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JRC technical work supporting Commission second level legislation on risk based contributions to the (single) resolution fund

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Abstract

JRC supported the DG MARKT by developing quantitative analyses for the preparation of the second level legislation on bank contributions to be paid to the EU national Resolution Funds and to the Single Resolution Fund SRF for countries participating to the Banking Union. The present report summarizes all the extensive analyses on the calculation of banks contributions supporting the whole policy process.
All analyses were based on a dataset that JRC built assembling individual bank unconsolidated balance sheet data, provided directly by the MS.
JRC developed the technical details to measure the risk profile of each bank. Starting from a selection of balance sheet indicators, which account for the different aspects of each bank activity, the methodology aggregates them into a single composite risk indicator. The risk indicator is then combined with the bank size measure to compute the share of aggregated contribution each bank joining the fund would pay.
JRC also investigated the decrease in contributions of applying a special treatment for the computation of the small banks' contributions: these banks will not pay contributions based on their risk profile but will be instead lump-sum contributions, depending on their size only.
JRC assessed the sensitivity of the distribution of contributions when changing some elements of the overall mechanism used to measure risk and compute contributions.
Finally, following the discussion at the political level, JRC also assessed some technical issues related to the calculation of the contribution base and it tested the impact on banks contributions of different options for the phasing in of the single resolution fund.

JRC technical work supporting Commission second level legislation on risk based contributions to the (single) resolution fund

Executive Summary

The European Commission (EC) Joint Research Centre (JRC) supported the Directorate General for Internal Market and Services (DG MARKT) by developing quantitative analyses for the preparation of the second level legislation on bank contributions to be paid to the EU national Resolution Funds (RF) as of 1 January 2015 and to the Single Resolution Fund (SRF) that will replace national funds as of 1 January 2016 in all the Member States (MS) participating in the Banking Union.

These analyses laid out the technical framework for determining how such contributions should be defined, taking into account the existing legislation in the Bank Recovery and Resolution Directive (BRRD) and in the Single Resolution Mechanism Regulation (SRMR). The BRRD establishes that European (EU) countries must set up ex-ante funded national RF that can contribute to effective bank resolutions. According to the SRMR, MS participating in the Banking Union are required to build a single fund. BRRD and SRMR establish that banks are required to pay annual contributions, based on two ingredients:

1. a basic flat contribution , proportional to the amount of bank's liabilities excluding own funds and covered deposit (the so called BRRD base);
2. a risk adjustment to take into account the risk profile of each bank. This risk indicator is defined on a number of risk criteria, some of which depend upon balance sheet information.

National RF and the SRF must set aside a fund equal to at least 1% of the amount of covered deposits of all banks authorized in the respective banking system (i.e. each MS in the first case and the whole Banking Union in the latter).

JRC analyses covered a large number of issues and followed the policy evolution taking place during consultations with the EC Expert Group on Banking, Payments and Insurance.

All analyses were based on a dataset that JRC built assembling individual bank unconsolidated balance sheet data, provided directly by the MS. The final database comprises around 4,600 banks in the EU-28, accounting for 37 600 billion € of EU unconsolidated total assets (as of 2012).

JRC analyses started with the development of a composite risk indicator measuring the risk adjustment mentioned in the BRRD and SRMR. It is based on a set of balance sheet indicators identified by DG MARKT and the Expert Group, which must be combined into a single measure of risk. JRC analyzed alternative aggregation rules based on composite indicators theory. Individual indicators are combined using a set of weights based on expert judgment of DG MARKT and the Expert Group.

JRC also tested various ways of combining the flat contribution with the risk adjustment, to calculate the final fees that banks will pay. According to the retained preferred option, included in the second level legislation, each bank contributes in proportion to the BRRD base corrected by the risk adjustment which depends on the value of the composite risk indicator and ranges between 0.8 and 1.5.

A different regime applies to small banks: they are required to pay a lump sum, which is lower than the basic flat contribution and not depending on the risk profile. The JRC investigated the effects of this special treatment on the contributions of all banks.

JRC calculated the distribution of contributions by bank size: results show that the greater contributors to the (S)RF are the largest banks, which pay proportionately more than their share of total assets. For instance, in the Euro area the largest 261 banks, which represent 85% of total assets, cover around 90% of the contributions. The analyses also demonstrated that in general the smallest banks, among those paying a risk-adjusted contribution, tend to get a downward risk-based correction and therefore in large measure pay less than the flat contributions; on the other hand, the largest banks mostly get an increase in their contributions with respect to the flat fees. Small banks, though representing 55% of the whole number of institutions in the Euro Area, account only for 2% of total assets and their lump sum contributions cover 0.3% of the yearly target to be collected.

Following the discussion at the political level, JRC also assessed some technical issues related to the calculation of the BRRD base, including the treatment of intragroup exposures and the accounting rules for derivatives. The proposed legislation allows the netting of intragroup exposures in the calculation of the base and the application of leverage ratio accounting rules for derivative liabilities, in line with Capital Regulation Directive IV.

Due to the complete lack of individual bank-level data both on the level of intra-group exposure and on the structure of groups, JRC could not provide a detailed analysis at an individual bank level of the impact of netting intra-group loans. Instead, the focus of the analysis was on providing a tentative estimate of the average size and variation of intragroup exposures in each MS.

As for derivative liabilities, individual data were scarce; based on these data, JRC estimated averages amounts of derivatives held for groups of banks of different dimensions and used such figures to come up with tentative estimates of the potential impact of introducing the leverage ratio treatment in the calculation of the BRRD base.

Finally, given the potentially large variations in contributions when switching from national targets, imposed by the BRRD legislation, to the Banking Union target level of the SRF, the draft Implementing Act foresees an adjustment mechanism during an eight years transitional period. This mechanism introduces a gradual blending between contributions calculated under the national system and the SRF. JRC tested the impact on banks contributions of different options for the phasing in of the SRF. Moreover, JRC tested the effect of an optional special treatment for contributions, applicable during the phase-in, to institutions with total assets below 3 billion €.

1. Introduction

The European Commission (EC) adopted a Delegated Act on the 21st October 2014 and a draft proposal for a Council Implementing Act on the 24th November 2014 specifying how the contributions of banks to the national resolution funds and to the Single Resolution Fund should be calculated. These two funds are established by the Bank Recovery and Resolution Directive (BRRD) and by the Single Resolution Mechanism Regulation (SRMR).

The BRRD establishes that EU countries must set up national Resolution Funds (RF), *ex-ante* funded, that contribute to effective bank resolution, e.g. by providing temporary support to distressed banks via loans, guarantees and other measures. In the SRM legislation, Resolution Funds of the participating member states are pooled into a Single Resolution Fund (SRF).

According to Article 94 of BRRD and Article 66 of SRMR, the calculation of banks contributions to these funds should be based on a *flat contribution* and a *risk adjustment*. The former is defined as "pro–rata based on the amount of an institution's liabilities excluding own funds and covered deposits, with respect to the total liabilities, excluding own funds and covered deposits, of all the institutions authorised in the territories of the participating Member States (MS)"; this is referred to as the BRRD base. The risk adjustment should be based on a number of risk criteria (listed in the BRRD Directive), some of which depend upon balance sheet information.[1]

The Directorate General for Internal Market and Services (DG MARKT) has asked the EC Joint Research Centre (JRC) to **run quantitative analyses to determine the effect of alternative rules for the calculation of banks contributions to the (S)RF**. All the main outcomes of this exercise are included in the Commission staff working document accompanying the new rules for both pieces of legislation.[2] The present report details all the technical work developed by the JRC to support DG MARKT in the preparation of the two Acts.

JRC analyses covered the following issues.

- **Assembling data collected from MS into a final database.** JRC collected, processed and harmonized data on banks' balance sheet directly provided by the MS representatives.[3]
- **Assessing different approaches to compute contributions of banks taking into account the size and the risk profile.** JRC proposed different mathematical formulas to compute banks contributions combining the BRRD base and the risk adjustment. This report sets down the technical steps to build a robust composite indicator able to capture the risk criteria explicitly listed in the BRRD. JRC also investigated the effects on individual contributions of applying a special treatment for small banks, which will pay a lump-sum amount, and the potential impact of introducing a fourth pillar based on supervisory discretion and data, reflecting trading activities, off-balance sheet exposures, derivatives, complexity and resolvability.
- **Estimating the size of intragroup exposures.** JRC estimated the magnitude of intragroup liabilities to provide an idea of the impact of excluding them from the contribution base. As contributions are calculated

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[1] Article 94(7) of BRRD states: "*The Commission shall be empowered to adopt delegated acts to specify the notion of adjusting contributions in proportion to the risk profile of institutions […], taking into account the following:*
(a) the risk exposure of the institution, including the importance of its trading activities, its off-balance sheet exposures and its degree of leverage;
(b) the stability and variety of the company's sources of funding and unencumbered highly liquid assets;
(c) the financial condition of the institution;
(d) the probability that the institution enters into resolution;
(e) the extent to which the institution has previously benefited from extraordinary public financial support;
(f) the complexity of the structure of the institution and the resolvability of the institution, and
(g) the importance of the institution to the stability of the financial system or economy or one or more Member States or of the Union.
(h) the fact that the institution is part of an IPS."

[2] The figures presented in the Commission Staff Working Document slightly differ from the ones presented in this report: the latter are based on an updated dataset including data provided by some MS in early autumn 2014.

[3] Due to confidentiality issues, JRC also set a special (secure) platform to work with these data. For this reason, the present report does not show raw balance sheet data at single entity level.

at individual entity level, intragroup exposures should be excluded from the base otherwise the same liability would be counted twice in the same banking group, thus inducing a kind of double payment. As data on intragroup liabilities at a single entity level are missing, JRC used the distribution of interbank deposits to obtain a proxy of the average level of intragroup liabilities at country level and its dispersion. Though this estimate represents an upper bound proxy for intragroup liabilities, it should be much correlated to actual values.

- **Estimating the size of derivatives liabilities.** JRC developed a rough estimate of the potential impact on banks' contributions when applying a special treatment for derivative liabilities. In fact, to ensure a harmonized approach in the treatment of derivatives, the Delegated Act requires derivatives to be accounted for according to the rules for the calculation of the leverage ratio under the Capital Requirements Regulation. As no data on derivative liabilities at individual bank level was available, JRC made use of Bankscope database to come up with a proxy of the values and then used assumptions on the possible scope of application of the rule to assess its impact.
- **Analysing the phase-in methodology.** JRC estimated the impact on banks contributions of different options for a phase-in of the SRF calculation in the Euro area. The proposal for the Council Implementing Act contained transitional measures by way of a gradual phasing-in of the SRM contribution in order to limit the sharp change that would arise when moving from the BRRD system, where contributions are determined based upon the national target, to the single fund mechanism, where contributions will be paid based on a joint target level.

During the policy process, the EC organized a series of meetings with the Expert Group on Banking, Payments and Insurance, composed by representatives of the Member States, to discuss the key elements of the proposed rules. JRC has been requested to participate to most of the Expert Group meetings, and to present the analyses developed and the evidence found in order to feed the policy discussion.

The remainder of this report is structured as it follows. Section 2 presents the data collection exercise and some statistics for the final database the JRC assembled. Section 3 discusses all the mathematical steps to compute the composite indicators from raw data and to compute the risk-based contributions for each bank. Sections 4 and 5 describe the results at banks' level. Section 4 focuses on "small" banks, which are subject to a specific treatment, and Section 5 focuses on the remaining banks. Section 6 presents a scenario analysis simulating results when introducing the additional supervisory pillar in the composite indicator, reflecting risks due to trading activities and off-balance sheet exposures, derivatives, complexity and resolvability. Section 7 discusses estimates of intragroup exposures. Section 8 illustrates the potential effects on contributions of using the leverage ratio accounting treatment for derivatives. Section 9 presents some analyses of possible phasing-in mechanisms from the national systems to the single fund for member states participating in the Banking Union. Section 10 concludes.

The present report is accompanied by three annexes. Annex A.1 contains a numerical example on how to compute the composite indicator. Annex A.2 discusses the pros and cons of geometric versus arithmetic averages when constructing the composite indicator. Annex A.3 shows the different effects of alternative treatments for the right-tails of the indicators' distributions.

2. The database

JRC ran a preliminary set of analyses and simulations using Bankscope data, a commercial provider of banks' balance sheet dat. Then, as MS provided JRC with banks data in response to the request launched by DG MARKT on June 2014, new analyses and simulations were run using the new database made up by data directly provided by the MS, unless the database was incomplete or the data were not compliant with what requested (in this case Bankscope data were used). This section is devoted to describe the database, to compare it with other sources and to detail the steps and the checks performed to detect incoherencies and mistakes to come up with the final and coherent version of the database.

2.1 Data comparisons

The data comparison for each country focuses on the following variables.

- Number of banks. For each country the total number of banks recorded in Bankscope (irrespective if they have data or not), the number of banks from Bankscope that have all the necessary data to perform the analyses (hereinafter referred to as JRC sample), the number of all banks recorded in each country's database (irrespective of whether they have complete data or not) and the figures published by ECB and EBA are compared.[4] By doing this, one can have an idea on the quality of coverage of the samples in terms of number of banks. Results for all MS are reported in Table 1.
- Amount of total assets. The sum of total assets of the JRC sample, the original MS sample and country-level estimates by EBA are taken into account. This information, combined with the previous one, allows to understand which part of the banks' distribution is missing in one database with respect to the other (i.e. if a negligible amount of total assets, corresponding to a relevant number of banks is missing, the database is likely not to account for data on small banks). All aggregated numbers are shown in Table 2.
- Amount of deposits and covered deposits. The sum of deposits and covered deposits[5] of the JRC sample, the original MS sample and country-level estimates JRC has performed using Deposit Guarantee Schemes (DGS hereinafter) data[6] are taken into account. Also this information allows understanding which part of the banks' distribution is missing in one database with respect to the other.
- Coverage ratio. This variable is defined as the ratio between the total amount of covered deposits and the total amount of customer deposits. Two values for this ratio are taken into account: one is the estimate of the coverage ratio calculated for each country by JRC using DGS data and the second is the same ratio computed using MS data. JRC figures are used in conjunction with Bankscope information on customer deposits to obtain estimates of covered deposits for each bank in the JRC sample, and are based on data provided by DGS. This estimated coverage ratio is contrasted to the values observed in the sample provided by each MS, calculated by dividing the total of customer deposits and covered deposits for all banks with available data. All aggregated numbers are shown in Table 3. If these two ratios are different, while the

[4] See http://www.eba.europa.eu/supervisory-convergence/supervisory-disclosure/aggregate-statistical-data

[5] Customer deposits: any deposit as defined in Article 1(1) of Directive 94/19/EC, excluding those deposits left out from any repayment by virtue of Article 2.
Deposit" shall mean any credit balance which results from funds left in an account or from temporary situations deriving from normal banking transactions and which a credit institution must repay under the legal and contractual conditions applicable, and any debt evidenced by a certificate issued by a credit institution.
The following shall be excluded from any repayment by guarantee schemes:
a) subject to Article 8 (3), deposits made by other credit institutions on their own behalf and for their own account,
b) all instruments which would fall within the definition of 'own funds' in Article 2 of Council Directive 89/299/EEC of 17 April 1989 on the own funds of credit institutions,
c) deposits arising out of transactions in connection with which there has been a criminal conviction for money laundering as defined in Article 1 of Council Directive 91/308/EEC of 10 June 1991 on prevention of the use of the financial system for the purpose of money laundering.

[6] For data and methodology of the estimate see G. Cannas, J. Cariboni, L. Kazemi Veisari, A. Pagano: *Updated estimates of EU eligible and covered deposits*, JRC Technical Report JRC87531, 2014.

amount of covered deposits in the two samples turns out to be similar, differences could exist in the definition of deposits employed in the Bankscope reporting template and by national authorities.

The main underlying assumptions used in the analysis are:

- All the zeros in the databases provided by MS were treated as "true" zeros. This is done both for cases where missing data are clearly distinguished from zero, and for cases where apparently no data points were missing.
- For countries outside Euro area, where data was not already provided in Euro, the exchange rate used for the conversion is the end-of-period rate provided by Eurostat.
- For countries with no data on covered deposits, these are estimated for each bank by applying to MS-reported deposits the coverage ratio estimated by JRC from DGS data (as done in the JRC sample). However, it should be noted that the coverage ratio estimate is based on the definition of customer deposits employed in the Bankscope reporting template. Therefore, if the definition of deposits employed by the relevant MS were not in line with that of Bankscope, the estimated coverage ratio would not be reliable.

Table 1: Number of institutions by country as of 2012

Number of banks 2012					
Country	**Original Bankscope Download**	**JRC sample**	**ECB**	**EBA**	**Original MS data**
AUSTRIA	313	196	751	809	703
BELGIUM	60	29	103	104	49
BULGARIA	25	17	31	31	26
CYPRUS	26	6	137	135	13
CZECH REPUBLIC	24	12	56	43	23
GERMANY	1741	1617	1869	1737	1799
DENMARK	92	61	161	106	95
ESTONIA	9	3	16	16	8
SPAIN	148	99	314	302	104
FINLAND	19	16	313	313	289
FRANCE	284	209	639	381	550
UNITED KINGDOM	312	127	373	200	193
GREECE	13	7	52	n.a.	25
CROATIA	37	23	n.a.	n.a.	27
HUNGARY	30	12	189	172	172
IRELAND	32	12	472	38	36
ITALY	605	538	714	706	627
LITHUANIA	11	8	94	18	8
LUXEMBOURG	94	61	141	141	111
LATVIA	21	15	29	29	20
MALTA	16	11	28	28	23
NETHERLANDS	57	24	266	122	105
POLAND	50	33	695	642	616
PORTUGAL	42	18	152	186	145
ROMANIA	29	18	39	n.a.	31
SWEDEN	102	67	176	113	142
SLOVENIA	22	17	23	21	20
SLOVAKIA	17	7	28	31	29
TOTAL	**4,231**	**3,263**	**7,861**	**6,424**	**5,989**

Note: purple cells are figures as of 2013.

Table 2: Total assets by country as of 2012

Total Assets 2012				
Country	**ECB (b€)**	**EBA (b€)**	**JRC sample (b€)**	**Original MS data (b€)**
AUSTRIA	974	982	465	903
BELGIUM	1085	1099	550	996
BULGARIA	45	42	34	40
CYPRUS	128	111	17	43
CZECH REPUBLIC	192	184	104	167
GERMANY	8219	8593	6171	8364
DENMARK	1158	1042	545	571
ESTONIA	20	19	12	13
SPAIN	3574	3145	1673	2785
FINLAND	597	619	433	582
FRANCE	7712	7128	7052	8555
UNITED KINGDOM	9553	8678	8277	8679
GREECE	441	n.a.	148	301
CROATIA	58	n.a.	52	8
HUNGARY	107	102	39	96
IRELAND	1124	951	786	1014
ITALY	4211	3803	2959	3199
LITHUANIA	24	23	19	18
LUXEMBOURG	868	735	497	656
LATVIA	28	28	23	25
MALTA	53	53	20	52
NETHERLANDS	2490	2688	1766	2476
POLAND	354	336	230	302
PORTUGAL	556	508	402	466
ROMANIA	91	0	63	74
SWEDEN	1211	1756	795	1230
SLOVENIA	51	45	41	45
SLOVAKIA	60	56	32	58
TOTAL	**44,984**	**42,727**	**33,203**	**41,719**

Table 3: Amount of deposits and covered deposits as of 2012

	Customer Deposits 2012			Covered Deposits 2012			coverage Ratio	
Country	**JRC estimates from DGS (b€)**	**JRC sample (b€)**	**Original MS data (b€)**	**JRC estimates from DGS (b€)**	**JRC sample (b€)**	**Original MS data (b€)**	**JRC DGS survey**	**Original MS data**
AUSTRIA	325	185	577	173	99	183	53%	32%
BELGIUM	529	281	712	229	122	n.a.	43%	n.a.
BULGARIA	29	26	32	18	16	19	63%	58%
CYPRUS	104	13	53	52	7	n.a.	50%	n.a.
CZECH REPUBLIC	124	64	114	65	34	65	53%	57%
GERMANY	3172	2767	3292	1575	1374	n.a.	50%	n.a.
DENMARK	167	198	233	105	125	n.a.	63%	n.a.
ESTONIA	11	8	11	5	4	5	49%	49%
SPAIN	1569	750	1917	675	322	816	43%	43%
FINLAND	137	98	141	78	56	73	57%	51%
FRANCE	1577	2026	2198	1103	1417	1099	70%	53%
UNITED KINGDOM	2922	2825	2905	1219	1178	n.a.	42%	30%
GREECE	175	77	206	105	46	n.a.	60%	n.a.
CROATIA	n.a.	32	6	n.a.	17	0.2	54%*	3%
HUNGARY	60	19	131	30	9	44	50%	33%
IRELAND	194	185	202	80	76	n.a.	41%	n.a.
ITALY	1512	956	958	490	555	547	58%	57%
LITHUANIA	13	12	12	7	6	6	50%	47%
LUXEMBOURG	216	195	494	30	28	30	14%	6%
LATVIA	18	16	16	6	5	6	34%	36%
MALTA	28	13	27	7	3	n.a.	25%	31%
NETHERLANDS	864	626	1072	447	324	451	52%	42%
POLAND	279	153	216	103	57	n.a.	37%	n.a.
PORTUGAL	222	187	307	110	93	129	50%	42%
ROMANIA	64	36	64	27	15	28	43%	43%
SWEDEN	267	292	329	141	154	24	53%	7%
SLOVENIA	24	23	30	15	15	15	63%	50%
SLOVAKIA	46	23	42	24	12	28	53%	65%
TOTAL	**14,646**	**12,088**	**16,296**	**6,922**	**6,171**	**3,565**	**49%**	**40%**

*Note: purple cells are figures as of 2013; * JRC estimates.*

Table 4: Deposits over total assets

Deposits / total assets		
Country	**JRC sample**	**Original MS data**
AUSTRIA	40%	64%
BELGIUM	51%	71%
BULGARIA	76%	82%
CYPRUS	81%	88%
CZECH REPUBLIC	62%	68%
GERMANY	45%	39%
DENMARK	36%	41%
ESTONIA	71%	80%
SPAIN	45%	69%
FINLAND	23%	24%
FRANCE	29%	26%
UNITED KINGDOM	34%	33%
GREECE	52%	62%
CROATIA	62%	85%
HUNGARY	47%	136%
IRELAND	24%	20%
ITALY	32%	30%
LITHUANIA	63%	66%
LUXEMBOURG	39%	75%
LATVIA	69%	65%
MALTA	63%	52%
NETHERLANDS	35%	43%
POLAND	66%	72%
PORTUGAL	47%	66%
ROMANIA	57%	86%
SWEDEN	37%	27%
SLOVENIA	57%	76%
SLOVAKIA	72%	73%
AVERAGE	**51%**	**61%**

Note: purple cells are figures as of 2013.

2.2 Final database

Data provided either by Bankscope or by MS cannot be directly used to run all the simulations and analyses, but some checks and imputations are needed in order to guarantee the coherence of the data collected and of the final results based on them. Depending on the data sources, different treatments need to be performed. In the following all the steps taken before coming up with the final database will be detailed.

2.2.1 Imputations and checks on data from Bankscope

Bankscope database reports data on Risk Weighted Assets (RWA) and capital for few banks only. In order to come up with a reliable estimate of these items, the following steps have been implemented.

1. RWA estimates from Total and Tier 1 capital and corresponding ratios.

   In Bankscope the following variables are available: Total regulatory capital, Tier 1 capital, Total regulatory capital ratio, Tier 1 capital ratio and RWA.

   Where not available, RWA is estimated in one of the following ways (and it is labelled RWA*):

$$RWA^{*} = \frac{Total\ Capital}{Total\ Capital\ Ratio}\ \ or\ \ RWA^{*} = \frac{Tier\ 1\ Capital}{Tier\ 1\ Capital\ ratio}.$$

2. Capital estimates from RWA, RWA* and ratios.

   Matching original available data and RWA', capital is computed as it follows:

$$Total\ Capital^{*} = Total\ Capital\ Ratio * RWA^{*}\ \ \ or\ \ \ Total\ Capital\ Ratio * RWA$$

$$Tier\ 1\ Capital^{*} = Tier\ 1\ Capital\ Ratio * RWA^{*}\ \ \ or\ \ \ Tier 1\ Capital\ Ratio * RWA.$$

3. Clean up the dataset.

   Banks are removed from the sample when they meet at least one of the following criteria:

   - Total assets not available
   - Common equity not available
   - Tier 1 capital > total assets
   - Total capital > total assets
   - Common equity > total assets
   - Total capital plus customer deposits > total assets (this is a conservative approach to guarantee that the BRRD base is not negative).

4. Robust regression to estimate capital

   For every banks' specialization[7] the following linear models are considered:

$$Tier\ 1\ Capital^{**} = \beta_0 + \beta_1 * Common\ equity$$

$$Total\ Capital^{**} = \gamma_0 + \gamma_1 * Common\ equity$$

[7] Bankscope provides a classification of banks according to their specialization. For the purpose of the present analysis the following classifications has been considered.

- Commercial banks: mainly active in a combination of Retail Banking (Individuals, SMEs), Wholesale Banking (large corporates) and Private banking (not belonging to groups of saving banks, co-operative banks).
- Cooperative banks: banks that have a cooperative ownership structure and are mainly active in Retail Banking (Individuals, SMEs).
- Saving banks: mainly active in Retail Banking (Individuals, SMEs) and usually belonging to a group of savings banks.
- Private banking & asset management companies: banks mainly active in private banking and asset management.
- Real estates and mortgage banks: mainly active in mortgage financing and project development.

JRC estimates parameters by means of a linear regression, without considering outliers, and then applies them to estimate capitals from common equity.

5. RWA estimates with new capital data

   JRC performs the same computations as those described in Step 1 using data on capital estimated via the above regressions Total regulatory capital ratio estimates.

   For those banks without Total regulatory capital ratio, JRC approximates it with ECB solvency ratios at country level[8].

6. RWA estimates with new ratios

   Repeat the same computations of step 1 to estimate RWA starting from ECB solvency ratios.

Covered deposits are estimated for all banks starting from deposits and applying the coverage ratio estimated by JRC based on DGS data.

2.2.2 Imputations and checks on data from MS

Also data provided by MS have to be processed in order to remove banks with incongruities in the data. Before proceeding with the checks and assumptions, all the banks with some missing data in at least one of the variables necessary to build the database are deleted.

Assumptions to estimate some missing data:

- Common Equity is approximated with the Common equity Tier 1 or, in case the latter is missing, with Tier 1 capital.
- Total capital is approximated with the sum of Tier 1 and Tier 2 capital.
- If data on covered deposits are missing, they are estimated from customer deposits by applying the average coverage ratio estimated at country level by JRC.

The following checks are performed:

- Total assets >Total Capital.
- Total assets >Common equity.
- Total assets > Deposits plus total capital (this is a conservative approach to check that the BRRD base is not negative).
- Deposits > Covered deposits.
- Deposits > 0 (otherwise the ratio loans over deposits cannot be computed).
- Total Capital > 0.

If a bank does not fulfil one of the above constraints, it is removed from the database.

2.2.3 Composition of the final database

Table 5 shows the composition of the final database that has been built using data from JRC sample and from MS. As already mentioned, MS data have been used when all requested data were provided and there is no need for additional details, otherwise JRC sample is used. For 3 MS data are as of 2013 as they claimed these figures are more representative of their banking systems.

Table 5: Data source for each MS for the new database

MS	AT BE BG CZ DE DK EE ES FI FR GB HR IE IT LT LU LV MT PL PT RO SE SK
JRC	HU
MS (2013 DATA)	CY GR NL SI

[8] Available at https://www.ecb.europa.eu/stats/money/consolidated/html/index.en.html

Among the countries that provided a comprehensive database, there are some that did not provide any data on covered deposits: they can be estimated starting from deposits and applying the coverage ratio estimated by JRC based on DGS data, but particular attention should be paid to the concordance of the definitions of deposits employed to estimate the coverage ratio and to report data provided by MS. The list of MS whose covered deposits have been estimated from customer deposits can be found in Table 6.

Table 6: Source of covered deposits

2012 covered deposits estimated from customer deposits	MS data: BE, CY, DE, DK, GR, IE, MT§, PL, GB§, SE* Bankscope data: HU
2012 covered deposits provided by MS	AT, BG, CZ, EE, ES, FI, FR, HR, IT, LT, LU, LV, NL, PT, RO, SI, SK

*Note: * provided data on covered deposits for selected banks only; § covered deposits estimated from customer deposits by applying the coverage ratio computed using 2013 MS data*

The following Table 7 and Table 8 show the composition of the final database in terms of number of banks and amount of total assets for each MS. It is important to stress that the last column in both tables shows the percentage number/amount of total assets corresponding to the removed banks.

Table 7: Final composition of the database in terms of number of banks

Country	Final Data Source used	Number of banks 2012				
		ECB	EBA	Original Db from MS	Final Database	% removed
AUSTRIA	MS data	751	809	703	668	5%
BELGIUM	MS data	103	104	49	45	8%
BULGARIA	MS data	31	31	26	24	8%
CYPRUS	MS data	137	135	13	10	23%
CZECH REPUBLIC	MS data	56	43	23	23	0%
GERMANY	MS data	1869	1737	1799	1740	3%
DENMARK	MS data	161	106	95	70	26%
ESTONIA	MS data	16	16	8	6	25%
SPAIN	MS data	314	302	104	62	40%
FINLAND	MS data	313	313	289	266	8%
FRANCE	MS data	639	381	550	195	65%
UNITED KINGDOM	MS data	373	200	193	177	8%
GREECE	MS data	52	n.a.	25	10	60%
CROATIA	MS data	n.a.	n.a.	27	21	22%
HUNGARY	Bankscope	189	172	172	12	
IRELAND	MS data	472	38	36	31	14%
ITALY	MS data	714	706	627	595	5%
LITHUANIA	MS data	94	18	8	7	13%
LUXEMBOURG	MS data	141	141	111	105	5%
LATVIA	MS data	29	29	20	19	5%
MALTA	MS data	28	28	23	19	17%
NETHERLANDS	MS data	266	122	105	48	54%
POLAND	MS data	695	642	616	245	60%
PORTUGAL	MS data	152	186	145	123	15%
ROMANIA	MS data	39	n.a.	31	25	19%
SWEDEN	MS data	176	113	142	64	55%
SLOVENIA	MS data	23	21	20	17	15%
SLOVAKIA	MS data	28	31	29	12	59%
TOTAL		**7,861**	**6,424**	**5,989**	**4,639**	**26%**

Table 8: Final composition of the database in terms of amount of total assets

Country	Final Data Source used	Total Assets 2012 b€				
		ECB	EBA	Original Db from MS	Final Database	% removed
AUSTRIA	MS data	974	982	903	879	3%
BELGIUM	MS data	1085	1099	996	936	6%
BULGARIA	MS data	45	42	40	39	1%
CYPRUS	MS data	128	111	59*	55*	8%
CZECH REPUBLIC	MS data	192	184	167	167	0%
GERMANY	MS data	8219	8593	8364	8267	1%
DENMARK	MS data	1158	1042	571	567	1%
ESTONIA	MS data	20	19	13	13	5%
SPAIN	MS data	3574	3145	2785	2409	13%
FINLAND	MS data	597	619	582	487	16%
FRANCE	MS data	7712	7128	8555	6466	24%
UNITED KINGDOM	MS data	9553	8678	8679	8365	4%
GREECE	MS data	441	n.a.	330*	317*	4%
CROATIA	MS data	58.063	n.a.	8	7	8%
HUNGARY	Bankscope	107	102		39	
IRELAND	MS data	1124	951	1014	979	3%
ITALY	MS data	4211	3803	3199	3163	1%
LITHUANIA	MS data	24	23	18	17	6%
LUXEMBOURG	MS data	868	735	656	635	3%
LATVIA	MS data	28	28	24.914	24.908	0.02%
MALTA	MS data	53	53	52	28	47%
NETHERLANDS	MS data	2490	2688	2243*	2034*	9%
POLAND	MS data	354	336	302	290	4%
PORTUGAL	MS data	556	508	466	443	5%
ROMANIA	MS data	91	n.a.	74	66	11%
SWEDEN	MS data	1211	1756	1230	836	32%
SLOVENIA	MS data	51	45	39*	37*	7%
SLOVAKIA	MS data	60	56	58	51	12%
TOTAL					**37,614**	**9%**

*Note: * refer to 2013 data*

3. Procedures and methods to build the composite risk indicator and simulate the contributions to be paid to Resolution Funds in the EU

This section provides details on the procedures and methods developed by JRC to calculate the composite risk indicators used as risk adjustment and to allocate the payments of contributions to Resolution Funds in the EU. It also focuses on some relevant technical issues that must be taken into account when preparing the legislation due to the intrinsic statistical characteristics of the dataset.

Section 3.1 provides details on the construction of the composite indicator while Section 3.2 looks at alternative models for the allocation of the risk based contributions.

3.1 From balance sheet data to composite indicator: mathematical steps

According to Articles 94 of the BRRD and 66 of SRM Directive, the contributions banks would have to pay are not only based on their size, but also on their risk profile. This risk profile should account for a number of risky aspects of the banks' functioning which are listed in Article 94 of the BRRD. In order to translate the risk behaviour of each bank into a single numerical measure, JRC computes what in the following will referred to as *risk indicator* or *composite indicator*.[9] In general terms, a composite indicator is a mathematical aggregation of a set of indicators; within this framework, the aggregation is made using a set of balance sheet data and ratios that reflect different behaviours of the banks functioning. A composite indicator has some advantages (a comprehensive list can be found in the link reported in footnote 9), the most relevant is that it can be used to summarise complex or multi-dimensional issues into a single dimension. However, it may also lead to misleading messages if it is poorly constructed and thus a robust statistical analysis is necessary to corroborate its robustness.

In the following the steps used to compute the composite indicator will be detailed, starting from raw banks' balance sheet data from a dataset comprising *N* banks. This composite indicator is used as risk adjustment and combined with the flat base, as detailed in the next section. The balance sheet ratios currently used to compute the risk adjustment in this report are presented in the following Table 9. Ratios which describe similar risk features are grouped into pillars, which are shown in the first column of the Table.

Table 9: Balance sheet ratios used to build the composite indicator.

Pillar	Indicator	Definition
RISK EXPOSURE	RWA/TA	Risk Weighted Assets / Total Assets
	CE/TA	Common Equity / Total Assets
	Cap/RWA	Regulatory Capital/Risk Weighted Assets
STABILITY AND VARIETY OF FUNDING	Loans/Dep	Customer Loans / Customer Deposits
IMPORTANCE OF THE INSTITUTION TO THE STABILITY OF THE FINANCIAL SYSTEM	Share $IB^{+} + IB^{-}$	(Interbank loans + interbank deposits)/Sum of (Interbank loans + interbank deposits) at EU level

Important notes:

1. The list of indicators has been discussed with DG MARKT the Commission Expert Group on Banking Payments and Insurance.[10] Any change in the list of indicators and/or introduction of additional pillars should be carefully assessed and thus the Delegated Acts should contain a revision clause (see also below).

[9] Detailed information on composite indicators can be found at https://composite-indicators.jrc.ec.europa.eu/

[10] The complete list of balance sheet ratios that the Commission has proposed includes

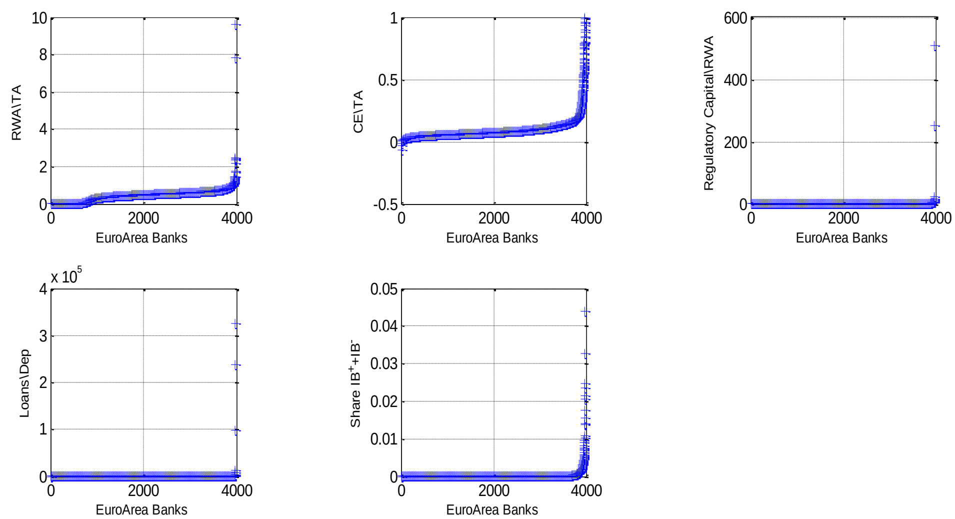
- Pillar risk exposure: Bail-in able funds and Common Equity Tier 1 ratio (in addition to the others);
- Pillar Stability and Variety of Funding: Liquidity Coverage ratio and net Stable Fund ratio (substituting the loan to deposit ratio);
- Additional pillar to the discretion of the resolution authority.

Quantitative data on these ratios are not available and thus cannot be included in the present analysis.

2. The Commission allows the Resolution Authority to include an additional pillar covering other risk factors. It should be noted that the robustness of the composite indicator and its statistical coherence can be undermined if additional indicators are added without a statistical assessment (see also below).

The shape of the distribution of the ratios for the banks in the Euro Area[11] is characterized by the presence of a long tail on the right. Figure 1 shows the values of these ratios for the sample of roughly 3900 banks in the Euro area considered in the JRC analyses, with data as of 2012[12]. Each plot refers to a different ratio, which is plotted on the *y* axis from its minimum to its maximum value; the *x* axis represents the banks in the sample. For all ratios one can observe on the right hand part of the graph a small set of banks with extreme values. This part of the distribution is referred to as a right fat tail.[13,14]

Figure 1: Original values of the balance sheet ratios used for the computation of the risk composite indicator.



In building the composite indicator, the right fat tail and in particular its extreme values should be treated in some way, since their presence could be highly problematic. For instance the fact that most of the range of variation of a ratio is populated by a small number of banks (e.g. the number of banks with CE/TA greater than 40% is roughly 50, representing 1% of the complete sample) can affect the statistical properties of the composite indicators.

The popular ways of treating such tail are:

- Winsorization, i.e. pulling the most extreme values of the ratios back towards the centre of the distribution by substituting extreme values of the indicators with a "limit" value which is high but not extreme;

[11] Similar behaviour is observed for the MS not participating in the Banking Union.

[12] Data for CY, GR and SI, which have been provided directly by these MS, are as of December 2013.

[13] In reality the CE/TA indicator has a right fat tail after being "inverted" to reflect the sign of its influence on total risk, as detailed in step 2 of the procedure for the construction of the composite indicator, presented in the next section. In other words, the problem with this indicator, for which low values are associated with increasing risk, are not too many extremely high but too many extremely low values.

[14] The term refers to the fact that a histogram or probability density function for the indicator would have far more points in the "right tail" (i.e. extremely high values for indicators with "positive sign" and extremely low values for indicators with "negative sign", see step 2 of the composite indicator construction procedure in the next section) than what would be expected in a Normal or Gaussian distribution.

- Discretization, i.e. dividing the points into a number of bins and substituting the original values of the indicators with the order number of the bin to which each point is assigned, thus leading to grouping all extreme values in the top-ranked bin.

The next Section 3.1.1 presents examples of the fat tail treatment. The other steps for constructing the composite indicator are performed after treating the fat tail and are presented in Section 3.1.2.

