on). This quantitative requirement was unexpected by industry and investors (compared to the previously announced qualitative rules) and its inclusion gave rise to multiple debates and protests the most serious of which came from the United Kingdom. The country voted against this rule and its representatives appealed against the European Parliament decision at the European Court of Justice. This appeal was cancelled eventually and the country was the last one to adopt the rule which became binding on January 2015, one year after the official effective date.

According to the new rule each bank had to satisfy a limit of 100% for this ratio with an option for shareholders of an entity to increase the limit to 200% of remuneration package. The Directive was approved by the European Parliament in April 2013, full text was published in June 2013 and the provisions became effective starting January 1^{st} 2014. Those three dates together with the previously mentioned releases of remuneration guidelines and bonus cap rules form the base for the event study analysis I conduct. In addition the synthetic control analysis is done around January 2011 and January 2014-January 2015. First date marks the moment when the CRD IIIvcame into force. Next set of dates is covering the period of bonus rules implementation in the member states. Remuneration rules were relevant for the so called "identified staff which included the following individuals:

- those with remuneration of EUR 500 000/more in the preceding financial year
- those staying within 0.3% of the top employees by remuneration amount
- those with remuneration being equal or greater than the lowest total remuneration of senior management

The regulation has also amended the rules related to the deferral of variable remuneration discount rate used to evaluate deferred payment and the acceptable proportions of cash and non-cash payments. Despite the unique announced effective date CRD IV part covering remuneration practices belonged to provisions which had to be transposed into the regulations on the national level. Some of the countries diverged in terms of implementation dates (with rules being implemented up to January 2015 in the UK). While several clauses related to remuneration rules were amended during the transposition, none of the countries eventually removed the bonus cap. The Directive was further clarified through a series of technical standards and guidelines to ensure appropriate implementation in the related institutions. Tables 11 shows the regulatory updates split into two categories.

Table 11: Remuneration-related rules

Date	Announcement	Authority	Description
1. Public consultation on the draft of CRD IV	26/02/2010	EC	The draft of a Capital Requirements Regulation (CRR) and a fourth edition of the Capital Requirements Directive (CRD IV) is released for discussion
2. CRD IV EU Parliament Approval	16/04/2013	EC	The package consisting of a Capital Requirements Regulation (CRR), Capital Requirements Directive (CRD IV) is approved by the EP
3. CRD IV Official journal publication	27/06/2013	EC	Regulation text in the Official Journal of the European Union
4. Public consultation - guidelines on remuneration policies and practices	07/10/2010	CEBS	Joint decision of European financial regulators on the new rules regarding bankers' remuneration (proportion paid in cash, bonus deferrals)
5. Guidelines on remuneration policies	10/12/2010	EBA	Confirmation of rules introduced in the drafted version: deferral of 60% to up to 5 years, 50% proportion for share pay
6. "Within reach" agreement on bonus caps	13/12/2012	EP	Drafted rule on capping the bankers' bonuses. "...most severe crackdown on pay since the 2008 financial crisis" (ft.com)
7. Agreement on bonus caps	27/02/2013	EBA	Official aproval of quantitative threshold for variable to fixed ratio
8. Identified staff definition	13/12/2013	EBA	Drafted guidelines on the criteria to determine identified staff
9. Identified staff definition	21/05/2013	EBA	Consultation paper on the criteria to determine identified staff
10. Standards on variable instruments	19/02/2014	EC	Classes of instruments to be used for the purposes of variable remuneration
11. Guidelines on the applicable discount rate	27/03/2014	EBA	Discount rate used to assess the deferred part of variable remuneration
12.Technical standards on identified staff	06/06/2014	EC	Quantitative criteria to determine the personnel subject to bonus caps
13. Consultation on guidelines on remuneration policies and practices	04/03/2015	EBA	Updated version with details on identified staff definition
14. Correction to identified staff rules	16/07/2015	EBA	Updated version with details on identified staff definition
15. Final guidelines on sound remuneration policies	21/12/2015	EBA	Updated version with details on identified staff definition

EC - European Commission, EBA - European Banking Association, EP - European Parliament

B List of institutions

Bank	Country	Affected	Gov. support	Bank	Country	Affected	Gov. support
Aareal Bank	DE	YES		BKS Bank	AT	NO	
Alandsbanken	FI	NO		BNP Paribas	FR	NO	
Allied Irish Banks	IE	NO	2009-10	BPER Banca	IT	NO	
Alpha Bank	GR	NO	2012-14	CaixaBank	ES	NO	
Attica Bank	GR	NO	2016	Close Brothers Group	GB	YES	
Banca Generali	IT	NO		Comdirect bank	DE	NO	
Banca Popolare di Sondrio	IT	NO		Commerzbank	DE	NO	2009-12
Banca Carige SpA	IT	YES		Credit Industriel Commercial	FR	NO	
Banco Popular Espaol	ES	NO		Credit Suisse Group	CH	YES	
Banco BPI	PT	NO	2013	Credit Agricole	FR	NO	
Banco Comercial Portugues	PT	NO	2013	Credito Emiliano	IT	NO	
Banco de Sabadell	ES	YES		Credito Valtellinese	IT	NO	
Banco di Desio e della Brianza	IT	NO		Danske Bank	DK	NO	
Banco Santander	ES	NO		Deutsche Bank	DE	YES	
Bank Handlowy Warszawie	PL	NO		Dexia	BE	NO	2008-17
Bank fur Tirol und Vorarlberg	AT	NO		DNB	NO	NO	
Bank of Valletta	MT	NO		EFG International	CH	NO	
Bank Zachodni	PL	NO		Erste Group Bank	AT	NO	
Bankia	ES	NO	2012	Eurobank Ergasias	GR	NO	2012-15
Bankinter	ES	NO		Getin Noble Bank	PL	NO	
Banque Cantonale de Geneve	CH	NO		Hellenic Bank	CY	NO	2013-14
Barclays Plc	GB	NO		HSBC Holdings	GB	YES	
BBVA	ES	YES		IKB Deutsche Industriebank	DE	NO	2008-09
ING Groep N.V.	NL	NO	2008-12	SpareBank 1 SMN	NO	NO	
Intesa Sanpaolo	IT	NO		SpareBank 1 SR-Bank	NO	NO	
Julius Br Gruppe	CH	YES		SpareBank 1 SR-Bank ASA	NO	NO	
KBC Group	BE	NO	2008-12	St. Galler Kantonalbank	CH	NO	
Lloyds Banking Group	GB	YES		Standard Chartered	GB	YES	

Luzerner Kantonalbank	CH	NO		Svenska Handelsbanken	SE	NO
mBank	PL	NO		Swedbank AB	SE	NO
Mediobanca	IT	NO		UBS Group	CH	NO
Monte dei Paschi di Siena	IT	NO	2012	UniCredit	IT	YES
National Bank of Greece	GR	NO	2011-15	Unione di Banche Italiane	IT	NO
Natixis	FR	YES		Valiant Holding AG	CH	NO
Nordea Bank	SE	NO		Van Lanschot Kempen	NL	YES
Nordnet	SE	NO		Vontobel Holding	CH	YES
Oberbank	AT	NO				
Oldenburgische Landesbank	DE	YES				
OTP Bank	HU	NO				
Paragon Banking Group	GB	NO				
Piraeus Bank	GR	NO	2012-15			
Permanent TSB Group	IE	NO	2011-15			
Raiffeisen Bank International	AT	NO				
Royal Bank of Scotland	GB	YES				
Skandinaviska Enskilda Banken	SE	NO				
Societe Generale	FR	YES				

C Event study - robustness checks

In this section I present the results of robustness checks for my event study analysis. I start with the baseline results using the "above 200%" criterion for the CEO variable-to-fixed ratio to assign the banks to affected group and estimate the cross-sectional regressions. I then check whether the results are robust to changing the reference index in the market model and using the original Fama-French market factor including all stocks for which the market equity data as available at the computation period. Finally, I repeat the analysis for two specific samples. First one includes the banks under Financial Stability Board Jurisdiction. Second omits from the analysis the banks from the UK.

$$r_{jt} = \alpha + \beta_j r_{mt} + \epsilon_{jt} \tag{8}$$

Abnormal returns for the CDS returns are instead coming from the constant returns model:

$$r_{jt} = \alpha + \epsilon_{jt} \tag{9}$$

The rest of the analysis is similar to the baseline one.

Cumulative abnormal returns (CAR) are computed as:

$$CAR_{jt} = \sum_{t=k_1}^{k_2} \frac{1}{N} (\sum_{j=1}^{N} AR_{jt}) \tag{10}$$

I use a variety of event windows$[k_1; k_2]$. [-1; 1] captures the immediate markets' reaction while [-10; -2] , [-5; -2], [2; 5] and [2; 10] allow to capture the potential pre-event information releases (likely for the major events) and the delayed markets' reaction (likely for more technical publications). Following the computation of cumulative abnormal returns I estimate the cross sectional models regressing the abnormal returns on the binary variable $Affect_{100,j}$ taking the value of one if a bank has bonus ratio exceeding 100% (or 200%) and zero otherwise, the set of bank-level controls and the dummy variable taking the value of one in case the bank is under government support program around the introduction of new regulations (such banks are fundamentally different from the remaining group: they were prohibited from paying any bonuses as a condition ofobtaining state support).

