

Did the Basel Process of Capital Regulation Enhance the Resiliency of European Banks?

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Outline

Motivation

Sample and Systemic Risk Measures

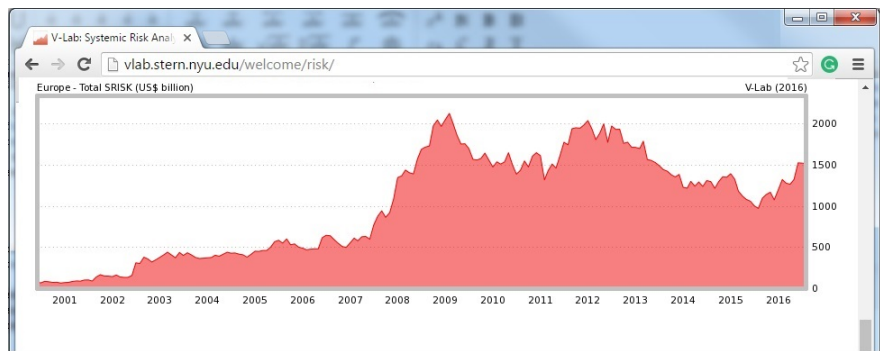
Methodology and Results

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Systemic risk in Europe

SRISK (Robert Engle's V-Lab)



Basel process - Objects

Basel Committee of Banking Supervision, 1988:

- ▶ Increase **safety and soundness** of global banking system
 - ▶ recommendations of minimum standards for capitalization and risk management
- ▶ Maintain **level playing-field** for international banks
 - ▶ Attempt to harmonize accounting standards

Basel process - open questions

- ▶ **Evidence-based policy evaluation:** Did the process achieve the intended goals? (Hellwig 1996, Wagster 1996)
- ▶ **Structural analysis:** Which policies did contribute to increase/reduce the resiliency? (Hellwig 2010, Eberlein et al. 1998, Danielson et al. 2001)
- ▶ **Market failure:** Which is the underlying market failure that requires correction? (Goodhart 2011)
- ▶ **Self regulation** versus **statutory regulation:** Role of internal models? (Behn et al. 2014, Acharya et al. 2014)

Motivation

We analyse the evolution of resiliency of the European banking sector after the implementation of the Basel Capital Accord.

→ We trace both systemic risk (SRISK and CoVaR) and systematic risk measures (beta and CAPM cost of equity),

→ back to late 1980's,

→ Has the process of capital regulation increased the resilience of European Banks?

→ What are the main drivers of the evolution of systemic risk?

The Basel Process of Capital Regulation

The process was initiated in late 1974:

- ▶ Basel I: The first Basel Capital Accord, July 1988
→ risk-based capital requirements with fixed risk-weights
- ▶ Market Risk Amendment: January 1996
→ self-regulatory option to use **internal models** for market risk
- ▶ Basel II: Revised Framework of the Basel Accord, June 2006
→ standard approach vs. **internal ratings-based credit risk models**
- ▶ Basel III: Principles for Sound Liquidity Risk Management and Supervision, September 2008
→ triggering the ongoing process after the Great Financial Crisis
→ Santiago summit (Nov. 2016): role of **internal models**

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Sample

400 European financial institutions

- from 1987 to 2015
- from core Euro-area, Switzerland, and United Kingdom
- from Compustat Global, SNL, hand-collected data.

1. banks
2. diversified institutions
3. insurance companies
4. real estate companies

Empirical analysis

1. We estimate systemic risk: SRISK (Brownless and Engel, RFS 2017) and Delta CoVaR (Adrian and Brunnermeier, AER 2016))
2. We explain SRISK with weekly market data or quarterly bank/country data.
3. We test the impact of the Basel process with two sets of dummies:
 - ▶ time dummies: market risk internal models (Jan 1996), Basel II (June 2006), Basel III guidelines (Sept 2008).
 - ▶ bank-level dummies: use of credit risk internal models

Systemic risk measures

Exposure SRISK is the capital shortfall of an institution conditional on the whole financial sector being in severe decline (Brownlees and Engle, RFS 2017):

$$\begin{aligned}SRISK_{i,t} &= E_{t-1}[Capital\ shortfall_i | Crisis] \\ &= E_{t-1}[k(D_{i,t} + E_{i,t}) - E_{i,t} | Crisis]\end{aligned}$$

Contribution $\Delta CoVaR$ is the difference between the $CoVaR_{mt}$, conditional on firm i being in distress or in its median state (Adrian and Brunnermier, AER 2016):

$$\Delta CoVaR_{it}(\alpha) = CoVaR_t^m | r_{it} = VaR_{it}(\alpha) - CoVaR_t^m | r_{it} = Median(r_{it})$$

MES and LRMES

We estimate (Acharya, Engel and Richardson, AER 2012):

- ▶ Expected one-day loss of the bank returns in the event of an extreme aggregate shock (daily market index falls more than its 95% VaR):

$$MES_{it}(c) = E_{t-1}(r_{it} | r_{mt} < c = q_{5\%})$$

- ▶ Long-Run Marginal Expected Shortfall (LRMES) in a six-month horizon:

$$LRMES \approx 1 - e^{(-18 * MES)}$$

Exposure to systemic risk - SRISK

Capital shortfall of an institution conditional on the whole financial sector being in severe decline (Brownlees and Engle, 2017):

$$\begin{aligned}
 SRISK_{i,t} &= E_{t-1}[Capital\ shortfall_i | Crisis] \\
 &= E_{t-1}[k(Debt_{i,t} + Equity_{i,t}) - Equity_{i,t} | Crisis] \\
 &= E_{t-1}[k(Debt_{i,t}) - (1 - k)(1 - LRMES_{i,t})Equity_{i,t}]
 \end{aligned}$$

- ▶ bivariate daily time series model of equity returns on firm i and on a value-weighted market index (MSCI Europe index).
- ▶ volatilities are asymmetric GJR GARCH processes, and
- ▶ correlations are estimated by DCC (Engel, 2002).