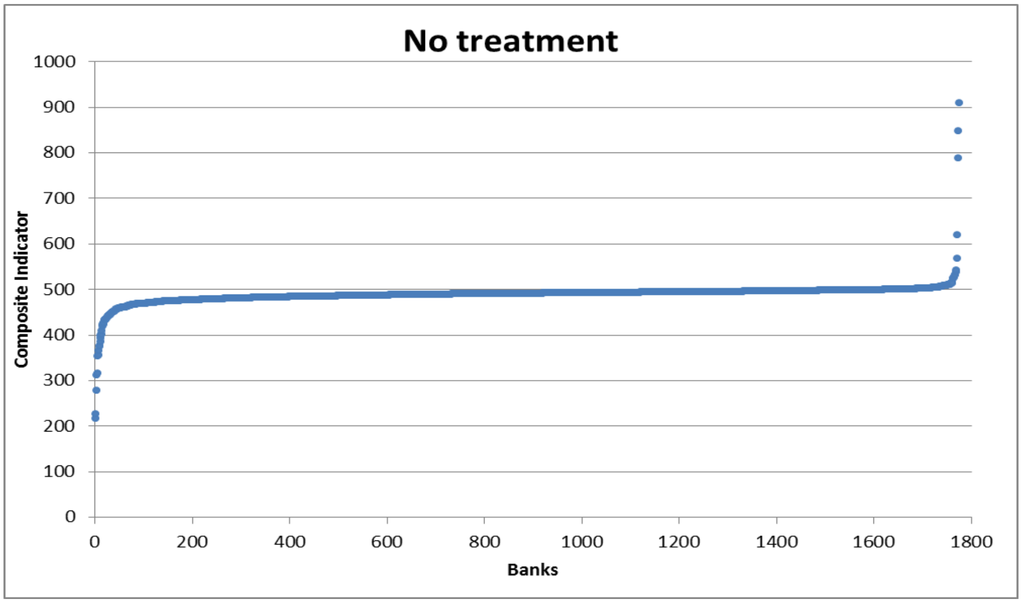
3.1.1 Right fat tail treatment

Doing nothing for treating the right fat tail in the distribution of risk indicators is not an acceptable option as this would mean that:

1. Most of the range available to “score” the indicator in the composite would be occupied by a tiny minority of points;
2. This means that the vast majority of points will be densely packed in a very limited space, concentrating points with “normal” values of the indicator and points with large or very large values, but not as extreme as the most extreme points in the sample;
3. As a consequence, points which are associated with values of the indicator which could normally be considered a sign of high riskiness (e.g. Risk Weighted Assets of more than 80% of Total Assets, or values of Capital to Total Assets below 5%) would receive a very low score and appear not to be “high risk” by comparison to the mass of the sample;
4. On the other hand, only those points that are extremely high in a single dimension, by receiving a single “off scale” score would be assigned a high score for the overall composite, and stand out as the only riskier institutions.
5. As a result, basically all of the sample ends up possessing a set of very low, extremely similar set of values for the indicator (see Figure 2 below), with just a few points receiving a very high value which is very different from the average value for the vast majority of the population. (i.e. it seems that all risk is concentrated in an extremely limited number of banks[15]).

[15] In fact, completely extreme values of the indicators could also be due particular circumstances such as extraordinary operations, or to peculiarities in the implementation of the business model rather than to actual extremely risky behavior

Figure 2: Distribution of the composite indicator for the Euro area with no treatment of the right fat tails of the indicators. Banks are sorted in ascending value of the composite indicator.



As specified above, the two procedures considered to deal with this problem were:

1. Winsorization: the winsorization procedures work by identifying a "cut-off value" which is high but not "too extreme" either using a fixed rule or given the characteristics of the distribution and then substituting it for all values which are greater than the limit.
2. Discretization: the discretization procedure works by identifying an optimal number of buckets or bins in which to divide the points of the sample, then assigning each point to a bucket according to some pre-defined rule, with an identical value being assigned to all points in each bucket.

Both procedures require the identification of a rule to select the cut-off value or the number of buckets. These are common problems tackled in the scientific literature of several different fields and a large number of highly efficient methods are offered, but most of them require discretion by the operator or the performance of highly complex optimization procedures. A choice was therefore made in favor of a transparency and simplicity: the JRC concentrated on methods which would exclude discretion by the operator and keep the need for specialized knowledge to the bare essential. This means that in both cases a simple, accepted, "rule of thumb" for the determination of the cut-off points or the number of bins was adopted, based on the number of points in the sample and their dispersion. Where necessary several commonly employed parameterizations or rules to assign values to buckets where tested.

After an initial phase, three alternative approaches where retained for further testing:

a. A "light" winsorization, where 1% of the points at the top are discarded and substituted with the cut-off value sitting at 99% of the distribution. This is an amount normally advised in statistical manuals to calculate more robust sample statistics.
b. A "strong" winsorization, where 10% of the points at the top are discarded and substituted with cut-off value sitting at 90% of the distribution. This s approach is commonly used with data known to come from distribution with extreme right tails and is employed also by the FDIC to determine the reference ranges to build their own risk indicators.

c. A discretization where the rule for determining the optimal number of buckets is the widely used rule of thumb known as Doane's rule,[16] which provides a number of buckets based on the dimension of the sample and on the size of its right tail. Points are assigned to buckets so that each bucket contains the same number of points (a methodology advised in older scientific literature to discretize distributions with a very heavy right tail). All points in the same bucket are then given the value of the order of the bucket, counting from the left to the right (i.e. points in the leftmost bucket get a value of 1, those in the following bucket get a two …).

A worked out example of how the three methods perform on a single indicator is presented in Annex A.3.

After testing alternative combinations of parameters, discretization seems to be a preferable option, based on the following observations:

Winsorization:

- Is extremely easy to implement
- Both light and strong winsorization are rather efficient in reducing the range of variation of the indicator, but produce a concentration of points at the "cut-off value" and do not fully avoid the problem of extremely penalizing banks which are extreme in a single dimension.
- It does not affect the distribution of points with lower values, this could be seen as good as it limits manipulation of the original data, but this also seems to imply that points that are associated with sensibly different values of the indicator (in terms of its risk implications) are still left "too close";
- A strong winsorization will accentuate the "concentration" of the distribution at the top end, but will result in a smoother distribution in the middle and lower ranges, dealing better with the problems of excess penalization and better discriminating points in the mass of the distribution which are different in terms of their risk implications.
- As a results of these two properties, winsorization, especially the "strong" version, tends to produce a "lumpy" distribution for the composite risk indicators, with banks more or less concentrated in several clumps with very similar values for the indicator. "Light winsorization" will tend to produce clustering towards the lower end of the range, and a small set of institutions possessing a maximum value which is very different from the average of the rest of the population, while "strong" winsorization will tend to produce clustering at the top end.

Discretization:

- Is easy to implement;
- Is extremely efficient in reducing the range of variation of the indicator, at the small cost of assigning an identical value to all points assigned to the same bucket (but points tend to end up in different buckets for different indicators);
- It does affect the distribution of points with lower values. This introduces a further manipulation of the data but seems to be very efficient in discriminating points which are associated with sensibly different values of the indicators (in terms of risk implications), at the cost of introducing a risk of sometimes "separating" points which are very close in terms of risk implications;
- As a result of these two properties, it tends to produce a very "smooth" distribution for the composite risk indicator, with banks spread out over a larger range of values. This approach guarantees that institutions which possess a single extreme value are grouped in the top ranked bin, which is not too far away from the bin with values higher than the average of the overall population, but not so extreme.

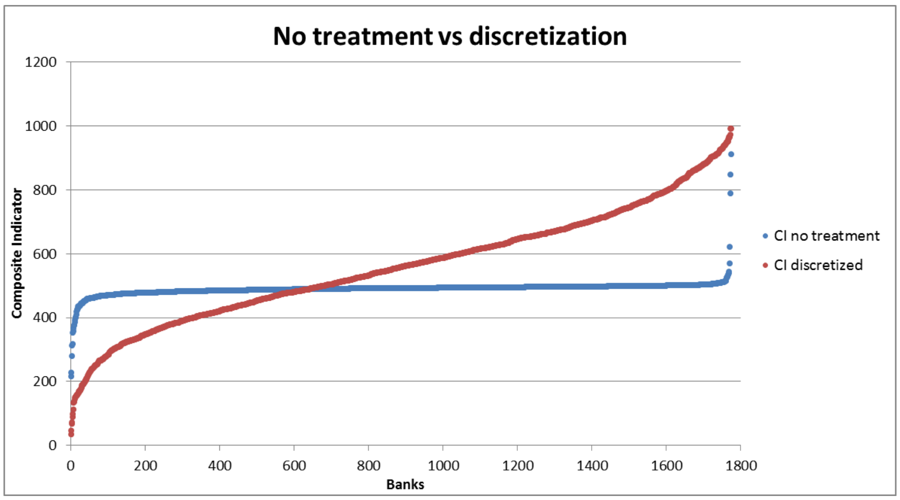
[16] Alternative rules were considered, but based on results and on a review of the literature they were discarded.

Table 10: Qualitative comparison between winsorization and discretization.

Method	Ease	Reducing range of variation	Discriminate close points with different risk	Risk of penalizing close points with not too different risk	Reducing extreme penalization for single extreme values	Smoother distribution of composite and of contributions
Winsorization (light)	++	+	+	0	0	+
Winsorization (strong)	++	++	+	-	+	-
Discretization	+	++	++	-	+	++

An example of the impact of discretization on the final distribution of the indicator is provided in Figure 3.

Figure 3: Distribution of the composite indicator for the Euro area with discretization treatment of the right fat tails of the indicators.



Important notes:

As a final remark, it has to be noted that all methods have the "double hedged" advantage of not needing a calibration to a set of absolute values which could be seen as conflicting with supervisory prescriptions (i.e. if the cut-offs are set at levels which some supervisors might consider with a different view), but at the same time cannot be based on some absolute threshold which is known to be risky based on empirical or theoretical observations.

Technical details for Discretization:

Doane's rule give the number of buckets as:

$$k = 1 + \log_2(n) + \log_2\left(1 + \frac{|g_1|}{\sigma_{g1}}\right)$$

where:

$$\sigma_{g1} = \sqrt{\frac{6 * (n-2)}{(n+1) * (n+3)}}$$

with *n* being the number of points in the sample, and g1 is the sample skewness, defined as:

$$g_1 = \frac{m_3}{s^3} = \frac{\frac{1}{n}\sum_{i=1}^{n}(x_i - \bar{x})^3}{\left[\frac{1}{n-1}\sum_{i=1}^{n}(x_i - \bar{x})^2\right]^{3/2}}$$

where $\bar{x}$ is the sample mean.

In case the number of points cannot be exactly divided by the number of buckets, a number of buckets equal to remainder, starting from the first on the left, is given an additional point. (e.g. if there are 3500 points and Doane's rule suggests to use 18 buckets, 194 points should be assigned to each bucket, with a remainder of 8. Thus the first 8 buckets from the left would be assigned 195 points, and all other 194, giving a total of 3500).

3.1.2 Steps to build the composite indicator

A composite indicator is built combining individual indicators: in this specific case balance sheet ratios of each individual bank are the starting points and the aim is to obtain a single measure of its risk, at a given point in time (the reference year is December 2012[17]). As detailed above, all the steps described in the current section are performed after the fat right tail treatment.

Each indicator is associated with a sign (+1 or -1): sign +1 means higher values of the indicator are riskier, sign –1 means higher values are safer. Table 11 (column C) shows the signs for the indicators used in the aggregation.

Indicators within the various pillars are assigned weights (columns D) according to the importance of each indicator within the pillar. The sum of the weights of the indicators within each pillar must be 1. In this specific case to assess the risk exposure of each bank, the risk-weighted asset ratio and the leverage ratio are assigned equal weights. The other two pillars contain a single indicator with weight 100%.

The various pillars are assigned the weights in the last column of Table 11.[18] The sum of the weights over all pillars must be 1.

In the remainder of this report the following will hold true:

- *n=1,2,….N* will indicate the banks in the sample*;*
- *j=1,…,J* will indicate the pillars (in this case *J*=3);
- *i=1,…, I* will indicate the ratios;
- $I_{i,j,n}$ will indicate the value of indicator *i* of pillar *j* for bank *n*;

Table 11: Signs and weights of the indicators/pillars. Signs and weights based on DG MARKT expert judgment.

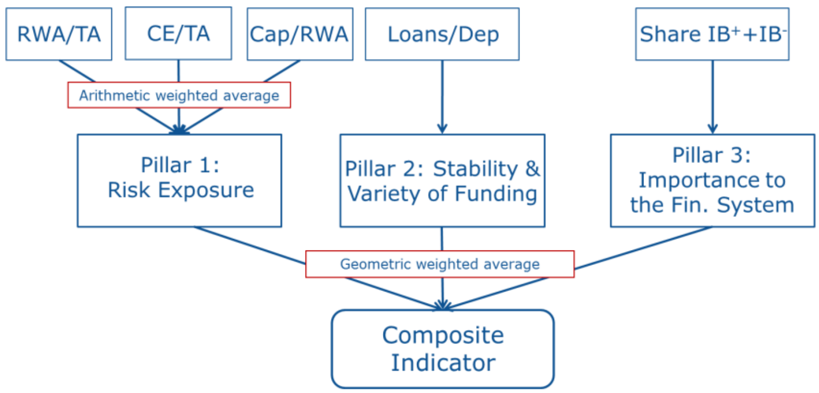
A	B	C	D	E
Pillar $PI_{j,n}$	**Indicator $I_{i,j,n}$**	**Sign $s_{i,j}$**	**Weight of Indicator $w_{i,j}$**	**Weight of Pillar W_j**
RISK EXPOSURE	RWA/TA	+1	33.3%	62.5%
	CE/TA	-1	33.3%	
	Cap/RWA	-1	33.3%	
STABILITY AND VARIETY OF FUNDING	Loans/Dep	+1	100%	25%
IMPORTANCE OF THE INSTITUTION TO THE STABILITY OF THE FINANCIAL SYSTEM	Share $IB^+ + IB^-$	+1	100%	12.5%

[17] A statistical analysis of the composite indicator based on a panel of data covering more years would help corroborating the robustness of the composite indicator.

[18] DG MARKT provided the JRC with a set of weights covering also the additional ratios and pillars. Since some of the indicators from this list are excluded from the analysis due to lack of data, the weights of the remaining are rescaled to sum to 1.

In general terms, first information within each pillar is aggregated into a single pillar-indicator ($PI_{j,n}$) using the weights of the indicators; then the pillars are combined into the final composite indicator using the weights of the pillars (CI_n). Figure 4 exemplifies such two-steps aggregation for our specific set of indicators and pillars.

Figure 4: Aggregation of the ratios/pillars presented in Table 9.



A more detailed description of how to build a robust composite indicator can be found in OECD/EC JRC (2008) (see the list of references at the end of Annex A.1).

- **Step 1: normalization via re-scaling**

Each indicator is rescaled over the range [1-1000] to make all the ratios comparable. The rescaled indicator *RI* for each *i*, *j* and *n*:

$$RI_{i_j,n} = (1000-1) * \frac{I_{i_j,n} - \min_n I_{i_j,n}}{\max_n I_{i_j,n} - \min_n I_{i_j,n}} + 1 \qquad (\textit{formula 1})$$

The *min* and the *max* are taken over all banks in the Euro area for MS participating to the Banking Union and over all banks in the national systems for the remaining MS.

In this way, all indicators are in a common range of values and can be aggregated in a single composite indicator without having to worry about different ranges and scales or measurement units.

The choice of such range depends upon two technical points:

1. a large range amplifies differences between different values of a ratio.

2. having an interval which excludes the value 0 is necessary as the formula aggregating various pillars (see step 4) multiplies the values of the ratios and thus having a single ratio equal to 0 would imply having the whole composite indicator equal to 0, irrespective of the values of the other indicators.

- **Step 2: inclusion of the sign assigned**

The following transformation, to account for the sign of the various indicators $s_{i,j}$ is applied:

$$TRI_{i_j,n} = \begin{cases} RI_{i_j,n} & if\ s_{i_j} = -1 \\ 1001 - RI_{i_j,n} & if\ s_{i_j} = 1 \end{cases} \qquad (\textit{formula 2})$$

This ensures that all Transformed Rescaled Indicators will be higher for safer banks and smaller for riskier banks. This step is necessary in the light of step 4, which aggregates the pillars via a geometric average: one of the properties of this averaging approach is that it is more sensitive to small values and to their changes. As the final composite indicator is meant to capture "bad performances", indicators with positive signs must be reverted in order to have smaller values for riskier banks.

- **Step 3: Aggregation WITHIN pillars**

  A weighted arithmetic average is employed to aggregate the ratios within each pillar and obtain a single value describing the risk that each pillar aims to capture. In our case this aggregation is performed only for the risk exposure pillar which contains three indicators:

  $$PI_{j,n} = \sum_{i_j=1}^{N_j} w_{i_j} * TRI_{i_j,n} = w_{1_j} * TRI_{1_j,n} + \dots + w_{N_j} * TRI_{N_j,n} \qquad (\textit{formula 3})$$

  where w_{i_j} is the weight of indicator *i* in pillar *j* (column D of Table 11) and N_j is the number of indicators within pillar *j* (in our case 3).

  The use of the arithmetic average allows for full compensability among the indicators (see also Annex A.2). This means that for example a high value of RWA/TA ratio can be compensated for by sufficiently high value of CE/TA. In Section 2.3 potential problems that this type of aggregation can imply are discussed.

- **Step 4: Aggregation BETWEEN pillars**

  The composite indicator for each bank *n* is obtained by a geometric weighted average among the various $PI_{j,n}$:

  $$CI_n = \prod_j PI_{j,n}^{W_j} = PI_{1,n}^{W_1} * \dots * PI_{J,n}^{W_J} \qquad (\textit{formula 4})$$

  where W_j is the weight of pillar *j* (column E of Table 11) and J is the number of pillars (in our case 3).

  In our specific case, this means considering the aggregated value of RWA/TA, CE/TA and Cap/RWA and combine this single value with the other two indicators. Using a weighted geometric average among pillars has the advantage of not allowing for full compensability, since the ratios are multiplied by each other. There are other desirable properties of the geometric average with respect to the arithmetic average, which will be detailed and exemplified in Annex A.2 below.

- **Step 5: computation of the final composite indicator**

  As the final composite indicator must be meant as "the higher the riskier", the following transformation is applied:

  $$CI_n = 1000 - CI_n. \qquad (\textit{formula 5})$$

  A worked example of how these steps should be applied is presented in Annex A.1.

3.1.3 Other technical issues

When building a composite indicator, there is a need to perform statistical checks on the data to confirm for instance the coherence in the signs assigned to the indicators and in the weights chosen for the indicators/pillars. There is an extensive scientific literature on composite indicators (see the list of references).

This section presents to a non-technical reader the most important technical issues that need to be taken into account when building the composite indicator.

Beyond the issue of the fat right tail that is already discussed in Section 3.1.1, another important point to be considered is the **correlation structure between the indicators**. There is a number of reasons why correlation should be carefully taken into account when deciding on how to build a composite indicator. The most important ones are the following.

- Correlation analysis helps understanding if indicators are grouped into pillars correctly. For instance, a very low correlation between indicators within the same pillar suggests that these indicators may not be capturing the same aspect.
- Correlation analysis also helps assigning correct weights to the various indicators/pillars. In this respect it is common to distinguish between ***nominal weights***, i.e. the weights assigned a priori to indicators/pillars by expert judgment, and ***effective weights***, the real importance of the various indicators/pillars in the final composite indicator. The latter can be measured using statistical tools such as sensitivity analysis. It is not rare to have effective weights that differ substantially from nominal weights. For instance, the presence of high correlation between ratios in different pillars can enhance their importance in the composite indicators and thus can drive effective weights to be substantially different than the assigned nominal weights.

Table 12 shows the correlation matrix estimated using the sample of data for large banks[19] (the distinction between small and large banks will be clarified in Section 4 and subsequently where contributions are presented, as different treatments are applied to small and large banks). Data show the existence of a non-negligible positive correlation (0.44) between the two ratios (RWA/TA and CE/TA) included in pillar 1 (risk exposure). This fact, coupled with the opposite sign attributed to these indicators, reduces the effective importance of such pillar in the whole composite indicator.

Important notes:

1. JRC would thus suggest considering an aggregation without grouping into pillars, performed via geometric weighted average on the 5 indicators, should this positive correlation persist in the official data used for the calculation.
2. Due to these technical issues, JRC believes that it is fundamental that additional indicators/pillar are statistically assessed before being included in the risk adjustment for (S)RF contribution. Including an additional single indicator may change the relative importance of the others and affect the statistical coherence of the whole composite indicator. JRC suggests that data on the additional indicators that the supervisory authority may include are collected yearly among all banks in order to perform statistical analyses on an extended dataset.
3. JRC suggests performing a robust statistical assessment on the composite indicator based on a panel of data covering more years. These statistical checks could be performed yearly when new data will become available and additional/new indicators should be introduced.

Table 12: Correlation matrix between the indicators currently used. Note that the correlation is a rank correlation (best practice in the assessment for composite indicator construction).

	Sign of indicator	+	-	-	+	+
		RWA/TA	**CE/TA**	**Cap/RWA**	**Loans/Dep**	**Share $IB^+ + IB^-$**
RWA/TA	+	1	0.44	-0.55	0.12	-0.30
CE/TA	-	0.44	1	0.26	0.15	-0.22
Cap/RWA	-	-0.55	0.26	1	-0.04	0.09
Loans/Dep	+	0.12	0.15	-0.04	1	0.18
Share $IB^+ + IB^-$	+	-0.30	-0.22	0.09	0.18	1

3.2 Formulas to determine risk-based contributions

The contribution to the Fund to be paid by large banks should include a risk-based element, obtained aggregating indicators as described in the previous Section. Risk-based contributions could be determined according to some

[19] According to DG MARKT definition adopted in the current exercise, big banks are those with base for contribution to (S)RF larger than 300 m€ or with total assets larger than 1 b€.

different formulas, depending on the way the base for contributions and the risk adjustment are combined. After examination by the JRC and presentation to the Commission Experts Group on Banking Payments and Insurance three models were retained as alternatives for the final exact mechanism for risk adjustment:

1. A Multiplicative model which rescales the composite risk indicator into a given range (Model A - MA)
2. A Multiplicative model using an exponent on risk to assign relative weights to the size-based and risk-based parts (Model O - MO)
3. A hybrid model summing a purely size-based component and a risk-adjusted component (the latter based on a multiplicative formula) (Model H - MH).

The next Sections focus on the main properties of these models. The following notation is adopted for all the models:

- *Target* is the total annual target that should be collected, excluding the amount collected from small banks (lump sums, as detailed in Section 4).
- B_i is the amount of the total liabilities, excluding own funds and covered deposits for bank *i*, (i.e. the so called BRRD base).
- R_i: it is the risk correction for bank *i*, i.e. the composite indicator computed as detailed in the previous Section.
- *Pure flat contribution* is the contribution which would be paid by each bank in the absence of a risk adjustment. This is given by the share of the BRRD base owned by the bank within the Euro area or within the non-participating MS, multiplied by the target:

$$p_i = Target * \underbrace{\frac{B_i}{\sum_j B_j}}_{\substack{\text{Share of the BRRD base of bank i} \\ \text{in the banking system (€-area or MS} \\ \text{not participating to the BU)}}} = Target * \frac{B_i}{B_1 + \cdots + B_N}$$

where *N* is the number of banks in the Euro area or number of banks at national level for the non-participating MS.

In all of the following discussion, it should be noted that the contribution for any bank depends upon the risk and bases of *all* the others: as a pre-assigned total has to be divided between a set of institutions, what counts are exclusively ***relative*** size and risk. In other words, starting from a situation where the target is exactly reached, increasing/decreasing the riskiness for even only one bank would imply a change to its risk contribution which in turn would generate an overshooting/undershooting of the target. This would require the amount of the overshooting/undershooting to be divided between all other banks, proportionally to what they are already paying, and cause a variation of the contributions of all the banks which did not vary their absolute risk. This re-adjustment to the target is given in all models by the so-called normalization terms, which are included in the denominators.

3.2.1 Multiplicative – Model A

In the first model the composite indicator is rescaled into a pre-defined range [*Rmin, Rmax*] which specifies the ideal maximum penalization and discount to be awarded to the most risky and least risky banks in the sample. This rescaled risk indicator will be labelled as $\tilde{R}_i$ and the transformation applied to the composite indicators obtained is:

$$\tilde{R}_i = (Rmax - Rmin) * \frac{CI_i - \min_i CI_i}{\max_i CI_i - \min_i CI_i} + Rmin$$

where CI_i is the value of the composite indicator for bank *i* obtained via *formulas 4 and 5* above and the *min*/*max* are taken over all banks in the Euro area for MS participating to the Banking Union and over all banks in the national systems for the remaining MS.

The general expression to compute contributions c_i that bank *i* would pay to the RF under the multiplicative *model A* is the following:

$$c_i = Target * \frac{\frac{B_i}{\sum_j B_j} \cdot \tilde{R}_i}{\sum_j \left(\frac{B_j}{\sum_k B_k} \cdot \tilde{R}_j \right)}$$

where $\frac{B_i}{\sum_j B_j}$ is the "flat component", or the share of the target that would be paid by each institution under a "pure flat" contribution based exclusively on the BRRD base unadjusted for risk. [20]

The denominator $\sum_j \left(\frac{B_j}{\sum_k B_k} \cdot \tilde{R}_j \right)$ is the "normalization term" which again is identical for all banks within the Euro area or non-participating MS and assures that the target is met exactly.

The range of variation of $\tilde{R}_i$, where the composite indicator is rescaled, could be set for instance to [0.8, 1.5]. This choice would imply that, before applying the normalization term to assure reaching the target, the highest risk bank would see its pure flat contribution increase by 50%, while the least risky bank would see its pure flat contribution decreased by 20%.

One should note that, given necessity of renormalization to meet the pre-determined target, the final range of discounts and penalizations will not coincide with those implied by the initial rescaled range of the composite risk indicator. By way of example on Euro Area data (where indicators are discretized), rescaling R_i on [0.8, 1.5] yields a final range of ratios 0.604-1.133 (or an implied maximum discount of about 40% and maximum penalization of about 13%). However, the ratio of the final maximal discount to the final maximal penalty will be the same as those imposed in the initial range: in other words: $\frac{1.133}{0.604} = \frac{1.5}{0.8} = 1.875$.

As a final remark, it should be noted that, given this property, the exact extremes of the range actually become unimportant, as only their ratio determines the final ratio of the maximum adjustments which are applied under the constraint of having to meet the target. In other words, in the above case, imposing an initial range of [0.8, 1.5] or of [1, 1.875] or of [0.6, 1.125] would always result in a final maximal discount of 40% and maximal penalty of 13% (i.e. the range of [0.604, 1.133] after renormalization).

3.2.2 Multiplicative – Model O

The general expression to compute contributions c_i that bank *i* would pay to the (S)RF under the multiplicative *model O* is the following:

$$c_i = Target * \frac{B_i \ * R_i^{\beta}}{\sum_j B_j \ * R_j^{\beta}} = Target * \frac{B_i \ * R_i^{\beta}}{B_1 \ * R_1^{\beta} + \cdots + B_N \ * R_N^{\beta}}$$

where β is a parameter assigning a "weight" to the risk component vis-à-vis the size component. In theory, an exponent could be applied also to the size component. However, theoretical reasons suggest that an exponent of 1 is the best choice for size.[21]

[20] It should be noted that the two $\sum_j B_j$ terms in the numerator and denominator cancel out, so that calculating the contribution based on the share of the BRRD base or on the absolute BRRD base is indifferent. However, this method of presenting the indicator highlights that the risk factor multiplies the "pure flat" contribution by a risk factor and then re-normalizes the result in order to exactly reach the target.

[21] An exponent equal to 1 grants that given a certain relative increase in size of the institution its contribution will increase by the same relative amount, before the normalization to reach the target is applied. Moreover, empirical tests showed that an exponent different from one would make the whole indicator overtly sensitive to changes in both size and risk. The relative weight of risk vis-à-vis size is roughly given by the ratio of β to $1+\beta$ but this does not take into account the renormalization term.

The denominator is the "normalization term" which is identical for all banks within the Euro area or non-participating MS and ensures that the sum of the risk-based contributions will be exactly identical to the given target.[22]

The exponent β can be calibrated to produce the desired distribution of contributions between banks, based on their relative riskiness. Given that the target must be reached, similarly to the range of $\tilde{R}_i$ in MA, the exponent cannot be used to reach any desired distribution, or to reproduce a given target "penalization" or "discount" in absolute terms, but it can be calibrated to reproduce a desired ratio between the maximum penalization and the maximum discount. For instance, it cannot ensure that the riskiest banks will be penalized by, say, 50%, but it can be calibrated to ensure that if two banks have the same size and one has the maximum risk value, and the other the minimum, the risky one will pay roughly 50% more than the safe one after renormalization.

The calibration needs to be performed via a numerical optimization procedure, the exact result of which will depend on the joint distribution of risk and size within the sample considered (e.g. Euro area banks or national banks in a non-participating MS). While an exponent of 0.4-0.5 seems able to reproduce a final distribution of outcomes similar to that obtained by using a [0.8, 1.5] range in MA, there is no theoretical guarantee that this could be equally valid across all MS and over time, especially for non-participating MS with a limited number of banks contributing to their fund.

3.2.3 Hybrid formula - Model H

The general expression to compute contributions c_i that bank *i* would pay to the RF under the additive model is the following:

$$c_i = Target * \left(\alpha * \frac{B_i}{\sum_j B_j} + (1-\alpha) * \frac{B_i \; * R_i^{\beta}}{\sum_j B_j \; * R_j^{\beta}} \right)$$

All the variables have the same meaning as above:

$\frac{B_i}{\sum_j B_j}$ is the share of the "pure flat" contribution

$\frac{B_i \; R_i^{\beta}}{\sum_j B_j \; R_j^{\beta}}$ is a risk-adjustment component, which is based on the MO model. [23]

α is the weight assigned to the "pure flat" term, while $(1-\alpha)$ is the weight assigned to the risk-adjusted term, which is based on both size and risk.[24] In order to fulfil the constraint that all banks contributions c_i must sum up to the target, α must lie between 0 and 1. An α offset to 0.8 or 0.85 has been discussed in the Commission Expert Group on Banking Payment and Insurance.

It should be noted that in this model the normalization term is included only in the risk adjustment term (i.e. the term after the 1-α). This model has therefore two properties which set it aside from purely multiplicative models:

1. Risk-based contributions will never be able to go below α times the pure flat contribution which would be paid in the absence of risk adjustment, so that the maximum discount vis-a-vis the pure flat contribution in

[22] It should be noted that, when the exponent of the base is set to one, the absolute BRRD base B_i could be substituted with the "flat component" $\frac{B_i}{\sum_j B_j}$ and the results would be exactly the same. In this sense, the risk factor with its exponent can be seen as a modifier to the "pure flat" contribution, exactly like $\tilde{R}_i$ in model MA.

[23] A correction terms based on model MA is also possible, but this was seen to possess inferior properties as it requires an excessively large scale for the risk component in order to produce reasonable results.

[24] A purely additive model where the size component did not enter the risk adjustment was tested at the beginning of the process and excluded because of its property of penalizing excessively small banks due to lack of consideration of the size component when adjusting for risk. This risked generating risk-based contributions which were up to several times larger than the pure flat contribution for small banks.

this model is hard-wired to be $(1-\alpha)$ (i.e. if α = 80%, then no bank can ever get a discount bigger than 20% after normalization, even if contributions from all banks would need to be reduced in order to meet the target). Given that there is a constraint to reach a target, this will also introduce an implicit constraint to the maximum penalty which would be assigned to the most risky banks (i.e. if some low risk banks are already enjoying the maximum discount and a risky bank increases its risk, the surplus payment this generates cannot be attributed to the low risk bank which is already enjoying the maximum discount);

2. Any overshooting or undershooting will therefore not be distributed between banks proportionally to what they are already paying, but will insist more on banks which are "far" from enjoying their maximum discount. This implies that, in case of a massive overshooting caused by the presence of some very risky banks, the less risky banks will be prevented from enjoying a large discount, and the risky banks will not be able to be penalized too much in order to allow the system to stay on target (i.e. : the reduction which cannot be attributed to the low risk banks enjoying maximal discounts will need to be re-distributed to the others, including the risky bank who generated the surplus by increasing their contributions, thereby mitigating the impact of their risk increase). On the upside, a massive shortfall caused by a widespread low riskiness of the largest banks in the system would in theory be somehow capped under this model. However, it has to be noted that since there is a rather strong positive association between size and risk, it does not seem likely that the largest banks would be able to enjoy the lowest risk adjustments.

The exponent of the risk adjustment factor can be calibrated using a numerical procedure, as per model MO. However, the fact that only a limited part of the contribution is subject to risk adjustment will impose a trade-off between being able to reach the same ratios between the maximal penalty and discount and not making the model become very sensitive to changes in risk. In other words, in order for the risk-adjustment component to have a relatively large impact on contributions, an extremely high exponent would have to be chosen at the start of the collection period, potentially leading the model to being over-sensitive to changes in risk over time. Moreover, the fact that only part of the contribution is subject to renormalization makes MH potentially even more sensitive to changes in the joint distribution of risk vs. size.[25]

3.2.4 Main properties of the models and comparison

JRC would suggest the adoption of model MA based on the following observations:

- MA can be calibrated just by setting limits of the rescaled risk range to coincide with maximal desired penalization and discount for risk adjustment.
- MH and MO need to be calibrated by a numerical procedure and calibration differs depending or range/distribution of risk AND size;
- In MA normalization will automatically shift this range but leave the ranking and the shares of contributions on the total untouched. It will also assure that the ratio between maximal discount and penalty after normalization will be identical to the ratio of the extremes of the range before normalization;
- MA will therefore allow knowing final ratio of adjustments, even after calibration, just by knowing the max and min risk adjustments;
- In MH normalization will alter relative position of risk-based contributions (generally by "compressing" relative position of top);
- In MA and MO surpluses or shortfall due to a change in the riskiness of a single bank will be distributed across all banks which did not change their indicators proportionally to their pre-change contribution payments (i.e. all unchanged banks will see their contributions vary by an identical percentage);
- In MH, "bottom" of range has a "hard" limit which is not affected by normalization, but "top" is also severely limited and either makes model "insensitive" to risk, or needs an extremely strong risk exponent in the risk adjusted component;

[25] In "toy models" one could observe cases where the ideal exponent to reach a desired ratio between the maximal penalty and discount would change fourfold in response to a dramatic change in the joint distribution of risk and size (namely, an inversion of riskiness between the largest and smallest banks in the sample). While this is an extremely unlikely event in reality, nonetheless this behaviour was not observed in the calibration of MO.

- While the absence of a "hard limit" in MA and MO would allow a theoretical risk of allowing the largest banks to enjoy the lowest risk indicators and thus push smaller banks to pay a large share of the contributions, this seems unlikely given the distribution of the indicator (though it cannot be ruled out a-priori).

Table 13: Qualitative comparison of the characteristics of alternative models for the calculation of contributions

	MA	MO	MH
Ability to fix (or ease of calibration) a desired ratio of maximal penalty to maximal discount w.r.t. pure flat contribution	++	+	-
Ability to fix (or ease of calibration) of minimal contribution w.r.t. pure flat contribution	-	-	++
Proportionality in distribution of surpluses and shortfalls due to variation of other banks' characteristics	++	++	0
Maintenance of relative contributions and shares of contributions after application of normalization term	++	++	-
Strength of implicit limits to setting maximal discount and penalty w.r.t. pure flat contribution	0	-	- -
Maintenance of incentives to decrease riskiness for most risky banks	-	0	0
Risk of applying different risk based contributions to banks with similar size and risk profiles	-	0	+
Risk of non-well adapted calibration to different areas or over time periods	0	-	-

Figure 5: A toy example of the properties of the different models under changes to the "distribution" of BRRD bases and risks.

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(a) Brrd base
(b) Risk Composite
(c) Risk Adjusted contribution, before normalization
(d) Ratio of top to bottom payer
(e) Risk adjusted contribution, after normalization
(f) Ratio of top to bottom payer
(g) Ratio of risk adjusted after normalization to pure flat fee
(h) Ratio of maximal penalty to maximal discount, after normalization
(green) Changed values with respect to baseline (top left)

<u>Exponents of MO, MH, calibrated to reproduce ratio of maximal penalty to maximal discount obtained in MA model with range 0.8-1.5</u>

Model MA range **0.8 - 1.5**

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Bank1	700	20	105	*4.375*	81.39535	*4.375*	1.162791	*1.875*
Bank2	300	10	24		18.60465		0.620155	

Model MO Exp. **0.9**

(c)	(d)	(e)	(f)	(g)	(h)
1037.59	*4.354154*	81.32291	*4.354*	1.161756	*1.866*
238.298		18.67709		0.62257	

Model MH alpha **0.8** Exp. **8**

(c)	(d)	(e)	(f)	(g)	(h)
3.6E+11	*597.3333*	75.96657	*3.161*	1.085237	*1.355*
6E+08		24.03343		0.801114	

Model MA range **0.8 - 1.5**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
900	20	135	*16.875*	94.40559	*16.875*	1.048951	*1.875*
100	10	8		5.594406		0.559441	

Model MO Exp. **0.9**

(c)	(d)	(e)	(f)	(g)	(h)
1334.042	*16.79459*	94.38032	*16.795*	1.04867	*1.866*
79.43282		5.619684		0.561968	

Model MH alpha **0.8** Exp. **8**

(c)	(d)	(e)	(f)	(g)	(h)
4.61E+11	*2304*	91.99132	*11.486*	1.022126	*1.276*
2E+08		8.008677		0.800868	

Model MA **0.8 - 1.5**

	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
Bank1	700	10	56	*1.244444*	55.44554	*1.244*	0.792079	*1.875*
Bank2	300	20	45		44.55446		1.485149	

Model MO Exp. **0.9**

(c)	(d)	(e)	(f)	(g)	(h)
556.03	*1.250402*	48.56847	*1.172*	0.793764	*1.866*
444.681		41.43863		1.481217	

Model MH alpha **0.8** Exp. **8**

(c)	(d)	(e)	(f)	(g)	(h)
1.4E+09	*109.7143*	56.18065	*1.282*	0.802581	*1.82*
1.5E+11		43.81935		1.460645	

Model MA **0.8 - 1.5**

(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)
900	10	72	*4.8*	82.75862	*4.8*	0.91954	*1.875*
100	20	15		17.24138		1.724138	

Model MO Exp. **0.9**

(c)	(d)	(e)	(f)	(g)	(h)
714.8954	*4.822981*	82.82666	*4.823*	0.920296	*1.866*
148.2269		17.17334		1.717334	

Model MH alpha **0.8** Exp. **2.3**

(c)	(d)	(e)	(f)	(g)	(h)
3663.472	*1.856648*	84.99879	*5.6661*	0.944431	*1.588*
1973.165		15.00121		1.500121	

4. Analysis of banks' contributions – focus on small banks

This section and the following ones present numerical results on the contributions of banks to the SRF. This section focuses on small institutions, while Sections 5 and 6 deal with different aspects related to large institutions.

A bank is considered as a *small bank* if it meets two cumulative conditions: BRRD base (defined as total liabilities excluding own funds and covered deposits) below 300 million € and Total Assets below 1 billion €. A special treatment consisting in a lump sum annual payment is applied to small banks in view of their lower need to access the resolution financing arrangements compared to that of large institutions. Before detailing how the lump sum system works, Table 14 presents some statistics on the set of small banks within each economic area. This table shows the number of small banks, the amount of their total assets and BRRD bases and their shares with respect to the whole dataset. According to these figures, in the euro area small banks represent 55% of the banks, 1.7% of total assets and 1% of the BRRD base. Nevertheless, MS are rather heterogeneous: small institutions can represent as much as 93% of the total banking system in Finland and as little as 7% in Ireland; in terms of total assets and BRRD base they can represent as much as 37% in Croatia and as little as around 0.1% in Spain, Ireland, the Netherlands and United Kingdom.

