Basel III Counterparty Credit Metrics

EXECUTIVE SUMMARY

An important element of Basel III is the definition of minimum capital adequacy requirements for counterparty credit exposures (derivative instruments, long settlement transactions, securities financing transactions, and counterparty master agreements where the counterparty to the transaction is a credit-risky entity) held by banks.

Basel III defines two forms of capital adequacy requirements for counterparty credit exposures. The first form specifies the minimum capital required to cover potential future losses from counterparty defaults in terms of the probability of counterparty default (PD), the loss rate given default (LGD) on a defaulted exposure, the exposure at default (EAD) of the exposure, and the effective maturity (M) of the exposure. The second form specifies the minimum capital required to cover potential future losses from future changes in the credit quality of the counterparty that result in changes in the credit spreads for the counterparty's credit exposures.

Pillar 1 of Basel III requires that banks satisfy these minimum capital requirements at all times. In addition, Pillar 2 of Basel III requires that banks establish plans for capital resources sufficient to satisfy the capital requirements in future periods, which requires forecasts of future capital requirements.

Capital adequacy requirements under Basel III are calculated using a potential future exposure (PFE) approach, where future credit exposure amounts for a counterparty credit exposure are estimated and used to determine the exposure at default (EAD) amount for the counterparty credit exposure. Basel III provides three alternative methods for estimating future exposure amounts the Current Exposure Method, the Standardized Method, and the Internal Model Method. Moreover, the KRM solution supports the collateral management process enabling the optimal allocation of collaterals to exposures. Our consultants perform this task under the objectives of the optimisation procedure specified by the bank. (minimising capital charge, reputation risks, level of complexity desired etc).

The fact that there are numerous successful implementation projects in the entire region is a great plus for Kamakura, and is testimony to the credentials of Kamakura's subject matter experts. Kamakura is well-positioned to meet the burgeoning regulatory demands imposed on financial institutions in the region and has the wherewithal to keep pace with regulation. Among others, Kamakura has undertaken a number of litigation support projects and is prepared to provide expert testimony supported by methodical analysis employing the KRM system.

KEY BENEFITS AND FEATURES

1. Basel III Expected Exposure (EE) Forecast for Future Periods

The exposure risk factor (ERF) vector and the yield curves as well as their associated stochastic process models are required to simulate the specific sources of risk affecting the future economic values of the derivative instruments, and both the derivative instrument, and collateral pool valuation models are required to calculate future economic values of the derivative instruments and any collateral agreement covering it based upon the projected future values of the ERF vector and the yield curves.

Exposure Simulation Calendar
- For an initial date t, define an exposure simulation calendar $\boldsymbol{T} \equiv [T_1, T_2, \cdots, T_N]$ consisting of N periods $(T_{i-1}, T_i), T_0 = t$ such that T_N equals or exceeds the expiration date T_X of the derivative instrument $\mathcal{D}$ and $t < T_1$ is the initial date for exposure simulation, choosing N to provide adequate time granularity in expected exposure analysis

Exposure Risk Factor Vector
- Identify the sources of market and macroeconomic risk other than yield curves affecting the economic value of the derivative instrument , model these sources as component risk factors in an exposure risk factor (ERF) vector containing component risk factors, and specify values for these component risk factors at time. [1]

Valuation Yield Curves
- Identify any yield curves $Y_k(t, T), k \geq 1$ required for pricing the derivative instrument and define an n-factor ($n \geq 1$) dynamic term structure model (DTSM) for each yield curve, define an interest rate risk factor for each factor in each DTSM, include each interest rate risk factor as an additional component in the ERF vector $\boldsymbol{X}(t)$, specify the set of yield curve tenor points $\mathcal{T}_{kp}, p \geq 2$ for which yield changes are to be simulated for the yield curve, and specify values for these yield curve tenor points at time t. [2]

