AWALEE NOTES

CVA RISK : REVISED MINIMUM CAPITAL REQUIREMENTS

BASEL III : FINALISING POST – CRISIS REFORMS

Study carried out by the Risk & Regulatory Practice

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1. CONTEXT

The document "Basel III: Finalising post-crisis reforms" published by the Basel Committee in December 2017 sets out the Basel Committee's finalisation of the Basel III framework. A key objective of the revisions is to reduce excessive variability in risk-weighted assets (RWAs). In particular, this framework should in the end:

- Enhance the robustness of standardised approaches for credit risk and operational risk.
- Constrain the use of internally-modelled approaches.
- Complement the risk weighted ratio with a finalised leverage ratio, which both make a more robust capital floor.

The list of revisions to regulatory frameworks includes (day or period of application):

- Revisions to standardised approach for credit risk (1/1/2022)
- Revisions to IRB framework (1/1/2022)
- Revisions to CVA framework (1/1/2022)
- Revisions to operational risk framework (1/1/2022)
- Leverage ratio (1/1/2018-1/1/2022)
- Output floor (1/1/2022- 1/1/2027)

Nevertheless, in the next chapters of this document, not all the revisions to the regulatory framework will be summarized but only the ones that focus on CVA framework. More especially, the two following points will be explained:

- The revised framework for the minimum capital requirements of CVA risk in terms of the calculations approaches: BA-CVA and SA-CVA .
- The evolution compared to previous framework and its impact.

2. REVISED MINIMUM CAPITAL REQUIREMENTS FOR CVA RISK

2.1. CAPITAL REQUIREMENTS FOR CVA RISK IN BASEL III

CVA Risk capital charge is introduced by BASEL III after the 2007-2008 crisis. It aims at absorbing the CVA risk associated with deterioration in the credit worthiness of counterparties.

The CVA risk is defined as the risk of losses arising from changing CVA values in response to changes in counterparty credit spreads and market risk factors that drive prices of derivatives transactions.

BCBS Consultative document (December 2009) :

- "Roughly two-thirds of CCR losses were due to CVA losses and only about one-third were due to actual defaults. The current framework addresses CCR as a default and credit migration risk, but does not fully account for market value losses short of default."

- "Banks will be subject to a capital charge for potential mark-to-market losses (CVA) associated with a deterioration in the credit worthiness of a counterparty."

The introduction of CVA risk capital charge has enhanced the counterparty credit risk management. First consultative paper has been published on May of 2012 and the final implementation is supposed to be functional in 2019. Between these 2 dates, several steps have been performed.

Work plan	
May 2012	First FRTB consultative paper
October 2013	Second FRTB consultative paper
April 2014	Quantitative Impact Study 1 (QIS 1) Hypothetical Portfolios
June 2014	Consultation : Sensitivity Based Approach FRTB
September 2014	Quantitative Impact Study 2 (QIS 2) Real Trading Portfolios
December 2014	Third FRTB consultative paper
2015 Q1	Quantitative Impact Study 3 (QIS 3) Real Trading Portfolios
July 2015	**First FRTB-CVA consultative paper**
2015 Q3	Quantitative Impact Study 4 (QIS 4) Real Trading Portfolios
January 2016	Final Draft FRTB
2016 Q2	**QIS FRTB-CVA**
2016 Q2	Quantitative Impact Study 5 (QIS 5) Real Trading Portfolio
December 2017	**Final Draft FRTB-CVA**
January 2022	**Setting of FRTB and FRTB-CVA**

Before the revisions, there were 3 ways to calculate CVA Risk. It can now be measured distinctly by two measures:

- Either using Basis CVA formula (BA-CVA)
- Or Standard CVA (SA-CVA)

The new framework does not allow anymore the use of internal model.

In what follows, the letter K refers to capital charges.

