Comparing Alternate Methods for Calculating CVA Capital Charges under Basel III

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1 **Introduction**

The global financial crisis brought counterparty credit risk and CVA very much into the spotlight. The Basel III proposals first published in December 2009 [2] introduced changes to the Basel II rules [1] including a new capital charge against the volatility of CVA. As the Basel committee noted, two thirds of the counterparty risk related losses during the credit crisis were actually from CVA volatility rather than defaults. Not surprisingly then, the new 'CVA 'VaR' capital charge is quite punitive and worthy of focus.

There are two ways for a bank to compute CVA VaR – what are commonly called the standardised and the advanced methods. The alternatives available to a bank depend on their current regulatory approval within related aspects of Basel III. Under both methods there is also the potential to reduce the capital charges via eligible hedges. This paper aims to explore the capital charges under the two regimes and the capital relief that can be achieved using hedging.

In **Section 2** we describe the Basel II capital charges for counterparty default, partly to emphasize that CVA Basel III capital is an addition to already existing CCR regulatory charges, and partly because many notations from Basel II RWA calculations are part of Basel III standardised formula. In **Section 3** we introduce the standardised formula for the CVA volatility capital charge and analyse it in detail. As in Pykhtin [4] we show that this charge can be interpreted as the 99% 1-year VaR of a portfolio with a specific correlation structure. **Section 4** is dedicated to the advanced formula for the CVA volatility capital charge. After describing it, we show that it can be approximated as the 99% VaR of a specific portfolio and thus can be directly compared to the standardised formula. In **Section**

5 we simplify this approximation based on a single netting set, and demonstrate the test results for three different approaches: Standardised (CEM), Standardised (IMM), and Advanced. In **Section 6** we provide results for a real portfolio and illustrate the impact of hedging. **Section 7** is a conclusion.

2. Basel II RWA Capital Charges

2.1 Counterparty Default Capital Charges under A-IRB

The Basel III capital CVA charges are not the first regulatory measures addressing counterparty risk. Basel II [1] already included capital charges regarding provisions for counterparty default.

Under the Advanced Internal Ratings Based Approach (A-IRB) for derivatives trades, the Basel II Regulatory Capital Charge is a fixed percentage of Risk Weighted Assets (RWA) which are calculated for each transaction or netting set using the following formula:

$$RWA = EAD \cdot 12.5 \cdot K$$

Here EAD is the calculated Exposure-At-Default and K is the Capital requirement. K is a specified function of the Probability-of-Default (PD), Loss-Given-Default (LGD) and the Effective Maturity (M):

$$K = LGD \cdot \left(N \left[\frac{N^{-1}(PD)}{\sqrt{1-R}} + \sqrt{\frac{R}{1-R}} \cdot N^{-1}(0.999) \right] - PD \right) \cdot \frac{1+(M-2.5) \cdot b}{1-1.5 \cdot b},$$

where R is Correlation factor based on default probability: $R = 0.12 + 0.12 \cdot (1 + e^{-50 \cdot PD})$, and b is a maturity adjustment factor based on PD: $\mathrm{b} = (0.11852 - 0.05478 \cdot \ln(\mathrm{PD}))^2$

For calculating M and EAD for derivatives, banks tend to use one of two alternate methods - the Current Exposure Method (CEM) or the Internal Model Method (IMM). Collateralised trades can be accounted for in these methods but are often treated separately via the so-called “shortcut method”.

When using CEM, EAD is calculated using a simplified approach based on the current MTM plus some add-on. CEM is widely recognised as having significant shortcomings, most notably understating the benefit of netting and collateral.

When using IMM, EAD is based on the Effective Expected Positive Exposure (EEPE) calculated using a Monte Carlo model approved by regulators. The IMM approach is more sophisticated and results in a significant RWA savings relative to the CEM approach due to:

- The EEPE methodology allows future collateral to be projected based on contract terms, while the CEM approach only uses current collateral held. Note that some Banks approved for IMM have yet to receive approval for a collateral model and instead use the shortcut method.
- CEM allows netting benefits for the add-on amount of up to 60% (based on the current netting benefit from MTM), while using EEPE provides full netting of future exposures.

In addition, the IMM approach links capital charges most directly to the actual risks incurred and aligns regulatory capital more closely with economic capital. This means that real risk reduction is more likely to be associated to capital savings.

Further details on calculating capital charges based on each method are given below.

2.2 RWA Calculations under CEM

CEM is a simpler method and does not require complex calculations. Here EAD is expressed as a function of the current MTM plus some add-on. For example, for a single uncollateralised trade:

$$EAD = \max(0, MTM) + Not \cdot CCF,$$

where *CCF* (Credit Conversion Factor) depends on the type of derivative and remaining maturity *Mat*. For example, for interest rate swaps:

$$CCF = (0, Mat < 1yr \mid 0.5\%, Mat\ is\ 1-5yrs \mid 1.5\%, Mat > 5yrs)$$

Within a netting set, 60% of the current netting benefit is allowed to be applied in terms of offsetting add-ons.