ERF Vector and YC simulations
- Simulate M ERF vector $\boldsymbol{X}(t)$ sample paths $\boldsymbol{X}_j(T_i), i = 1, \cdots, N; j = 1, \cdots, M$ over the N exposure simulation periods, choosing M to provide a representative distribution of sample paths **(i) *Simulate ERF Vector:*** simulate the value of the ERF vector components of $\boldsymbol{X}_j(T_i)$ at the end of each simulation period $T_i, i = 1, \cdots, N$ using either historical or model-based Monte Carlo sampling methods and an appropriate vector stochastic process model *and* ***(ii) Simulate YC Sample Paths:*** apply the simulated changes to the DTSM to produce changes in the yield curve values. [3]

Potential Future Exposure
- For each ERF vector sample path j at the end of each exposure simulation period T_i, calculate the potential future exposure (PFE) amount $E_j(T_i)$ for the derivative instrument $\mathcal{D}$ using the simulated exposure risk factor (ERF) vector sample path value $\boldsymbol{X}_j(T_i)$ and the simulated yield curve values $Y_{jk}(T_i, \mathcal{T}_{kp}), \forall k, \forall p$ at time T_i as inputs to the exposure amount calculation

Expected Exposure (EE)
- For each exposure simulation period i, calculate the expected exposure amount $EE_i(\mathcal{D}, t)$ as the average of the adjusted exposure amounts $E_j^*(\mathcal{D}, T_i)$ across the M ERF vector sample paths j, i.e. $EE_i(\mathcal{D}, t) = \sum_{j=1}^{M} E_j^*(\mathcal{D}, T_i)/M$, and assign the results to the Expected Exposure vector $\boldsymbol{EE}(\mathcal{D}, t) \equiv [EE_1(\mathcal{D}, t), EE_2(\mathcal{D}, t), \cdots, EE_N(\mathcal{D}, t)]$.

[1] Paragraph 718(lxxiv) of the Basel II guidelines specifies that a spot FX rate risk factor must be modeled for each FX rate to which a derivative instrument is exposed, and at least one equity market index risk factor must be modeled for each of the equity markets to which a derivative instrument is exposed. Additionally, a commodity price risk factor must be modeled for each commodity price to which a derivative instrument is exposed.

[2] Paragraph 718(lxxiv) of the Basel II guidelines specifies that there must be a set of interest rate risk factors for each yield curve in each currency to which a derivative instrument is exposed. If the risk factors are associated with yield curve tenor points, there should be a minimum of six tenor point risk factors for each yield curve in each currency. In addition, interest rate spread risk factors should be used to describe differences in spreads across various interest rate exposures.

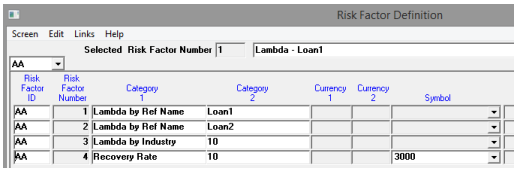
[3] Under the Internal Model Method described in Section V.A. of Annex 4 of the Basel II guidelines, the ERF vector sample path simulation should be performed across possible future values of the market risk factors that affect the future economic values of a derivative instrument, but no specific methodology for the simulation is required. However, paragraph 98 of the Basel III guidelines specifies that the sampling process for the ERF vector and the yield curves must be performed for both current market and economic conditions as well as historically stressful conditions based upon three consecutive years of historical data.

Accounting Period	Start Date	End Date
1 001	2004-01-30	2005-01-30
2 002	2005-07-01	2006-01-30
3 003	2006-07-01	2007-01-30
4 004	2007-07-01	2008-01-30
5 005	2008-07-01	2009-01-30
6 006	2009-07-01	2014-01-30

User defined time steps

Simulation Calendar

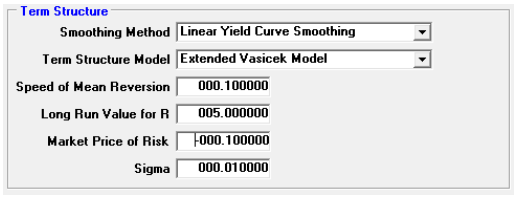
KRM will aggregate the information into user-defined time buckets referred to as Accounting Periods. Each Accounting Period ID will be linked to a specific range of forecast dates (i.e., beginning date and ending date).



