Capital Buffers and the lack thereof: Did they influence Bank-Sovereign risk Spillovers?

A complicated investigation of a supposedly simple idea

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Content

Sovereign Risk during the Eurocrisis

> *"The purpose of the required assistance is to contain the risks to the Cypriot economy, notably those arising from the negative spillover effects through its financial sector, due to its large exposure in the Greek economy*[...]*"* — Wilson (2012)

What was going on?

- Until 2011: Cypriot banks had invested into high-risk Greek bonds to benefit from high yields
- 2011: Greek private sector involvement (PSI): Creditors had to write off 21 % of their debt holdings
- 2012: Cypriot banks had to be recapitalized by the government

General Research Question

Did banks across Europe experience risk spillovers due to their sovereign exposures?

From Cyprus to Greece I: How sovereign risks affect banks

Basel's Committee on the Global Financial System (2011)
If a bank holds sovereign debt which loses its value...

- ... it will get less liquidity when using it as collateral in repo transactions.
- ... its balance sheet will shrink, either automatically (marked to market), or if it sells it before maturity

Both, bank and government debt will lose in value if...

- ... the bank is systemic and it defaults
- ... it is the domestic sovereign and it experiences a rating downgrade

$\rightarrow$ We exclude these last two channels.

From Cyprus to Greece II: How sovereign risks spreads

This presumes financial integration in the sense of Bolton & Jeanne (2011): Banks can use bonds of foreign states as collateral. This has ambivalent consequences:

- Lager pool of debt and collateral $\rightarrow$ more economic activity
- States can extract safe heaven rents due to monopoly on safe debt
- Defaulting states can drag down banks in healthy countries
- Fragile states can extract concessions (Farhi & Tirole 2017)

Why would banks hold risky sovereign bonds?

- 'The Greatest Cary Trade ever': Banks buy risky sovereign bonds and sell safe bonds (or find short term funding) $\rightarrow$ profit from decreasing spreads Acharya & Steffen (2015)
- Banks still have 'profit targets' on their bond holdings Minenna (2017)
- Regulatory situation which allows limitless, uncushioned exposure to sovereign debt

Prior Studies

- Acharya et al. (2014*a*): After the bailouts of the financial crisis, correlations between banks and their domestic sovereign CDS increased
- Beltratti & Stulz (2015): Bank stocks of banks which held more European sovereign bonds relative to assets were more negatively correlated to European sovereign CDS than stocks from banks which held less European sovereign bonds relative to assets
- Altavilla et al. (2016): Higher European sovereign bond holdings relative to assets amplify bank-sovereign CDS corelations. No longer significant once domestic sovereign CDS was controlled for
- Kirschenmann et al. (2016): European Sovereign CDS index was positively related to European bank CDS and amplified by ratio of risk-weighted European sovereign bond holdings to assets. Effect decreased with introduction of sovereign buffer

Regulatory Situation I

European sovereign bond holdings are (almost) not regulated

- No large exposure limits
- Do not influence capital ratios

Capital ratio: Sum of capital instruments 1 to K divided by the sum of a bank's exposures/investments 1 to R multiplied by their respective riskiness represented by a risk weight

$$CapitalRatio = \frac{\sum_{k=1}^{K} Capital\ \ Intstrument_k}{\sum_{r=1}^{R} risk\ \ weight_r * Exposure_r} \tag{1}$$

For European sovereign bonds, banks can apply a risk-weight of 0!

Regulatory Situation II - How not to care about sovereign risks

- Large banks apply internal ratings based (IRB) approach to calculate risk weights
- Some banks apply foundational internal ratings based (F-IRB)formulas
- Small banks read risk-weights out of a table (Standardized approach, (StA))
- For European sovereign bonds, all banks may apply the StA approach (due to CRR Art. 150 (1)d) in conjunction with Art 114)

Credit Requirements Regulation Art. 114 (4):
4. Exposures to Member States' central governments, and central banks denominated and funded in the domestic currency of that central government and central bank shall be assigned a risk weight of 0 %