The contribution to aggregate SRISK by firm i is:

$$SRISK\%_{i,t} = \frac{SRISK_{i,t}}{\sum_{j \in J} SRISK_{j,t}}, \quad \text{where } J = \{firms\ with\ SRISK > 0\}$$

Contribution to systemic risk - Delta CoVaR

CoVaR focuses on tail-dependency between the whole sector and one institution i (Adrian and Brunnermier, 2011).

- ▶ maximum loss of the market return within the $\alpha\%$ -confidence interval, conditionally on an event $C(r_{it})$:

$$Pr(r_{mt} \leq CoVaR_{mt} | C(r_{it}) = \alpha$$

- ▶ distress event on firm i is a loss equal to its $(1 - \alpha)\%$ VaR:

$$r_{it} = VaR_{it}(\alpha)$$

$\Delta CoVaR$ is the difference between the $CoVaR_{mt}$, conditional on firm i being in distress or in its median state:

$$\Delta CoVaR_{it}(\alpha) = CoVaR_t^{m|r_{it}=VaR_{it}(\alpha)} - CoVaR_t^{m|r_{it}=Median(r_{it})}$$

Systematic risk measures

We use two measures of cost of equity:

- ▶ time-varying beta between bank asset returns and MSCI Europe index:
→ from the DCC GARCH model
- ▶ CAPM cost of equity required by the market, given dynamic beta and market risk premium:

$$CostEquity_{it} = R_{ft} + \widehat{beta}_{it} * (R_{mt} - R_{ft})$$

R_{ft} : daily annualized yield on German Bonds;

R_{mt} : MSCI Europe index compounded over the previous year.

Outline of the empirical analysis

1. a baseline regressions of SRISK with quarterly data on the overall sample, both as panel fixed effects and quantiles regressions.
2. long-run relationship between average SRISK and market capitalization, Z-score of default and interest rate, with a VECM on weekly averages.
3. in a subsample of banks where microdata on the implementation on credit risk models is available, we apply both panel fixed effects and quantile regressions
4. a counterfactual analysis to compare the observed SRISK on the systemic risk that would have been realized without Basel regulation.
5. (many robustness checks).

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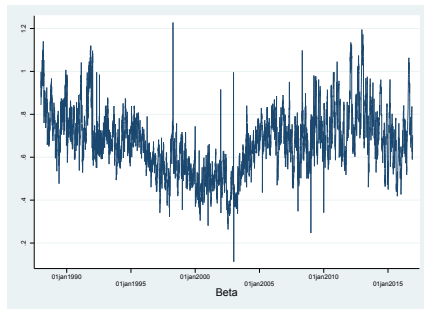
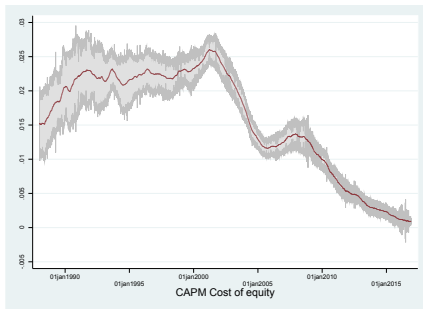
Sample and Systemic Risk Measures

Methodology and Results

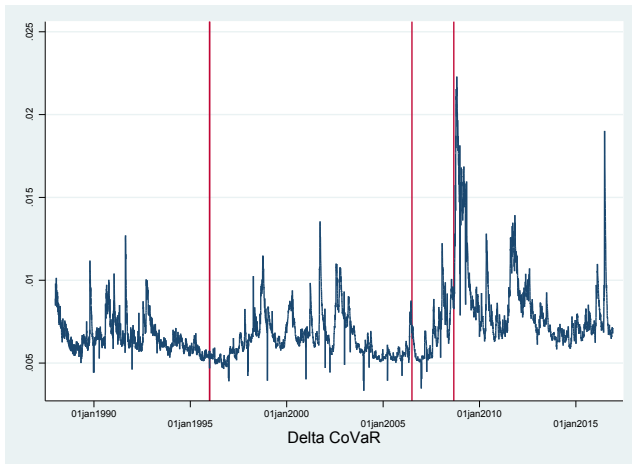
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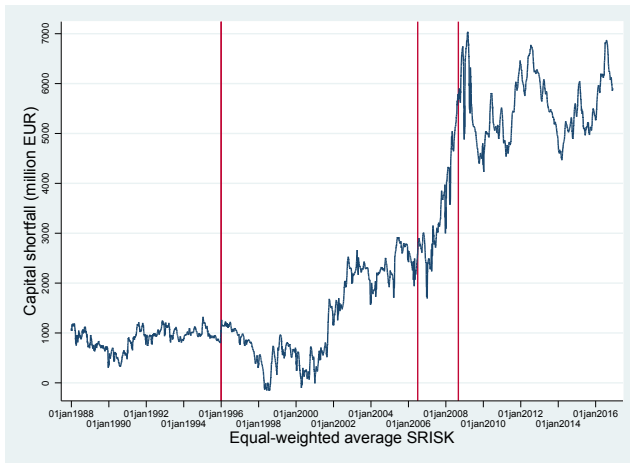
Systematic Risk