User-defined risk factors

Exposure Risk Factor Vector

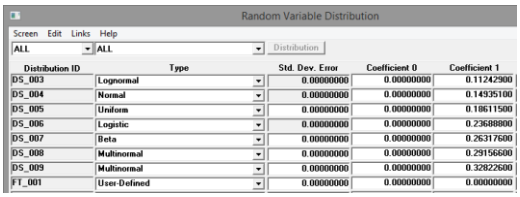
Modelling risk drivers (such as spot foreign exchange rates, equity indices, etc.), which is provided by the KRM-var functionality



Yield Curve Term Structure setup

Yield Curve Term Structure

Term structure models for the modeling of the evolution of the yield curve are absolutely critical for the valuation of most derivative securities. Neither implied forward rates nor selected, deterministic, forecasts of future rates provide sufficiently accurate, unbiased predictions. The KRM solution supports Advanced Heath Jarrow & Morton Interest Rate Modeling which is the most general model consistent with a no arbitrage multi-factor evolution of the yield curve (every model used in industry is a special case of the general structure). Also the KRM solution allows an arbitrary number of risk factors[4] (KRM can handle up to 999,999!!!)



Random Variable Distributions setup

Advanced stress testing

Provides a deeper understanding of the portfolio with detailed scenario by simulating the evolution of yield curves and risk drivers from the current date to the future date for PFE calculations using Monte Carlo simulation techniques, which is provided by the KRM-var functionality

2. Basel III Exposure at Default (EAD) and Effective Maturity (M)

The Exposure at Default and Effective Maturity metrics are point-in-time counterparty exposure metrics required to support the credit risk capital requirement calculations discussed in Section III. Credit Risk – The Internal Ratings-Based Approach of the Basel II guidelines. The KRM solution supports the Exposure at Default and Effective Maturity metrics calculations according to the procedures specified in paragraphs 27 to 39 of Annex 4 of the Basel II guidelines.

Expected Exposure Forecast

- Generate an Expected Exposure forecast $\boldsymbol{EE}(\mathcal{D},t) \equiv [EE_1(\mathcal{D},t), EE_2(\mathcal{D},t), \cdots, EE_N(\mathcal{D},t)]$ for the derivative instrument $\mathcal{D}$ on date t over the time periods $\boldsymbol{T}$ applicable to the forecast using the ERF vector value $\boldsymbol{X}(t)$, the yield curve values $\{Y_k(t,T)\}_k$, the derivative instrument valuation model $V(\mathcal{D},t;\boldsymbol{X}(t),\{D_k(t,T)\}_k)$, and the collateral agreement valuation model $C(\mathcal{C},t;\boldsymbol{X}(t),\{D_k(t,T)\}_k)$ for the date t as inputs using the procedure described in the Section *Basel III Expected Exposure (EE) Forecast for Future Periods*.

Effective Expected Exposure

- Recursively calculate Effective Expected Exposure $EEE_i(\mathcal{D},t)$ for the derivative instrument $\mathcal{D}$ for each of the time periods ending on dates $T_i, i = 1,\cdots,N$ by successively applying the following recursive equation defined in paragraph 30 of Annex 4 of the Basel II guidelines $EEE_i(\mathcal{D},t) = \max\{EEE_{i-1}(\mathcal{D},t), EE_i(\mathcal{D},t)\}, i = 1,\cdots,N$ to the components $EE_i(\mathcal{D},t)$ of the Expected Exposure forecast $\boldsymbol{EE}(\mathcal{D},t)$ to produce the Expected Exposure forecast $\boldsymbol{EEE}(\mathcal{D},t) \equiv [EEE_1(\mathcal{D},t), EEE_2(\mathcal{D},t), \cdots, EEE_N(\mathcal{D},t)]$.