Table 14: Statistics on small banks, sample figures

Economic area	Number of banks			Total Assets			BRRD base		
	All banks	Small banks	Small banks (as % of total number of banks)	All banks (th €)	Small banks (th €)	Small banks (as % of TA all banks)	All banks (th €)	Small banks (th €)	Small banks (as % of BRRD base all banks)
AT	668	575	86.1%	879,305,789	105,728,335	12.0%	610,421,541	34,978,834	5.7%
BE	45	11	24.4%	935,583,114	3,465,139	0.4%	588,932,347	1,690,438	0.3%
CY	10	1	10.0%	54,850,025	531,294	1.0%	26,162,767	270,127	1.0%
DE	1740	859	49.4%	8,266,923,037	203,737,392	2.5%	6,159,144,464	107,629,466	1.7%
EE	6	3	50.0%	12,797,090	510,163	4.0%	6,274,212	231,530	3.7%
ES	62	15	24.2%	2,409,149,066	3,467,520	0.1%	1,529,801,692	1,359,232	0.1%
FI	266	246	92.5%	486,844,150	35,094,280	7.2%	394,116,010	8,962,910	2.3%
FR	195	75	38.5%	6,466,453,443	11,444,101	0.2%	5,265,822,355	6,499,658	0.1%
GR	10	3	30.0%	316,886,598	750,742	0.2%	169,938,198	259,010	0.2%
IE	31	2	6.5%	978,971,513	925,474	0.1%	833,190,116	535,585	0.1%
IT	595	263	44.2%	3,162,595,451	56,974,526	1.8%	2,338,762,774	34,245,608	1.5%
LT	7	3	42.9%	16,878,730	660,783	3.9%	9,559,361	377,353	3.9%
LU	105	21	20.0%	634,960,991	5,016,354	0.8%	559,634,807	2,928,011	0.5%
LV	19	7	36.8%	24,908,053	1,655,150	6.6%	16,221,678	1,079,816	6.7%
MT	19	7	36.8%	27,510,463	588,009	2.1%	15,733,147	325,694	2.1%
NL	48	8	16.7%	2,033,738,687	2,654,584	0.1%	1,488,773,348	946,954	0.1%
PT	123	98	79.7%	442,544,164	15,134,910	3.4%	279,930,483	3,264,986	1.2%
SI	17	4	23.5%	36,853,241	2,321,050	6.3%	19,125,053	604,395	3.2%
SK	12	2	16.7%	50,806,559	849,048	1.7%	21,330,174	202,059	0.9%
Euro area	**3,978**	**2,203**	**55.4%**	**27,238,560,163**	**451,508,854**	**1.7%**	**20,332,874,525**	**206,391,668**	**1.0%**
BG	24	10	41.7%	39,270,243	3,933,947	10.0%	15,865,362	1,637,241	10.3%
CZ	23	3	13.0%	166,882,156	1,240,178	0.7%	88,993,553	218,517	0.2%
DK	70	38	54.3%	566,547,859	7,964,072	1.4%	377,124,381	2,995,186	0.8%
HR	21	15	71.4%	7,012,864	2,563,948	36.6%	5,957,418	2,184,727	36.7%
HU	12	5	41.7%	39,384,364	828,420	2.1%	26,148,415	445,561	1.7%
PL	245	210	85.7%	289,793,612	11,329,352	3.9%	183,366,909	6,615,035	3.6%
RO	25	8	32.0%	65,695,654	1,402,626	2.1%	33,293,416	628,494	1.9%
SE	64	43	67.2%	836,497,962	14,341,859	1.7%	605,233,004	5,099,237	0.8%
GB	177	62	35.0%	8,364,505,719	14,211,076	0.2%	7,008,941,282	9,165,757`	0.1%

4.1 Lump-sum system for small banks

According to the lump sum system small banks are split into different buckets depending on the dimension of their BRRD base. A different fixed payment (the lump sum) is associated to each bucket.

Two alternative approaches for splitting small banks among buckets have been tested. The first one divides small banks into three buckets according to some thresholds set on the BRRD base and then it associates a fixed payment to each bucket, as described in Table 15; the second approach replicates this mechanism by increasing the number of buckets (to six) and the associated lump sums, as described in Table 16.

Table 15: The three buckets system: thresholds and lump sums, th €

Buckets		Lump sum
BUCKET 1: BRRD base <= 100,000	& TA <= 1,000,000	5
BUCKET 2: 100.000 < BRRD base <= 200,000	& TA <= 1,000,000	10
BUCKET 3: 200.000 < BRRD base <= 300,000	& TA <= 1,000,000	15

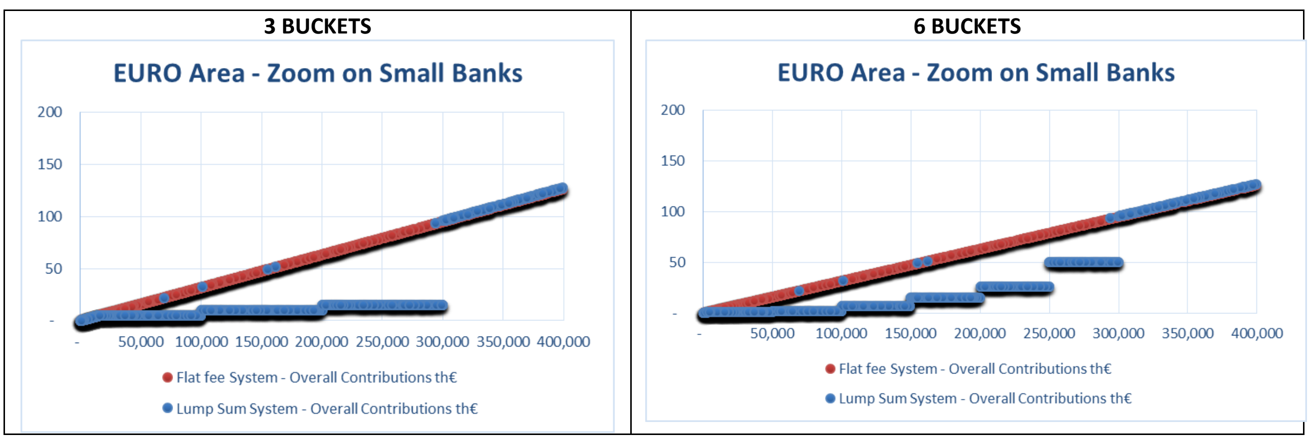
Table 16: The six buckets system: thresholds and lump sums, th €

Buckets		Lump sum
BUCKET 1: BRRD base <= 50.000	& TA <= 1,000,000	1
BUCKET 2: 50.000 < BRRD base <= 100.000	& TA <= 1,000,000	2
BUCKET 3: 100.000 < BRRD base <= 150.000	& TA <= 1,000,000	7
BUCKET 4: 150.000 < BRRD base <= 200.000	& TA <= 1,000,000	15
BUCKET 5: 200.000 < BRRD base <= 250.000	& TA <= 1,000,000	26
BUCKET 6: 250.000 < BRRD base <= 300.000	& TA <= 1,000,000	50

Moreover, a *safeguard clause* has been introduced and it imposes that all small banks pay the minimum between the lump sum associated to the bucket in which they fall and the flat fee. This avoids that a small bank could be penalized by the lump sum system.

The basic flat contributions are compared with the lump sums (both 3 and 6-buckets) to assess the subsidy given to small banks under the special treatment. Figure 6 shows results for banks in the Euro area (the three buckets system is on the left-hand side and the six buckets system is on the right-hand side of the figure).

Figure 6: 3-buckets system versus flat fee (left-hand side) and 6-buckets system versus flat fee (right-hand side), Euro area, th €



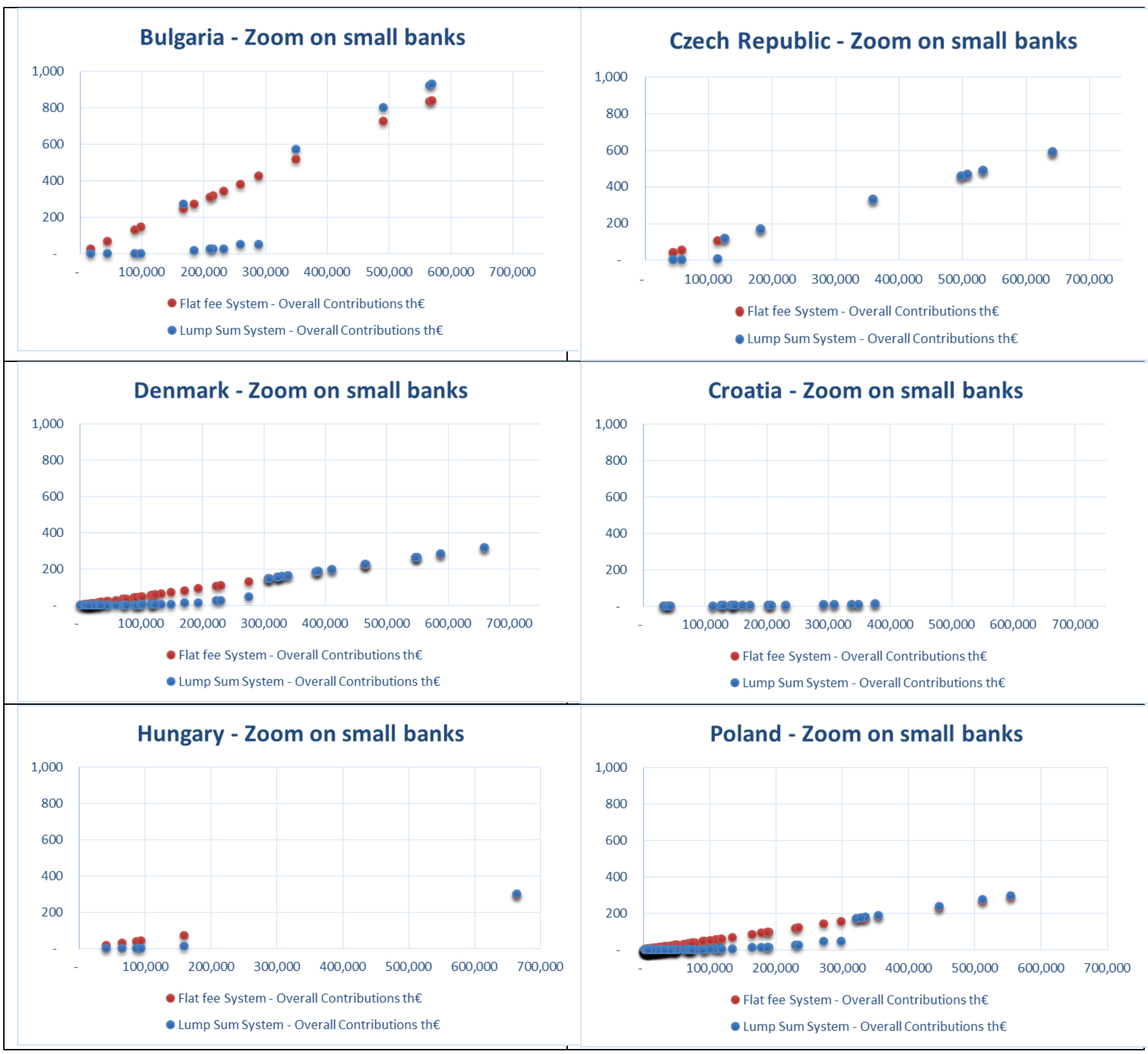
The major concern that comes out when comparing a lump sum system (discrete) with the flat fee (continuous) is the existence of a cliff effect between the highest lump sum and the flat fee that a big bank right above the 300 million € of BRRD base threshold would pay. By comparing the 3-buckets system with the 6-buckets, the second one seems to mitigate this effect. Indeed, increasing the number of buckets and, most importantly, increasing the level at which lump sums are set in an adequate progression over the BRRD base (but always well below the pure flat contribution) seems to effectively address the cliff effect. Table 17 reports the magnitude of the cliff effects (i.e. the difference between the payment of the first bank outside the buckets and the last bank in the highest bucket) under the two systems.

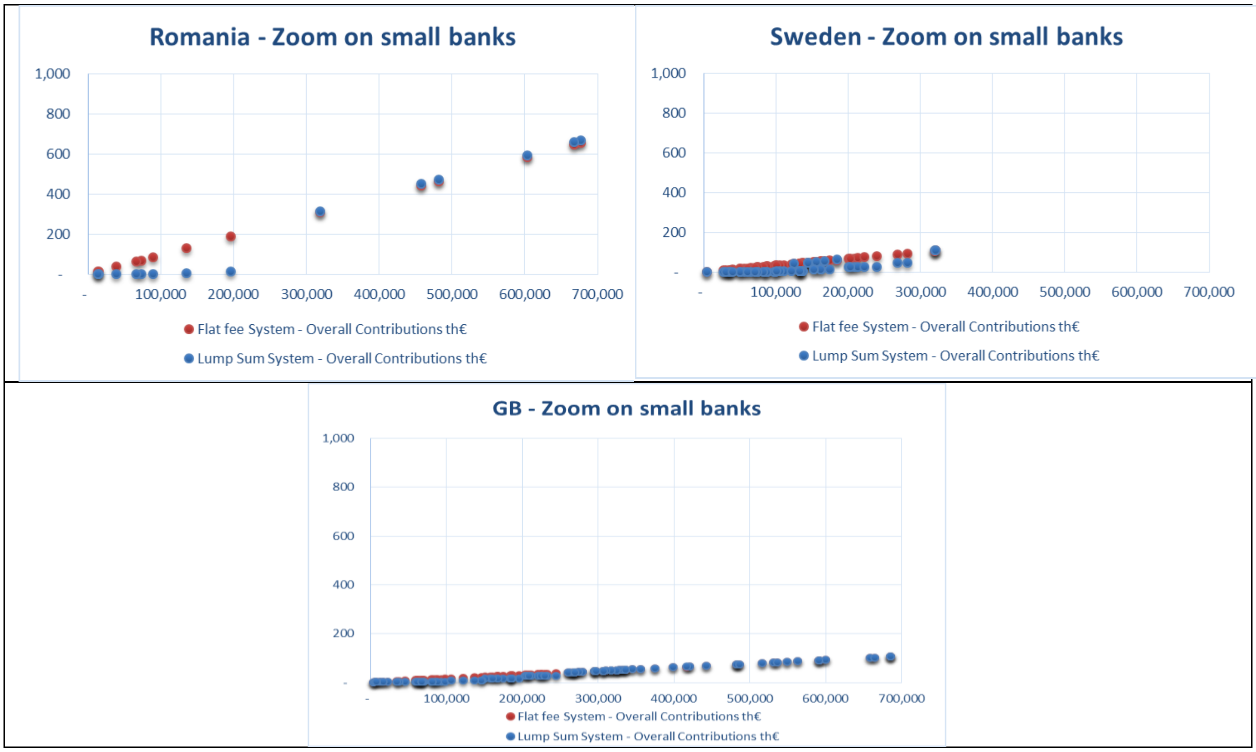
Table 17: Cliff effect under the 3-buckets system and the 6-buckets system, Euro area, th €

System	Last bucket Lump sum	Payment of the smallest big bank	Magnitude of the cliff effect
3-buckets	15	87	72
6-buckets	50	93	43

Figure 7 below shows the 6-buckets system applied to Member States outside the Euro area.

Figure 7: 6-buckets system versus flat fee for MS outside Euro area, th €





Additional remark: *in Croatia the safeguard clause applies to 12 small banks out of 15. This explains why the two series almost overlap in the graph.*

4.1.1 Overall "subsidy" given to small banks under the 6-buckets approach

Table 18 reports the overall contributions per MS paid by small banks under the flat fee and the 6-buckets system. Results are reported both in th € and as a share of the total annual target under the assumption that there would be only a flat fee and no risk fee. The last column presents the overall subsidy given to small banks when moving from the flat contribution to the 6-buckets systems. For example, -70% for the Euro area is the percentage variation in small banks' aggregate contributions (i.e. (18,979 th €- 63,492 th €)/ 63,492 th €)).

It is worth noting that the overall reduction in contributions of small banks is not the same across MS belonging to the Euro area and non-participating MS. In particular, for Croatia the lump sums are too high when compared to the estimated flat fees, which triggers the safeguard clause in 12 out of 15 cases, thereby yielding an insignificant aggregate reduction in the contributions of small banks.

Table 18: Small banks annual contributions under different scenarios, sample estimates

Economic area	Small banks - Overall Flat fee		Small banks - Overall lump sums		Reduction when moving from the flat fee to the lump sum
	th €	as % of annual target(*)	th €	as % of annual target(*)	
AT	10,761	0.1720%	2,501	0.0400%	-77%
BE	520	0.0083%	170	0.0027%	-67%
CY	83	0.0013%	50	0.0008%	-40%
DE	33,110	0.5293%	10,532	0.1684%	-68%
EE	71	0.0011%	10	0.0002%	-86%
ES	418	0.0067%	118	0.0019%	-72%
FI	2,757	0.0441%	552	0.0088%	-80%
FR	1,999	0.0320%	648	0.0104%	-68%
GR	80	0.0013%	10	0.0002%	-87%

Economic area	Small banks - Overall Flat fee		Small banks - Overall lump sums		Reduction when moving from the flat fee to the lump sum
	th €	as % of annual target(*)	th €	as % of annual target(*)	
IE	165	0.0026%	100	0.0016%	-39%
IT	10,535	0.1684%	3,333	0.0533%	-68%
LT	116	0.0019%	24	0.0004%	-79%
LU	901	0.0144%	365	0.0058%	-59%
LV	332	0.0053%	121	0.0019%	-64%
MT	100	0.0016%	19	0.0003%	-81%
NL	291	0.0047%	110	0.0018%	-62%
PT	1,004	0.0161%	229	0.0037%	-77%
SI	186	0.0030%	69	0.0011%	-63%
SK	62	0.0010%	16	0.0003%	-74%
Euro area	**63,492**	**1.0151%**	**18,979**	**0.3034%**	**-70%**
BG	2,416	10.32%	199	0.85%	-92%
CZ	200	0.25%	10	0.01%	-95%
DK	1,445	0.79%	215	0.12%	-85%
HR	75	36.67%	74	36.21%	-1%
HU	200	1.70%	22	0.19%	-89%
PL	3,453	3.61%	465	0.49%	-87%
RO	610	1.89%	31	0.10%	-95%
SE	1,722	0.84%	435	0.21%	-75%
GB	1,398	0.13%	939	0.09%	-33%

Note: the annual target in each economic area (Eurozone, BG, CZ, DK, HR, HU, PL, RO, SE, GB) has been calculated as 1% of overall covered deposits divided by 8.

4.1.2 Additional burden for big banks under the 6-buckets approach

Under the 6-buckets system every large bank would pay an additional burden to guarantee that the target will be reached despite the favourable treatment given to small institutions. This additional burden is summarized in Table 19 (it should be noted that the percentage variation is the same for each bank within the same economic area).

Table 19: Big banks annual additional payment (as a share of flat fee)

Economic area	Additional burden for each big bank
Euro area	+ 0.72%
BG	+ 10.56%
CZ	+ 0.23%
DK	+ 0.68%
HR	+ 0.73%
HU	+ 1.54%
LT	+ 3.75%
PL	+ 3.24%
RO	+ 1.83%
SE	+ 0.64%
UK	+ 0.04%

In conclusion, a minor additional burden for every big bank translates in a big overall reduction for small banks. Bulgaria stands out for the particularly high estimated additional burden that would be placed on the non-small banks when introducing the 6-buckets system. This is probably due to the fact that a sizeable estimated reduction in small banks contributions (-92%) is distributed among other big banks which are not very large (the biggest bank in Bulgaria has 6 billion € only of total assets).

5. Analysis of banks' contributions – focus on large banks

This section presents estimates of the risk-based contributions to the Resolution Fund due by large banks. Large banks are defined as banks with BRRD base greater than 300 million € or total assets greater than 1 billion €.[26] According to this definition and to the final database, Table 20 reports aggregate basic figures on the sample of large banks; Table 21 and Table 22 summarize the distribution of their total assets and BRRD bases for each economic area respectively. These distributions vary in a huge range. When considering TA, the ratio of the maximum to the minimum is about 5 thousand in the Euro area and in UK; when considering the BRRD base this ratio peaks at 22 thousand in the Euro area and reaches as high as 160 thousand in Denmark. Also, distributions present very long right tails (the mean value is almost always above the median and for many economic areas it is even above the third quartile).

Table 20: Basic figures on large banks, sample

MS	Number of banks			Total Assets			BRRD base		
	All banks	Large banks	Large banks (as % of total number of banks)	All banks (th €)	Large banks (th €)	Large banks (as % of TA all banks)	All banks (th €)	Large banks (th €)	Large banks (as % of BRRD base all banks)
AT	668	93	13.9%	879,305,789	773,577,454	88.0%	610,421,541	575,442,707	94.3%
BE	45	34	75.6%	935,583,114	932,117,975	99.6%	588,932,347	587,241,908	99.7%
CY	10	9	90.0%	54,850,025	54,318,731	99.0%	26,162,767	25,892,640	99.0%
DE	1740	881	50.6%	8,266,923,037	8,063,185,645	97.5%	6,159,144,464	6,051,514,997	98.3%
EE	6	3	50.0%	12,797,090	12,286,927	96.0%	6,274,212	6,042,682	96.3%
ES	62	47	75.8%	2,409,149,066	2,405,681,546	99.9%	1,529,801,692	1,528,442,460	99.9%
FI	266	20	7.5%	486,844,150	451,749,870	92.8%	394,116,010	385,153,100	97.7%
FR	195	120	61.5%	6,466,453,443	6,455,009,342	99.8%	5,265,822,355	5,259,322,697	99.9%
GR	10	7	70.0%	316,886,598	316,135,856	99.8%	169,938,198	169,679,187	99.8%
IE	31	29	93.5%	978,971,513	978,046,039	99.9%	833,190,116	832,654,531	99.9%
IT	595	332	55.8%	3,162,595,451	3,105,620,925	98.2%	2,338,762,774	2,304,517,165	98.5%
LT	7	4	57.1%	16,878,730	16,217,947	96.1%	9,559,361	9,182,009	96.1%
LU	105	84	80.0%	634,960,991	629,944,637	99.2%	559,634,807	556,706,796	99.5%
LV	19	12	63.2%	24,908,053	23,252,903	93.4%	16,221,678	15,141,862	93.3%
MT	19	12	63.2%	27,510,463	26,922,453	97.9%	15,733,147	15,407,452	97.9%
NL	48	40	83.3%	2,033,738,687	2,031,084,103	99.9%	1,488,773,348	1,487,826,394	99.9%
PT	123	25	20.3%	442,544,164	427,409,253	96.6%	279,930,483	276,665,497	98.8%
SI	17	13	76.5%	36,853,241	34,532,191	93.7%	19,125,053	18,520,658	96.8%
SK	12	10	83.3%	50,806,559	49,957,511	98.3%	21,330,174	21,128,115	99.1%
Euro area	**3,978**	**1,775**	**44.6%**	**27,238,560,163**	**26,787,051,309**	**98.3%**	**20,332,874,525**	**20,126,482,856**	**99.0%**
BG	24	14	58%	39,270,243	35,336,297	90.0%	15,865,362	14,228,121	89.7%
CZ	23	20	87%	166,882,156	165,641,978	99.3%	88,993,553	88,775,036	99.8%
DK	70	32	46%	566,547,859	558,583,787	98.6%	377,124,381	374,129,194	99.2%
HR	21	6	29%	7,012,864	4,448,917	63.4%	5,957,418	3,772,691	63.3%
HU	12	7	58%	39,384,364	38,555,944	97.9%	26,148,415	25,702,854	98.3%
PL	245	35	14%	289,793,612	278,464,260	96.1%	183,366,909	176,751,874	96.4%
RO	25	17	68%	65,695,654	64,293,028	97.9%	33,293,416	32,664,921	98.1%
SE	64	21	33%	836,497,962	822,156,103	98.3%	605,233,004	600,133,767	99.2%
UK	177	115	65%	8,364,505,719	8,350,294,643	99.8%	7,008,941,282	6,999,775,525	99.9%

[26] Large banks are the banks not classified as small banks in Section 4.

Table 21: Summary statistics on large banks' total assets per economic area, th €

Economic area	Total assets					
	min	25th percentile	median	75th percentile	max	average
Euro area	348,859	929,290	1,794,794	5,089,564	1,723,459,000	15,091,297
BG	700,736	1,191,853	2,357,157	3,223,111	6,472,304	2,524,021
CZ	801,116	2,900,874	3,748,431	2,900,874	32,863,763	8,282,099
DK	705,669	1,078,465	2,065,650	1,078,465	315,957,333	17,455,743
HR	354,835	405,473	414,831	922,954	1,769,738	741,486
HU	926,211	1,411,918	1,886,513	5,070,745	22,777,895	5,507,992
PL	525,695	1,373,279	4,127,224	10,278,079	47,224,675	7,956,122
RO	579,080	1,063,319	1,555,801	5,638,767	15,867,911	3,781,943
SE	662,285	1,466,041	5,836,870	18,879,969	221,025,879	39,150,291
UK	378,179	975,281	2,604,007	15,841,186	1,806,937,831	72,611,258

Table 22: Summary statistics on large banks' BRRD base per economic area, th €

Economic area	BRRD base					
	min	25th percentile	median	75th percentile	max	average
Euro area	69,123	523,004	1,035,719	3,297,558	1,544,017,886	11,338,864
BG	167,177	566,219	836,181	1,206,797	3,402,258	1,016,294
CZ	126,099	526,637	2,023,126	5,194,030	18,173,681	4,438,752
DK	1,389	49,273	207,383	641,058	224,180,702	5,387,491
HR	309,278	340,800	362,474	764,983	1,505,738	628,782
HU	663,753	1,163,058	1,227,024	3,665,505	14,154,952	3,671,836
PL	320,746	1,018,877	2,802,704	6,653,889	29,341,269	5,050,054
RO	319,134	667,613	918,643	2,344,824	7,947,751	1,921,466
SE	124,999	184,945	3,900,477	15,528,332	169,752,726	28,577,798
UK	307,052	629,950	1,794,660	12,387,981	1,573,086,254	60,867,613

5.1 Risk-based contributions

Contributions to the Fund due by the large institutions are calculated taking into account their degree of risk according to the formula described in Section 3.2.1. To this aim, a composite risk indicator has been built to measure the riskiness of each large bank, following the steps detailed in Section 3.1. The list of individual risk indicators and the associated effective weights applied to build the composite indicator are reported in Table 23 below.

Table 23: Balance sheet ratios and de-facto weights currently used in the current analysis

Pillar / Indicator	Effective weight
Pillar: Risk exposure	**62.5%**
Indicator: RWA over Total Assets	*33.33%*
Indicator: Leverage ratio (Common equity over Total Assets)	*33.33%*
Indicator: Capital ratio (Total regulatory capital over RWA)	*33.33%*
Pillar: Stability and variety of the sources of funding and unencumbered highly liquid assets	**25%**
Indicator: Loan to Deposits (Customer loans over Customer deposits)	*100%*
Pillar: Importance of an institution to the stability of the financial system or economy	**12.5%**
Indicator: Share of interbank loans and deposits to the system (Interbank loans + interbank deposits)/sum(Interbank loans + interbank deposits) at EU level	*100%*

The following differences should be noted with respect to the provisions detailed in the Delegated act:

- In the first pillar, the capital ratio is calculated with total regulatory capital instead of common equity tier 1.
- The following indicators are not included: "own funds and eligible liabilities held by the institution in excess of MREL" in the first pillar, "net stable funding ratio" and "liquidity coverage ratio" in the second pillar (they are replaced by the ratio of customer loans to customer deposits).
- The fourth pillar "Additional risk indicators to be determined by the resolution authority" is not included. An estimate of its potential impact on the contributions of large banks is presented in Section 6.

Because of these discrepancies, the weights of risk pillars and indicators used in the present exercise are different with respect to what is stated in the article 7 of the Delegated act. In particular, weights of pillars have been rescaled so that they sum up to one (62.5%, 25% and 12.5% instead of 50%, 20% and 10%) and the same procedure has been applied to the weights of indicators within each pillar.

Moreover, the following options have been chosen to get the final calculations:

- The discretization procedure has been applied to tackle the long-tailed distributions of risk indicators.
- Risk indicators within a pillar are aggregated through an arithmetic average while pillars are aggregated according to a geometric average.
- The BRRD base includes the intra-group liabilities because the final available database does not set this item apart from the total liabilities (Section 7 details this issue).
- The BRRD base includes derivative liabilities as they are reported by banks according to the accounting standard in use (Section 8 attempts to address this issue by providing an estimate of the potential impact of introducing a leverage ratio treatment for derivatives as under the Capital Requirements Regulation).
- Risk-adjusted contributions are calculated according to Model A (see Section 3.2.1), with the risk indicator ranging between 0.8 and 1.5 (i.e. the ratio of the riskiest bank to the least risky one in terms of risk-adjustment component is 1.875).

5.1.1 Contributions by size

Figure 8 plots the contributions of banks belonging to the Euro area (blue dots represent the flat fee and green dots the risk-based contribution) as a function of the BRRD base: each point in the plot represents a bank. A set of four zoomed in plots (from Figure 9 to Figure 12) depicts the payments to the fund due by specific categories of banks defined according the BRRD base size as it follows:

- S (from the minimum BRRD base to 1 billion €);
- M (from 1 billion € to 25 billion €);
- L (from 25 billion € to 500 billion €);
- XL (from 500 billion € to the maximum value)

Figure 8: Contributions to the Fund, Euro area, th €

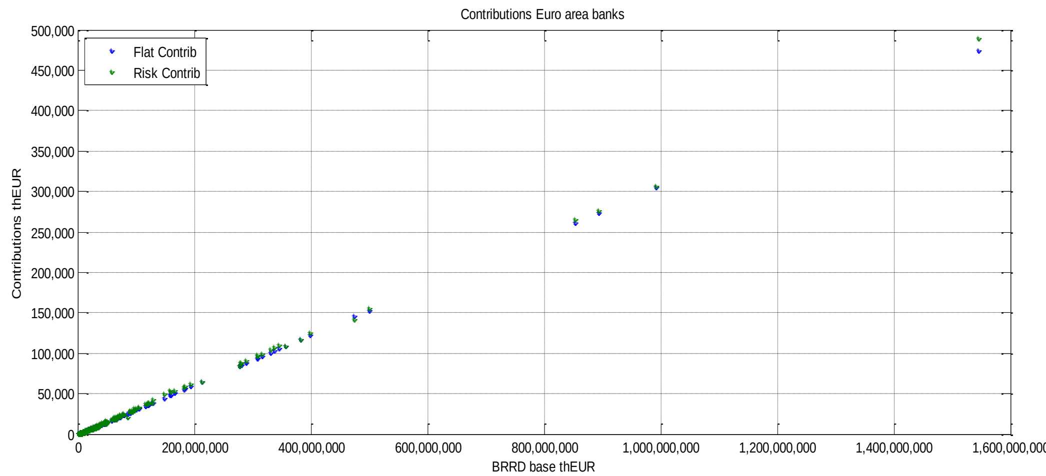


Figure 9: Zoom on S category (BRRD base up to 1 billion €), Euro area, th €

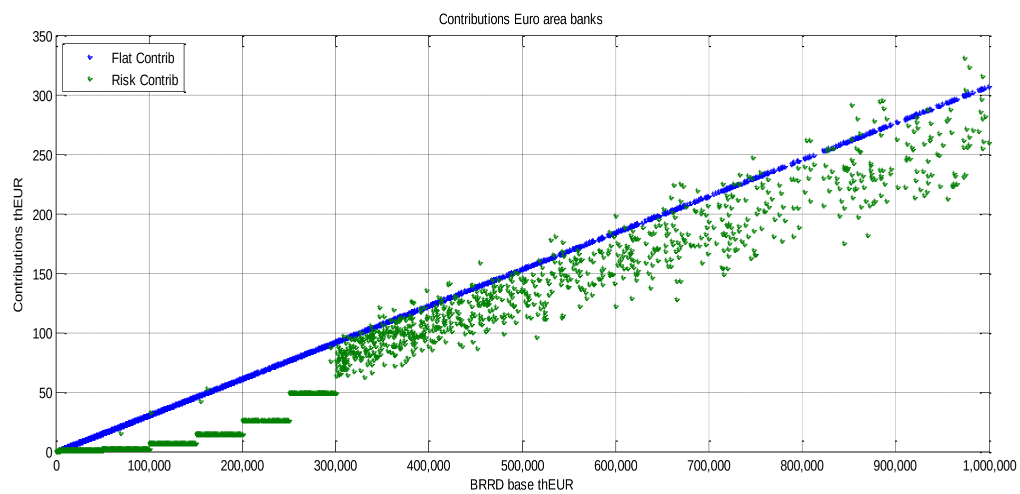
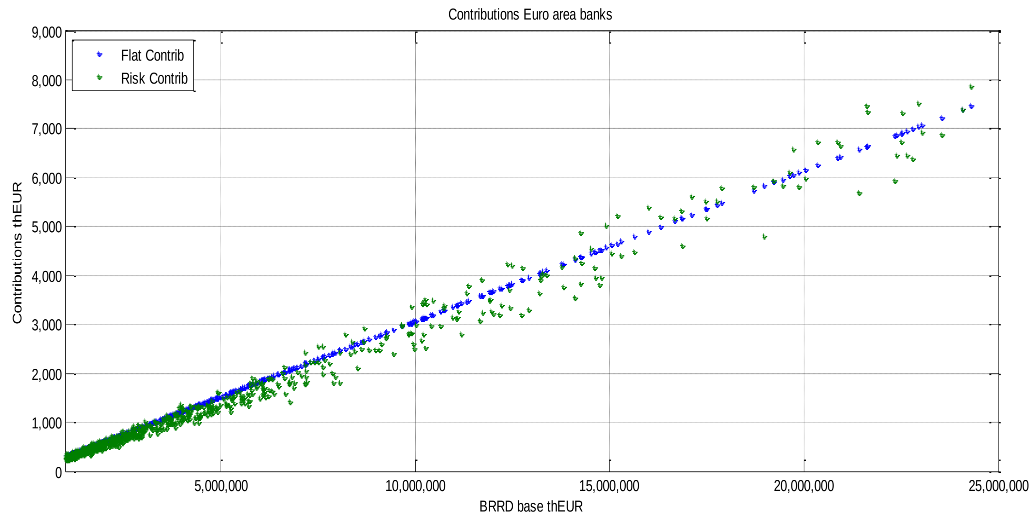


Figure 9 above shows that the vast majority of the "smallest large banks" gets a downward risk-adjustment and thus they almost always pay less than the flat fee. Moreover, it seems that the lump sums are calibrated in a way that no risk-based contribution falls below the lump sums (no negative cliff-effect), i.e. no big bank pays less than any small bank.

Figure 10 below zooms in the "M-size" banks. It seems that the risk-adjustment still reduces contributions, especially for the banks with a BRRD base up to 10 billion €.

Figure 10: Zoom on M category (BRRD base from 1 billion € up to 25 billion €), Euro area, th €



The "L-size" banks are represented in Figure 11. The graph shows that the risk-adjustment generally works as a punishment for these banks, thus increasing the payment with respect the flat fee. Moreover, this result holds true for the biggest banks depicted in Figure 12.

Figure 11: Zoom on L category (BRRD base from 25 billion € up to 500 billion €), Euro area, th €

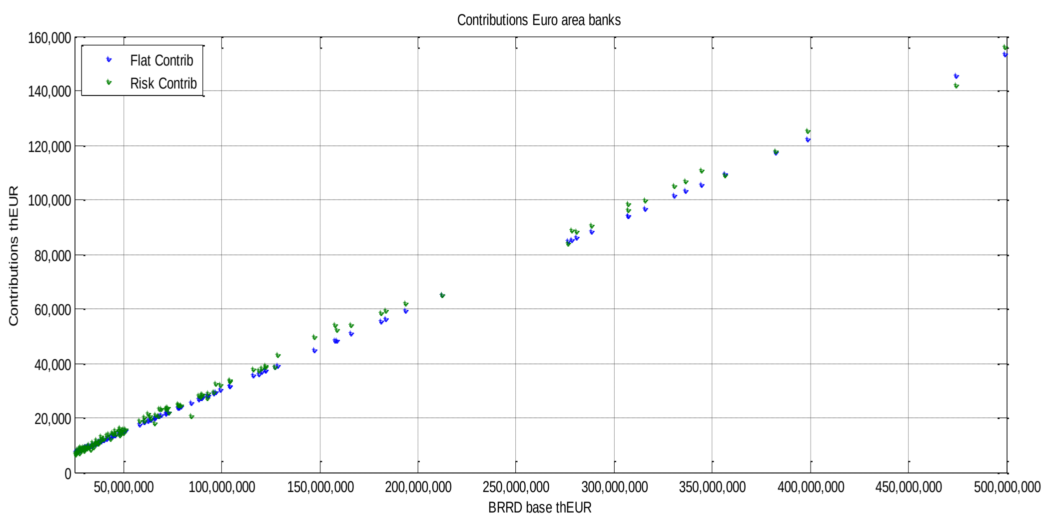
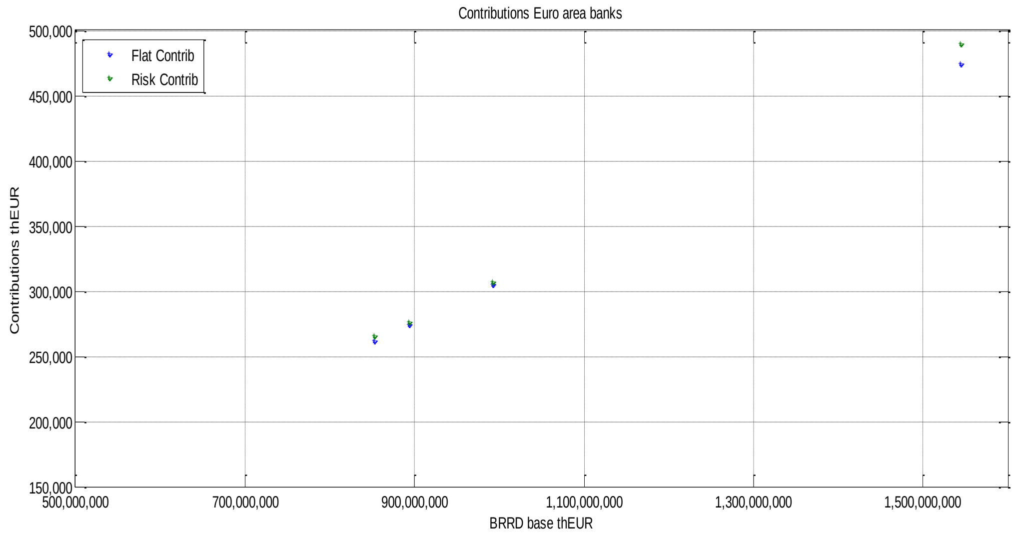


Figure 12: Zoom on XL category (BRRD base from 500 billion € up to the maximum value), Euro area, th €



To complement the information provided by the graphs above, Table 24 provides aggregate amounts of total assets, BRRD base and contributions for the different size categories. As for banks within the S category, though they represent the most populated group (49% of big banks), they cover a negligible part of total assets (3%) and of BRRD base (2%) and they also contribute for 2% only of the overall target. On the other hand, banks within the extra-large category represent a negligible share of the total number of big banks (they are only 4 out of 1775), but they account for around 20% of the total assets and BRRD base and collect around 22% of the target.

Table 24: Aggregated figures for large banks within the Euro area

		S	M	L	XL
Number of banks	Number	867	786	118	4
	Share of total	21.8%	19.8%	3.0%	0.1%
Total assets	Amount th€	884,576,739	5,479,897,665	15,669,077,667	4,753,499,238
	Share of total	3.2%	20.1%	57.5%	17.5%
BRRD base	Amount th€	484,907,100	3,517,900,246	11,842,533,718	4,281,141,792
	Share of total	2.4%	17.3%	58.2%	21.1%
Aggregated Contributions	Amount th€	130,284	1,016,041	3,749,625	1,340,088
	Share of total	2.08%	16.24%	59.95%	21.42%

The following series of scatter plots (from Figure 13 to Figure 21) shows the contributions in non-participating MS.