$$CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt} \tag{11}$$

C.1 Stock market outcomes - robustness checks

Table 13: Stock market reaction - MSCI Europe model - 200% threshold

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.022	.008	.008***	-.001	.001
2. European parliament approval of CRD IV	.034	.011	.001***	.003	.014
3. Official publication of CRD IV	-.016	-.001	-.017***	-.011	-.039
4. Public consultation - guidelines on remuneration policies	.019	.014	.005	-.003	.003
5. Guidelines on remuneration policies and practices	.010	-.005	-.001	-.013	-.028
6. "Within reach" agreement on bonus caps	-.011	-.025**	.015	.007	.012
7. Agreement on bonus caps	-.023	-.013	-.021*	-.024	-.030
8. Identified staff definition	.054	.029	-.043	-.009	.002
9. Revised identified staff definition	.010	.006	-.003	-.009	-.012
10. Standards on variable instruments	.006	.001	-.008	.000	.008
11. Guidelines on the applicable discount rate	-.020	-.024**	-.001	.028**	.010
12.Technical standards on identified staff	.027	.011	.011	-.024***	-.039***
13. Consultation on guidelines on remuneration policies	.016	-.013	.003	.009	.002
14. Correction to identified staff rules	-.013	.008	.004	.013	.003
15. Final guidelines on remuneration policies	-.018	.008	.018	-.006	-.006
Panel B - significance of "above 200%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.029	.018	-.014	.026	.024
2. European parliament approval of CRD IV	-.028	.020	-.008	.010	.027
3. Official publication of CRD IV	.001	-.006	.025	.009	.008
4. Public consultation - guidelines on remuneration policies	-.009	-.013*	-.003	-.023	-.042***
5. Guidelines on remuneration policies and practices	.015	-.003	-.009	-.024	.009
6. "Within reach" agreement on bonus caps	.021*	.032**	-.021**	.005	.004
7. Agreement on bonus caps	-.004	.000	.011	-.019*	-.029
8. Identified staff definition	.145**	.072**	-.052	-.040*	-.073**
9. Revised identified staff definition	-.003	-.013	-.007	-.013*	-.008
10.Technical standards on variable instruments	-.017	-.006	-.006	-.006	.000
11. Guidelines on the applicable discount rate	.004	.021	.002	-.043**	-.012
12.Technical standards on identified staff	-.008	-.004	.001	.007	.014
13. Consultation on guidelines on remuneration policies	.002	-.011	.013	-.022	-.036
14. Correction to identified staff rules	.008	.005	.007	-.012	.001
15. Final guidelines on remuneration policies	.011	.017	.006	.021**	.028**
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a 1-factor model

Panel B shows $\beta_{Affected}$ from $CAR_{j,win} = \alpha + \beta_{Affect} Affect_{200,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$ with lagged controls including size, capital ratio, proportion of NPLs, income diversification, deposits/assets ratio, liquidity ratio and government support indicator

*** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

Table 14: Stock market reactions - Fama French 1-factor model for the stock market

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.002	.003	.004***	.006	-.001
2. European parliament approval of CRD IV	.010	.018	-.002***	.010	.005
3. Official publication of CRD IV	-.001	.007	-.008***	-.003	-.033
4. Public consultation - guidelines on remuneration policies	-.020*	.001	-.004	-.013	.003
5. Guidelines on remuneration policies and practices	.014	-.005	-.006	-.001	-.006
6. "Within reach" agreement on bonus caps	-.008	-.016	.000	.003	.008
7. Agreement on bonus caps	.005	.012**	-.020**	-.013	-.016
8. Identified staff definition	.075	.041*	-.044	-.013	-.025
9. Revised identified staff definition	-.011	-.002	.000	.002	-.001
10.Technical standards on variable remuneration instruments	.002	-.002	-.007	.002	.006
11. Guidelines on the applicable discount rate	-.012	-.020	.005	.032*	.004
12.Technical standards on identified staff	.029	.011	.013	-.019**	-.036***
13. Consultation on guidelines on remuneration policies	.021	-.007	.014	.045**	.007
14. Correction to identified staff rules	-.015	.009	.017**	-.001	-.008
15. Final guidelines on remuneration policies	-.011	.022	.005	-.007	.003
Panel B - significance of "above 100%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.041	.029	-.008	.027*	.029
2. European parliament approval of CRD IV	-.017	.018	.001	.019	.035**
3. Official publication of CRD IV	.033**	.030**	.005	.016	.002
4. Public consultation - guidelines on remuneration policies	-.008	-.015**	-.006	-.010	-.030**
5. Guidelines on remuneration policies and practices	.009	.014	-.003	-.025**	-.014
6. "Within reach" agreement on bonus caps	.017	.017	-.010	-.007	-.011
7. Agreement on bonus caps	.002	-.007	-.008	-.021**	-.017
8. Identified staff definition	.096**	.052**	-.025	-.012	-.029
9. Revised identified staff definition	-.011	-.005	-.006	-.011	-.004
10.Technical standards on variable remuneration instruments	-.013	.000	-.003	.014	.032
11. Guidelines on the applicable discount rate	-.027*	-.007	.007	-.020*	-.017
12.Technical standards on identified staff	-.027*	-.021**	-.001	-.001	.012
13. Consultation on guidelines on remuneration policies	.027**	.001	.010	-.009	-.025
14. Correction to identified staff rules	-.004	.003	.005	.002	.005
15. Final guidelines on remuneration policies	-.007	.004	.003	.010*	.011
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a constant returns model, significance tests use the ADJ-BMP t-statistic by Kolari & Pynnönen (2010). Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$. Lagged controls include size, capital ratio, proportion of NPLs, measure of income diversification, deposits/assets ratio, liquidity ratio and government support indicator. *** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

Table 15: Stock market reactions, FSB banks - MSCI Europe

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.019	.001	.009***	.002	.008
2. European parliament approval of CRD IV	.038**	.008	.012***	.000	.013
3. Official publication of CRD IV	-.010	-.005	-.017***	-.002	-.029
4. Public consultation - guidelines on remuneration policies	.012	.008	.004	.000	.007
5. Guidelines on remuneration policies and practices	-.001	-.007	.004	-.019	-.026
6. "Within reach" agreement on bonus caps	-.015	-.034**	.025*	.021	.019
7. Agreement on bonus caps	-.025	-.008	-.031*	-.019	-.025
8. Identified staff definition	-.009	.001	-.029	-.007	.028
9. Revised identified staff definition	.015	.015	.002	-.003	-.009
10.Technical standards on variable remuneration instruments	.004	.000	-.012	-.004	.011
11. Guidelines on the applicable discount rate	-.016	-.025***	.003	.038**	.015
12.Technical standards on identified staff	.029	.010	.014	-.022***	-.045**
13. Consultation on guidelines on remuneration policies	.023	.006	-.004	.018	.007
14. Correction to identified staff rules	-.012	.009	.004	.026***	.008
15. Final guidelines on remuneration policies	-.019	.001	.008	-.008	-.009
Panel B - significance of "high-bonus" category, 100%	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.055*	.034	-.008	.019	.018
2. European parliament approval of CRD IV	-.024	.016	-.007	.023	.043*
3. Official publication of CRD IV	.039**	.042***	.007	.019	.018
4. Public consultation - guidelines on remuneration policies	-.006	-.013*	-.003	-.023**	-.051***
5. Guidelines on remuneration policies and practices	.013	.004	-.010	-.001	-.003
6. "Within reach" agreement on bonus caps	.023	.014	-.009	-.020*	-.029*
7. Agreement on bonus caps	.001	-.006	-.003	-.013	.012
8. Identified staff definition	.027	.010	.005	.012	-.008
9. Revised identified staff definition	-.003	-.009	-.009	-.003	.014
10.Technical standadrs on variable remuneration instruments	-.023	-.001	-.007	.033***	.031*
11. Guidelines on the applicable discount rate	-.046***	-.022***	.000	-.002	.002
12.Technical standards on identified staff	-.018	-.010	-.006	.002	.008
13. Consultation on guidelines on remuneration policies	.032*	.010	.014	.005	-.008
14. Correction to identified staff rules	.011	.015	-.004	.001	.019
15. Final guidelines on remuneration policies	-.026**	-.012*	.001	.010	.017
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a constant returns model, significance tests use the ADJ-BMP t-statistic by Kolari & Pynnönen (2010). Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$. Lagged controls include size, capital ratio, proportion of NPLs, measure of income diversification, deposits/assets ratio, liquidity ratio and government support indicator. *** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

Table 16: Stock market reactions - MSCI Europe 1-factor model for the stock market, UK banks omitted

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.027*	.006	.010***	-.002	.001
2. European parliament approval of CRD IV	.038	.012	.001***	.004	.016
3. Official publication of CRD IV	-.018	-.001	-.017***	-.013	-.043
4. Public consultation - guidelines on remuneration policies	.019	.015	.007	-.001	.006
5. Guidelines on remuneration policies and practices	.012	-.004	-.001	-.011	-.028
6. "Within reach" agreement on bonus caps	-.010	-.026**	.015	.006	.011
7. Agreement on bonus caps	-.024	-.013	-.021*	-.022	-.027
8. Identified staff definition	.056	.029	-.047	-.007	.003
9. Revised identified staff definition	.010	.007	-.003	-.009	-.012
10.Technical standards on variable remuneration instruments	.008	.001	-.009	.001	.011
11. Guidelines on the applicable discount rate	-.021*	-.026**	.001	.029**	.009
12.Technical standards on identified staff	.029	.013	.012	-.025***	-.039***
13. Consultation on guidelines on remuneration policies	.018	.013	.003	.011	.005
14. Correction to identified staff rules	..012	.008	.005	.014	.004
15. Final guidelines on remuneration policies	-.020	.007	.018	-.007	-.006
Panel B - significance of "high-bonus" category, 100%	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.051*	.029	-.013	.026*	.028
2. European parliament approval of CRD IV	-.009	.013	.007	.027	.034*
3. Official publication of CRD IV	.045***	.044***	-.007	.013	.000
4. Public consultation - guidelines on remuneration policies	-.009	-.013*	-.003	-.023	-.042***
5. Guidelines on remuneration policies and practices	.010	.011	-.003	-.024*	-.019
6. "Within reach" agreement on bonus caps	.029	.014	-.006	-.003	-.007
7. Agreement on bonus caps	.001	-.017	-.016	-.017*	-.004
8. Identified staff definition	.082	.037	-.002	.017	.001
9. Revised identified staff definition	-.012	-.011	-.004	-.016*	-.005
10.Technical standadrs on variable remuneration instruments	-.040*	-.012	-.008	.017	.046*
11. Guidelines on the applicable discount rate	-.028	-.017	.007	-.020	-.017
12.Technical standards on identified staff	-.028*	-.024**	.002	-.006	.011
13. Consultation on guidelines on remuneration policies	.030***	-.003	.017**	-.004	-.035
14. Correction to identified staff rules	.006	.005	.004	.008	.021
15. Final guidelines on remuneration policies	-.021	-.010	.003	.006	.012
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a constant returns model, significance tests use the ADJ-BMP t-statistic by Kolari & Pynnönen (2010). Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$. Lagged controls include size, capital ratio, proportion of NPLs, measure of income diversification, deposits/assets ratio, liquidity ratio and government support indicator. *** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