Effective Expected Positive Exposure

- Calculate Effective Expected Positive Exposure $EEPE(\mathcal{D},t)$ of the derivative instrument $\mathcal{D}$ on date t by calculating the weighted sum of the Effective Expected Exposure $EEE_i(\mathcal{D},t)$ amounts for the derivative instrument $\mathcal{D}$ over the time periods of $\boldsymbol{T}$ not exceeding the lesser of one year or the expiration date T_X of the instrument by applying the following equation described in paragraph 31 of Annex 4 of the Basel II guidelines $EEPE(\mathcal{D},t) = \sum_{i=1}^{min\{1\ year, T_X\}} EEE_i(\mathcal{D},t) \cdot (T_i - T_{i-1}), T_0 = t$

Exposure at Default

- Calculate Exposure at Default $EAD(\mathcal{D},t)$ of the derivative instrument $\mathcal{D}$ on date t as the product of the Effective Expected Positive Exposure $EEPE(\mathcal{D},t)$ of the derivative instrument $\mathcal{D}$ on date t and a constant factor α, which using the equation $EAD(\mathcal{D},t) = EEPE(\mathcal{D},t) \cdot \alpha$ where is set to 1.4 or higher as specified in paragraphs 29, 32, and 33 of Annex 4 of the Basel II guidelines.

Effective Maturity

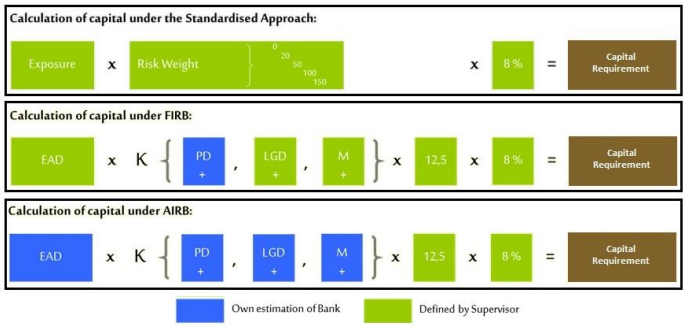
- Calculate the Effective Maturity of the derivative instrument on date using the Expected Exposure forecast , the Effective Expected Exposure forecast , and the discount rates for each time period ending on date by performing the following calculations described in paragraph 38 of Annex 4 of the Basel II guidelines. To be precise, the formula of the calculation of the Effective Maturity $M(\mathcal{D},t)$ of the derivative instrument $\mathcal{D}$ on date t is as follows: $M(\mathcal{D},t) = 1 + DEE(\mathcal{D},t)/DEEE(\mathcal{D},t)$ where DEE and DEEE are the *Discounted Expected Exposure and* the *Discounted Effective Expected Exposure respectively.*

[4] Basel market risk rules require at least 6 factors driving interest rate risk.

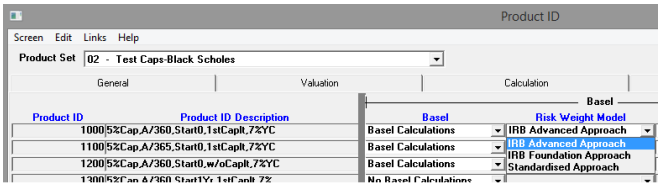
3. Basel III Default Risk Capital Requirement Forecast

The pending risk-adjusted capital requirements that have been proposed by the BIS Basel Committee (Basel II) will impose a more flexible and risk sensitive approach to determining bank capital that the current approach but will require banks to improve their credit and operational risk methodologies and solutions. The KRM solution includes full capabilities to satisfy Basel II requirements. Basel II provides three alternative approaches to measuring credit risk:

