Introducing the "Leverage Ratio" in Assessing the Capital Adequacy of European Banks

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Abstract

The European Banking Authority (EBA) disclosed the effect of losses in a stress test on bank capital ratios on 29 July 2016. We assess the capital adequacy of these banks based on these disclosures and using two supervisory approaches (the approach used by the EBA in the Asset Quality Review in 2014 and the methodology used by U.S. supervisors in the Comprehensive Capital Analysis and Review (CCAR) in 2016) and a market based approach. The two supervisory approaches yield an ordering of banks with respect to their capital shortfall (or surplus) that is negatively correlated. The CCAR 2016 approach, however, ranks banks similarly as the market based approach. The capital shortfall differences between the approaches can be attributed to (i) different prudential thresholds applied to capital ratios, (ii) different loss projections under the stress scenario, and (iii) the difference between market and book values of bank equity. The differences are particularly large for banks in France, Germany, Italy, Spain and the United Kingdom.

Motivation

The European Banking Authority (EBA) conducted another round of stress test in 2016 including a set of 51 large European banks covering about 70% of bank assets in Europe.[4] Similar to earlier stress tests, the EBA applied an adverse (i.e. stress) scenario and calculated the effect on the bank balance sheet, profits and losses, and eventually on bank capital. In contrast to earlier tests, however, it did not specify a benchmark capital ratio and threshold relative to which a bank can either pass or fail the stress test.

In this note, we use two supervisory approaches to calculate bank capital shortfalls based on the scenarios and losses disclosed by the EBA. More precisely, we use the same target capital ratio and prudential thresholds applied by the EBA in the Asset Quality Review (AQR) in 2014. Moreover, we use the four target capital ratios and respective prudential thresholds used in the U.S. stress tests. As in Acharya, Pierret, and Steffen (2016), we use a third methodology and calculate capital shortfalls for banks using market data as an objective

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[4] The EBA 2016 stress test and the methodology are described in EBA (2016).

benchmark, compare them to the supervisory stress test results, and explain the differences and what they mean for the supervisory process.

Stress Test Sample

The EBA has published a list of 53 European banks that were part of the 2016 stress test and comprise about 70% of the banking sector in Europe.[5] 34 of these banks are publicly listed. Balance sheet information and market data collected to produce this report are as of 31 December 2015, comparable to the information used in the 2016 EBA stress test.

EBA 2014 AQR methodology

Capital shortfalls using the EBA 2014 AQR methodology are calculated using the Common Equity Tier 1 ratio as target capital ratio. They are calculated in both a baseline and an adverse scenario. The prudential threshold in the baseline (resp. adverse) scenario is 8% (resp. 5.5%). The final capital shortfall is determined by summing the largest capital shortfall of each bank occurred in either scenario.[6]

Comprehensive Capital Analysis and Review (CCAR 2016) methodology

The assessment of bank resilience to the stress scenario in the CCAR is based on four different capital ratios and thresholds in the adverse scenario in each of the years of the scenario (2016, 2017 and 2018):

1. **Common Equity Tier 1 Capital ratio:** The first method uses a Common Equity Tier 1 Capital ratio (**CET 1**) and a 4.5% threshold as benchmark to calculate shortfalls. The ratio is defined as common equity tier 1 capital over risk-weighted assets (fully loaded). The (equally weighted) average CET 1 ratio in our sample as reported based on 31 December 2015 numbers is 15% (Appendix I).

2. **Tier 1 Capital ratio:** The second capital ratio is the Tier 1 Capital ratio (**Tier 1**) and a benchmark capital ratio of 6%. Tier 1 capital ratio is defined as tier 1 capital over risk-weighted assets (fully loaded). The (equally weighted) average Tier 1 ratio in our sample as reported based on 31 December 2015 numbers is 18.9% (Appendix I).

3. **Total Capital ratio:** The third capital ratio is the Total Capital ratio (**Total Capital**) and a benchmark of 8%. This ratio is defined as total capital over risk-weighted assets (fully loaded). The (equally weighted) average Total Capital ratio in our sample as reported based on 31 December 2015 numbers is 15.2% (Appendix I).

4. **Tier 1 Leverage ratio:** The fourth capital ratio is the Tier 1 Leverage ratio (**Leverage**) and a benchmark of 4%. This ratio is defined as tier 1 capital over total leverage ratio exposure (fully loaded). The (equally weighted) average Tier 1 Leverage ratio in our sample as reported based on 31 December 2015 numbers is 5.3% (Appendix I).

[5] Three banks are excluded from the sample in our analysis: DZ Bank and National Bank of Greece are not tested and we do not have financial data for Confédération Nationale du Crédit Mutuel.
[6] Calculations of shortfalls in the EBA 2014 AQR are explained in EBA (2014). Two banks in 2014 experienced higher capital shortfalls in the baseline than the adverse scenario.

a. The banks with the lowest Tier 1 Leverage ratios as of 31 December 2015 are N.V. Bank Nederlandse Gemeelen (2.3%), Deutsche Bank (3.5%), and Bayerische Landesbank (3.6%).

For each of these four capital ratios, we take the maximum capital shortfall over the three years (2016-2018) and derive the final capital shortfall measure taking the maximum of these shortfalls.

Capital Shortfall in a Systemic Crisis (SRISK)

We assume a systemic financial crisis with a global stock market decline of 40% over six months. SRISK is our measure for a bank's capital shortfall in this scenario, assuming a 5.5% prudential threshold to the capital ratio with losses estimated using the VLAB methodology to estimate the downside risk of bank stock returns.[7] While this scenario and the resulting SRISK measure uses market data and market equity (instead of book equity) in determining leverage, the approach is conceptually similar to that of the EU-wide stress tests, which is to estimate losses in a stress scenario and determine the capital shortfall between a prudential capital requirement and the remaining equity after losses.

Main Results using the EBA 2016 projected losses in the adverse scenario

1. Based on the EBA 2016 AQR capital requirements (8% of CET 1 in the baseline scenario and 5.5% CET 1 in the adverse scenario) the total capital shortfall of all 51 banks in the stress test is **€5.6 billion**. Only Banca Monte dei Paschi di Siena has a capital shortfall using this benchmark (Table 1).