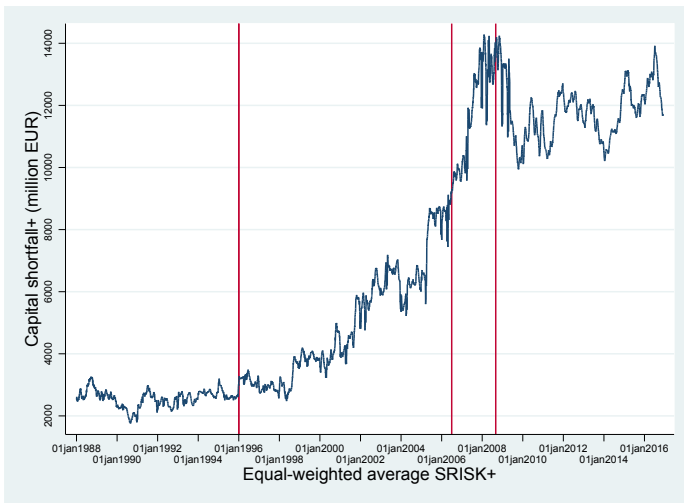
Delta CoVaR



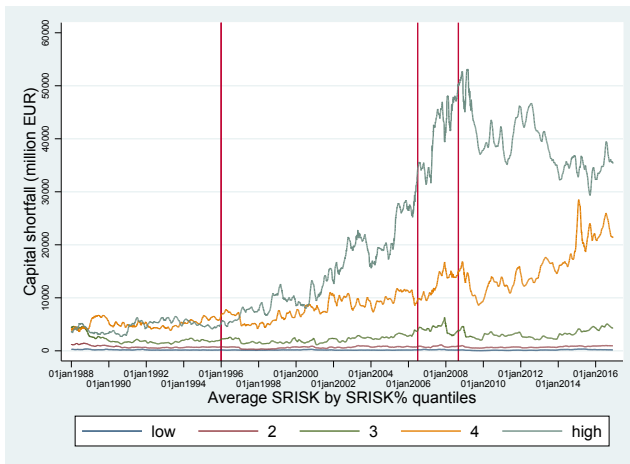
SRISK



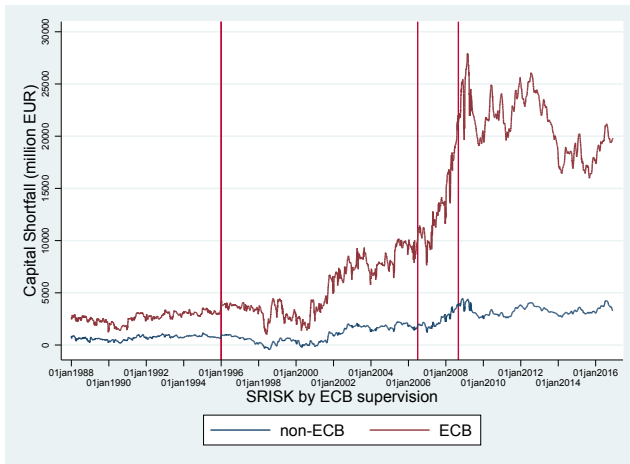
SRISK positive



SRISK% quantiles



SRISK under ECB supervision



Basel process (1)

We estimate SRISK on:

1. time dummies for the enfolding of the Basel process:
 - ▶ Market Risk Amendment: January 1996
 - ▶ Basel II: Revised Framework of the Basel Accord, June 2006
 - ▶ Basel III: Principles for Sound Liquidity Risk Management and Supervision, September 2008

→ with quarterly data, controlling for other SRISK drivers as bank-characteristics, total assets, non-performing loans, total loans, investment in securities, market capitalization and leverage, and macro country variables GDP, unemployment, equity market growth

We use:

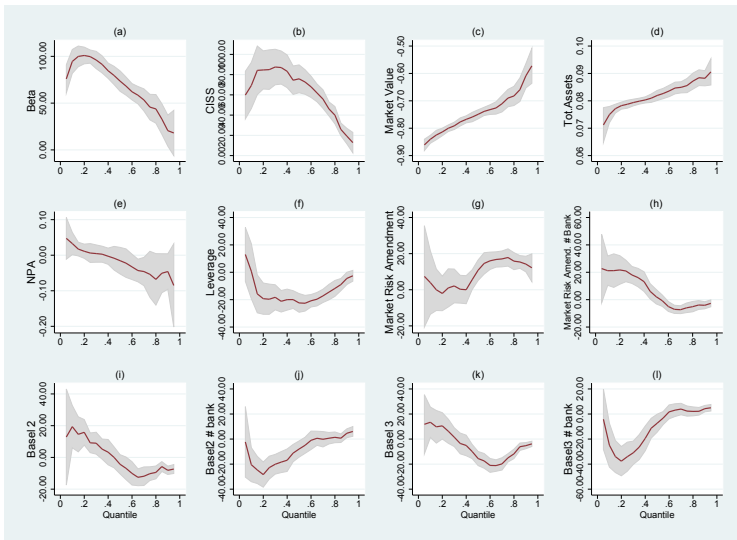
- ▶ panel regressions
- ▶ quantile regressions

Quantile quarterly regressions results

	(1) Q.25	(2) Q.50	(3) Q.75
Beta	108.6*** (13.66)	76.34*** (10.34)	36.62*** (10.80)
CISS	103.5*** (16.00)	86.89*** (12.29)	63.96*** (12.12)
Tot.Assets	0.0791*** (0.000728)	0.0822*** (0.000308)	0.0854*** (0.00289)
NPA	0.00915*** (0.00233)	-0.00651* (0.00368)	-0.0200 (0.0544)
Equity Securities	0.0247*** (0.00308)	0.0314*** (0.00148)	0.0313 (0.0388)
Fixed Income Securities	-0.00359*** (0.00106)	-0.0112*** (0.000448)	-0.0178*** (0.00375)
Mark.Cap.	-0.803*** (0.0237)	-0.752*** (0.00624)	-0.671*** (0.00620)
Leverage	0.0745*** (0.0172)	0.0497*** (0.00726)	0.0333*** (0.00854)
Market Risk Amendment	-20.52* (12.06)	4.101 (10.53)	20.61* (10.95)
Basel 2	-13.80*** (4.711)	-5.467 (3.598)	-1.539 (1.761)
Basel 3	-24.86*** (6.388)	-13.79** (5.918)	12.76 (10.24)
Constant	-61.38*** (13.02)	-49.68*** (11.89)	-43.31*** (11.94)
Year effects	yes	yes	yes
Observations	16,746	16,746	16,746