C.2 CDS markets outcomes - robustness checks

Table 17: CDS market reaction - 1-factor model, 200% threshold

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.041**	.030***	-.020***	-.026	-.040
2. European parliament approval of CRD IV	.008	.024	.006***	-.016	-.021
3. Official publication of CRD IV	.037	.001	-.001***	.020	.015
4. Public consultation - guidelines on remuneration policies	-.039	-.045**	-.013***	-.028*	-.022
5. Guidelines on remuneration policies and practices	.018	.009	.018***	.015	.057*
6. "Within reach" agreement on bonus caps	-.035*	-.005	.002***	-.036**	-.057***
7. Agreement on bonus caps	.002	-.007	.039***	-.022	-.016
8. Identified staff definition	.000	-.032**	-.025***	.034*	.039
9. Revised identified staff definition	.010	-.014	-.004***	.001	-.007
10.Technical standards on variable remuneration instruments	-.012	-.011	.014***	.004	.018
11. Guidelines on the applicable discount rate	.005	.014	-.005***	-.032	-.069*
12.Technical standards on identified staff	.014	.015	-.035***	-.004	-.016
13. Consultation on guidelines on remuneration policies	-.031	-.023	.005***	.002	.019
14. Correction to identified staff rules	-.054	-.093*	-.005***	-.033	-.037
15. Final guidelines on remuneration policies	.035	.003	-.019***	-.041***	-.026*
Panel B - significance of "above 200%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.038	-.023	.000	.022	-.020
2. European parliament approval of CRD IV	.027	.010	.005	.005	-.021
3. Official publication of CRD IV	.012	.010	-.016	-.016	.021
4. Public consultation - guidelines on remuneration policies	-.038	.002	.006	.029*	.021
5. Guidelines on remuneration policies and practices	.001	.017	.003	.040	-.011
6. "Within reach" agreement on bonus caps	-.007	-.003	-.013	-.004	-.005
7. Agreement on bonus caps	-.012	-.004	.003	-.005	.020
8. Identified staff definition	.009	.002	.036	-.001	-.013
9. Revised identified staff definition	.009	.015	-.011*	.019*	.004
10.Technical standards on variable instruments	.012	.025*	-.032*	.000	.008
11. Guidelines on the applicable discount rate	.025	.008	-.009	.042	.008
12.Technical standards on identified staff	-.007	-.034	.009	.021	-.043
13. Consultation on guidelines on remuneration policies	.016	-.031	-.011	-.037	-.032
14. Correction to identified staff rules	-.004	.051	-.009	.015	.018
15. Final guidelines on remuneration policies	-.007	-.020	.035	-.010	.013
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a 1-factor model with significance determined by the Kolari & Pynnönen (2010) ADJ-BMP t-statistic.

Panel B shows β_{200} from $CAR_{j,win} = \alpha + \beta_{200} Affect_{200,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$

Lagged controls include size, capital ratio, proportion of NPLs, income diversification, deposits/assets ratio, liquidity ratio and government support indicator

*** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

Table 18: CDS market reaction - 1 factor model, FSB banks

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.042**	.032**	-.015***	-.028	-.045
2. European parliament approval of CRD IV	.008	.027	.008***	-.020*	-.020
3.Official publication of CRD IV	.037	.005	.011***	.011	.003
4. Public consultation - guidelines on remuneration policies	-.050*	-.057***	-.014***	-.032**	-.023
5. Guidelines on remuneration policies and practices	.003	.018	.023***	.011	.051*
6. "Within reach" agreement on bonus caps	-.034	-.006	.001***	-.039**	-.059***
7. Agreement on bonus caps	.004	-.006	.037***	-.022	-.024
8. Identified staff definition	-.004	-.037**	-.026***	.041***	.048**
9. Revised identified staff definition	.007	-.018	-.003***	-.003	-.005
10.Technical standadrs on variable remuneration instruments	-.006	-.005	.016***	.002	.022
11. Guidelines on the applicable discount rate	.004	.017	-.005***	-.039	-.078
12.Technical standards on identified staff	.017	.014	-.048***	-.007	-.019
13. Consultation on guidelines on remuneration policies	-.049	-.035	.007***	.014	.033
14. Correction to identified staff rules	-.069**	-.114**	-.008***	-.048**	-0.063
15. Final guidelines on remuneration policies	.047	.005	-.025***	-.042***	-.024
Panel B - significance of "above 100%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.007	-.010	-.053	.056***	.067***
2. European parliament approval of CRD IV	-.014	.010	.013**	-.027	-.046
3. Official publication of CRD IV	-.012	-.018	-.001	-.009	.011
4. Public consultation - guidelines on remuneration policies	0.006	0.016	0.015**	0.014	-0.004
5. Guidelines on remuneration policies and practices	.014	.036	.015	-.024	-.032
6. "Within reach" agreement on bonus caps	.029	.040	-.002	-.016	-.023
7. Agreement on bonus caps	-.013	-.018	.015	-.014	.007
8. Identified staff definition	.014	-.002	.016	.010	.026
9. Revised identified staff definition	-.026	-.029	-.007	-.016	-.010
10.Technical standadrs on variable remuneration instruments	-.033	-.010**	.017	-.008	.034
11. Guidelines on the applicable discount rate	.006	.003	.002	.071*	.077
12.Technical standards on identified staff	-.014	.002	-.028	.034	.026
13. Consultation on guidelines on remuneration policies	-.006	-.010	-.015	-.025	-.002
14. Correction to identified staff rules	-.037	.002	.016	.039	.084
15. Final guidelines on remuneration policies	.026	-.021	.004	-.012	.000
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a 1-factor model, significance tests use the ADJ-BMP t-statistic by Kolari & Pynnönen (2010). Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$. Lagged controls include size, capital ratio, proportion of NPLs, measure of income diversification, deposits/assets ratio, liquidity ratio and government support indicator. *** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

Table 19: CDS market reaction - 1 factor model, no UK

Panel A - cumulative abnormal returns	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	.041**	.029**	-.016***	-.022	-.035
2. European parliament approval of CRD IV	.007	.024	.007***	-.018	-.023
3. Official publication of CRD IV	.035	.002	.001***	.017	.009
4. Public consultation - guidelines on remuneration policies	-.042	-.48**	-.017***	-.026	-.019
5. Guidelines on remuneration policies and practices	.014	.007	.019***	.011	.055*
6. "Within reach" agreement on bonus caps	-.035*	-.008	.002***	-.037**	-.059***
7. Agreement on bonus caps	.001	-.008	.036***	-.021	-0.02
8. Identified staff definition	-.005	-.034**	-.027***	.033	.036
9. Revised identified staff definition	.008	-.015	-.003***	.001	-.008
10.Technical standards on variable remuneration instruments	-.014	-.013	.016***	.003	.018
11. Guidelines on the applicable discount rate	.004	.014	-.005***	-.034	-.069*
12.Technical standards on identified staff	.013	.016	-.038***	-.007	-.017
13. Consultation on guidelines on remuneration policies	-.035	-.024	.009***	.005	.021
14. Correction to identified staff rules	-.056	-.095	-.004***	-.037	-.044
15. Final guidelines on remuneration policies	.039	.008	-.023***	-.038***	-.023
Panel B - significance of "above 100%" category	[-10;-2]	[-5;-2]	[-1;1]	(2;5]	[2;10]
1. Public consultation on the draft of CRD IV	-.017	-.009	-.032	.032*	.031
2. European parliament approval of CRD IV	-.012	.010	.009	-.012	-.042*
3.Official publication of CRD IV	-.000	-.006	-.003	-.024	-.010
4. Public consultation - guidelines on remuneration policies	-.014	.007	.005	.004	-.029
5. Guidelines on remuneration policies and practices	.030	.038	.008	-.013	-.039
6. "Within reach" agreement on bonus caps	.016	.014	-.003	.000	.002
7. Agreement on bonus caps	.001	-.008	.036***	-.021	-0.02
8. Identified staff definition	-.026*	-.028	.004	-.007	.009
9. Revised identified staff definition	.009	.004	.026	-.003	.009
10.Technical standadrs on variable remuneration instruments	-.011	.000	.011	-.007	.029
11. Guidelines on the applicable discount rate	.016	.004	-.001	.048	.034
12.Technical standards on identified staff	-.004	-.007	-.022	.032	-.002
13. Consultation on guidelines on remuneration policies	.024	.005	-.010	-.012	.016
14. Correction to identified staff rules	-.034	.025	.014	.018	.036
15. Final guidelines on remuneration policies	.025	-.024***	.012	-.006	.007
Bank-level controls	YES	YES	YES	YES	YES

Panel A shows CARs from a constant returns model, significance tests use the ADJ-BMP t-statistic by Kolari & Pynnönen (2010). Panel B shows β_{100} from $CAR_{j,win} = \alpha + \beta_{100} Affect_{100,j} + \delta Controls_{j,t-1} + \epsilon_{jt}$. Lagged controls include size, capital ratio, proportion of NPLs, measure of income diversification, deposits/assets ratio, liquidity ratio and government support indicator. *** p-value < 0.01, ** 0.01 < p-value < 0.05, * 0.05 < p-value < 0.1

D Synthetic controls - methodology, robustness check

In this section I give the details on the synthetic controls approach and repeat the analysis using the 100% cutoff point to identify the affected banks.