Regulatory Situation III - Capital Ratios and the Sovereign Buffer

Different definitions of capital lead to different ratios

- Common Equity T1 ratio (CET1 ratio): retained earnings, provisions, paid up shareholder capital. (CRR: Banks need at least 4.5%)
- Core T1 ratio (CT1 ratio): retained earnings, provisions, paid up shareholder capital + government guarantees

The sovereign buffer European Banking Authority (2012):

- 71 banks should hold 9 % CT1 ratio by June 2012
- After accounting for an additional buffer against sovereign risks, build on "conservative valuation of European sovereign bonds"
- Ultimately withdrawn in December 2014

Specific Research questions and Design

1. Did banks, who held more risky sovereign bonds compared to their capital experience stronger spillovers?
2. Did the sovereign buffer change anything during the time it was applied?
(3. Was the mechanism different for core and periphery banks?)

- Get banks' sovereign holdings from EBA stress tests, transparency exercises, a capitalization exercise and the capital exercise and weight them by risk (as if they were non EU)
- Proxy risk correlations with 5 year CDS
- Explain bank CDS by a weighted, bank-specific sovereign CDS index, similar to Kirschenmann et al. (2016)

Risk-weighted Sovereign Exposure I

In total the EBA reports sovereign holdings data for 157 banks. We calculate the sovereign exposures for all banks i in country j at time t by applying the risk-weight of country c in t and multiplying it with the sovereign exposure of bank i in j at t:

$$Risk - weighted\ Sovereign\ Exposure_{i,j,t} = \sum_{c=1\ for\ c\neq j}^{C} RiskWeight_{c,t} * Sovereign\ Exposure_{i,j,t} \quad (2)$$

Divide risk-weighted sovereign exposure by CET1 capital to get *Sovereign Ratio*

Caveat: We assume constant maturity.

Risk-weighted Sovereign Exposures II

Obtaining Risk-weights

- obtain Credit Ratings from Bloomberg (Fitch Ratings in our case)
- use table calculated by Kirschenmann et al. (2016)
- as robustness test: use table from CRR Article 114

Fitch Rating	F-IRB Risk Weights	StA Risk Weights
From AAA	0.144	0
To AA-	0.144	0
From A+	0.505	0.2
To A-	0.505	0.2
From BBB+	0.776	0.5
To BBB-	0.776	0.5
From BB+	1.244	1
To B-	1.91	1
Equal or worse than CCC+	2.451	1.5

CDS and Yield Data Selection

- Retrieve CDS data for banks and sovereigns from Bloomberg and Reuters Datastream
- Filter insufficient data
  a. Illiquid bank CDS: Throw out bank-period combinations for which banks have more than 5 NAs since unbalanced panel is not a problem
  $\rightarrow$ left with 33 out of 77 banks
  b. Illiquid sovereign CDS: Throw out sovereigns with more than 5% NAs in all periods $\rightarrow$ stricter requirement since we calculate a sovereign CDS index which is NA if one out of all sovereigns is NA
  $\rightarrow$ left with 15 states (dictates Yield sample, using iBoxx Yield indices)

$$SovereignIndex_{i,j,t} = \sum_{c=1 \ for \ c \neq j}^{C} CDS_{c,t} * ExposureShare_{i,c,t} \quad (3)$$

Control Variables

- Follow literature on Bank CDS determinants (Annaert et al. (2010), Samaniego-Medina et al. (2016), Drago et al. (2017))
- Primary concern: Endogeneity due to omitted variable bias Acharya et al. (2014*b*): Bank and Sovereign CDS influenced by variables indicating economic outlook
  a. During the Eurocrisis the prospects of one country could have influenced the prospects of all banks and countries
  b. If sovereign CDS correlate with each other a Spanish bank exposed to Portugese sovereign bonds might correlate with these bonds if Spain is in trouble
  c. Daily Macro Control variables: Europe STOXX600, VSTOXX, Markit iTraxx Sub Financials, CDS of domestic soveregin
- Bank specific: CET1 ratio (periodically) to control for time dependent idiosyncratic bank risk
- Allow varying betas of banks to account for different exposures to control variables