2. Based on CCAR rules (based on 4 ratios including a 4% Min Tier 1 leverage ratio requirement over the stress scenario) the total capital shortfall of all 51 banks in the stress test is **€123 billion** (Table 1).

a. There are no shortfalls under either (i) the CET 1 capital ratio, (ii) the Tier 1 Capital ratio or (iii) the Total Capital ratio (Appendix II and Appendix III).

b. Capital shortfalls of all banks are derived using the Tier 1 Leverage ratio as a benchmark capital ratio (Appendix II and Appendix III).

c. The bank with the largest capital shortfall of €19 billion is Deutsche Bank, followed by Société Générale (€13 billion), and BNP Paribas (€10 billion, Figure 1 and Table 1).

d. Capital shortfalls of the 34 publicly listed banks in the stress test using the CCAR 2016 methodology are €92 billion or 75% of the total capital shortfalls of all banks (Panel A of Table 2).

[7] The data are provided by New York University's VLAB (http://vlab.stern.nyu.edu/welcome/risk/).

3. Comparing capital shortfalls under SRISK and CCAR 2016

    a. The total capital shortfall of the 34 publicly listed banks in the stress test using the CCAR 2016 methodology is €92 billion, and €640 billion using the SRISK methodology (Panel A of Table 2).

    b. The difference between the capital shortfalls using SRISK versus CCAR 2016 is €583 billion, and is particularly large for Crédit Agricole (€79 billion), BNP Paribas (€75 billion) and Deutsche Bank (€ 60 billion) as shown in Panel A of Table 2.

    c. CCAR 2016 capital shortfalls are particularly large among German banks (€24 billion), French banks (€23 billion) and Italian banks (€18 billion). Overall, the five countries that account for more than 90% of the shortfall difference between SRISK and CCAR 2016 are France, United Kingdom, Germany, Spain and Italy (Panel B of Table 2).

    d. Capital shortfalls under SRISK and EBA 2014 AQR are strongly negatively correlated; the rank correlation is -0.7. Both, capital shortfalls under the baseline and adverse scenario are negatively correlated (Table 3).

    e. Capital shortfalls under SRISK and CCAR 2016 are positively correlated; the rank correlation is 0.36. The positive rank correlation reflects the shortfalls when we apply the Tier 1 Leverage ratio as target capital ratio. Using all other three target capital ratios individually (CET 1, Tier 1, and Total Capital), which are all regulatory capital ratios and include risk-weighted assets as the denominator, the rank correlation is high and negative (Table 3 and Figure 2).

Understanding the differences between shortfalls under SRISK and CCAR 2016

The difference between the capital shortfalls based on SRISK and CCAR 2016 is €583 billion and is reported in Panel B of Table 2 on a country level. The five countries that account for €533 billion of that amount are France, United Kingdom, Germany, Spain and Italy. In this section, we describe the main drivers of this shortfall difference.

Our decomposition of the difference between SRISK and CCAR 2016 capital shortfalls includes four categories:[8]

1. **Threshold**: SRISK and CCAR 2016 use different prudential thresholds to capital ratios (i.e., thresholds under which the bank is considered undercapitalized) to derive the capital shortfalls. The CCAR capital shortfall is based on a 4% prudential capital ratio, while SRISK considers a 5.5% prudential capital ratio.

2. **Market-to-book**: banks differ substantially in their market-to-book ratios at the start of the stress test, which will eventually affect how much additional capital they need to raise under SRISK methodology.

[8] All categories affecting the difference between the two capital shortfalls, and the methodology to derive the contribution of these categories are described in Appendix IV in this report.

3. **Stress**: SRISK and CCAR 2016 differ both in the severity of their stress scenarios as well as how losses in these scenarios affect bank capital.

4. **Other**: The "Other" category includes additional factors explaining the difference in shortfalls such as the static balance sheet assumption in the EBA stress test or differences in the measurement of banks assets.

Our results about the main drivers of the capital shortfall difference are summarized below:

1. The difference in capital shortfalls using SRISK and CCAR methodologies is driven by a more severe prudential threshold to capital ratios (explaining 45% of the difference), larger stressed capital losses in SRISK (26%), and a low market-to book ratio (18%, Table 5).

2. We find large differences between countries on the relative importance of market-to-book and stress components

    a. The market-to-book ratio contributes to 29% and 33% of the capital shortfall difference in France and Germany respectively, reflecting the discount applied by market participants to the asset values of banks located in these countries.[9]

    b. We find a large impact of the stress component in Spain (43%), the UK (35%), and Italy (27%). The large effect of the stress components reflects the divergence in the severity of loss projections under the EBA stress test and VLAB. For example, two Spanish banks (CaixaBank SA, Banco Bilbao Vizcaya Argentaria SA) have projected positive profits under the EBA stress scenario, while their market capitalization is projected to drop in the VLAB stress scenario.

3. The two drivers (market-to-book and stress) explain the variations in capital shortfall differences across banks (Table 4).

    a. The correlation between the capital shortfall difference and the market-to-book ratio is -0.436, reflecting that banks with low market-to-book ratio have larger SRISK compared to their CCAR capital shortfall. This correlation is illustrated in Figure 3.

    b. The correlation between the capital shortfall difference and the difference in projected losses is 0.686. This correlation is illustrated in Figure 4.

        i. The correlation between the 3-year cumulative loss under the EBA stress scenario and the market capitalization loss in the VLAB stress scenario is 0.121. This low correlation reflects divergences in loss projections between VLAB and the EBA stress test, in particular due to banks with projected profits under the EBA stress scenario. The profits come from positive net income for all banks, and trading gains (at German, French, Italian, Swedish and UK banks). In contrast, impairments correlate well with the market capitalization loss (0.692).

[9] Note that for French banks, the low market-to-book ratio also reflects the capital structure of cooperative banks (i.e., Crédit Agricole in our sample). For a measure of SRISK accounting for the capital structure of cooperative banks, see http://www.crml.ch/fileadmin/raw_content/NoteCA04022014/NoteCooperativeBanks.pdf.

Implications

The EBA conducted a new round of stress tests in 2016. In contrast to earlier stress test and capitalization exercises, the 2016 assessment was not meant to identify capital weaknesses that have to be urgently dealt with but rather to provide information about banks' performance in an adverse scenario as input in the supervisory process (Pillar 2 requirements). We use two different supervisory methods to translate the losses in the stress test into a capital requirement, and add another, market based assessment as a benchmark to the regulatory approach. Overall, our results should be valuable in the supervisory process going forward, especially in recognizing the limits of risk-weighted assets and book value of equity as providing estimates of bank capital adequacy that are in line with market data.