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

Quantile Coefficients



Basel process (2)

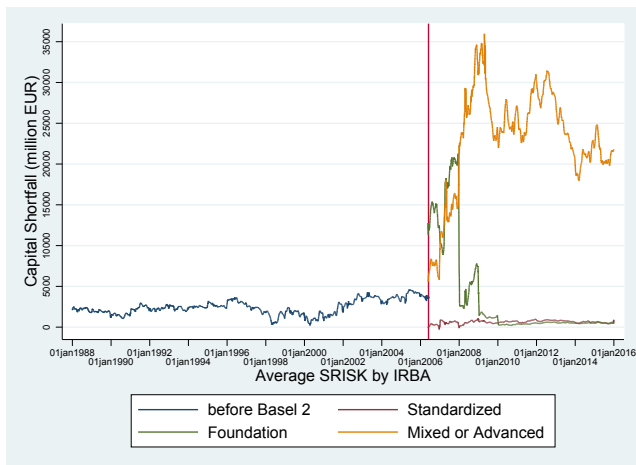
We estimate SRISK on:

2. a subsample of 100 banks, and we use bank-level quarterly information on the implementation of IRBA models for credit risk, after Basel II (2006):
 1. Standardised
 2. Foundation
 3. Mixed
 4. Advanced approach

→ we regress residuals of an AR(2) model of weekly SRISK

→ we control for other drivers, as market-characteristics: market stress (CISS), market return, EU policy rate, market capitalization, book-to-market.

SRISK by IRBA models



Panel weekly regression results: SRISK

	(1)	(2)	(3)	(4)	(5)	(6)
Beta	-186.0*** (48.19)	-186.2*** (48.94)	-118.1*** (30.22)			
Cost of Equity				-135.0** (57.05)	-130.0** (56.39)	-125.8** (60.43)
CISS	-2.253 (33.06)	-11.65 (31.68)	-9.949 (31.41)	-88.42** (39.54)	-95.69** (38.92)	-83.70** (36.74)
Zscore	-1.136 (1.007)	-1.118 (0.962)	-0.0187 (0.0326)	-0.846 (0.865)	-0.838 (0.775)	0.0288 (0.0257)
Market return	-13,267*** (3,448)	-13,239*** (3,439)	-13,309*** (3,460)	-13,308*** (3,481)	-13,284*** (3,474)	-13,296*** (3,478)
Policy rate	822.1** (405.5)	976.2** (427.9)	1,170*** (373.4)	1,765*** (486.2)	1,915*** (508.9)	1,656*** (428.7)
Market-to-Book	0.127*** (0.0111)	0.138*** (0.0118)	0.132*** (0.0109)	0.144*** (0.0101)	0.155*** (0.0124)	0.136*** (0.0109)
MV	0.00248 (0.00192)	0.00560*** (0.00203)	0.00505*** (0.00137)	0.00392* (0.00208)	0.00705*** (0.00202)	0.00384*** (0.00116)
1.IRBA#MV	-0.00129 (0.00488)		0.00162 (0.00430)	-0.00105 (0.00333)		-0.000532 (0.00299)
2.IRBA#MV	0.00931** (0.00452)		0.00976*** (0.00333)	0.00993** (0.00403)		0.00918*** (0.00338)
3.IRBA#MV	0.00460** (0.00201)		0.00185 (0.00201)	0.00463** (0.00230)		0.00300 (0.00183)
4.IRBA#MV	0.00575 (0.00492)		0.00510 (0.00502)	0.00540 (0.00462)		0.00448 (0.00440)
1.IRBA	-14.33 (14.82)	-8.897 (13.22)	-15.23 (14.25)	18.55* (9.786)	24.11** (10.40)	17.62* (10.32)
2.IRBA	-34.42 (64.84)	133.2** (63.56)	-51.28* (26.77)	-36.08 (60.90)	143.0** (68.46)	-6.346 (25.04)
3.IRBA	55.27 (34.27)	130.3** (50.08)	71.72** (31.64)	0.738 (26.30)	75.99* (41.90)	26.48 (21.35)
4.IRBA	-44.73 (67.85)	47.54 (61.54)	4.758 (38.76)	-26.97 (47.86)	58.47 (50.03)	8.108 (25.08)
Market Amend.	57.47** (26.43)	35.95 (24.20)	22.09 (15.89)	42.52* (24.57)	20.48 (21.46)	50.80*** (16.75)
Constant	5.667 (32.52)	-7.302 (32.68)	-45.73* (26.46)	-117.1*** (26.71)	-130.0*** (29.03)	-142.0*** (32.18)
Country Effects	no	no	yes	no	no	yes
R-squared	0.014	0.014	0.016	0.012	0.011	0.014
Number of gvkey	95	95		95	95	

Unconditional Quantile regressions (weekly results)