Figure 13: Flat fees (blue dots) and risk-based contributions (green dots), Bulgaria, th €

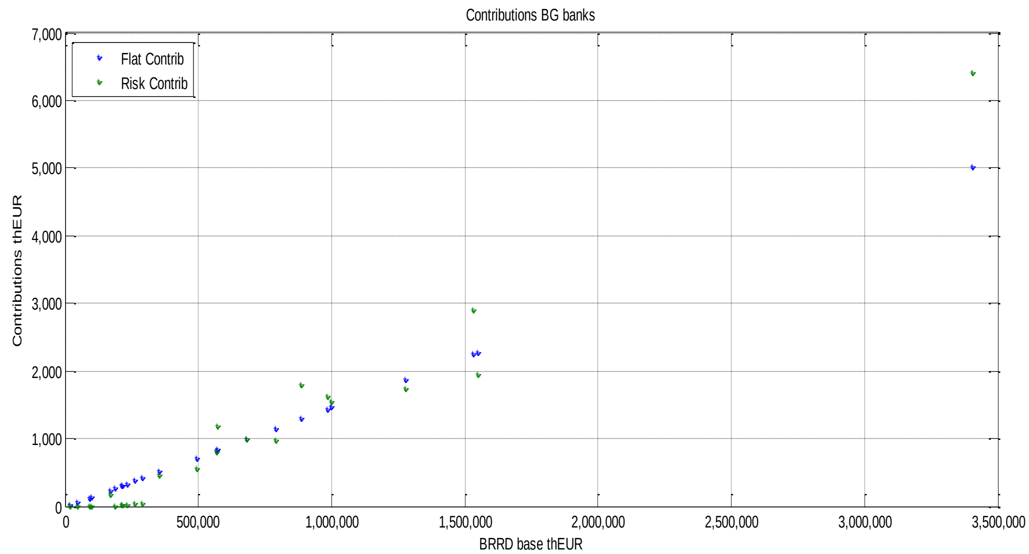


Figure 14: Flat fees (blue dots) and risk-based contributions (green dots), Czech Republic, th €

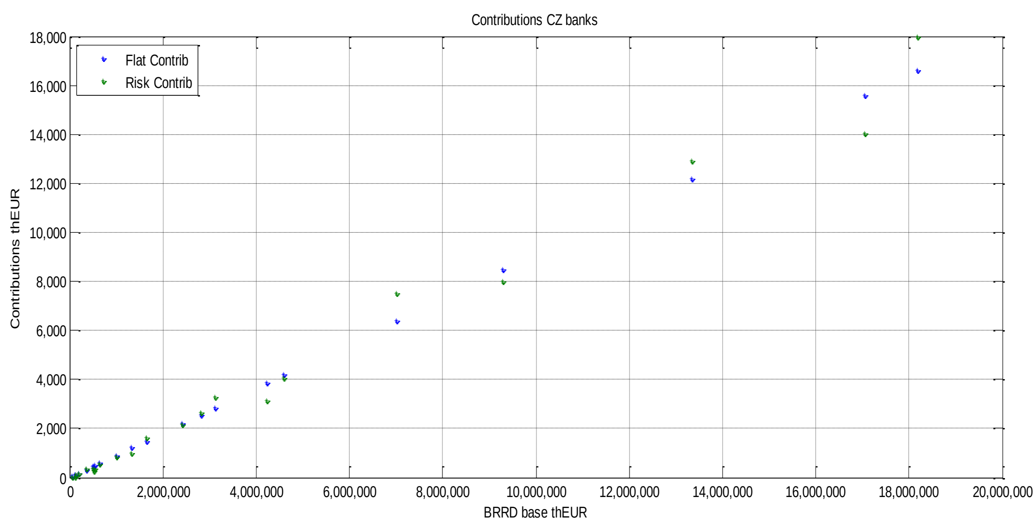


Figure 15: Flat fees (blue dots) and risk-based contributions (green dots), Denmark, th €

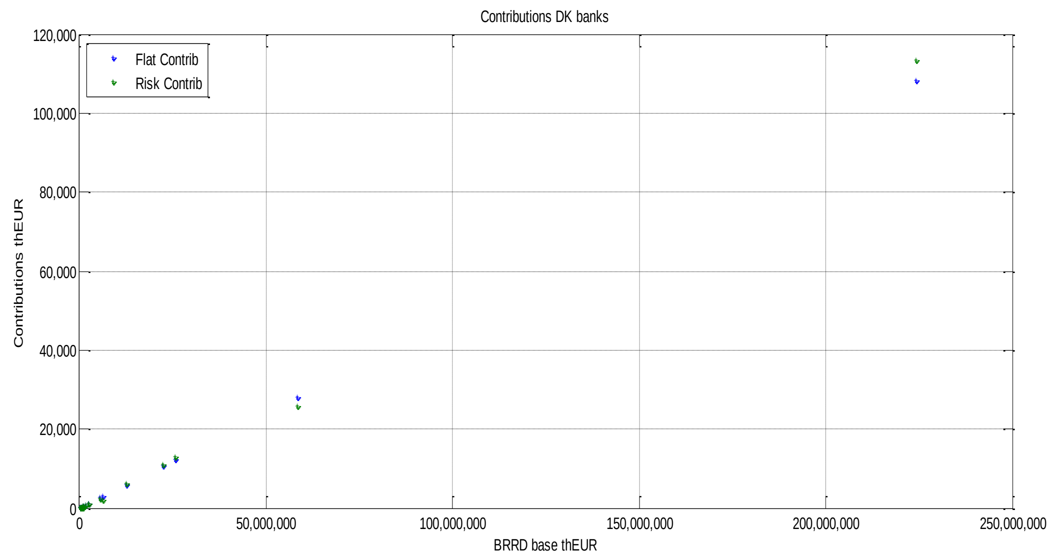


Figure 16: Flat fees (blue dots) and risk-based contributions (green dots), Croatia, th €

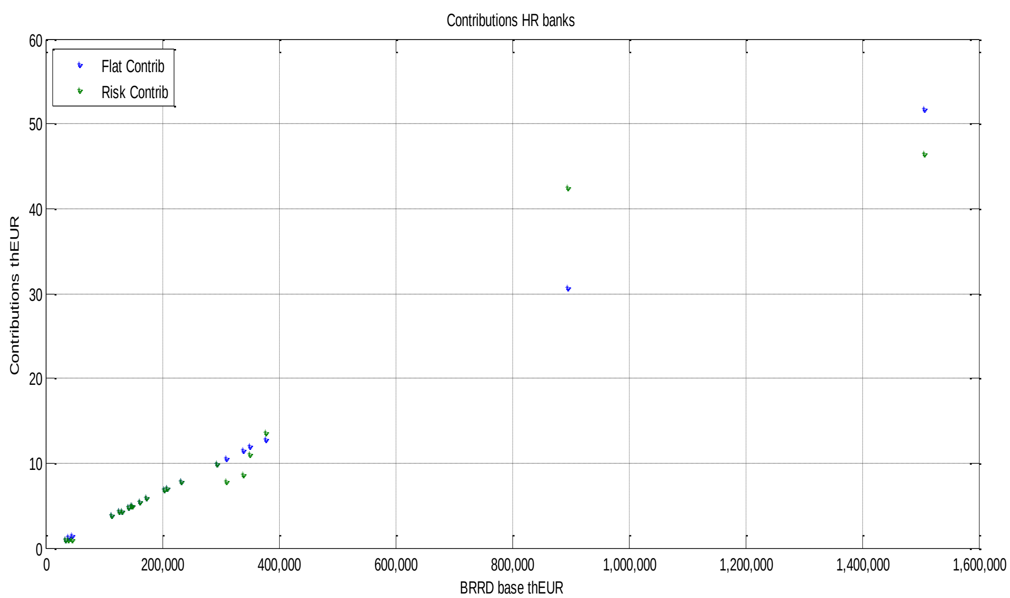


Figure 17: Flat fees (blue dots) and risk-based contributions (green dots), Hungary, th €

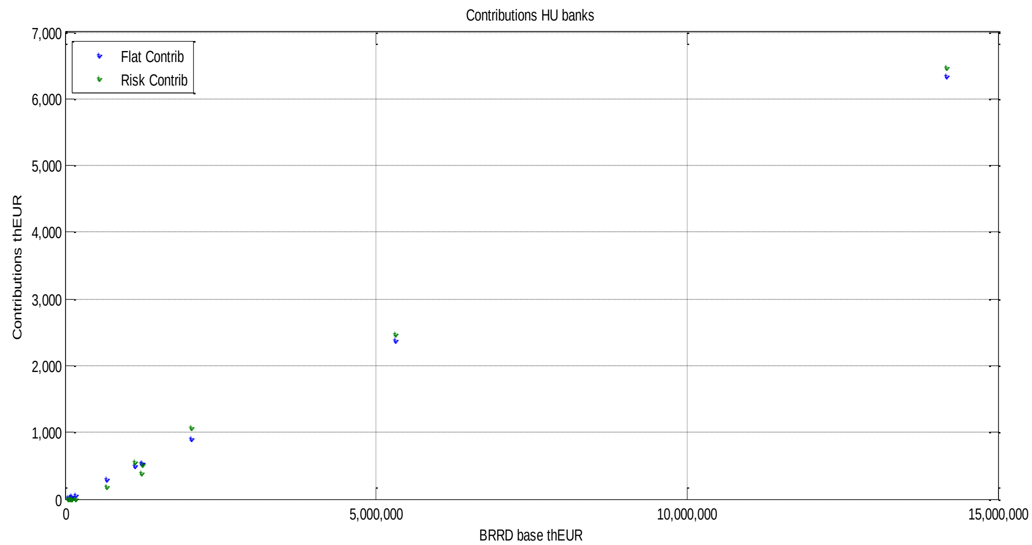


Figure 18: Flat fees (blue dots) and risk-based contributions (green dots), Poland, th €

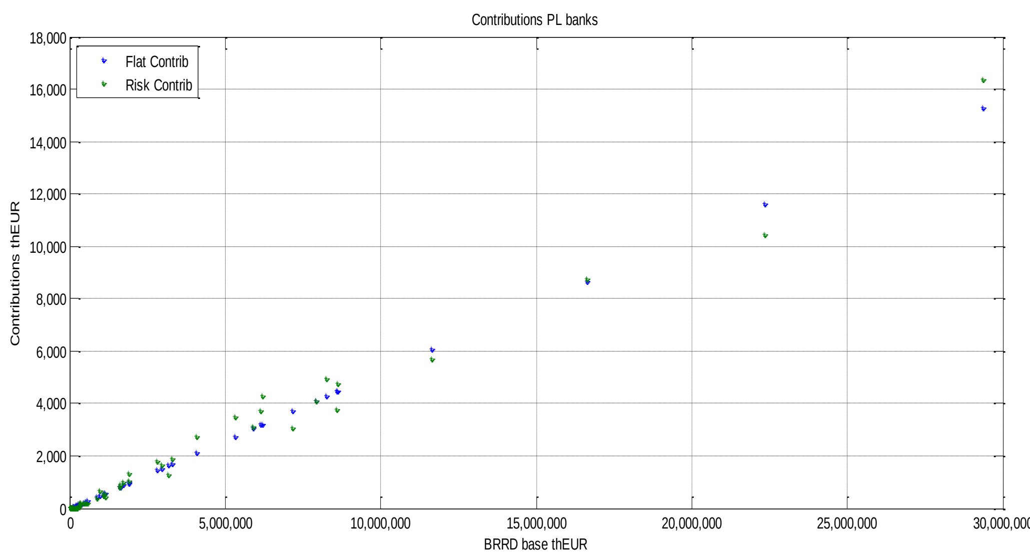


Figure 19: Flat fees (blue dots) and risk-based contributions (green dots), Romania, th €

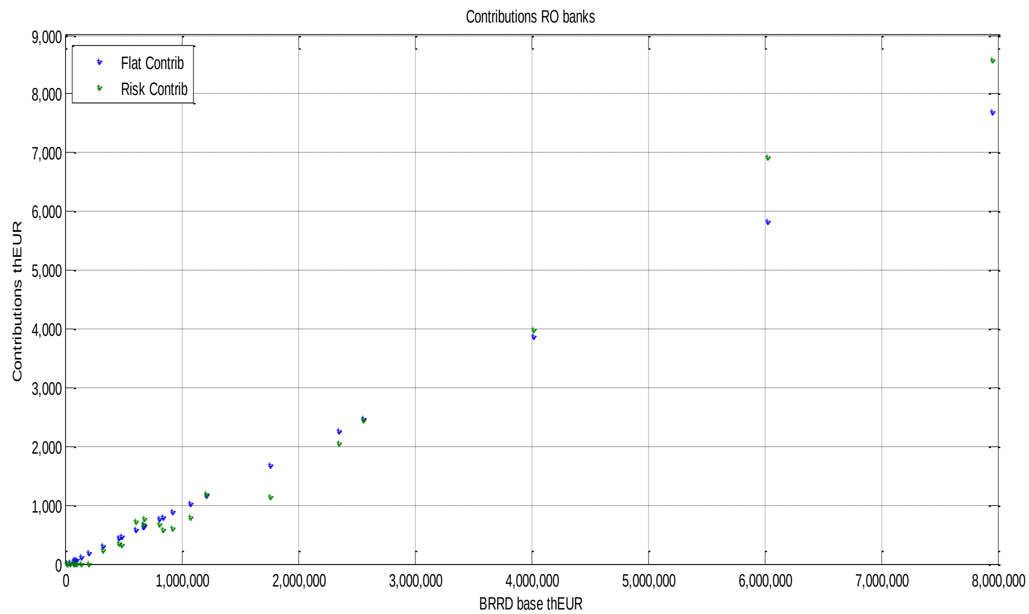


Figure 20: Flat fees (blue dots) and risk-based contributions (green dots), Sweden, th €

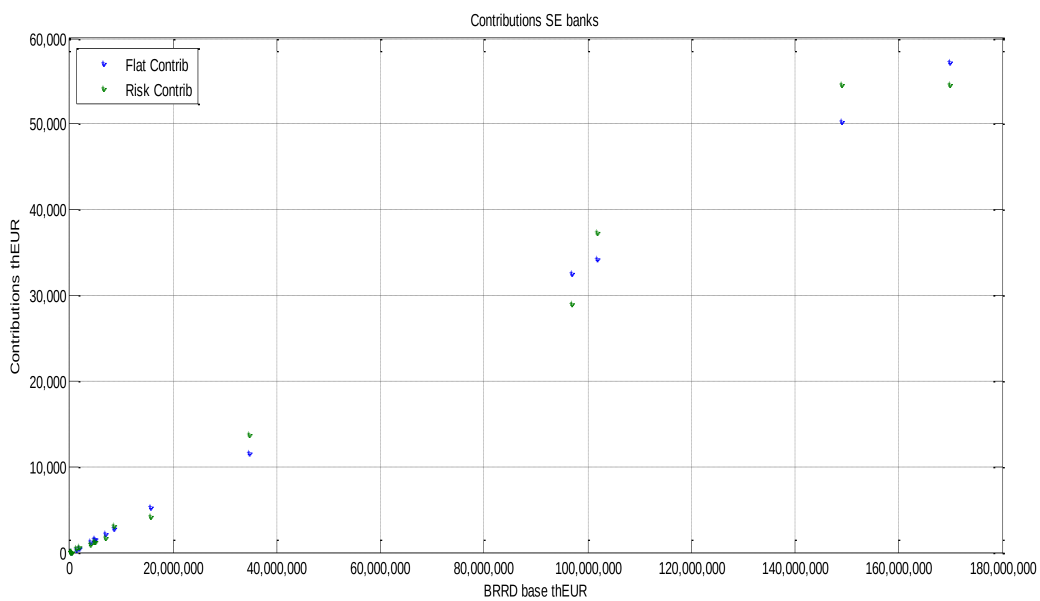


Figure 21: Flat fees (blue dots) and risk-based contributions (green dots), United Kingdom, th €

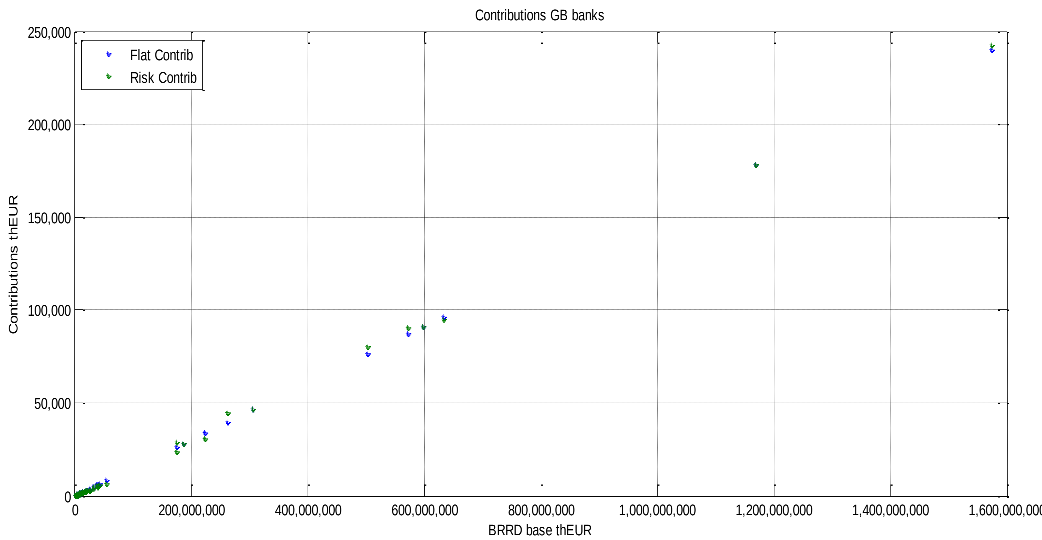
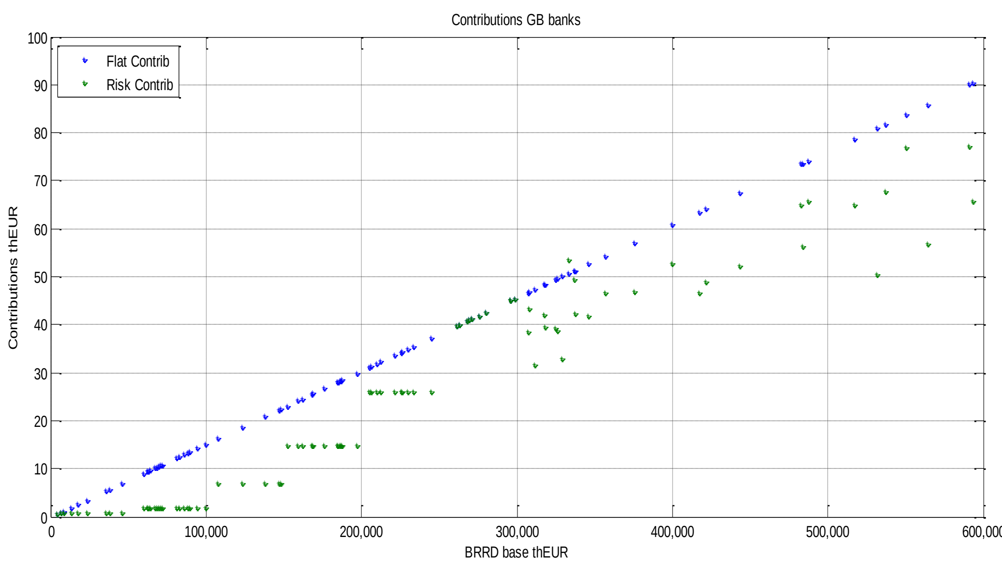


Figure 22: United Kingdom - Zoom on small banks, th €



It is worth noting that in the UK a negative cliff-effect occurs, as represented in Figure 22. In fact, the safeguard clause setting the flat fee as the maximum contribution for small banks applies to every bank in bucket number six. So, while the small banks in the 6th bucket pay the flat fee, the big banks right above the threshold pay less thanks to a favourable risk-adjustment.

5.1.2 Example banks: how contributions work

To better understand how the risk-adjustment works, Table 25 highlights, for each size category, some example banks in the Euro area with similar size and different risk indicator. Two banks similar in size would pay a very similar amount under the flat system while the risk-adjusted contribution can let banks pay less or more than the flat depending on their relative risk.

Table 25: Example banks with similar size and different risk profile, Euro area, th €

Size category	BRRD base th €	Flat fee th €	Riskiness	Risk-based Contribution th €	Variation (from the flat to the risk-based)
S	664,608	206	0.8247	128	-38%
	661,894	205	1.4469	224	+9%
M	14,727,777	4,563	1.1099	3,825	-16%
	15,178,094	4,703	1.4703	5,223	+11%
L	276,134,623	85,559	1.3002	84,025	-2%
	277,859,551	86,093	1.3703	89,105	+3%

The following tables illustrate contributions for some selected banks to highlight that similar banks, both in terms of size and riskiness, pay a similar fee if they belong to the same economic area (Table 26), but failing this condition, contributions can significantly vary (Table 27).

Table 26: Example banks with similar size and similar risk profile among different MS in the Euro area

Size category	Country	BRRD base th €	Riskiness	Risk-based Contribution th €
S	Participating MS 1	603,715	1.1350	160
	Participating MS 2	605,105	1.1460	162
M	Participating MS 1	16,292,099	1.3665	5,210
	Participating MS 2	16,659,950	1.3307	5,188
L	Participating MS 1	330,310,614	1.3623	107,245
	Participating MS 2	336,207,073	1.3630	105,311

Table 27: Example banks with similar size and similar risk profile belonging to different economic areas.

Size category	Country	BRRD base th €	Riskiness	Risk-based Contribution th €
S	Participating MS 1	661,894	1.4469	224
	Non-participating MS 1	665,007	1.4490	109
	Non-participating MS 2	658,814	1.1569	261
M	Participating MS 1	22,923,458	1.4043	7,534
	Non-participating MS 1	22,100,895	1.3163	3,304
	Non-participating MS 2	22,224,291	1.4545	11,082
L	Participating MS 1	276,134,623	1.3002	84,025
	Non-participating MS 1	261,623,219	1.5000	44,570
	Non-participating MS 2	224,180,702	1.4738	113,267
XL	Participating MS 1	1,544,017,886	1.3556	489,843
	Non-participating MS 1	1,573,086,254	1.3588	242,762

5.1.3 Cumulative distribution of contributions by Total Assets

In the following, graphs from Figure 23 to Figure 34 represent the cumulative distributions of overall contributions by total assets[27] in each economic area. To help the reader better understand these figures, Table 28 reports for each decile of the Euro area distribution the corresponding number of banks whose cumulative total assets are

[27] Banks are sorted in descending order (from largest to smallest) in terms of total assets. The biggest banks are on the left-hand side of the x-axis.

below the corresponding percentage. For example, the top 10 biggest banks in the Euro area represent around 30% of the overall total assets (third row in Table 28).

Focusing on the Euro Area (Figure 23 and zoom in Figure 24) it can be noticed that the largest banks covering 85% of TA pay around 88% of the flat fees and 90% of the risk-based contributions.[28]

Figure 23: Cumulative distribution of contributions by TA, Euro area

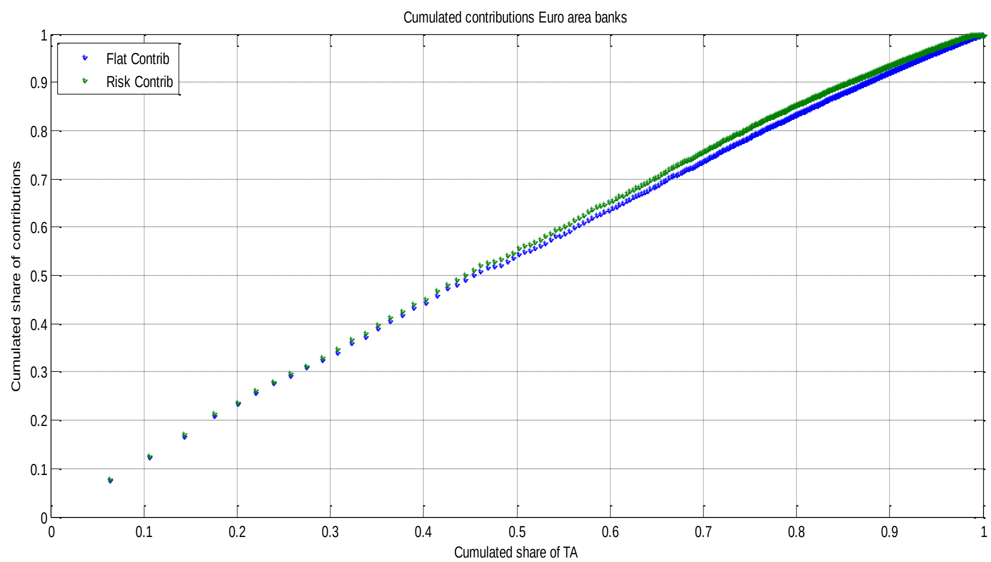
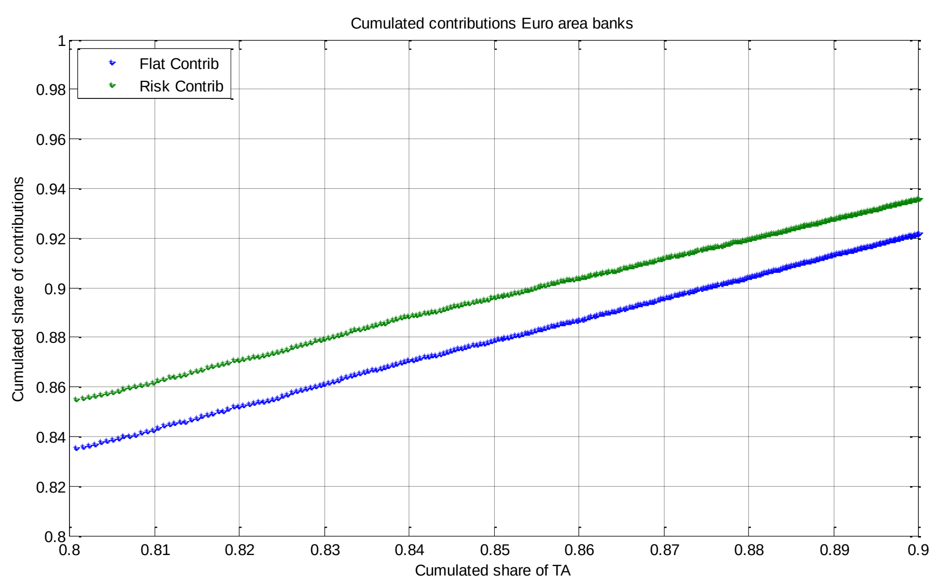


Figure 24: Cumulative distribution of contributions by TA, Euro area – zoom around 85% of TA



[28] Banks corresponding to the cumulative 85% of total assets in the Euro area hold 11 billion € of total assets.

Table 28: Sample cumulative counts of banks by decile of total assets in the Euro area

Cumulative share of TA	Cumulative number of banks
10%	1
20%	4
30%	10
40%	17
50%	29
60%	49
70%	86
80%	169
90%	431
100%	3979

Figure 25 adds a piece of information to the cumulative contributions plot: the blue and green lines are the cumulative curves already shown in Figure 23 (the *y*-axis is that on the left-hand side); the red bars show, for each bank, the variation in contributions when moving from the flat fee system to a the risk based one (the *y*-axis is the red one on the right-hand side). Results show that contributions tend to increase for the largest banks (i.e. in general there are upward variations on the left-hand side where the largest banks are), while they noticeably decrease for the small banks (on the very right-hand side of the graph). This result confirms that, as already pointed out in the scatter plots in Section 5.1.1, small banks tend to get a downward risk-adjustment while the largest banks tend to get an increase in contributions because of their riskiness.

Figure 25: Cumulative contributions for Euro area banks and punctual percentage variation in contributions

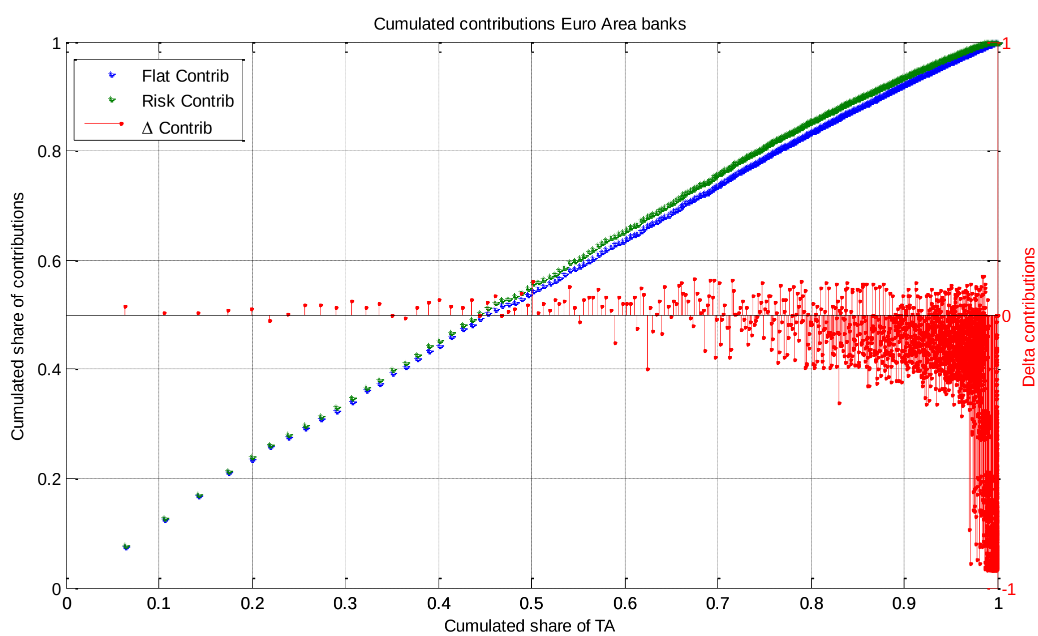


Figure 26: Cumulative distribution of contributions by TA, Bulgaria

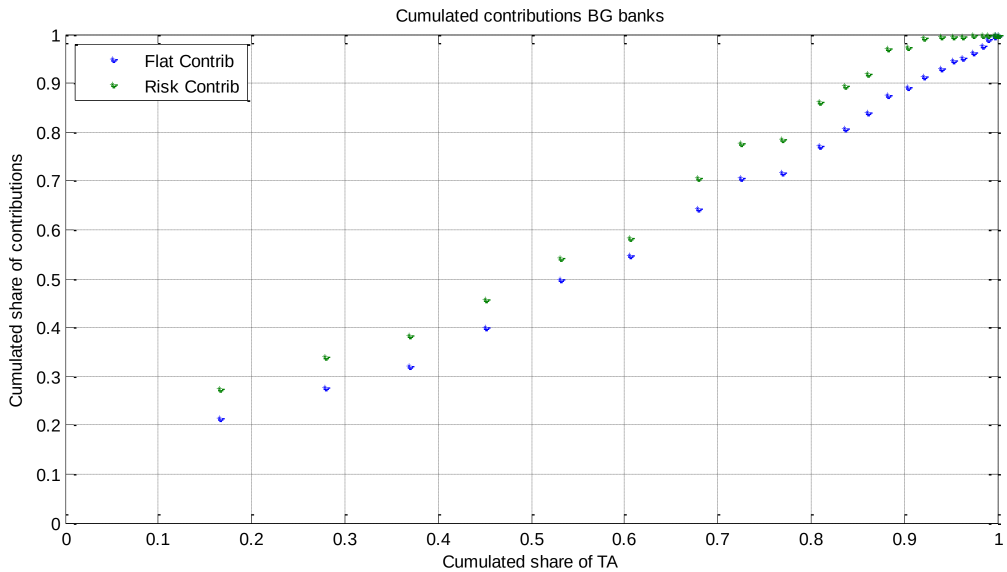


Figure 27: Cumulative distribution of contributions by TA, Czech Republic

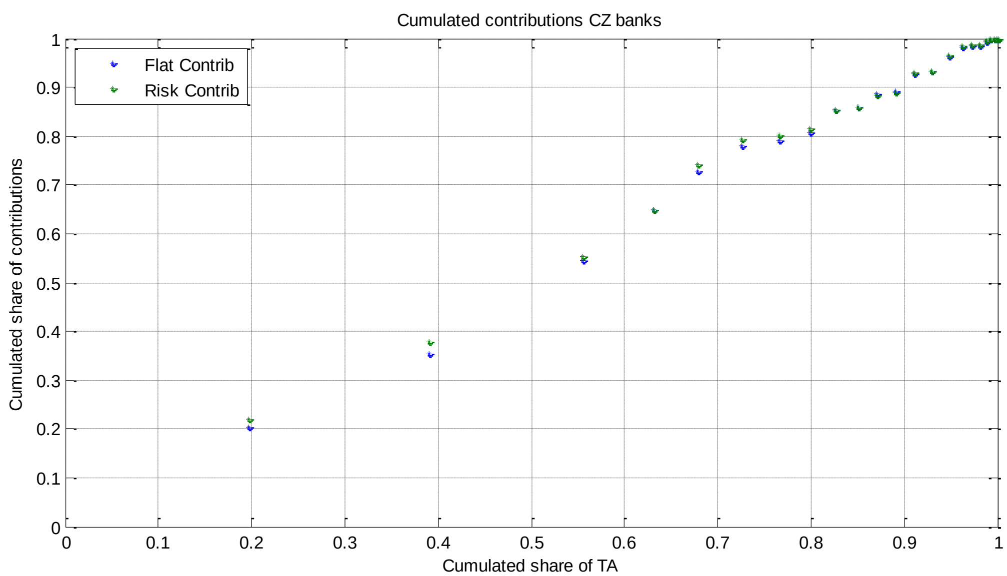


Figure 28: Cumulative distribution of contributions by TA, Denmark

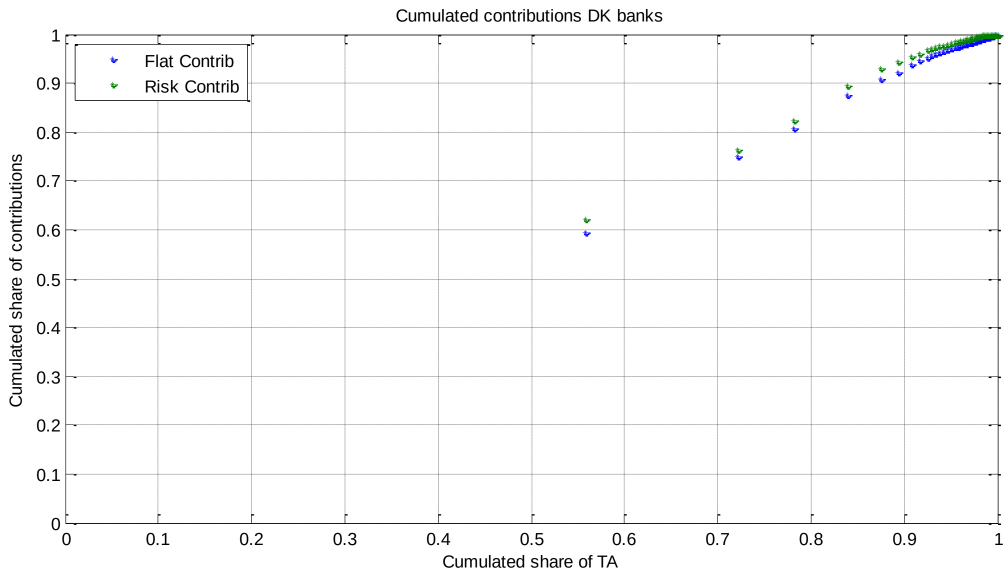


Figure 29: Cumulative distribution of contributions by TA, Croatia

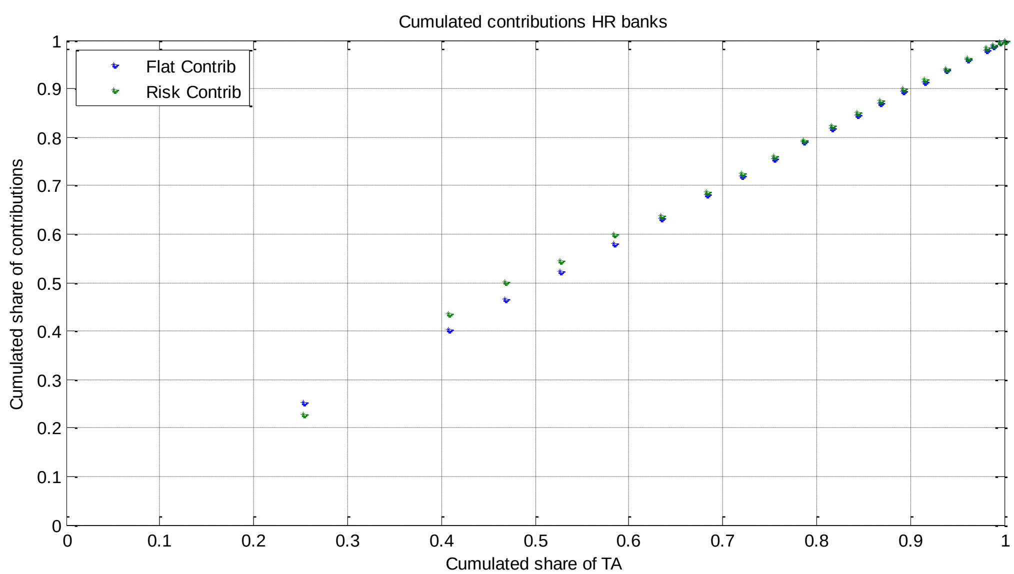


Figure 30: Cumulative distribution of contributions by TA, Hungary

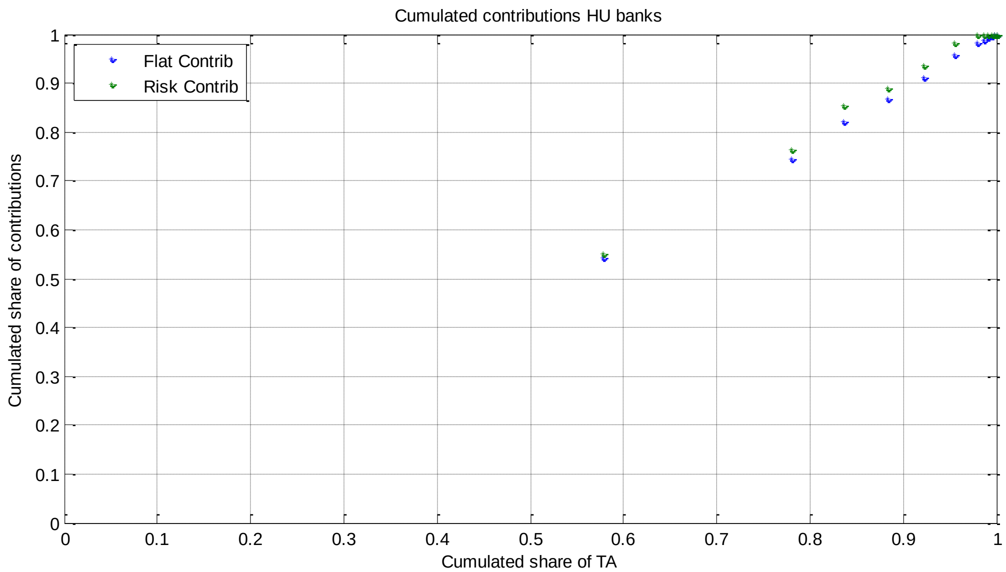


Figure 31: Cumulative distribution of contributions by TA, Poland

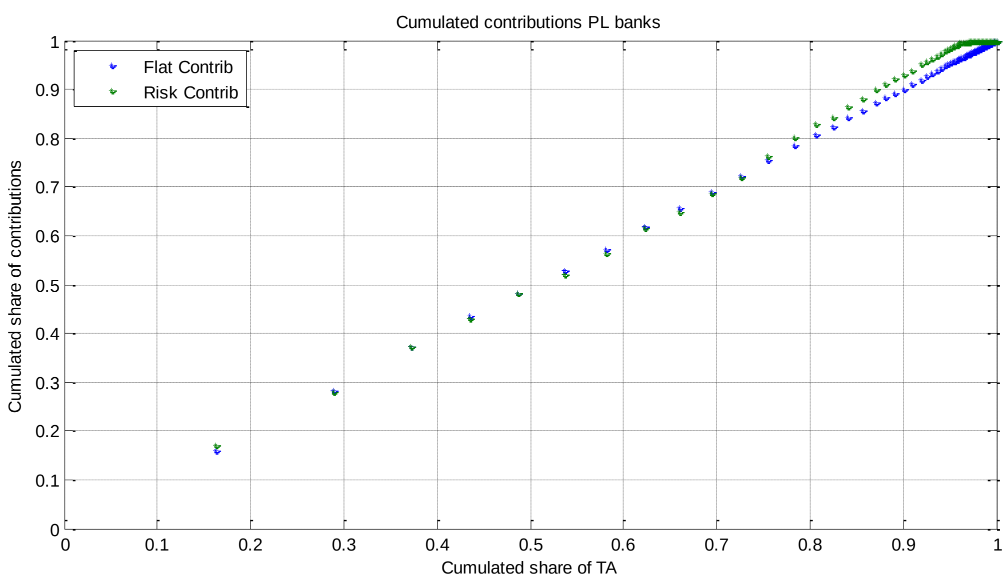


Figure 32: Cumulative distribution of contributions by TA, Romania

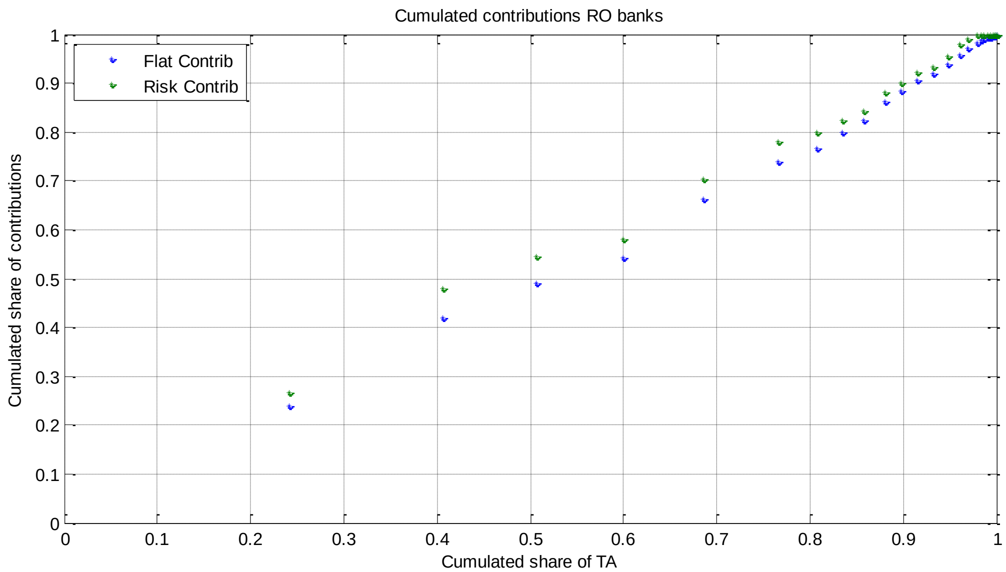


Figure 33: Cumulative distribution of contributions by TA, Sweden

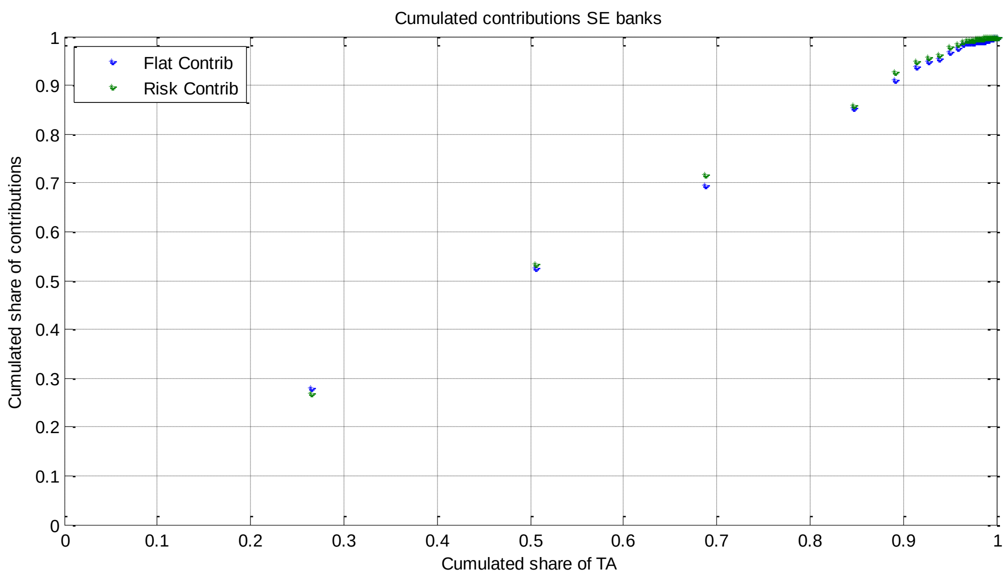
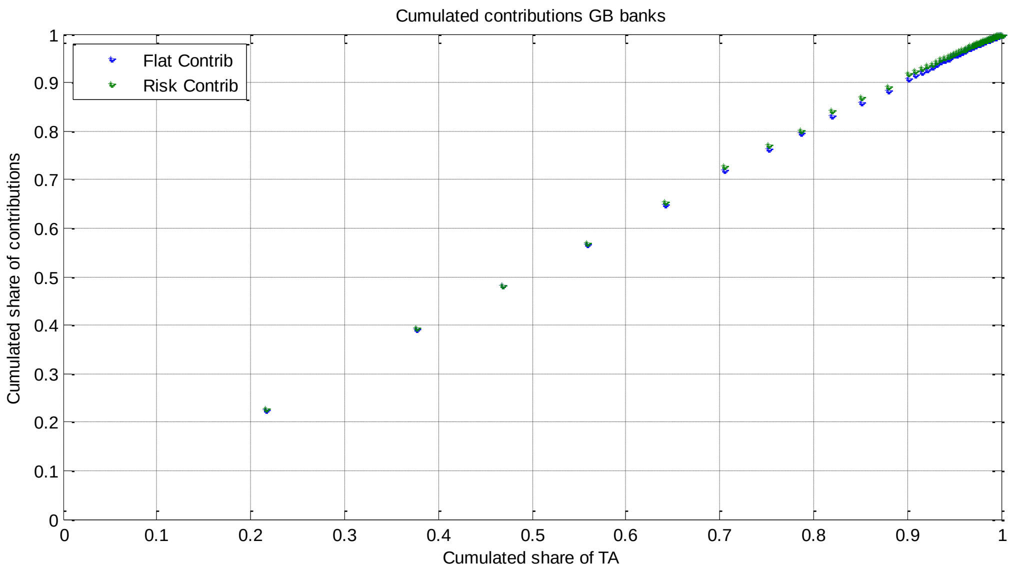


Figure 34: Cumulative distribution of contributions by TA, United Kingdom



6. Analysis of banks' contributions – Introduction of the fourth pillar

This section presents the potential impact on contributions of including the "additional risk factors to be specified by the resolution authority" pillar in the composite risk indicator. This pillar consists of 3 indicators (namely "trading activities and off-balance sheet exposures, derivatives, complexity and resolvability", "membership in an Institutional Protection Scheme" and "extent of previous extraordinary public financial support" each associated to the weights 45%, 45% and 10% respectively) for which a specific discretional assessment of the resolution authority will be required.