Synthetic controls are obtained as the weighted average of the available control units solving the following optimization problem:

$$\sqrt{(X_1 - X_0 W(V))' V (X_1 - X_0 W(V))} \xrightarrow{W} min \tag{12}$$

where W(V) - solution of the nested optimization problem determining the weights of the control units, X_1 and X_0 stand for the matrices containing the set of control variables for the affectted and non-affected units respectively. The elements of the diagonal positive semidefinite matrix V define the importance of the individual control variables in determining the ideal synthetic control. V is determined as the solution to:

$$\sqrt{(Y_1 - Y_0 \hat{W(V)})' (Y_1 - Y_0 \hat{W(V)})} \xrightarrow{V} min \tag{13}$$

Completing the nested optimisation procedure which I used in determining the results of the baseline analysis.

I perform the analysis on monthly basis and add three lags of the outcome variables to find the synthetic control. Resulting difference in a post-treatment trend for treated and synthetic units is then interpreted as intervention impact. Assigning the status of treated to each of the control group's units it is possible to make an inference on the impact significance for truly affected units. The p-value (assuming N units with the first being the treated one) is obtained using the following formula[20]:

Significance of results is determined using the p-value criterion.

$$p - value = \frac{\sum_{j=2}^{N} 1[RMSPE_j \geq RMSPE_1]}{N} \tag{14}$$

$$RMSPE_j = \frac{\sum_{t=T_0+1}^{T} \frac{Y_{j,t} - \hat{Y_{j,t}^N}}{T - T_0}}{\sum_{t=1}^{T_0} \frac{Y_{j,t} - \hat{Y_{j,t}^N}}{T_0}} \tag{15}$$

[20]The estimate can be used to make inferences assuming the intervention is randomized conditional on observables (including the trend of the outcome variable). However even if the randomness of treatment assignment is arguable, the fraction still demonstrates the probability of obtaining a given impact estimate when the intervention is reassigned at random.

Table 20: Synthetic controls, FSB banks - results

100% group	January 2011				February 2013				January 2014			
	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)
month 1	-0.18***	-0.01	0.05***	0.14	-0.05**	0.00	-0.09	-0.13*	-0.03	0.00	0.05	-0.10
month 2	-0.24***	0.00	0.01***	-0.10**	-0.02*	0.00	-0.12**	-0.12	-0.04*	0.00	0.10	0.04
month 3	-0.20***	0.00	0.02***	0.03	0.00	0.00	-0.17*	-0.10	-0.01	0.00	0.16	0.03
month 4	-0.18***	0.00	-0.03	0.05	-0.05*	-0.01	-0.05	-0.01	-0.01	0.00	0.16	-0.01
month 5	-0.20***	0.00	0.00	-0.16**	0.01	-0.01	-0.07	-0.11	0.00	0.00	0.10	-0.10
month 6	-0.20***	0.00	-0.04	-0.19*	-0.02*	0.00	-0.07*	-0.06	-0.03	0.00	0.10	-0.06
month 7	-0.20***	0.00	0.01***	-0.16*	-0.07*	-0.01	-0.13***	-0.06	-0.01	0.00	0.08	-0.15
month 8	-0.13	0.00	0.03***	-0.09	-0.13**	0.00	-0.12***	-0.05	-0.02	0.00	0.09	-0.06
month 9	-0.07	0.01*	0.13***	0.03	-0.11**	0.00	-0.11***	-0.10*	-0.03	0.00	0.13	-0.09
month 10	-0.04	0.02	0.14***	0.11	-0.12**	0.00	-0.12***	0.06	-0.04	0.01	0.18	0.04
month 11	-0.02	0.01	0.13***	0.16*	-0.13**	-0.01	-0.14***	-0.04	-0.05	0.01	0.21	0.12
month 12	-0.05	0.00	0.11***	0.09	-0.13**	-0.01	-0.12**	-0.17**	-0.06	0.01	0.21	0.02

200% group	January 2011				February 2013				January 2014			
	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)	CDS (log)	CoVaR	SRISK (log)	Volatility (log)
month 1	-0.23**	-0.01	-0.03***	-0.02	-0.01**	-0.01	-0.24***	-0.20***	-0.01	0.00	-0.01	-0.17
month 2	-0.24*	0.00	-0.06***	-0.27**	0.04*	0.00	-0.31***	-0.13	0.01	0.00	0.07	0.12
month 3	-0.21**	0.00	-0.02***	-0.05	0.02***	0.00	-0.47***	-0.22*	0.03	0.00	0.21	0.07
month 4	-0.16	0.00	-0.06	-0.03	-0.04***	-0.01	-0.27***	0.14	0.04	0.00	0.20	-0.12
month 5	-0.21**	0.00	-0.04	-0.24*	0.07**	0.00	-0.31***	0.21*	0.02	0.00	0.14	-0.21*
month 6	-0.21	0.00	-0.10	-0.29**	0.05**	0.00	-0.27***	0.09	-0.04	0.00	0.13	-0.21
month 7	-0.21*	0.00	-0.05***	-0.24	0.01**	0.00	-0.38***	0.00	-0.04	0.00	0.12	-0.12
month 8	-0.19	0.00	0.01***	-0.22	-0.03**	0.00	-0.36***	0.05	-0.05	0.00	0.06	-0.01
month 9	-0.13	0.01*	0.2***	-0.11	-0.02**	0.00	-0.34***	-0.01	-0.02	0.00	0.13	-0.04
month 10	-0.07	0.02	0.28***	-0.06	0.00	0.00	-0.43***	0.23**	-0.03	0.01	0.21	0.09
month 11	-0.05	0.01	0.25***	0.07	-0.05	0.00	-0.44***	0.05	-0.07	0.01	0.18	-0.04
month 12	-0.06	0.00	0.22***	-0.06	-0.05	0.00	-0.38***	-0.23***	-0.12	0.01	0.23	0.02

The table shows the difference in outcomes between the affected group and the constructed synthetic controls; *** p-value < 0.01, ** $0.01 <$ p-value < 0.05, * $0.05 <$ p-value < 0.1

P-value (assuming N units with the first being the treated one) is obtained as $\frac{\sum_{j=2}^{N} 1[RMSPE_j \geq RMSPE_1]}{N}$, $RMSPE_j = \frac{\sum_{t=T_0+1}^{T} \frac{Y_{j,t} - Y_{j,t}^N}{T - T_0}}{\sum_{t=1}^{T_0} \frac{Y_{j,t} - Y_{j,t}^N}{T_0}}$

Prudential policies and systemic risk: the role of interconnections

Madina Karamysheva and Ekaterina Seregina *

Abstract

The impact of prudential policies in open economies depends not only on their intrinsic efficacy but also on the feedback of the policy through close trade and financial partners. Using a sample of advanced countries, we find that prudential policy measures reduce systemic risk in the financial systen in the 2000-2014 time period. We show that the indirect effect enforces the direct one and accounts for 70% of total risk reduction. The policies though remain insignificant for GIIPS countries which are dependent only on actions and responses of their financial counterparties.

Keywords: systemic risk, prudential policy, banking regulation, networks

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1 Introduction

Starting from 2000 policymakers have introduced a number of prudential tools aimed at detecting the build-up of systemic risk stemming from the interconnections between the financial institutions as opposed to the risk inherent to each one of them individually. The use of prudential policy is especially important in the Eurozone because of the significant difference across economic and financial conditions across its member states. As mentioned by Vitor Constancio, Vice-President of the ECB, at the Financial Stability Conference, Berlin, 28 October 2015: "We are, of course, very much aware that side effects are also possible, in particular in the form of excessive asset valuations or excessive risk-taking by market operators." Our analysis allows to shed light on the magnitude of those side effects and includes the major developed economies to capture the maximum fraction of the financial market interlinkages. While it's important to show that policy interventions indeed limit the systemic risk, an equally important question is to what extent country-specific policy impact is amplified through the financial network.

As to our best knowledge our paper is the first one to look into the prudential policy consequences using the systemic risk indicators and to decompose the policy impact into the direct home country effect and the indirect (spillover) effect coming from the network of connected countries. We are also the first to emphasize the indirect impact of tools which are more microprudential in nature (e.g. capital requirements, reserve requirements and sector-specific buffers) as opposed to the tools specifically targeting the exposure to the other financial market participants (e.g. exposure concentration limits or interbank limits). We consider the network of advanced economies[1] and the Eurozone only sample.

We evaluate the indirect impact of prudential policy interventions using a spatial econometric methodology which allows to combine the data for all counterparty countries into one global factor reducing the number of parameters to be estimated and yet allowing to capture the interdependencies. Direct impact comprises the own country's systemic risk indicator's response to the prudential policy, indirect one considers the risk spillovers from the network. Our major findings are the following. Country-level policy interventions result in an economically and statistically significant reduction in systemic risk outcomes. Policy tightening (loosening) on average leads to a decrease (increase) in systemic fragility (measured by the SRISK of Acharya et al. (2017)) with indirect effect playing a major role. 70% of the impact on the level of banking systems is coming from the network while 30% is attributable to the direct effect. Both total impact and indirect impact proportion increase if we consider the financial systems (including the non-banking financial institutions) - network effect raises to 85% suggesting the important role of non-banking sector in the

[1] we include Austria, Belgium, Denmark, Finland, France, Germany, Greece, Italy, Ireland, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom, Australia, Canada, and the USA

policy propagation.

Our baseline approach considers the average direct and indirect effects for the major European countries. As an extension, we evaluate the differences between different country groups (core and periphery European countries versus the rest of the world). When doing so we find that the core countries stay responsive to policy interventions: non-EU players see the major risk reduction with 52% of impact coming from the network; core EU countries are responsive, but for them, the network impact stays close to the baseline and constitutes 74%. GIIPS[2] countries represent the group which does not experience any risk reduction following the policy interventions. Despite the strong EU-US connections network effects remain significant for the setup in which we restrict the system to the EU countries: core EU group is responsive to the policies and has a significant amplifying effect, while GIIPS countries are policy irresponsive.

