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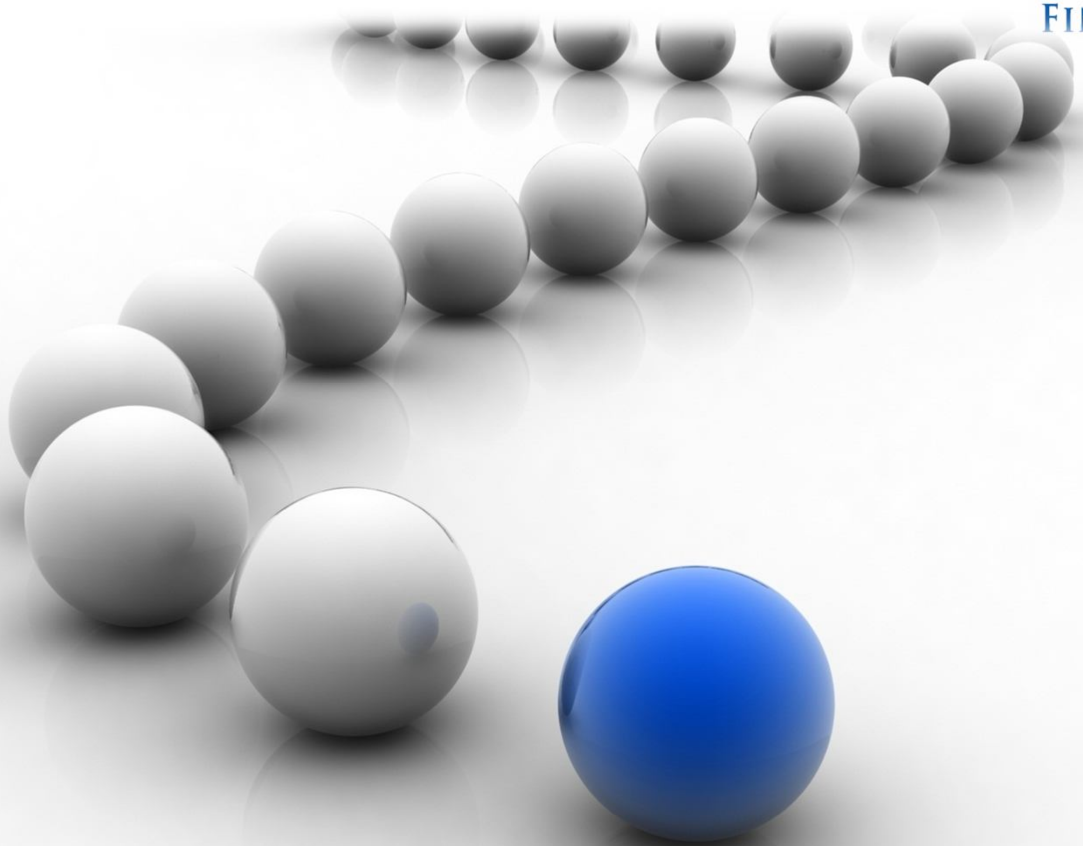

# A Critical Analysis of Counterparty Credit Risk and CVA in a Basel III World

Jon Gregory, Partner

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OTC Derivatives
Taking the "fun" out of funding?

October 2012

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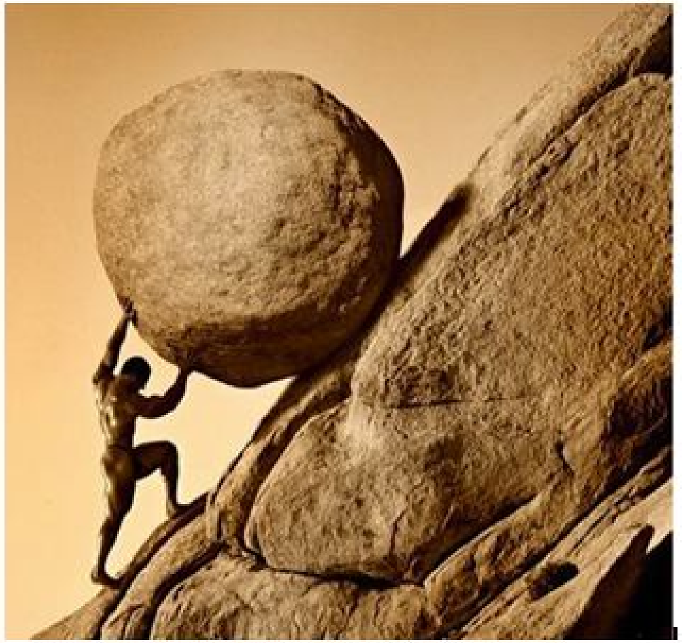

CVA Capital Charges:
A comparative analysis

November 2012

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The Different Guises of CVA

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Regulation and the difference guises of CVA

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## CVA and Accounting Rules

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- IFRS 13 (1st January 2013)
  - "The entity shall include the effect of the entity's net exposure to the credit risk of that counterparty or the counterparty's net exposure to the credit risk of the entity in the fair value measurement when market participants would take into account any existing arrangements that mitigate credit risk exposure in the event of default" (CVA)
  - Non-performance risk includes, but may not be limited to, an entity's own credit risk" (DVA)
- Exit price concept
  - Explicit that own credit must be incorporated into the fair value measurement based on the concept of "exit price"
  - Exit price implies the use of risk-neutral default probabilities

# CVA and Basel III capital requirements

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

**Counterparty Spread**

$$CVA = LGD_{mkt} \sum_{i=1}^{T} max\left(0; exp\left(-\frac{s_{i-1}t_{i-1}}{LGD_{mkt}}\right) - exp\left(-\frac{s_i t_i}{LGD_{mkt}}\right)\right)\left(\frac{EE_{i-1}B_{i-1} + EE_i B_i}{2}\right)$$

- BCBS "Application of own credit risk adjustments to derivatives"
  - "the Basel Committee is of the view that all DVAs for derivatives should be fully deducted….."

# Overview of counterparty risk related capital charges

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<table>
<tr><th></th><th>Default Risk Capital Charge</th><th>CVA Risk Capital Charge</th></tr>
<tr><td>Banks with IMM approval and with specific risk VAR approval for bonds</td><td rowspan="2">Higher of IMM capital charge based on EAD calculated with<br><br>a) standard calibration<br>b) stressed calibration<br><br>Note : IMM approval will typically not cover 100% of trades</td><td>Advanced method:<br><br>• uses banks VAR model for bonds to model spreads<br>• eligible hedges (CDS, CCDS, indices) can be included<br>• sum of normal and stressed VAR<br>• CVA formula below must be used<br><br>$CVA = (LGD_{MKT}) \cdot \sum_{i=1}^{T} Max\left(0; exp\left(-\frac{s_{i-1} \cdot t_{i-1}}{LGD_{MKT}}\right) - exp\left(-\frac{s_i \cdot t_i}{LGD_{MKT}}\right)\right) \cdot \left(\frac{EE_{i-1} \cdot D_{i-1} + EE_i \cdot D_i}{2}\right)$</td></tr>
<tr><td>Banks with IMM approval only</td><td rowspan="2">Standardised method:<br><br>$K = 2.33 \cdot \sqrt{h} \cdot \sqrt{\left(\sum_i 0.5 \cdot w_i \cdot (M_i \cdot EAD_i^{total} - M_i^{hedge} B_i) - \sum_{ind} w_{ind} \cdot M_{ind} \cdot B_{ind}\right)^2 + \sum_i 0.75 \cdot w_i^2 \cdot (M_i \cdot EAD_i^{total} - M_i^{hedge} B_i)^2}$<br><br>• Variance type formula assuming 50/50 split between idiosyncratic and systematic spread components<br>• Hedges included but index hedges gives only moderate capital relief</td></tr>
<tr><td>Other banks</td><td>Sum of EAD’s from:<br><br>• current exposure method<br>• standardised method<br>• shortcut method (collateralised)</td></tr>
</table>

# The Different Guises of CVA

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| | Default Probability | Exposure | DVA |
|---|---|---|---|
| Accounting | • If CVA is seen as a reserve then real world parameters are used<br>o Historical (or blended) default probabilities<br>o Historical volatilities and correlations<br>• If CVA is seen as a market price then risk-neutral parameters are used<br>o Credit spread implied default probabilities<br>o Market implied volatilities and correlations (where available)<br>• Current accounting rules (IAS 39 / FAS 157) do not give clear direction<br>• IFRS 13 requirements over exit price imply a risk-neutral approach (particularly relevant for the calculation of default probabilities) | | • Currently mandatory (FAS 157) or optional (IAS39)<br>• Future IFRS 13 requirements make DVA mandatory for all banks |
| Front-office (for pricing) | • Typically risk-neutral (spread based) even if bank's accounting CVA is defined historically<br>• May charge based on historical (or blended) but then ignore DVA | • Typically risk-neutral exposure<br>• Real world simulation if used will probably be a facet of using older PFE type systems for CVA calculations | • Typical price will include some (but not all) of the DVA (not with real world default probs) |
| Regulatory (CVA VAR) | • Risk-neutral (Basel III clearly defines CVA with respect to credit spreads)<br>• Mapping methods are important | • Real world parameters for simulation (IMM), or implicitly in other methods (e.g. CEM)<br>• Risk-neutral approach consideration for IMM banks to get better alignment<br>• Additional of stressed VAR component creates misalignment | • Not allowed (no DVA offset in calculation of CVA VAR) |