2.2 BA-CVA

In the revised framework for BA-CVA, the modeling differs quite a lot from the previous one proposed in the Basel Committee's consultative document - «Review of the Credit Valuation Adjustment Risk Framework » which was published in January 2015. Mainly, there are two differences compared to the previous model:

- In the previous model, BA-CVA was modeled using the following metric and risk factor:
    - Exposure of counterparty
    - Credit spread of counterparty
- Expected shortfall was also used in the calculation.

$$K_{CVA} = K_{spread} + K_{expected\ exposure} + K_{spread}^{unhedged}$$

For the new BA-CVA calculation, it can be performed either via the reduced version or full version: The reduced version is designed to simplify BA-CVA implementation for less sophisticated banks that do not hedge CVA, while the full version recognizes counterparty spread hedges and is intended for banks that hedge CVA risk. Hence the reduced version is part of the full BA-CVA.

The following formulas are used:

Reduced version of the BA – CVA (hedges are not recognised):

$$K_{reduced} = \sqrt{\left(\rho \sum_c SCVA_c\right)^2 + (1-\rho^2) \sum_c SCVA_c^2}$$

- $SCVA_c$: standalone CVA capital for counterparty C
- ρ^2 : correlation between credit spreads of any two counterparties

Full version of the BA-CVA(hedges are recognised):
Eligible CVA hedges are:

- Single Name CDS
- Single-name Contingent CDS
- Index CDS

Eligible single-name credit instrument must:

- Reference the counterparty directly
- Reference as entity legally related to the counterparty
- Or reference an entity that belongs to the same sector of region as the counterparty

$$K_{full} = \beta K_{reduced} + (1 - \beta) K_{hedged}$$

- $\beta = 0.25$, parameter used to provide a floor

That limits the extent to which hedging can reduce the capital that is required to cover CVA risk.

$$K_{hedge} = \sqrt{\left(\rho \sum_c (SCVA_c - SNH_c) - IH\right)^2 + (1-\rho^2) \sum_c (SCVA_c - SNH_c)^2 + \sum_c HMA_c}$$

Regarding the main parameters:
- SNH_c : Hedge of CVA risk of the counterparty C by single name hedges of credit spread risk
- IH : hedge of CVA risk of counterparty C by index hedges
- HMA_c : hedge of CVA risk by indirect hedges

See Appendix B for the calculation details

2.2 SA-CVA

We list below the evolutions introduced by the 2017 document [1] with regards to the previous published documents ([2], [3]):

- (P30) Among the based inputs for regulatory CVA computation, the use of market implied expected loss given default (ELGD) is relaxed to market-consensus ELGD.

- (P30) Only one option remains (option A or alternative 1 in the previous version) for the floor value of the margin period of risk (MPoR) : *The supervisory floor is equal to 9 + N business days, where N is the re-margining period specified in the margin agreement (in particular, for margin agreements with daily or intra-daily exchange of margin, the minimum MPoR is 10 business days). Option B or alternative 2 which should be used for IMM-based CVA is no longer approved.*

- (P31) Only one option remains for generating scenario for discounted exposure, namely accounting-based CVA : *The paths of discounted exposure are obtained via exposure models used by a bank for calculating forn office/accounting CVA, adjusted (if needed) to meet the requirements imposed for regulatory CVA calculation. Model calibration process (with exception of the MPoR), market and transaction data used for regulatory CVA calculation must be the same as the ones used for accounting CVA calculation.* The IMM-based option is no longer approved.

