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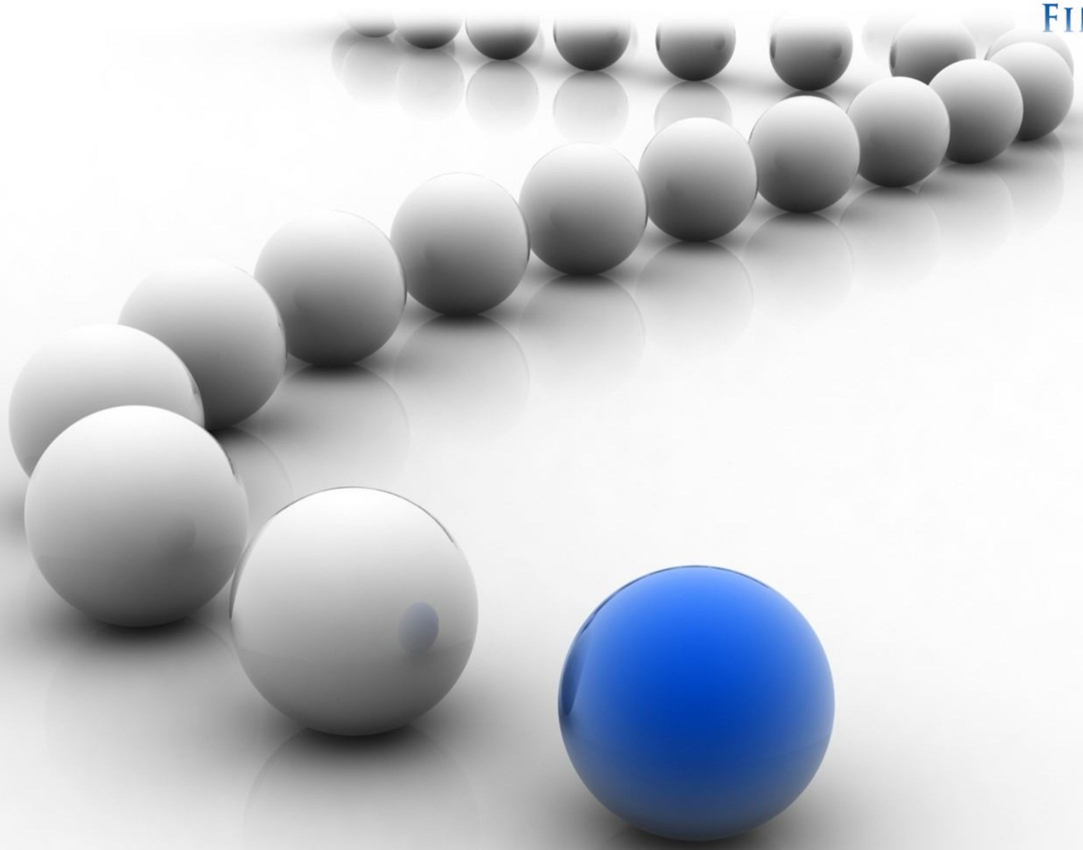

Analysis of the CVA Capital Charge

Jon Gregory, Partner

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OTC Derivatives
Taking the "fun" out of funding?

October 2012

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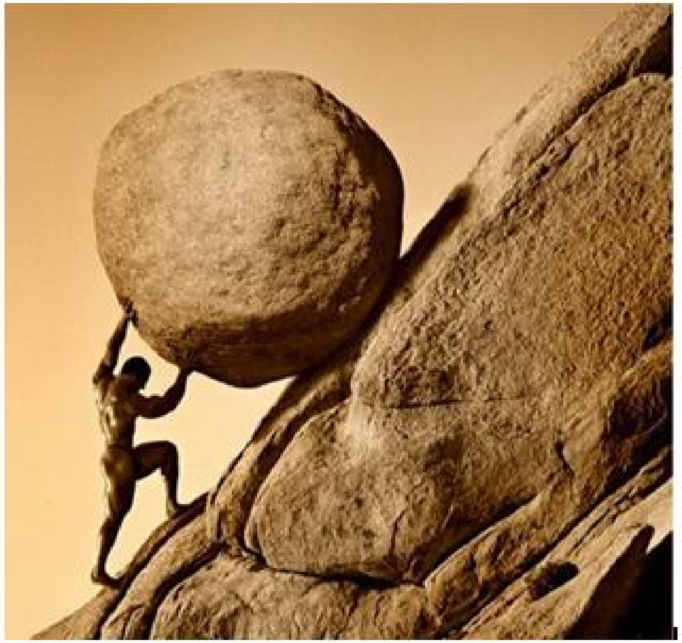

CVA Capital Charges: A comparative analysis

November 2012

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The Different Guises of CVA

December 2012

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Regulation and the Difference Guises of CVA