The effective maturity *M* is calculated as a the notional weighted average over all remaining maturities in a netting set, floored at 1 and capped at 5, i.e.

$$M = max\ (1, min\ (5, \frac{\sum_i Mat_i \cdot Not_i}{\sum_i Not_i}))$$

2.3 RWA Calculations under IMM (EEPE approach)

This approach uses the Effective Expected Positive Exposure (EEPE), calculated using a Monte Carlo model approved by regulators. Definitions of its components are:

Effective Expected Exposure (EEE) – is a non-decreasing function based on the expected exposure $EE(t)$:

$$EEE(t_k) = max\{EEE(t_{k-1}), EE(t_k)\}$$

The final EEE must be the maximum of this formula calculated using the standard calibration and a calibration including a 1-year period of stress.

Effective Expected Positive Exposure (EEPE) – is the average of the EEE over the first year, weighted in proportion to the time interval.

$$EEPE = \frac{\sum_{i=1}^{n} EEE(t_i) * \Delta t_i}{T}$$

Exposure-at-Default (EAD) – is EEPE multiplied by a factor α to compensate for inaccuracies in the model (granularity, correlation of exposures and wrong-way risk for example) and to adjust for a "bad state" of the economy. This factor is currently 1.4 but is subject to change from regulators in the future. It can be lowered to 1.2 for banks that have approval from their regulator to calculate alpha themselves.

$$EAD = EEPE \cdot \alpha$$

Effective Maturity (M) – as in the case of CEM, it is floored at 1 year and capped at 5 years, and is calculated as:

$$M = min\,(1 + \frac{\sum_{t_i > 1yr}^{Maturity} EE(t_i) * \Delta t_i}{\sum_{i=1}^{t_i \le 1yr} EEE(t_i) * \Delta t_i}, 5)$$

3 Basel lll CVA Capital Charges- Standardised Formula

3. 1 CVA Volatility

During the recent credit crisis, according to the Basel committee, more bank counterparty risk losses resulted from credit market volatility than from realised defaults. CVA was part of a banks' balance sheet due to "fair value" accounting rules and by some estimation around two thirds of counterparty risk related losses were coming from CVA volatility and only one third from actual defaults. Consequently the revised Basel III document [2] introduced a special provision for capitalising for losses resulting from CVA volatility.

As in the case of Basel II, these new capital charges can be calculated using either a simplified standardised formula or an advanced method that requires calculating the CVA VaR of the full portfolio using a Monte Carlo model approved by regulators. The advanced method is available to banks with IMM counterparty risk and specific risk approval. As with IMM over CEM, it may be expected that the advanced approach would be more beneficial than the simpler standardised approach. However, we will see that this is not necessarily the case.

Reflecting the fact that banks are actively hedging CVA positions, Basel III recognises credit hedges (single name CDS, Contingent CDS and CDS indexes) for alleviating CVA volatility. However, the benefit of these hedges differs between the standardised and advanced approaches. Next we analyse optimal hedges which minimise capital charges for both methods.

3.2 Standardised Formula

The standardised formula for the CVA capital charge given in the BIS Basel III document

$$CVA_{Stn} = 2.33 \cdot \sqrt{h} * \tag{1}$$

$$* \sqrt{\left(\sum_i 0.5 \cdot w_i \cdot \left(M_i \cdot EAD_i^{total} - M_i^{hedge} \cdot B_i\right) - \sum_{ind} w_{ind} \cdot M_{ind} \cdot B_{ind}\right)^2 + \sum_i 0.75 \cdot w_i^2 \cdot \left(M_i \cdot EAD_i^{total} - M_i^{hedge} \cdot B_i\right)^2}$$

- where w_i is the weight depending on rating of i-th counterparty.
- M_i and EAD_i^{total} are the effective maturity and Exposure-at-Default for the i-th netting set, which as discussed in the previous section can be calculated using either the CEM or IMM approaches. The difference between the Basel III and earlier Basel II definitions for the CEM approach is that the five-year cap for the effective maturity has been removed and that, EAD_i should be multiplied by the discount factor $df = (1 - \exp(-5\% \cdot M_i))/(5\% \times M_i)$.
- B_i is the notional of the single name hedge corresponding to the i-th counterparty.
- B_{ind} is the notional of the index hedge.

- M_{ind} is the maturity adjustment factor for the index hedge.

We analyse the standardised formula in detail below. Though it was not specified explicitly in the Basel document, we will show that this capital charge can be interpreted as the 99% confidence interval for a portfolio of normally distributed assets with some specific variance matrix.