• (P33) Only one option remains for netting recognition: *Netting recognition is the same as in the accounting CVA calculations. In particular, netting uncertainty can be modelled.*

• (P35) More precision in the level of detail for initial and ongoing validation documentation : *Banks must document the process for initial and ongoing validation of their exposure models to a level of detail that would enable a third party to understand how the model operates, its limitations, and its key assumptions ; and recreate the analysis. This documentation must set out the minimum frequency with which ongoing validation will be conducted as well as other circumstances (such as a sudden change in market behaviour).*

• (P35) Sign-off for the process of recognising netting arrangements is no longer an obligation as stated in the previous version : *The process for recognising netting arrangements must require sign-off by legal staff to verify the legal enforceability of netting and be input into the database by an independent unit.*

• (P36) More precise condition for transactions used for mitigating CVA risk : *Only whole transactions (transactions cannot be split into several effective transactions) that are used for the purpose of mitigating CVA risk, and managed as such, can be eligible hedges.*

• (P40) **The default value for the multiplier** $m_{CVA} = 1.25$ **, which is lower than the previous proposition (1.5).**

• (P43) *If an instrument is deemed as an eligible hedge for credit spread delta risk, it must be assigned in its entirety either to the counterparty credit spread or to the reference credit spread risk type. Instruments cannot be split beween the two risk types.*

• (P46) The use of risk factor shifts are more flexible. A bank may use smaller values (than the values defined by the regulator) of risk factor shifts if doing so is consistent with internal risk management calculations. The use of the same seed for the random number generator is not an obligation as specified in the previous version : *The CVA calculation with the shifted value of a risk factor must be performed using the same seed for the random number generator as the calculation without the shift.*

• (P48) More precise condition to compute the sensitivities when a hedging instrument is an index : *If a hedging instrument is an index, its sensitivities to all risk factors upon which the value of the index depends must be calculated. The index sensitivity to risk factor k must be calculated via applying the shift of risk factor k to all index constituents that depend on this risk factor and recalculating the index.*

• (P55) New definition of interest rate delta risk factors for bank's domestic currency and USD, EUR, GBP, AUD, CAD, SEK, JPY: *Interest rate delta risk factors are the absolute changes of the inflation rate and of the risk-free yields for the following five tenors : 1 year, 2 years, 5 years and 30 years. Comparing to the previous definition (interest rate delta risk factors are the absolute change of the inflation rate and the parallel shift of three pieces of the risk-free yield curve : up to one year, one to five years and greater than five years)*, the new definition requires more granularity and more information of the yield curve to be taken into account (drift and curvature). The risk weights RW_k are correspondingly changed in a more conservative direction for the medium tenors (1 year to 5 year).

• (P57, P61, P72, P76) For all risk types (interest rate, foreign exchange, equity and commodity) vega risk factors are simultaneous relative change of the volatility. The use of the market-implied volatility is no longer an obligation as in the previous version.

• (P62) For counterparty credit spread, buckets for delta risk present new regrouping : (i) between sovereigns including central bank, multilateral development banks and local government, government-backed non –financials, education and public administration which are correlated at 75% in the previous version ; there is no division between investment grade group and high yield and non-rated group as in the previous version.

• (P64) For counterparty credit spread delta risk factors, the correlation structure is much more conservative (higher).

The different steps for SA-CVA computation are synthesized in the table below:

Computation order	Formula	Parameters
SA-CVA CR	$SA - CVA\ CR = Delta\ CR + Vega\ CR$	
Delta CR, Vega CR	$Delta\ CR = \sum_{i=1}^{6} K^{i}_{delta}\ ;\ Vega\ CR = \sum_{i=1}^{5} K^{i}_{vega}$	m_{cva} Risk model multiplier with default value [1.25]
Risk types (CCS IR, FX RCS, Eq, Co)	$K^{i}_{delta,vega} = m_{cva}\sqrt{\sum_b K_b^2 + \sum_b \sum_{c \neq b} \gamma_{bc} K_b K_c}$	γ_{bc} Correlation between risk types
Buckets of risk factors	$K_b = \sqrt{[\sum \rho_{kl} WS_k WS_l] + R \sum [(WS_k^{Hdg})^2]}$	R Hedging disallowance parameter set at 0.01
Risk factors	$WS_k = WS_k^{CVA} + WS_k^{Hdg}$	ρ_{kl} Correlation between risk factors
Weighted sensitivities	$WS_k^{CVA} = RW_k \times s_k^{CVA}\ ,\ WS_k^{Hdg} = RW_k \times s_k^{Hdg}$	RW_k Risk weight
Net sensitivities	$s_k^{CVA}\ ,\ s_k^{Hdg}$	

- The SA-CVA capital requirement (SA-CVA CR) is calculated as the sum of the capital requirement for delta risks (delta CR) and vega risks (vega CR) calculated for the entire CVA portfolio (including eligible hedges). These two capital requirements are calculated following similar schemas.