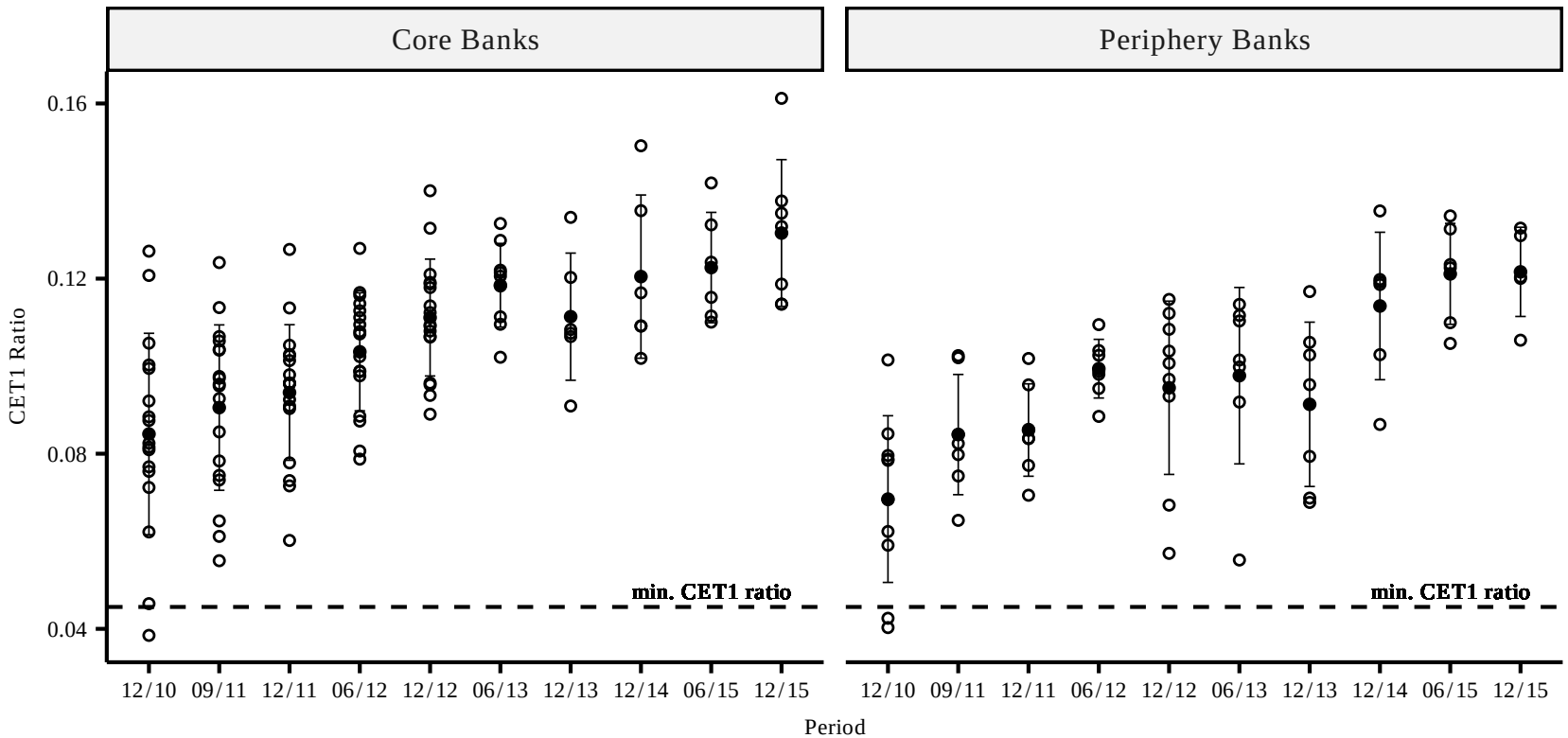
We obtain all variables except CET1 ratios from Bloomberg and Datastream.

