

FIXED INCOME RISK ENGINE

Module 0: Model parameters

Methodological notes

Table of contents

1	Sovereign Risk Framework.....	3
1.1	Currently applied Sovereign Risk Framework	3
1.2	<i>Reviewed</i> Sovereign Risk Framework.....	7
1.3	Core model parameters / assumptions.....	8

1 Sovereign Risk Framework

In this paragraph a comparison between the currently applied Sovereign Risk Framework and the *reviewed* Sovereign Risk Framework to be applied with the *Expected Shortfall* methodology under development is provided.

1.1 Currently applied Sovereign Risk Framework

Along with the margining methodology a process of review has also been undertaken concerning the Sovereign Risk Framework.

The Sovereign Risk Framework (SRF) is the tool that is applied in order to retrieve the combination of parameters to be used in the margining process. In particular, each issuer country is assigned to a specific matrix of combinations (*holding period, lookback period and confidence level*) on the basis of its score in terms of rating and credit quality market indicators. The score of each country is reviewed periodically in order to verify whether the assignment still holds or if it is necessary to assign the country to a new matrix of combinations.

The criteria driving the definition of the score for each country are defined as follows:

- a) average rating from the three agencies (Moody's, S&P, Fitch);
- b) 5 years CDS quote retrieved from the market;
- c) 1 year probability of default;

The currently applied SRF has 8 score bands defined on the basis of a parameter B (ranging from 1 to 5 and linked to the rating as per point a) above) and a parameter L (ranging from 1 to 5 and linked to credit market indicators as per points b) and c) above). In particular, the following definitions of B and L apply:

Table 1: sovereign Risk Framework B and L criteria

B	B score criteria	L	L score criteria
B1	AAA	L1	5Y CDS, 1 year DP and Markit Data
B2	AA+ to AA-	L2	
B3	A+ to A-	L3	
B4	BBB+ to BBB-	L4	
B5	Below BBB-	L5	

where for the L parameter the 5Y CDS, the 1 year default probability and Markit iTraxx credit indices are checked against specific thresholds which are defined for each score band B (so that each band B has its own criteria for defining which countries within that B band are respectively L1, L2 etc...).

The possible set of combinations obtained by putting together B and L parameters is as follows:

Table 2: B and L combinations

B1	L1
B1	L2
B1	L3
B1	L4
B1	L5
B2	L1
B2	L2
B2	L3
B2	L4
B2	L5
B3	L1
B3	L2
B3	L3
B3	L4
B3	L5
B4	L1
B4	L2
B4	L3
B4	L4
B4	L5
B5	L1
B5	L2
B5	L3
B5	L4
B5	L5

In the currently applied Sovereign Risk Framework 8 score bands are currently defined. To each score band a matrix of combinations between *holding periods*, *lookback periods* and *confidence level* is assigned. The 8 score bands are as follows:

Table 3: SRF – score bands

B1	L1
B1	L2
B1	L3
B1	L4
B1	L5
B2	L1
B2	L2



B2	L3
B2	L4
B2	L5
B3	L1
B3	L2
B3	L3
B3	L4
B3	L5
B4	L1
B4	L2
B4	L3
B4	L4
B4	L5
B5	L1
B5	L2
B5	L3
B5	L4
B5	L5

- *Score Band 1: from B1L1 to B3L2;*
- *Score Band 2: B3L3;*
- *Score Band 3: B3L4;*
- *Score Band 4: from B3L5 to B4L2;*
- *Score Band 5: B4L3;*
- *Score Band 6: B4L4;*
- *Score Band 7: B4L5;*
- *Score Band 8: from B5L1 to B5L5¹.*

In the following table are reported the specific combinations assigned to each of the Score Band defined above:

Table 4: SRF – combinations²

¹ Score Band 8 refers to non investment grade issuers.

² The 6 months lookback period is currently disabled.