As quantitative data on this additional pillar are not available in the database, JRC implemented two scenarios by artificially assigning values to the indicator "Trading activities and off-balance sheet exposures, derivatives, complexity and resolvability" under the assumption that larger banks would tend to have higher values.[29]

In both scenarios the maximum value of the indicator (i.e. 1,000)[30] has been assigned to the "riskiest" banks in the EU. The criterion to select these banks is the following: the largest banks up to cover 65% of cumulative TA in each economic area, provided that the selected bank holds more than 30 billion € of TA. This approach is loosely in line with figures produced for the banking structural reform[31] and it leads to select the number of banks shown in Table 29.

Table 29: Geographical distribution of the "riskiest" banks

Economic Area	**Number of selected "riskiest" banks**
Euro Area	64
CZ	2
DK	1
GB	5
PL	2
SE	2
TOTAL	**76**

The other banks have been assigned values chosen *a priori*: in Scenario 1 all the other banks are attributed the average value of all the other indicators; in Scenario 2 all the remaining institutions are set to the minimum value. This second scenario can be considered as an extreme scenario and thus it might help in assessing the maximum potential effect that in principle could be associated with the additional fourth pillar.

JRC would like to stress that, as data for the fourth pillar have been created *ad hoc*, results should be carefully taken as, once data on the additional indicators would become available to the resolution authority, results might change.

The list of indicators and relative weights is described in Table 30 below.

[29] "Membership in an Institutional Protection Scheme" and "Extent of previous extraordinary public financial support" indicators cannot be modelled as data are missing for the vast majority of the banks and no information is available *a priori* about the characteristics of an entity that is member of an IPS or that received extraordinary public support.

[30] It is worth noting that this indicator has (+1) sign and thus it is transformed in step 2 when building the composite indicator, as detailed in Section 3.1.2.

[31] See Annex A8 of the Commission Staff Working Document Impact Assessment Accompanying the document Proposal for a Regulation of the European Parliament and of the Council on structural measures improving the resilience of EU Credit Institutions and the Proposal for a Regulation of the European Parliament and Council on reporting and transparency of securities financing transactions (http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52014SC0030&from=EN)

Table 30: Balance sheet ratios and *de-facto* weights used when introducing the "additional risk factors" pillar

Pillar / Indicator	Effective weight
Pillar: Risk exposure	**50%**
Indicator: RWA over Total Assets	*33.33%*
Indicator: Leverage ratio (Common equity over Total Assets)	*33.33%*
Indicator: Capital ratio (Total regulatory capital over RWA)	*33.33%*
Pillar: Stability and variety of the sources of funding and unencumbered highly liquid assets	**20%**
Indicator: Loan to Deposits (Customer loans over Customer deposits)	*100%*
Pillar: Importance of an institution to the stability of the financial system or economy	**10%**
Indicator: Share of interbank loans and deposits to the system (Interbank loans + interbank deposits)/sum(Interbank loans + interbank deposits) at EU level	*100%*
Pillar: Additional risk factors to be specified by the resolution authority based on the remaining elements covered by Article 103(7) of the BRRD.	**20%**
Indicator: Trading activities and off-balance sheet exposures, derivatives, complexity and resolvability	*100%*

The 76 riskiest banks in the EU account for a very large part of the total population in most of the economic areas including these selected banks (Euro Area, DK, GB and SE, where they represent more than 50% of TA and of BRRD base), while they are slightly less representative in CZ and PL. Further details are reported in Table 31.

Table 31: Statistics on the "riskiest" banks

Economic area	Aggregated TA		Aggregated BRRD base	
	th €	as % of overall TA in the economic area	th €	as % of overall BRRD bases in the economic area
Euro Area	17,680,628,641	64.91%	13,975,406,661	68.73%
CZ	65,200,852	39.07%	31,507,056	35.40%
DK	315,957,333	55.77%	224,180,702	59.44%
GB	5,366,351,945	64.16%	4,544,375,612	64.84%
PL	83,504,251	28.82%	51,662,896	28.17%
SE	422,000,706	50.45%	318,640,260	52.65%

6.1 Scenario 1: maximum-average

Table 32 shows some statistics on the distribution of the percentage variation in contributions for the riskiest banks when introducing pillar 4. Results show that, on average, banks contributions increase from few percentage points (DK) to more than 20% (PL).

Table 32: Statistics on the percentage variations in contributions of the "riskiest" banks when introducing pillar 4.

	Statistics on the percentage variation in contributions					
	Euro Area	CZ	DK	GB	PL	SE
Average	2.4%	7.7%	1.1%	3.2%	21.8%	8.3%
Median	1.8%	7.7%	1.1%	3.5%	21.8%	8.3%
min	-3.8%	6.9%	1.1%	0.8%	13.3%	3.0%
max	23.5%	8.6%	1.1%	4.8%	30.4%	13.6%

It is worth noting that in the Euro Area there are few banks among the selected "riskiest" ones for which their contributions decrease (i.e. the minimum variation is a negative number), though their composite indicator increases. This happens because of the following:

- although the absolute risk (expressed via the risk indicator) increases, as expected, for all the selected banks, the final risk contribution depends upon the relative share of risk;

- some of these banks significantly increase their absolute risk, while others do so to a smaller extent. When computing the risk contributions, which reflect the relative riskiness of each bank, the former will face a sizeable increase in their contributions, while the latter will face a moderate increase in their contributions and in some cases they might also benefit from a reduction in their contributions.

In order to provide some additional statistics on this characteristic, Table 33 shows the percentage range of variation of the absolute risk indicator, the rescaled risk indicator and the final risk contributions for the selected banks in the Euro area facing an increase in their contributions and for those facing a reduction. The figures demonstrate that those benefiting from a reduction are those facing a slight increase in the risk indicator (in the range 2% - 11%), with respect to the other group (from 12% to 113%).

Table 33: Percentage ranges of variations for Euro area selected banks increasing and reducing their risk-based contributions

	Range of % variation in the absolute CI	Range of % variation in the CI rescaled over [0.8-1.5]	Range of % variation in risk contributions
Banks increasing contributions	[12% 113%]	[5% 30%]	[0.1% 24%]
Banks reducing contributions	[2% 11%]	[1% 5%]	[-4% -0.3%]

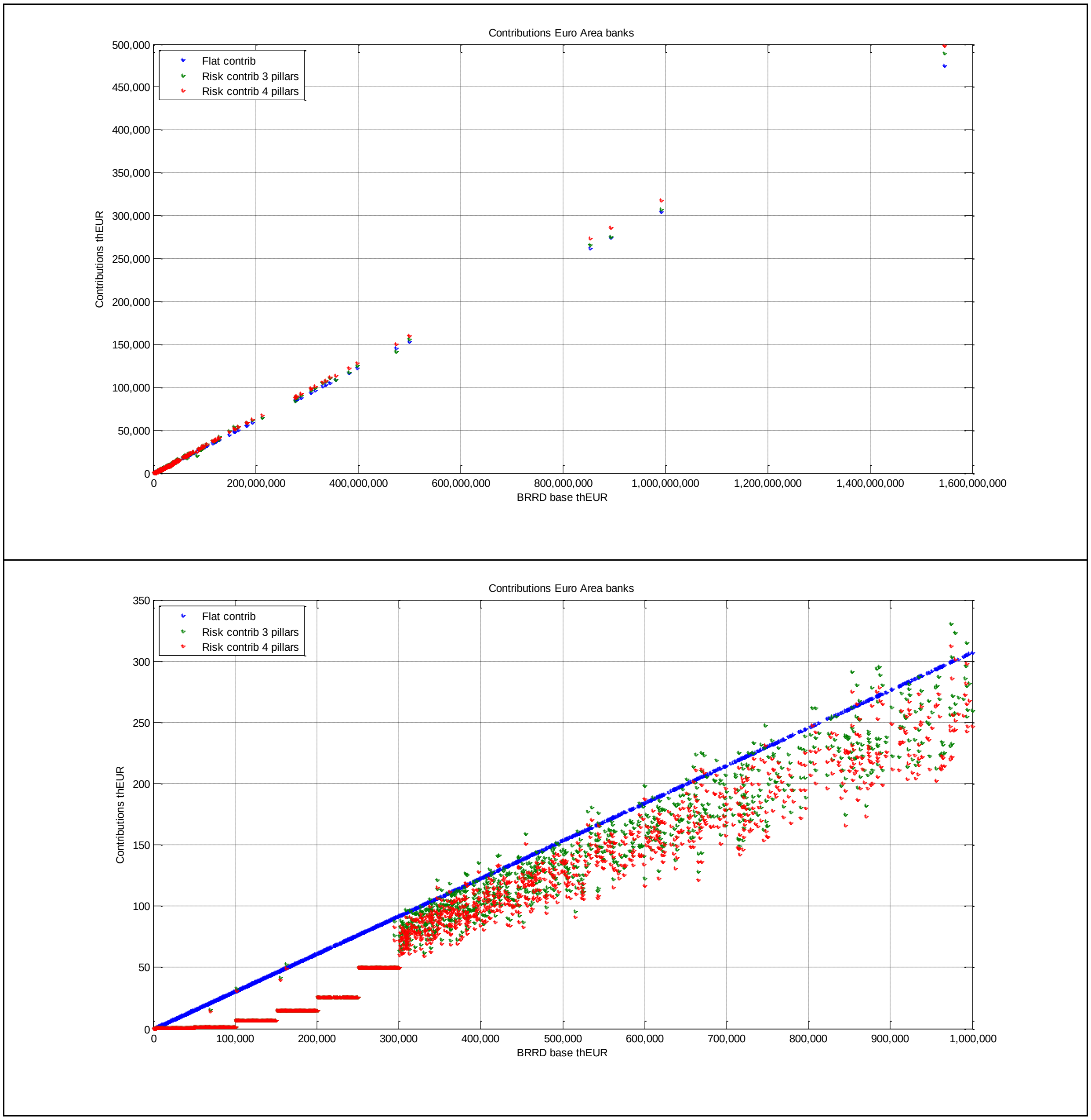
Artificially increasing the pillar for selected banks also has an impact on the remaining big banks: all those banks benefit from a reduction in their contributions (ranging on average from -1% to around - 10%) when moving from three to four pillars. Selected statistics on this reduction can be found in Table 34.

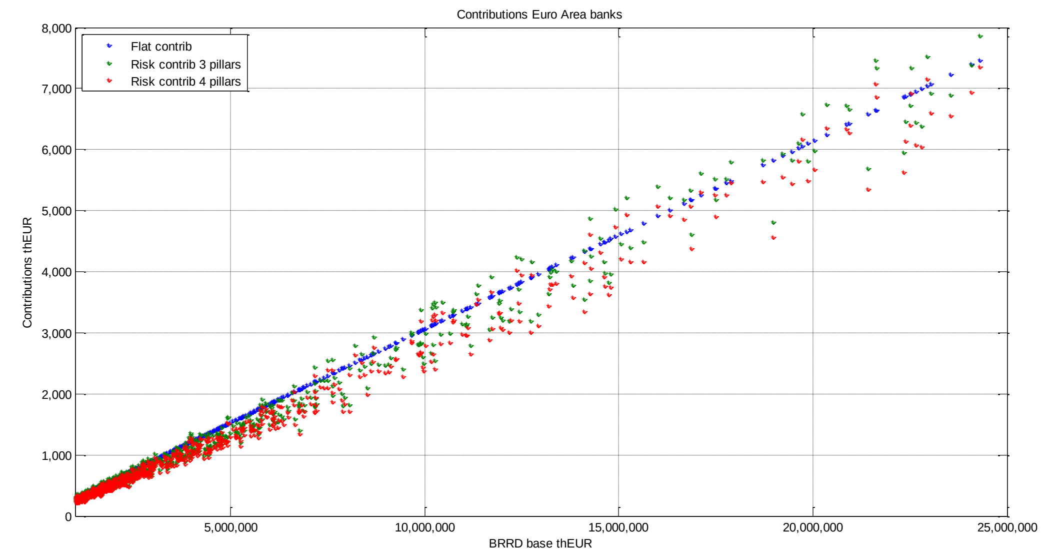
Table 34: Statistics on the percentage variation in contributions of the "non-riskiest" big banks when introducing pillar 4

	Statistics on the percentage variation in contributions					
	Euro Area	**CZ**	**DK**	**GB**	**PL**	**SE**
Average	-5.32%	-4.38%	-1.11%	-5.85%	-7.90%	-9.58%
Median	-5.23%	-4.20%	-1.00%	-5.75%	-7.87%	-9.67%
min	-7.43%	-7.66%	-2.55%	-7.50%	-8.60%	-11.06%
max	-4.73%	-1.58%	-0.41%	-5.05%	-7.04%	-8.21%

Figure 35 compares the flat contribution (blue dots), the risk-adjusted contribution based upon a 3-pillars indicator (green dots) and the risk-adjusted contribution including pillar 4 (red dots) for banks in the Euro area. The first graph in Figure 35 represents the overall sample, while the following graphs are zoomed in graphs for the selected size categories as presented in Section 5. Moreover, Figure 36 to Figure 41 show cumulative contributions based on a 4-pillars indicator (green dots) for all economic areas the selected banks belong to. Results are compared with the cumulative flat contributions (blue dots).

Figure 35: Flat fee (blue dots), risk-adjusted contribution based upon a 3-pillars indicator (green dots) and risk-adjusted contribution based upon a 4-pillars indicator (red dots), Euro area, th €




Contributions Euro Area banks
Flat contrib
Risk contrib 3 pillars
Risk contrib 4 pillars
Contributions thEUR
BRRD base thEUR
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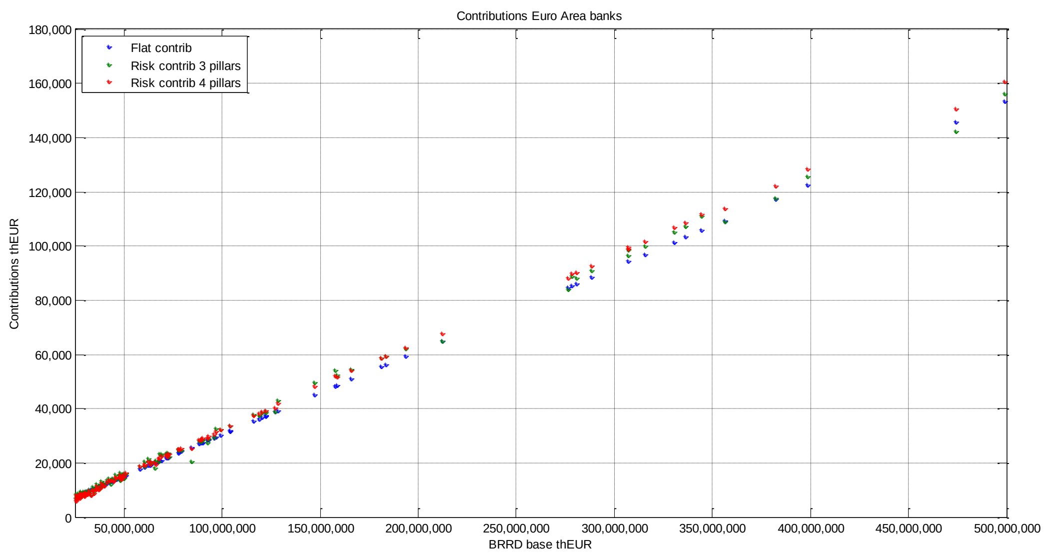
Contributions Euro Area banks
Flat contrib
Risk contrib 3 pillars
Risk contrib 4 pillars
Contributions thEUR
BRRD base thEUR
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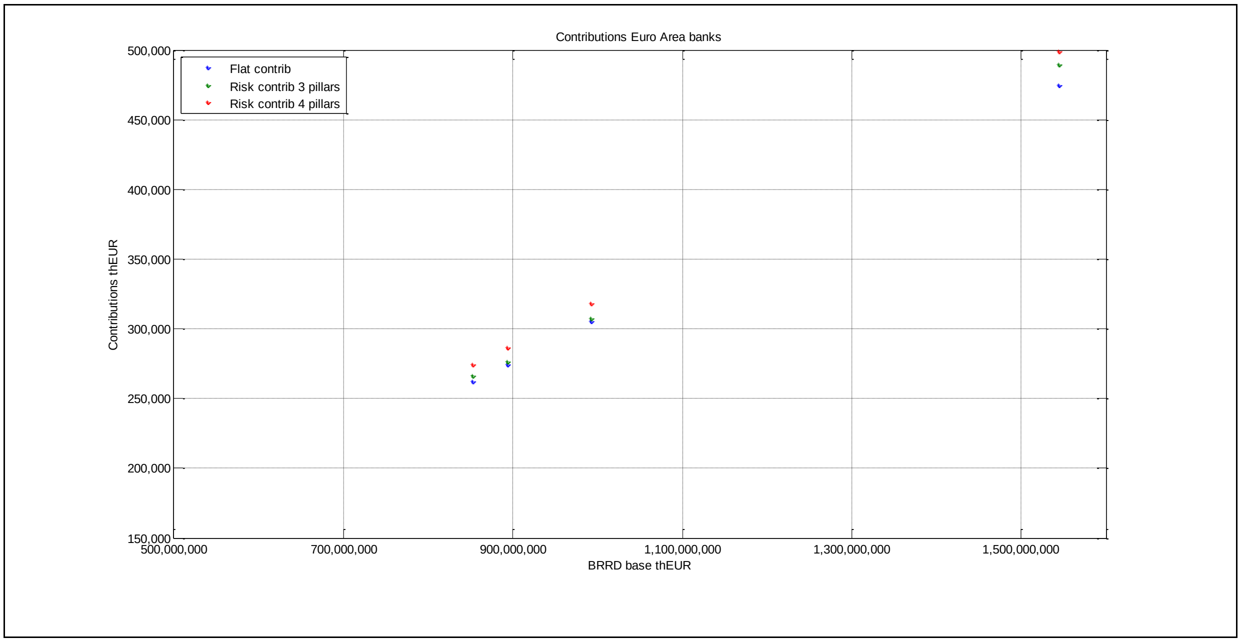


Figure 36: Cumulative risk-adjusted contributions based upon a 4-pillars indicator (green dots) and the cumulative flat fee (blue dots), Euro area

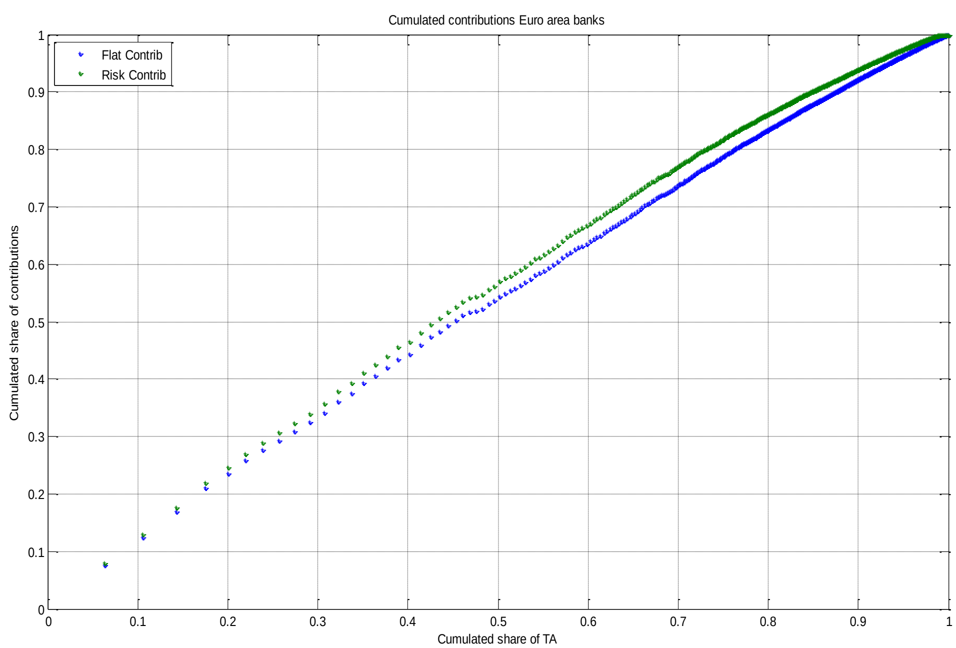


Figure 37: Cumulative risk-adjusted contributions based upon a 4-pillars indicator (green dots) and the cumulative flat fee (blue dots), CZ

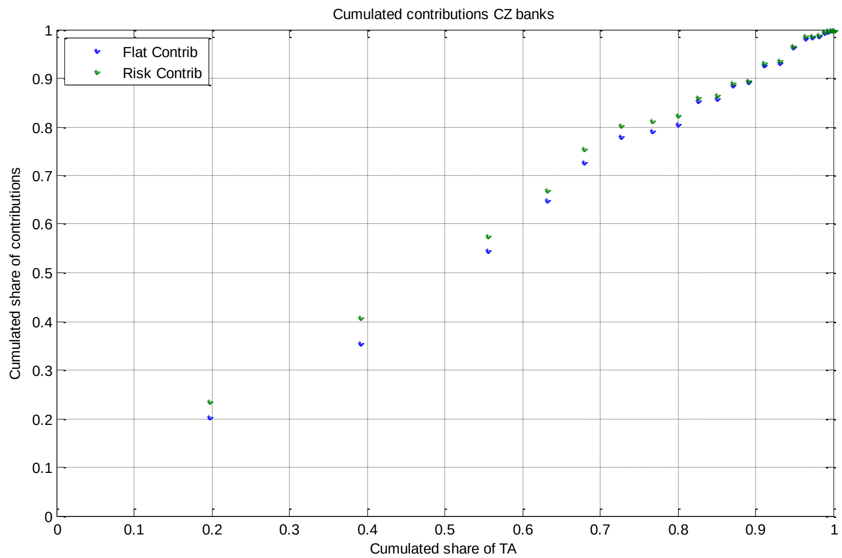


Figure 38: Cumulative risk-adjusted contributions based upon a 4-pillars indicator (green dots) and the cumulative flat fee (blue dots), DK

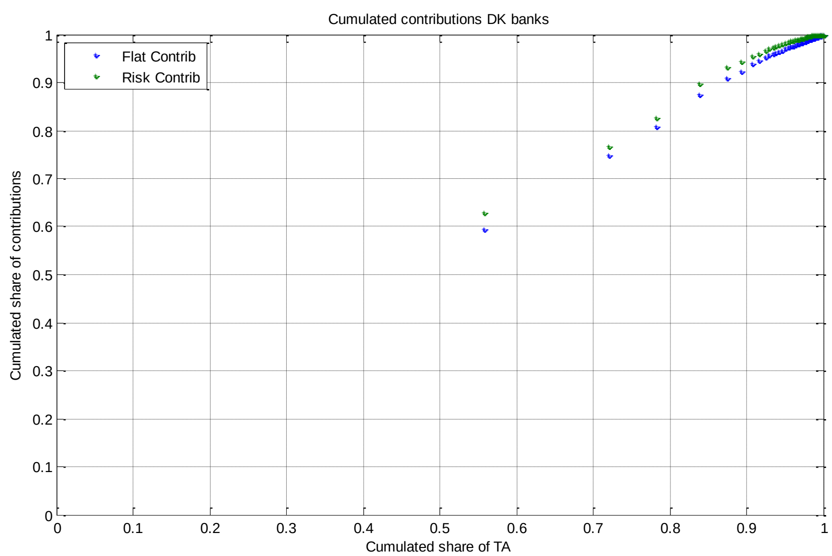


Figure 39: Cumulative risk-adjusted contributions based upon a 4-pillars indicator (green dots) and the cumulative flat fee (blue dots), GB

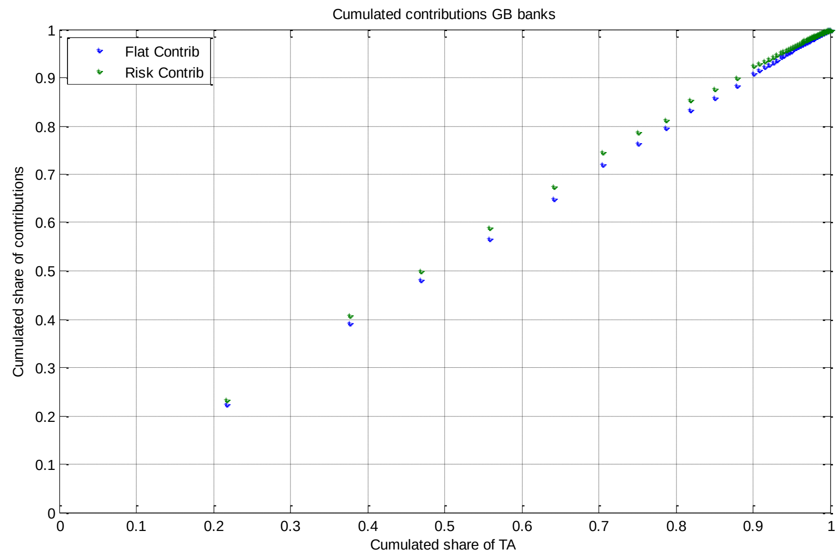


Figure 40: Cumulative risk-adjusted contributions based upon a 4-pillars indicator (green dots) and the cumulative flat fee (blue dots), PL

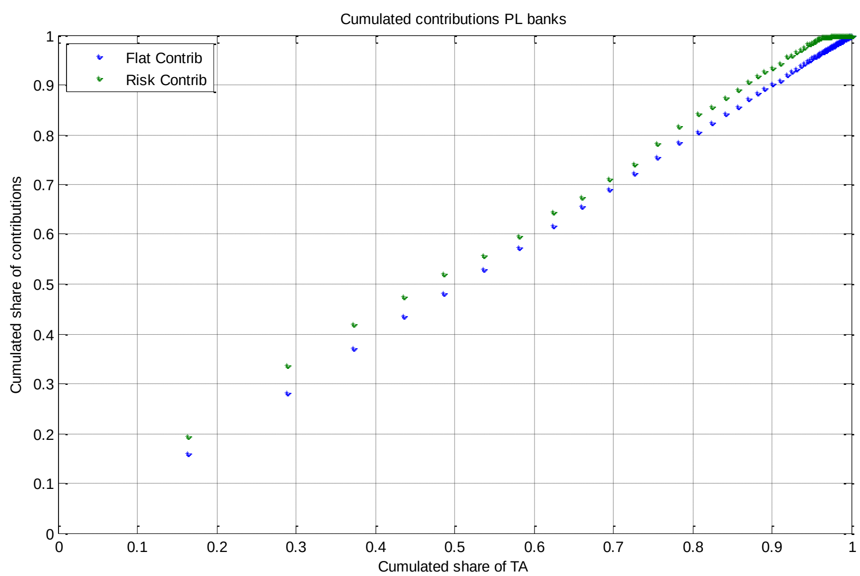
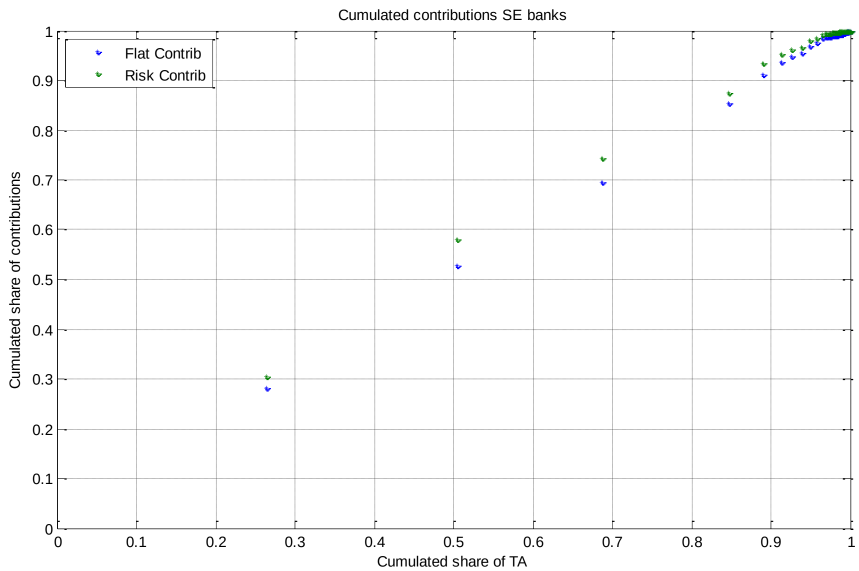


Figure 41: Cumulative risk-adjusted contributions based upon a 4-pillars indicator (green dots) and the cumulative flat fee (blue dots), SE



6.2 Scenario 2: maximum-minimum

According to this alternative modelling of pillar 4, the “riskiest” banks get the maximum value (1,000) while the others get the minimum (1). Table 35 shows some statistics on the percentage variation in contributions when introducing pillar 4. On average, banks contributions increase by 3.2% in the Euro area. On the other hand, the “non-riskiest” banks reduce their contributions by around 8% in the Euro area (see Table 36 below).

Table 35: Summary statistics on the percentage variation in contributions of the "riskiest" banks when moving from a 3-pillars indicator to a 4-pillars one – Scenario 2

	Statistics on the percentage variation in contributions					
	Euro Area	**CZ**	**DK**	**GB**	**PL**	**SE**
Average	3.2%	10.0%	1.9%	4.0%	25.1%	9.7%
Median	2.6%	10.0%	1.9%	4.4%	25.1%	9.7%
min	-4.0%	9.1%	1.9%	1.7%	16.2%	4.2%
max	24.6%	10.9%	1.9%	5.7%	34.0%	15.2%

Table 36: Statistics on the percentage variation in contributions of the "non-riskiest" big banks when moving from a 3-pillars indicator to a 4-pillars one – Scenario 2

	Statistics on the percentage variation in contributions					
	Euro Area	**CZ**	**DK**	**GB**	**PL**	**SE**
Average	-7.9%	-5.6%	-3.2%	-8.1%	-8.9%	-10.5%
Median	-8.1%	-6.0%	-3.8%	-8.5%	-9.3%	-10.8%
min	-8.2%	-6.8%	-4.2%	-8.6%	-9.7%	-11.7%
max	-4.6%	0.5%	0.1%	-5.1%	-7.1%	-7.6%

7. Proxying intragroup liabilities in European countries using interbank data

As there is a need to assess the potential impact of intra-group liabilities in the calculation of the BRRD base, JRC has been asked to prepare some summary statistics on the distribution of interbank deposits as an upper bound proxy for intra-group liabilities.[32] While as a proxy interbank deposits almost surely provide a large over-estimation of intra-group liabilities, they should be much correlated to actual values (i.e. countries with much higher value of interbank deposits should also be those with high levels of intra-group linkages).

Interbank liabilities are compared to the BRRD base (defined as Total Assets less Total Regulatory Capital and Covered Deposits, where Total Regulatory Capital is used as a proxy for total own funds[33]) and to Total Assets.

These ratios are calculated for all banks in the final database as of Monday August 4 2014 and results are presented in terms of summary statistics of the resulting distributions of ratios over countries and Euro/Non Euro member states.

"Small banks" (BRRD base less than 300 million €) are excluded from the sample before running the calculations. These banks are excluded as they are a very large number and are often not active in the interbank market (with some exceptions in some countries) so that including them would lead to a biased estimate of the mean and median, which would not be representative of the typical values of the banks which do participate in interbank/intra-group exchange activities.

An alternative estimation methodology based on aggregate statistics from BIS and ECB is presented in the last section.

7.1 Proxying intragroup via the distribution of micro-level interbank data: results in terms of BRRD base

The following graphs and tables present results in terms of BRRD base (defined as Total Assets less Own funds and Covered Deposits).

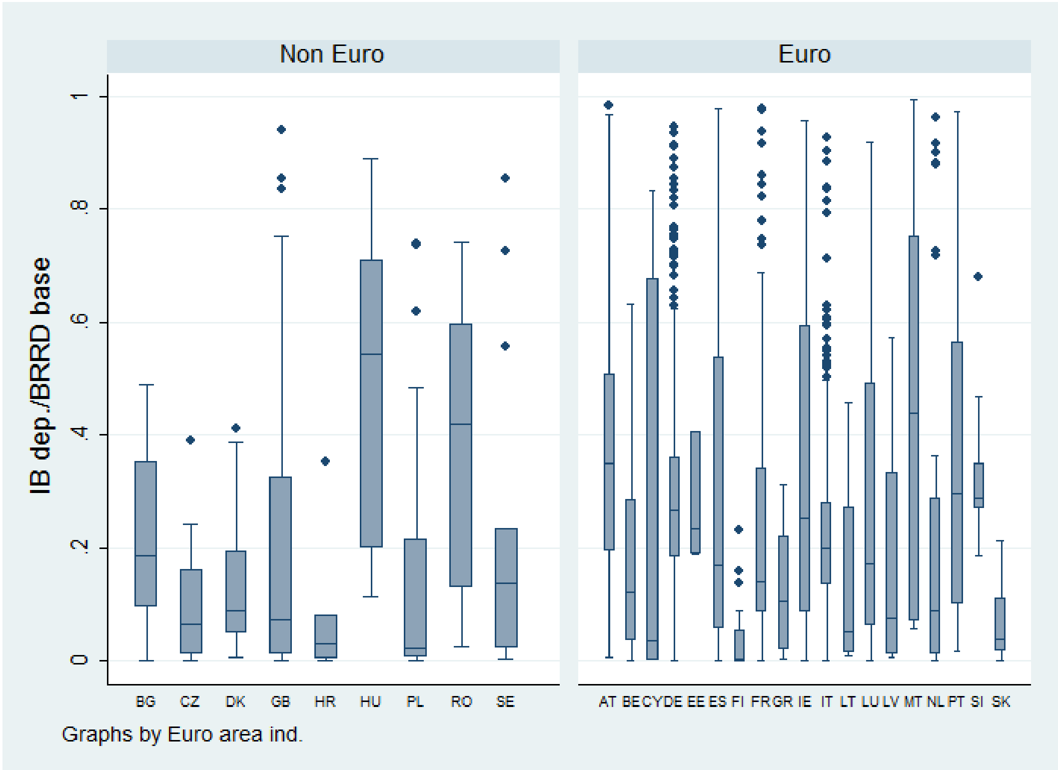
Figure 42 is a box plot of the ratio of interbank liabilities to BRRD base for each country, grouped by its membership in Euro area. In the graph, the lower and upper limits of the box identify the 1st and 3rd quartile (one fourth of all banks have a value of the ratio which is lower than the 1st quartile, and one quarter of all banks have a value of the ratio which is higher than the 3rd quartile), the line in the box denotes the median (the value which splits the sample in two identical parts: half of the banks have a value of the ratio which is lower than the median, and half of the banks have a value which is higher), and the limits of the lower and upper whiskers denote the lowest and highest points which can be considered "normal" given the shape of the distribution.[34] All individual points outside the whiskers are outliers: actual points which are "unexpected" given the shape of the rest of the distribution for that particular country. The biggest is the distance between the extremes of the box, the more spread-out is the distribution and the least the median and the mean can be considered "representative" of all other banks within the country which are not considered "outliers" (i.e. represented as individual points).

[32] Though not all intra-group liabilities take the form of interbank deposits, these should be the most common form.

[33] Own funds are not directly available for most banks in the sample. Total Regulatory Capital and own capital are seen to be almost coincident in the sub-sample of the JRC sample for which both variables are available.

[34] This depends on the assumptions on the general shapes of statistical distributions employed to assess it. Here we use the classical Tukey definition of the box plot: the end points of the whiskers coincide with the lowest and highest actual points which fall within 1.5 times the inter-quartile range from the 1st and 3rd quartiles. The inter-quartile range being the distance between the 1st and the 3rd quartile.

Figure 42: Box plot of interbank deposits over BRRD base, excluding "small banks" (BRRD base<300m €)



How to read the box-plot, an example: in BE about a quarter of all banks have a ratio of Interbank liabilities to BRRD which is lower than roughly 5% (3.47%, see Table 37); half of all banks in the sample have a ratio which is lower than about 10% and about half of the banks have a ratio which is above it; about a quarter of all banks have a ratio which is above about 30% (i.e. three quarters of all banks lie below this value); the bank with the highest value which is "not unexpected" given the general shape of BE distribution has a ratio of about 65%, and there are no banks with higher values; the bank with the lowest value has a value of about zero, and there are no banks with a lower value.