Summary Statistics

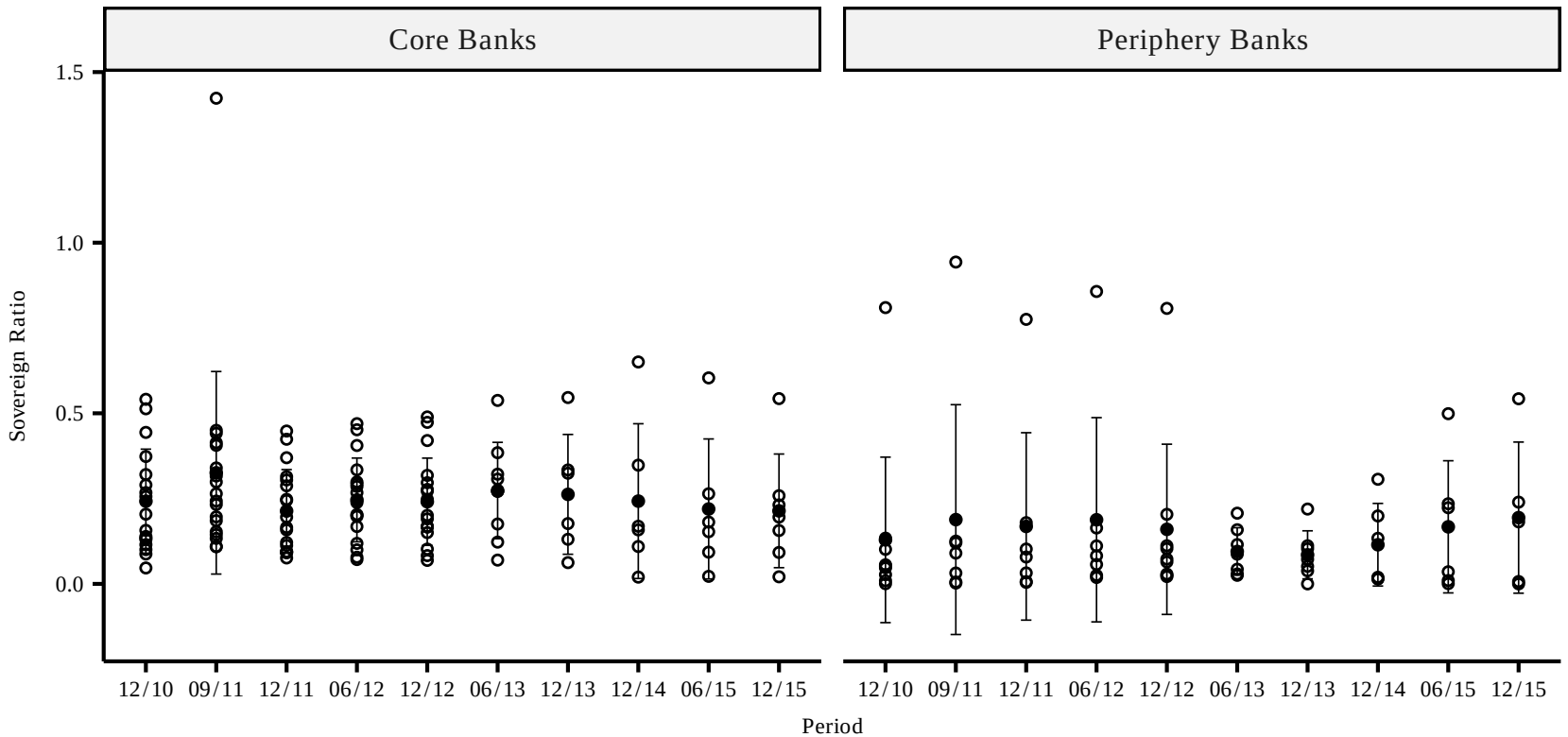
Periodical Variables	N	Mean	St. Dev.	Min	Median	Max
Total Risk-Exposure	196	288,780.900	218,846.100	42,376.110	268,644.600	1,066,401.000
Common Equity T1 Capital	196	30,490.020	24,582.260	2,717.014	28,551.750	123,406.500
Gross Sovereign Exposure	196	22,026.330	20,265.400	3.499	18,283.210	108,492.400
Gross non-domestic Sovereign Exposure	196	12,542.350	14,810.480	0.001	8,431.670	91,080.450
IRB risk-weighted Sovereign Exposure	196	15,966.850	14,832.790	1,522.208	11,947.840	74,978.120
IRB risk-weighted non-domestic Sovereign Exposure	196	6,038.162	5,314.508	0.656	4,858.337	26,394.270
StA risk-weighted Sovereign Exposure	196	2,575.140	3,079.709	0.000	1,343.950	16,768.020
StA risk-weighted non-domestic Sovereign Exposure	196	981.993	1,080.594	0.000	766.502	6,634.387
CET1 Ratio	196	0.102	0.021	0.039	0.103	0.161
Gross Sovereign Ratio	196	0.397	0.613	0.00000	0.251	3.661
IRB Sovereign Ratio	196	0.207	0.193	0.0001	0.159	1.423
StA Sovereign Ratio	196	0.038	0.053	0.000	0.023	0.534

