Falling Short of Expectations?
Stress-Testing the European Banking System

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Motivation

- In 2013, the GDP of all 17 eurozone countries fell by 0.5% and the outlook for 2014 shows considerable risks across the region.

- To stabilize the common currency area and its (partly insolvent) financial system, a eurozone banking union is being established.
  - Before the ECB takes over oversight of these banks, it plans to conduct an Asset Quality Review (AQR) in 2014 to identify the capital shortfalls of these banks

- Too little capital in the banking system appears to have also caused a misallocation of credit in the euro area preventing a widespread economic recovery.
  - Under-capitalized banks loaded up on risky assets which destabilized them even further and resulted in substantial liquidity and solvency problems (Acharya and Steffen, 2013).

- This study provides estimates of the capital shortfalls of peripheral *and* core banks that will be stress-tested under the AQR.

Table 1. Descriptive Statistics

Country	C Tier 1 (%)	Equity/Assets (%)	IFRS Tier1 LVG (%)	Tangible Equity/Tangible Assets (%)	RWA/Assets (%)	Net Impaired Loans/ C Tier 1 Capital	Assets (€ m)	Number of Banks
France	11.60	4.00	3.06	3.29	24.56	0.26	7,136,917	7
Germany	14.11	4.78	4.20	4.30	30.99	0.46	5,211,695	24
Spain	9.07	5.20	4.11	3.93	45.88	0.96	3,242,570	15
Italy	9.32	6.61	5.09	5.34	55.68	1.27	2,409,718	14
Netherlands	28.88	3.19	3.07	4.76	28.96	0.85	2,007,259	6
Belgium	16.30	3.28	2.76	4.29	22.85	0.29	788,188	5
Austria	11.04	7.46	5.26	6.26	54.91	0.34	482,921	6
Finland	14.90	6.10	5.62	6.00	37.26	0.13	435,429	3
Greece	9.05	8.81	6.60	2.96	61.68	2.22	347,075	4
Ireland	14.23	10.33	9.80	8.33	60.35	1.29	333,898	4
Portugal	12.34	6.05	3.45	7.62	61.33	0.68	326,572	4
Luxembourg	13.69	7.27	6.80	3.85	26.77	0.08	71,803	3
Cyprus	3.08	3.88	2.69	1.84	65.12	-2.11	37,671	2
Slovakia	16.32	10.80	9.89	8.70	55.59	0.16	31,968	3
Slovenia	7.52	6.51	5.41	5.87	77.33	2.84	19,042	2
Malta	9.90	7.44	6.65	4.83	49.46	0.55	12,965	2
Estonia	33.11	19.00	18.97	16.80	50.49	0.09	12,914	2
Latvia	16.97	12.15	12.00	14.77	63.09	0.18	11,796	3
Total	**13.97**	**7.38**	**6.41**	**6.32**	**48.46**	**0.59**	**22,920,400**	**109**

- Total asset size of AQR banks is about € 22.9 trillion and there is substantial cross-sectional variation in RWA/Assets

Unstressed Capital Shortfall Measures

- We employ four book capital ratios

  1. **Core Tier 1 ratio (C Tier 1):** Core Tier 1 capital divided by risk weighted assets (RWA)
  2. **Equity/Assets:** Book equity divided by total book assets.
  3. **Tangible Equity/Tangible Assets**: Book equity less intangible assets divided by total assets less intangibles assets.
  4. **IFRS Tier 1 LVG ratio**: Core Tier 1 capital divided by tangible assets minus derivative liabilities.

- Unstressed capital shortfall measures
  - **C Tier 1** is 8% as in the AQR (4.5% core Tier 1 ratio, a 2.5% capital conservation buffer, and a 1% G-SIFI surcharge)
  - **Equity/Assets, Tangible Equity/Tangible Assets and IFRS Tier 1 LVG ratio**: Shortfalls are calculated relative to a 3% threshold.

Table 2. Capital Shortfall – *Unstressed* Book Capital Measures

Country	Assets	C Tier 1	Equity/Assets	Tangible Equity/Tangible Assets	IFRS Tier 1 LVG
		8% AQR	**3%**	**3%**	**3%**
France	7,136,917	0	9,470	32,491	15,476
Germany	5,211,695	413	1,646	21,177	2,171
Spain	3,242,570	3,167	662	1,819	3,710
Italy	2,409,718	1,010	0	950	82
Netherlands	2,007,259	0	1,316	1,511	0
Belgium	788,188	0	5,239	5,964	190
Austria	482,921	0	0	55	0
Finland	435,429	0	153	256	0
Greece	347,075	769	0	0	9,616
Ireland	333,898	0	0	0	0
Portugal	326,572	0	0	1,330	0
Luxembourg	71,803	0	0	0	14
Cyprus	37,671	2,134	595	1,226	1,329
Slovakia	31,968	0	0	0	0
Slovenia	19,042	60	0	0	0
Malta	12,965	0	0	0	0
Estonia	12,914	0	0	0	0
Latvia	11,796	0	0	0	0
Total	**22,920,400**	**7,553**	**19,082**	**66,777**	**32,589**

- We identify a capital shortfall of between €7.6 billion and €66.8 bilion.