The capital shortfall estimate of €123 billion using U.S. capital requirement rules in the 2016 CCAR stress test is larger than the capital shortfall estimate using the requirements of the previous EBA AQR stress test of 2014 (€5.6 billion). Only Banca Monte dei Paschi di Siena would require an additional €5.6 billion capital using the EBA 2014 AQR rules, while 29 banks would require additional capital using CCAR 2016 rules. Applying the Tier 1 Leverage capital ratio produces these shortfalls under CCAR 2016. The key difference between the Tier 1 Leverage ratio and the CET 1 capital ratio used in the EBA 2014 AQR is the denominator, which is based on total (book value) of assets in the Tier 1 Leverage ratio and risk-weighted assets in the CET 1 capital ratio. Rank correlation of banks with capital shortfall (or surplus) based on the Tier 1 Leverage ratio and the measure based on risk-weighted assets that we consider are highly negative. Supervisors should therefore consider these differences in the Pillar 2 requirements and adopt a robust ("belt and suspenders") approach that takes the greater of the two shortfalls to assess bank capital adequacy.

Focusing on the 34 publicly listed banks participating in the 2016 EBA stress test, the CCAR 2016 capital shortfall is €92 billion. For this set of banks, we estimate a third measure of capital shortfalls based on a market capital requirement in a systemic crisis (SRISK). The capital shortfall estimate SRISK amounts to €675 billion. The rank correlation of banks with capital shortfalls based on SRISK and CCAR 2016 is large and positive. This highlights the dissonance between the market's assessment of banks' capital adequacy and typical regulatory approaches based on risk-weighted assets while results based on unweighted book value of assets are highly congruent.

While the ordering of banks with capital shortfalls is similar between CCAR 2016 approach and the market-based approach, there are substantial differences in the absolute capital shortfalls particularly for banks in large countries such as France, United Kingdom, Germany, Spain and Italy. These differences can be attributed to three factors in particular: (i) a higher prudential threshold to the capital ratio applied in SRISK (explaining 45% of the difference), (ii) larger stressed losses in SRISK (26%), and (iii) low market-to- book ratios (18%).

References

1. Acharya, V., D. Pierret, and S. Steffen (2016). Capital Shortfalls of European Banks since the Start of the Banking Union. Working Paper.

2. Board of Governors of the Federal Reserve, 2016. Comprehensive Capital Analysis and Review 2016: Assessment Framework and Results.

3. EBA, 2014. Results of 2014 EU-wide stress test.

4. EBA, 2016. EU-Wide Stress Test – Methodological Note.

Figure 1
Capital Shortfalls of European Banks using the CCAR 2016 Methodology
This figure shows the ranking of banks with the highest capital shortfall in the EBA 2016 stress test using the losses in the adverse scenario of the EBA stress test and the CCAR 2016 methodology (using CCAR prudential capital ratios). Capital shortfalls are reported in million euros and banks are shown if the capital shortfall is at least two billion euros.

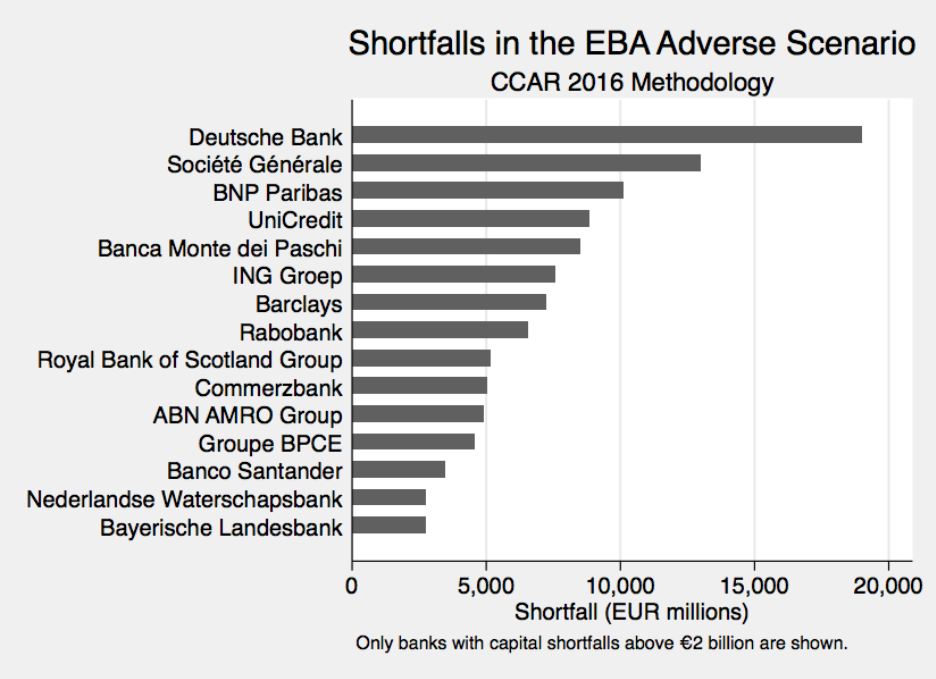

Figure 2
Capital Shortfalls SRISK vs. CCAR
This figure shows the correlation between capital shortfalls using SRISK and CCAR prudential capital ratios. Capital shortfalls are in million euros. SRISK is measured as of 31 Dec 2015.