Our choice of risk indicators is related to the concepts of systemic importance and systemic fragility. In our setup the first-term refers to countries the instability of which is relevant for the others, second relates to the countries vulnerable to defaults of other. Our baseline model is evaluated on SRISK (see Acharya et al. (2017)) indicator reflecting systemic fragility and available on daily frequency allowing to match the frequency of policy interventions. SRISK quantifies the capital shortfall in case of the crisis which is a key indicator for the financial system and allows no shifting of capital across banks, i.e. the banks with negative shortfall do not compensate those with the capital shortage. Yet, using the aggregated metrics allows the single-institution disruptions to be somewhat smoothed by the rest of the financial system.

The data on prudential policy interventions comes from a quarterly frequency database of Cerutti et al. (2016). Previous analyses of policy impact looked at the single country policy changes (e.g. Aiyar et al. (2012) with UK analysis of capital requirements or Jiménez et al. (2017) analyzing the dynamic provisioning policy in Spain) or at cross-sectional snapshots (e.g. Barth et al. (2013)). Cerutti et al. (2016) provide one of the first consistent cross-country databases[3] spanning a considerably long time period. This is a country-level database including the instances of tightening or loosening episodes for a set of tools including the changes in capital requirements, reserve requirements, sector-specific capital buffers, exposure concentration limits (including interbank exposure limits) and loan-to-value ratios. We perform the estimation for a set of financial-based measures (aimed at the regulation of bank's risk position) and the subsetset of instruments which do not specifically target institutions' exposure to specific counterparties (i.e. those which do not explicitly target systemic risk). The latter specification brings about an increase in the overall policy effectiveness with no impact on direct and indirect income splits.

[2]Greece, Ireland, Italy, Portugal, and Spain

[3]See also Cerutti et al. (2015), Reinhardt & Sowerbutts (2015) and Akinci & Olmstead-Rumsey (2017)

We evaluate the strength of the country-to-country linkages using the share of the country's investment into each of the counterparty countries. We base on the data covering the cross-border investment exposures from the Coordinated Portfolio Investment Survey(CPIS) database. It covers around 30% of interlinkages between countries and represents a relatively stable part of intra-country operations. We construct the weights using the beginning-of-sample data to minimize the potential endogeneity of weights. We have to rely only on a fraction of intra-country investments given the data constraints (detailed and consistent country-to-country exposures for the FDI and cross-border loans are available from 2009 onwards only). We perform the robustness checks to prove that our choice of weighting scheme does not bias our results. In particular, we recompute the weights for each country assigning a weight of one to top 10 counterparties or to countries exceeding the 5% threshold in terms of total exposure. This reduces the total policy impact and the indirect impact proportion but does not affect our results for the banking system in terms of effects' direction and significance.

Putting our paper into the literature perspective we contribute to the set of studies covering the impact of prudential policies on country-level outcomes (with a non-exhaustive list including Cerutti et al. (2016), Cerutti et al. (2015), Reinhardt & Sowerbutts (2015) and Akinci & Olmstead-Rumsey (2017), Buch & Goldberg (2016), Elliott et al. (2013), Bakker et al. (2012) and Nistor Mutu & Ongena (2015). Those look into a set of financial and real outcomes including credit growth, policy rates, house prices, and cross-border lending and borrowing operations. Nistor Mutu & Ongena (2015) is the only to look into the systemic risk outcomes, but they consider the set of ex-post interventions - bank bailouts which occurred in 2008-2014. They found significant impact which was dependent on the type of operation, bank characteristics, and the length of the period considered. Our paper focuses on the cases of ex-ante policies used to reduce the system-wide levels of systemic risk and/or to prevent its build-up.

Our baseline results hold for the SAR[4] specification including and excluding the lagged values of the baseline dependent variables. As mentioned above we use the baseline estimation (where only constants allowed to be country-specific) where we find the average direct and indirect effects for our system and the specifications with coefficients allowed to be unequal for the selected country groups. Planned extensions include the more thorough analysis for banking and non-banking financial sectors motivated by the difference for full financial system and banking system's outcomes.

The rest of the paper is structured as follows. Section 2 reviews the relevant literature, Section 3 discusses the data and empirical strategy, Section 4 provides the baseline results, Section 5 shows the results for country groups, Section 6 presents the robustness checks, the last section concludes.

[4]SAR stands for the Spatial Autoregressive model

2 Literature

Our paper relates to the several literature strands. First one includes the studies of financial contagion which occurs due to the existence of linkages between banks. Allen & Gale (2000) and Freixas et al. (2000) consider the importance of the network formed by the bilateral operations in the payments' system, the interbank market and the derivatives' market putting a start to a large part of literature connecting systemic risk and network analysis. Financial system is viewed as a set of nodes connected via the links representing the various types of interconnections with various ways to evaluate their strength depending on the unit of analysis and data availability.

First group of studies we consider focus on the evaluation of links between the institutions. Certain papers (see e.g. Hałaj & Kok (2013)) use simulation methods to generate the various types of networks and analyze the shocks' propagation in each of them. Others rely on the combination of the balance sheet data and simulation to calibrate the links (Aldasoro & Alves (2016) and Montagna & Kok (2016)). The more widely used connectedness measures rely on CDS and stock market returns which are based on the readily available data. Billio et al. (2012) use the principal component analysis to capture changes in returns' correlation among four groups of financial institutions: banks, brokers, hedge funds and insurance companies. The direction of the relationship is then determined using the Granger causality tests. Keiler & Eder (2013) rely on the equity market returns to infer the strength of interconnections.

Second strand of related looks at the prudential policy outcomes in terms of real and financial variables. The analysis is typically done on a country level with possible subdivision into bank and non-bank borrowers/lenders data. Instruments are split into groups according to their essence and the objects of policy application. The prudential policy datasets used in the literature till recently include the cross-sectional snapshots (e.g. Barth et al. (2013)) limiting the options for the analysis and interpretation of results. Given the low frequency of available datasets (yearly basis) the studies usually cover large cross sections of countries. Heterogeneous country groups (e.g. developed and developing) are pooled together though certain studies concentrate on particular regions (Ongena et al. (2013) for the EU and Vandenbussche et al. (2015) for the Central and Eastern Europe).

Recent improvements in the field involve the construction of consistent cross-country databases spanning the extended time periods. Examples of those include Cerutti et al. (2016), Cerutti et al. (2015), Reinhardt & Sowerbutts (2015) and Akinci & Olmstead-Rumsey (2017). Buch & Goldberg (2016) summarize a series of country-level studies done basing on the Cerutti et al. (2016) dataset. The uniqueness and consistency of both instrument definitions and empirical approach make the study quite important. The authors documented the policy spillovers in terms of bank lending. However, they saw

heterogeneity across instruments and banks' characteristics (balance sheet conditions and business models). The economic significance of policy impact for the loan growth turned out to be quite limited and could be driven by few country-specific policy implementations.

Instrument coverage typically varies across studies. Cerutti et al. (2016) include five types of instruments: capital buffers, interbank exposure limits, concentration limits, loan to value (LTV) ratio limits, and reserve requirements. Cerutti et al. (2015) add to those the data on the leverage ratio for banks; dynamic loan-loss provisioning, tax on financial institutions and capital surcharges on SIFIs. Elliott et al. (2013) split the tools into demand side (limits on loan-to-value ratios, loan maturities, margin requirements) and supply side (limits on deposit rates, limits on lending rates, restrictions on banks' portfolios, reserve requirements, capital requirements, and supervisory guidance). Bakker et al. (2012) group the policies into capital and liquidity requirements, asset concentration and credit growth limits and loan eligibility criteria. Reinhardt & Sowerbutts (2015) looks into three groups of instruments: capital regulations (capital requirements and risk-weights changes), lending standards (LTV and DTI ratios) and reserve requirements. Finally, Cizel et al. (2016) split the measures into those aimed at price and quantity of lending activity. Examples of price-based policies include dynamic provisioning requirements and taxes on banks. Examples of quantity-based include the exposure limits.

The typical study in the field looks into the loan volumes and growth rates (with emphasis on changes in geography and type of exposures). As mentioned by Buch & Goldberg (2016) "bank lending as the key transmission channel running from banks to the real economy is the dependent variable". Cerutti et al. (2016) analyze the evolution of key variables such as credit, policy rates, and house prices. They find the low correlation between the instrument changes and the credit and policy rates as well as house prices. Correlation with credit growth demonstrates the counter-cyclicality of policies (tightening in the moments of credit booms). The correlations with respect to house prices are mostly not statistically significant across most countries. LTV caps are found to be complementary for monetary policy actions (measured by policy rates). Cerutti et al. (2015) use a bigger panel of countries (119) and a greater number of instruments (12) combined into a unique index. They find macroprudential policies to be less effective in relatively open economies (which have a greater potential for spillover effects).

They find a positive association between the policy usages and the share of cross-border credit. Bakker et al. (2012) study the relation between macroprudential policies and credit booms. Overall the measures are effective in alleviating the credit booms i.e. they reduce the risk of boom ending up with the crisis. However, they did not prevent the booms from starting and did not shorten the periods of booms. Reinhardt & Sowerbutts (2015) perform the analysis for the BIS bank flows data. They found tightening capital requirements in a country to be associated with an increased aggregate borrowing from abroad (including the lending from the affiliates of the foreign banks). They also found no impact of

changes in lending standards and mixed evidence on the impact of reserve requirements. The impact is expectedly reduced if foreign countries have a comparable tightening of policy. Akinci & Olmstead-Rumsey (2017) study the 2000-13 of changes in macroprudential policy with certain focus on instruments affecting the housing market (LTV and DTI ratios). They find that overall real domestic bank credit declines if prudential measures are tightened. Mortgage lending and house prices are affected only by macroprudential instruments related to the housing market which outperform the non-targeted measures in terms of effectiveness. Ongena et al. (2013) cover a sample of multinational banks and assess the impact of regulation in one country on the same bank's lending standards in host country. They consider two alternatives: stricter home regulation leading to a more conservative lending in all markets or risk-reduction in home country accompanied by a transfer of risky activity to the foreign markets. Empirical evidence was in favor of the second argument. Cizel et al. (2016) emphasized the phenomenon of risk shifting across sectors in addition to risk-shifting to foreign jurisdictions. Specifically they document the presence of cross-sector substitution effects from bank to non-bank lending activity. They find evidence of substitution effects towards nonbank credit in advanced economies with strongest impact from quantity restrictions when compared to the price-related ones.