3.3 Analysis of Standardised Formula for Basel III CVA Capital Charge

Note that in eq. (1) the current value of h is 1, thus denoting

$$X_i = w_i \cdot \left(M_i \cdot EAD_i^{total} - M_i^{hedge} \cdot B_i\right) \qquad X_{ind} = w_{ind} \cdot M_{ind} \cdot B_{ind},$$

it can be rewritten as

$$CVA_{Stn} = 2.33 \cdot \sqrt{\sum_i X_i^2 + 0.5 \cdot \sum_i \sum_{j<i} X_i \cdot X_j - X_{ind} \cdot \sum_i X_i + X_{ind}^2} \qquad (2)$$

Now consider a set of normal random variables $N_i's$, each with 0 mean and volatility σ_i, i.e. $N_i \sim N(0, \sigma_i)$ and assume that they are all correlated with single correlation $\rho = correl(N_i, N_j)$. Consider now another normal random variable $N_{ind} \sim N(0, \sigma_{ind})$ which is correlated with $N_i's$ with single correlation $\rho_{ind} = correl(N_i, N_{ind})$. Finally, consider random variable $Y = \sum_i N_i - N_{ind}$.

Then $Y \sim N(0, \sigma_Y)$ where

$$\sigma_Y = \sqrt{\sum_i \sigma_i^2 + 2 \cdot \rho \cdot \sum_i \sum_{j<i} \sigma_i \cdot \sigma_j - 2 \cdot \rho_{ind} \cdot \sigma_{ind} \cdot \sum_i \sigma_i + \sigma_{ind}^2}$$

Assume that we want to find the 99% percentile of Y $\alpha_{0.99}$, then:

$$\alpha_{0.99} = N^{-1}(0.99) \cdot \sigma_Y = 2.33 \cdot \sqrt{\sum_i \sigma_i^2 + 2 \cdot \rho \cdot \sum_i \sum_{j<i} \sigma_i \cdot \sigma_j - 2 \cdot \rho_{ind} \cdot \sigma_{ind} \cdot \sum_i \sigma_i + \sigma_{ind}^2}.$$

Comparing this with eq. (2), one can see that the Standardised Capital Charge has the meaning of a 99% percentile of the sum of random variables $Y = \sum_i N_i - N_{ind}$, where N_i's have 0 expectation and volatility X_i and are intra-correlated with $\rho = 0.25$ and N_{ind} have 0 expectation and volatility X_{ind} and its correlation with N_i's is $\rho_{ind} = 0.5$

Therefore, though it was not specified explicitly in the Basel document, we showed that this capital charge can be interpreted as the 99% confidence interval for a portfolio of normally distributed assets with some specific variance matrix. More specifically, the volatility of the i-th asset is $\sigma_i = w_i \cdot \left(M_i \cdot EAD_i^{total} - M_i^{hedge} \cdot B_i\right)$, volatility of index is $\sigma_{ind} = w_{ind} \cdot M_{ind} \cdot B_{ind}$, correlations between each pair of assets are assumed to be 25%, and their correlations with the index is implied to be 50%.

In risk management terms, the standardised formula has the interpretation of being the 1-year 99% CVA VaR under normal distribution assumptions for the portfolio of netting sets (with individual hedges included) with additional index hedges applied to the whole portfolio.

4 Basel lll CVA Capital Charges- Advanced Method

4.1 Advanced formula for Basel III CVA Capital Charge

For the advanced method, Basel requires calculating two 10-day 99% VaR's of CVA – one for the current one-year period and one for a one-year stressed period defined as one with increasing credit spreads. The total capital charge is their triple sum:

$$CVA_{ADV} = 3 \cdot (CVAVaR^{Cur} + CVAVaR^{Str}) \qquad (3)$$

For CVA VaR calculations, the Basel III guidelines recommend the following expression:

$$\mathrm{CVA} = \mathrm{LGD_C} \cdot \sum_{i=1}^{n} \frac{\mathrm{EE}(t_{i-1}) + \mathrm{EE}(t_i)}{2} \cdot \max(q_c(t_{i-1}) - q_c(t_i), 0)$$

where $\mathrm{EE}(t)$ is a discounted expected exposure at time t, and counterparty survival probability at time t is approximated as $q_c(t) = e^{-\frac{S_c(t) \cdot t}{\mathrm{LGD_C}}}$.

Note that this expression, though an approximation, is pretty close to the CVA calculated based on bootstrapped credit curve, see e.g. [3].

4.2 Credit Hedges

Basel III allows CDS, Contingent CDS (CCDS) referencing the counterparty, and CDS Indices containing the counterparty as a hedge against CVA. The net notional of hedges at each time step can be overlayed on exposure profiles. For example, a single CDS hedge can be represented as:

$$CDS\_H = LGD_C \cdot Not_{cds} \cdot \sum_{i=1}^{n} \frac{Z(t_{i-1}) + Z(t_i)}{2} \cdot max(q^C(t_{i-1}) - q^C(t_i), 0)$$

where $Z(t)$ is a discount from time t to today.