Table 3. Descriptive Statistics – Market Capitalization

Country	MES	Variance	Beta	Correlation	Market-to-Book	Market Equity/Assets	Assets (€ m)	Market Cap (€ m)	Banks
France	3.95%	0.86%	1.39	0.58	0.44	1.81%	4,900,325	89,346	3
Germany	3.77%	0.95%	1.32	0.55	0.44	1.79%	2,591,184	41,596	3
Spain	3.03%	1.66%	1.07	0.44	0.59	3.63%	2,520,831	105,521	6
Italy	3.43%	1.51%	1.20	0.42	0.36	2.66%	2,315,944	56,493	11
Belgium	2.73%	60.24%	0.95	0.23	0.38	2.38%	500,507	11,946	2
Greece	4.71%	22.84%	1.65	0.20	0.87	7.36%	347,075	24,385	4
Ireland	2.81%	4.01%	0.99	0.22	1.33	9.21%	292,986	37,426	3
Austria	3.22%	7.36%	1.13	0.28	0.54	3.42%	235,054	8,781	2
Portugal	2.49%	1.63%	0.88	0.37	0.42	2.19%	213,888	4,233	3
Cyprus	1.43%	1.32%	0.49	0.20	0.63	0.99%	37,671	437	2
Slovakia	0.74%	2.60%	0.25	0.05	0.65	8.16%	11,375	848	1
Malta	0.61%	0.28%	0.21	0.13	1.25	9.56%	7,217	681	1
Total	**2.74%**	**8.77%**	**0.96**	**0.31**	**0.66**	**4.43%**	**13,974,058**	**381,692**	**41**

- MES is the co-movement of the banks' stock return with the market index in a financial crisis over a one-day period.
- The average market-to-book ratio of 0.66 suggests that the market is heavily discounting banks' assets portfolios.

Stressed Capital Shortfall Measures

- To account for potential losses in future stress scenarios, we employ four stressed capital shortfall measures.

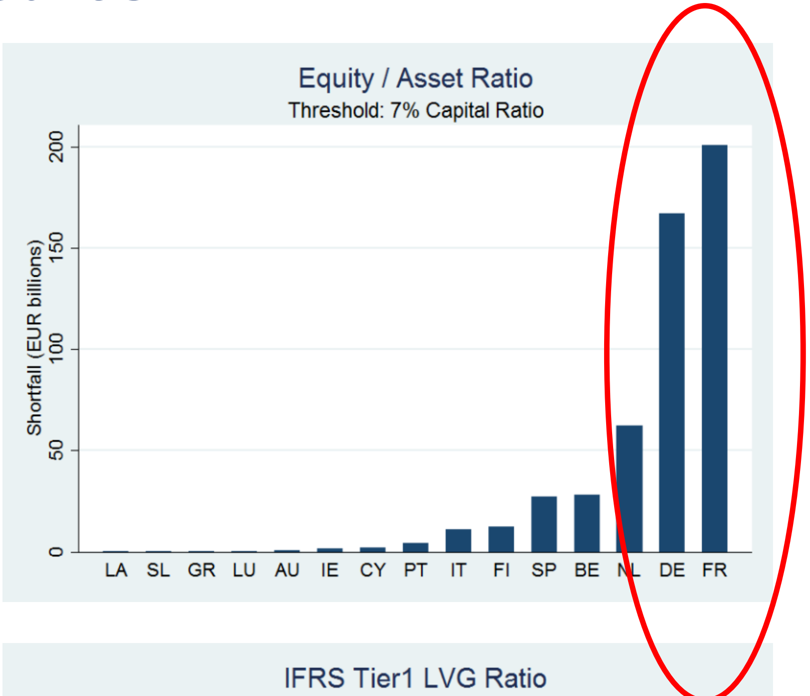
1. **Book Capital Shortfall**: Less stringent benchmark is a leverage ratio (book equity/assets) of 4% and the more stringent benchmark is a 7% leverage ratio.
2. **Market Capital Shortfall**: Less stringent benchmark is a leverage ratio (market equity/assets) of 4% and the more stringent benchmark is a 7% leverage ratio.
3. **SRISK or Capital Shortfall in a Systemic Crisis**: We assume a systemic financial crisis with a global stock market decline of 40% and a 5.5% prudential capital ratio.
4. **Capital Shortfall after Write-down:** We assume that banks have to write-down their entire non-performing loan portfolio net of reserves during a severe financial crisis and a leverage ratio (book equity/assets) of 4%.