- The delta CR (resp. vega CR) is calculated as the simple sum of delta capital requirements calculated independently for the following six (resp. five) risk types: (i) counterparty credit spread(CCS) (only for delta risk) ; (ii) interest rate (IR) ; (iii) foreign exchange (FX) ; (iv) reference credit spread (RCS) ; (v) equity (Eq) ; (vi) commodity (Co).

- Each risk type is divided into buckets. The delta CR (resp. vega CR) at risk type level (K) is calculated from the delta CR (resp. vega CR) at bucket level *(K_b,K_c)* (formula (1)). The multiplier m_{CVA} is used to take into account the model risk and fixed at default value of 1.25 but its default value can be increased by the bank's supervisory authority if it determines that the bank's CVA model warrants it. γ_{bc} is the correlation parameter between buckets.

- Each bucket contains a number of risk factors (RF). The delta CR (resp. vega CR) at bucket level (K_b) is calculated from the net sensitivities (WS_k) and the weighted sensitivities (WS_k^{CVA}, WS_k^{Hdg}) of each risk factors k (formula (2)), where R is the hedging disallowance parameter, set at [0.01], and ρ_{kl} is the correlation parameter between risk factors.

- The weighted sensitivities for risk factor k (WS_k) is the sum of the weighted sensitivities of the global CVA (WS_k^{CVA}) and the weighted sensitivities of all eligible hedges of the CVA book (WS_k^{Hdg}).

- The weighted sensitivities WS_k^{CVA} (resp. WS_k^{Hdg}) of each risk factor k are obtained by multiplying the net sensitivity s_k^{CVA} (resp. s_k^{Hdg}) by the corresponding risk weights RW_k.

- The net sensitivities (s_k^{CVA}, s_k^{Hdg}) are defined as the ratio of the change of the quantity in question (aggregate CVA or market value of all CVA hedges) caused by a small change of the risk factor current value to the size of the change. More specific definitions including specific values of risk factor shifts are provided for each asset class by the regulator. However, a bank may use smaller values of risk factor shifts if doing so is consistent with internal risk management calculations.

CONCLUSION

Basel Committee conducted an extensive consultation process with a wide range of stakeholders, which have contributed to the revisions of the FRTB-CVA Framework. It has conducted a serious assessment of the impact of these revisions on the banking system and the wider macro economy.

As a result, the Committee focused on not significantly increasing overall capital requirements and on giving a more comprehensible, simplified framework. Indeed, CVA risk charge calculation formula for BA-CVA has been modified to a more comprehensive and simplified one, and SA-CVA new framework has been amended by taking banks consideration by between others:

- Lowering the level of the multiplier m, which captures wrong way risk.

- Giving a more reasonable framework for the vega risk computation. Indeed, the use of market implied volatilities is no longer required.