After combining the hedge with CVA, the hedge-adjusted *CVA_H* will be

$$CVA\_H = LGD_C \cdot \sum_{i=1}^{n} \frac{E\_H(t_{i-1}) + E\_H(t_i)}{2} \cdot max(q_c(t_{i-1}) - q_c(t_i), 0)$$

where the hedge-adjusted exposure is: $E_{H(t)} = EE(t) - Not_{cds} \cdot Z(t)$

4.3 Approximation for CVA VaR Charge

We will derive an approximation which can help to gain an intuitive understanding of this charge and more easily compare it to the standardised formulas (1) and (2).

The change in CVA (including credit hedges) for some specified time horizon Δt can be expressed as:

$$\Delta CVA = \sum_i (\Delta CVA_i - \Delta Hedge_i) - \Delta Hedge_{ind}$$

Keeping just first moments, we get:

$$\Delta CVA_i \approx \frac{\partial CVA_i}{\partial s_i} \cdot \Delta s_i \quad \Delta Hedge_i \approx \frac{\partial Hedge_i}{\partial s_i} \cdot \Delta s_i \qquad \Delta Hedge_{index} \approx \frac{\partial Hedge_{ind}}{\partial s_{ind}} \cdot \Delta s_{index}$$

where sensitivities are calculated at the ‘today’ value of spreads. Assume that spread changes for all CDS’s and indices are normal random variables with 0 means and “lognormal” volatilities σ_i : $\Delta s_i \sim N(0, s_i \cdot \sigma_i \cdot \sqrt{\Delta t})$. Then

$$\Delta CVA^{Cur} \approx \sqrt{\Delta t} \cdot (\textstyle\sum_i Z_i - Z_{index}),$$

where $Z_i \sim N(0, (\frac{\partial CVA_i}{\partial s_i} - \frac{\partial Hedge_i}{\partial s_i}) \cdot s_i \cdot \sigma_i)$ $\qquad Z_{ind} \sim N(0, \frac{\partial Hedge_{index}}{\partial s_{index}} \cdot s_{ind} \cdot \sigma_{ind})$

Thus the 99% CVA VaR for a 10-day period based on current historical data will be

$$CVAVaR^{Cur} \approx 2.33 \cdot \sqrt{10/252} \sqrt{\sum_i Z_i^2 + 2 \cdot \rho^s \cdot \sum_i \sum_{j<i} Z_i \cdot Z_j - 2 \cdot Z_{ind} \cdot \rho^{s,ind} \cdot \sum_i Z_i + Z_{ind}^2}$$

Adding tildes to corresponding terms for stressed period, we get:

$$\Delta CVA^{Str} \approx \sqrt{\Delta t} \cdot \left(\textstyle\sum_i \tilde{Z}_i - \tilde{Z}_{index}\right),$$

where $\tilde{Z}_i \sim N(0, (\frac{\partial CVA_i}{\partial s_i} - \frac{\partial Hedge_i}{\partial s_i}) \cdot \tilde{s}_i \cdot \tilde{\sigma}_i)$ $\qquad \tilde{Z}_{ind} \sim N(0, \frac{\partial Hedge_{index}}{\partial s_{index}} \cdot \tilde{s}_{ind} \cdot \tilde{\sigma}_{ind})$.

Although Basel III recommends calculating stressed CVA VaR using all market data from a stressed period, we assume that only spreads are changing and thus we can use the same exposure as for the current VaR. Assuming that spread movements (in normal terms) for all counterparties and indices can be scaled by the same ratio: $\gamma = \frac{\tilde{s}_i \cdot \tilde{\sigma}_i}{s_i \cdot \sigma_i} = \frac{\tilde{s}_{ind} \cdot \tilde{\sigma}_{ind}}{s_{ind} \cdot \sigma_{ind}}$, one can add them to get the final result (noticing also that $\sqrt{10/252} \approx 0.2$)

$$CVA_{ADV} \approx$$

$$2.33 \cdot 3 \cdot 0.2 \cdot (1+\gamma) \cdot \sqrt{\sum_i Z_i^2 + 2 \cdot \rho^s \cdot \sum_i \sum_{j<i} Z_i \cdot Z_j - 2 \cdot Z_{ind} \cdot \rho^{s,ind} \cdot \sum_i Z_i + Z_{ind}^2} \quad (4)$$

Here $Z_i \sim N(0, (\frac{\partial CVA_i}{\partial s_i} - \frac{\partial Hedge_i}{\partial s_i}) \cdot s_i \cdot \sigma_i)$ and $Z_{ind} \sim N(0, \frac{\partial Hedge_{index}}{\partial s_{index}} \cdot s_{ind} \cdot \sigma_{ind})$ are normally distributed random variables, and γ is the ratio of the spread movements (in normal terms) to stressed over the current period, which we will assume is the same for all counterparties and indexes.