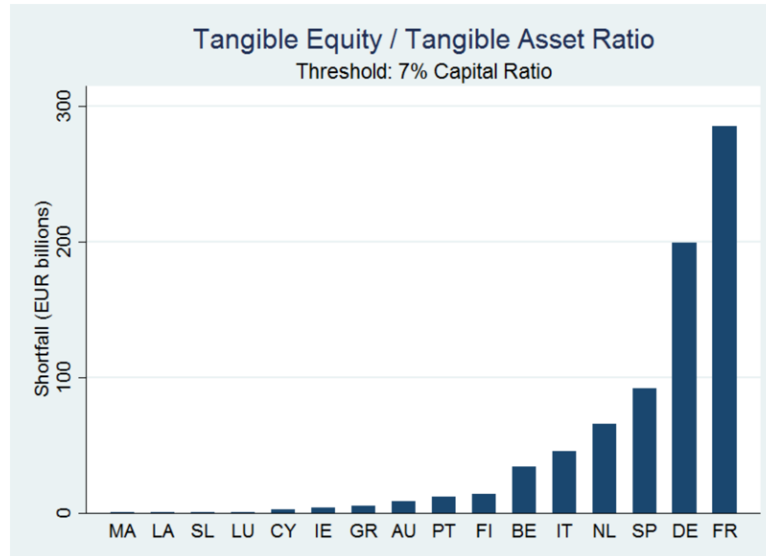
Table 4. Book Capital Shortfall

Country	Assets	Shortfall assuming a 4% threshold: Equity/Assets	Shortfall assuming a 4% threshold: Tangible Equity/Tangible Assets	Shortfall assuming a 4% threshold: IFRS Tier 1 LVG	Shortfall assuming a 7% threshold: Equity/Assets	Shortfall assuming a 7% threshold: Tangible Equity/Tangible Assets	Shortfall assuming a 7% threshold: IFRS Tier 1 LVG
France	7,136,917	31,382	78,309	41,675	201,056	285,365	212,662
Germany	5,211,695	28,035	54,223	19,392	167,145	199,374	120,264
Spain	3,242,570	2,681	12,473	5,285	27,385	91,853	53,782
Italy	2,409,718	2,388	3,730	800	10,857	45,344	32,775
Netherlands	2,007,259	6,118	6,925	738	62,477	65,702	38,915
Belgium	788,188	10,233	11,036	658	28,026	33,876	13,705
Austria	482,921	0	382	0	544	8,308	3,143
Finland	435,429	3,219	3,321	984	12,417	13,709	9,144
Greece	347,075	0	654	10,666	131	5,184	17,109
Ireland	333,898	0	0	0	1,671	3,953	2,181
Portugal	326,572	0	3,029	0	4,073	11,445	34
Luxembourg	71,803	0	0	212	296	359	2,023
Cyprus	37,671	906	1,536	1,636	1,858	2,506	2,690
Slovakia	31,968	0	0	0	0	0	0
Slovenia	19,042	0	0	0	79	194	149
Malta	12,965	0	0	0	0	63	266
Estonia	12,914	0	0	0	0	0	0
Latvia	11,796	0	0	0	59	67	0
Total	**22,920,400**	**84,962**	**175,616**	**82,046**	**518,074**	**767,303**	**508,841**

- The book capital shortfall estimates indicate a capital shortfall for all banks of between €82 billion and €176 billion (4% benchmark capital ratio) or between €509 billion and €767 billion (7% capital ratio).

Figure 1. Capital Shortfall Using Stressed Book Capital Measures





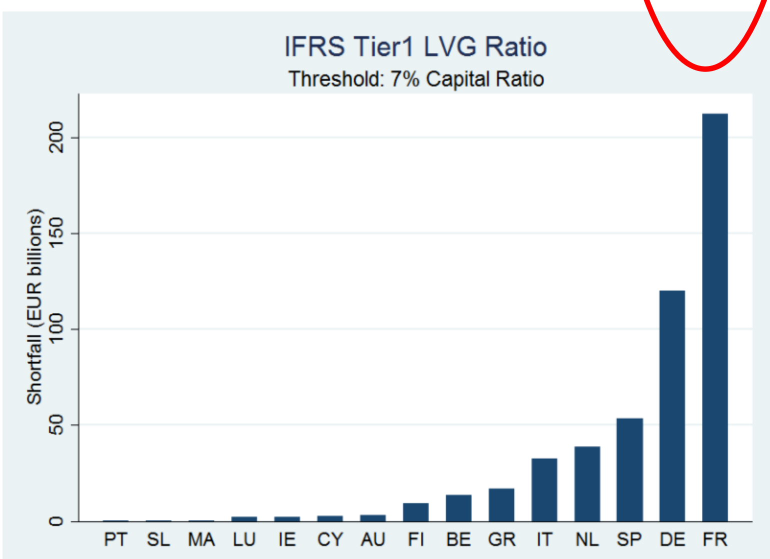


Table 5. Book Capital vs. Market Capital Based Measures

	Book Capital Ratio Stress Test			Market Capital Ratio Stress Test		
Country	Equity / Assets	Equity / Assets	Equity / Assets	Market Equity/ Assets	Market Equity/ Assets	Market Equity/ Assets
Benchmark	**3%**	**4%**	**7%**	**3%**	**4%**	**7%**
France	7,883	25,732	150,117	57,491	106,494	253,504
Germany	0	18,660	94,784	37,017	62,929	140,665
Spain	0	653	17,860	3,554	9,768	70,401
Italy	0	1,963	8,907	13,665	34,265	103,192
Belgium	3,856	6,328	15,498	7,393	9,865	22,959
Greece	0	0	131	0	0	2,118
Ireland	0	0	1,671	219	1,630	6,802
Austria	0	0	544	43	291	7,325
Portugal	0	0	3,291	2,112	4,237	10,654
Cyprus	595	906	1,858	730	1,107	2,237
Slovakia	0	0	0	0	0	0
Malta	0	0	0	0	0	0
Total	**12,335**	**54,242**	**294,661**	**122,224**	**230,587**	**619,856**

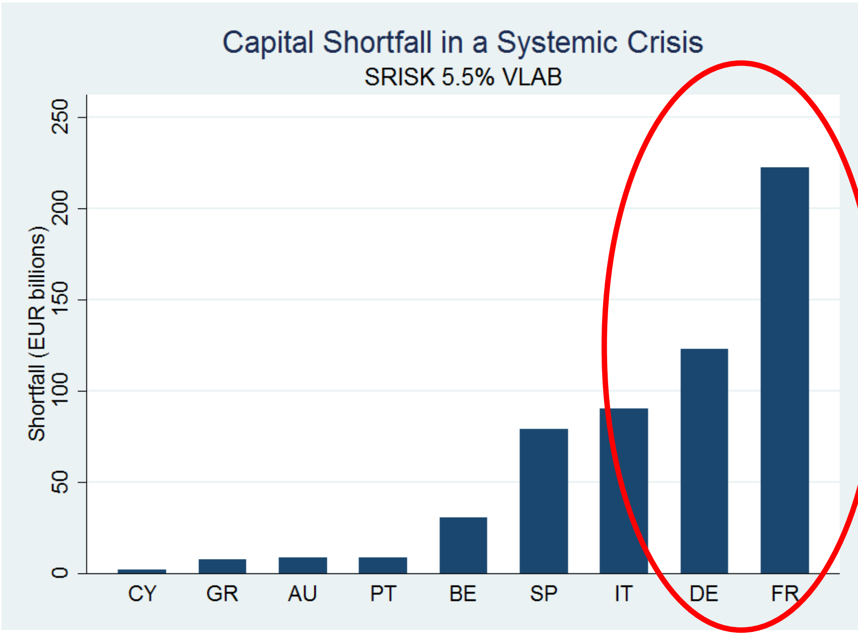
- The market capital shortfall estimates indicate a capital shortfall of €230 billion (4% benchmark capital ratio) or €620 billion (7% capital ratio) for the 41 publicly listed banks.