	SRISK	(1) Q.25	(2) Q.50	(3) Q.75	(4) Q.25	(5) Q.50	(6) Q.75
L.Beta	77.72**	56.18	3.292***	-5.214	170.5***	4.372***	
	(34.58)	(49.12)	(687.2)	(5.392)	(5.194)	(93.97)	
Zscore	-14.78***	-19.10***	-110.6**	-0.0197	0.340***	-3.659***	
	(3.973)	(3.789)	(53.17)	(0.0232)	(0.0437)	(0.244)	
L.CISS	406.4***	339.8***	4.035***	310.2***	254.5***	2.535***	
	(68.94)	(68.11)	(1,200)	(13.98)	(14.71)	(211.9)	
L.market return	-711.1***	-572.9**	-9,580***	-649.5**	-612.4**	-11,634***	
	(235.0)	(224.0)	(2,947)	(299.6)	(309.7)	(4,350)	
L.policy rate	-6,574***	-8,558***	-52,525**	-4,451***	-3,803***	-8,343**	
	(1,661)	(1,691)	(20,667)	(284.0)	(279.1)	(4,178)	
Market-to-Book	-0.465***	-0.375***	-6.981***	-0.551***	-0.263***	-3.178***	
	(0.0570)	(0.0977)	(0.431)	(0.0220)	(0.0205)	(0.188)	
Market Value	-0.00901**	-0.00973***	-0.0813*	0.000749**	0.0116***	0.262***	
	(0.00366)	(0.00326)	(0.0434)	(0.000294)	(0.000332)	(0.00578)	
1.IRBA-Standardized	22.38	95.56	468.1	176.4***	97.08***	-453.5***	
	(60.09)	(62.30)	(580.5)	(8.409)	(6.919)	(81.82)	
2.IRBA-Foundation	13.92	32.16	860.7	-121.5***	293.5***	-2,519***	
	(155.3)	(160.3)	(1,175)	(16.33)	(14.50)	(181.2)	
3.IRBA-Mixed	227.9*	250.5**	7,136***	219.6***	440.0***	9,082***	
	(126.5)	(122.5)	(2,037)	(9.790)	(9.982)	(188.2)	
4.IRBA-Advanced	441.4*	403.6*	589.2	375.5***	879.9***	766.7***	
	(235.7)	(206.3)	(1,741)	(10.81)	(12.82)	(164.0)	
Market Risk Amend.	-453.9***	-432.3***	-184.4	-521.6***	-657.5***	-4,561***	
	(104.1)	(102.5)	(2,041)	(16.49)	(16.63)	(273.7)	
1.MV#IRBA-Standardized	0.00258	-0.00136	-0.0191	-0.0138***	0.0207***	0.487***	
	(0.00750)	(0.00758)	(0.135)	(0.00131)	(0.00117)	(0.0219)	
2.MV#IRBA-Foundation	0.00688	0.00582	0.0817	0.00532***	-0.00576***	0.0444***	
	(0.00582)	(0.00569)	(0.0734)	(0.000689)	(0.000704)	(0.0150)	
3.MV#IRBA-Mixed	0.00385	0.00405	0.0432	-0.00448***	-0.0155***	-0.272***	
	(0.00560)	(0.00546)	(0.0892)	(0.000361)	(0.000392)	(0.00714)	
4.MV#IRBA-Advanced	-0.0117	-0.0105	0.0814	-0.0180***	-0.0319***	-0.189***	
	(0.00832)	(0.00784)	(0.136)	(0.000744)	(0.000788)	(0.0140)	
Firm Fixed Effects	yes	yes	yes	no	no	no	
Country Fixed Effects	no	no	no	yes	yes	yes	
Constant	750.7***	1,011***	3,866	650.5***	633.6***	4,253***	
	(171.3)	(160.9)	(2,529)	(27.75)	(28.81)	(430.1)	
R-squared	0.165	0.192	0.261	0.189	0.418	0.572	

Counterfactual analysis (1)

What would SRISK have been in case of

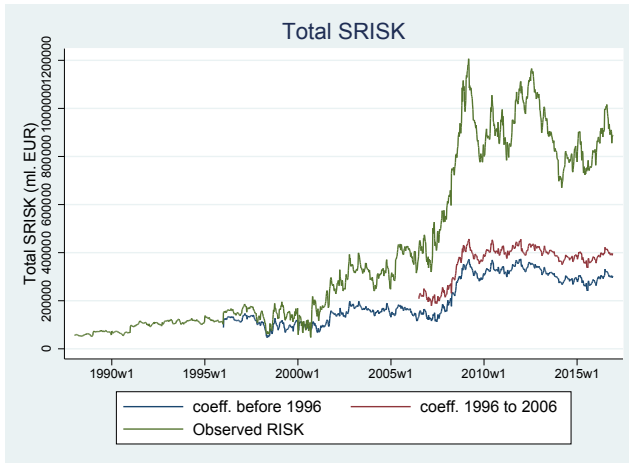
- ▶ no Market Risk Amendment in Jan. 1996?
- ▶ no Basel II in June 2006?

We regress separately for the three sub-groups of (1) banks, (2) insurance companies and (3) real estates:

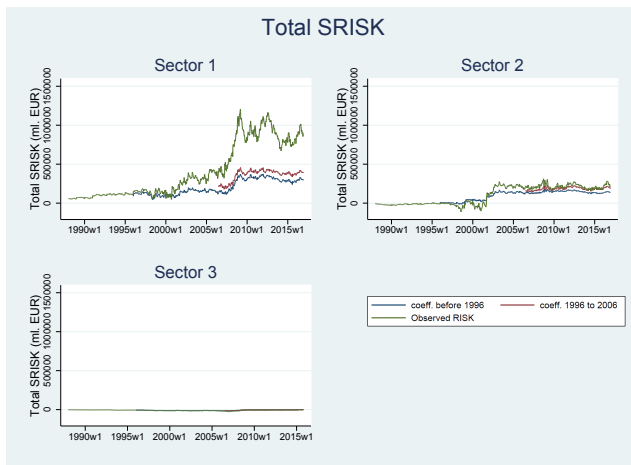
$$\widehat{SRISK}_{i\tau}^{(e, noMRA)} = \sum_k \hat{\gamma}_k^{(\tau < Jan1996)} X_t \quad (1)$$

$$\widehat{SRISK}_{i\tau}^{(e, noBII)} = \sum_k \hat{\gamma}_k^{(Jan1996 \leq \tau < Jun2006)} X_t \quad (2)$$