Table 37 contains summary statistics for the interbank deposits to BRRD base ratio for all Euro area countries. Values are expressed as fractions (i.e. 0.1 corresponds to a 10% ratio). The table reports the average, the standard deviation (a measure of the "spread" of the distribution: the higher this value the less representative of the whole distribution the mean can be considered[35]) as well as four key measures of the boxplot graph shown above: the first quartile, the median, the third quartile and the interquartile range (i.e. the difference between the third and first quartiles, another measure of the spread of the distribution). The table also reports the minimum and maximum value for each country. Table 38 reports the same information for non-Euro area MS.

[35] Values of the same magnitude of the mean roughly imply that almost 20% of all banks would have a value at least double than the mean itself. This under the assumption that the distribution has a Normal Distribution (i.e. Gaussian) shape.

Table 37: Summary statistics for interbank deposits over BRRD base, excluding "small banks" (BRRD<300m €). Euro area

Country	Mean	Standard deviation	1st quartile	Median	3rd quartile	Interquartile range	Min	Max
AT	36.31%	22.94%	19.54%	35.09%	50.85%	31.31%	0.52%	98.37%
BE	18.16%	17.02%	3.47%	12.24%	28.64%	25.17%	0.01%	63.30%
CY	24.17%	35.63%	0.00%	3.68%	67.72%	67.72%	0.00%	83.30%
DE	28.26%	15.41%	18.25%	26.73%	35.99%	17.74%	0.00%	94.67%
EE	27.64%	11.48%	18.77%	23.54%	40.60%	21.83%	18.77%	40.60%
ES	29.88%	30.95%	5.65%	16.99%	53.89%	48.25%	1.74E-06	97.85%
FI	3.95%	6.62%	0.01%	0.12%	5.47%	5.46%	1.61E-06	23.21%
FR	24.24%	24.32%	8.81%	14.07%	34.16%	25.36%	7.46E-06	97.91%
GR	12.25%	11.21%	1.88%	10.48%	22.12%	20.25%	0.27%	31.19%
IE	35.93%	31.02%	8.77%	25.24%	59.34%	50.56%	0.03%	95.76%
IT	23.30%	16.25%	13.45%	20.05%	28.09%	14.63%	0.20%	92.86%
LT	14.21%	21.24%	1.33%	5.19%	27.10%	25.77%	0.82%	45.66%
LU	28.11%	27.02%	6.23%	17.34%	49.37%	43.14%	0.00%	92.07%
LV	17.64%	21.41%	1.24%	7.62%	33.45%	32.21%	0.64%	57.34%
MT	42.20%	36.62%	6.99%	43.98%	75.39%	68.40%	5.81%	99.59%
NL	23.84%	30.86%	1.23%	9.08%	28.93%	27.70%	0.00%	96.26%
PT	36.55%	31.15%	9.95%	29.56%	56.41%	46.45%	1.79%	97.41%
SI	32.93%	13.61%	27.05%	28.96%	34.96%	7.91%	18.68%	68.15%
SK	6.92%	7.02%	1.63%	3.94%	11.03%	9.40%	0.00%	21.20%
Total	**27.05%**	**19.75%**	**13.66%**	**23.51%**	**35.53%**	**21.87%**	**0.00%**	**99.59%**

How to read the table, an example: in AT the average interbank liabilities over total assets is 36.3%; the distribution is relatively spread out. As with the boxplot: 25% of AT banks have a value of the ratio below roughly 19%, half of all banks have a value below 35% and three quarters of the banks have a value below 50.8%. The interquartile range is equal to 31%. The minimum value for all banks which are not "small" for our purposes (i.e with a BRRD base above 300 m €) is almost zero, while the biggest observed value is around 98%.

Table 38: Summary statistics for interbank deposits over BRRD base, excluding "small banks" (BRRD<300m €). Non-Euro area

Country	mean	standard deviation	1st quartile	median	3rd quartile	Interquartile range	min	Max
BG	20.70%	15.63%	9.52%	18.71%	35.35%	25.83%	0.20%	49.08%
CZ	9.92%	10.53%	1.13%	6.49%	16.12%	14.99%	0.00%	39.16%
DK	12.94%	10.90%	4.87%	8.94%	19.35%	14.48%	0.62%	41.20%
GB	18.93%	23.40%	1.06%	7.24%	32.64%	31.58%	0.00%	94.09%
HR	8.25%	13.57%	0.33%	2.93%	8.11%	7.78%	0.01%	35.17%
HU	50.70%	28.44%	20.04%	54.46%	70.88%	50.84%	11.41%	89.13%
PL	13.84%	21.94%	0.72%	2.21%	21.68%	20.96%	0.00%	74.06%
RO	39.25%	24.50%	12.89%	42.10%	59.84%	46.95%	2.43%	74.25%
SE	21.70%	27.29%	2.23%	13.66%	23.56%	21.33%	0.25%	85.44%
Total	**19.11%**	**22.62%**	**1.85%**	**8.75%**	**29.32%**	**27.47%**	**0.00%**	**94.09%**

Figure 43 offers a visual summary of the average values from the table above, for Euro area and non-Euro area countries.

Figure 43: Average by country for interbank deposits over BRRD base, excluding small banks

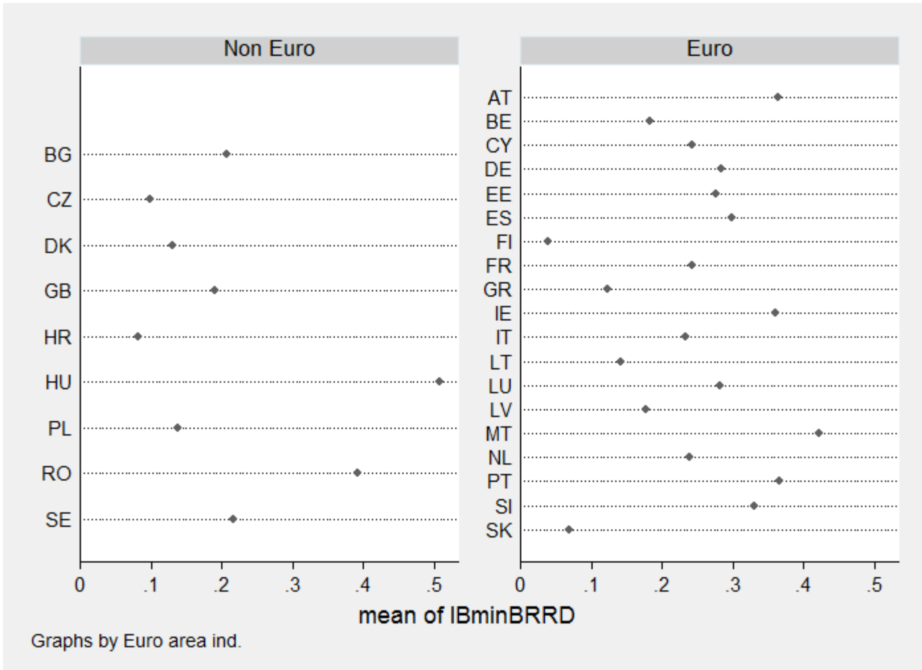
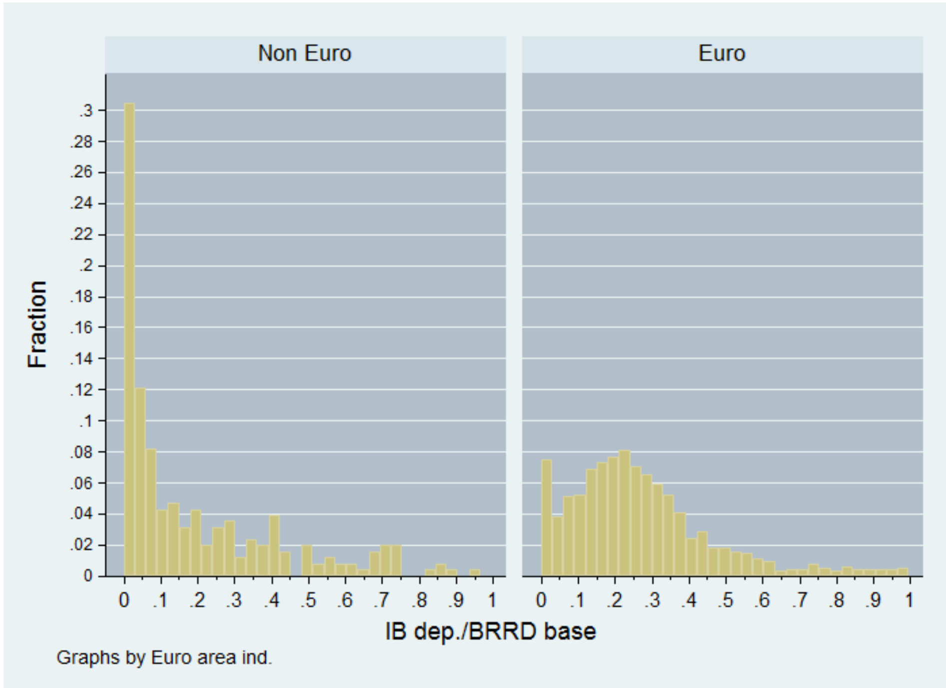


Figure 44 shows a histogram for the distribution of the value of the interbank deposits to total assets for the Euro area and non-Euro area. The height of each bar represents the share of all banks in each area possessing a value of the ratio comprised between those falling at the hedges of each bar.

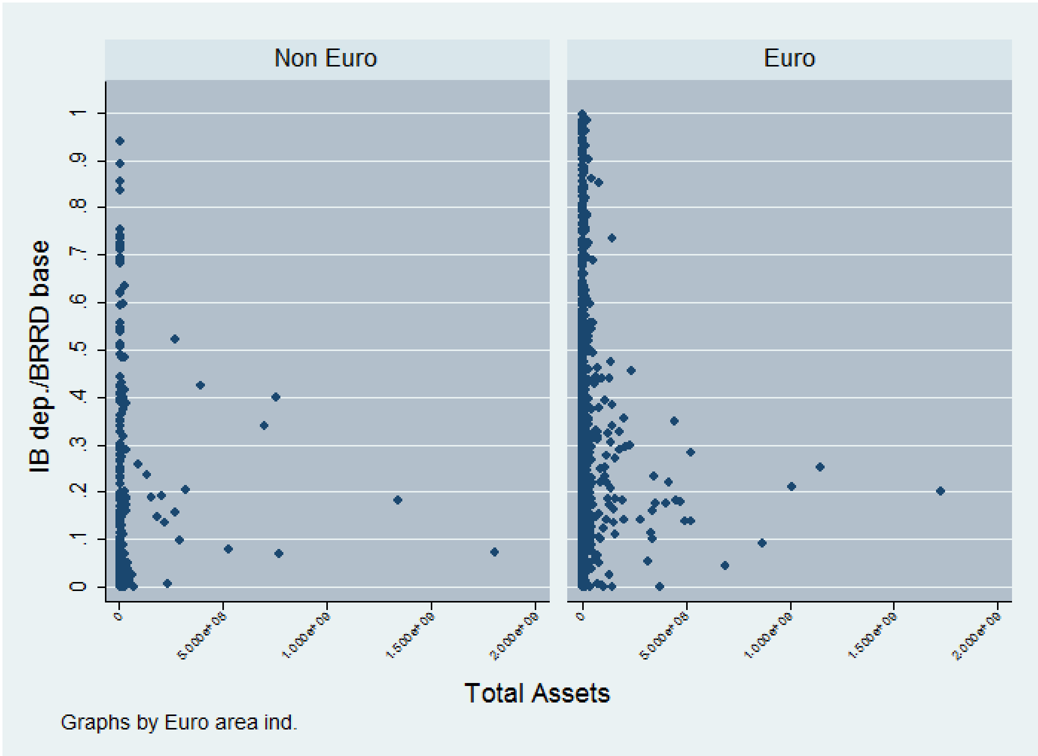
Figure 44: Histogram of distribution of values of interbank deposits over BRRD base, excluding "small" banks, for Euro area and non-Euro area



How to read the histogram, an example: in the Euro area roughly 8% of all banks have a value of the interbank deposits to total assets ratio which is between roughly 22% and 25%, and another 7% of all banks have a value of the ratio between 25% and roughly 28%. About 1% of all banks have a value of the ratio roughly between 75% and 81%.

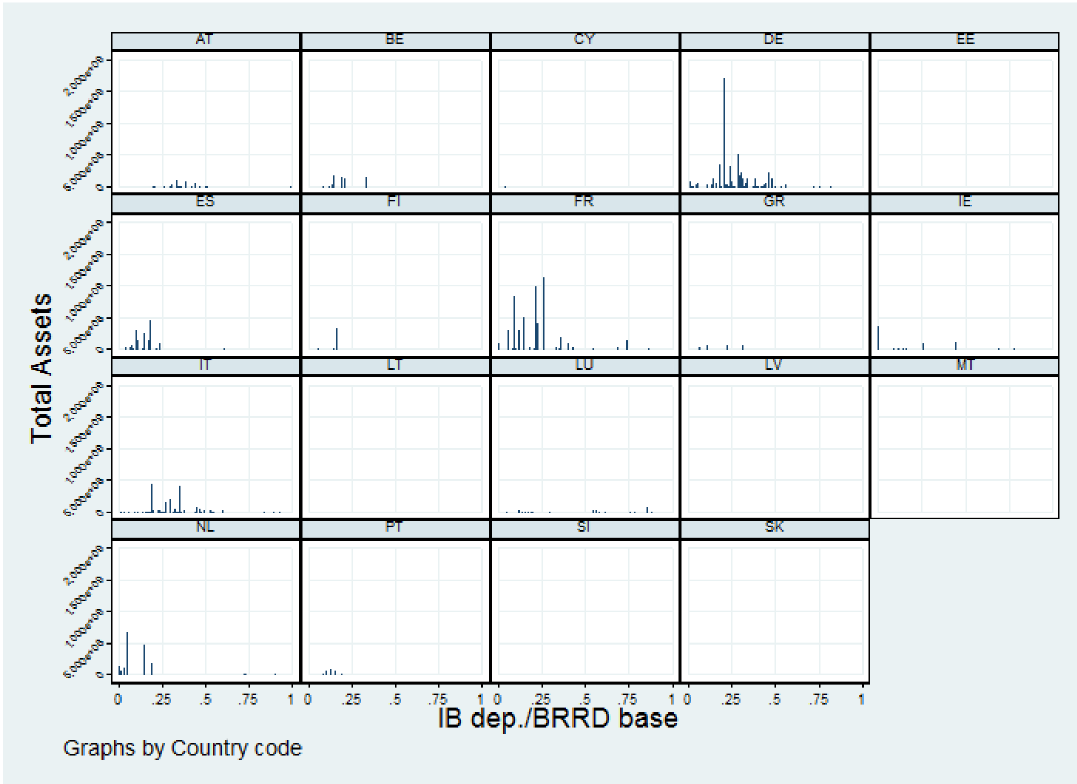
Finally, Figure 45 illustrates the relationship between the interbank deposits to total assets ratio, and the size of institutions in terms of total assets. The horizontal axis reports total assets in thousands of Euro (i.e. a value of 5 followed by 8 zeros corresponds to 500 bn €, the biggest bank has total assets of roughly 1.5 tn €). From this graph it is possible to see that largest banks tend to have values of the ratio of interbank deposits over BRRD base which are relatively lower than the mass of other banks, but which can be non-negligible (i.e. about 25% for banks in the Euro area)

Figure 45: Scatterplot of values of interbank deposits over BRRD base vs TA, excluding "small" banks, for Euro area and non-Euro area



A detail of the same data is provided in Figure 46, with a spike graph (i.e. a scatterplot with drop lines) of the same relationship, on a country-by-country basis for euro area countries.

Figure 46: Spike graph (scatterplot with drop lines) of values of Total Assets vs BRRD base, on a country by country basis, for countries in Euro area (boxes which are apparently blank are due to use a constant scale across countries).



7.2 Estimating Intragroup Liabilities by means of BIS and ECB statistics: results in terms of BRRD base

Intra-group liabilities can also be estimated as a share of interbank deposits by using some ratios from BIS and ECB statistics on interbank to intra-group deposits.[36]

In its international banking statistics[37], BIS provides a breakdown of international liabilities to foreign banks into liabilities to all foreign banks and liabilities to related foreign offices for 13 European countries (AT, BE, CY, DE, ES, FI, FR, GR, IE, IT, LU, NL, PT).

In its MFI statistics,[38] ECB provide data on the amounts of deposit liabilities towards other MFIs for each Euro area country, breaking it down into liabilities towards Euro area MFIs, MFIs within the European Union but outside Euro area, MFIs in the rest of the world.

Ignoring the possibly major complication of the different statistical populations involved in the two exercises (credit institutions in the BIS exercise, MFIs including money market funds in the ECB exercise) it is therefore possible to obtain an estimate of intragroup interbank liabilities by following these steps:

1. Estimate the total interbank for a country's banks by summing deposit liabilities of its MFIs to all MFIs within the Euro area, other EU MS and other foreign countries;
2. Estimate the share of foreign interbank on this total by comparing it to international interbank liabilities obtained from BIS statistic;
3. Estimate the share of intragroup on foreign interbank deposits by comparing BIS data on total foreign interbank and intragroup foreign interbank;
4. Obtain an estimate of the share of intragroup on domestic interbank by applying a "correction factor" to the estimate for the share of intra-group on foreign interbank obtained above. In this case the correction is 70%, based on the observation that domestic money market transactions are probably more likely to be conducted on the open IB market, while foreign transactions are relatively more likely to be conducted with a related office;
5. Finally obtain the share of intragroup liabilities on interbank liabilities as the (weighted) average of the ratios obtained in points 3 and 4.

Table 39 below shows the ratio of intra-group liabilities to BRRD base by country. For each Member State, this is obtained by multiplying the ratio of intragroup liabilities to interbank liabilities as per step 5 above to the ratio of interbank liabilities to total assets obtained from the final database. While it is not possible to obtain estimates for the range of variation of these estimates based on the data available, variation for interbank loans data estimated above could be a considered a proxy.

Based on a similar reasoning, the overall median of the mean could be a good proxy of the impact at Euro area level (based on comparisons of the median of the means and of the total Euro area level mean on interbank data used in the previous section)

[36] All data is sourced as of Q1 2014. BIS data is converted from USD to EUR at the exchange rate of 1.33 USD/EUR (Source: AMECO, end 2013 data point).

[37] http://www.bis.org/statistics/about_banking_stats.htm as of 5 September 2014.

[38] Statistics for credit institutions balance sheets do not provide the necessary breakdowns, thus leaving MFI statistics as the only possible choice: https://www.ecb.europa.eu/stats/money/aggregates/bsheets/html/index.en.html as of 5 September 2014.

Table 39: Ratio of intra-group liabilities to BRRD by country.

Country	Average intragroup as share of foreign IB	Share of foreign IB	Average intragroup as share of BRRD base
AT	9.4%	32.7%	**3.4%**
BE	44.2%	94.1%	**8.0%**
CY	14.1%	3.6%	**3.4%**
DE	56.7%	74.5%	**16.0%**
ES	33.3%	58.9%	**10.0%**
FI	13.8%	4.0%	**0.5%**
FR	52.6%	61.8%	**12.8%**
GR	25.5%	52.9%	**3.1%**
IE	53.8%	33.1%	**19.3%**
IT	38.0%	37.4%	**8.9%**
LU	12.4%	5.1%	**3.5%**
NL*	63.4%	94.1%	**14.5%**
PT	26.0%	46.5%	**9.5%**
Overall median			**8.9%**

*Note *: for NL, the share of foreign IB would result larger than 100%. This estimate is therefore substituted with the second highest estimated value in the sample before proceeding with the calculations.*

Also these estimates make apparent that there could be large variations between countries, which could be further amplified by individual bank level variation which cannot be captured in the current analysis.

7.3 Conclusions

Based on the evidence presented above the main conclusions which can be taken are that, although using interbank loans as a proxy for intra-group liabilities is probably a rather large over-estimation, there could be cases where these could represent a non-negligible amount. Moreover, the distribution of these impacts would not be even between countries, with some which could be affected sensibly more than others. An alternative methodology based on ECB and BIS data, also points to the possibility of large between-country variations.

7.4 Additional results in terms of Total Assets

This section reproduces all graphs and tables reported above as ratio of interbank loans over TA.

Figure 47: Box plot of interbank deposits over TA, excluding "small banks"

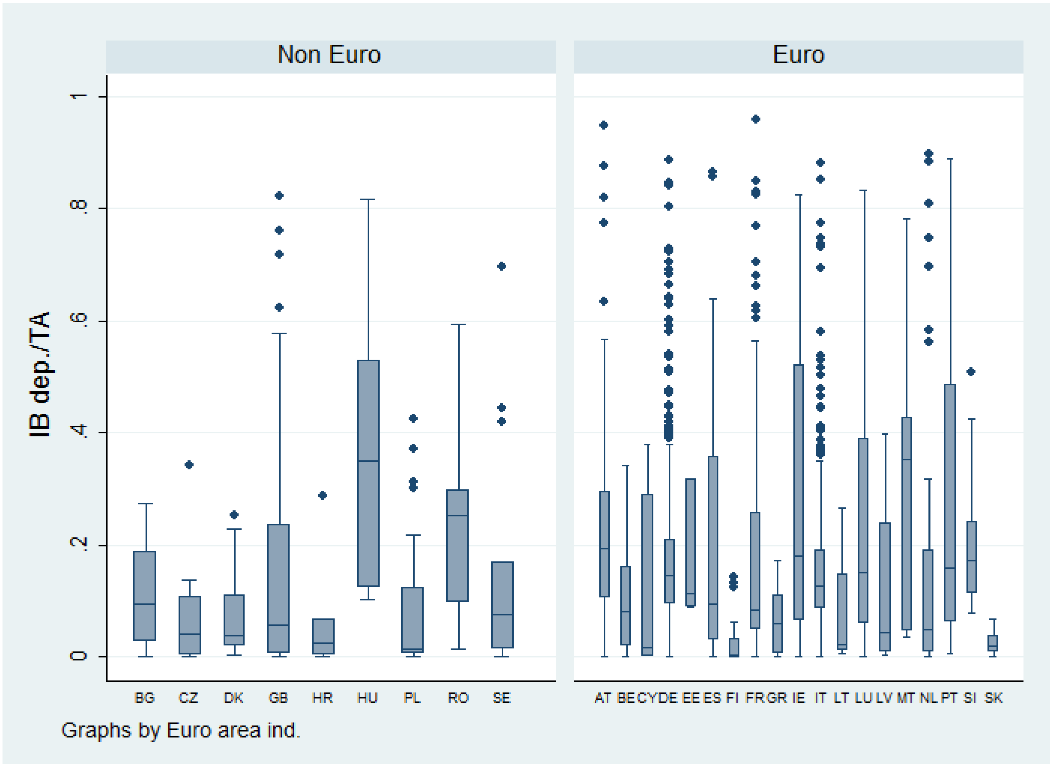


Table 40: Summary statistics for interbank deposits over TA, excluding "small banks" Euro area.

Country	mean	standard deviation	1st quartile	median	3rd quartile	Interquartile range	min	Max
AT	23.80%	18.94%	10.61%	19.53%	29.71%	19.09%	0.08%	94.83%
BE	10.49%	9.41%	1.88%	8.18%	16.09%	14.21%	0.01%	34.17%
CY	10.77%	15.83%	0.00%	1.76%	28.97%	28.97%	0.00%	37.89%
DE	16.99%	12.20%	9.56%	14.66%	21.02%	11.46%	0.00%	88.79%
EE	17.43%	12.59%	8.96%	11.43%	31.89%	22.94%	8.96%	31.89%
ES	19.85%	22.89%	2.97%	9.48%	35.73%	32.76%	1.05E-06	86.67%
FI	2.78%	4.84%	0.00%	0.04%	3.25%	3.25%	3.99E-07	14.30%
FR	17.97%	21.89%	4.87%	8.55%	25.91%	21.04%	6.73E-06	95.89%
GR	6.44%	6.09%	0.77%	5.94%	11.08%	10.31%	0.10%	17.28%
IE	28.85%	27.15%	6.50%	17.97%	52.19%	45.69%	0.03%	82.48%
IT	16.36%	13.66%	8.57%	12.80%	19.20%	10.63%	0.13%	88.17%
LT	8.02%	12.50%	1.04%	2.35%	15.00%	13.96%	0.69%	26.69%
LU	25.10%	24.63%	5.89%	15.21%	38.98%	33.09%	0.00%	83.39%
LV	12.27%	15.62%	0.86%	4.50%	24.07%	23.20%	0.49%	39.92%
MT	29.37%	25.59%	4.71%	35.35%	42.69%	37.98%	3.61%	78.18%
NL	18.48%	27.47%	0.80%	5.02%	19.04%	18.24%	0.00%	89.83%

Country	mean	standard deviation	1st quartile	median	3rd quartile	Interquartile range	min	Max
PT	29.96%	29.71%	6.14%	15.99%	48.67%	42.53%	0.63%	88.94%
SI	20.33%	12.97%	11.25%	17.22%	24.22%	12.97%	7.92%	50.73%
SK	2.53%	2.29%	0.82%	1.89%	3.91%	3.09%	0.00%	6.93%
Total	17.81%	16.36%	7.78%	13.67%	21.94%	14.16%	0.00%	95.89%

Table 41: Summary statistics for interbank deposits over TA, excluding "small banks", non-Euro area.

Country	mean	standard deviation	1st quartile	median	3rd quartile	Interquartile range	min	Max
BG	10.82%	9.65%	2.80%	9.62%	18.83%	16.03%	0.04%	27.40%
CZ	6.62%	8.40%	0.28%	4.20%	10.75%	10.48%	0.00%	34.26%
DK	6.78%	6.80%	2.02%	3.94%	11.10%	9.08%	0.26%	25.31%
GB	14.22%	18.65%	0.70%	5.63%	23.86%	23.15%	0.00%	82.38%
HR	6.85%	11.12%	0.28%	2.59%	6.76%	6.47%	0.01%	28.88%
HU	38.43%	25.29%	12.45%	35.04%	53.01%	40.56%	10.40%	81.83%
PL	8.66%	13.38%	0.51%	1.42%	12.34%	11.83%	0.00%	42.58%
RO	23.57%	17.65%	9.86%	25.48%	29.97%	20.11%	1.41%	59.55%
SE	15.46%	20.48%	1.51%	7.62%	17.01%	15.50%	0.12%	69.65%
Total	13.05%	17.04%	1.17%	4.67%	18.83%	17.66%	0.00%	82.38%

Figure 48: Average by country for interbank deposits over TA, excluding "small banks"

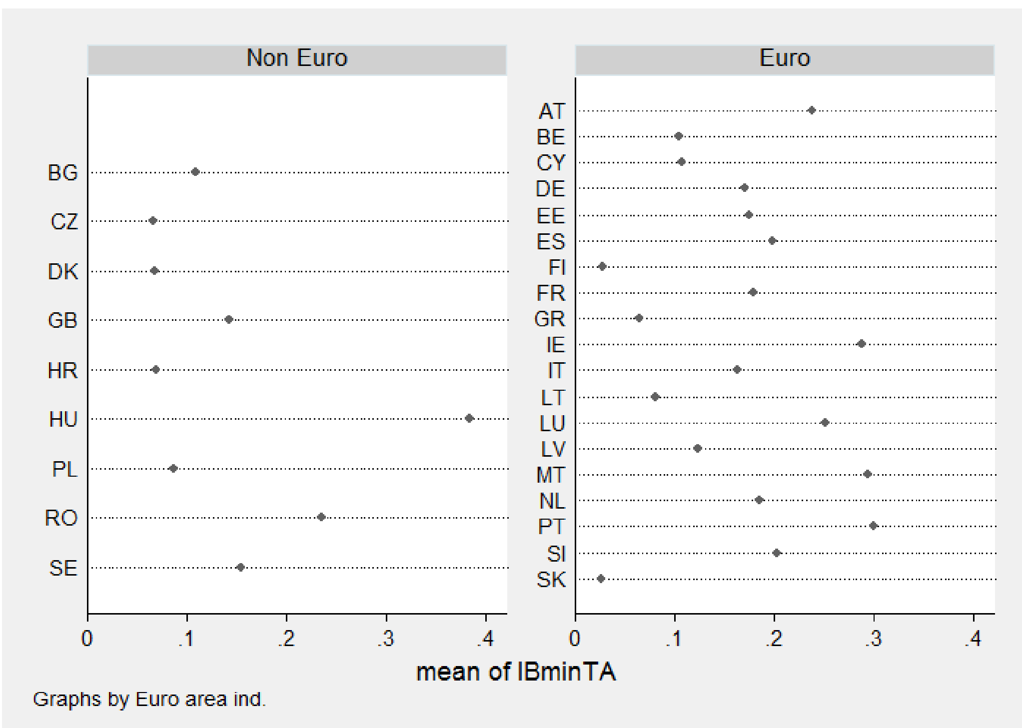


Figure 49: Histogram of distribution of values of interbank deposits over TA, excluding "small" banks for Euro area and non-Euro area

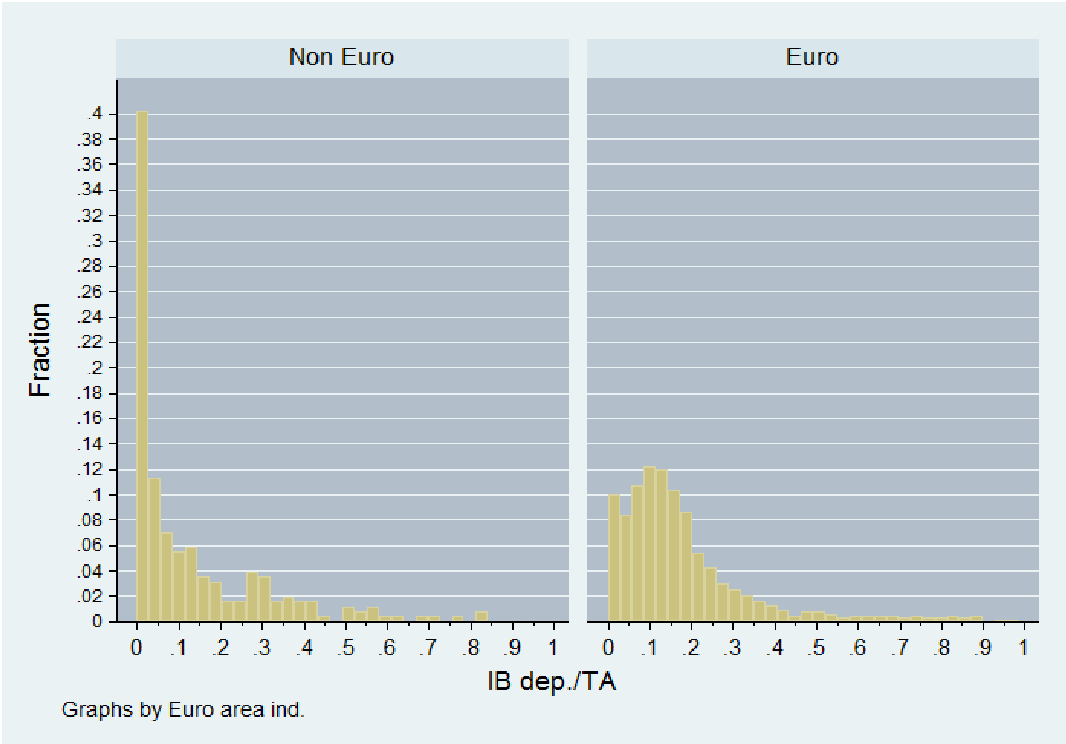
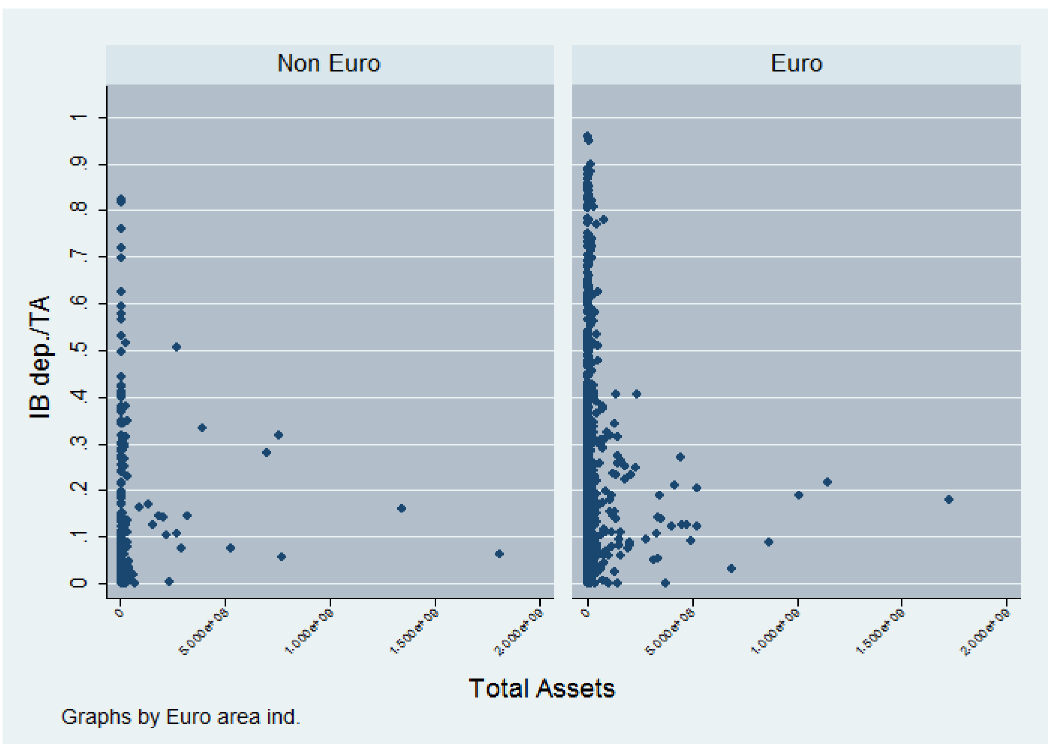


Figure 50: scatterplot of values of interbank deposits over TA vs TA, excluding "small" banks for Euro area and non-Euro area



7.5 Distribution of BRRD base to TA

Here it is reported for reference purposes a histogram of the distribution of the ratio of the BRRD base to TA, within and outside the Euro area.

Figure 51: histogram of the ratio of BRRD base to TA, excluding "small banks" for Euro and non-Euro area

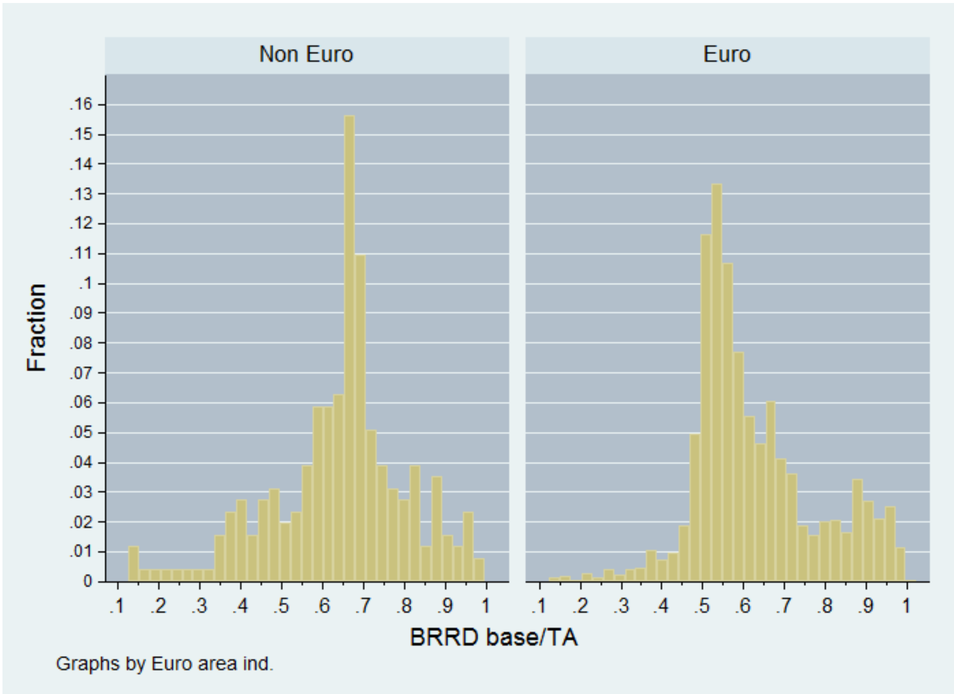


Table 42: Results of the estimates of intragroup based on BIS and ECB data, in terms of Total Assets

Country	Average intragroup as share of foreign IB	Share of foreign IB	Average intragroup as share of TA
AT	9.4%	32.7%	2.2%
BE	44.2%	94.1%	4.6%
CY	14.1%	3.6%	1.5%
DE	56.7%	74.5%	9.6%
ES	33.3%	58.9%	6.6%
FI	13.8%	4.0%	0.4%
FR	52.6%	61.8%	9.5%
GR	25.5%	52.9%	1.6%
IE	53.8%	33.1%	15.5%
IT	38.0%	37.4%	6.2%
LU	12.4%	5.1%	3.1%
NL*	63.4%	94.1%	9.2%
PT	26.0%	46.5%	7.8%
Overall median			6.2%

7.6 Assessment of intragroup linkages by comparing ECB data

Another approach to assess the relative magnitude of intragroup interbank is to make a comparison between aggregated and consolidated banking statistics, which are produced by ECB. This exercise is fraught with problems due to inconsistencies between definitions employed in the two sets of statistics which are due to them being created and used for very different purposes.

This notwithstanding, a comparison is contained in the ECB occasional paper 140 of January 2013 by Borgioli, Gouveia and Labanca: “Financial stability analysis – insights gained from consolidated banking data from the EU”.

Tables 4 and 5 in section 3 in particular compare total interbank loans and deposits and reported hereunder:

Figure 52: Tables 4 and 5 from ECB occasional paper 140/2013. Total interbank loans under CBD and MFI statistics

Table 4 Total loans under MFI statistics and CBD, by country, end-2011

(EUR billion)

MFI data		CBD data				Difference	Percentage
Total (1)			Domestic	Foreign	Total (2)	(2) - (1)	difference[1]
BE	691	BE	350	335	685	-6	-1
DE	5,464	DE	4,438	291	4,729	-734	-13
EE	18	EE	0	15	15	-3	-16
IE	696	IE	250	258	508	-187	-27
GR	341	GR	250	71	320	-20	-6
ES	2,371	ES	2,442	246	2,688	316	13
FR	5,137	FR	3,539	88	3,627	-1,510	-29
IT	2,596	IT	1,753	179	1,932	-664	-26
CY	99	CY	63	30	94	-6	-6
LU	600	LU	36	508	543	-57	-9
MT	33	MT	6	27	33	-1	-2
NL	1,704	NL	1,753	166	1,919	215	13
AT	735	AT	592	222	815	79	11
PT	361	PT	290	92	382	21	6
SI	41	SI	28	12	40	-1	-2
SK	40	SK	3	35	39	-1	-3
FI	374	FI	96	131	226	-148	-39
Total EA	21,301	Total EA	15,890	2,705	18,595	-2,706	-13

Sources: ECB and ESCB.
Note: 1) Computed as [(CBD total / MFI total)-1]*100.

Table 5 Total interbank deposits under MFI statistics and CBD, by country, end-2011

(EUR billion)

MFI data		CBD data				Difference	Percentage
Total (1)			Domestic	Foreign	Total (2)	(2) - (1)	difference[1]
BE	290	BE	53	77	130	-160	-55
DE	1,833	DE	1,216	79	1,295	-537	-29
EE	4	EE	0	5	5	0	6
IE	472	IE	18	94	112	-360	-76
GR	121	GR	11	34	45	-77	-63
ES	687	ES	274	209	483	-203	-30
FR	2,693	FR	637	22	659	-2,034	-76
IT	916	IT	304	82	387	-530	-58
CY	41	CY	6	21	27	-14	-35
LU	375	LU	5	350	355	-20	-5
MT	21	MT	1	19	20	0	-1
NL	419	NL	137	136	273	-146	-35
AT	274	AT	152	55	208	-66	-24
PT	156	PT	23	52	75	-82	-52
SI	15	SI	7	7	14	-1	-4
SK	4	SK	0	2	2	-2	-50
FI	171	FI	7	125	132	-39	-23
Total EA	8,492	Total EA	2,851	1,370	4,221	-4,271	-50

Sources: ECB and ESCB.
Note: 1) Computed as [(CBD total / MFI total)-1]*100.