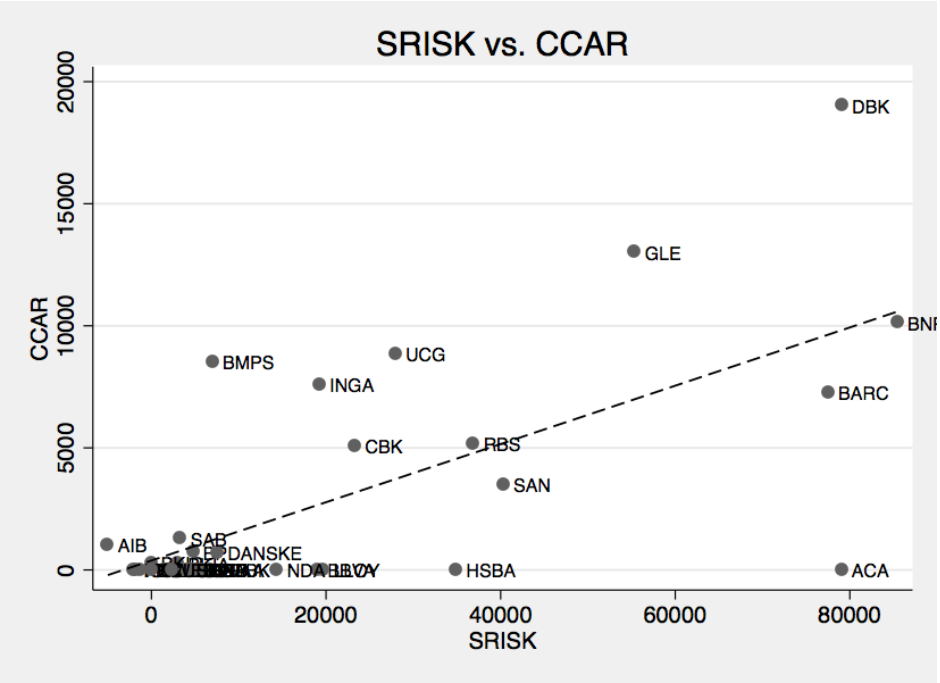

Figure 3
Understanding Capital Shortfall Differences: Market-to-book Ratios
This figure shows the correlation between the difference between SRISK and CCAR capital shortfalls and banks' market-to-book ratio. Capital shortfalls are scaled by the market value of banks' equity. Market values and market-to-book ratios are as of 31 Dec 2015.

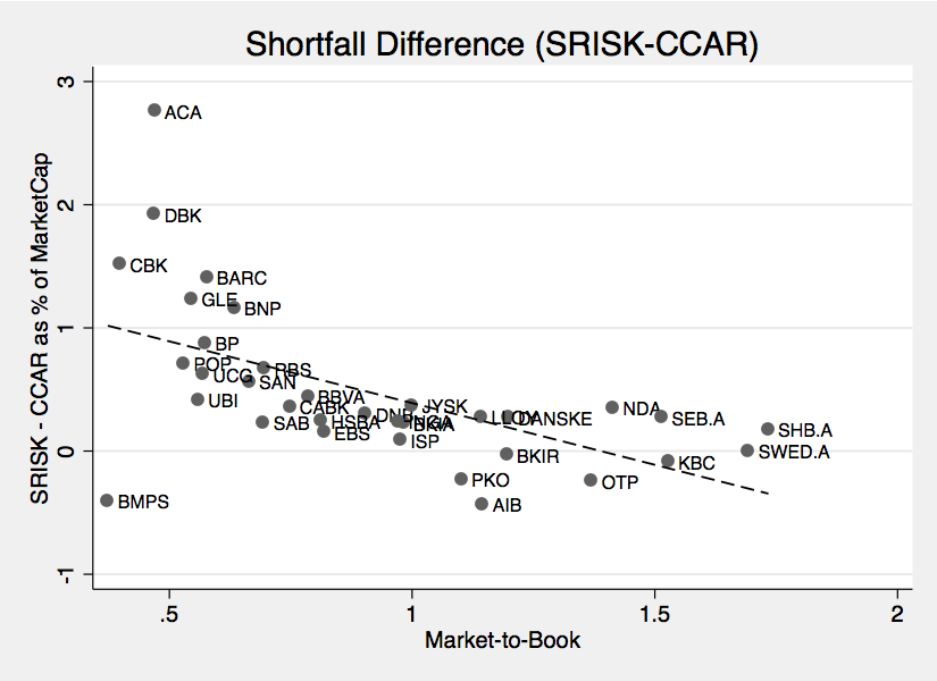

Figure 4
Understanding Capital Shortfall Differences: Profits & Losses
This figure shows the correlation between the difference between SRISK and CCAR capital shortfalls and the differences between losses under the SRISK methodology and cumulative 3yr losses in the EBA adverse scenario.

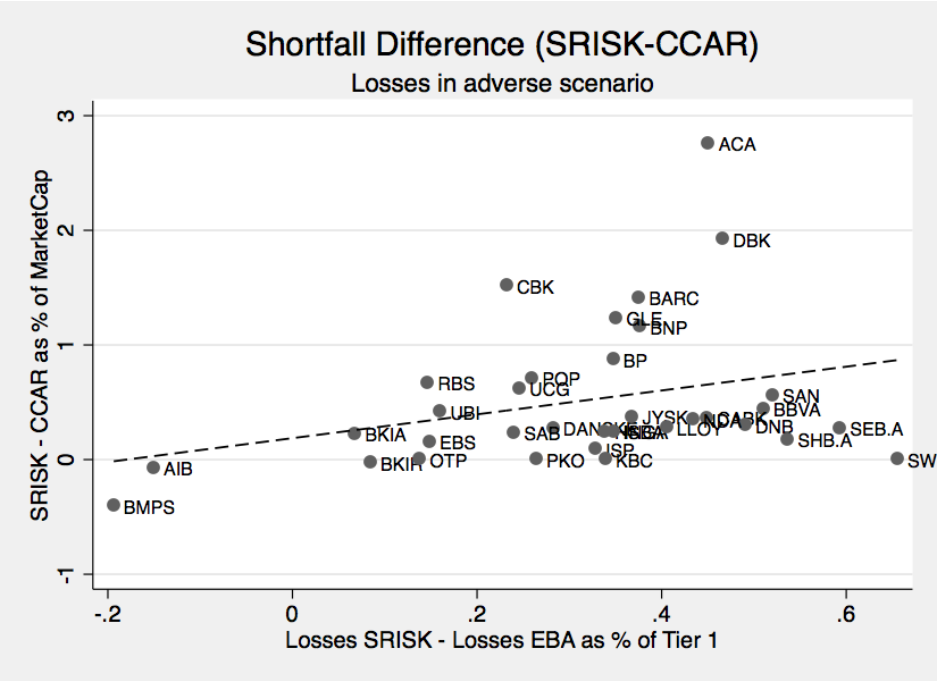

Table 1

This table reports capital shortfalls of 51 European banks that participated in the 2016 EBA stress test. Shortfalls are calculated under (i) the EBA 2014 AQR and (ii) the CCAR 2016 methodology. Shortfalls are reported in million euros.