Regulation and the difference guises of CVA

Credit spread mapping

Comparison of default risk capital charges

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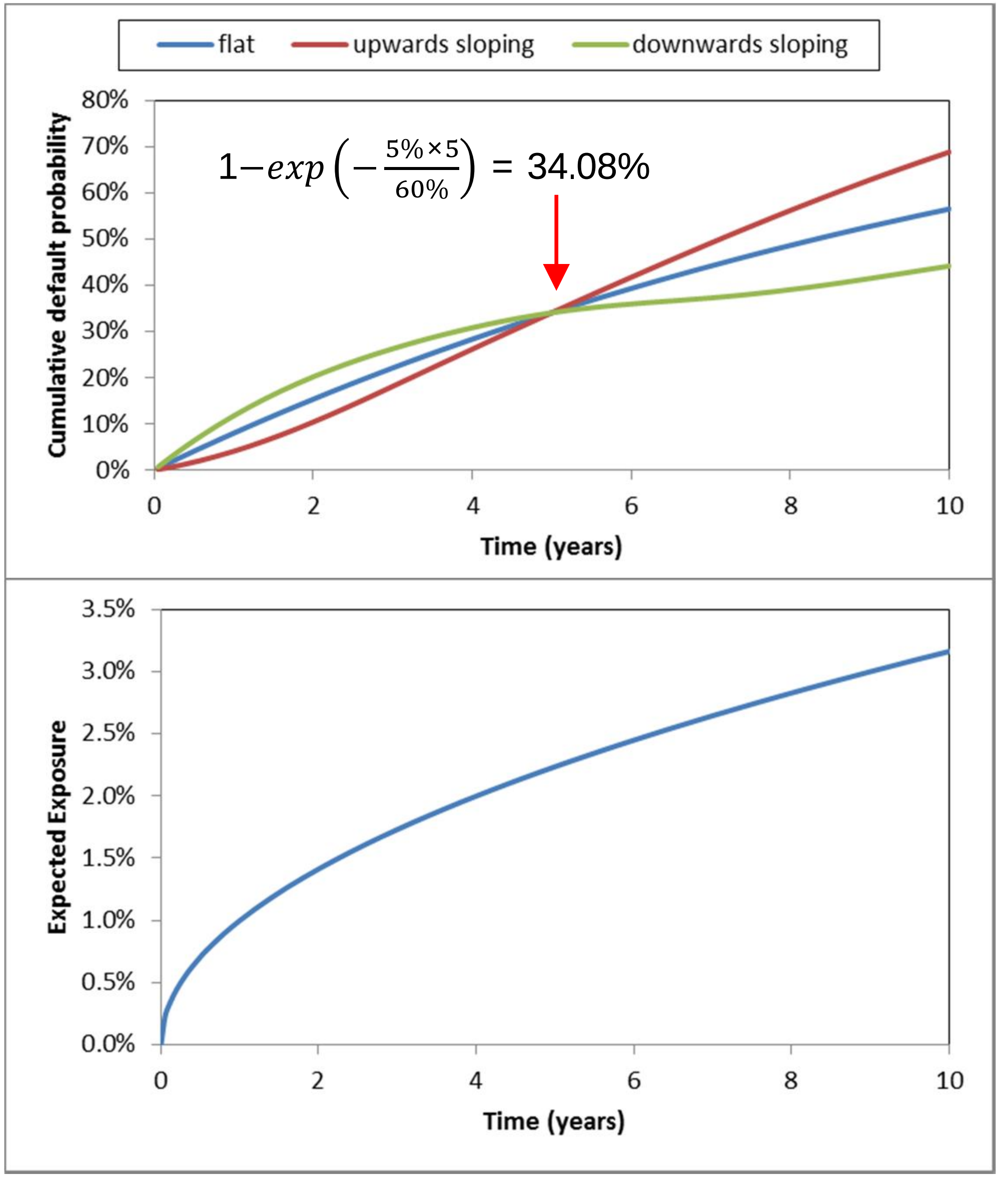
CVA VaR Examples

# Impact of curve shape on CVA




5Y Spread = 500 bps, Recovery = 40%

| CVA | 5-year trade | 10-year trade |
|---|---|---|
| Upwards | 2.3% | 13.5% |
| Flat | 2.6% | 12.4% |
| Downwards | 3.0% | 11.1% |
| Range | 30% | 22% |

# Mapping Approach – European Names



- Example categorisation for European counterparties

| CDS | Counterparty | Rating | Index |
|---|---|---|---|
| CDS Index Proxy | Corporates | BBB & better | iTraxx EUR Non-Financials |
| | | BBB and below | iTraxx EUR crossover |
| | Financials | | iTraxx EUR Financials |
| | Sovereigns | | Itraxx SovX |
| Single name CDS proxy | | | |
| Single name CDS | | | |

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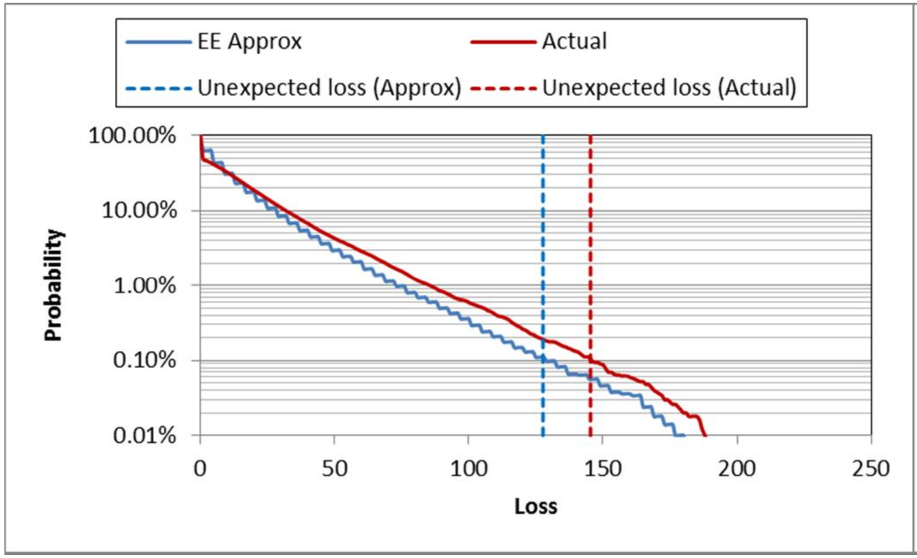
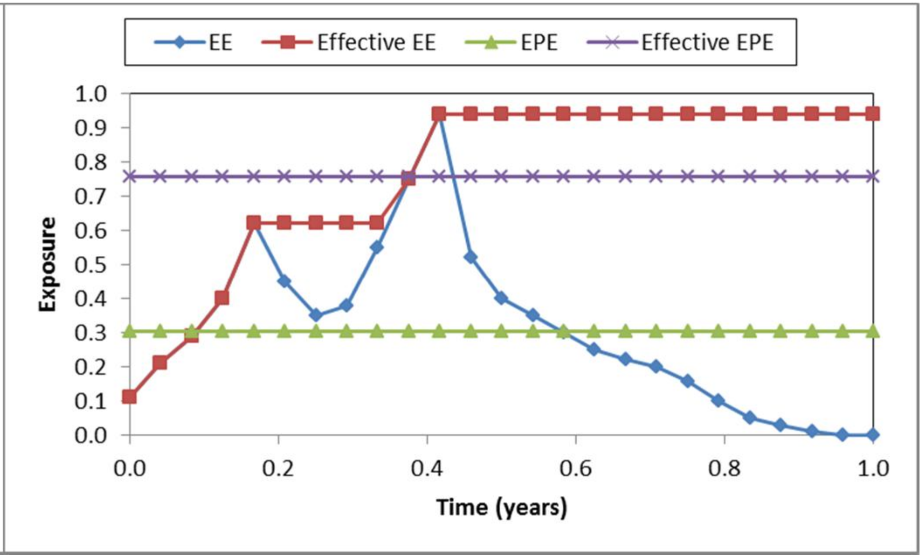
## Definition of Exposure at Default (EAD)