The term under the square root in this formula is similar to the one in the standardised formula (1). Note, however, that while standardised formula assumes an intra-correlation of 25%, correlation between spreads ρ^s is defined by historical data, and the higher the correlation (and we expect to see it higher for banks) the higher the CVA charge calculated by the advanced method. The effect on capital charge of correlation $\rho^{s,ind}$ between spreads and index is opposite – the higher correlation the less capital charge. An advantage of the advanced approach is that it may be possible to argue that some index correlations are greater than 50%, especially since the index may be an obvious way to map illiquid credit spreads using a largely subjective methodology.

4.4 Optimal single-name hedges

In the absence of index hedges in eq. (4), one has to select individual hedges to minimise volatilities of $Z_i's$, so that $\frac{\partial Hedge_i}{\partial s_i} = \frac{\partial CVA_i}{\partial s_i}$. If this hedge is simply a single at-the-money CDS, then the optimal hedge-notional $B_i = \frac{\partial CVA_i}{\partial s_i} / RDV_i$, where RDV_i is a risky annuity of the corresponding CDS hedge. This kind of delta-neutral hedging strategy is similar to how a CVA desk typically hedges its spread risk.

The optimal hedge strategy which minimises the Basel standardised charge in (2) implies a somewhat different hedge notional: $B_i = M_i \cdot EAD_i^{total}/M_i^{hedge}$. This reflects the difference between delta-neutral (advanced) and default-neutral (standardised) hedging strategies. The former coincides more directly with the natural hedge from a CVA desk. Optimal hedges will also be impacted by other aspects, for example the use of stressed market parameters and the alpha multiplier creating the need to over-hedge (especially for the standardised approach) in order to achieve optimum capital relief.

5. Comparison for a simple case: single netting set with no hedges

5.1 Simplified Formulae

We showed that formulae (1) and (3) for the standardised and advanced methods are fairly similar (modulo some scalar) in the sense that both have the meaning of 99% VaR of a portfolio of normally distributed assets (assuming we use normal assumptions for advanced or make this as an approximation), so the main difference comes from the volatilities of these assets.

To gain a better intuition, let's consider the simple case of a single netting set with no hedges. In this scenario the standardised formula for a CVA capital charge is:

$$CVA_{Stn} = 2.33 \cdot w \cdot M \cdot EAD$$

By rewriting the definition of EAD under the Basel II rules, but now with the additional discounted factor $df = (1 - \exp(-5\% \cdot M))/M$. Under CEM

$$EAD_{CEM} = max\,(0, MTM + Not \cdot CCF) \cdot df$$

Under IMM:

$$EAD_{IMM} = EEPE \cdot 1.4 \cdot df.$$

Finally, if we assume that CVA is almost linear with respect to credit spreads, then $\frac{\partial CVA}{\partial s} \approx \frac{CVA}{s}$ and the advanced formula can be approximated as:

$$CVA_{ADV} \approx 2.33 \cdot 0.6 \cdot CVA \cdot (\sigma^{Cur} + \sigma^{Str}) \quad (5)$$

where σ^{Cur} and σ^{Str} are lognormal volatilities of counterparty spread during current and stressed periods.

Now one can directly apply these formulae for comparison between three approaches for the trades with different maturities, MTMs, counterparties.

5.2 Test Results

We ran a series of tests for this case. First we considered a netting set consisting of a single trade: a 100 million USD receiver standard IR swap. To gain an understanding of the maturity effect, we considered 1yr, 2yr, 3yr, 5yr, 7yr, 10yr and 15yr swaps. For each maturity we considered two swaps: at-the-money and in-the-money, where the in-the-money fixed coupon is 1.25 of the corresponding swap rate. We also modelled two counterparties:

- Counterparty 1 – Flat credit spread 100 bps, recovery 40%; S&P rating AA, thus weight w=0.7%; lognormal volatilities: current – 50%; stressed – 100%
- Counterparty 2 – Flat credit spread 300 bps, recovery 40%; S&P rating BBB, thus weight w=1.0%; lognormal volatilities: current – 75%; stressed – 150%

We calculated capital charges resulting from the Standardised method (CEM), the Standardised method (IMM), and the Advanced method. Results for both counterparties including the three methods of calculating capital charges are given in the Figures 1-3 *(see pages 15-16).* For the Advanced method we used historical data as is required by Basel III, rather than approximate formula (5), but we also verified that this formula gave very similar results. We simulated movements in spreads with volatilities close to historical levels. As a final note, in the IMM calculations we did not use a stress period for calibrating Effective Expected Exposure, assuming that the exposure in the stressed period is similar to the non-stressed one.