Confidence Levels from B1L1 To B3L2		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,80%	99,80%	99,80%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,70%	99,70%	99,70%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,50%

Confidence Levels B3L3		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,80%	99,80%	99,99%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,70%	99,70%	99,70%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,50%

Confidence Levels B3L4		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,80%	99,80%	99,99%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,70%	99,70%	99,99%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,50%

Confidence Levels from B3L5 To B4L2		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,80%	99,80%	99,99%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,70%	99,70%	99,99%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%

Confidence Levels B4L3		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,80%	99,80%	99,99%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,70%	99,70%	99,99%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%
4 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%

Confidence Levels B4L4		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,80%	99,80%	99,99%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,70%	99,70%	99,99%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%
4 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%
5Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,50%

Confidence Levels B4L5		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,80%	99,80%	99,99%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,70%	99,70%	99,99%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%
4 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%
5Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,35%	99,40%	99,99%

Confidence Levels From B5L1 To B5L5		Lookback Period										
Holding period	> 10 Years	10 Years	9 Years	8 Years	7 Years	6 Years	5 Years	4 Years	3 Years	2 Years	1 Year	6 Months
1 Day	99,50%	99,55%	99,60%	99,65%	99,70%	99,75%	99,80%	99,80%	99,80%	99,99%	99,99%	99,99%
2 Days	99,40%	99,40%	99,45%	99,50%	99,55%	99,60%	99,65%	99,70%	99,70%	99,99%	99,99%	99,99%
3 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,99%	99,99%	99,99%
4 Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,99%	99,99%	99,99%
5Days	99,00%	99,00%	99,00%	99,05%	99,10%	99,15%	99,20%	99,25%	99,30%	99,99%	99,99%	99,99%

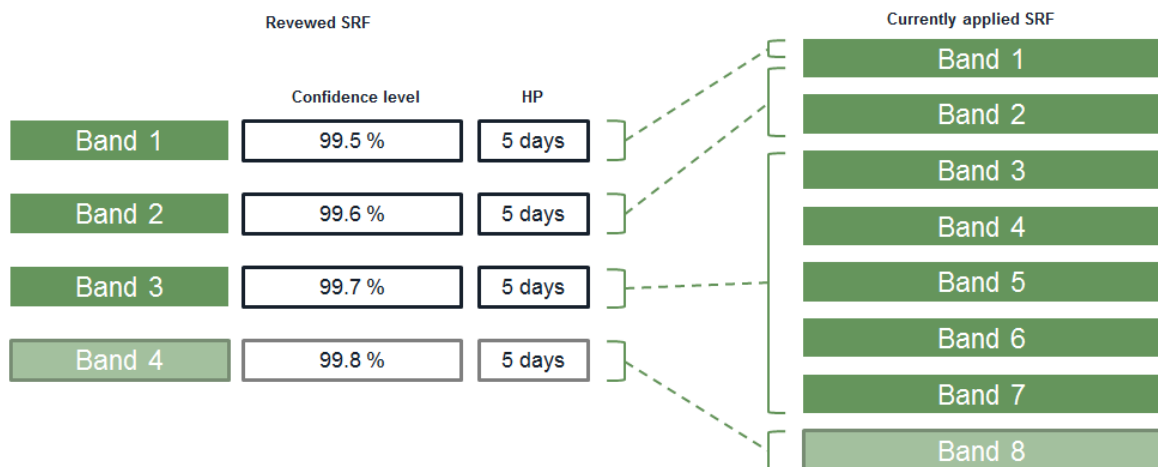
In the current MVP margining methodology each country is assigned to one of the score bands above. The deposit factor for each node of that country's curve is obtained as the worst result (most conservative result) between the VaRs computed on the time series for each combination of *lookback period / holding period / confidence level* of that specific score band.

1.2 *Reviewed* Sovereign Risk Framework

The *Expected Shortfall* margining methodology will benefit from the use of a single *lookback period*. Furthermore, the *holding period* used will also have a lesser degree of granularity (meaning that if a *holding period* of 3 days is used, only the 3-days variations are considered and not the maximum between the 1-day, 2-day and 3-day variations). The different granularity of the *reviewed* Sovereign Risk Framework will allow for an aggregation of the pre-existing score bands (given the lower number of possible combinations) thus resulting in a more intelligible and less burdensome framework.

The *reviewed* Sovereign Risk Framework has been designed as follows:

Figure 1: *reviewed* Sovereign Risk Framework



the score bands on the right side of Figure 1 refer to the currently applied SRF, while the score bands on the left are related to the *reviewed* SRF. The number of score bands has been reduced from 8 to 4 (with the last score band still representing non investment grade countries). The first 3 *reviewed* score bands are the result of the aggregation of the first 7 score bands of the SRF currently applied. In particular, *reviewed* score band 1 is reserved to highly rated countries (typically countries with a rating ranging from AAA to AA+) and with a quoted 5Y CDS rate that witnesses the high credit standing of those countries. *Reviewed* score band 2 is for countries typically ranging from AA to A and still with a 5Y CDS representing a mid to low probability of triggering the default event. *Reviewed* score band 3 is reserved to countries typically ranging from A- to BBB-.