Daily Variables	N	Mean	St. Dev.	Min	Median	Max
Bank CDS	7,433	243.881	167.559	39.119	199.186	997.012
Sovereign CDS	7,433	158.012	153.329	12.433	101.217	1,184.951
Sovereign Yields	7,433	2.000	1.803	−0.300	1.270	13.780
Bank specific Sovereign CDS Index	7,433	227.095	145.384	17.080	188.613	1,175.702
Bank specific Sovereign Yield Index	7,433	2.821	1.711	−0.242	2.600	13.661
Stoxx Europe 600	7,433	284.166	46.508	214.886	280.454	405.680
EuroSTOXX50 Volatility	7,433	49,520.870	33,606.780	9,949.960	47,057.390	126,093.000
iTraxx Financials 5 Year CDS Index (Subordinated)	7,433	324.773	140.313	122.260	285.330	580.500

Rising CET1 Ratios



No Change in Sovereign Ratios



Model Specification

- Panel data approach allows using fixed effects model $\rightarrow$ we can control for time invariant bank specifics (e.g. risk savviness)
- Due to non-stationarity of CDS time series $\rightarrow$ use approximate growth (logged first differences) to avoid spurious correlations

Model Specification

$$\begin{aligned}\Delta \log CDS_{i,j,t} = \alpha_i + \delta_t + \beta_1 \Delta \log SovereignIndex_{i,t} + \beta_2 SovereignRatio_{i,t} \\ + \beta_3 \Delta \log SovereignIndex_{i,t} * SovereignRatio_{i,t} + \beta_4 CET1ratio_{i,t} + \\ \beta_5 \Delta \log DomesticCDS_{j,t} + \beta_6 \Delta \log Vola_t + \beta_7 \Delta \log EuropeStoxx600_t + \\ \beta_8 \Delta \log iTraxxFin_t\end{aligned} \tag{4}$$

With bank individual betas:

$$\begin{aligned}\Delta \log CDS_{i,j,t} = \alpha_i + \delta_t + \beta_1 \Delta \log SovereignIndex_{i,t} + \beta_2 SovereignRatio_{i,t} \\ + \beta_3 \Delta \log SovereignIndex_{i,t} * SovereignRatio_{i,t} \\ + \beta_4 CET1ratio_{i,t} + \theta' * \mathbf{X}_{i,j,t} + \varepsilon_{i,j,t}\end{aligned} \tag{5}$$

bank-beta matrix: θ' (rows represent betas, columns represent banks)
bank-timeseries matrix: $\mathbf{X}_{j,t}$ (rows represent banks, columns represent time series)

A note on standard errors

- it is likely that standard errors are correlated within banks
- Since we find evidence for serial correlation and heteroskedasticity, we use Arellano (1987) clustered standard errors (SE) which correct for both
- Cameron & Miller (2015): Clustered SE may induce downward bias
- We only highlight coefficients "robust" to both kinds of errors and interpret our findings with care