Counterfactual SRISK (banks)



Counterfactual SRISK



Counterfactual analysis (2)

We implement a Difference-in-Differences analysis:

$$SRISK_{it}^e = \sigma_0 + \sigma_1 IRBA + \sigma_2 Basel2 + \sigma_3 Basel2 * IRBA + \varepsilon_{it}$$

- ▶ IRBA: dummy for advanced or mixed credit risk internal models,
- ▶ Basel2: time dummy June 2006,

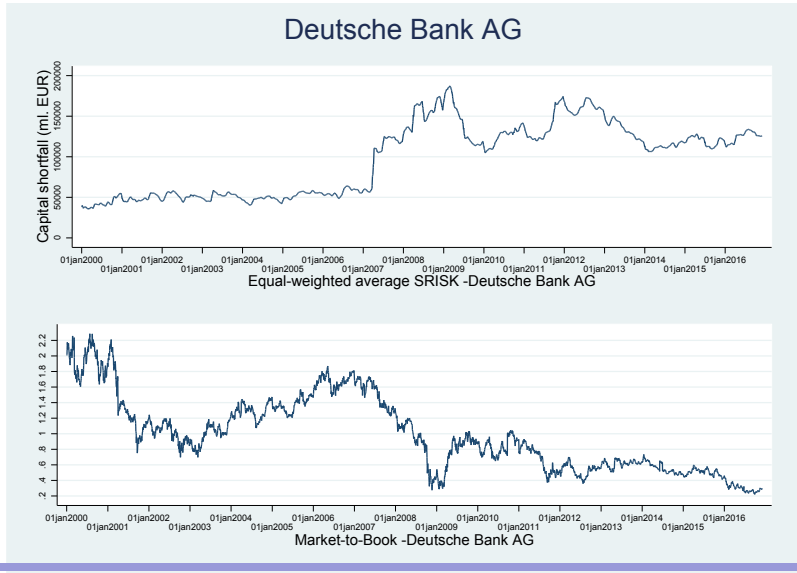
$$\hat{\sigma}_3 = (\overline{SRISK}_{IRBA,post} - \overline{SRISK}_{IRBA,pre}) - (\overline{SRISK}_{nonIRBA,post} - \overline{SRISK}_{nonIRBA,pre})$$

First, we run a probit regression: the probability of implementing IRBA models given market beta, Z-score, market capitalization, market-to-book ratio. A PS is then assign to balance treated and comparison.

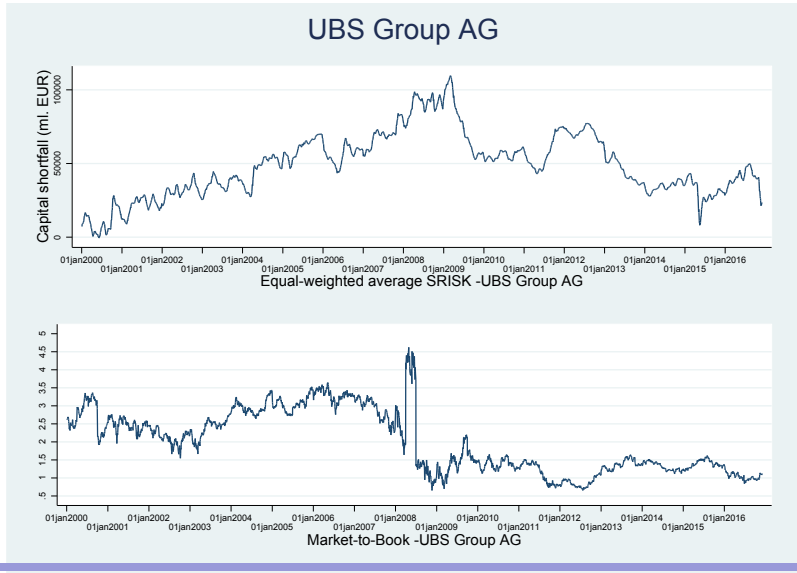
Diff-in-Diffs results

Outcome var.	SRISK	t	p-value
Baseline period:			
Control	5892.937		
Treated	5275.271		
Diff (T-C)	-617.666	-0.22	0.83
Follow-up period:			
Control	1684.41		
Treated	2.00E+04		
Diff (T-C)	1.80E+04	3.3	0.002***
Diff-in-Diffs	1.90E+04	3.73	0.000***

SRISK as a tool for supervision? - Deutsche Bank



SRISK as tool for supervision? - UBS



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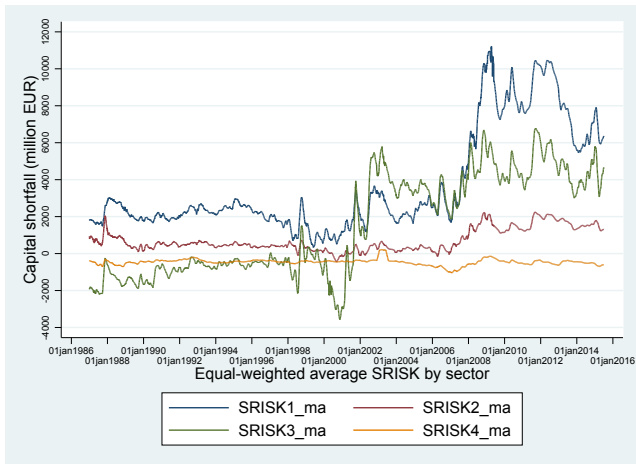
Conclusions: A summary of the Main Results

- ▶ Though we observe a decrease in funding costs for European institutions, *exposure to systemic risk* has heightened after the implementation of Basel Accord.
- ▶ Basel process has succeeded in containing systemic risk of smaller banks, but it has been less successful for the larger institutions.
- ▶ Larger institutions could opportunistically exploit the option of self-regulation by employing internal models, but reducing system stability.