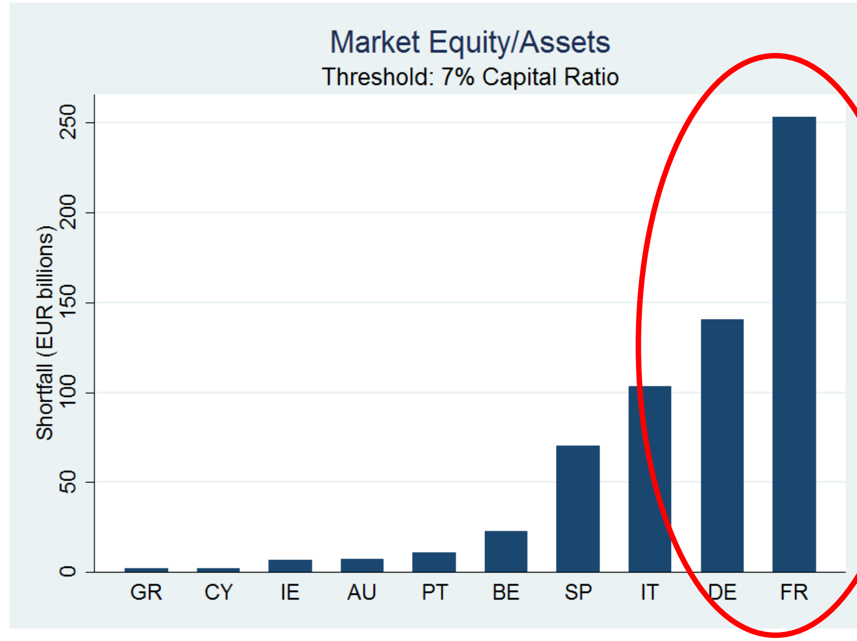
Table 6. SRISK or Capital Shortfall in a Systemic Crisis

CountryName	MarketCap	Market Equity/ Assets	LRMES	LRMES* Market Equity	SRISK Prudential Capital Ratio 5.50% VLAB
France	89,346	1.81%	50.92%	59,329	222,127
Germany	41,596	1.79%	48.90%	26,926	123,123
Italy	56,493	2.66%	45.31%	33,982	90,253
Spain	105,521	3.63%	41.72%	64,593	79,038
Belgium	11,946	2.38%	36.31%	8,406	30,520
Portugal	4,233	2.19%	34.72%	2,048	8,701
Austria	8,781	3.42%	38.40%	6,851	8,639
Greece	24,385	7.36%	56.88%	18,293	7,731
Cyprus	437	0.99%	22.72%	130	6,796
Slovakia	848	8.16%	12.52%	138	1,924
Malta	681	9.56%	10.34%	92	0
Ireland	37,426	9.21%	39.62%	18,328	0
Total	**381,692**	**4.43%**	**36.53%**	**239,116**	**578,854**

- Estimates of SRISK or the capital shortfall in a systemic financial crisis (40% market decline over a six-month period) is €579 billion; 41% is due to downside correlation with the market, while 59% is due to the leverage of these institutions.

Cross-country Analysis of Capital Shortfall Estimates Indicates Substantial Absolute Shortfalls in Core European banks





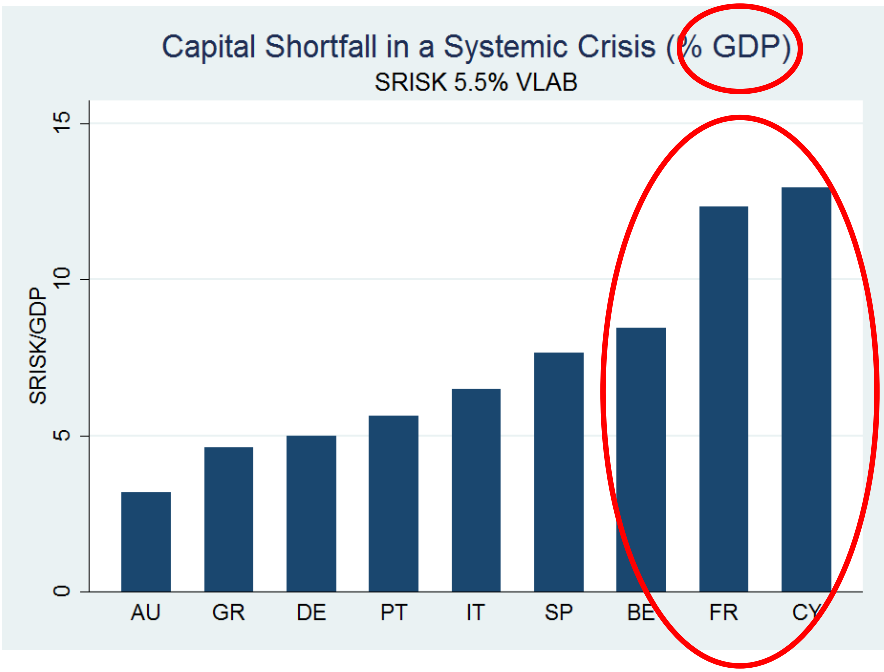
- French banks are leading each book and market capital shortfall measure. The SRISK stress scenario suggests a shortfall of €222 billion, which corresponds to almost 13% of the country's GDP.
- German banks are close seconds, although they benefit from a stronger domestic economy with a higher GDP and capacity for public backstops

Table 6. SRISK or Capital Shortfall in a Systemic Crisis as a % of the Countries GDP

CountryName	MarketCap	Market Equity/ Assets	LRMES	LRMES* Market Equity	SRISK Prudential Capital Ratio 5.5% VLAB
Cyprus	437	0.99%	22.72%	0.88%	12.95%
France	89,346	1.81%	50.92%	3.29%	12.33%
Belgium	11,946	2.38%	36.31%	2.32%	8.44%
Spain	105,521	3.63%	41.72%	6.26%	7.66%
Italy	56,493	2.66%	45.31%	2.44%	6.47%
Portugal	4,233	2.19%	34.72%	1.32%	5.63%
Germany	41,596	1.79%	48.90%	1.09%	4.99%
Greece	24,385	7.36%	56.88%	10.90%	4.61%
Ireland	37,426	9.21%	39.62%	11.54%	4.28%
Austria	8,781	3.42%	38.40%	2.53%	3.19%
Malta	681	9.56%	10.34%	1.66%	0.00%
Slovakia	848	8.16%	12.52%	1.66%	0.00%
Total	**381,692**	**4.43%**	**36.53%**	**3.82%**	**5.88%**

- Cypriot and French banks exhibit largest capital shortfalls relative to GDP.
- German banks‘ shortfall below 5% of Germany‘s GDP despite high absolute shortfall estimates.