An interesting result can be seen in Figure (2) where the advanced capital charge for Counterparty 2 is always larger than standardised ones. The credit spread of Counterparty 2 is three times than that of Counterparty 1 and its lognormal volatility is 50% bigger. Therefore, as we expect, the advanced charge for Counterparty 2 is around 3-4 times than that of Counterparty 1, but for the standardised charges the only difference is in the weight, which grows from 0.7% to just 1%, i.e.an increase of just 43%.

Another interesting result is that the Standardised CEM charge in Figures (1) and (2) is almost always least punitive compared to the other two methods. The reason is that so far we have considered ATM swaps, therefore their MTM is 0, and for interest rates the max add-on in CEM EAD calculation is only 1.5% of the notional (for comparison, for equity products it is 10%). However, as demonstrated in Figure (3), this changes when we consider in-the-money swaps (the fixed coupon is 1.25 of par swap).

The exact capital amounts for ITM swaps with both counterparties are given in Table 1. Finally, to demonstrate the advantage of advanced formula for a more realistic netting set we considered a Portfolio consisting of long ITM swaps with maturities 1, 2, 3, 5, 7, 10 years and short ITM swap with a maturity of 15 years. The MTM of the long positions in this portfolio is 11.16 million and the MTM of the short positions is 9.4 million giving a current exposure of 1.76 million. The results are shown in the last row of the Table 1 *(see page 17).* One can see that netting is most beneficial for the advanced approach.

6. Results of Hedging for a Real Portfolio

It has been noted that delta-neutral hedges are much more beneficial when using the advanced method of calculating CVA capital charges. In order to test how hedges can alleviate capital charges in a realistic example we set up a portfolio of trades with two counterparties.

Counterparty 1 is BB rated, has a 383 bps current CDS spread and a collateral threshold of \$25 m. Trades with Counterparty 1 are 31 IR swaps, cross-currency swaps and FX forwards with a total notional of \$10.5 billion, a PV \$1.03 billion, and a notional-weighted maturity of 2.6 years. CVA \$2.9 million; Hedge Notional for 5yr CDS \$12.4 million; Hedge Notional for 5 yr Index \$11.2 million.

Counterparty 2 is AA rated, has a 56 bps current CDS spread and a collateral threshold of \$15 million. Trades with Counterparty 1 are 125 IR swaps, cross-currency swaps and FX forwards with a total notional of $17.3 billion, a PV $1.9 billion, and a notional-weighted maturity of 4.3 years. CVA $0.6 million; Hedge Notional for 5yr CDS $14.7 million; Hedge Notional for 5 yr Index $16.1 million.

We calculated Standardised (IMM only for the fairest comparison) and Advanced capital charges for a combined portfolio, results are plotted in a Figure (4) *(See page 16).*

It is evident that while the advanced and standardised approaches produce very similar results in the case of no hedges, applying a delta-neutral hedge, especially a single name CDS, alleviates the capital charge much more significantly when the advanced method is used as opposed to the standardised one. Under the advanced method the capital charge is reduced by almost 70% compared to the standardised method. Whilst the capital relief in the advanced approach is unlikely to be perfectly aligned to the optimal CVA hedge (mainly due to the use of stressed parameters to calculate the EEPE), it is much better than in the case of the standardised approach (where the alpha factor alone would imply an over-hedge of 40%). The impact of index hedges is also more beneficial under the advanced approach since the correlation between index and counterparty is not fixed at 50%.

7. Conclusions

We have described and compared the various methodologies for calculating counterparty credit risk capital under Basel regulations to demonstrate that the difference in capital between simple and more advanced approaches when considering hedging can be significant. In the sample portfolio the advanced method reduced the capital charge by almost 70%. The difference between the two methods, however, is complex and depends on the portfolio in question. We have also compared the implicit assumptions in the standardised and advanced approaches for CVA VaR. Finally, we have illustrated the capital relief achievable from hedges and shown that this is significantly misaligned from market risk. In particular, in the standardised approach, the definition of exposure at default and assumption of 50% correlation for index hedges mean that a CVA desk will receive very limited capital relief even when actively hedging their credit risk.