According to Galati & Moessner (2013), one of the main objectives of macro-prudential policy is limiting systemic risk and negative externalities on the financial system. As to our best knowledge our paper is the first one to look into the policy consequences using the systemic risk indicators and to decompose the policy impact into the direct home country effect and the indirect (spillover) effect coming from the network of connected countries. Another paper which is looking at systemic risk outcomes is Nistor Mutu & Ongena (2015) looking into the impact of bailout events on systemic risk in 2008-2014. The impact turned out to depend on the type of operation (recapitalization. liquidity injection,), bank characteristics and length of the period. The policy interventions considered aimed at saving the institutions which are insolvent or close to insolvency. Our paper instead focuses on the cases of ex-ante policies used to reduce the system-wide levels of systemic risk and/or to prevent its build-up. Similarly to Cizel et al. (2016) we split country systemic risk into the bank and non-bank parts. In this way, we see whether there is, in fact, a risk transfer from one part of the financial system to the other.

3 Dataset and empirical strategy

3.1 Systemic risk measurement

SRISK measure which we use for our estimation was introduced by Acharya et al. (2017) and measures the amount of capital a bank needs to raise in case of market distress (with distress being a 40% drop in the market index).

$$SRISK_{i,t} = E_{t-1}(CapShortfall_{i,t} \mid Crisis) = E(k(Debt_{i,t} + Equity_{i,t}) - \\ -Equity_{i,t}|Crisis) = kDebt_{i,t} - (1-k)(1 - LRMES_{i,t})Equity_{i,t}, \quad (1)$$

where $Debt_{i,t}$ and $Equity_{i,t}$ - stand for the book levels of debt and equity, k refers to the capital requirement (8% Basel requirements lowered to 5.5% for the non-US countries given the existing accounting differences). Long run marginal expected shortfall ($LRMES_{i,t}$) is defined as the equity loss of a bank i in case of a crisis: $LRMES_i, t = -E(R_{i,t} \mid R_{S,t} < Q_S^{\alpha})$ ($R_{i,t}$ stands for the return of a given institution, $R_{S,t}-$ for the system return). It is estimated using the bivariate daily time series model characterizing the dynamics of daily bank's and stock market returns. Resulting measure depends on individual stock volatility, its correlation with the market, bank's size and leverage.

We obtain the country level SRISK measure from the VLab database[5]. We aggregate the data on individual financial institutions to obtain the aggregated series for the banking and financial sectors for each of the sample countries. To ensure comparability between countries we scale the aggregated metrics by the market capitalization and take the 90% quantile value for each of the periods we consider. We perform the estimation on a quarterly basis to match the frequency of regulatory interventions. Table 1 shows the descriptive statistics for the overall sample, and three country groups (non-EU, core EU and GIIPS[6]). Appendix shows the statistics on a country-by-country basis.

Table 1: Descriptive statistics for SRISK/MCap indicators

Country	Mean	Std	MIN	Q25	MED	Q75	MAX
Overall sample	0.89	1.83	0.00	0.06	0.33	0.90	33.17
Non-EU	0.21	0.23	0.00	0.07	0.16	0.30	1.66
EU-core	1.02	1.54	0.00	0.19	0.50	1.14	17.87
EU-GIIPS	0.96	2.70	0.00	0.00	0.17	0.74	33.17

3.2 Country-level linkages

The baseline data on the country-level links are coming from the Coordinated Portfolio Investment Survey (CPIS) covering the amounts of country's assets invested into debt and equity securities split by the issuers' country of residency. Portfolios related to countries in our list cover 66 to 95 percent of overall portfolio investment. Endogeneity concerns

[5]https://vlab.sterm.nyu.edu

[6]non-EU group contains Australia, Canada, and the USA, core EU countries comprise Austria, Belgium, Denmark, Finland, France, Germany, Luxembourg, Netherlands, Sweden, Switzerland, United Kingdom, the USA

require the usage of the pre-sample data (i.e. the interlinkages should not be influenced by the evolution of risk measures and policies implemented). Hence we refer to the 2001 (earliest possible) data and use only the part of data covering around a third of intra-country linkages (with other two-thirds represented by the cross-border loans and the foreign direct investment). We justify this decision by the relative stability of weights throughout the sample period and do several checks to verify that our results are robust to the choice of weights.

3.3 Prudential policy tools

For the purpose of this study, we use the IMF data from Cerutti et al. (2016). It covers a broad range of instruments for 64 countries during 2000-2014 and is consistent both in the cross-section and over time.[7] The dataset includes five types of prudential instruments recorded as 1 or -1 entry, depending on whether there was a tightening or a loosening policy change in a given quarter.[8] We concentrate on the financial-based tools aimed at financial institutions' assets or liabilities:

- General capital requirements represent the regulatory changes introduced in the Basel Accords and are recorded as +1 at the implementation date
- Sector specific capital buffer represents the requirement to adjust the amount of capital held according to the phase of the financial cycle. In particular, it adjusts the risk-weights assigned to the specific bank exposures (real estate credit or consumer credit). This index may take values higher than 1 and lower than -1, as it represents a sum of prudential instruments across different categories of credit
- Reserve requirements represent the amount of foreign and local currency reserves to be held against the banks' liabilities. It can take discrete values higher than 1 and lower than -1 capturing the intensity of changes
- Limits on concentrated exposures (including interbank exposure limits) represent the thresholds set for an exposure to a particular counterparty and/or type of counterparties. They might be changed due to the definition of a large exposure, the level of aggregate or individual limit, sectors and assets that are covered by the regulation. The limits are coded as policy tightening (loosening) if on net, taking into account change in all characteristics the policy is tightened (loosened)

[7]Primary source for the dataset is Cerutti et al. (2015), national authorities information provided either through the IBRN or the IMF. Cerutti et al. (2016) claim that consistency of the dataset was the result of feedback received directly from country regulator on the accuracy of the policy changes recorded in the database

[8]The index is coded as 0 in those quarters when no change occurs or if the instrument is coded as "missing", i.e. if the tool has not been enacted until the time for implementation has passed

Table 2 shows the instances of policy loosening/tightening in three different periods covering the pre-crisis, crisis and post-crisis thresholds. Here we note the relatively more frequent interventions in the later period which is typical for the more advanced countries which became more proactive since the financial crisis.

Table 2: Prudential policy changes

Country	2000-05		2006-10		2011-14	
Country	Loosening	Tightening	Loosening	Tightening	Loosening	Tightening
Australia	0	3	1	0	0	2
Austria	1	0	0	0	1	2
Belgium	1	0	0	0	0	1
Canada	0	0	0	0	0	2
Denmark	0	0	0	0	0	2
Finland	1	0	0	0	0	1
France	1	1	0	2	1	3
Germany	0	0	0	1	0	2
Greece	1	0	0	0	0	1
Ireland	1	0	0	2	0	1
Italy	1	0	0	1	0	1
Luxembourg	1	0	0	0	1	3
Netherlands	1	0	0	1	0	2
Norway	1	1	1	1	0	2
Portugal	1	0	0	1	1	2
Spain	1	0	0	1	1	2
Sweden	0	1	0	0	0	6
Switzerland	0	0	0	1	0	4
United Kingdom	0	0	0	1	0	2
United States	0	0	0	0	0	2

3.4 Empirical strategy

3.4.1 Static and dynamic models

We use spatial econometric model (SAR) to capture the direct and spillover effects from the prudential policies. Baseline specification may be described by the following equations:

$$y_{it} = \alpha_i + \rho y^*_{it} + \beta x_{it} + \theta_t + u_{it} \tag{2}$$

$$y^*_{it} = \sum_{i^* \neq i} \omega_{i^* j} y_{i^* t} \tag{3}$$

where y is $N \times 1$ vector of country-specific dependent variables, α_i captures non-spatial country fixed effects, y^* is $N \times 1$ vector of foreign variables specific to country i, ω_{ij} is i, j element of matrix of weights W, x_{it} - stands for the country-specific macro-prudential tools. Finally, u_{it} is a vector of country-specific idiosyncratic shocks with

$$\begin{aligned} E(u_{it} u^{'}_{jt}) &= \Sigma_{ij} \\ E(u_{it} u^{'}_{jt'}) &= 0, \forall i, j \text{ and } t \neq t^{'} \end{aligned} \tag{4}$$

This model allows us to decompose the overall reaction of country-level systemic risk to prudential policy into direct and indirect effects.

In current specification the global variable for country i is a weighted sum of systemic risks of other countries $j \neq i$, where weights capture the investment of country i into the other countries (i.e. how much other countries $j \neq i$ need to repay to country i). Hence we expect the tightening of policy in a given country to have a risk-reducing effect for the investor-countries.

The weighting matrix has zero diagonal which is typical for the standard spatial models which typically base the weights on the geographic distance between the units of observation. However, our matrix is asymmetric (investment of country i into assets of country j does not have to match the investment of country j into country i)

The country-specific effects of prudential policy can be computed as:

$$\frac{\partial \Delta \mathbf{y}_i}{\partial u_i} = (I - \rho \cdot W)^{-1} \cdot \mathbf{1} \cdot \beta$$

given estimates for ρ and β the matrix $(I - \rho \cdot W)^{-1}$ become observable, and therefore the overall, direct and indirect effect of prudential policy can be computed as follows:

- *Average total effect:* the sum across the ith row of $(I - \rho \cdot W)^{-1}$ represents the total impact on country i from the prudential policy shock. There are n sums like this. The average of this sums is an average total effect.

- *Average direct effect:* the average of the diagonal elements of $(I - \rho \cdot W)^{-1}$

- *Average indirect effect*: the difference between the average total effect and the average direct effect.

Given the availability of time series dimension it is natural to consider also time dependence between main variables.To obtain dynamic model we employ spatial vector autoregressive model with temporal lag of the dependent variable. We refer to this secification as a baseline dynamic model.

$$y_{it} = \alpha_i + \mu y_{it-1} + \rho y^*_{it} + \beta x_{it} + \theta_t + u_{it} \tag{5}$$

where

$$y^*_{it} = \sum_{i^* \neq i} \omega_{i^* j} y_{i^* t} \tag{6}$$

μ - is autoregressive coefficient.