The rating ranges given above are not an absolute reference as the 5Y CDS and the 1 year default probability are also driving criteria (and the *reviewed* score bands are not defined only on the basis of parameter B, i.e. average rating, but also on the basis of parameter L, i.e. credit quality indicators):

- *Reviewed Score Band 1: from B1L1 to B2L2;*
- *Reviewed Score Band 2: from B2L3 to B3L3;*
- *Reviewed Score Band 3: from B3L4 to B4L5;*
- *Reviewed Score Band 4: from B5L1 to B5L5.*

To each *reviewed* score band is assigned a different *confidence level* ranging from the 99.5% of the higher band up to 99.8% of the non investment grade band (i.e. *reviewed* score band 4). A 5 days *holding period* is used for all *reviewed* score bands with the result that a higher *holding period* would therefore be applied to countries ranked in all the original score bands. Only the hp-days variations are considered (not the maximum between all the possible sub-*holding periods*). The whole time series are taken into consideration for the *lookback period*.

Please note that the SRF framework will only be applied to the scaled margining methodology, since the unscaled floor will benefit from the application of a single set of parameters (in particular, the only difference between the two is that for the floor a constant 99.5% confidence level is applied across all countries regardless of their ranking).

1.3 Core model parameters / assumptions

The following table summarizes the parameters / assumptions that will be used in the margining model under development:

Table 5: parameters / assumptions

Typology	<i>Expected Shortfall</i>
Tail / s approach	<i>Single tail</i>
Cross margining	<i>Currently not applied</i>
Scaling window	<i>60 days</i>
λ	<i>99.9%</i>
Holding period	<i>5 days (see Figure 1)</i>
Confidence level	<i>From 99.5% to 99.8% (see Figure 1) for the scaled ES; 99.5% for the unscaled floor</i>
Lookback period	<i>Anchored to 2004</i>
Weighting	<i>Spectral Risk Measures (1.35 steps)</i>

a description of the table above is provided in the following paragraphs.

1) TYPOLOGY

The *Expected Shortfall* is the chosen risk measure. Given the distribution of gains/losses of the variations computed over a specific time series, it represents the weighted average of the observations that lie on the tail/s. By definition, it represents a more conservative risk measure with respect to VaRs methodologies.

2) TAIL/S APPROACH

The single tail approach has been chosen. It means that only the distribution tail of the losses is taken into consideration (see more in module 4). This choice is coherent with the sign of the marginable position.

3) CROSS MARGINING

Cross margining between different issuers is currently not applied. Each issuer country is treated separately, meaning that if a Member has positions on securities issued by different countries a sub-portfolio with its own margin requirement shall be defined for each issuer. The *Undiversified Expected Shortfall* approach is therefore currently applied.

4) SCALING WINDOW, λ

In order to compute the *Scaled Expected Shortfall* (see modules 3 and 4) a seeding volatility must be defined at first. The seeding volatility window (also scaling window) is defined in 60 business days. The λ parameter of 99.9% is calibrated in order to balance the model reactivity to market volatility and the satisfaction of the anti pro-cyclicality concern.

5) HOLDING PERIOD

Holding period is 5 days for all countries of the *reviewed* score bands. Given a *holding period* n , only the n -days variation is considered in the computation of the *Expected Shortfall*.

6) CONFIDENCE LEVEL

Confidence level ranges from 99.5% up to 99.8% depending on the issuer country and its position in the *reviewed* SRF matrix for the scaled approach. A constant *confidence level* of 99.5% is applied for the unscaled floor across all countries regardless of their ranking in the *reviewed* SRF.

7) LOOKBACK PERIOD, WEIGHTING

The *lookback period* used for margining purposes is anchored to 2004. It has been chosen not to use a moving window in order to avoid the possibility of significant events moving out of the observation window (in particular, with a 10 years *lookback period* in 1 year from now the 2011 timeframe would slip out of the observation window). The downside effect of using the entire time series is that, by maintaining a fixed confidence level, the size of the distribution's tail is destined to increase as the time series gets longer. This would imply a less conservative

measure of the risk of the margined portfolios, due indeed to the dilution of the tails. A trade-off is therefore implied when choosing the *lookback period* of the model between preservation of crisis events within the observation window and the dilution of the analyzed tails. In order to account for the dilution of the tail / s resulting from using the whole time series (and in order to account for the risk-aversion of the CCP - see module 4 for more details) a non equally weighted *Expected Shortfall* is computed as increasing weights are applied along the tail / s. The step applied for the definition of weights is calibrated so that both the Risk Appetite Framework and the anti pro-cyclicality concerns of the CCP are respected.