References

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Figure 1: CVA VaR capital charges for ATM swaps of different maturities; Counterparty 1

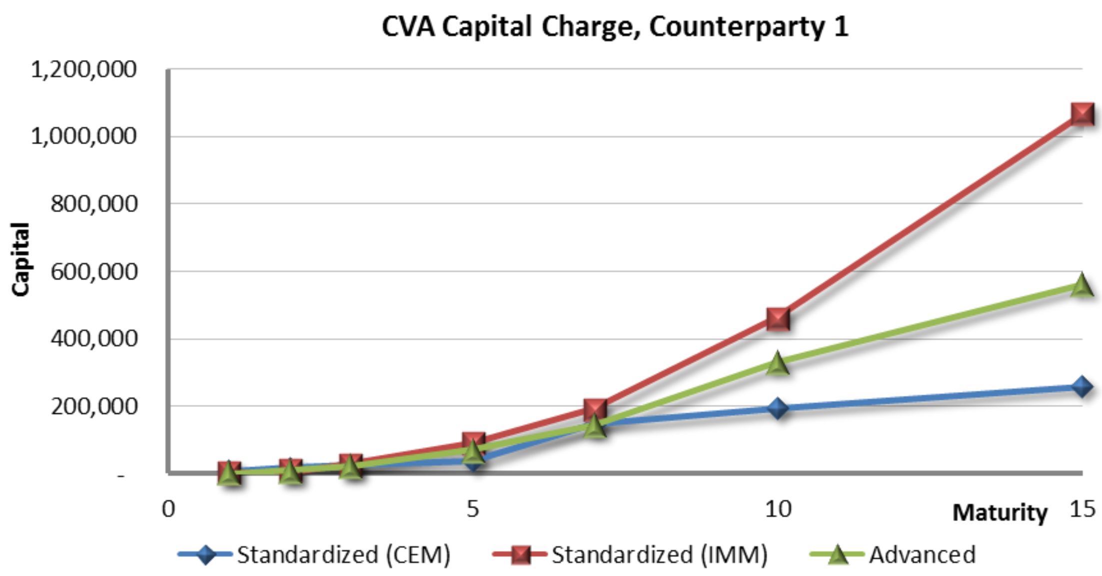

Figure 2: CVA VaR capital charges for ATM swaps of different maturities; Counterparty 2

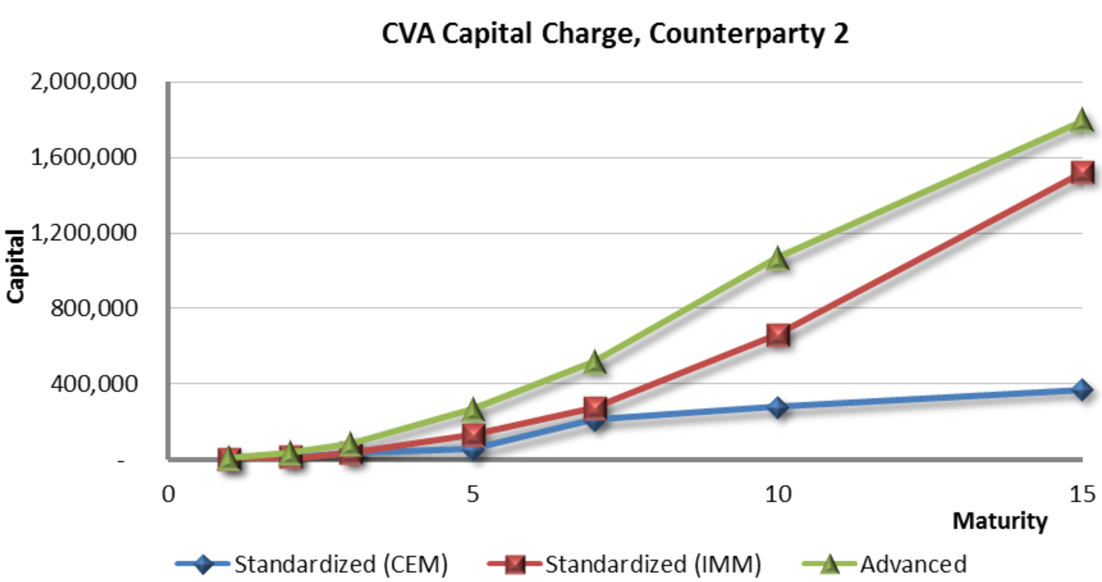

Figure 3: CVA VaR capital charges for ITM swaps of different maturities; Counterparty 1