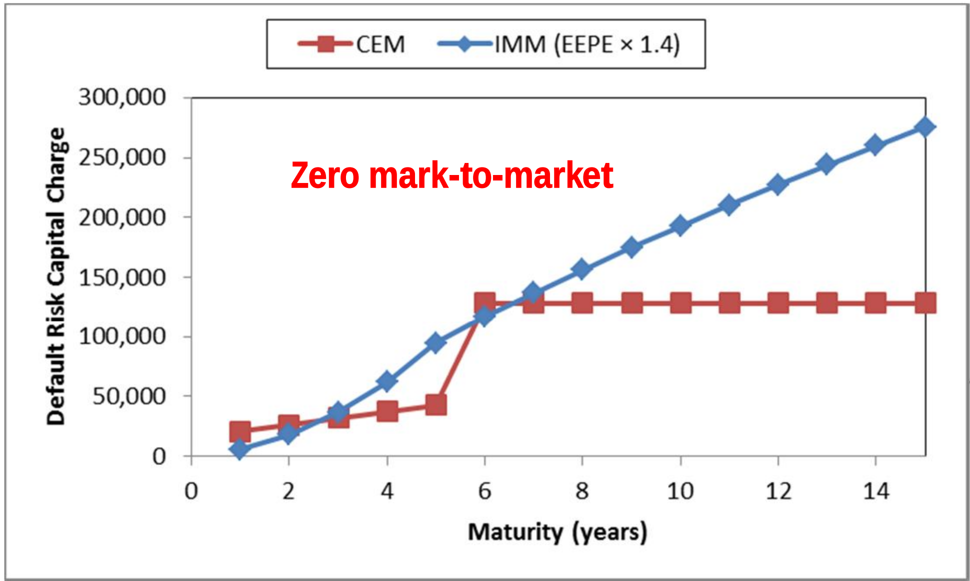
- Simple approaches to define EAD directly
  - Current exposure method (CEM), standardised method, shortcut method
  - Limitations is potentially overcapitalisation due to inherent simplicity and misalignment of capital requirements with actual economic risk
- Under IMM, exposure can be calculated more directly and EAD is defined as:
  - Alpha factor × Effective EPE
  - Some conservativeness and misalignment potentially introduced via alpha factor and definition of Effective EPE

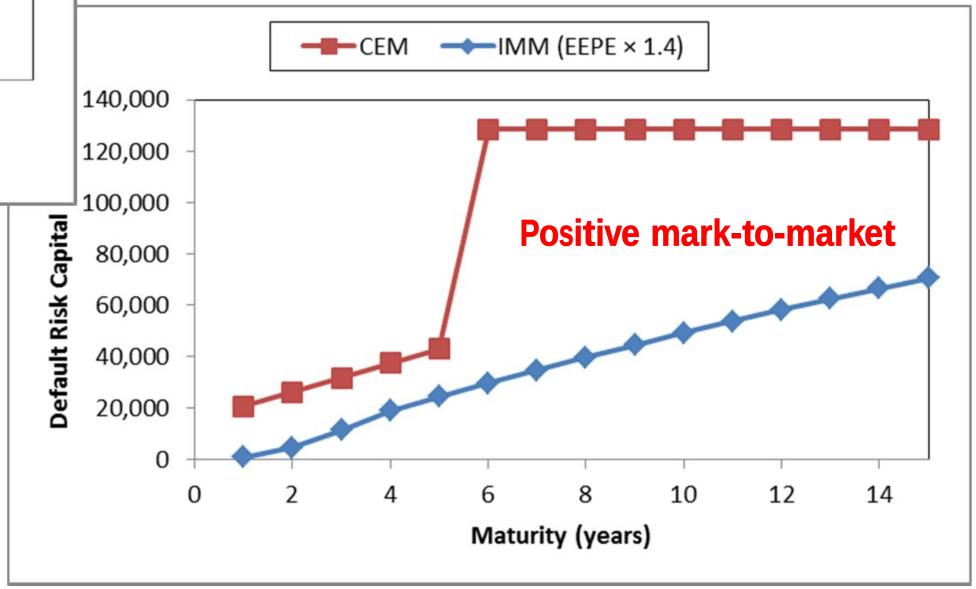


## Capital Charges – CEM vs. IMM For Single Swaps

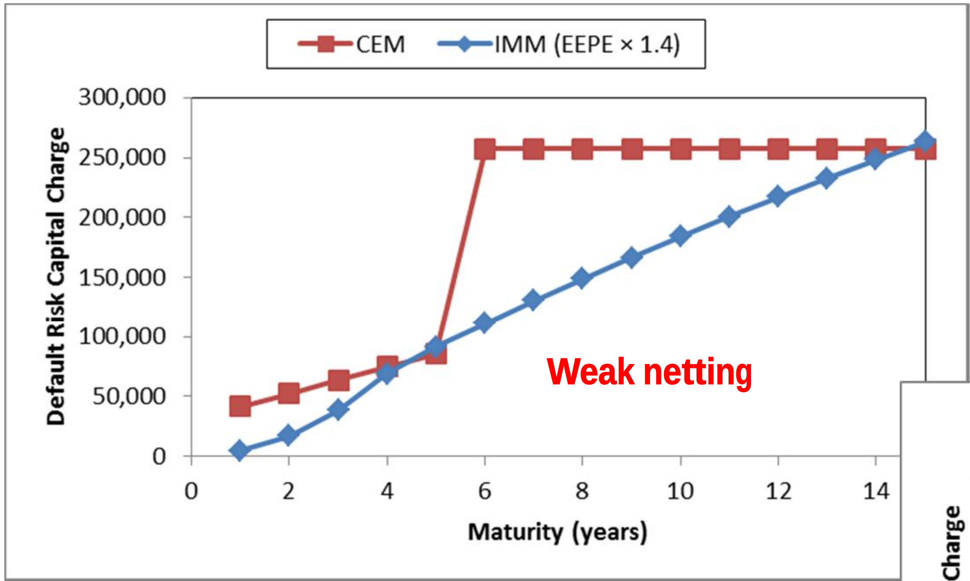
- Single interest rate swap

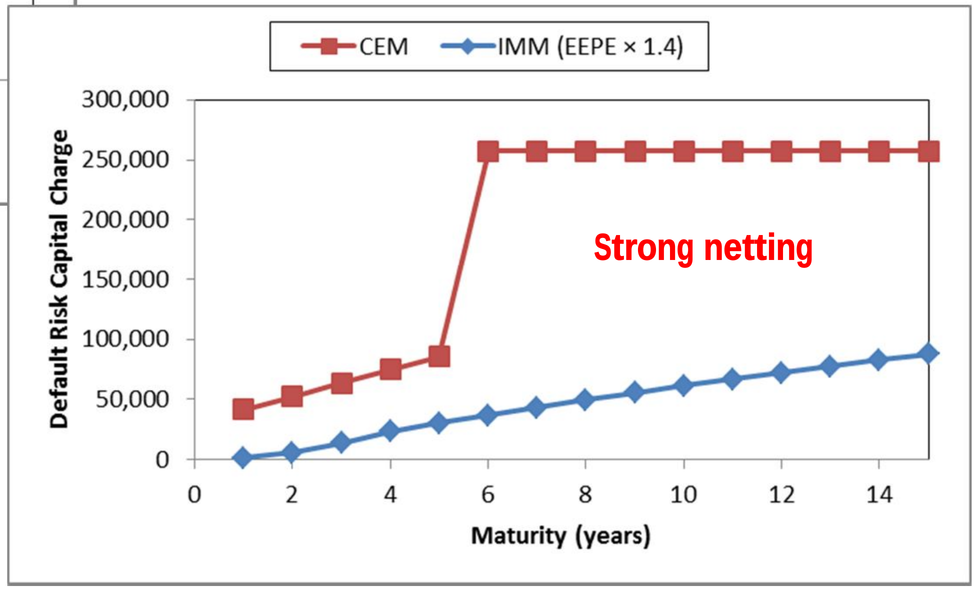


# Capital Charges – Impact of Netting

- Portfolio of two swaps



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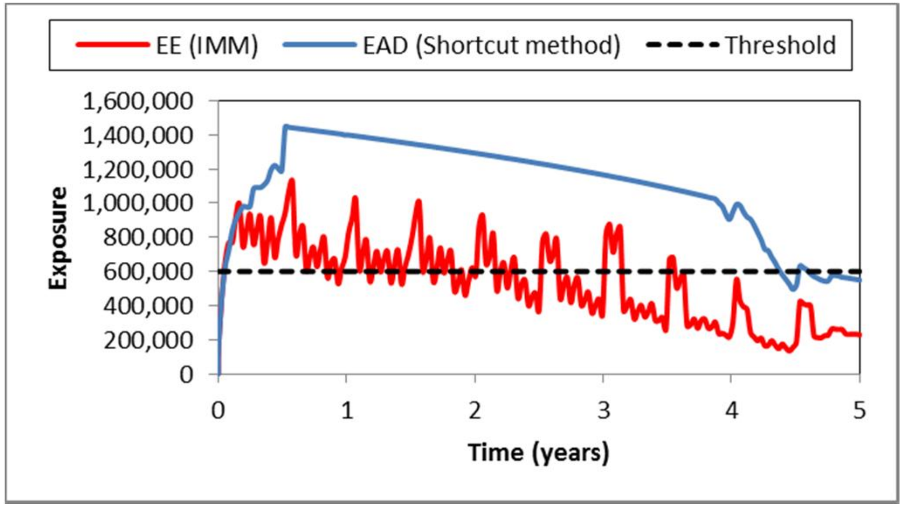
CVA VaR Examples