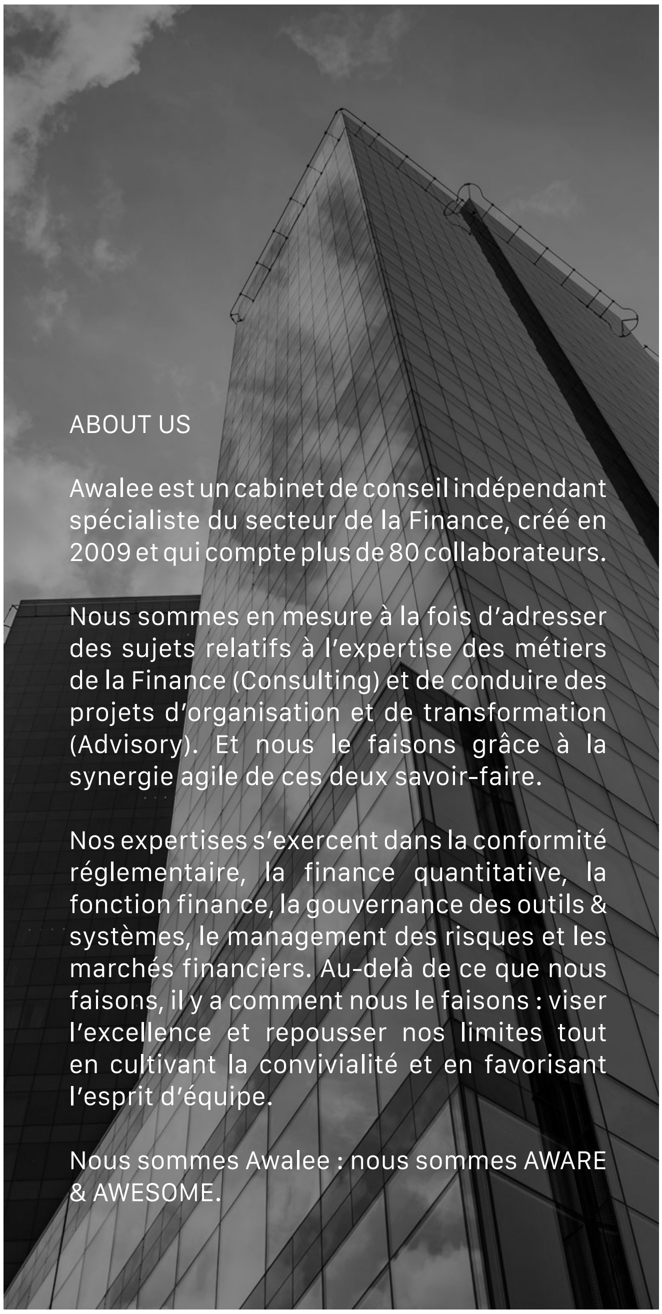
Nevertheless, banks will have to implement CVA sensitivities calculation which will be a complex task in terms of time computation and work processes. Adding that, they will have to improve their data management system and link them to risk factors.

REFERENCE

[1] Basel Committee on Banking Supervision. Basel III: Finalising post-crisis reforms, December 2017 (https://www.bis.org/bcbs/publ/d424.pdf)

[2] Basel Committee on Banking Supervision. Instructions: CVA QIS, February 2016

[3]Basel Committee on Banking Supervision. Review of the Credit Valuation Adjustment Risk Framework, July 2015 (https://www.bis.org/bcbs/publ/d325.pdf)



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APPENDIX A : ORIGIN OF SENSITIVITY BASED APPROACH – DELTA CALCULATION

We can justify and motivate the nested formulas approach in the following way. Let us define the random variables Y_i^a to be the random 10 days evolution in the market rate corresponding to node i of bucket a. We assume that this has zero mean and unit variance, because the 10 days scaling and 99% percentile have been put in the risk-weighted scaled delta. This lets us focus on the correlation structure. Within each bucket a, the correlation structure of the nodes is given by a matrix U_a where :

$$Cov(Y_i^a, Y_j^a) = (U_a)_{ij} = \rho_{ij}^a$$

Let us denote the change in value of the portfolio due to changes in the market rate of node i of bucket a by X_{ai}, where :

$$X_{ai} = \sum_{i=1}^{n} WS_i^a . Y_i^a$$

So that this change is driven by the random variable Y_i^a which is the change in the relevant market rate. Then the distribution of the change in value of the portfolio due to changes in bucket a over all its nodes is given by the formula :

$$X_a = \sum_{i=1}^{n} X_{ai} = \sum_{i=1}^{n} WS_i^a . Y_i^a$$

This shows, in line with our intuition, that K_a has a specific interpretation as the amount of PV variation caused by bucket a overall. So the first formula in the nested sequence makes sense.