Figure 4. Capital Shortfall Using SRISK (Scaled by GDP and Market Equity)



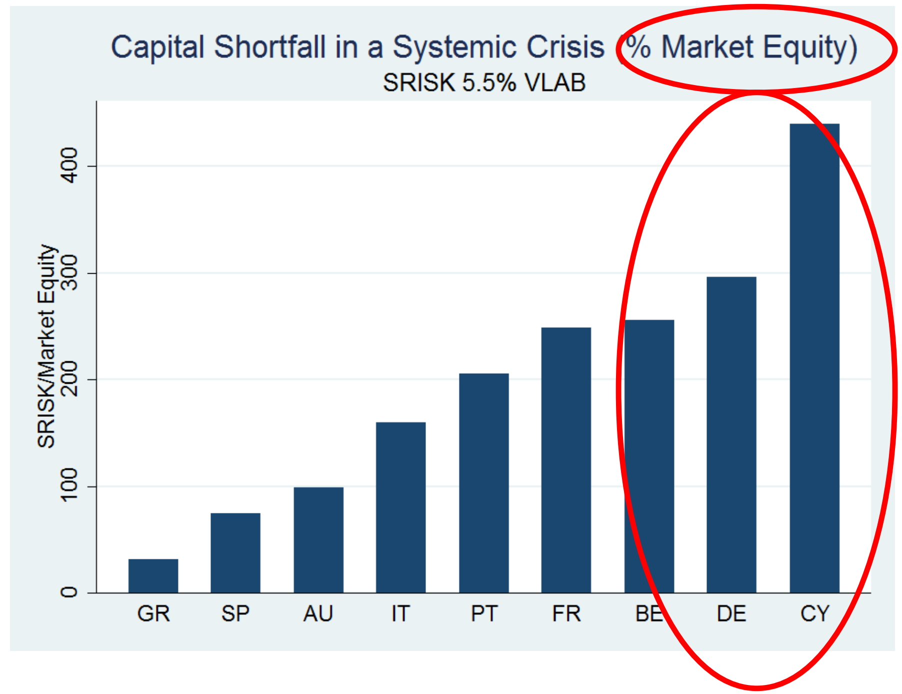


Table 7. Write-Down of Non-Performing Loan Portfolio

Country	C Tier 1	Equity / Assets	Tangible Equity / Tangible Assets	IFRS Tier 1 LVG	Assets
Threshold	**8% AQR**	**4%**	**4%**	**4%**	
France	8,872	50,232	118,945	86,934	7,136,917
Germany	12,326	54,674	77,372	45,660	5,211,695
Spain	45,391	29,897	57,294	30,517	3,242,570
Italy	105,886	66,195	104,576	104,081	2,409,718
Netherlands	2,489	10,415	10,713	7,644	2,007,259
Belgium	0	13,118	17,197	4,414	788,188
Austria	2,921	0	3,139	842	482,921
Finland	0	4,293	4,394	2,058	435,429
Greece	26,324	16,496	16,497	26,293	347,075
Ireland	14,518	14,178	14,392	15,124	333,898
Portugal	4,828	6,654	7,236	3,223	326,572
Luxembourg	0	0	0	284	71,803
Cyprus	4,799	3,404	336	4,126	37,671
Slovakia	0	0	0	0	31,968
Slovenia	3,738	3,165	3,194	3,316	19,042
Malta	114	0	24	123	12,965
Estonia	0	0	0	0	12,914
Latvia	0	0	0	0	11,796
	232,204	**272,720**	**435,310**	**334,641**	**22,920,400**

- Spanish and Italian banks appear to have large capital shortfalls when non-performing assets are fully written down. Both countries account for about a third of the total shortfall after write-downs