## Requirement to use Stressed Data

- Similar to market risk VAR rules under “Basel 2.5”
  - Calibrations using historical data - quiet period tend to precede crises, creating procyclicality
  - Basel 3 defines that a “stressed” calibration must be used in addition to standard calculation
  - Data must be 3-years with 1-year period of stress (increasingly spreads)
  - EEPE is defined by the **max** of the normal and stressed calculations
  - Note that this is in addition to the stress period for CVA VAR (see later)
- Does switching to a risk neutral calibration solve the problem?
  - No - must use a “stressed risk-neutral calibration” also

## Modelling Collateralised Exposures

- Shortcut method can be rather conservative
- IMM method requires modelling
  - Threshold / minimum transfer amount
  - Time to receive collateral
  - Volatility of collateral
  - Need to post collateral

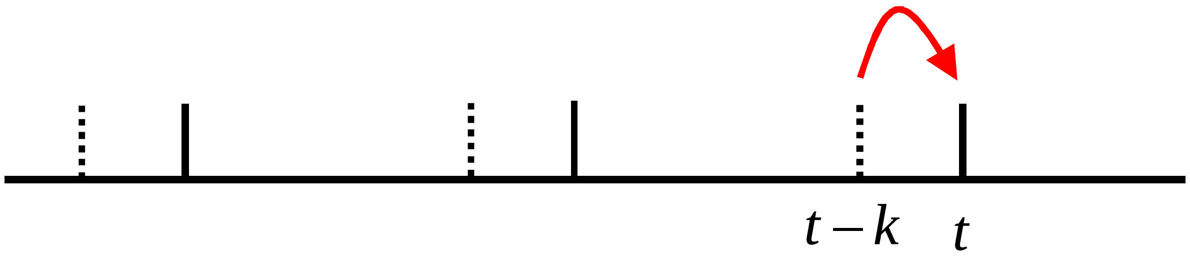



$$E_t = \max(V_t - C_{t-k}, 0)$$

Positive exposure at time *t*

Future value at time *t*

Total collateral account *k* days ago



## Basel III Changes in Collateral Modelling Assumptions

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- The important parameter, the margin period of risk was previously required to be (at least) 10 business days for OTC derivatives portfolios
- Margin period of risk increased in the following cases
  - Netting sets with more than 5,000 trades at any time during a quarter (20 days)
  - Illiquid collateral or OTC derivatives that are hard to replace (20 days)
  - Two or more collateral disputes in last two quarters (at least doubled)
- Disallow rating triggers
  - Under IMM, cannot model any benefit from taking (more) collateral linked to a deterioration in credit quality
  - These tend not to work and create cliff edge effects

## Margin Period of Risk

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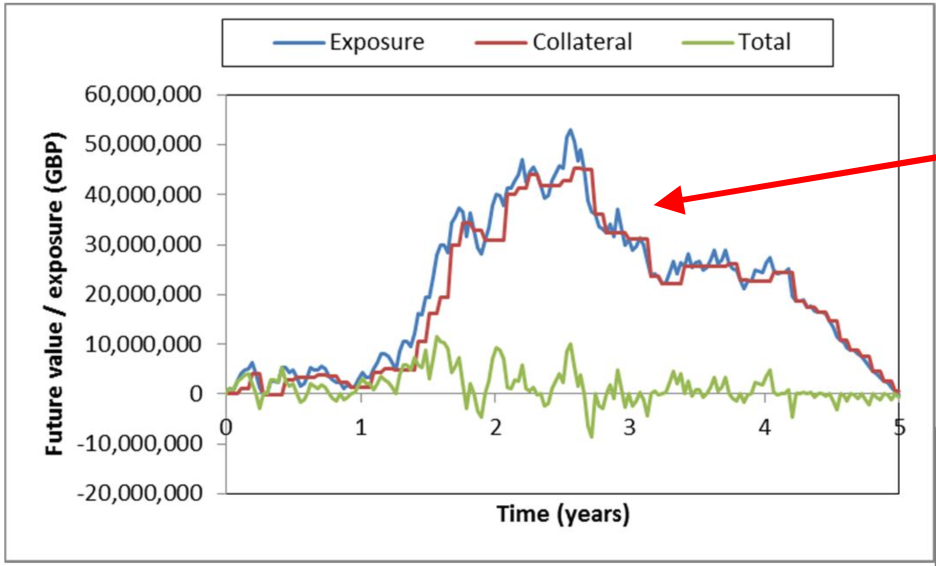
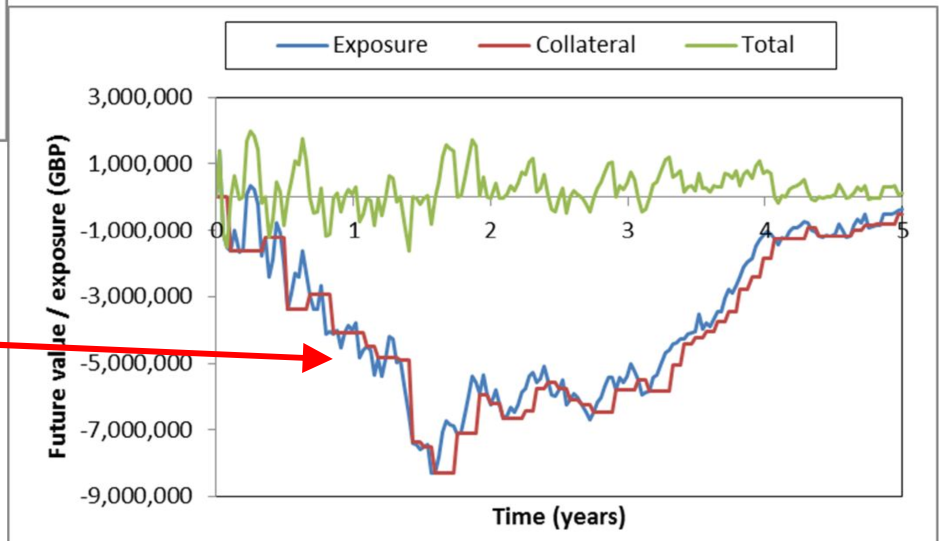
- IMM impact of margin period of risk of 20-days (zero threshold)




Imperfect receipt of collateral

Need to post collateral



# Impact of Collateral on Exposure

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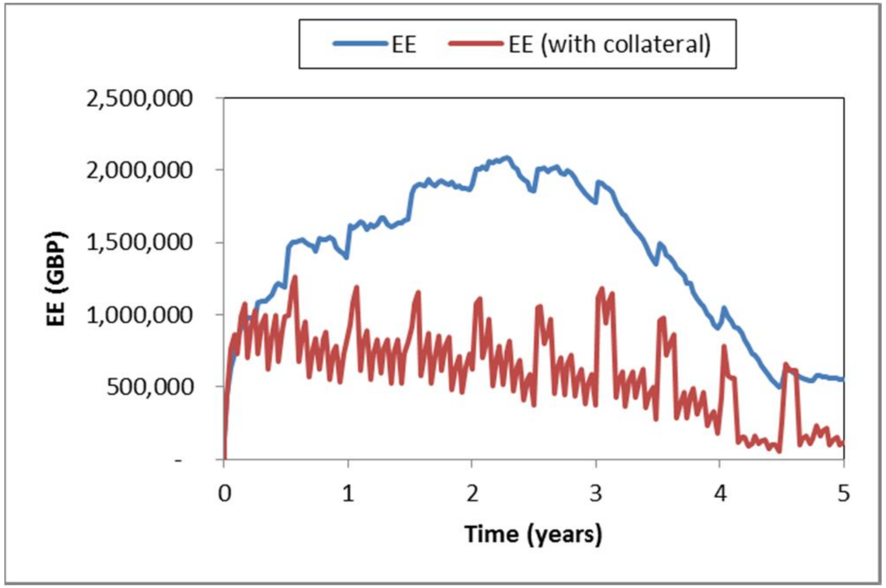