The next nested formula is based on an idea of representing each overall bucket with an individual random variable. The random variable can be interpreted as the first principal component of changes in the bucket. For each bucket a, we have a random principal component Z_a, and we calibrate the covariance structure of these variables Z_a to have correlation γ_{ab},

where $\gamma_{ab} = Cov(Z_a, Z_b)$.

As before we have scaled the random variables to have unit variance.

We can derive an explicit formula for Z_a as follows: Let us denote the maximum eigen value of the correlation matrix U_a as λ_a, with corresponding eigenvector z_a, with unit length ($z_a^T z_a = 1$).

Then $Z_a = \lambda_a^{-\frac{1}{2}} \sum_{i=1}^{n} z_a[i] . Y_i^a$

This has unit variance because $Z_a = \lambda_a^{-1} z_a^T U_a z_a = 1$

To derive the nested formula, we regress the random variable X_a against the bucket's principal component Z_a, to write it as a multiple of Z_a plus an independent term ε_a. That is we write $X_a = S_a Z_a + \varepsilon_a$, where $S_a = Cov(X_a, Z_a)$.

Then the total portfolio value change X will be given by $X = \sum_a X_a = \sum_a \varepsilon_a + \sum_a S_a Z_a$

Its variance is the square of the total margin requirement and substituting $Var(\varepsilon_a)$ by $K_a^2 - S_a^2$, we get the nested variance/covariance formula

$$\sum_a K_a^2 + \sum_{a \neq b} \gamma_{ab} S_a S_b$$

APPENDIX B : DETAIL OF PARAMETERS CALCULATION

$$SCVA_c = \frac{1}{\alpha} RW_c \sum_{NS} M_{NS} . EDA_{NS} . DF_{NS}$$

$\rho = 0.5$, supervisory collelation parmeter, represents the credit spreads of any two counterparties.

RW_c : risk weight for counteparty C that reflects the volatitity of its credit spread.

M_{NS} : effective maturity for netting set NS

EAD_{NS} : exposure at default of the netting set NS

DF_{NS} : supervisory discount factor

$\alpha = 1.4$, multiplier used to convert EEPE to EAD. $1/\alpha$ is to convert EA to EEPE

The breakdown of SNH_c, IH, HMA_c is show as below :

$$SNH_c = \sum_h \gamma_{hc} . RW_h . M_h^{SN} . B_h^{SN} . DF_h SN$$

$$IH = \sum_i RW_i . M_h^{SN} . B_i^{ind} . DF_i^{ind}$$

$$HMA_c = \sum_h (1 - \gamma_{hc}^2) . (RW_h . M_h^{SN} . B_h^{SN} . DF_h^{SN})^2$$

- *γ_{hc} : supervisory corelation of counterparty C's credit spread and the SN hedge h' s credit spread`*
- *M_h^{SN}, M_h^{SN} : remained matury of hedge*
- *B_h^{SN}, B_i^{ind} : notional of hedge*
- *RW_i, W_h : supervisory risk weight of hedge*
- $\left(\rho \sum_c (SCVA_c - SNH_c) - IH\right)^2$ *: aggregation of systematic components of CVA risk a rising from the used of SN Hedges and Index hedges*

- $(1 - \rho^2) \sum_c (SCVA_c - SNH_c)^2$ *aggregation of idiosyncratic components of CVA arising from the bank' s counterparties and the SN hedges*

- *$\sum_C HMA_c$: aggregation of the components of indirect hedges that are not aligned with counterparties' credit spreads.*