Counterparty Credit Risk Capital Charges

Analysis of the CVA Capital Charge

Impact of Central Clearing

CVA and Accounting Rules

- **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

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- **BCBS Consultative document (December 2009)**
  - Two-thirds of CCR losses due to CVA and only about one-third were due to actual defaults
- **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"**
  - "...... all DVAs for derivatives should be fully deducted....."
- **Exemptions in Europe under CRD IV**
  - Sovereigns / non-financials

The Different Guises of CVA

	Default Probability	Exposure	DVA

Accounting	• If CVA is seen as a reserve then real world parameters are used
	  o Historical (or blended) default probabilities
	  o Historical volatilities and correlations
	• If CVA is seen as a market price then risk-neutral parameters are used
	  o Credit spread implied default probabilities
	  o Market implied volatilities and correlations (where available)
	• Current accounting rules (IAS 39 / FAS 157) do not give clear direction
	• 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)
			• 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 • May charge based on historical (or blended) but then ignore DVA	• Typically risk-neutral exposure • 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) • Mapping methods are important	• Real world parameters for simulation (IMM), or implicitly in other methods (e.g. CEM) • Risk-neutral approach consideration for IMM banks to get better alignment • Additional of stressed VAR component creates misalignment	• Not allowed (no DVA offset in calculation of CVA VAR)

Real World or Risk-Neutral Parametrisation

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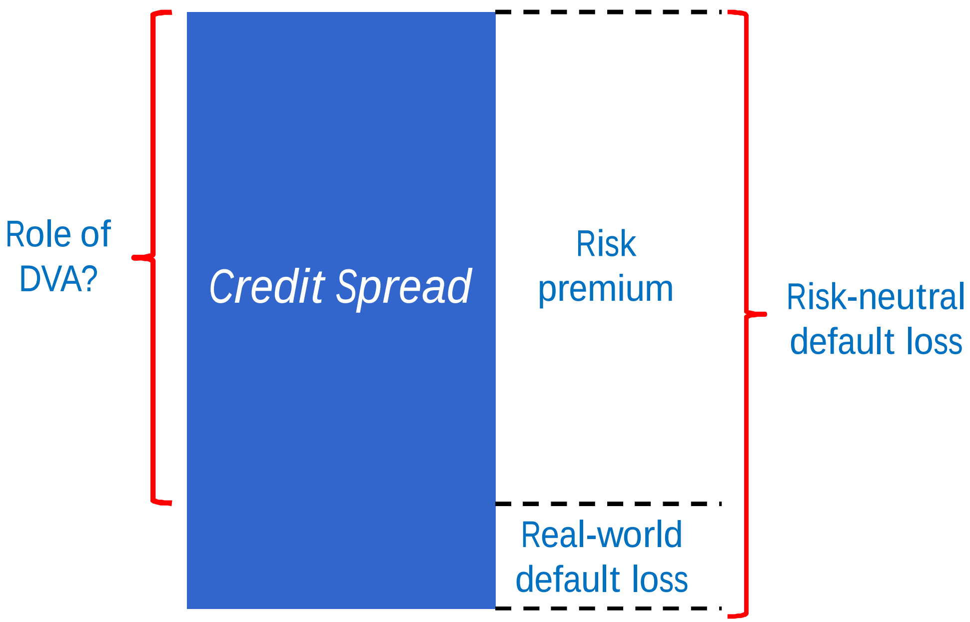
	Real world	Risk-neutral	Market practice
Default probability	Historical (rating based)	CDS, bonds, proxies and indices	Risk-neutral
Drift	Forecasting	Forward rates	Risk-neutral
Volatility	Historical time series	Implied volatility surface	Mainly risk-neutral
Correlation	Historical time series	Spread options, quantos, baskets	Mainly real world

Market Implied and Real World Default Probabilities

- **Using credit spreads (compared to historical default probabilities)**
  - Resulting CVA will be many times higher (although DVA reduces this)
  - But most credit spreads cannot be easily obtained
  - Mapping rules required and hedging not obvious



	Real world loss (bps)	Risk neutral loss (bps)	Ratio
Aaa	4	67	16.8
Aa	6	78	13.0
A	13	128	9.8
Baa	47	238	5.1
Ba	240	507	2.1
B	749	902	1.2
Caa	1690	2130	1.3

Hull, J., M. Predescu and A. White, 2004

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			

Example Marking Methodology

- **Direct mapping**
  - Single name CDS
  - Names with liquid bond/loan spreads (but then there is a basis issue)
- **Proxies**
  - Sovereign mapping (e.g. states, cities, banks, names with explicit or implicit sovereign guarantees)
  - Other direct link to similar credit
  - But no capital relief!
- **Remaining generic names**
  - Stratify names into rating/region/industry categories
  - Mark to relevant index
  - Perform regression periodically