- Standardized Approach
- Foundation IRB
- Advanced IRB



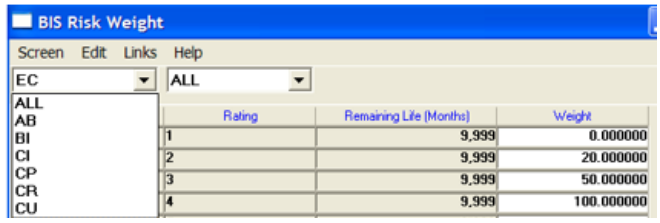
The credit risk component values required to calculate risk-weighted asset and capital requirement amounts under the Basel II/III Internal Ratings Based (IRB) Advanced Approach for default risk capital adequacy are the Probability of Default (PD), Loss Rate Given Default (LGD), Exposure at Default (EAD), and the Effective Maturity (M) for the derivative instrument.



Risk Weight Model Selection

Regulatory Compliance

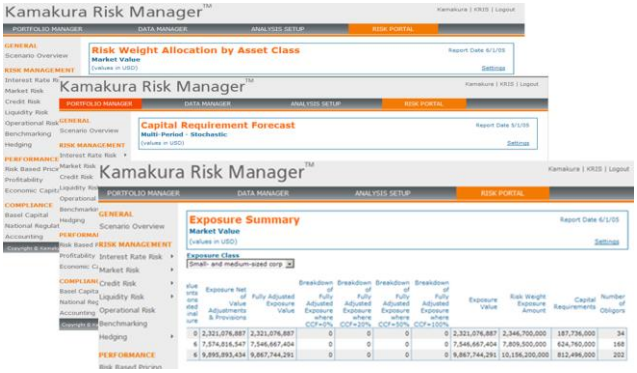
The KRM Solution offers organizations the tools required for calculating Regulatory Capital requirements. Moreover, it allows users to simultaneously calculate Regulatory Capital under any of the abovementioned approaches.



Risk Weights for all Basel STD exposure classes (can be customized)

Local Regulatory Compliance

The KRM Solution can be easily configured to meet the parameterization of local regulations.



Sample set of reports

Reporting

A wide range of pre-defined reports is available. It enables users to create user-defined outputs which can be used to create ad-hoc reports.

The Dashboard Designer is an intuitive tool used for building and modifying reports

Different objects types such as charts, tables and filters are being combined to a dashboard

4. XVA – Credit Valuation Adjustments/Debt Valuation Adjustments/Funding Valuation Adjustments

4.1. Basel III Credit Valuation Adjustment (CVA)

The Credit Valuation Adjustment value of the derivative instrument $\mathcal{D}$ is a point-in-time counterparty valuation metric[5]. Evaluation of this formula is required to calculate the Advanced CVA risk capital charge for derivative instruments[6]. The regulatory formula for the CVA value presented in paragraph 98 is of the following form:

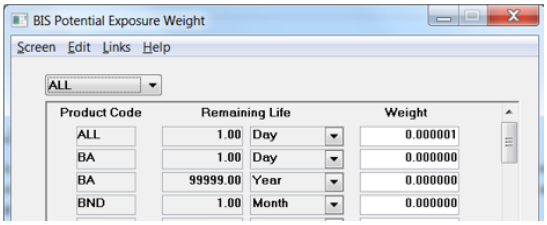
$$CVA = (LGD_{MKT}) \cdot \sum_{i=1}^{T} max\left\{0, e^{\left(-\frac{s_{i-1} \cdot t_{i-1}}{LGD_{MKT}}\right)} - e^{\left(-\frac{s_i \cdot t_i}{LGD_{MKT}}\right)}\right\} \cdot \left(\frac{EE_{i-1} \cdot D_{i-1} + EE_i \cdot D_i}{2}\right)$$

[5]As described by the regulatory formula described in a new paragraph 98 in Annex 4 of the Basel II guidelines inserted by paragraph 99 of the Basel III guidelines
[6]As described in a new paragraph 97 in Annex 4 of the Basel II guidelines inserted by paragraph 99 of the Basel III guidelines

where $s_i = s_i(\mathcal{D}, t)$ is the credit spread for the counterparty of the derivative instrument $\mathcal{D}$ at tenor T_i, $t_i = T_0$, D_i is the default-free discount rate for tenor T_i, and EE_i is the Expected Exposure of the derivative instrument $\mathcal{D}$ at tenor T_i, $t_i = T_0$.