		Capital shortfall	
Bank	**Country**	**EBA 2014 AQR**	**CCAR 2016**
Deutsche Bank	DE	0	19,023
Société Générale	FR	0	13,015
BNP Paribas	FR	0	10,125
UniCredit	IT	0	8,864
Banca Monte dei Paschi	IT	5,565	8,514
ING Groep	NL	0	7,605
Barclays	GB	0	7,258
Rabobank	NL	0	6,586
Royal Bank of Scotland Group	GB	0	5,171
Commerzbank	DE	0	5,077
ABN AMRO Group	NL	0	4,913
Groupe BPCE	FR	0	4,585
Banco Santander	ES	0	3,502
Nederlandse Waterschapsbank	NL	0	2,777
Bayerische Landesbank	DE	0	2,773
NORD/LB	DE	0	1,940
La Banque Postale	FR	0	1,847
Landesbank Baden-Württemberg	DE	0	1,646
Raiffeisen Zentralbank	AT	0	1,576
Banco de Sabadell	ES	0	1,283
Landesbank Hessen-Thüringen	DE	0	1,246
Allied Irish Banks	IE	0	1,033
Banco Popolare	IT	0	721
Danske Bank	DK	0	694
DekaBank Deutsche Girozentrale	DE	0	571
Governor and Co. of the bank	IE	0	301
Bankia SA	ES	0	263
Banco Popular Español	ES	0	19
Nykredit Realkredit	DK	0	6
CaixaBank	ES	0	0
UBI Banca	IT	0	0
Intesa Sanpaolo	IT	0	0
Nordea Bank	SE	0	0
Lloyds Banking Group	GB	0	0
KBC Group	BE	0	0
HSBC Holdings	GB	0	0
NRW.BANK	DE	0	0
Volkswagen Financial Svcs AG	DE	0	0
Erste Group Bank	AT	0	0
Swedbank	SE	0	0
Handelsbanken	SE	0	0
Belfius Banque	BE	0	0
BBVA	ES	0	0
OP Financial Group	FI	0	0
Crédit Agricole SA	FR	0	0
Jyske Bank	DK	0	0
OTP Bank	HU	0	0
DNB ASA	NO	0	0
PKO Bank Polski	PL	0	0
Skandinaviska Enskilda Banken	SE	0	0
Total capital shortfall (€ million)		**5,565**	**122,932**

Table 2
SRISK and CCAR 2016

This table reports capital shortfalls of all 34 publicly listed banks that participated in the EBA 2016 stress test comparing CCAR to SRISK. Shortfalls are sorted by SRISK and reported in million euros.

Panel A. Capital shortfalls (Bank level)

		Capital shortfall		
Bank	**Country**	**CCAR 2016**	**SRISK**	**SRISK - CCAR 2016**
BNP Paribas	FR	10,125	85,466	75,341
Deutsche Bank	DE	19,023	79,117	60,094
Crédit Agricole SA	FR	0	79,079	79,079
Barclays	GB	7,258	77,567	70,309
Société Générale	FR	13,015	55,373	42,358
Banco Santander	ES	3,502	40,330	36,828
Royal Bank of Scotland Group	GB	5,171	36,908	31,737
HSBC Holdings	GB	0	34,917	34,917
UniCredit	IT	8,864	27,961	19,097
Commerzbank	DE	5,077	23,359	18,282
Lloyds Banking Group	GB	0	19,731	19,731
ING Groep	NL	7,605	19,283	11,678
BBVA	ES	0	19,062	19,062
Nordea Bank	SE	0	14,402	14,402
Danske Bank	DK	694	7,581	6,887
Banca Monte dei Paschi	IT	8,514	7,044	-1,470
CaixaBank	ES	0	6,787	6,787
Skandinaviska Enskilda Banken	SE	0	5,672	5,672
DNB ASA	NO	0	5,596	5,596
Banco Popolare	IT	721	4,787	4,066
Banco Popular Español	ES	19	4,685	4,666
Intesa Sanpaolo	IT	0	4,370	4,370
Handelsbanken	SE	0	4,087	4,087
Banco de Sabadell	ES	1,283	3,343	2,060
Bankia SA	ES	263	3,060	2,797
UBI Banca	IT	0	2,435	2,435
Erste Group Bank	AT	0	1,928	1,928
Jyske Bank	DK	0	1,483	1,483
Allied Irish Banks	IE	1,033	0	-1,033
Governor and Co. of the bank	IE	301	0	-301
OTP Bank	HU	0	0	0
KBC Group	BE	0	0	0
Swedbank	SE	0	0	0
PKO Bank Polski	PL	0	0	0
Total shortfall (€ million)		**92,466**	**675,411**	**582,946**

Panel B. Capital shortfalls (Country level)

	Capital shortfall		
Country	**CCAR 2016**	**SRISK**	**SRISK - CCAR 2016**
France	23,139	219,918	196,779
United Kingdom	12,429	169,124	156,694
Germany	24,100	102,476	78,376
Spain	5,066	77,266	72,200
Italy	18,099	46,597	28,498
Sweden	0	24,161	24,161
Netherlands	7,605	19,283	11,678
Denmark	694	9,064	8,371
Norway	0	5,596	5,596
Austria	0	1,928	1,928
Belgium	0	0	0
Hungary	0	0	0
Ireland	1,334	0	-1,334
Poland	0	0	0
Total shortfall (€ million)	**92,466**	**675,411**	**582,946**

Table 3
Rank Correlation of SRISK with EBA 2014 AQR and CCAR 2016
This table reports rank correlations of SRISK with EBA 2014 AQR and CCAR 2016 capital shortfalls as well as shortfalls based on different capital shortfalls.

Baseline	Adverse	**EBA 2014 AQR**		
-0.815	-0.705	**-0.712**		
CET 1	Tier 1	Total Capital	Leverage	**CCAR 2016**
-0.749	-0.711	-0.669	0.359	**0.359**

Table 4
Understanding Capital Shortfall Difference between SRISK and CCAR 2016

This table shows rank correlations of (a) losses under the SRISK methodology (Vlab loss) with the cumulative 3-year loss under the EBA scenario (3-yr EBA loss), minus net interest income, trading loss, and impairments; and of (b) the difference between shortfalls SRISK and CCAR 2016 with the difference in losses under the SRISK methodology (Vlab loss) and the 3-year cumulative loss under the EBA scenario (scaled with market capitalization or using absolute amounts).