ECB notes that: *"in Table 4, CBD figures are more than 10% lower than MFI data (in terms of total assets the euro area difference is 2%), highlighting the importance of intra-group loans (that are netted out in CBD). This effect is particularly relevant in the case of Finland, Italy, France and Ireland. In a few countries CBD data actually exceed MFI data, meaning that the intra-group loans effect just described is less present or compensated for by important cross-border branches/subsidiaries."* while *"Table 5 shows that there are very large differences between MFI and CBD interbank deposits figures both at euro area and at country level. CBD values are around 50% lower than MFI values for the euro area as a whole, ranging from -1% in Malta to -76% in Ireland and France. This highlights the role of the group, and in particular of interbank loans, in providing funding in the different countries. Estonia is the only country where values for CBD are higher than MFI values"*

These conclusions, at least in their qualitative part, are in line with those which can be taken by looking at interbank as a proxy for intragroup: the distribution is very uneven between different countries, and the size of intragroup can be relevant compared to other liabilities.

8. Analysis on the potential impact of introducing a leverage ratio treatment of derivative liabilities in the calculation of the BRRD base

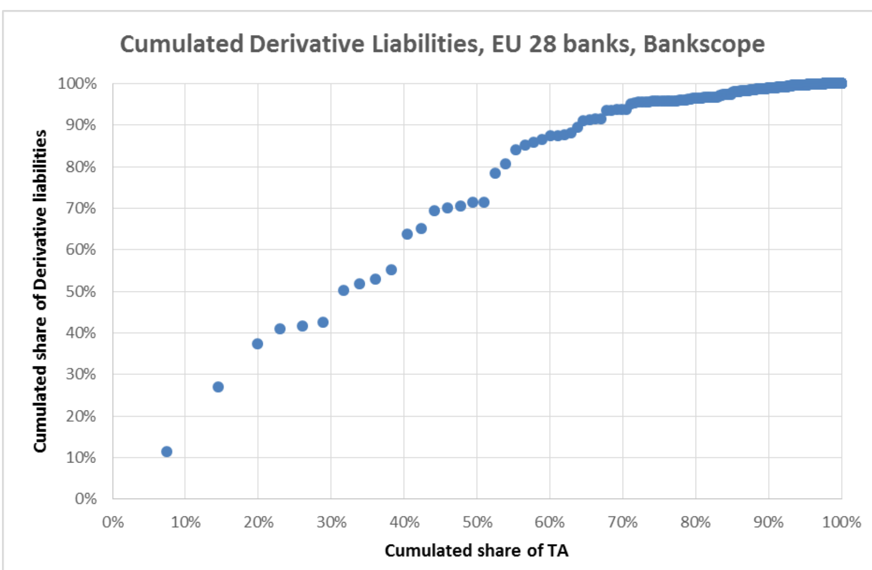
Among all the liabilities which are included in the contribution base, derivative liabilities deserve special attention as the accounting standards for them are not harmonised in the EU and different approaches may in principle lead to very different outcomes. To overcome this level playing field issue, the Delegated Act requires derivatives to be accounted for as they are in the calculation of the leverage ratio under the Capital Requirements Regulation.[39] This aims to ensure a harmonized approach in the treatment of derivatives. However, to avoid significant reductions in the BRRD base, this harmonized treatment proposed in the Delegated act cannot lead to more than 25% reduction in the total liabilities.

As data on derivative liabilities have not been provided by the MS, JRC performed an estimate of derivatives by using the Bankscope data sample; this dataset reports balance sheet data at solo level. The original Bankscope sample includes 3,710 entities in the EU 28 area, but data on derivatives are missing for a large part of the database. After excluding banks that do not report data on derivatives, the final subsample is made of 809 banks corresponding to 24,265 bn € in terms of total assets. With respect to the database (see Section 2.2), the Bankscope subsample including data on derivatives covers 17% of the sample size (809 over 4,639 credit institutions) and 65% of the overall total assets for the whole EU 28 area (that is 24,265 bn € over 37,614 bn €). This might lead to conclude that the most part of the missing observations in the Bankscope subsample concerns small banks.

The analysis on derivatives has been performed along the lines of the analysis on the inclusion of the fourth pillar into the risk indicator (Section 6). The underlying assumption is that differences in the adopted accounting standards are more relevant for the largest banks selected for the analysis on pillar 4 (i.e. banks with total assets greater than 30 bn € and covering 65% of cumulative total assets in each economic area). This implies that in the present analysis these banks are the only ones assumed to hold derivatives (hereafter referred to as "holding-derivatives" banks for convenience).

To verify whether limiting the analysis to the biggest banks would be a too restrictive assumption, the cumulative distribution of derivative liabilities by total assets has been computed. The banks with total assets higher than 30 bn € make up a subsample of 110 entities and represent 89% of the overall total assets in the sample. As can be seen in Figure 53, this point on the x-axis corresponds to almost all (i.e. 98.5% in the y-axis) the derivative liabilities.

Figure 53: Cumulative distribution of derivative liabilities, EU 28 banks, Bankscope sample



[39] http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32013R0575&from=EN

Table 43 reports some descriptive statistics on the ratio of derivative liabilities over total assets. The median value is 0.2% while the mean is located on the right-hand part of the distribution at a value of 2.6%. As this value is higher than the 75th percentile, this reveals the existence of a right long tail with few banks having extreme high values.

Table 43: Descriptive statistics on the ratio of derivative liabilities to total assets, full sample

Distribution	Derivative Liabilities (as share of TA)
Number of banks	809
Minimum	0.00%
25th percentile	0.02%
Median	0.21%
75th percentile	1.38%
Maximum	89.76%
Average	**2.55%**

In order to analyse the distribution of derivative liabilities per size category, the sample has been divided into a number of buckets according to the total assets size. Table 44 reports descriptive statistics for the size categories. In general, the percentage of derivatives held by banks varies significantly among banks of different size categories with an increasing trend correlated to the size. Moreover, when looking at the columns reporting the minimum/maximum values, it appears that quite relative small/large amounts of derivatives can be held also by large/small banks.

Table 44: Descriptive statistics on the ratio of derivative liabilities to total assets per size category

Bucket	Thresholds	Number of banks	Minimum	25th percentile	Median	75th percentile	Maximum	Average
Bucket 1	TA <= 300 mn	103	0.00%	0.00%	0.01%	0.12%	12.39%	**0.22%**
Bucket 2	TA > 300 mn & <= 1 bn	187	0.00%	0.00%	0.05%	0.22%	15.49%	**0.43%**
Bucket 3	TA > 1 bn & <= 15 bn	358	0.00%	0.03%	0.29%	1.30%	44.91%	**1.69%**
Bucket 4	TA > 15 bn & <= 30 bn	51	0.06%	0.46%	1.36%	4.15%	24.84%	**3.58%**
Bucket 5	TA > 30 bn	110	0.00%	1.36%	3.25%	12.24%	89.76%	**10.67%**

Two major points come out from this analysis. On the one hand, the vast majority of the outstanding derivatives belongs to the largest banks. On the other hand, the share of derivatives held in each institution can significantly vary both among banks of different size categories and among banks of similar size. Nevertheless there is evidence that the percentage of derivative liabilities in the balance sheet tends to increase with the size of the bank.

All results presented in the following analysis should be taken with caution as they rely on a limited dataset and on a set of working hypotheses, as detailed in the above section.

The following scenario analysis focuses on the potential impact of excluding a part of derivative liabilities from the BRRD base when calculating the contributions to the RF. The following assumptions hold true:

- Banks holding derivatives are the same entities selected for the analysis on the fourth pillar. It should be noted that banks have been picked according to criteria broadly in line with those proposed for the structural separation, i.e. banks with total assets greater than 30 bn € and up to 65% of cumulative total assets in each economic area. All other banks are assumed not having derivative liabilities.
- The "holding-derivatives" banks cannot exclude more than 25% of their derivative liabilities from the BRRD base.
- All the "holding-derivatives" banks hold an amount of derivative liabilities equal to 10.67% of their total assets. This percentage is the average value of derivative liabilities scaled to total assets for banks with total assets above 30 bn €, as reported in Table 44.

The results one can derive from the present analysis are the following:

- the discount for the "holding-derivatives" banks in terms of BRRD base and contributions to the RF, considering both the flat and the risk-adjusted contribution.
- The additional burden for the other banks.
- The cumulative distribution of the risk-adjusted contributions by TA.

Results will be presented according to two different modelling of the composite risk indicator:

- 3 pillars only (referred to as 3 pillars);
- 4 pillars under the two scenarios presented in Section 6, i.e. when the 4th pillar is built by assigning the largest value to the largest banks and the average value to the other banks (4 pillars - average) and when it is built by assigning the largest value to the largest banks and the minimum value to the others (4 pillars - minmax).

8.1 Reduction for the "holding-derivatives" banks

Derivatives are estimated by applying the average ratio of derivatives over total assets computed for banks falling into bucket 5 in Table 44 (i.e. 10.67%).

Table 45 presents summary statistics on the distributions of the percentage variations of the BRRD base and contributions (flat and risk-adjusted) for the “holding-derivatives” banks in the Euro area. In this table the minimum values represent the maximum discount and *vice versa*.

It appears that an average 4% reduction in the BRRD base translates in an average 1.5% reduction in the contributions. No significant difference comes out when comparing the flat and the risk-adjusted contribution variations. The reduction in contributions is just slightly compensated by the introduction of the fourth pillar.

Table 45: Percentage variations in the BRRD base, flat fee and risk-adjusted contributions for the "holding-derivatives" banks in the Euro area

	BRRD base	Flat fee	Risk-adjusted contribution		
			3 Pillars	4 Pillars - average	4 Pillars - minmax
Average	-3.8%	-1.5%	-1.5%	-1.4%	-1.4%
Median	-3.4%	-1.1%	-1.1%	-1.0%	-1.0%
Minimum	-11.7%	-9.6%	-9.5%	-9.4%	-9.4%
maximum	-2.7%	-0.3%	-0.3%	-0.2%	-0.2%

8.2 Additional burden for the other large banks

If a discount is granted to a specific category of banks and a certain target level has to be reached, it is important to quantify the additional burden imposed to the other entities.

To reach this goal, the first step is to derive the formulas to calculate the percentage increase in the burden of all other large banks that do not hold derivatives.

<u>Flat fee</u>

If no reduction is granted on the amount of derivatives, for each non-small bank not holding derivatives *i*, the flat fee would be:

$$flat_i = \frac{BRRD_i}{\sum_j BRRD_j} * (T - T_{small \in €area})$$

where $BRRD_i = TL_i - K_i - CovDep_i$, $j \in J$ represents an element in the group of non-small banks *J, T* is the target and $T_{small \in €area}$ is the overall amount paid by small banks under the SRM.

If a maximum percentage reduction α on the amount of accounted derivatives is introduced, then the new flat fee would be:

$$\widetilde{flat_i} = \frac{BRRD_i}{\sum_j BRRD_j - \alpha \cdot \sum_k D_k} * \left(T - \tilde{T}_{small \in €area}\right)$$

where $k \in K$ is a generic one among the largest, derivative-holding banks, with $K \subset J$, D denotes derivative liabilities, T is the target and $\tilde{T}_{small \in €area}$ is the overall amount paid by small banks within this new framework.

The percentage increase in the burden for all other banks that do not hold derivatives is:

$$\frac{(\widetilde{flat_i} - flat_i)}{flat_i} = \frac{\sum_j BRRD_j}{\sum_j BRRD_j - \alpha \cdot \sum_k D_k} * \frac{\left(T - \tilde{T}_{small \in €area}\right)}{(T - T_{small \in €area})} - 1$$

Given a sample of banks, this factor is a constant for each bank. Table 46 below reports the results assuming α equal to 25%.

Table 46: Annual additional payment for big non-holding derivatives banks, as share of flat fee, Euro area

$\sum_j BRRD_j$ **(bn€)**	$\sum_k D_k$ **(bn€)**	$\left(T - \tilde{T}_{small \in €area}\right)$ **(th€)**	$(T - T_{small \in €area})$ **(th€)**	**Percentage additional burden**
20,126	1,886	6,236,037.798	6,236,038.128	+2.40%

Risk-adjusted contributions

The same steps can be used to derive the formula for the additional burden in the risk based contributions system. The percentage increase between contributions computed with ($\widetilde{c_i}$) and without (c_i) the reduction in derivatives is:

$$\frac{(\widetilde{c_i} - c_i)}{c_i} = \frac{\sum_j BRRD_j \cdot R_j}{\sum_j BRRD_j \cdot R_j - \alpha \cdot \sum_k D_k \cdot R_k} * \frac{\left(T - \tilde{T}_{small \in €area}\right)}{(T - T_{small \in €area})} - 1$$

where R_j is the risk adjustment. Table 47 reports the results assuming α equal to 25%.

Table 47: Annual additional payment for big non-holding derivatives banks, as share of risk-adjusted fee, Euro area

Risk indicator modelling	$\sum_j BRRD_j \cdot R_j$ **(bn€)**	$\sum_k D_k \cdot R_k$ **(bn€)**	**Percentage additional burden**
3 pillars	26,646	2,541	+2.44%
4 pillars average	28,076	2,740	+2.50%
4 pillars minmax	27,948	2,750	+2.53%

8.3 Cumulative contributions

Plots from Figure 54 to Figure56 compare the cumulative distributions of risk adjusted contributions by total assets (alternatively computed including 3 and 4 pillars, in this second case both average and minmax modelling) under the baseline scenario when the accounting treatment of derivatives applies (blue line) and the alternative leverage ratio treatment (red line). Table 48 shows the exact percentage of contributions paid by Euro area big banks accounting for 85% of total assets under the base scenarios and with the derivative discount.

Figure 54: Cumulative distributions of risk-adjusted contributions (3 pillars) by TA, Euro area, zoom around the 85% of TA

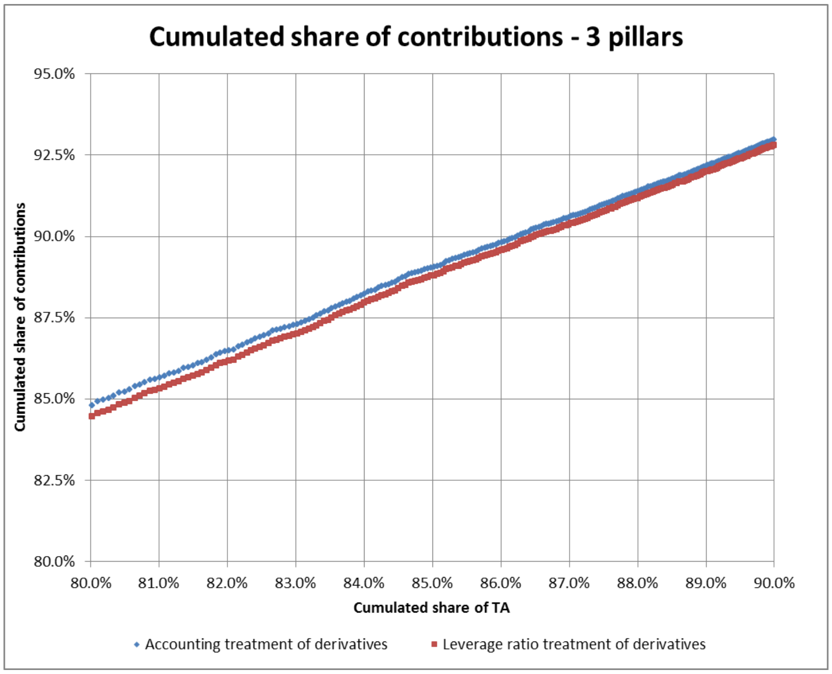


Figure 55: Cumulative distributions of risk-adjusted contributions (4 pillars - average) by TA, Euro area, zoom around the 85% of TA

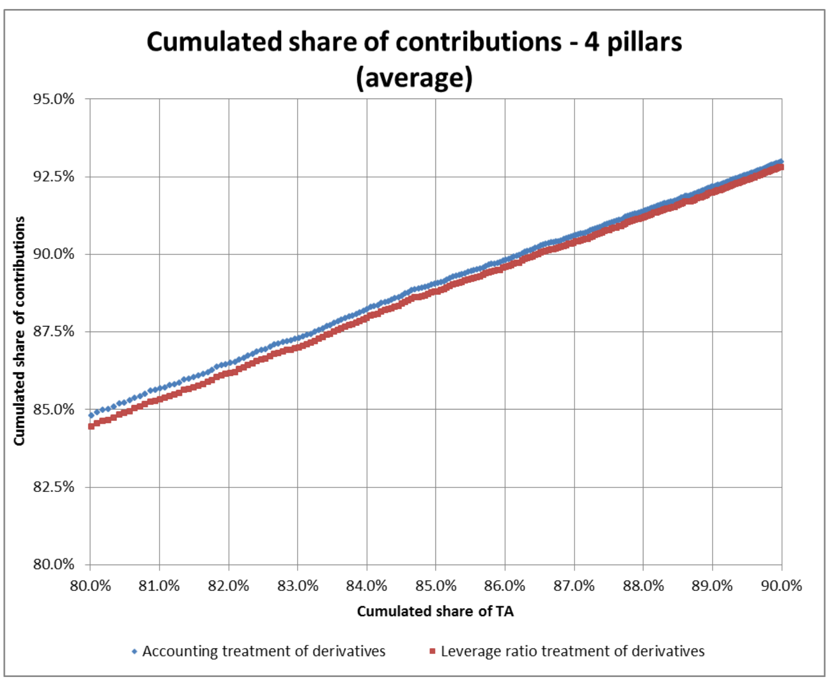


Figure56: Cumulative distributions of risk-adjusted contributions (4 pillars - minmax) by TA, Euro area, zoom around the 85% of TA

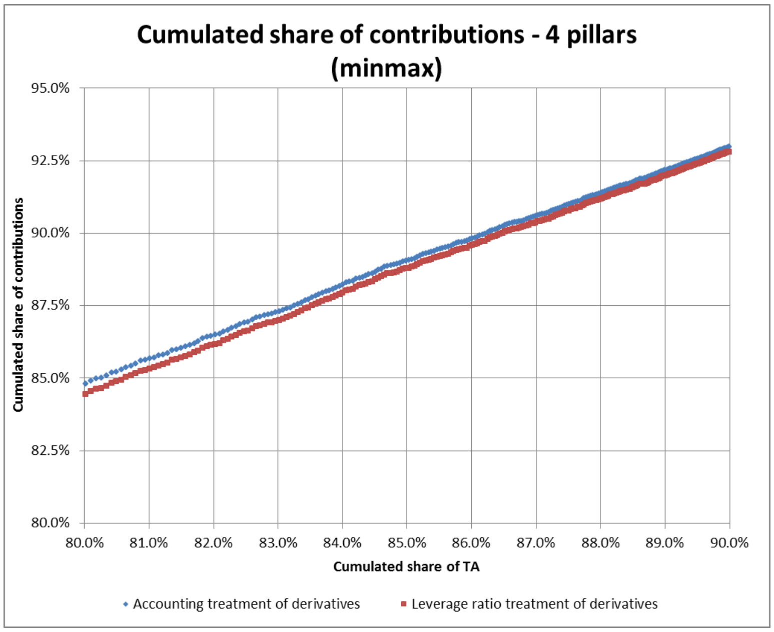


Table 48: Share of contributions paid by Euro area banks accounting for 85% of TA

	Accounting treatment of derivatives	Leverage ratio treatment of derivatives
3 pillars	89.06%	88.80%
4 pillars - average	89.62%	89.37%
4 pillars - minmax	89.95%	89.70%

9. Phasing-in the SRM: an analysis of different blending options

9.1 Introduction

Contributions computed under the BRRD and SRM frameworks appear to be rather different, as the former depend upon the national target, i.e. the sum of covered deposits of a specific country only, while the latter depend upon the overall target at Euro area level. In particular, contributions of banks established in MS with a high level of covered deposits will in general decrease when moving to the national system to the SRM, while contributions of those banks established in MS with fewer covered deposits will in general increase.

To limit the effects of this difference, the proposal of the Commission for a Council Implementing Act foresees an adjustment mechanism during the transitional period by way of a gradual phasing in of the SRM methodology. JRC analysed different blending options that could be implemented during this transitional phase, which should start in 2016, when contributions for the SRM will start to be raised and should end 8 years later, when the target level of the SRF will be reached.

9.2 Reasons for the deviations between the BRRD and SRM aggregated contributions

This section aims at detailing via mathematical formulas the reasons causing the deviations between contributions under the national and the Euro area systems. This can be exploited by computing the ratio of the aggregated SRM contributions to the aggregate BRRD contributions for a generic participating MS.

The pure flat contribution[40] of bank *i* under the SRM is:

$$flat_i^{SRM} = \frac{TL_i - K_i - CovDep_i}{\sum_{i \in €area}(TL_i - K_i - CovDep_i)} \cdot \alpha \cdot \sum_{i \in €area} CovDep_i$$

where the target is expressed as a fixed percentage (α, i.e. 1%/8) of the sum of covered deposits of all banks belonging to the Euro area.

The aggregated contributions over all banks within a generic participating country *N* under the SRM can be computed as it follows:

$$\sum_{i \in N} flat_i^{SRM} = \frac{\sum_{i \in N}(TL_i - K_i - CovDep_i)}{\sum_{i \in €area}(TL_i - K_i - CovDep_i)} \cdot \alpha \cdot \sum_{i \in €area} CovDep_i.$$

This can be decomposed as it follows:

$$\sum_{i \in N} flat_i^{SRM} = \frac{\sum_{i \in N}(TL_i - K_i - CovDep_i)}{\sum_{i \in N}(TL_i - K_i - CovDep_i) + \sum_{i \notin N}(TL_i - K_i - CovDep_i)} \cdot \alpha \cdot \left(\sum_{i \in N} CovDep_i + \sum_{i \notin N} CovDep_i\right)$$

The aggregate BRRD contributions in a generic country *N* is merely equal to the national target:

$$\sum_{i \in N} flat_i^{BRRD} = \alpha \cdot \sum_{i \in N} CovDep_i.$$

For a generic country *N*, the ratio of the aggregate SRM to the aggregate BRRD contributions is:

$$\frac{\sum_{i \in N} flat_i^{SRM}}{\sum_{i \in N} flat_i^{BRRD}} = \frac{\sum_{i \in N} CovDep_i + \sum_{i \notin N} CovDep_i}{\sum_{i \in N}(TL_i - K_i - CovDep_i) + \sum_{i \notin N}(TL_i - K_i - CovDep_i)} \cdot \frac{\sum_{i \in N}(TL_i - K_i - CovDep_i)}{\sum_{i \in N} CovDep_i.}$$

If the above ratio is roughly equal to 1, aggregate contributions under the SRM and the BRRD are very similar. This ratio is composed by two factors. The first factor is a constant as it is the ratio of the overall covered deposits in the Euro area to the overall BRRD bases in the Euro area. The second factor is country-specific as it is the ratio of the aggregate BRRD bases to the aggregate covered deposits within each country.

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[40] For the sake of simplicity, this formula refers to the SRM pure flat contribution. The rationale behind the computations does not change if considering the SRM risk-adjusted contribution.

9.3 Phase-in mechanism

This section presents the contributions due according to the phase-in methodology during the transitional period towards the SRF.

Small banks are excluded from the phase-in mechanism. Under the BRRD regulation (in year 2015) they are assumed to pay the minimum between the lump sum associated to the bucket where each small bank falls and the pure flat calculated under the national target. Under the transitional period towards the SRF they are assumed to pay the minimum between the lump sum payment and the pure flat calculated under the joint euro area target. Thus, the blending of BRRD and SRM payments has been applied to non-small banks only.

From a technical perspective, the contribution each individual non-small bank in each participating MS has to pay during the phase-in is a linear convex combination of BRRD and SRM contributions. This combination provides for increasing weights of the SRM part during the transitional period, up to a final weight of 100% in the last year. The schedule of the weights is shown in Table 49.

Table 49: Schedule of the share of SRM contribution used in the calculation of total contributions during the transition period

Year	β = share of SRM contribution	(1–β) = share of BRRD contribution
1	40.00%	60.00%
2	60.00%	40.00%
3	66.67%	33.33%
4	72.33%	27.67%
5	80.00%	20.00%
6	86.67%	13.33%
7	93.33%	6.67%
8	100.00%	0%

In each year *t* during the transitional period, the contribution of each non-small bank *i* participating in the banking union is:

$$c_{i,t}^{PhaseIn} = \beta_t \cdot c_{i,t}^{SRM} + (1-\beta_t) \cdot c_{i,t}^{BRRD}$$

where $i \in L$ represents an entity in the group of non-small banks *L* and, in any given *t* during the transitional period, $c_{i,t}^{SRM}$ and $c_{i,t}^{BRRD}$ are computed according the following formulas:

$$c_i^{SRM} = \frac{BRRD_i \cdot R_i^{SRM}}{\sum_{i \in €area} BRRD_i \cdot R_i^{SRM}} \cdot \left(\alpha \cdot \sum_{i \,\in\, €area} CovDep_i - T_{small \,\in\, €area} \right)$$

$$c_i^{BRRD} = \frac{BRRD_i \cdot R_i^{BRRD}}{\sum_{i \in N} BRRD_i \cdot R_i^{BRRD}} \cdot \left(\alpha \cdot \sum_{i \in N} CovDep_i - T_{small \,\in\, N} \right)$$

where $BRRD_i = TL_i - K_i - CovDep_i$, $T_{small \,\in\, €area}$ represents the overall contributions of small banks in the euro area and $T_{small \,\in\, N}$ represents the overall contributions of small banks in country *N*. R_i^{SRM} is the risk indicator computed for all non-small banks in the Euro area (the least risky bank in the Euro area gets 0.8 and the riskiest banks in the Eurozone gets 1.5) and R_i^{BRRD} is the risk indicator computed for non-small banks in country *N* only (the least risky bank in country *N* gets 0.8 and the riskiest banks in country *N* gets 1.5, before applying the re-normalization to assure that the target is reached).

9.3.1 Contributions by size category

Figure 57 compares phase-in (red dots), BRRD (blue dots) and SRM risk-adjusted contributions (green dots) during the first year of the transitional period. It has to be noted that blue dots present a much higher variance than the green dots as under the BRRD system banks of similar size and riskiness can pay very different fees if they belong to different MS.

Only results for the first year are presented, as they show the largest possible differences between phase-in and SRM contributions and thus produce “perverse” effects. A set of four zoomed in plots (from Figure 58 to Figure 61) depict the above-mentioned payments for the categories of banks defined upon the BRRD base size in Section 5.

Figure 57: Comparison of Phase-in, BRRD and SRM contributions, year 1 of the transitional period

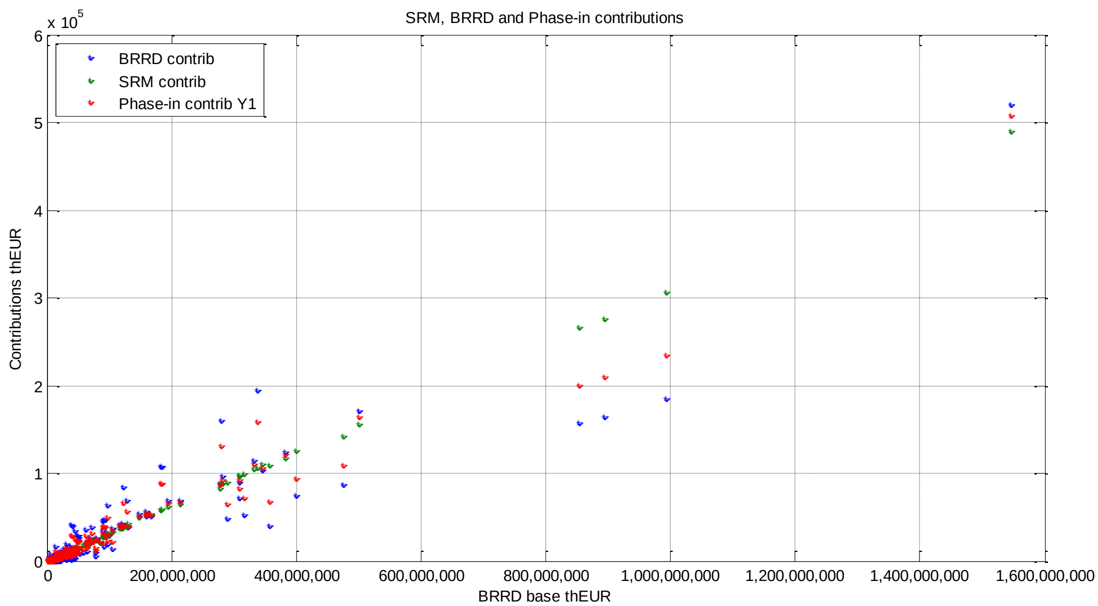


Figure 58: Comparison of Phase-in, BRRD and SRM contributions, year 1 of the transitional period – zoom on S category

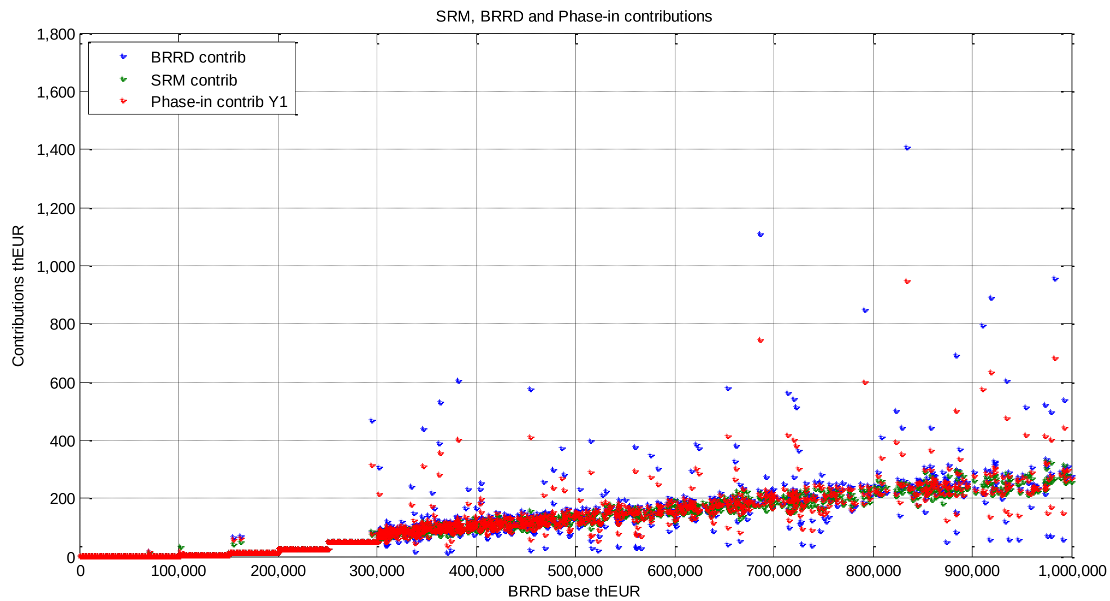


Figure 59: Comparison of Phase-in, BRRD and SRM contributions, year 1 of the transitional period – zoom on M category

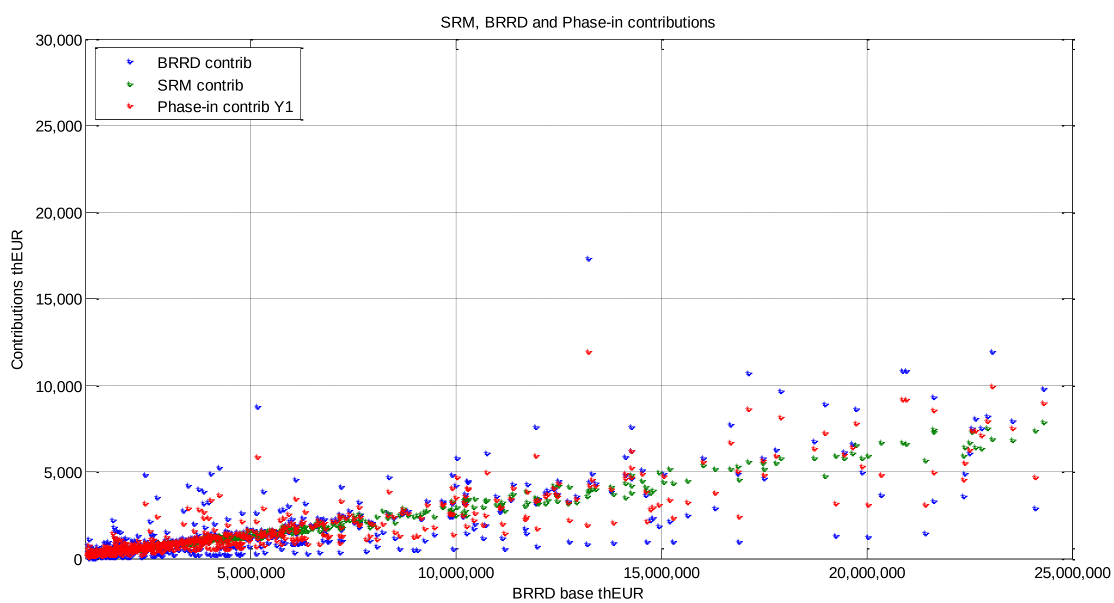


Figure 60: Comparison of Phase-in, BRRD and SRM contributions, year 1 of the transitional period – zoom on L category

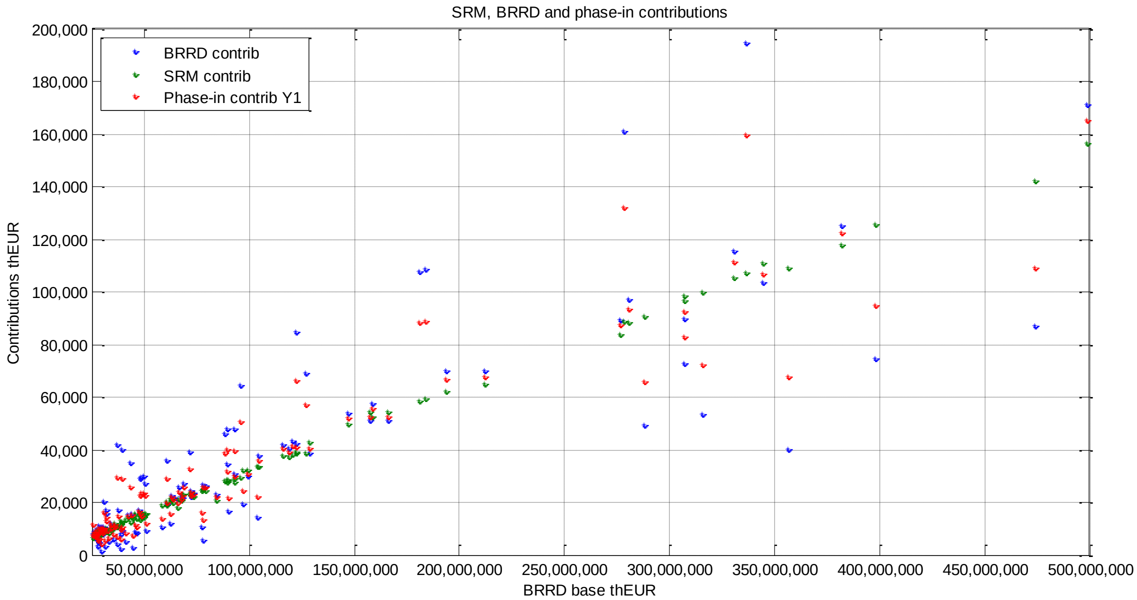
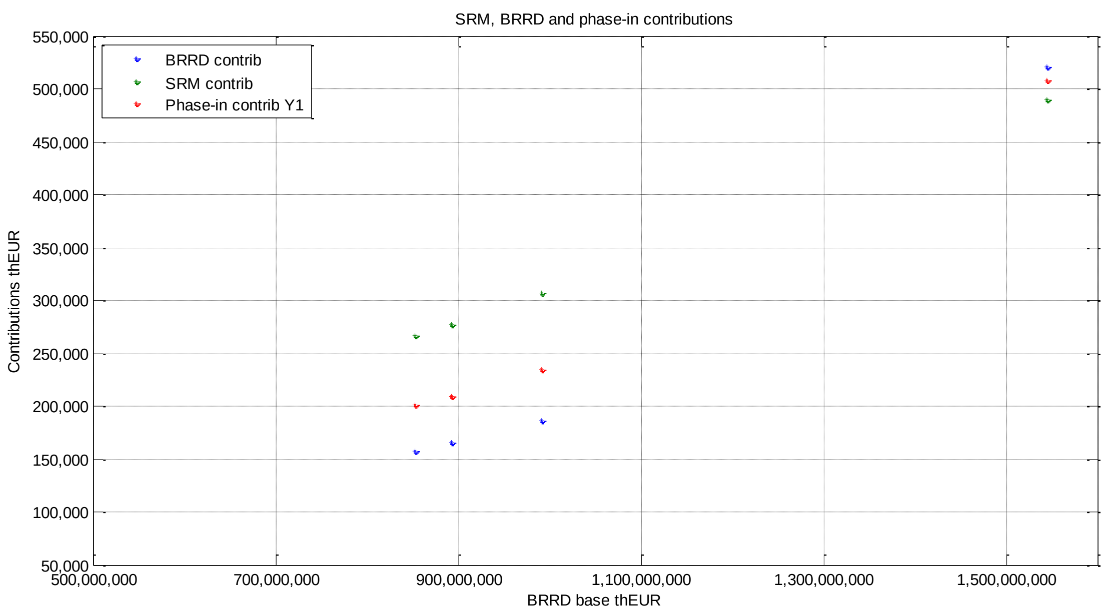


Figure 61: Comparison of Phase-in, BRRD and SRM contributions, year 1 of the transitional period – zoom on XL category



9.4 Proportionality principle during the transitional period: intermediate banks

The JRC tested the potential effect of an optional special treatment applicable to all non-small institutions[41] with total assets below or equal to 3 bn€.

This category of "intermediate" banks would pay the highest lump sum (50 th €) for their first 300 million € of BRRD base and the phase-in contribution for the rest. Intermediate banks with BRRD base below 300 million € would pay 50 th € only.[42] To formalize this contribution rule, let *I* be the set of intermediate banks and *L* be the set of non-small and non-intermediate banks. Moreover, let ∪ means the union of two different sets and ∩ represents the intersection between two sets.

A generic intermediate bank $i \in I$ benefiting from the special treatment would pay $\tilde{c}_{i,t}^{PhaseIn}$, defined as:

$$\tilde{c}_{i,t}^{PhaseIn} = 50k + \beta_t \cdot \tilde{c}_{i,t}^{SRM} + (1-\beta_t) \cdot \tilde{c}_{i,t}^{BRRD}, \qquad i \in I$$

where, in any given *t*:

$$\tilde{c}_i^{SRM} = \frac{\widetilde{BRRD}_i \cdot R_i^{SRM}}{\sum_{i \in (I \cup L) \cap €area} \widetilde{BRRD}_i \cdot R_i^{SRM}} \cdot \left(\alpha \cdot \sum_{i \in (I \cup L) \cap €area} CovDep_i - T_{small \in €area} - 50k * N_{I,€area} \right)$$

$$\tilde{c}_i^{BRRD} = \frac{\widetilde{BRRD}_i \cdot R_i^{BRRD}}{\sum_{i \in (I \cup L) \cap N} \widetilde{BRRD}_i \cdot R_i^{BRRD}} \cdot \left(\alpha \cdot \sum_{i \in N} CovDep_i - T_{small \in N} - 50k * N_{I,N} \right)$$

$$\widetilde{BRRD}_i = \begin{cases} BRRD_i, & i \in L \\ BRRD_i - 300mln, & i \in I \wedge BRRD_i > 300mln \\ 0, & i \in I \wedge BRRD_i \leq 300mln \end{cases}$$

and $N_{I,€area}$ and $N_{I,N}$ are the number of intermediate banks in the euro area and in country N, respectively.

Table 50 reports summary statistics on the intermediate banks in each MS participating to the banking union.