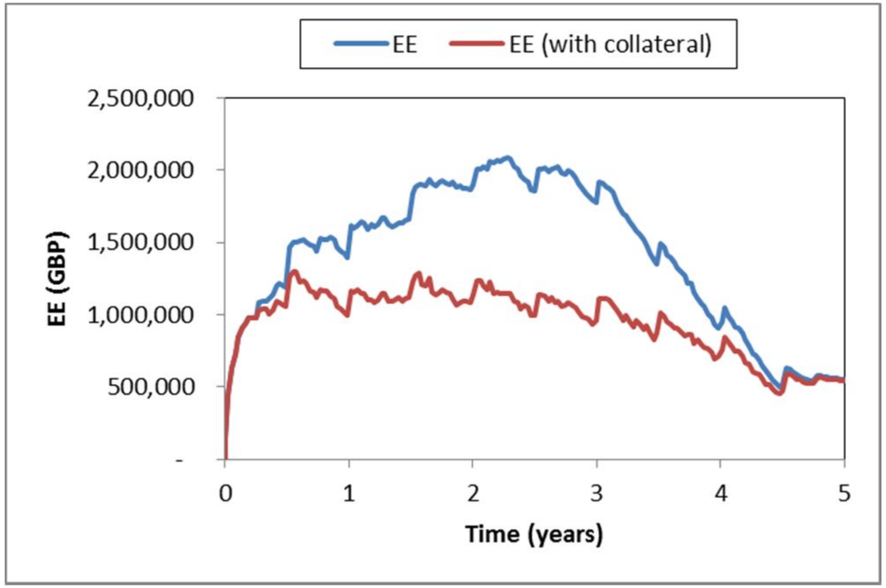


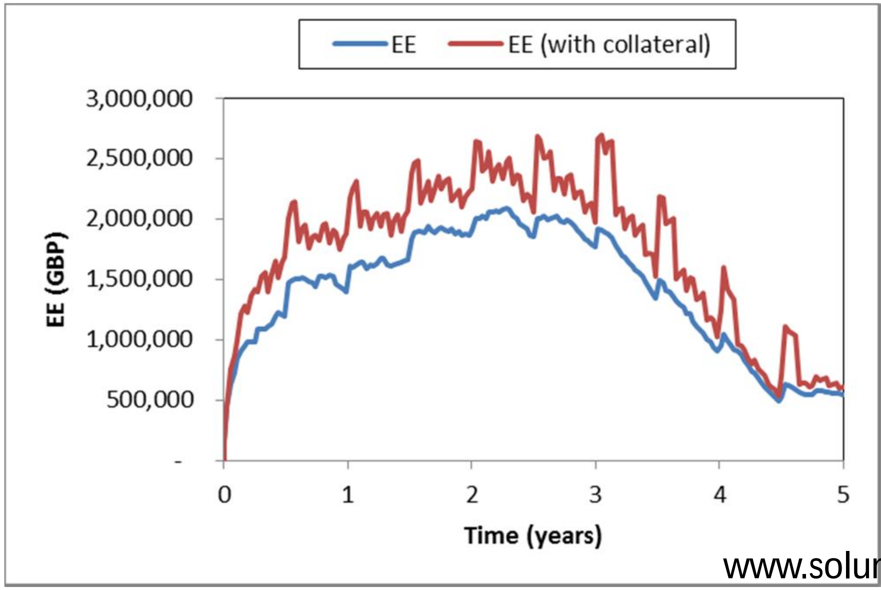


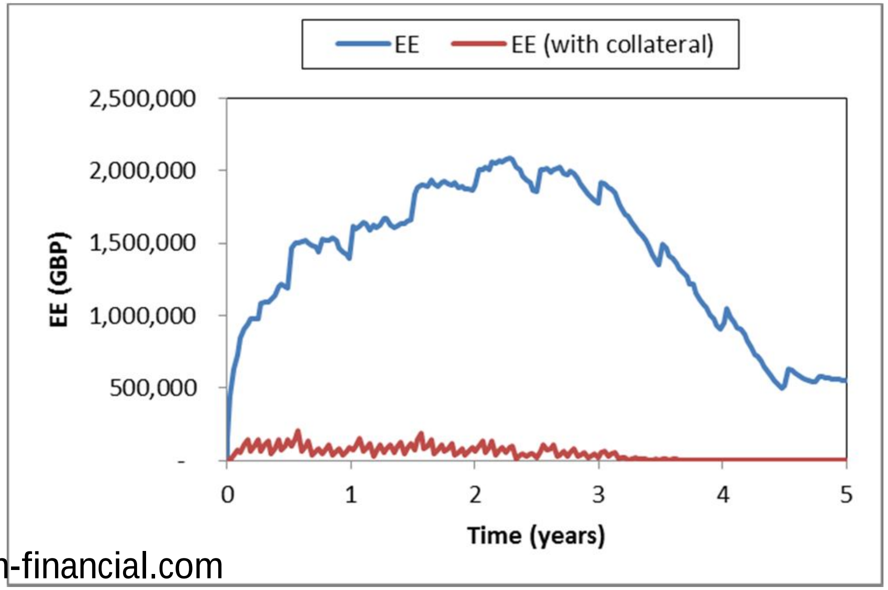

## Motivation for CVA VaR

- Capitalise mark-to-market losses for counterparty risk (CVA volatility)
  - Two thirds of the actual counterparty risk losses in the crisis
- Criticism
  - Some smaller banks see CVA as a reserve or provision and not a market value
- Challenges
  - CVA is very hard to define with no market standard (models, parameters)
  - Clearly a computational challenge (CVA is complex, VAR is complex)
  - How to give capital relief (single name hedging, index hedging, securitisation)
- Exemptions
  - CVA VAR to CCPs (Basel III)
  - European sovereigns (CRD IV)
  - CVA VAR to non-financials?

# CVA VaR – Standardised Approach (I)

- Normal distribution VAR approach based on the standard deviation of CVA
  - 99% confidence level, 1-year time horizon
  - Including single-name and index hedges
- Start with exposure to each counterparty (hedged with single name CDS)

$$N_i = M_i EAD_i^{total} - M_i^{hedge} B_i$$

Single name hedged notional

Effective maturities

Notional of single-name hedge

- EAD may be defined by
  - Current exposure method (MtM + add-on)
  - Standardised method
  - Shortcut method (collateralised trades)
  - IMM method (EEPE × alpha) – maximum of normal and stressed scenarios

## CVA VaR – Standardised Approach (II)

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- Index hedges (systematic risk) driven by a standard normal variable $V_{ind}$ and counterparties driven by another normal variable:

$$V_i = \rho V_{ind} + \sqrt{1-\rho^2}\varepsilon_i$$

**Note:** this implies counterparty – counterparty spread correlation of $\rho^2$

- The standard deviation of the portfolio would then lead to:

Systematic term

Idiosyncratic term

$$K_i = 2.33\sqrt{h}\sqrt{\left(\rho^2\sum_i w_i N_i - \underbrace{\sum_{ind} w_{ind} M_{ind} B_{ind}}_{\text{Index hedges}}\right)^2 + \left(1-\rho^2\right)\sum_i w_i^2 N_i^2}$$

Correlation parameter (50%)

Counterparty weight by rating

Single name hedged notional

- o $\rho$ =50%, 99% confidence level (2.33 factor) and 1-year time horizon ($h$ = 1)
- o Volatility represented by weights (w) according to rating (or average rating for index hedges)
- o Weights : AAA = 0.7%, AA = 0.7%, A = 0.8%, BBB = 1%, BB = 2%, B = 3%, CCC = 10%

## CVA VaR – Advanced Approach (I)

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- Bank can model the VAR with their own models with CVA defined by:

$$CVA = LGD_{mkt} \sum_{i=1}^{T} max\left(0; exp\left(-\frac{s_{i-1}t_{i-1}}{LGD_{mkt}}\right) - exp\left(-\frac{s_i t_i}{LGD_{mkt}}\right)\right) \overbrace{\left(\frac{EE_{i-1}B_{i-1} + EE_i B_i}{2}\right)}^{\text{Fixed}}$$

Loss given default

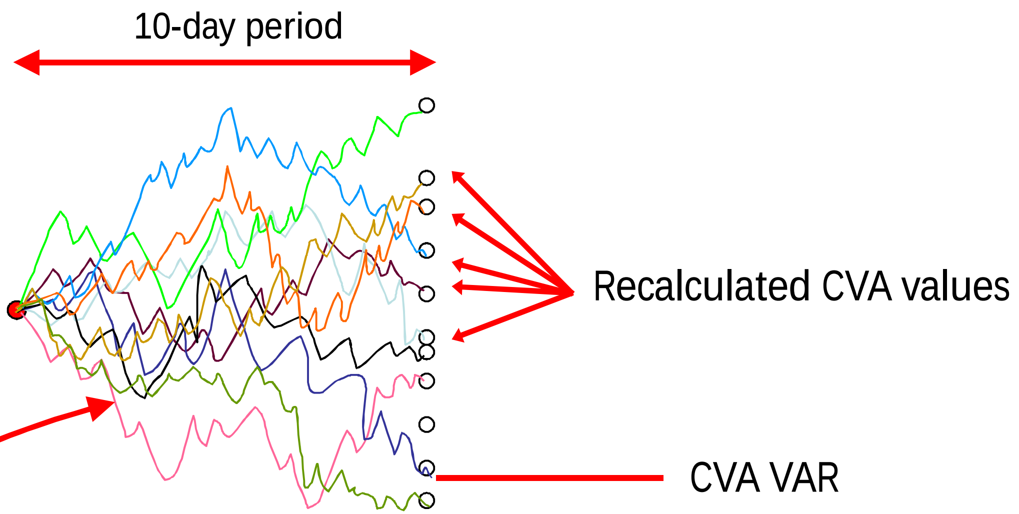
Spread for time point

EE (from IMM model)