In both static and dynamic models, we use the specification, allowing for heterogeneity across countries only in terms of the fixed effects. In this way, we save degrees of freedom without posing problems for the evaluation of average direct and indirect effects. We find the balance between the size of our dataset and the options to make more precise inferences. Starting from a baseline restricted specification we then do the analysis for the selected country groups and differentiating the outcomes for countries with diverse characteristics.

3.4.2 Instrumental Variable specification and endogeneity

Static and dynamic models shown above consider all explanatory terms (including the global variable) at time t. Using the contemporaneous values for dependent and global variables we have a risk of capturing the somewhat technical co-movement between the systemic risk indicators, especially during the turbulent periods which boost the risk levels for most of the market participants.

We tackle this issue in the following way. All our specifications contain the year fixed effects to capture the influence of global factors relevant for the sample overall in a given year. We also instrument the global variable with its lagged values (4 lags which is consistent with 1 year of observations) still capturing the system-wide risk for each of the countries but is less likely to exhibit the mechanical relation.

$$y^*_{it} = \gamma + \delta_1 y^*_{it-1} + \delta_2 y^*_{it-2} + \delta_3 y^*_{it-3} + \delta_4 y^*_{it-4} + \epsilon_{i,t} \tag{7}$$

The fitted value $\widehat{y^*_{it}}$ is then used in the static and dynamic specifications shown above.

Another issue we have is the potential endogeneity of policy interventions. While we are interested in policy impact on the systemic risk the policy intervention might be in

fact a response to the worsened systemic risk levels. In this case, however, we would be observing the positive correlation between the instances of policy interventions and the changes in systemic risk (i.e. our β would be biased upwards given the positive correlation of policy interventions with disturbance terms). Thus such a bias would enforce the policy significance if the resulting β turns negative.

4 Baseline results

Our first set of results for SRISK measure is presented in Table 3 showing the coefficient estimates[9]. First four columns give the results for the banking system, the next four give the results for the financial system. Table 4 shows the decomposition of policy impact into average (over 10000 bootstrap simulations) direct and indirect effects. All estimations for SRISK are done using the quarterly (logarithmic) returns (measured in %), hence relevant coefficients are showing the percentage changes in SRISK/capitalization indicator following the policy interventions.

We see the reduction of systemic risk following the policy change (negative and significant β) in all our specifications. On top, there is a network amplification effect as we find a positive and significant ρ which goes down (though less so for the banking system considered separately) when we move to the IV specification.

Simulating the outcome for 10000 times we get the distribution for total impact and the splits into direct and indirect parts. Total risk reduction impact ranges from -6.2% for banks only to -8.3% for the whole financial system (i.e. the ratio of the shortfall to capitalization falls by 6 to 8% following the policy intervention) suggesting an important role for the non-bank part of the financial sector. For an average sample country with a mean of SRISK/MCap equal to 89%, this reduction would imply a 6,97% to 9.36% fall of the indicator.

When we consider the outcomes for the banking system by itself the indirect impact accounts for 69% of the total (77% when the IV is introduced) while financial system-level estimates attribute 85% of the systemicity reduction is realized through the network. To see the evolution of the impact effect we consider dynamic spatial vector autoregression model. Main results in the form of impulse response functions are presented in Figure 1.

[9]We do not report the estimates of the country-specific constants. They are available upon request

Table 3: Prudential Policy and systemic risk (country level - banking and financial systems)

	SRISK/MCap - banking system				SRISK/MCap - financial system			
Variables	(1) Static	(2) Static - IV (4L)	(3) Dynamic	(4) Dynamic - IV(4L)	(1) Static	(2) Static - IV(4L)	(3) Dynamic	(4) Dynamic - IV(4L)
AutoregressiveTerm μ	-	-	-0.024	-0.067**	-	-	0.015	-0.037
	-	-	[0.017]	[0.026]	-	-	[0.011]	[0.027]
Global Variable ρ	0.878***	0.582***	0.884***	0.619***	1.101***	0.506***	1.090***	0.373***
	[0.020]	[0.085]	[0.020]	[0.086]	[0.015]	[0.109]	[0.016]	[0.121]
Prudential Policy β	-1.746***	-1.534***	-1.766***	-1.613***	-0.734***	-1.096**	-0.763***	-1.052***
	[0.489]	[0.515]	[0.488]	[0.516]	[0.366]	[0.427]	[0.370]	[0.427]
Year Fixed Effects	YES	YES	YES	YES	YES	YES	YES	YES
Country Fixed Effects	20	20	20	20	20	20	20	20
Observations	1180	1180	1160	1160	1180	1180	1160	1160
Countries	20	20	20	20	20	20	20	20

Panel A shows the results for SRISK/MCap (logarithmic returns) indicator for countries' banking systems, Panel B repeats the analysis using same indicator for the financial system overall
Estimation is done by SUR with country and year fixed effects. Estimation period: 2000Q1 - 2014Q4. *** - p-value below 0.01, ** - p-value between 0.01 and 0.05, * - p-value below 0.1

Table 4: Prudential Policy Effects Decomposition - country level

	SRISK/MCap - banking system		SRISK/MCap - financial system	
Variables	Static	Static - IV	Static	Static - IV
Total Effect	-6.199	-7.145	-7.042	-8.331
Direct Effect	-1.914	-1.650	-1.015	-1.303
Indirect Effect	-4.285	-5.494	-6.027	-7.028
P	0.016	0.043	0.051	0.021

Systemic risk variable is in log percentage change. Estimation is done by SUR with country-specific intercepts and year effects. Estimation period: 2000Q2 - 2014Q4. Simulations are done using bootstrap with resampling for 10 000 iterations. P stands for the probability for the average effect to be higher than zero, taking into account the total bootstrap distribution.

5 Results for the country groups

In this section, we perform the following modifications to our initial model. We first split our countries into three groups and allow β and ρ to be country group-specific. In this way, we move away from averaging the prudential policy responses for a group of countries which are quite divergent in terms of fundamentals and banking system state. In particular, we see that the non-EU countries in our sample have an average 21% ratio of the capital shortfall to the capitalization while the average for the remainder of the sample is around 100%. We then limit our system to European countries only and recompute the weights matrix in such a way that the system is "closed" respect to the major global players. This allows checking whether the major world economy (the USA) dominates our conclusions concerning the network importance. We limit our analysis to the static IV specification with other specifications' results available upon request.

Table 5: Composition of groups

Non-EU global players	Australia, Canada and the USA
EU - core	Austria, Belgium, France, Germany, Luxembourg, the Netherlands (Euro); Denmark, Finland, Norway, Sweden, Switzerland and UK (non-Euro)
EU - GIIPS	Greece, Ireland, Italy, Portugal and Spain

First set of results is shown in Tables 6 and 7 We scale the weights to unity, hence our results for all countries on average are different from the ones shown in the baseline model. We see the network effects to be present for all country groups while policy impact is significant for core countries only. The total impact of the policy stays at the -8.3% for the non-EU sample, -6.43% for core EU countries and becomes negligible and insignificant for GIIPS which do not generate the systemic risk reduction (neither directly nor indirectly) following the implementation of their policies. They, however, can still form part of the indirect impact when other countries' policies are concerned. Once we restrict the analysis to the EU sample the core countries see on average a -5.99% risk reduction while GIIPS sample still stays irresponsive.

Table 6: Results for the country groups, banking system SRISK

Variables	non-EU	EU - core	EU - GIIPS	EU only	EU core	EU - GIIPS
Global Variable	0.534***	0.771***	0.744***	0.432***	0.651***	0.661***
	[0.017]	[0.025]	[0.031]	[0.074]	[0.024]	[0.028]
Prudential policy	-3.830***	-1.460*	-0.172	-0.889	-2.095**	0.150
	[0.626]	[0.742]	1.066	[0.662]	[0.841]	[1.123]
Observations	1180	1180	1180	1020	1020	1020
Countries	3	12	5	17	12	5

The table shows the results for SRISK/MCap (logarithmic returns) indicator for countries' banking systems Estimation is done by SUR with country and year fixed effects. Estimation period: 2000Q1 - 2014Q4. *** - p-value is below 0.01, ** - p-value is between 0.01 and 0.05, * - p-value is below 0.1

Table 7: Results for country group, decomposition of effects

Variables	non-EU	EU - core	EU - GIIPS	EU only	EU - core	EU - GIIPS
Total Effect	-8.287	-6.431	-0.670	-2.282	-5.990	0.528
Direct Effect	-3.992	-1.678	-0.174	-0.717	-2.248	0.190
Indirect Effect	-4.295	-4.753	-0.497	-1.565	-3.741	0.339
P	0.000	0.059	0.466	0.220	0.018	0.543

The table shows the results for SRISK/MCap (logarithmic returns) indicator for countries' banking systems Estimation is done by SUR with country and year fixed effects. Estimation period: 2000Q1 - 2014Q4.
P stands for the probability for the average effect to be higher than zero, taking into account the total bootstrap distribution.

6 Robustness checks

6.1 Policy interventions subsets

In this section, we check whether our results are robust to alternative instrument sets. Results are shown in the first column of tables 8 and 9 with the first column reproducing the results of Static-IV model for the full set of instruments. First, we reestimate our model excluding the instruments which are explicitly targeting the banks' systemic vulnerability reduction by restricting the size of exposures to selected sectors of the economy (e.g. interbank exposures). The results for this set of instruments which are more micro-prudential in nature are shown in the second column. Third column restricts the instrument set to measures which are introduced following the BIS, CRD(CRR) or ECB resolutions, i.e. are typically the result of external regulatory intervention and are less likely to be a response to own country's systemic risk levels. In both cases (tables 8 and 9) we see an increase in the total impact with no influence on the direct/indirect splits.