Fundamental Regressions

	$\Delta \log CDS_{i,j,t}$		
	Basic Model	Basic Model with Market Controls	Complete Model
	(1)	(2)	(3)
$\Delta \log SovereignIndex_{i,t}$	**0.501**	**0.189**	**0.176**
	(0.054)	(0.031)	(0.027)
	[0.015]	[0.015]	[0.015]
$SovereignRatio_{i,t}$	0.005	−0.002	−0.002
	(0.006)	(0.002)	(0.002)
	[0.005]	[0.005]	[0.004]
$\Delta \log SovereignIndex_{i,t} * SovereignRatio_{i,t}$	0.163	0.009	0.121
	(0.181)	(0.164)	(0.114)
	[0.054]	[0.048]	[0.074]
$\Delta \log DomesticCDS_{j,t}$	**0.189**	**0.086**	
	(0.036)	(0.026)	
	[0.013]	[0.012]	
$CET1ratio_{i,t}$	**0.063**	−0.009	0.002
	(0.022)	(0.021)	(0.022)
	[0.022]	[0.031]	[0.030]
$\Delta \log Vola_t$		**0.081**	
		(0.021)	
		[0.015]	
$\Delta \log EuropeStoxx600_t$		−**0.389**	
		(0.078)	
		[0.048]	
$\Delta \log iTraxxFin_t$		**0.316**	
		(0.019)	
		[0.010]	
Bank&Time FE	B	Y	Y
Individual Coefficients	N	N	Y
Observations	7,237	7,237	7,237
R^2	0.330	0.477	0.531
Adjusted R^2	0.327	0.474	0.520

The two Dimensions of the Sovereign-Buffer: Dummy Equation

$$\begin{aligned}\Delta \log CDS_{i,j,t} = \alpha_i + \delta_t + \beta_1 \Delta \log SovereignIndex_{i,t} + \beta_2 SovereignRatio_{i,t} + \\ \beta_3 \Delta \log SovereignIndex_{i,t} * SovereignRatio_{i,t} + \\ \textbf{Before} * (\beta_4 \Delta \log SovereignIndex_{i,t} + \beta_5 SovereignRatio_{i,t} + \\ \beta_6 \Delta \log SovereignIndex_{i,t} * SovereignRatio_{i,t}) + \\ \textbf{After} * (\beta_7 \Delta \log SovereignIndex_{i,t} + \beta_8 SovereignRatio_{i,t} + \\ \beta_9 \Delta \log SovereignIndex_{i,t} * SovereignRatio_{i,t}) + \\ \beta_{10} CET1ratio_{i,t} + \theta' * \mathbf{X}_{j,t} + \varepsilon_{i,j,t}\end{aligned} \tag{6}$$

The two Dimensions of the Sovereign-Buffer

	$\Delta\log CDS_{i,j,t}$		
	Full Sample	Periphery	Core
	(1)	(2)	(3)
Δ log *SovereignIndex*$_{i,t}$	**0.137**	0.031	**0.192**
	(0.029)	(0.056)	(0.028)
	[0.019]	[0.038]	[0.026]
SovereignRatio$_{i,t}$	−0.001	−0.004	0.001
	(0.003)	(0.016)	(0.002)
	[0.005]	[0.018]	[0.007]
Δ log *SovereignIndex*$_{i,t}$ ∗ *SovereignRatio*$_{i,t}$	0.031	−0.018	−0.197
	(0.156)	(0.288)	(0.125)
	[0.116]	[0.213]	[0.167]
Before ∗ Δ log *SovereignIndex*$_{i,t}$	**0.112**	0.028	**0.158**
	(0.036)	(0.054)	(0.039)
	[0.023]	[0.039]	[0.031]
After ∗ Δ log *SovereignIndex*$_{i,t}$	0.013	−0.042	0.053
	(0.027)	(0.042)	(0.040)
	[0.027]	[0.042]	[0.038]