Rank correlation with Vlab loss			**Rank correlation with SRISK-CCAR 2016**	
3-yr EBA loss			**Vlab loss - 3yr EBA Loss**	**MTB**
0.121			0.686	-0.436
-Net interest income	**Trading loss**	**Impairments**	**Rank correlation with (SRISK-CCAR 2016)/MarketCap**	
-0.908	-0.261	0.692	**LRMES - (3yr EBA Loss/Tier1)**	**MTB**
			0.357	-0.681

Table 5

Decomposing the difference between SRISK and CCAR 2016

This table shows the difference between capital shortfalls based on SRISK and CCAR 2016 on a country level decomposed into five categories: (i) different thresholds to capital ratios applied to derive the capital shortfall (Threshold), (ii) market-to-book ratio (Market-to-book), (iii) the severity of the stress scenario and how it affects the numerator of the capital ratio (Stress), and (iv) Other factors explaining the capital shortfall difference (see Appendix IV). Shortfalls based on SRISK or CCAR 2016 are in million euros.

Country	Threshold	Market-to-book	Stress	Other
France	37%	29%	17%	17%
UK	52%	3%	35%	10%
Spain	47%	15%	43%	-6%
Germany	39%	33%	12%	16%
Italy	71%	6%	27%	-3%
Total	**45%**	**18%**	**26%**	**10%**

Appendix I
Capital Ratios as of 31 December 2015 (as reported)

This table reports capital ratios of 51 European banks that participated in the 2016 EBA stress test as reported on 31 December 2015.

Bank	Country	CET 1	Tier 1	Total Capital	Leverage
Erste Group Bank	AT	12.3%	12.2%	17.5%	5.8%
Raiffeisen Zentralbank	AT	10.5%	10.2%	13.5%	4.5%
Belfius Banque	BE	15.9%	14.6%	16.0%	4.9%
KBC Group	BE	15.2%	16.4%	19.0%	6.3%
Bayerische Landesbank	DE	15.2%	12.0%	16.2%	3.6%
Commerzbank	DE	13.8%	12.1%	14.9%	4.5%
DekaBank Deutsche Girozentrale	DE	14.4%	15.0%	17.8%	4.4%
Deutsche Bank	DE	13.2%	12.3%	13.9%	3.5%
Landesbank Baden-Württemberg	DE	16.6%	16.0%	20.6%	4.9%
Landesbank Hessen-Thüringen	DE	13.8%	13.1%	18.0%	3.9%
NORD/LB	DE	13.0%	12.1%	16.6%	4.0%
NRW.BANK	DE	42.8%	42.5%	46.7%	11.7%
Volkswagen Financial Svcs AG	DE	12.0%	11.7%	11.8%	11.1%
Danske Bank	DK	16.1%	16.8%	18.9%	4.3%
Jyske Bank	DK	16.1%	16.0%	16.8%	5.1%
Nykredit Realkredit	DK	19.4%	20.4%	23.9%	4.4%
BBVA	ES	12.0%	11.5%	14.3%	6.1%
Banco Popular Español	ES	13.1%	11.9%	12.9%	5.7%
Banco Santander	ES	12.7%	11.1%	13.2%	4.7%
Banco de Sabadell	ES	11.7%	11.8%	13.2%	4.9%
Bankia SA	ES	14.6%	13.7%	14.4%	5.5%
CaixaBank	ES	11.7%	9.7%	11.4%	5.3%
OP Financial Group	FI	19.5%	19.2%	22.2%	7.0%
BNP Paribas	FR	11.0%	11.7%	13.0%	4.0%
Crédit Agricole SA	FR	13.5%	14.5%	18.1%	5.3%
Groupe BPCE	FR	13.0%	12.8%	16.1%	4.5%
La Banque Postale	FR	13.2%	16.0%	18.8%	3.8%
Société Générale	FR	11.4%	12.6%	15.3%	3.8%
Barclays	GB	11.4%	12.9%	17.3%	4.5%
HSBC Holdings	GB	11.9%	12.7%	14.1%	5.0%
Lloyds Banking Group	GB	13.0%	15.5%	18.3%	4.8%
Royal Bank of Scotland Group	GB	15.5%	16.4%	19.7%	5.6%
OTP Bank	HU	13.4%	12.9%	15.8%	7.9%
Allied Irish Banks	IE	15.9%	14.0%	15.6%	7.8%
Governor and Co. of the bank	IE	13.3%	12.7%	15.7%	5.7%
Banca Monte dei Paschi	IT	12.0%	12.4%	15.5%	4.9%
Banco Popolare	IT	13.2%	12.5%	15.7%	4.7%
Intesa Sanpaolo	IT	13.0%	12.9%	15.6%	6.4%
UBI Banca	IT	12.1%	11.7%	14.0%	5.8%
UniCredit	IT	10.6%	10.8%	12.9%	4.4%
ABN AMRO Group	NL	15.5%	16.4%	19.1%	3.8%
ING Groep	NL	12.9%	13.1%	15.1%	3.9%
Nederlandse Waterschapsbank	NL	24.7%	29.5%	29.5%	2.7%
Rabobank	NL	13.5%	12.6%	19.7%	3.9%
DNB ASA	NO	14.3%	15.1%	17.7%	6.3%
PKO Bank Polski	PL	13.3%	13.4%	14.8%	9.3%
Handelsbanken	SE	21.2%	23.3%	26.7%	4.3%
Nordea Bank	SE	16.5%	18.0%	21.0%	4.5%
Skandinaviska Enskilda Banken	SE	18.8%	20.5%	23.0%	4.7%
Swedbank	SE	24.1%	28.3%	31.1%	5.0%
Average (unweighted)		**15.0%**	**15.2%**	**17.9%**	**5.3%**

Appendix II
Capital Ratios in the Adverse Scenario (31 Dec 2018)

This table reports capital ratios of 51 European banks that participated in the 2016 EBA stress test. We report stressed capital ratios in the adverse scenario on 31 December 2018.