1.4 Add-on model parameters / assumptions

A description of the parameters used for the computation of the add-ons follows (for how each single add-on participates in the definition of the final margin requirements please refer to the specific modules):

1) DE-CORRELATION

The 80% rule is applied.

2) CONCENTRATION / IDIOSYNCRATIC

COUNTRY	LOOKBACK PERIOD	CONFIDENCE LEVEL	ES/VaR	UNSCALED/SCALED	SINGLE TAIL/DOUBLE TAIL	ISIN ADD-ON MULTIPLIER
IT	1Y	0.997	ES	UNSCALED	DOUBLE TAIL	0.25
ES	1Y	0.997	ES	UNSCALED	DOUBLE TAIL	0.25
IE	1Y	0.996	ES	UNSCALED	DOUBLE TAIL	0.25
PT	1Y	0.997	ES	UNSCALED	DOUBLE TAIL	0.25

CLASS	CONCENTRATION RATIO FLOOR	CONCENTRATION RATIO CAP	HP
BULLETS / ZEROS	0.0	0.05	-
BULLETS / ZEROS	0.05	0.1	-
BULLETS / ZEROS	0.1	0.15	5,6,7
BULLETS / ZEROS	0.15	0.2	5,6,7,8
BULLETS / ZEROS	0.2	0.25	5,6,7,8,9
BULLETS / ZEROS	0.25	1.0	5,6,7,8,9,10
FLOATERS	0.0	0.05	5
FLOATERS	0.05	0.1	5,6
FLOATERS	0.1	0.15	5,6,7
FLOATERS	0.15	0.2	5,6,7,8
FLOATERS	0.2	0.25	5,6,7,8,9
FLOATERS	0.25	1.0	5,6,7,8,9,10
LINKERS	0.0	0.05	5
LINKERS	0.05	0.1	5,6
LINKERS	0.1	0.15	5,6,7
LINKERS	0.15	0.2	5,6,7,8
LINKERS	0.2	0.25	5,6,7,8,9
LINKERS	0.25	1.0	5,6,7,8,9,10

3) REPO CONCENTRATION

COUNTRY	LOOKBACK PERIOD	CONFIDENCE LEVEL	ES/VaR	UNSCALED/SCALED	SINGLE TAIL/DOUBLE TAIL	SPECTRAL RISK MEASURES FACTOR
IT	all data	0.997	ES	UNSCALED	DOUBLE TAIL	1.35
ES	all data	0.997	ES	UNSCALED	DOUBLE TAIL	1.35
IE	all data	0.996	ES	UNSCALED	DOUBLE TAIL	1.35
PT	all data	0.997	ES	UNSCALED	DOUBLE TAIL	1.35

MATURITY FLOOR (days)	MATURITY CAP (days)	AMOUNT FLOOR	AMOUNT CAP	HP
0	7	0	500000000	-
0	7	500000000	1000000000	-
0	7	1000000000	5000000000	-
0	7	5000000000	10000000000000	-
7	31	0	500000000	5
7	31	500000000	1000000000	5
7	31	1000000000	5000000000	5,6
7	31	5000000000	10000000000000	5,6,7
31	93	0	500000000	5,6
31	93	500000000	1000000000	5,6
31	93	1000000000	5000000000	5,6,7
31	93	5000000000	10000000000000	5,6,7,8
93	366	0	500000000	5,6,7
93	366	500000000	1000000000	5,6,7,8
93	366	1000000000	5000000000	5,6,7,8
93	366	5000000000	10000000000000	5,6,7,8,9
366	10000	0	500000000	5,6,7,8
366	10000	500000000	1000000000	5,6,7,8,9
366	10000	1000000000	5000000000	5,6,7,8,9
366	10000	5000000000	10000000000000	5,6,7,8,9,10

Parametric stress on holding periods for concentration purposes are not applied on Italian debt for those Participants which are deemed of strategic importance for the stability of the financial system (e.g. Banca d'Italia, Ministero delle Economie e delle Finanze).