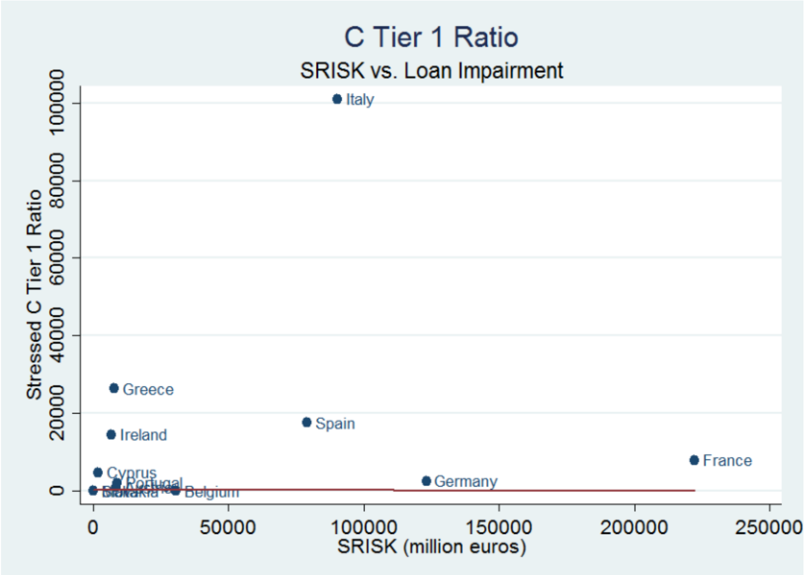
Table 8. Rank Correlation

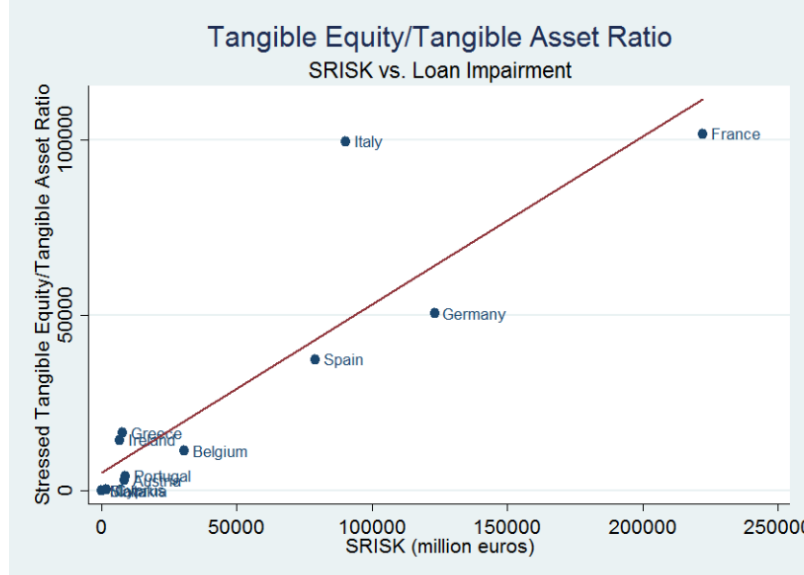
Panel A: Rank-Correlation: Shortfalls using book capital stressed measures of 7% and SRISK

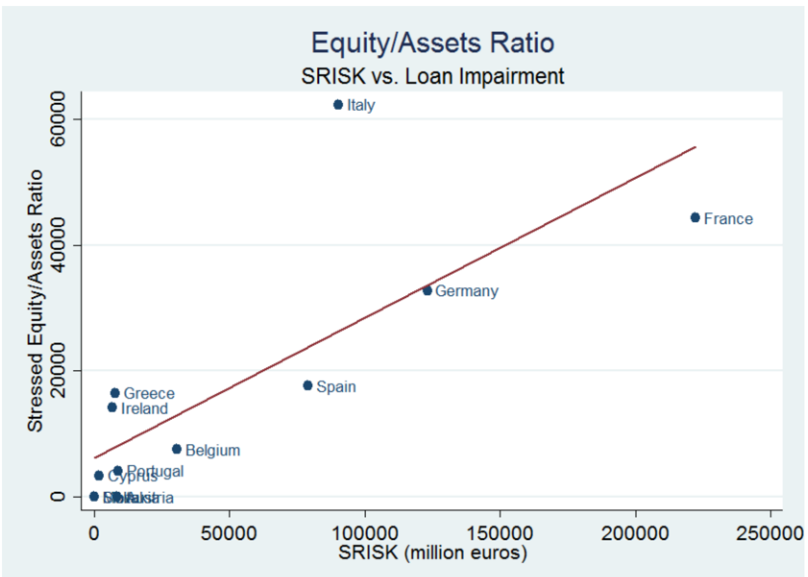
	SRISK	SRISK	SRISK	SRISK
C Tier 1	-0.147			
Equity / Assets		0.916***		
Tangible Equity / Tangible Assets			0.993***	
IFRS Tier 1 LVG				0.795***

- There is a high rank correlation between the shortfalls based on book and market capital ratio measures.
- We find *no* significant correlation between shortfalls calculated using regulatory (i.e., risk-weighted asset-based) capital ratios and shortfalls calculated under market or book capital ratios indicating flawed risk-weighted asset-based measures.

Figure 3. Correlation of Capital Shortfalls







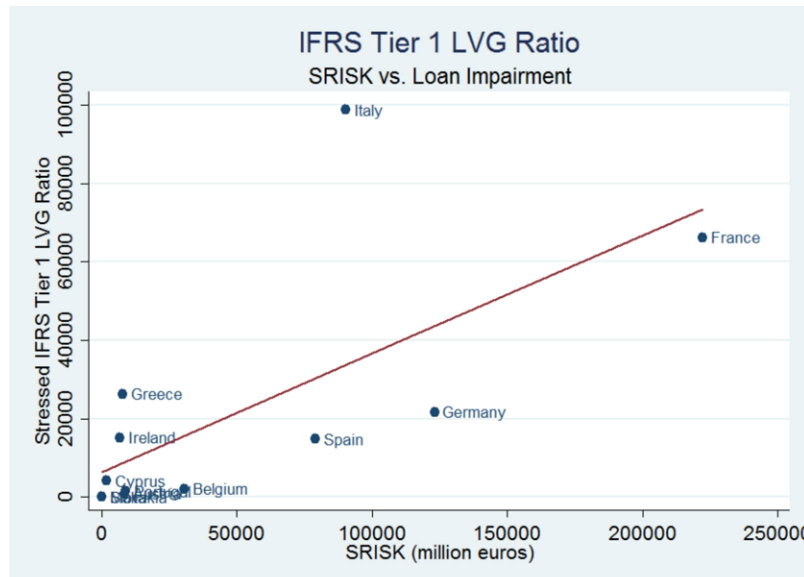


Table 9. Shortfall and “Bail-Ins” as % of Market Equity

Country	SRISK	Market Equity / Assets	Equity / Assets	Tangible Equity / Tangible Assets	IFRS Tier 1 LVG
	Shortfall assuming a 4% threshold (relative to Market Equity)				
Belgium	20844.0%	12520.9%	9209.9%	9692.0%	8.8%
Cyprus	301.6%	255.6%	769.2%	92.1%	928.3%
France	221.7%	173.4%	86.3%	163.8%	110.1%
Germany	206.8%	157.9%	83.1%	125.8%	56.1%
Portugal	150.0%	124.4%	220.5%	218.9%	75.0%
Italy	122.6%	82.3%	175.0%	244.2%	234.7%
Austria	60.4%	4.4%	0.0%	37.5%	10.4%
Spain	48.7%	16.5%	29.9%	51.8%	27.1%
Ireland	43.1%	18.1%	81.5%	82.3%	88.0%
Greece	14.7%	0.0%	98.3%	98.0%	157.6%
Malta	0.0%	0.0%	0.0%	0.0%	0.0%
Slovakia	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**1834.5%**	**1112.8%**	**896.1%**	**900.5%**	**141.3%**