	$\Delta\log CDS_{i,j,t}$		
	Full Sample	Periphery	Core
	(1)	(2)	(3)
Before ∗ *SovereignRatio*$_{i,t}$	0.003	0.006	−0.004
	(0.002)	(0.003)	(0.004)
	[0.004]	[0.005]	[0.007]
After ∗ *SovereignRatio*$_{i,t}$	−0.007	−0.014	0.000
	(0.005)	(0.011)	(0.003)
	[0.006]	[0.014]	[0.009]
Before ∗ Δ log *SovereignIndex*$_{i,t}$ ∗ *SovereignRatio*$_{i,t}$	0.344	0.190	0.313
	(0.220)	(0.224)	(0.263)
	[0.133]	[0.192]	[0.202]
After ∗ Δ log *SovereignIndex*$_{i,t}$ ∗ *SovereignRatio*$_{i,t}$	−0.088	−0.041	−0.066
	(0.127)	(0.263)	(0.135)
	[0.160]	[0.253]	[0.228]
Bank&Time FE	Y	Y	Y
Individual Coefficients	Y	Y	Y
Observations	7,237	2,541	4,696
R^2	0.533	0.596	0.511
Adjusted R^2	0.522	0.585	0.499

First results:

- Market control variables work as expected
- CET1 Ratios are not significant
- Risk Spillovers seem to exist, but are not moderated by sovereign ratio
- Spillovers were lower for Periphery Countries
- The coefficient for the sovereign index was higher before the sovereign buffer was introduced
- The coefficient was not significantly higher once the sovereign buffer was no longer applied

Yield robustness test:

- Calculate the sovereign index, and replace bank CDS with yields.
- Difficulty of negative yields
- Instead of logged first differences, we rely on simple growth rates (instead of adding a constant)

Standardized Approach

- Calculate sovereign ratio and sovereign risk index with risk-weighted sovereign exposures using the StA
- One bank for which all non-domestic sovereign exposure would be zero is dropped (leaving us with 28 banks)

Yield Robustness Test

	$\Delta\log CDS_{i,j,t}$ Full Sample	Periphery	Core
	(1)	(2)	(3)
Growth SovereignIndexYield$_{i,t}$	**0.082**	−0.042	**0.102**
	(0.017)	(0.035)	(0.017)
	[0.018]	[0.038]	[0.022]
SovereignRatio$_{i,t}$	−0.003	−0.002	−0.000
	(0.003)	(0.016)	(0.002)
	[0.005]	[0.018]	[0.007]
Growth SovereignIndexYield$_{i,t}$ ∗ *SovereignRatio*$_{i,t}$	0.178	−0.282	0.227
	(0.097)	(0.229)	(0.120)
	[0.114]	[0.219]	[0.142]
Before ∗ *Growth SovereignIndexYield*$_{i,t}$	**0.154**	**0.213**	**0.166**
	(0.034)	(0.036)	(0.046)
	[0.032]	[0.058]	[0.041]
After ∗ *Growth SovereignIndexYield*$_{i,t}$	**−0.099**	**−0.117**	**−0.100**
	(0.017)	(0.050)	(0.021)
	[0.019]	[0.040]	[0.024]

	$\Delta\log CDS_{i,j,t}$ Full Sample	Periphery	Core
	(1)	(2)	(3)
Before ∗ *SovereignRatio*$_{i,t}$	0.002	0.007	−0.006
	(0.002)	(0.002)	(0.004)
	[0.004]	[0.005]	[0.007]
After ∗ *SovereignRatio*$_{i,t}$	−0.006	−0.016	0.001
	(0.005)	(0.010)	(0.003)
	[0.006]	[0.014]	[0.009]
Before ∗ *Growth SovereignIndexYield*$_{i,t}$ ∗ *SovereignRatio*$_{i,t}$	0.099	0.518	−0.052
	(0.196)	(0.127)	(0.342)
	[0.186]	[0.295]	[0.271]
After ∗ *Growth SovereignIndexYield*$_{i,t}$ ∗ *SovereignRatio*$_{i,t}$	**−0.264**	−0.483	−0.217
	(0.113)	(0.292)	(0.137)
	[0.121]	[0.233]	[0.155]
Bank&Time FE	Y	Y	Y
Individual Coefficients	Y	Y	Y
Observations	7,224	2,541	4,683
R^2	0.510	0.572	0.487
Adjusted R^2	0.498	0.560	0.474