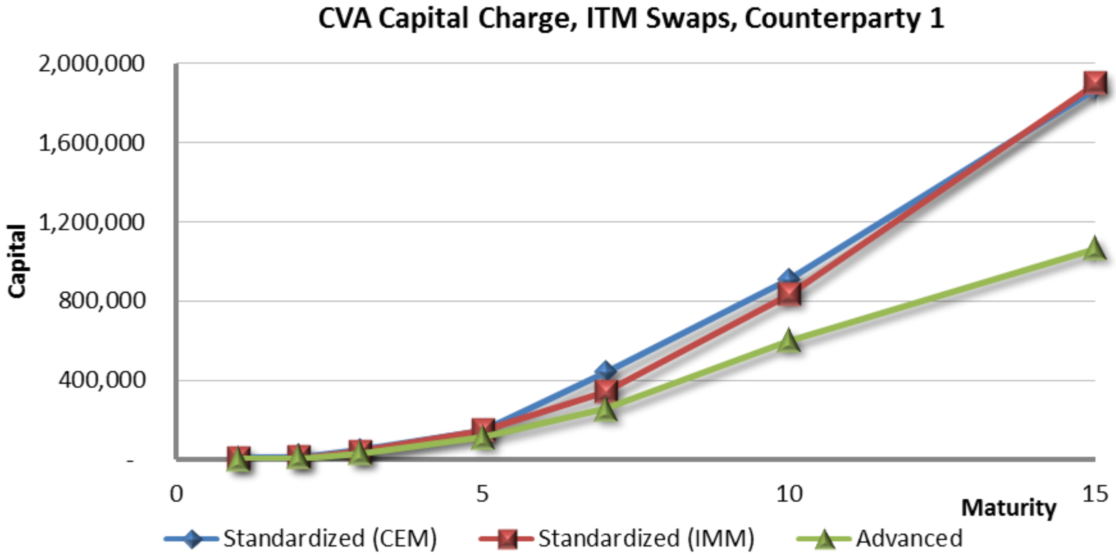

Figure 4: CVA capital charges for real portfolio, with and without hedges

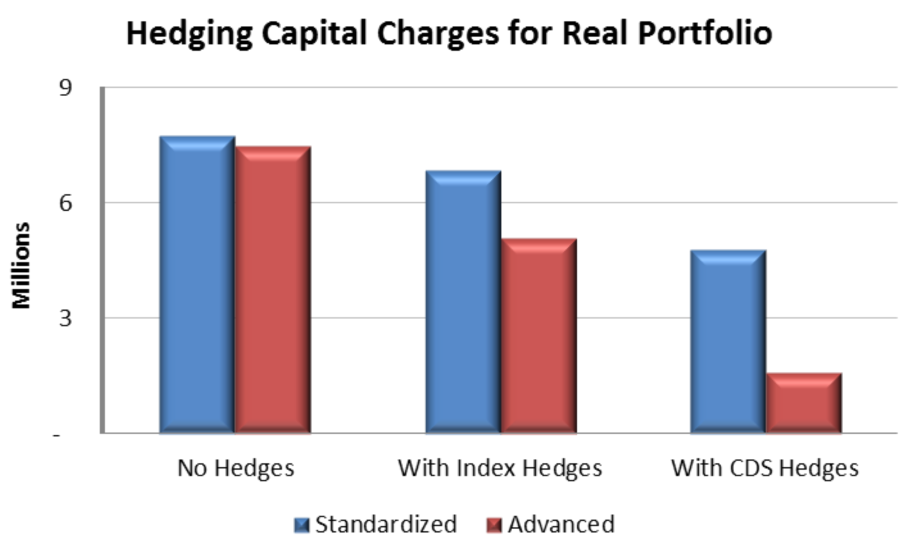

Table 1: CVA capital charges for ITM swaps of different maturities and for portfolio with netted trades.

	Counterparty 1			Counterparty 2		
Maturity	CEM	IMM	CVA VaR	CEM	IMM	CVA VaR
1	10,208	6,050	3,420	14,583	8,643	14,918
2	24,905	16,643	13,058	35,578	23,776	55,222
3	47,375	39,562	32,338	67,679	56,517	131,841
5	146,342	139,630	115,246	209,060	199,472	444,421
7	330,077	311,017	256,626	471,538	444,310	944,249
10	510,478	654,877	601,376	729,254	935,539	2,017,083
15	786,976	1,058,701	1,068,394	1,124,252	1,512,430	3,539,311
Portfolio	358,698	368,155	117,891	512,425	551,651	419,205

Authors:

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Rohan has over 25 years experience in the global financial industry. Prior to founding Quantifi in 2002, he was a Director of Research at Salomon Brothers and Citigroup, where he worked for ten years. He has extensive experience working in credit, interest rate derivatives, emerging markets and global fixed income. Mr.Douglas teaches as an adjunct professor in the graduate Financial Engineering program at NYU Poly in New York and the Macquarie University Applied Finance Centre in Australia and Singapore and is the editor of the book Credit Derivative Strategies by Bloomberg Press.

Dr. Dmitry Pugachevsky, Director of Research, Quantifi

Dmitry is responsible for managing Quantifi's global research efforts. Prior to joining Quantifi in 2011, Dmitry was Managing Director and a head of Counterparty Credit Modeling at JP Morgan. Before starting with JPMorgan in 2008 Dmitry was a global head of Credit Analytics of Bear Stearns for seven years. Prior to that, he worked for eight years with analytics groups of Bankers Trust and Deutsche Bank. Dr. Pugachevsky received his PhD in applied mathematics from Carnegie Mellon University. He is a frequent speaker at industry conferences and has published several papers and book chapters on modeling counterparty credit risk and pricing derivatives instruments.