Conclusions: Unintended consequences

- ▶ on stability of the global system: while providing increasing incentives for prudent in-house risk management over time, we observe a serious decline in resiliency
- ▶ on competition: Basel II provides competitive advantage to large and more systemic banks, who could implement risk models strategically at the expenses of smaller banks

Further Unintended Consequences: Spill-Overs?



1: banks, 2: diversified financials, 3: insurance, 4: real estates.

Spillover effects

Other financial sectors are recently building up high levels of systemic risk:

IFM GFSR Apr. 2016: "*The contribution of life insurers to systemic risk has increased in recent years [...] Supervisors and regulators should take a more macroprudential approach to the sector [...] it includes the international adoption of capital and transparency standards for the sector.*"

→ Are there any spillovers effects from the banking regulation to the non-banking financial sectors?

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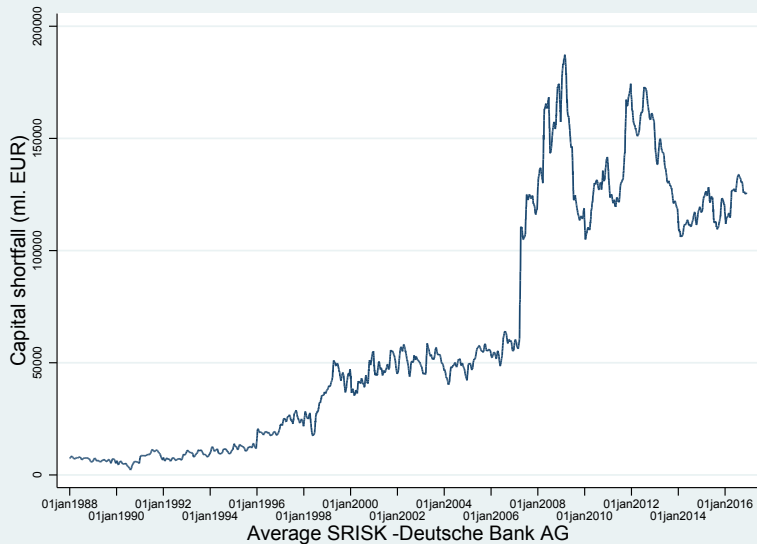
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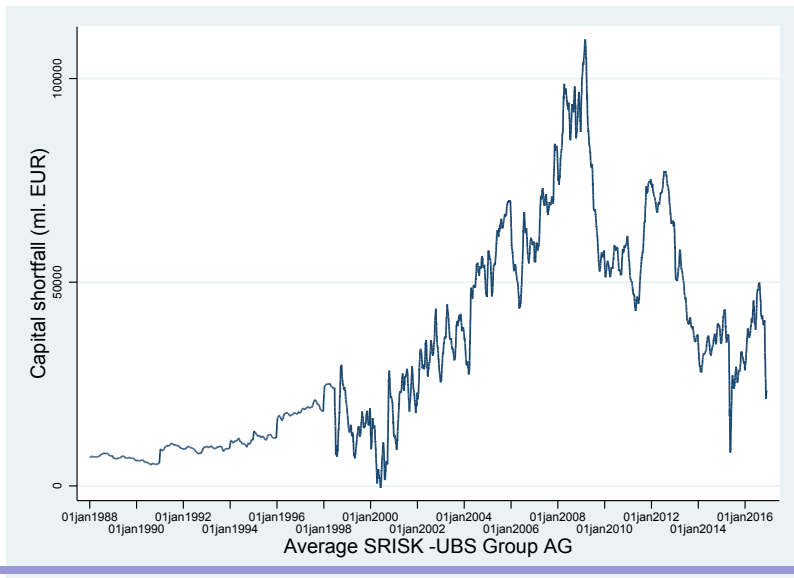
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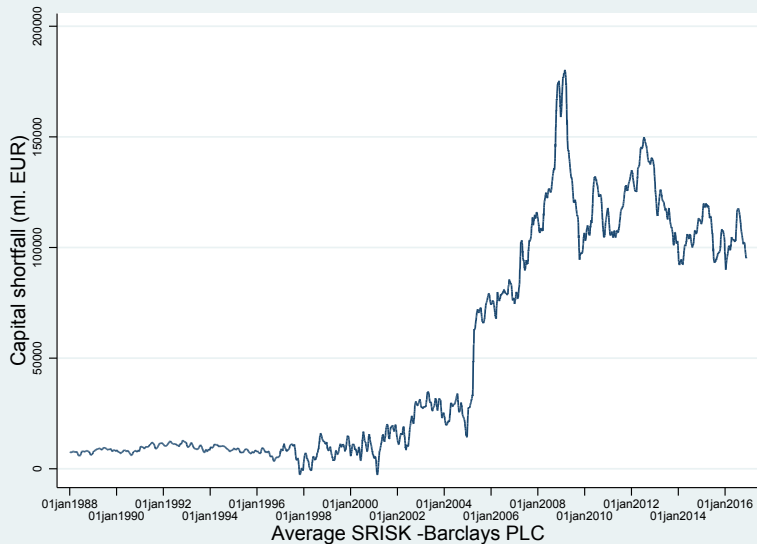
SRISK Deutsche Bank