		Capital ratios (Adverse Scenario, 31 Dec 2018)			
Bank	**Country**	**CET 1**	**Tier 1**	**Total Capital**	**Leverage**
Erste Group Bank	AT	8.2%	8.0%	12.8%	4.2%
Raiffeisen Zentralbank	AT	6.1%	6.2%	8.7%	3.0%
Belfius Banque	BE	11.4%	11.4%	12.5%	4.3%
KBC Group	BE	11.3%	12.6%	14.8%	5.7%
Bayerische Landesbank	DE	8.3%	8.3%	12.2%	2.8%
Commerzbank	DE	7.4%	7.4%	9.9%	3.0%
DekaBank Deutsche Girozentrale	DE	9.5%	10.9%	13.3%	3.6%
Deutsche Bank	DE	7.8%	8.8%	10.5%	3.0%
Landesbank Baden-Württemberg	DE	9.7%	9.4%	13.7%	3.3%
Landesbank Hessen-Thüringen	DE	10.1%	10.1%	14.5%	3.4%
NORD/LB	DE	8.7%	8.6%	11.8%	3.0%
NRW.BANK	DE	35.4%	35.4%	38.5%	11.4%
Volkswagen Financial Svcs AG	DE	9.6%	9.6%	9.6%	9.7%
Danske Bank	DK	14.0%	15.3%	17.3%	4.0%
Jyske Bank	DK	14.0%	14.0%	14.4%	4.9%
Nykredit Realkredit	DK	14.2%	14.8%	17.4%	4.1%
BBVA	ES	8.3%	9.4%	12.1%	5.1%
Banco Popular Español	ES	7.0%	8.3%	9.1%	4.0%
Banco Santander	ES	8.7%	9.1%	11.2%	4.0%
Banco de Sabadell	ES	8.2%	8.1%	9.2%	3.4%
Bankia SA	ES	10.6%	9.6%	10.8%	3.9%
CaixaBank	ES	9.0%	7.8%	9.6%	4.6%
OP Financial Group	FI	14.9%	14.6%	16.7%	5.8%
BNP Paribas	FR	8.6%	9.3%	10.2%	3.5%
Crédit Agricole SA	FR	10.5%	11.2%	14.3%	4.7%
Groupe BPCE	FR	9.7%	9.5%	12.1%	3.6%
La Banque Postale	FR	9.7%	11.0%	13.3%	3.2%
Société Générale	FR	8.0%	9.1%	11.6%	2.9%
Barclays	GB	7.3%	8.6%	12.2%	3.5%
HSBC Holdings	GB	8.8%	9.9%	11.4%	4.3%
Lloyds Banking Group	GB	10.1%	12.2%	14.6%	4.4%
Royal Bank of Scotland Group	GB	8.1%	8.8%	12.0%	3.6%
OTP Bank	HU	9.2%	9.2%	11.7%	5.8%
Allied Irish Banks	IE	7.4%	5.1%	6.9%	3.0%
Governor and Co. of the bank	IE	7.7%	7.4%	9.7%	3.7%
Banca Monte dei Paschi	IT	-2.2%	-2.2%	0.5%	-0.9%
Banco Popolare	IT	9.0%	9.1%	12.1%	3.5%
Intesa Sanpaolo	IT	10.2%	10.7%	13.4%	5.7%
UBI Banca	IT	8.8%	8.9%	11.4%	4.4%
UniCredit	IT	7.1%	7.5%	8.9%	3.1%
ABN AMRO Group	NL	9.5%	10.3%	12.4%	2.9%
ING Groep	NL	9.0%	9.4%	11.0%	3.3%
Nederlandse Waterschapsbank	NL	17.6%	20.6%	20.6%	2.1%
Rabobank	NL	8.1%	8.7%	14.2%	3.0%
DNB ASA	NO	14.3%	15.1%	17.7%	6.3%
PKO Bank Polski	PL	11.4%	11.4%	12.8%	7.9%
Handelsbanken	SE	18.5%	20.3%	23.3%	4.3%
Nordea Bank	SE	14.1%	15.5%	16.8%	4.3%
Skandinaviska Enskilda Banken	SE	16.6%	18.6%	20.7%	5.2%
Swedbank	SE	22.3%	24.6%	27.5%	4.8%
(Unweighted) Average Capital Ratio		**10.6%**	**11.2%**	**13.5%**	**4.2%**

Appendix III
Capital Shortfalls using the CCAR 2016 Methodology

This table reports capital shortfalls of 51 European banks that participated in the 2016 EBA stress test. Shortfalls are calculated under the CCAR 2016 methodology. The maximum shortfall for each capital ratio over the 2016-2018 period is reported. Capital shortfalls are reported in million euros.

Based on fully loaded measures		**CET 1**	**Tier 1**	**Total Capital**	**Leverage**	**Capital shortfall**
Threshold		**4.5%**	**6.0%**	**8.0%**	**4.0%**	
Bank	**Country**					
Erste Group Bank	AT	0	0	0	0	0
Raiffeisen Zentralbank	AT	0	0	0	1,576	1,576
Belfius Banque	BE	0	0	0	0	0
KBC Group	BE	0	0	0	0	0
Bayerische Landesbank	DE	0	0	0	2,773	2,773
Commerzbank	DE	0	0	0	5,077	5,077
DekaBank Deutsche Girozentrale	DE	0	0	0	571	571
Deutsche Bank	DE	0	0	0	19,023	19,023
Landesbank Baden-Württemberg	DE	0	0	0	1,645	1,645
Landesbank Hessen-Thüringen	DE	0	0	0	1,246	1,246
NORD/LB	DE	0	0	0	1,940	1,940
NRW.BANK	DE	0	0	0	0	0
Volkswagen Financial Svcs AG	DE	0	0	0	0	0
Danske Bank	DK	0	0	0	694	694
Jyske Bank	DK	0	0	0	0	0
Nykredit Realkredit	DK	0	0	0	6	6
BBVA	ES	0	0	0	0	0
Banco Popular Español	ES	0	0	0	19	19
Banco Santander	ES	0	0	0	3,502	3,502
Banco de Sabadell	ES	0	0	0	1,283	1,283
Bankia SA	ES	0	0	0	263	263
CaixaBank	ES	0	0	0	0	0
OP Financial Group	FI	0	0	0	0	0
BNP Paribas	FR	0	0	0	10,125	10,125
Crédit Agricole SA	FR	0	0	0	0	0
Groupe BPCE	FR	0	0	0	4,585	4,585
La Banque Postale	FR	0	0	0	1,847	1,847
Société Générale	FR	0	0	0	13,015	13,015
Barclays	GB	0	0	0	7,258	7,258
HSBC Holdings	GB	0	0	0	0	0