- The capital shortfalls are large as a multiple of the banks’ market value of equity.
- In particular, assuming a 4% stressed capital ratio and impairment of the non-performing loan portfolio, they range from multiples of 1.4 (IFRS Tier 1 LVG ratio) to 18.3 (SRISK).

Table 9. Shortfall and "Bail-Ins" (cont'd)

	Shortfall assuming a 4% threshold (relative to Market Equity + Subordinated Debt)				
Country	**SRISK**	**Market Equity / Assets**	**Equity / Assets**	**Tangible Equity / Tangible Assets**	**IFRS Tier 1 LVG**
Belgium	1124.9%	669.4%	493.0%	527.4%	5.6%
Cyprus	185.0%	156.4%	517.5%	16.0%	636.0%
France	111.4%	82.1%	35.6%	77.2%	51.5%
Germany	110.2%	82.4%	42.9%	66.2%	28.0%
Portugal	63.4%	54.1%	65.6%	65.1%	22.3%
Italy	51.3%	31.3%	58.1%	91.0%	90.1%
Spain	39.8%	14.4%	25.6%	42.4%	23.9%
Austria	36.4%	2.3%	0.0%	22.9%	6.4%
Ireland	31.6%	13.3%	62.8%	63.4%	67.8%
Greece	14.5%	0.0%	94.6%	94.3%	151.6%
Malta	0.0%	0.0%	0.0%	0.0%	0.0%
Slovakia	0.0%	0.0%	0.0%	0.0%	0.0%
Total	**147.4%**	**92.1%**	**116.3%**	**88.8%**	**90.3%**

- If we add subordinated debt as the next group of creditors that is going to be bailed-in, the shortfalls still range as a multiple of the banks' market value of equity and subordinated debt from 0.9 (IFRS Tier 1 LVG ratio) to 1.5 (SRISK).

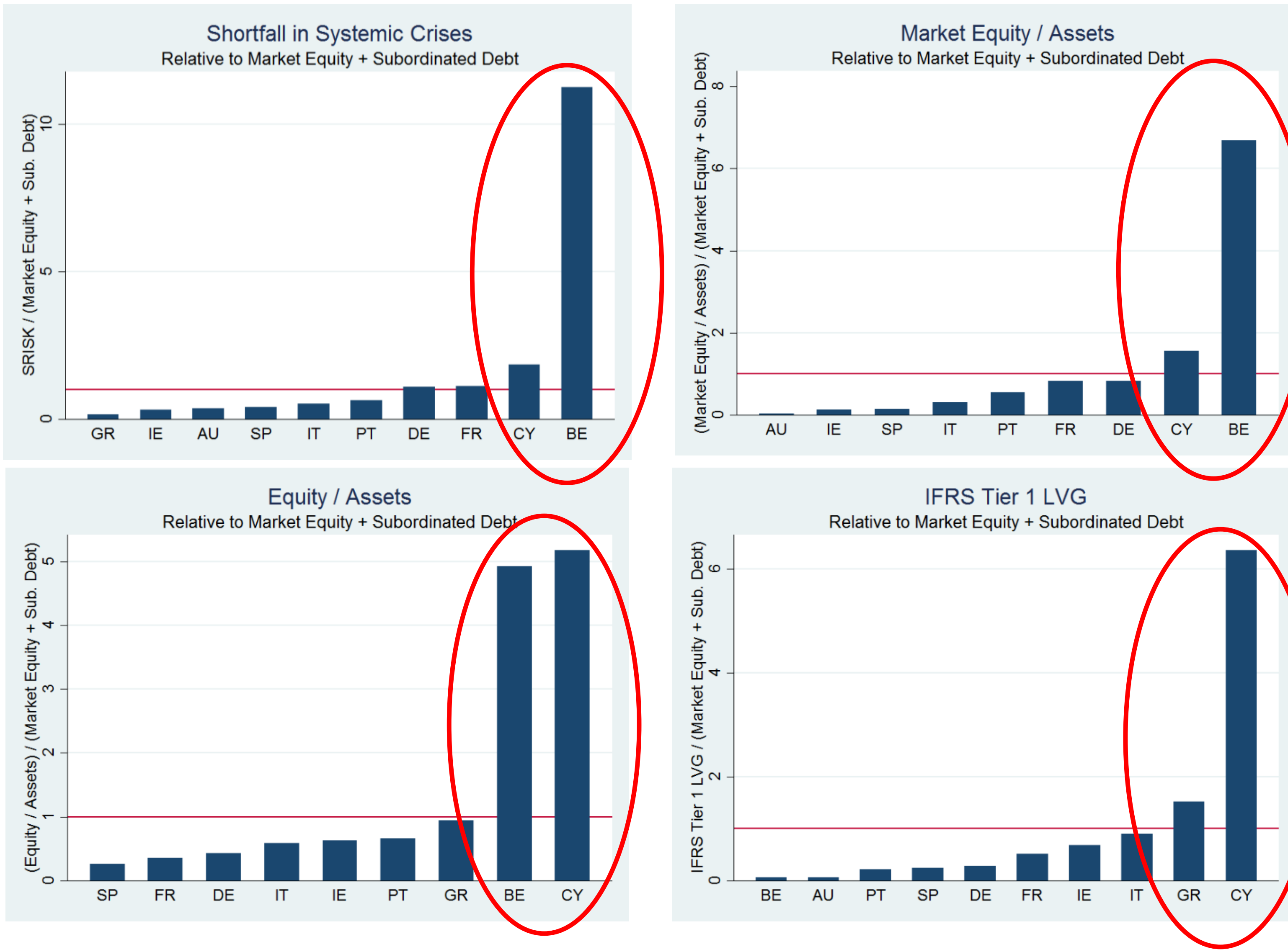
Shortfall and "Bail-Ins" – Cross Country Variation