Discount factor

- Exposure profile is held fixed for simplicity
  - Only credit spreads are simulated
  - Ignores other market factors (interest rates, FX, equity, commodity, .......)
- Other points to note
  - Separate to normal VAR calculations
  - Capital defined as **sum** of normal and stressed (wrt credit spreads) calculations
  - 10-day period, 99% confidence level, usual multiplier of 3

# CVA VaR – Advanced Approach (II)




Simulate credit spreads (and hedges)

$$LGD_{mkt}\sum_{i=1}^{T} max\left(0; exp\left(-\frac{s_{i-1}t_{i-1}}{LGD_{mkt}}\right) - exp\left(-\frac{s_i t_i}{LGD_{mkt}}\right)\right)\underbrace{\left(\frac{EE_{i-1}B_{i-1} + EE_i B_i}{2}\right)}_{\textbf{Fixed}}$$

# CVA VaR – Capital Relief

- Single name CDS
  - Standardised approach - offset according to EAD and maturity adjustment
  - Advanced approach - offset calculated within VAR simulation (delta neutral?)
- Index CDS
  - Standardised approach – as above but according to assumed 50% correlation
  - Advanced approach – correlation can be modelled although “If the basis is not reflected to the satisfaction of the supervisor, then the bank must reflect only 50% of the notional amount of index hedges in the VaR”
- Structured credit
  - No benefit from other credit derivatives (tranches, nth to default structures)
  - Securitisations?
- Market risk hedges
  - Split hedge issue - must be included in standard VAR calculation (unlike eligible hedges) and therefore will increase capital

Regulation and the difference guises of CVA

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# Comparison of Standardised and Advanced Approaches

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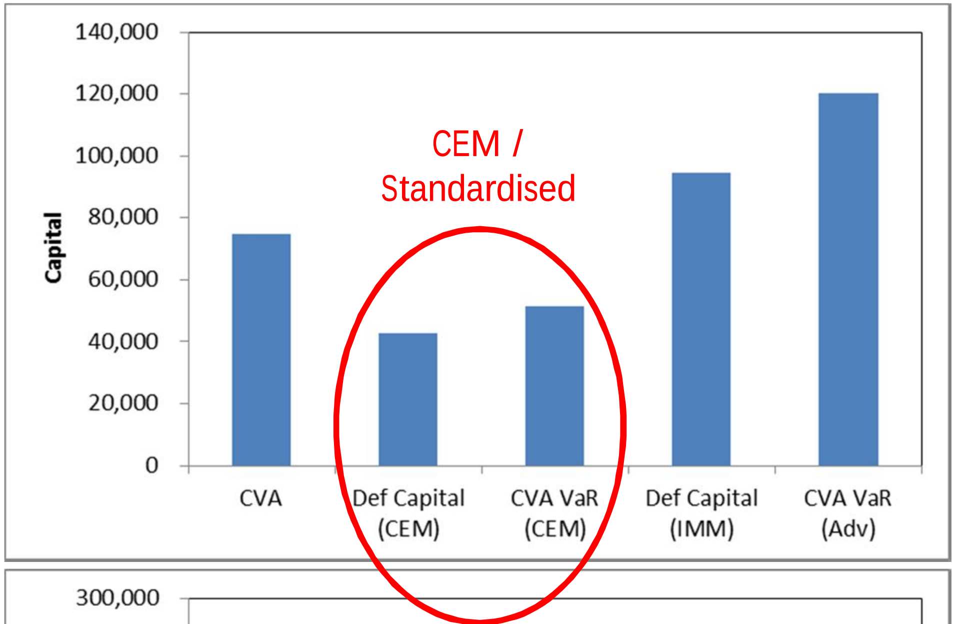
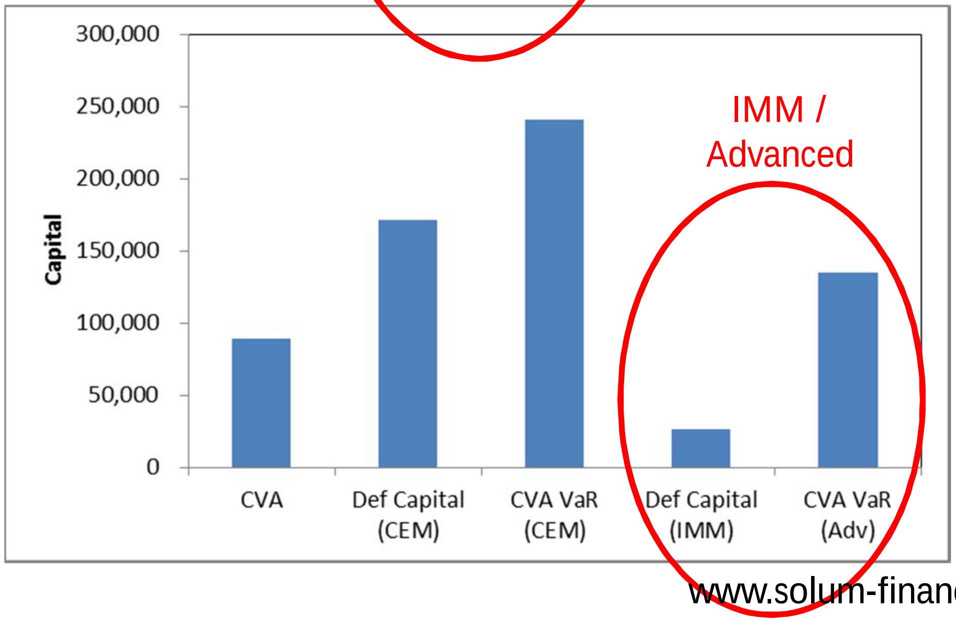
| | Standardised | Advanced | Change |
|---|---|---|---|
| **Time horizon, confidence level, other multipliers** | 1-year, 99%, no other multiplier = 2.33 | 10-days, 99% and standard VaR multiplier $2.33 \times \sqrt{10/250} \times 3 = 1.40$ | ↓ |
| **Distributional assumptions** | Gaussian | Empirical / Non-Gaussian | ↑ |
| **Exposure at default definition** | Impact of crude approaches (e.g. CEM) and alpha factor in IMM | Use of EE directly should be smaller and give better alignment with CVA | ↓ |
| **Credit spread volatility** | Introduced via the weights per rating category | Actual empirical data including stressed spreads may produce higher volatility | ↑ |
| **Spread correlation / portfolio effect** | Counterparty spread implicitly assumed 50% idiosyncratic. Intra spread correlation implicitly 25% | Higher correlation likely leading to a worse portfolio effect due to undiversifiable systematic risk | ↑ |
| **Delta hedging capital relief** | Likely underhedge due to conservative definition of EAD | Regulatory definitions better aligned with CVA producing better capital relief | ↓ |
| **Index hedging capital relief** | Correlation is assumed to be 50% | Higher correlations can be used if they can be justified | ↓ |
| **Procyclicality** | Spread parameters fixed through time | Spread parameters will change through the economic cycle | ↑↓ |

# Examples – Standardised vs. Advanced Capital Charges




*5-year swap. CEM approach gives relatively small exposure and much lower capital charge.*