Standardized Approach Robustness Test

	$\Delta\log CDS_{i,j,t}$		
	Full Sample	Periphery	Core
	(1)	(2)	(3)
$\Delta\log SovereignIndex_{i,t}$	**0.095**	−0.003	**0.120**
	(0.021)	(0.052)	(0.017)
	[0.017]	[0.043]	[0.021]
$SovereignRatioStA_{i,t}$	−0.017	−0.087	−0.009
	(0.009)	(0.080)	(0.009)
	[0.018]	[0.071]	[0.021]
$\Delta\log SovereignIndex_{i,t} * SovereignRatioStA_{i,t}$	−0.608	−1.689	−0.790
	(0.365)	(1.077)	(0.320)
	[0.442]	[1.493]	[0.502]
$Before * \Delta\log SovereignIndex_{i,t}$	**0.147**	0.076	**0.167**
	(0.036)	(0.071)	(0.041)
	[0.024]	[0.050]	[0.030]
$After * \Delta\log SovereignIndex_{i,t}$	0.031	−0.018	0.063
	(0.023)	(0.044)	(0.027)
	[0.026]	[0.055]	[0.034]

	$\Delta\log CDS_{i,j,t}$		
	Full Sample	Periphery	Core
	(1)	(2)	(3)
$Before * SovereignRatioStA_{i,t}$	0.007	0.070	−0.008
	(0.010)	(0.025)	(0.009)
	[0.017]	[0.044]	[0.019]
$After * SovereignRatioStA_{i,t}$	−0.034	−0.130	0.002
	(0.027)	(0.069)	(0.012)
	[0.034]	[0.088]	[0.040]
$Before * \Delta\log SovereignIndex_{i,t} * SovereignRatioStA_{i,t}$	0.398	0.433	0.476
	(0.495)	(1.764)	(0.496)
	[0.499]	[1.598]	[0.564]
$After * \Delta\log SovereignIndex_{i,t} * SovereignRatioStA_{i,t}$	0.211	0.306	0.033
	(0.516)	(1.208)	(0.427)
	[0.761]	[2.031]	[0.874]
Bank&Time FE	Y	Y	Y
Individual Coefficients	Y	Y	Y
Observations	6,998	2,302	4,696
R^2	0.531	0.602	0.506
Adjusted R^2	0.520	0.591	0.493

Robust results:

- Market control variables work as expected
- CET1 Ratios are not significant
- Risk Spillovers seem to exist, but are not moderated by sovereign ratio+
- Spillovers were lower for Periphery Countries
- The coefficient for the sovereign index was higher before the sovereign buffer was introduced
- No clear picture for the time once the sovereign buffer was dropped

General Findings

Our findings suggest...

- ...that bank CDS were related to non-domestic European sovereign risks, measured in yield and CDS
- ...that periphery banks were less influenced by non-domestic sovereign risks
- ...that risk relations were more pronounced before the sovereign buffer was introduced

Caveats and Questions

Caveats:

- Small sample size — possible downward bias of both errors
- No data to control for country specific non-sovereign exposures (but:difficult to isolate sovereign and country-specific economic risks)

Questions:

- Why would the buffer work, given the stagnant sovereign ratios?
- Increasing yields were negatively related with CDS → changing macroeconomic environment?

Final Question

Why did the sovereign ratio not moderate the spillover effect?

- Markets could mistakenly ignore bank capital
- Markets could rightly ignore bank capital (e.g. Altunbas et al. (2018))
- OR: Data problem: Not enough variation of sovereign ratios *within* banks $\rightarrow$ maybe try within-between approach?

Conclusion

It seems that bank risks had been influenced by non-domestic sovereign risks during the European debt crisis, but we do not see any effect of changing sovereign ratios. This is in line with several studies questioning the importance of regulatory capital ratios, but in our case we cannot rule out the possibility that our results are due to data limitations.

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