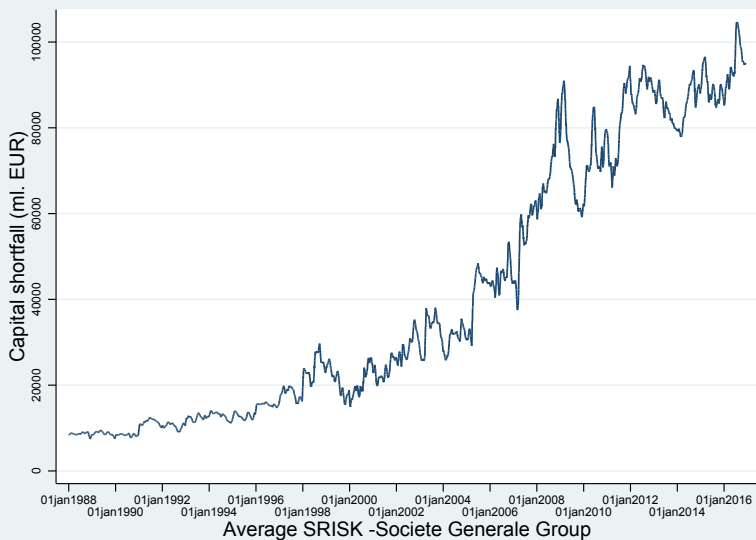
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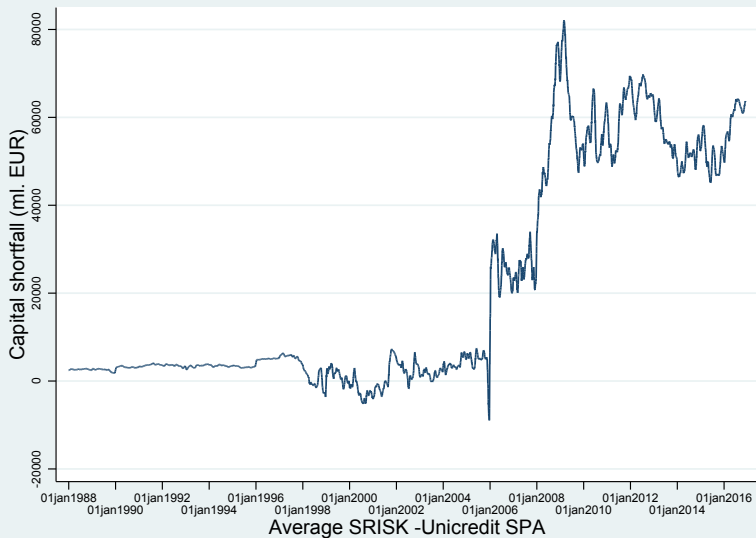
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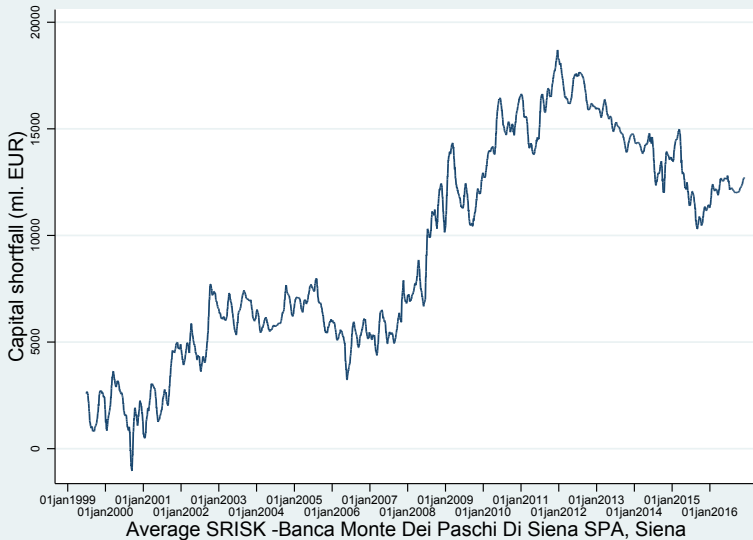
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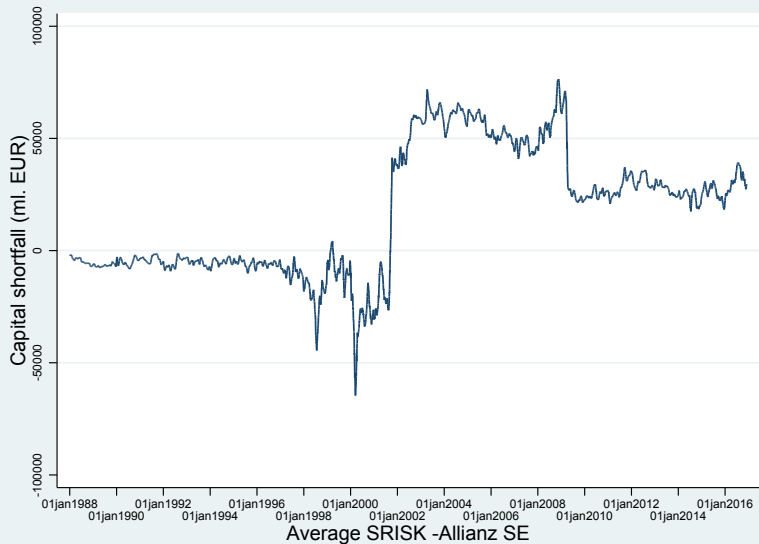
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SRISK Banca Monte Dei Paschi de Siena



SRISK Allianz



SRISK Generali Insurance Group