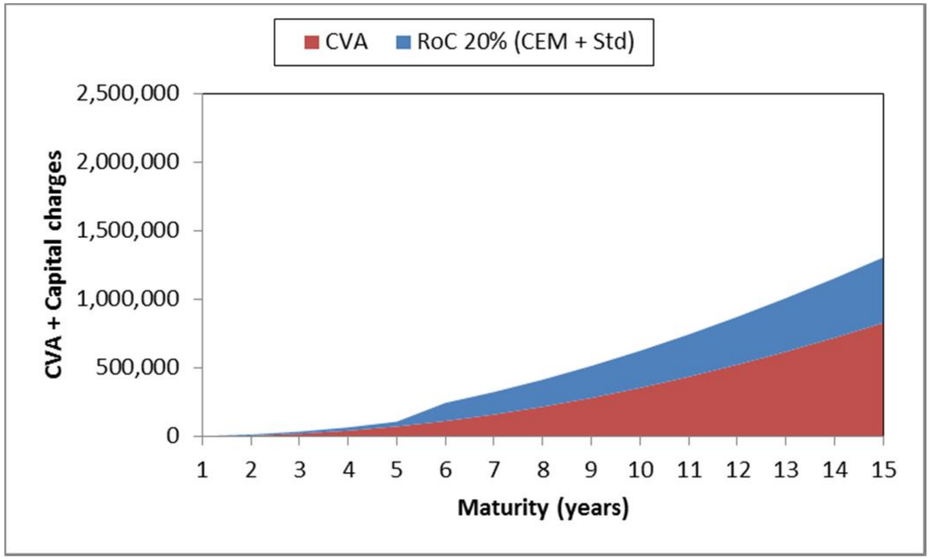
*Single counterparty examples*




*5-year + 7-year swap. Off market and strong netting benefit. CEM approach gives relatively small exposure and much lower capital charge.*

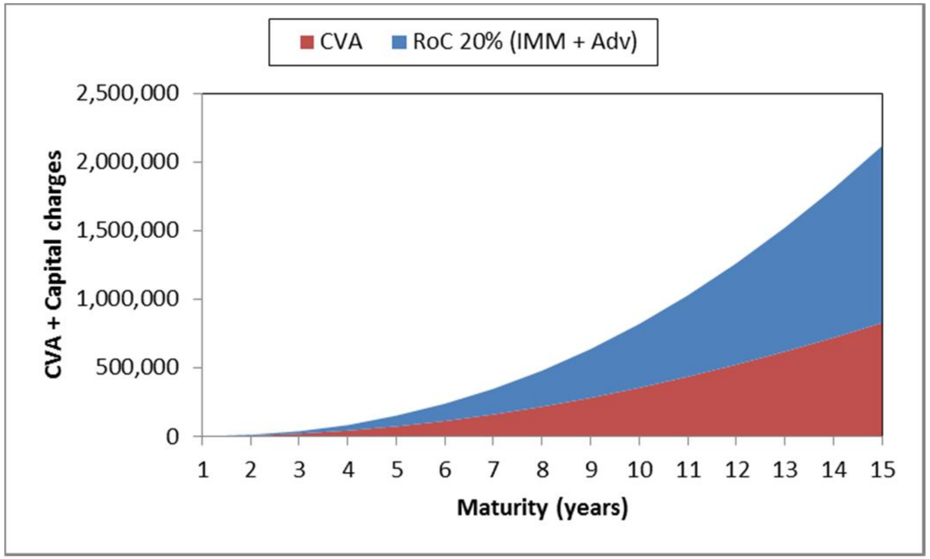
## Return on Capital Analysis (single swap)

- Pricing required to cover CVA and achieve a return on capital (RoC) for swaps as a function of maturity (DVA ignored)



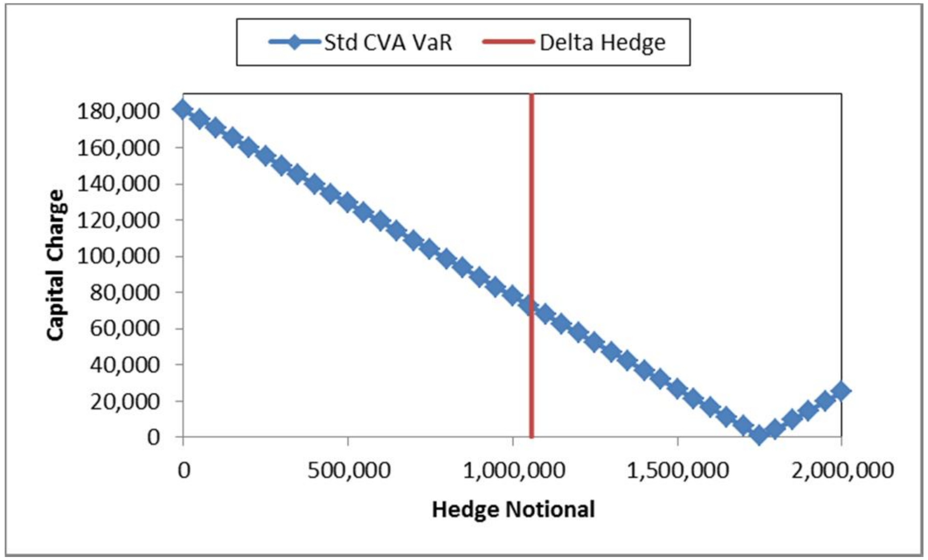

$$RoC = \frac{(Price - CVA)}{0.5 \times Regulatory\ Capital \times Maturity}$$

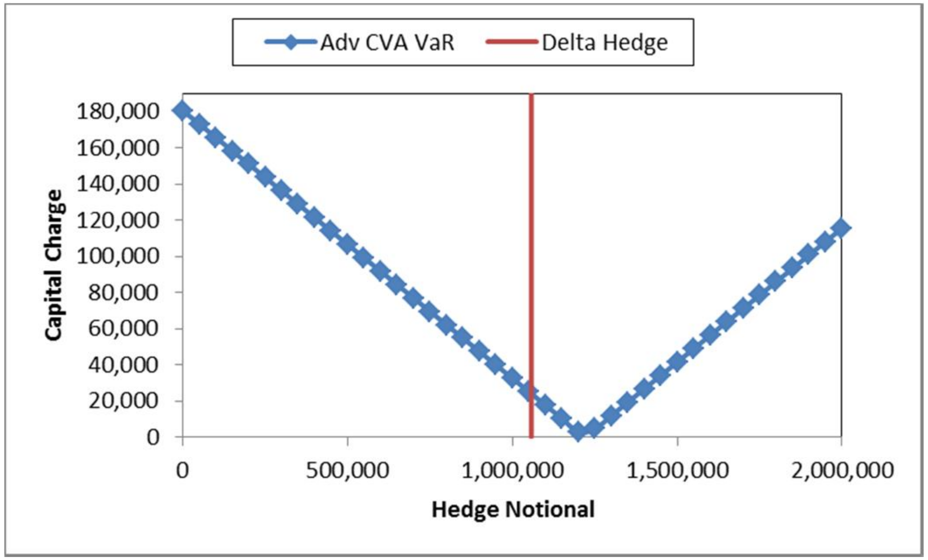
*Approximately the same for 6-year swap. Advanced approach gives higher costs for longer maturities*



# Impact of Single Name Hedges

*6-year swap (CVA VAR for standardised and advanced approximately the same)*




*Standardised approach*

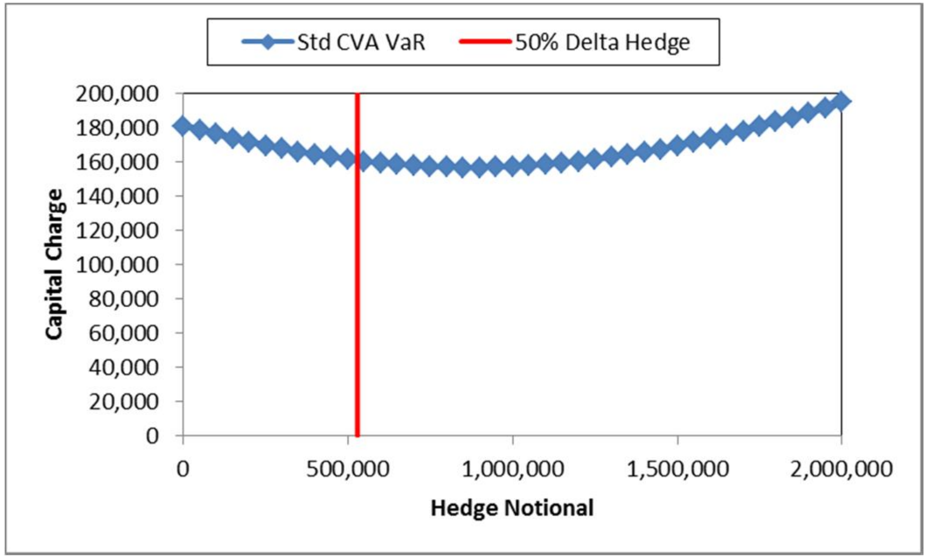
*Delta hedge too small as EAD is relatively large under CEM approach. Capital relief very misaligned with CVA hedging.*