Lloyds Banking Group	GB	0	0	0	0	0
Royal Bank of Scotland Group	GB	0	0	0	5,171	5,171
OTP Bank	HU	0	0	0	0	0
Allied Irish Banks	IE	117	550	656	1,033	1,033
Governor and Co. of the bank	IE	0	0	0	301	301
Banca Monte dei Paschi	IT	4,999	5,869	5,435	8,514	8,514
Banco Popolare	IT	0	0	0	721	721
Intesa Sanpaolo	IT	0	0	0	0	0
UBI Banca	IT	0	0	0	0	0
UniCredit	IT	0	0	0	8,864	8,864
ABN AMRO Group	NL	0	0	0	4,913	4,913
ING Groep	NL	0	0	0	7,605	7,605
Nederlandse Waterschapsbank	NL	0	0	0	2,777	2,777
Rabobank	NL	0	0	0	6,586	6,586
DNB ASA	NO	0	0	0	0	0
PKO Bank Polski	PL	0	0	0	0	0
Handelsbanken	SE	0	0	0	0	0
Nordea Bank	SE	0	0	0	0	0
Skandinaviska Enskilda Banken	SE	0	0	0	0	0
Swedbank	SE	0	0	0	0	0
Total capital shortfall (€ million)		**5,116**	**6,419**	**6,091**	**122,932**	**122,932**

Appendix IV
Decomposition of SRISK and CCAR 2015 - Methodology

We can decompose the difference between SRISK and CCAR capital shortfalls into five categories:

a. **Threshold**: different prudential thresholds to capital ratios are applied to derive the capital shortfalls. The CCAR capital shortfall is based on a 4% prudential threshold, while SRISK considers a 5.5% prudential threshold.

b. **Measure of assets**: the denominators in the capital ratios used to derive capital shortfalls are different. The denominator of Tier 1 leverage ratio is the Tier 1 leverage ratio exposure (including off-balance sheet items), while SRISK uses the quasi-market assets (book value of liabilities plus market value of equity). More specifically, it reflects differences in the amount of assets financed by the bank liabilities.

c. **Market-to-book:** the valuation of equity and the measure of capital are different in the two approaches. CCAR uses Tier 1 capital, while SRISK uses the market valuation of equity. Market-to-book is measured in this case by the ratio of market capitalization to Tier 1 capital.

d. **Stress**: the severity of the stress scenario and how it affects the numerator of the capital ratio. Differences in "stress" can be assessed by comparing the percentage change in Tier 1 capital over the stress scenario with the percentage change in market capitalization in Vlab stress scenario (LRMES).

e. **Balance sheet assumption**: different assumptions concerning the evolution of the size of the balance sheet over the stress scenario. The EBA stress test results (and the CCAR capital shortfall) are based on a static balance sheet assumption. The Tier 1 leverage ratio exposure amount stays constant over the EBA stress scenario, while the quasi-market assets in SRISK will be reduced by the market cap loss in Vlab stress scenario.

The quantitative decomposition of the difference between SRISK and CCAR in Table 5 and Figure 5 is based on the capital shortfall definitions

$$\begin{aligned} SRISK &= \mathrm{k}\{D + E(1 - LRMES)\} - E(1 - LRMES) \\ &= \mathrm{k}D - (1 - \mathrm{k})E(1 - LRMES), \end{aligned}$$

$$CCAR = \mathrm{j}(D^* + E^*) - E^*(1 - LRMES^*),$$

where E is the market value of equity (as of 2015), D is quasi-market assets minus E (as of 2015), E^* is Tier 1 capital before the stress scenario (as of 2015), D^* is the leverage ratio exposure minus E^* (as of 2015), $LRMES^*$ is the change in T1C in the stress scenario, and k=5.5% (SRISK prudential threshold), j=4% (CCAR prudential threshold).

It is possible to decompose SRISK – CCAR in its different components according to

$$SRISK - CCAR = kD - (1-k)E(1-LRMES) - j(D^* - E^*) + E^*(1-LRMES^*)$$

$$\begin{aligned}
&= (k-j)(D+E) && \text{(Prudential threshold)}\\
&\quad + j(D-D^*) && \text{(Measure of assets)}\\
&\quad + (1-LRMES^* - j)(E^*-E) && \text{(Market-to-book)}\\
&\quad + E(LRMES - LRMES^*) && \text{(Stress)}\\
&\quad - k\,E\,LRMES && \text{(Balance sheet assumption)}
\end{aligned}$$

Decomposing the difference between SRISK and CCAR 2016

This table shows the difference between capital shortfalls based on SRISK and CCAR 2016 on a country level decomposed into five categories: (i) different thresholds to capital ratios applied to derive the capital shortfall (Threshold), (ii) different denominators to the capital ratios (Measure of assets), (iii) market-to-book ratio (Market-to-book), (iv) the severity of the stress scenario and how it affects the numerator of the capital ratio (Stress) and (v) different balance sheet assumptions (Balance sheet assumption). Shortfalls based on SRISK or CCAR 2016 are in million euros.

Country	Threshold	Measure of assets	Market-to-book	Stress	Balance sheet assumption
France	37%	18%	29%	17%	-1%
UK	52%	14%	3%	35%	-4%
Spain	47%	-2%	15%	43%	-4%
Germany	39%	18%	33%	12%	-1%
Italy	71%	2%	6%	27%	-4%
Sweden	74%	26%	-129%	137%	-8%
Netherlands	86%	-49%	-9%	79%	-7%
Norway	38%	10%	-15%	71%	-4%
Denmark	74%	7%	-35%	59%	-5%
Austria	119%	-10%	-9%	7%	-7%
Belgium	218%	61%	-430%	274%	-22%
Poland	151%	-18%	-304%	297%	-26%
Hungary	-80%	3%	249%	-90%	18%
Ireland	-103%	-15%	109%	98%	10%

Appendix Figure 1
Decomposing the difference between SRISK and CCAR 2016
This figure shows the difference between capital shortfalls based on SRISK and CCAR 2016 on a country level decomposed into five categories: (i) different thresholds to capital ratios applied to derive the capital shortfall (Threshold), (ii) different denominators to the capital ratios (Measure of assets), (iii) market-to-book ratio (Market-to-book), (iv) the severity of the stress scenario and how it affects the numerator of the capital ratio (Stress) and (v) different balance sheet assumptions (Balance sheet assumption). Shortfalls are in million euros.