Table 50: Statistics on intermediate banks, sample figures

Economic area	Number of banks			Total Assets			BRRD base		
	All banks	Intermediate banks	Intermediate banks (as % of all banks)	All banks (th €)	Intermediate banks (th €)	Intermediate banks (as % of TA all banks)	All banks (th €)	Intermediate banks (th €)	Intermediate banks (as % of BRRD base all banks)
AT	668	55	8%	879,305,789	72,715,957	8%	610,421,541	43,084,142	7%
BE	45	14	31%	935,583,114	20,370,740	2%	588,932,347	11,127,538	2%
CY	10	4	40%	54,850,025	4,386,951	8%	26,162,767	2,020,558	8%
DE	1740	643	37%	8,266,923,037	824,442,513	10%	6,159,144,464	459,095,560	7%
EE	6	1	17%	12,797,090	485,110	4%	6,274,212	381,064	6%
ES	62	21	34%	2,409,149,066	26,483,061	1%	1,529,801,692	15,616,069	1%
FI	266	14	5%	486,844,150	21,147,737	4%	394,116,010	7,239,746	2%
FR	195	42	22%	6,466,453,443	50,801,556	1%	5,265,822,355	38,824,991	1%
GR	10	2	20%	316,886,598	3,427,542	1%	169,938,198	1,387,906	1%
IE	31	7	23%	978,971,513	14,874,375	2%	833,190,116	8,991,914	1%
IT	595	228	38%	3,162,595,451	259,090,111	8%	2,338,762,774	173,702,764	7%
LT	7	1	14%	16,878,730	849,011	5%	9,559,361	712,829	7%
LU	105	40	38%	634,960,991	53,236,476	8%	559,634,807	45,282,115	8%
LV	19	9	47%	24,908,053	10,971,585	44%	16,221,678	7,491,839	46%
MT	19	9	47%	27,510,463	9,297,074	34%	15,733,147	6,735,390	43%
NL	48	11	23%	2,033,738,687	13,986,199	1%	1,488,773,348	9,998,666	1%

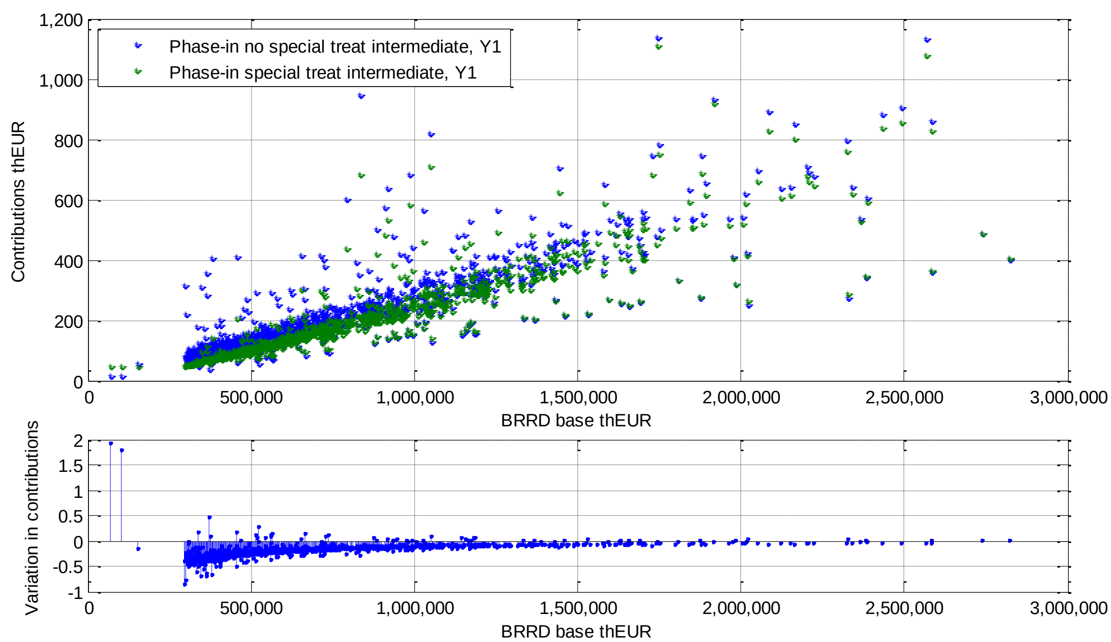
[41] For the sake of clarity, a bank is defined as small if it has a BRRD base below 300 mln € and total assets below 1 bn €.

[42] In the final database, 5 banks with BRRD base below 300 mln € belong to the intermediate banks category. JRC found that 3 banks out of 5 would be penalized by the 50 th€ lump sum as they would pay less when no special treatment is applied.

Economic area	Number of banks			Total Assets			BRRD base		
	All banks	Intermediate banks	Intermediate banks (as % of all banks)	All banks (th €)	Intermediate banks (th €)	Intermediate banks (as % of TA all banks)	All banks (th €)	Intermediate banks (th €)	Intermediate banks (as % of BRRD base all banks)
PT	123	13	11%	442,544,164	17,469,786	4%	279,930,483	13,819,693	5%
SI	17	9	53%	36,853,241	14,290,744	39%	19,125,053	7,937,059	42%
SK	12	4	33%	50,806,559	5,680,511	11%	21,330,174	2,281,325	11%
Euro area	**3,978**	**1,127**	**28%**	**27,238,560,163**	**1,424,007,039**	**5%**	**20,332,874,525**	**855,731,168**	**4%**

Figure 62 compares phase-in contributions due by intermediate banks (each dot in the graph represents an intermediate bank) under the special regime (green dots) and under the general phase-in rule when no special treatment is granted to them (blue dots). In order to better visualize intermediate banks that could be penalized by the special provision – thus increasing their contribution – an accessory plot draws the variation of payments when moving from the general phase-in to the phase-in with the special provision for intermediate banks. Following the same rationale mentioned in Section 9.3, only results for the first year are presented. The special regime for intermediate banks effectively reduces the contributory burden for the vast majority of them, but there are few banks (those with an upward stem in the accessory plot) which would pay more under the special regime.

Figure 62: Comparison of phase-in contributions of intermediate banks under the special regime (green dots) and under no special treatment (blue dots), year 1 of the transitional period. Accessory plot: variation in payments of intermediate banks



10.Conclusions

JRC supported DG MARKT in the preparation of the second level legislation on banks contributions to national/single RF. The analyses covered a large number of issues related to the technical framework for determining how such contributions should be defined, taking into account the existing legislation (BRRD and SRMR).

To perform this exercise, JRC built a database assembling individual bank unconsolidated balance sheet data directly provided by the MS. Using data directly provided by the MS, JRC assessed the comprehensiveness and coherence of such data, ran a number of checks to detect inconsistencies and estimated, where possible, missing data. After all these checks, the final database comprises around 4,600 banks in the EU 28, accounting for 37 600 billion € of unconsolidated total assets.

The analyses started with the development of a robust composite risk indicator measuring the risk adjustment introduced in the BRRD and SRMR. The composite indicator is obtained aggregating a set of balance sheet indicators, identified by DG MARKT and the Expert Group, grouped into pillars of risk. Following composite indicators best practices, JRC suggested how to properly combine the pillars into a single risk measure. JRC analyses also allowed defining the way to treat outlier values in the distributions of the indicators via discretization methods.

JRC contributed to choose the technical specifications for determining banks contributions. The approach proposes that contributions depend on bank size: small banks are required to pay a lump sum depending only on BRRD base; the others contribute to reach the leftover target proportionally to their BRRD base, corrected by a risk adjustment. This depends on the value of the composite risk indicator and ranges between 0.8 and 1.5. JRC assessed various options for defining the lump sum system, and quantified both the advantage for small banks of introducing such approach and the burden covered by the rest of the system. JRC also examined the effect of using alternative ranges of variation for the risk correction applied to large banks.

JRC analyses focused on the distribution of contributions by banks' size: results showed that the greater contributors to the (S)RF were the largest banks. For instance, in the Euro area the largest 261 banks, which represent 85% of total assets, cover around 90% of the contributions. The analyses also demonstrated that in general the smallest banks, among those paying a risk-adjusted contribution, would tend to get a downward risk based correction and therefore to a large extent pay less than the flat contributions. On the other hand, the largest banks mostly get an increase in their contributions with respect to the flat fees. Small banks, though representing 55% of the whole number of institutions in the Euro Area, account only for 2% of total assets and their contributions would cover 0.3% of the yearly target to be collected.

Following the discussion at the political level, JRC also assessed some technical issues related to how the BRRD base should be computed. The focus was on the treatment of intragroup exposures and on the accounting of derivatives. Due to the lack of individual bank-level data both on the level of intra-group exposure and on the structure of groups, JRC could only provide an estimate of the potential average size and variation of intragroup exposures in each Member State, in comparison to the contributions base. For derivative liabilities, individual data were lacking and it was possible to estimate averages values for groups of banks of different dimensions only.

Finally, JRC tested the impact on banks contributions of different options for the phasing in of the SRF calculations and the potential effect of an optional special treatment applicable to institutions with total assets below 3 billion €.

A.1 Annex 1: Example of how to compute the composite indicator for a sample of three banks

This Annex details with a concrete example how to compute the composite indicator for a set of three banks. The indicator data for the banks are the following:

Bank Name	Asset Composition (RWA/TA)	Leverage Ratio (CE/TA)	Capital Ratio (Regulatory Cap/RWA)	Net Loans 2 Deposits	Share IB+IB-
Bank 1	40.30%	4.99%	19.02%	113.49%	3.11%
Bank 2	64.38%	12.73%	24.40%	74.18%	0.71%
Bank 3	102.30%	14.99%	36.56%	102.06%	0.07%

The composite indicator is aggregated starting from single indicators by means of the following weights:

Pillars	Pillar 1 (Risk exposure)			Pillar 2 (Stability and variety of funding)	Pillar 3 (Importance of the institution to the stability of the financial system)
Weights of the pillars	62.5%			25%	12.5%
Indicators	Asset Composition (RWA/TA)	Leverage Ratio (CE/TA)	Capital Ratio (Regulatory Cap/RWA)	Net Loans 2 Deposits	Share IB+IB-
Weights of the indicators	33.3%	33.3%	33.3%	100%	100%

First, the data must be rescaled between 1 and 1000:

STEP 1	Asset Composition (RWA/TA)	Leverage Ratio (CE/TA)	Capital Ratio (Regulatory Cap/RWA)	Net Loans 2 Deposits	Share IB+IB-
Bank 1	1	1	1	1,000	1,000
Bank 2	389	774	307	1	209
Bank 3	1,000	1,000	1,000	710	1

Then, data are modified to account for the sign assigned. In this case, the second and third ratios are left unchanged.

Sign	+1	-1	-1	+1	+1
STEP 2	Asset Composition (RWA/TA)	Leverage Ratio (CE/TA)	Capital Ratio (Regulatory Cap/RWA)	Net Loans 2 Deposits	Share IB+IB-
Bank 1	1,000	1	1	1	1
Bank 2	612	774	307	1,000	792
Bank 3	1	1,000	1,000	291	1,000

Now one can compute weighted arithmetic averages within pillars: in this specific case, only pillar 1 is the result of the weighted average, the others are simply the values of the ratios. The indicators in pillar one are combined using the three weights (all equal to 0.333).

STEP 3	Pillar 1 (Risk exposure)	Pillar 2 (Stability and variety of funding)	Pillar 3 (Importance of the institution to the stability of the financial system)
Bank 1	1000*0.333+1*0.333+1*0.333 = 334	1	1
Bank 2	612*0.333+774*0.333+307*0.333= 565	1000	792
Bank 3	1*0.333+1000*0.333+1000*0.333 = 667	291	1000

Finally, one can aggregate results across pillars to come up with the composite indicator.

STEP 4	Composite Indicator
Bank 1	334^0.625*1^0.25*1^0.125=38
Bank 2	565^0.625*1000^0.25*792^0.125=680
Bank 3	667^0.625*291^0.25*1000^0.125=570

The values obtained have to be transformed:

STEP 5	Composite Indicator
Bank 1	1000-38=962
Bank 2	1000-680=320
Bank 3	1000-570=430

References on composite indicators

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For more information see the over 100 JRC audits on composite indicators (undertaken upon request of the index developers) at: http://composite-indicators.jrc.ec.europa.eu

A.2 Annex 2: Arithmetic versus geometric average

Let $\{I_{1,n}, I_{2,n}, \dots, I_{N,n}\}$ be a vector of *N* risk indicators of bank *n* to be aggregated and $\{w_{1,n}, w_{2,n}, \dots, w_{N,n}\}$ be their corresponding vector of weights such that they sum up to 1.

In the arithmetic average the indicators are weighted and summed.

$$CI_n = \sum_{i=1}^{N} I_{i,n} * w_i = I_{1,n} * w_1 + \dots + I_{N,n} * w_N$$

In the geometric average indicators are first raised to their weights and then multiplied:

$$CI_n = \prod_{i=1}^{N} I_{i,n}^{w_i} = I_{1,n}^{w_1} * \dots * I_{N,n}^{w_N}$$

Advantages of geometric average versus the arithmetic average are the following.

- The geometric average does not suffer from compensability, i.e. poor performance in one dimension cannot be fully compensated by good performance in another.
- The geometric average rewards balance by penalizing uneven performance between dimensions.
- The geometric average encourages improvements in the weak dimensions.

The following example illustrates these properties. Let us consider two banks (Bank 1 and Bank 2) with three risk indicators reported in Table 51 (columns A, B, C). In this framework it is assumed that the higher the indicator, the better the performance.

Table 51: Example comparing the arithmetic and geometric averages.

	A	B	C	D	E	F	G
	Indicator 1	**Indicator2**	**Indicator 3**	**Standard deviation**	**Arithmetic average**	**Geometric average**	**Bank 2 improvement**
Bank 1	0.496	0.270	0.346	0.115	0.371	0.359	
Bank 2	0.580	0.439	0.140	0.225	0.386	0.329	
Bank 2 Scenario A	0.680	0.439	0.140		0.419	0.347	5.5%
Bank 2 Scenario B	0.580	0.439	0.240		0.419	0.394	19.8%

Column D computes the standard deviations of the three values for the two banks: results show that values for Bank 1 are quite homogeneous (the standard deviation is low), while those for bank 2 are more dispersed (the standard deviation is higher). Columns E and F show the values of the arithmetic and geometric averages: arithmetic average for Bank 1 is lower than that for Bank 2 (0.371 versus 0.386), while results for the geometric one are the opposite (0.359 versus 0.329).

One can immediately see that the arithmetic average suffers from compensability: although Bank 2 is bad performing in indicator 3, its arithmetic average is higher than for Bank 1 due to the high value of indicator 1. This is not the case for the geometric average.

Now some indicators of Bank 2 are modified by a fixed amount (0.1): in scenario A indicator 1, which was already the highest (and thus the best) for bank 2, is increased by 0.1; in scenario B the worst indicator, indicator 3, is increased by the same quantity. Columns E and F show the corresponding arithmetic and geometric averages.

The following results can be highlighted:

- The arithmetic averages under the two scenarios are equal (0.419), because the arithmetic average is only affected by the overall absolute increase/decrease in any indicator. In other words, improving on a bad or well performing dimension is not accounted for by the arithmetic average.
- The geometric averages, on the contrary, change in the two scenarios. When the best indicator increases (Scenario A), the corresponding geometric average increases by 5.5% (see column G), while when the worst indicator increase (and thus improves), the geometric average noticeably increases, by around 20%. This shows that the geometric average is extremely sensitive not only to the absolute increase in one indicators' value, but also to its performance. In other words the geometric average rewards more for improvements in poor dimensions. For this reason, it would be desirable to use the geometric average when combining different dimensions (in the case of the composite indicator, the different pillars within a single value).

A.3 Annex 3: An example of right tail treatments at work

This example shows how discretization and winsorization work. The indicator used is Asset composition (RWA/TA) for Euro area large banks. In raw data (see Figure 63), around 1600 banks have a value between roughly 0.7 and 0 (see zoom), and around 200 banks have values going from 0.7 to the extreme value of roughly 10.

Figure 63: Raw data (no right tail treatment) on the asset composition indicator. The bottom plot is a zoom.

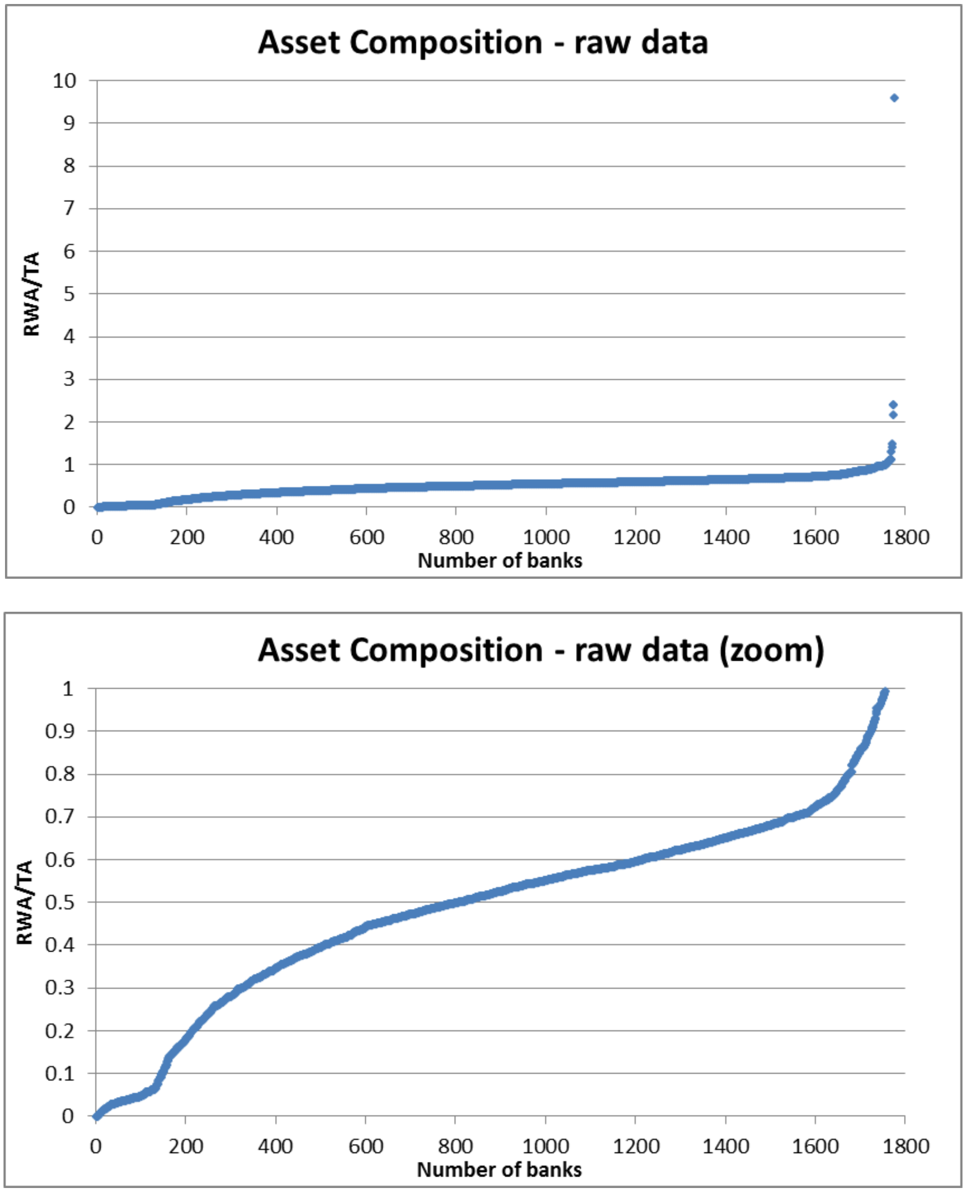
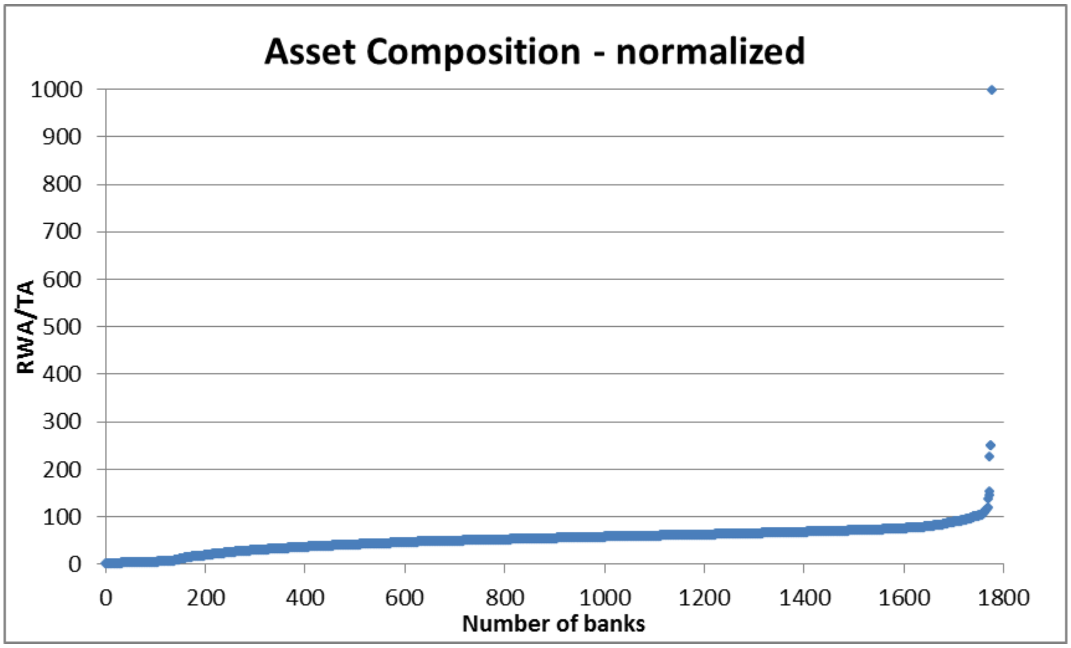


Figure 64 shows that when normalizing this leads the banks with the value of 10 to be assigned a value of 1000, while all 1600 banks with values between 0 (no risk) to 0.7 (considerable risk) are concentrated in the span 1-100.

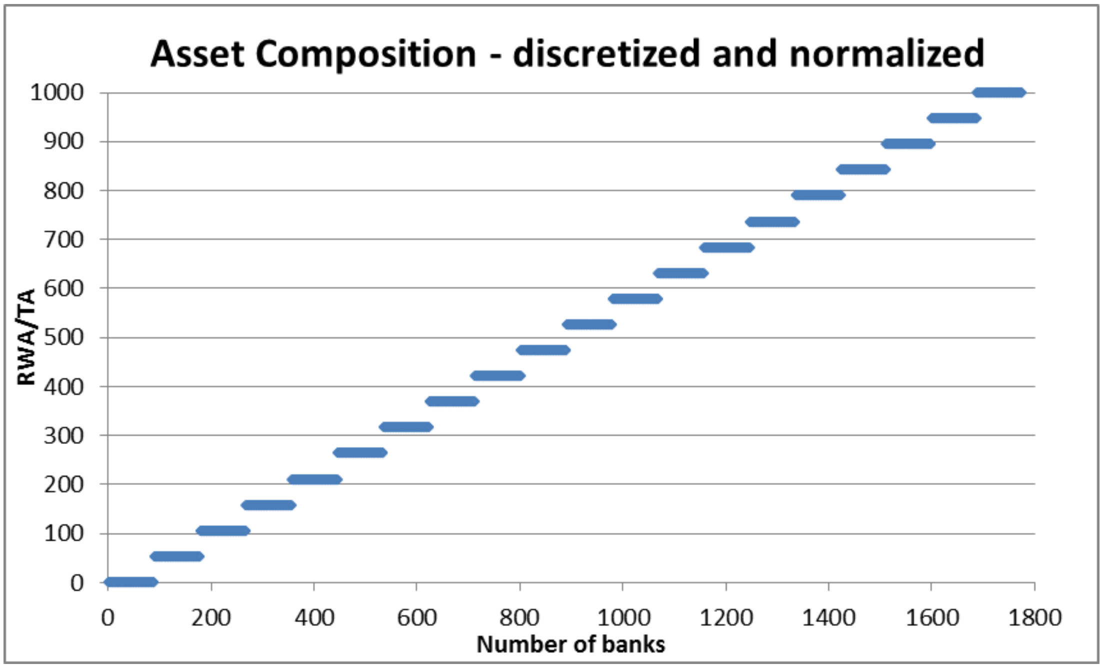
This leads the banks at the top to be considered extremely high risk in the composite, irrespective of its scoring on other dimensions, while banks with ratios in the 0.6-1 range would be considered extremely low risk.

Figure 64: Data on the asset composition indicator (RWA/TA) normalized in the 1-1000 range without right tail treatment



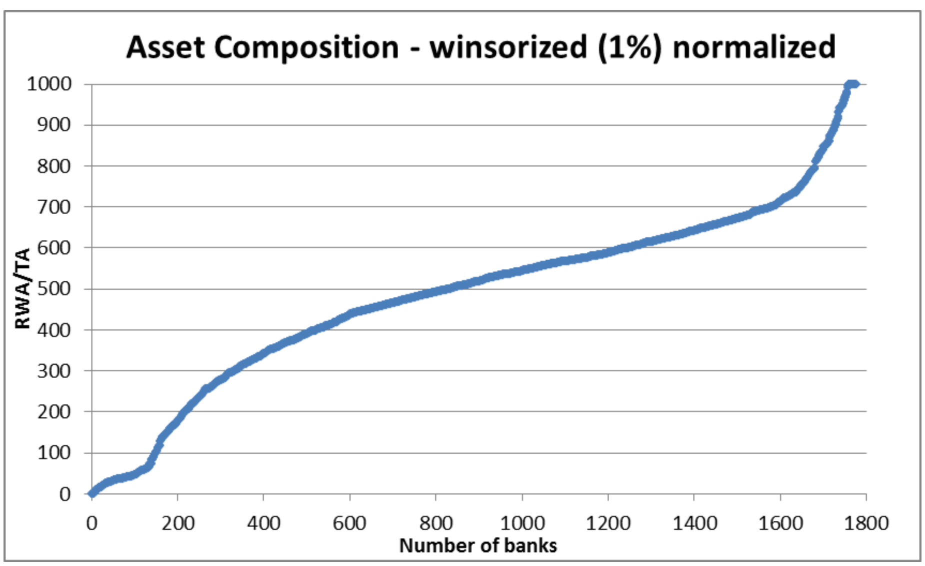
When applying the discretization (Figure 65), based on the size of the sample and on characteristics of this indicator, the sample is divided in 20 buckets each of which contains an identical number of points. This correctly pushes the points with a value around 0.7 to the top end of the distribution, but as everybody has been redistributed and the indicator is based on relative risk, the impact of this spreading of the distribution is mitigated. At the same time, extreme values will all be grouped in the top bucket.

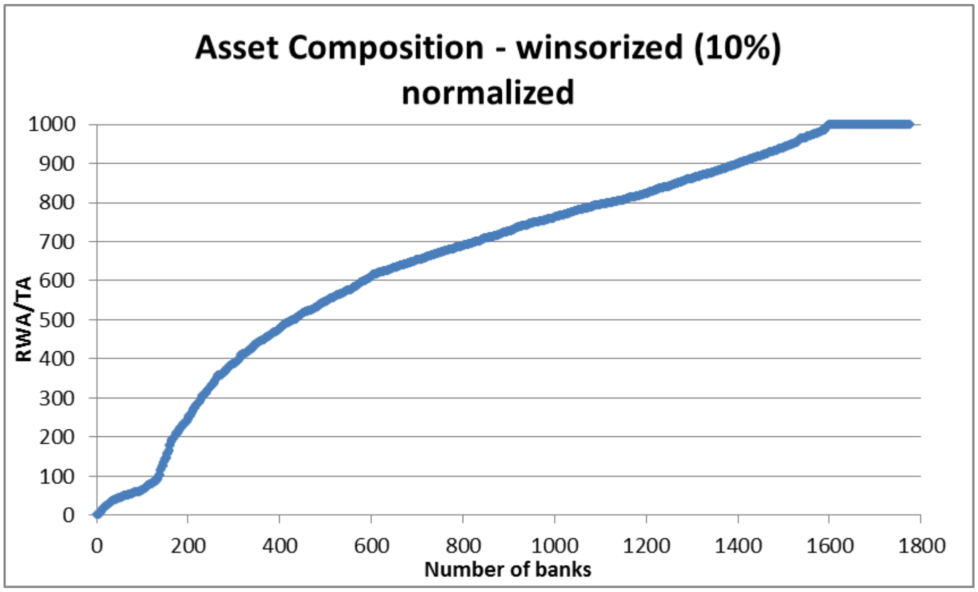
Figure 65: Data on the asset composition indicator normalized in the 1-1000 range after discretization to treat the right tail



With a "light" winsorization treatment (1% of the data, in this case – see Figure 66 top plot), the bank with an RWA/TA ratio of 0.7 is receiving a value of slightly less than 700, and 1% of the whole sample is going to receive an identical value of 1000, which is rather far from the center of the mass of the distribution.

Figure 66: Data on the asset composition indicator normalized in the 1-1000 range after light (1% - top plot) or strong (10% - bottom plot) winsorization to treat the right tail





Finally, a strong winsorization (but still considered perfectly reasonable in statistical use with banking data distributions: by way of example the FDIC "discards" 10% of its sample before calculating the ranges to be used for each indicator) pushes the indicator value for the bank with an RWA/TA ratio of about 0.7 to almost 1000 (see Figure 66 bottom plot). However, in this case 10% of the sample has now a value of 1000. These banks will not have a value of the composite as far off from the mass of all other banks in this case, as many other banks have relatively high values now, but still this will tend to create a large "clump" of banks with identical or very similar values of the total indicator.

Figure 67: Comparison between the distributions of the indicator RWA/TA with different right tail treatment

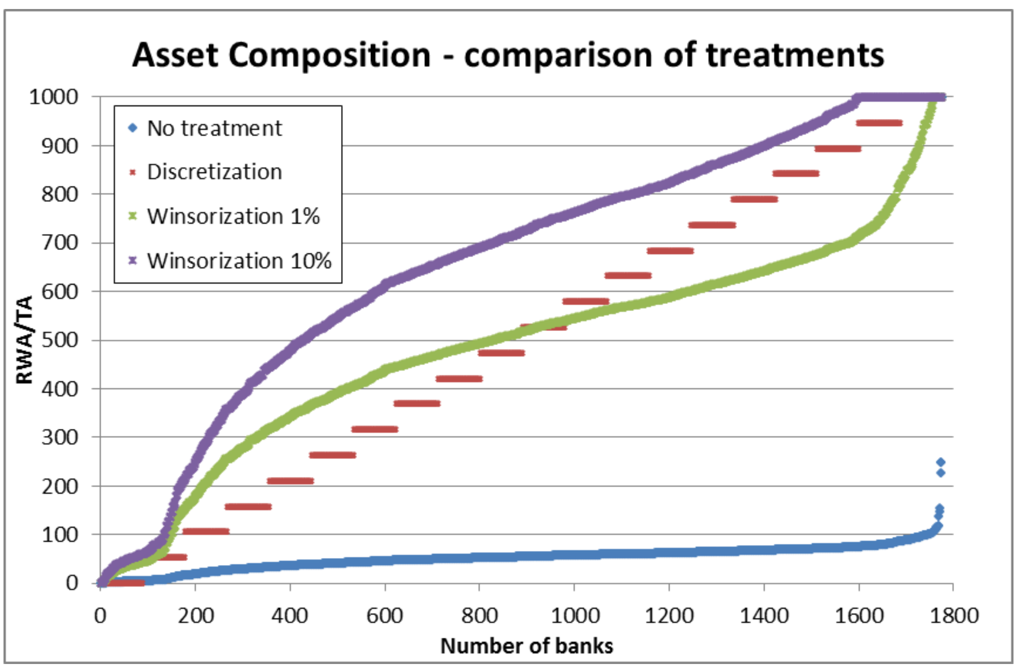


Figure 68 to Figure 71show a comparison between the distributions of the other where different tail treatments are applied.

Figure 68: Comparison between the distributions of the indicator Leverage ratio with different right tail treatment

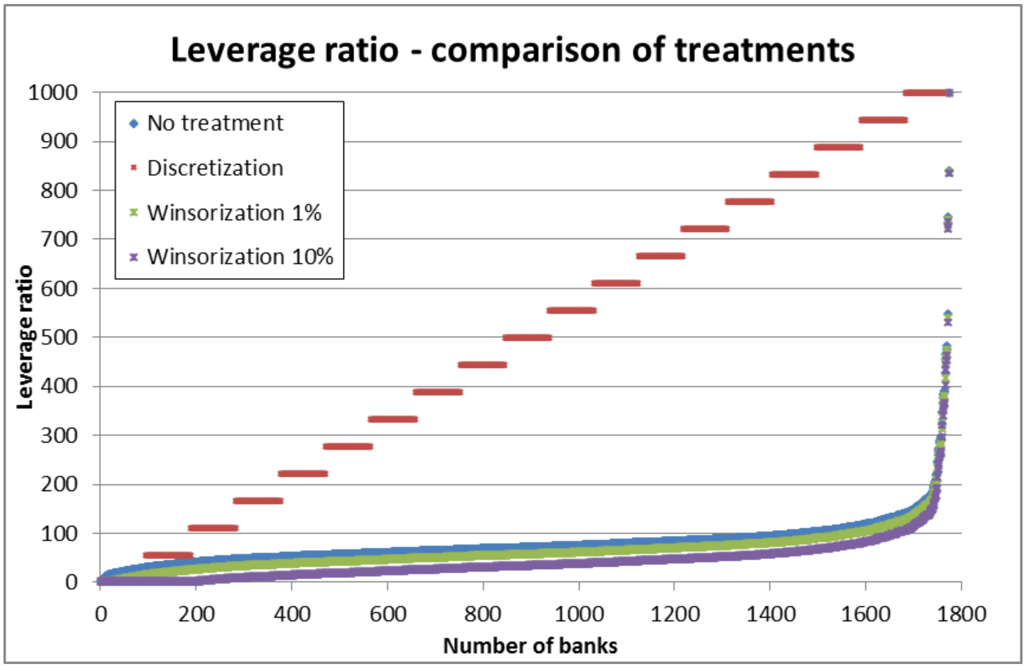


Figure 69: Comparison between the distributions of the indicator Capital ratio with different right tail treatment

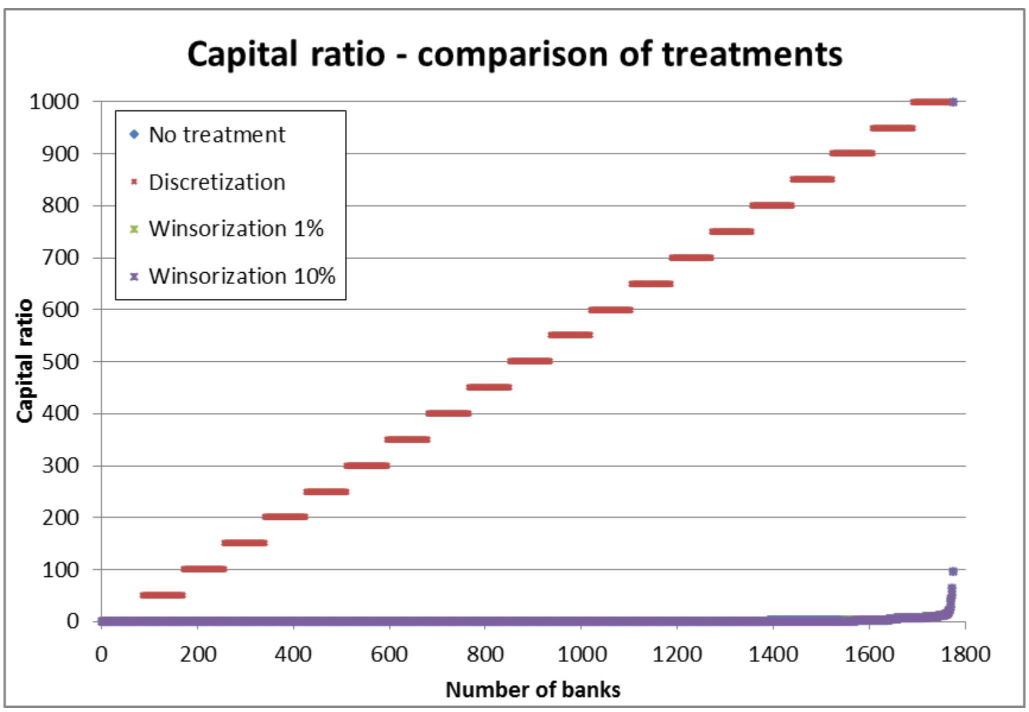


Figure 70: Comparison between the distributions of the indicator Net loans to deposits ratio with different right tail treatment

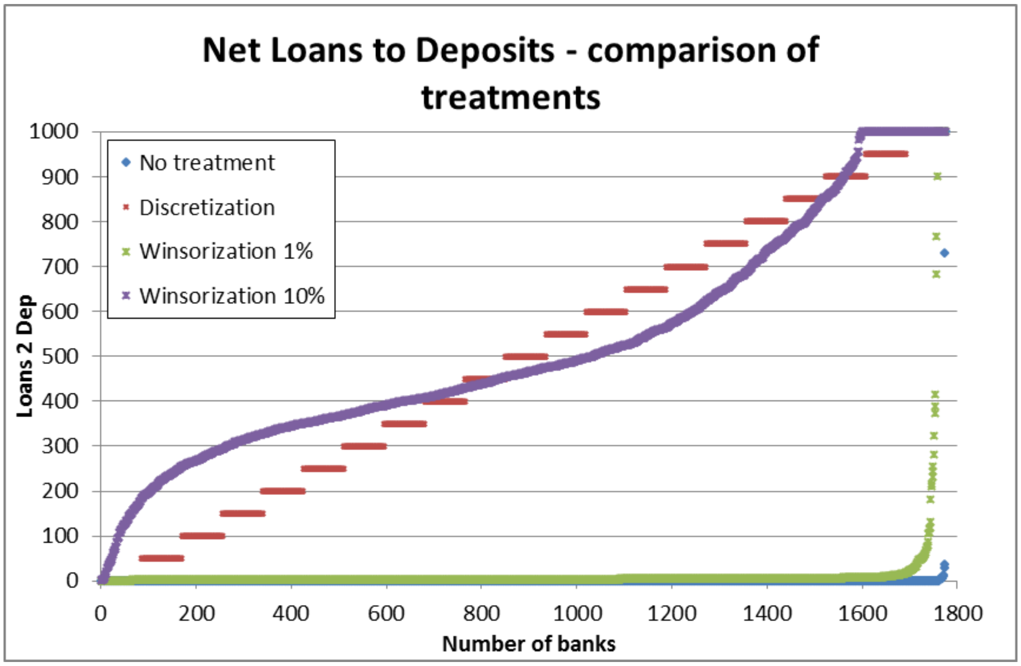
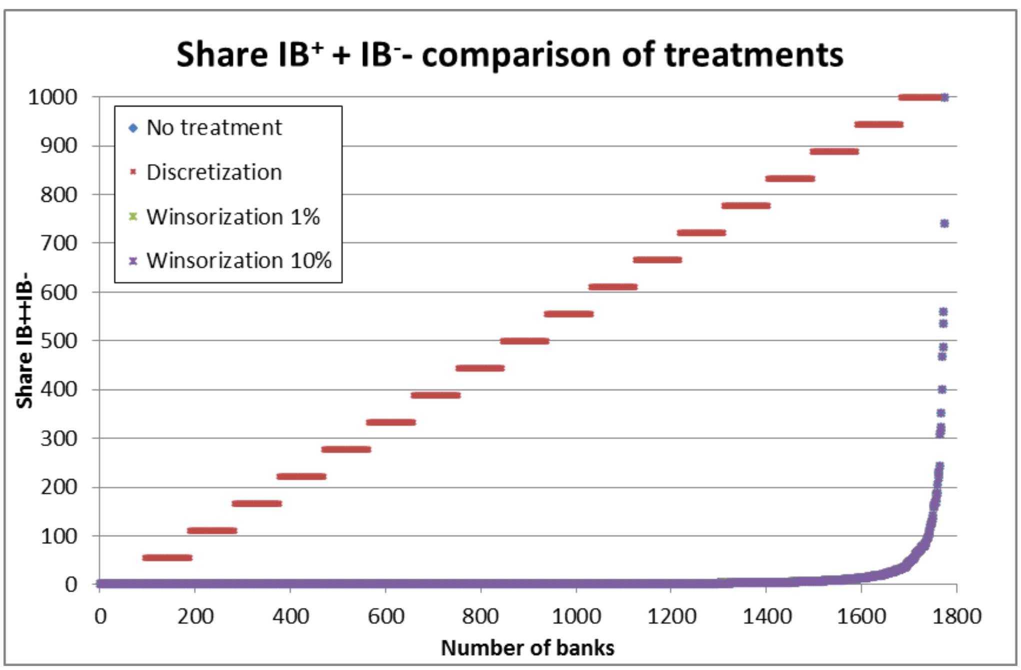


Figure 71: Comparison between the distributions of the indicator Share of interbank with different right tail treatment



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