4.2. Basel III CVA according to the Basel III standardized method

The formula proposed by the Basel Committee for the standardized approach is a Value At-Risk model with 99% confidence level and 1 year time horizon.



CEM method add-on weight

KRM supports EAD using CEM (MtM + Add-on) and IMM (α*Effective EPE) methods, and user can select either CEM or IMM EAD in the standardized CVA capital charge formula, and between standardized and advanced approach.

4.3. Debt Valuation Adjustment, Bilateral CVA and Funding Valuation Adjustment

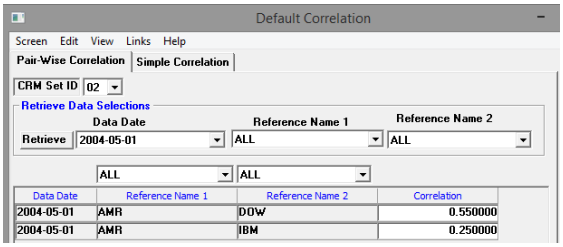
Debt Valuation Adjustment

It is an accounting valuation technique related to how a company handles changes in its issued fixed income securities. According to FASB 159 (adopted in 2007), firms can recognize market value declines in some debt instruments as earnings (income).

Use of this valuation method is optional for reporting companies, and can be adopted on a security by security basis (vs. applying to all outstanding bonds, for example). An interesting aspect of the rule is that once reporting companies adopt this rule for certain securities, switching to a different valuation technique is prohibited.

Bilateral CVA

In KRM, the user can choose whether to turn on first-to-default (FTD) feature in Bilateral CVA (BCVA) calculation.



Counterparty and the Banks's default correlation

When FTD option is turned off, BCVA is the netted result of Unilateral CVA and DVA.

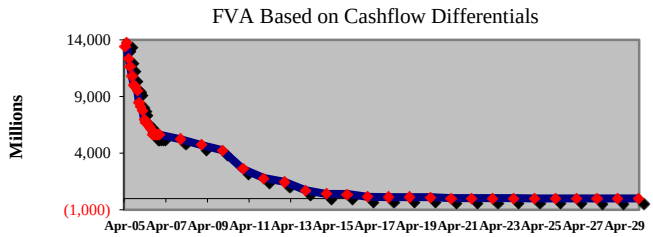
When FTD option is turned on, KRM uses the counterparty's and the bank's own instantaneous hazard rate and default correlations (as shown in the Figure) to simulate default events within each CVA time step.

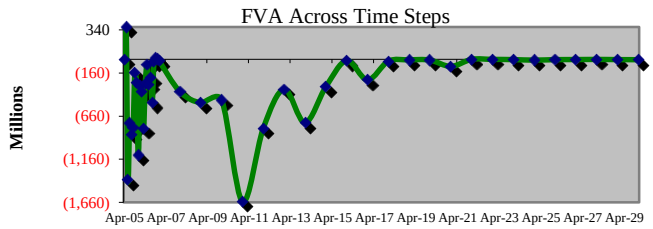
Therefore in a simulation scenario,

- If TTD (bank) is after TTD (counterparty), i.e. counterparty defaults first, CVA will be reduced.
- If TTD (bank) is before TTD (counterparty), i.e. bank defaults first, DVA will be reduced.

Funding Valuation Adjustments

While there is no common market standard for FVA calculation, one approach of FVA calculation is that FVA = the bank's funding spread * EE of the portfolio, which can be easily computed in KRM. The subject-matter expertise within Kamakura Corporation believes that rather than use a funding spread on market values, it would be a better option to generate FVA based on cashflow changes due to additional funding costs. However, both approaches can be clearly modelled within KRM.