Table 8: Prudential poicies in use

Variables	Baseline set	Excluding concentration limits	Centrally set measures
Global Variable ρ	0.502***	0.502***	0.495***
	[0.066]	[0.066]	[0.066]
Prudential Policy β	-1.180**	-1.708***	-1.857**
	[0.495]	[0.640]	[0.752]
Country Fixed Effects	YES	YES	YES
Year Fixed Effects	YES	YES	YES
Countries	20	20	20

The table shows the results for SRISK/MCap (logarithmic returns) indicator for countries' banking systems Estimation is done by SUR with country and year fixed effects. Estimation period: 2000Q1 - 2014Q4. *** - p-value is below 0.01, ** - p-value is between 0.01 and 0.05, * - p-value is below 0.1

Table 9: Prudential policies in use - decomposition

Variables	Baseline set	Excluding concentration limits	Centrally set measures
Total Effect	-4.534	-7.472	-8.488
Direct Effect	-1.035	-1.697	-1.972
Indirect Effect	-3.500	-5.775	-6.517
P	0.1027	0.062	0.052
Countries	20	20	20

The table shows the results for SRISK/MCap (logarithmic returns) indicator for countries' banking systems

Estimation is done by SUR with country and year fixed effects. The estimation period is 2000Q1 - 2014Q4.

P stands for the probability for the average effect to be higher than zero, taking into account the total bootstrap distribution.

6.2 Alternative weights and Instruments

In this section whether our results hold if we consider an alternative IV estimation or redefine the weighting matrix. First, instead of using the four lags of the global term in the first stage regression we do a first stage estimation using as instruments the spatial lag of explanatory variable and the fourth lag (equivalent to a year lag) of the global variable:

$$y^*_{it} = \gamma + \beta x_{it} + \gamma x^*_{it} + \delta y^*_{it-4} + \epsilon_{i,t} \tag{8}$$

$$x^*_{it} = \sum_{i^* \neq i} \omega_{i^* j} x_{i^* t} \tag{9}$$

$$y^*_{it} = \sum_{i^* \neq i} \omega_{i^* j} y_{i^* t} \tag{10}$$

$$\Downarrow$$

Second stage is estimated as before:

$$y_{it} = \alpha_i + \rho \widehat{y^*_{it}} + \beta x_{it} + u_{it} \tag{11}$$

Results are comparable to the baseline IV estimation both in terms of coefficient significance and in terms of size and split of total effect.

Next we look at the alternative weighting schemes. As mentioned before, the weights we use correspond to the portfolio investments into debt and equity securities (which is not ideal since we are also interested in lending relations). However, we believe that while weights might vary the set of major counterparties' in lending relations would be similar to the one coming from the portfolio investment side in terms of the top counterparties. Thus we reestimate our models with the alternative weighting matrices. We set $w_{i,j} = 1$

when the exposure of country i to country j exceeds the 5% of its overall investment. Alternatively we set $w_{i,j} = 1$ for their top 10 counterparties of country i. We then scale the weights so that they sum up to one for each of the rows. Our adjustment reduces the total policy impact (mainly at the expense of indirect effect). However, it still remains sizeable with a slightly reduced share of the indirect impact - 64% for the "top 10" case and 71% (similar to the baseline outcome) for the "above 5%" case.

Table 10: Alternative IV and alternative weights - results

Variables	Baseline result	Alternative IV	Top 10	Weight> 5%
Global Variable ρ	0.502***	1.097***	0.341***	0.431***
	[0.066]	[0.153]	[0.101]	[0.062]
Prudential Policy β	-1.180**	-1.283***	-1.288**	-1.076**
	[0.495]	[0.464]	[0.510]	[0.501]
Countries	20	20	20	20

The table shows the results for SRISK/MCap (logarithmic returns) indicator for countries' banking systems

Estimation is done by SUR with country and year fixed effects. Estimation period: 2000Q1 - 2014Q4. *** - p-value below 0.01, ** - p-value between 0.01 and 0.05, * - p-value below 0.1

Table 11: Alternative IV and alternative weights - impact decomposition

Variables	Baseline result	Alternative IV	Top 10	Weight>5%
Total Effect	-4.534	-4.233	-3.843	-3.415
Direct Effect	-1.035	-0.938	-1.405	-1.020
Indirect Effect	-3.500	-3.295	-2.437	-2.394
P	0.103	0.098	0.055	0.094

The table shows the results for SRISK/MCap (logarithmic returns) indicator for countries' banking systems

Estimation is done by SUR with country and year fixed effects. The estimation period is 2000Q1 - 2014Q4.

P stands for the probability for the average effect to be higher than zero, taking into account the total bootstrap distribution.

7 Conclusions

Our analysis allows shedding light on the side effects of prudential regulation. We have evaluated the impact of financial-based prudential policies on the systemic risk outcomes for a sample of 20 countries. While it's important to show that policy interventions indeed limit the systemic risk, an equally important question is to what extent country-specific policy impact is amplified through the financial network. We have shown that policy interventions are followed by economically and statistically significant reductions in systemic risk. Once the risk reduction is decomposed into the direct and indirect effects we see that with country-level estimates (for the banking sectors) 70% of policy impact is coming from the network and only 30% comprises the result of a direct relation. The indirect

This relation is observed in static and dynamic specifications (with and without year fixed effects). It also holds when we perform the analysis on the level of the overall financial system. The robustness checks confirm our findings. We use an alternative weighting matrix and consider "close" only the major counterparties for each of the countries. We have several directions for future research. A relevant extension would comprise a bank-country analysis or the analysis of spillovers between the banking and nonbanking sectors. While bank-to-bank connections are not disclosed openly, the bank-to-country exposures are disclosed in a centralized manner for the top players in the banking sector. Hence similar analysis and decomposition are plausible.

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Appendices

A Descriptive statistics for SRISK/MCap variables

Table 12: Descriptive statistics for SRISK/MCap indicators

Country	Mean	Std	MIN	Q25	MED	Q75	MAX
Overall sample	0.89	1.83	0.00	0.06	0.33	0.90	33.17
Australia	0.14	0.19	0.00	0.00	0.04	0.25	0.89
Canada	0.23	0.18	0.00	0.10	0.23	0.30	1.04
the USA	0.27	0.29	0.00	0.10	0.15	0.37	1.66
Non-EU	0.21	0.23	0.00	0.07	0.16	0.30	1.66
Austria	0.59	0.39	0.00	0.26	0.63	0.85	1.49
Belgium	1.83	2.36	0.00	0.34	0.89	2.61	10.21
Denmark	0.85	0.94	0.00	0.28	0.47	1.17	5.47
Finland	0.31	0.44	0.00	0.00	0.17	0.36	2.00
France	1.49	1.21	0.00	0.57	0.85	1.87	5.08
Germany	1.91	1.32	0.00	0.96	1.68	2.59	7.69
Luxembourg	2.07	3.18	0.00	0.00	0.00	3.42	17.87
Netherlands	1.50	1.65	0.00	0.48	0.96	2.11	9.78
Norway	0.42	0.54	0.00	0.05	0.27	0.52	2.66
Sweden	0.45	0.42	0.00	0.22	0.30	0.55	2.71
Switzerland	0.38	0.26	0.00	0.23	0.35	0.50	1.47
United Kingdom	0.51	0.69	0.00	0.05	0.24	0.73	3.92
EU-core	1.02	1.54	0.00	0.19	0.50	1.14	17.87
Greece	1.12	2.48	0.00	0.00	0.02	0.65	11.04
Ireland	2.24	5.18	0.00	0.07	0.27	0.44	33.17
Italy	0.57	0.68	0.00	0.05	0.16	0.94	2.37
Portugal	0.61	0.97	0.00	0.00	0.02	0.86	3.83
Spain	0.28	0.36	0.00	0.00	0.08	0.51	1.38
EU-GIIPS	0.96	2.70	0.00	0.00	0.17	0.74	33.17

B Impulse responses to policy interventions

Figure 1: Impulse responses to policy shock-banking systems

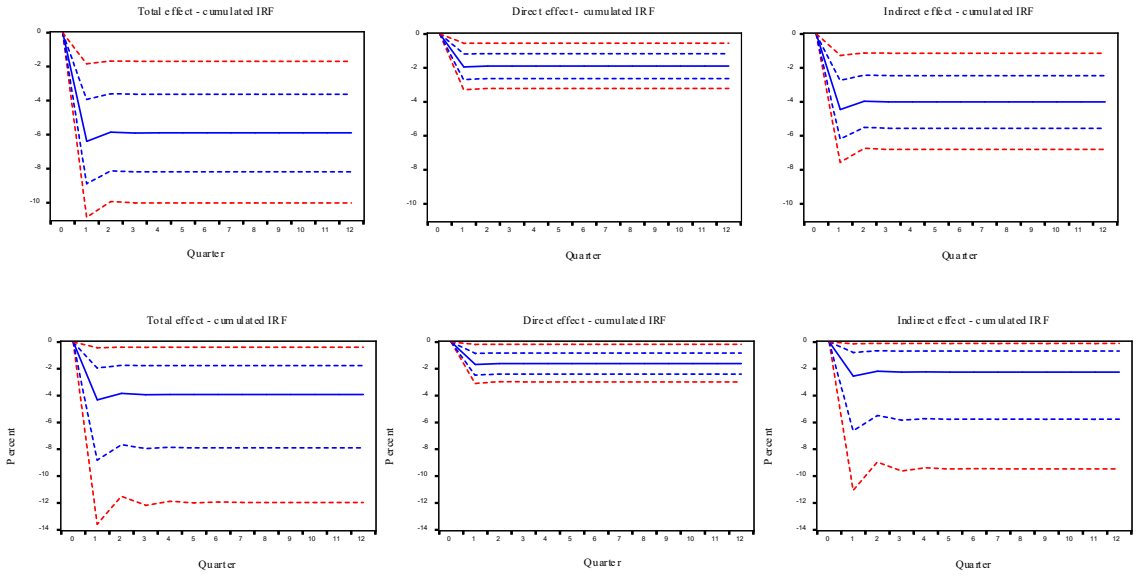

Figure 2: Impulse responses to policy shock-financial systems