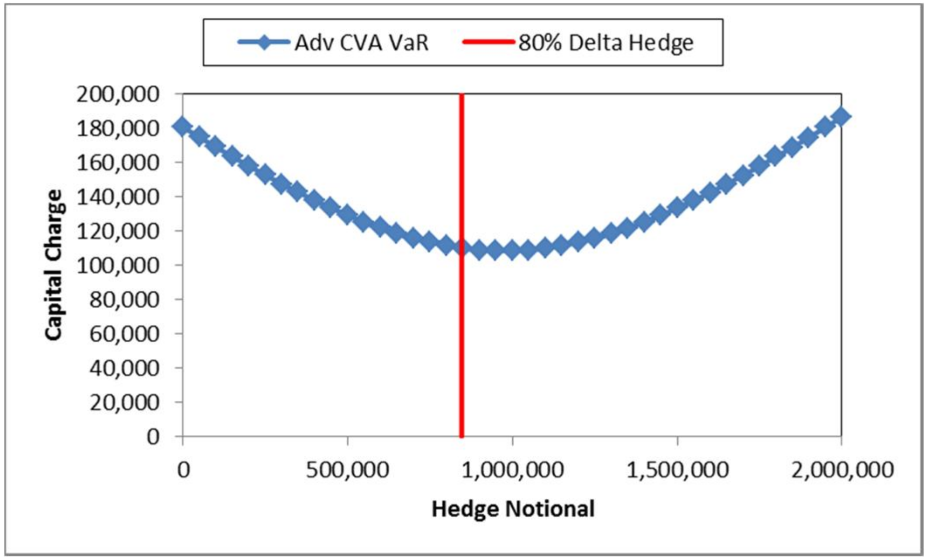
*Advanced approach*

*Delta hedge slightly too small due to need to use stressed data in EEPE calculation (assume all other components are aligned)*

## Impact of Index Hedges

*6-year swap (CVA VAR for standardised and advanced approximately the same)*




*<u>Standardised approach</u>*

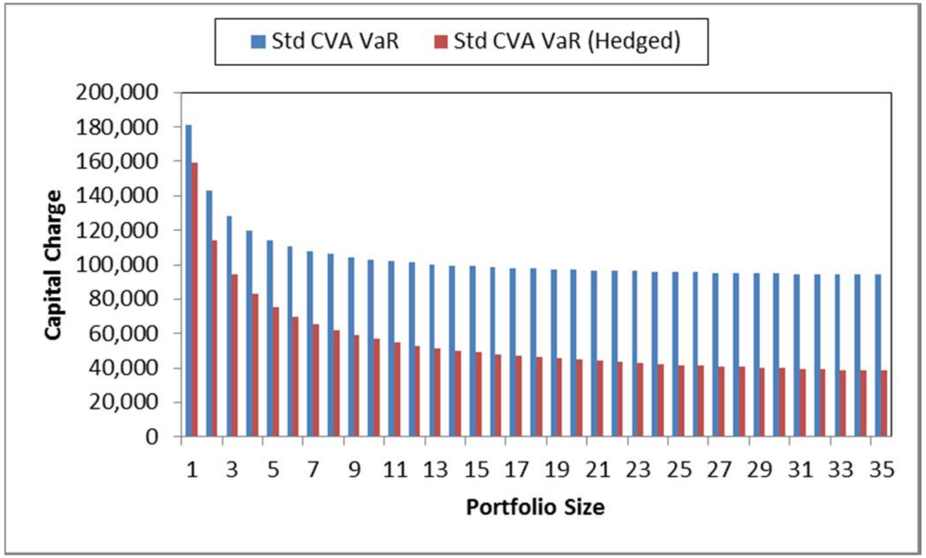
*Capital relief poor due to misaligned delta and 50% correlation assumption.*

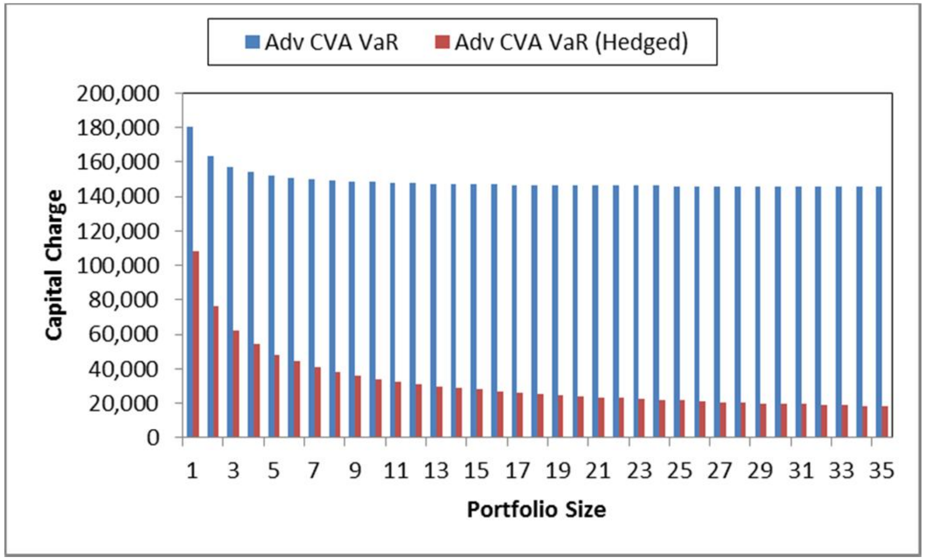
*<u>Advanced approach</u>*

*Delta hedge quite good giving almost 50% capital relief (80% correlation assumed).*

## Impact of Portfolio Effect

*Impact of increasing number of counterparties*




*Standardised approach*

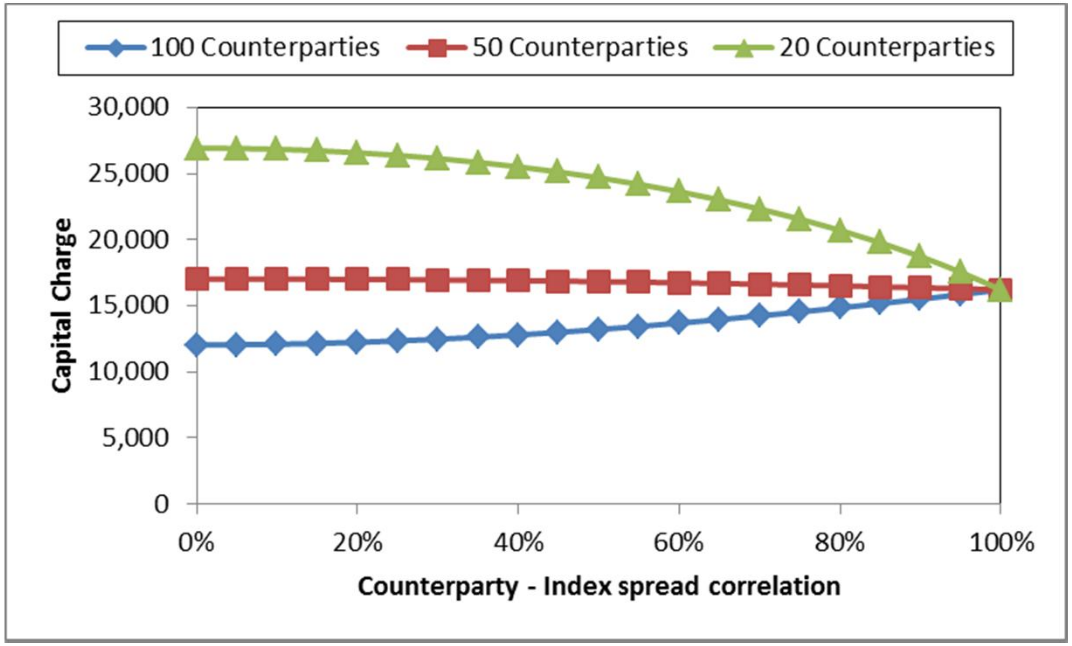
*Significant portfolio effect. Hedging improves with size of portfolio. Idiosyncratic risk diversifies and systemic risk can be hedged.*

*Advanced approach*

*Portfolio effect poor with high correlation of 80% assumed (more systemic risk). Not clear if high correlation is beneficial or not for large portfolios.*

# Advanced Approach - Portfolio Effect with Index Hedging

- High index-counterparty correlation likely to be assumed
  - This allows better hedging efficiency and capital relief
  - However, it also implies less diversifiable idiosyncratic risk as counterparty – counterparty spread correlation must also be high




*Lower correlation implies more diversifiable idiosyncratic risk* ↔ *Higher correlation gives better capital relief (index hedge more efficient)*

## Conclusions

- CVA charges and charges for CVA capital are comparable
- Advanced method generally gives higher capital charges than standardised
  - Most obvious driving force could be seen as need to add normal and stressed CVA VaRs
- Single-name hedging is misaligned with delta hedging
  - Much better in advanced approach where only stressed EEPE creates a problem
- Index hedging seemingly better in advanced approach
  - Since index – counterparty correlations can be argued to be much higher than the 50% in the standardised case
  - However, this is not completely clear as this limits diversifiable idiosyncratic risk
- Important questions for the future
  - Will Basel III incentive the right kind of hedging?
  - Is CVA VaR unraveling already with the issues with the advanced approach together with the need for exemptions?