Option 1

Generate the first scenario based on no funding costs for the user-defined time steps, and thereafter, generate the same cashflows after incorporating the credit spreads. The difference would be the FVA of the portfolio.

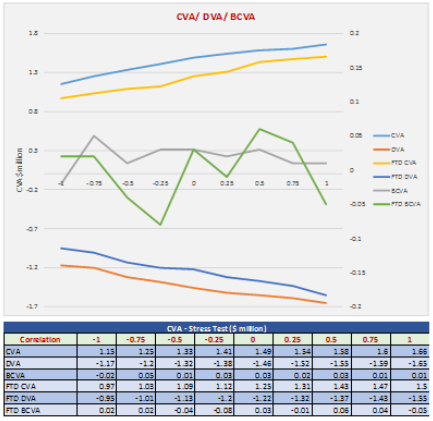
Option 2

As outlined above, use the bank's funding spread to compute the market value on a dynamic basis for the portfolio and for each time step therefore, the FVA can be computed.

Reporting:

KRM generates the following CVA related measures of each netting set:

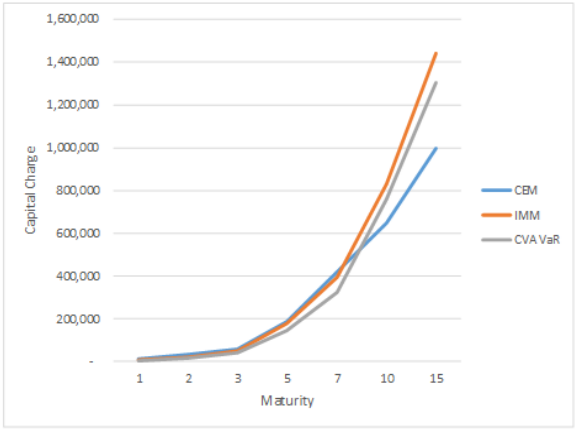
- Credit Valuation Adjustments (CVA)
- Incremental CVA for each transaction in the netting set
- Debt Valuation Adjustments (DBA)
- Incremental DVA for each transaction in the netting set
- Bilateral CVA (BCVA)
- Incremental BCVA for each transaction in the netting set
- Funding Valuation Adjustments



Sample Report for CVA, DVA and BCVA with and without FTD under different default correlation levels

5. Basel III CVA Capital Charge Forecast

The CVA Capital Charge $CVACC(T_i')$ for the time period with end date T_i' in $\boldsymbol{T}'$ is calculated as the Credit Valuation Adjustment Value at Risk for the sub-portfolio at the 99th percentile one-tailed confidence level over a 10 trading day holding period.[7] The forecasts of the Basel III CVA Capital Charge are time period counterparty risk metrics that provide the basis for estimating a bank's capital requirements for counterparty credit risk produced by changes in credit spreads in future periods.



Sample CVA capital charge report for IRS portfolio

The Basel III CVA Capital Charge (CVACC) requirement for derivative instruments is described in a new paragraph 98 in Annex 4 of the Basel II guidelines inserted by paragraph 99 of the Basel III guidelines, and the requirements for the calculation of Value at Risk for a bank's trading portfolio are discussed in paragraph 718(lxxvi) of the Basel II guidelines. In addition, under Pillar 2 of Basel II/III banks are required to establish plans for capital resources that satisfy the capital requirements in future periods, as discussed in paragraphs 729 and 748 of the Basel II guidelines and in paragraphs 124 and 131 of the Basel III guidelines.

[7] The Basel III CVA Capital Charge (CVACC) requirement for derivative instruments is described in a new paragraph 98 in Annex 4 of the Basel II guidelines inserted by paragraph 99 of the Basel III guidelines, and the requirements for the calculation of Value at Risk for a bank's trading portfolio are discussed in paragraph 718(lxxvi) of the Basel II guidelines.