- Banks in Belgium, Cyprus, and France are leading the group of banks with the largest capital shortfall estimates, with shortfalls as a multiple of the banks' market value of equity and subordinated debt up to 11 (Belgium, SRISK).

- France and Germany are among the five countries with the largest capital shortfall estimates for their banks. The shortfall estimates range as a multiple of the banks' market value of equity and subordinated debt from 0.3 (Germany, IFRS Tier 1 LVG ratio) to 1.1 (France, SRISK).

- Capital shortfalls for Italian and Spanish banks range as a multiple of the banks' market value of equity and subordinated debt from 0.1 for Spain (market equity/assets) to 0.91 for Italy (tangible equity/tangible assets).

Figure 5. Shortfalls Relative to Market Equity and Subordinated Debt



Sovereign Bond Holdings and Capital Shortfalls

- European Banking Authority (EBA) published results of a transparency exercise in December 2013 including 45 AQR banks.
  - 12 German banks, 5 Spanish banks, 4 Italian banks, 4 French banks, 4 Greek banks

- EBA reports 2 additional data points: (1) 31 Dec 2012, and (2) 30 June 2013

- The Basel II (and also Basel III) regulatory framework does not require European banks to hold equity against European sovereign debt exposure which facilitated European-wide carry trades by banks (Acharya and Steffen, 2013)
  - The treatment of sovereign debt exposure in the AQR still needs to be determined!

- Particularly Italian and Spanish banks purchased domestic sovereign debt 2011 and 2012 while core European banks were reducing exposure (“home bias“)

Sovereign Bond Holdings and Capital Shortfalls (cont'd)

	Holdings June 2013 (€ m)				
Country	**Greece**	**Italy**	**Portugal**	**Spain**	**Ireland**
AT	0	122	5	18	28
BE	0	571	35	247	372
CY	0	51	0	0	48
DE	43	32,960	2,769	14,482	1,247
ES	0	7,519	4,006	**186,614**	0
FI	0	0	0	0	0
FR	39	46,339	1,778	10,136	1,233
GR	23,117	113	0	7	0
IE	0	280	6	0	18,907
IT	18	**217,785**	404	1,900	82
LU	0	1,032	191	68	0
MT	0	2	3	0	7
NL	0	364	0	92	0
PT	47	1,264	26,150	1,897	568
SI	0	10	0	0	10
Total	**23,265**	**308,412**	**35,347**	**215,462**	**22,504**

- If European banks were required to hold capital for sovereign debt exposure reflecting the rating (and default risk) of the respective country, Italian (Spanish) banks would need additional capital of €13.5 billion (€11.6 billion) based on June 2013 exposures.

Sovereign Bond Holdings and Capital Shortfalls (cont‘d)

	Change in holdings Dec 2012 - June 2013 (million €)				
Country	**Greece**	**Italy**	**Portugal**	**Spain**	**Ireland**
AT	0	10	2	3	-11
BE	0	-44	0	-1	-12
CY	0	0	0	0	0
DE	-26	-1,921	-708	-1,893	-164
ES	0	2,716	682	28,680	0
FI	0	0	0	0	0
FR	-9	7,722	537	2,630	302
GR	-4,778	13	0	7	-15
IE	0	-3	-19	0	2,624
IT	12	20,069	201	-1,190	29
LU	0	39	1	-102	0
MT	0	-4	0	0	0
NL	0	3	0	7	0
PT	-6	192	1,902	1,143	-13
SI	0	0	0	0	0
Total	**-4,806**	**28,790**	**2,597**	**29,285**	**2,739**

- French banks are the only core European banks which are substantially increasing their sovereign exposures to GIPSI countries.

Implications

- As portfolio (micro-level) data of banks' individual exposures is not publicly available, our estimates of capital shortfalls employ publicly available book capital and market data and are motivated by empirical evidence and theory.

- Our results suggest that with common equity issuance and haircuts on subordinated creditors, it should be possible to deal with many banks' capital needs.

- Public backstops may be required especially if bail-ins are difficult to implement without imposing losses on bondholders, who may themselves be other banks and systemically important financial institutions.

- The banking sectors in Belgium, Cyprus, and Greece seem likely to require backstops.

Implications (cont‘d)

- Our results also suggest large shortfalls in core European countries such as France and Germany; Germany has many government-owned institutions that may require capital issuances and/or bail-ins.

- Interestingly, market measures of equity imply significantly greater capital shortfalls for France and Germany than book measures do.

- National governments might be inclined to influence the design of the AQR to prevent these banks from being singled out in the stress tests.

- Objective capital shortfall estimates such as ours can provide a valuable defense mechanism against any such political efforts to blunt the effectiveness of the proposed AQR and the intended recapitalization of the euro area banking system.

Implications (cont‘d)

- If the ECB deviates from the zero-risk weight policy applied currently in the Eurozone with respect to sovereign debt, particularly Italian and Spanish banks will face substantial capital shortfalls which will most likely require public backstops.

- Note that on December 18, 2013, the EU finance ministers agreed to set up a common resolution fund of €55 billion financed through contributions of banks.

- Our results suggest that these funds might be insufficient in a severe financial crisis and public back-stops (e.g. through the European Stability Mechanism (ESM)) might still be necessary.