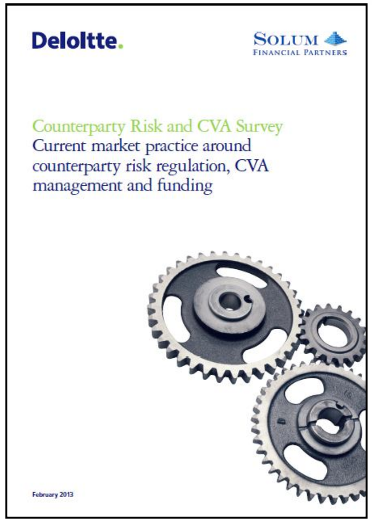
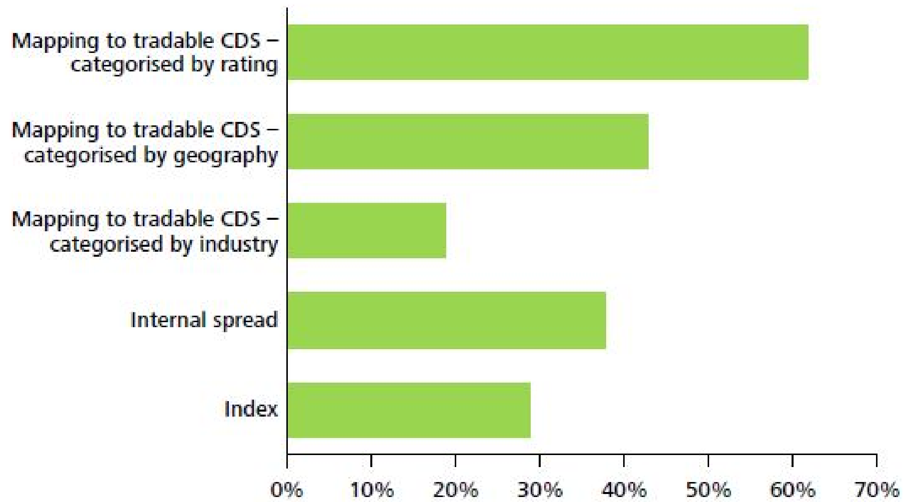


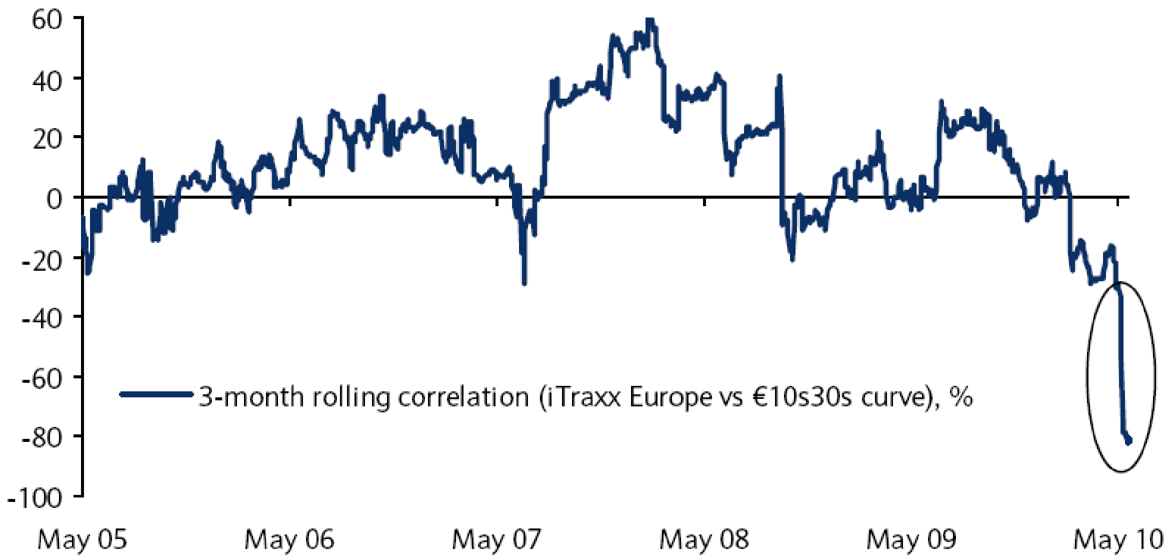
Figure 23. Probability of default mapping for illiquid counterparties



Spread Mapping and the "Doom Loop"

"… given the relative illiquidity of sovereign CDS markets a sharp increase in demand from active investors can bid up the cost of sovereign CDS protection. CVA desks have come to account for a large proportion of trading in the sovereign CDS market and so their hedging activity has reportedly been a factor pushing prices away from levels solely reflecting the underlying probability of sovereign default."

Bank of England Q2



Source: Barclays Capital

- **CVA desks with similar hedging requirements**
  - Extreme moves in a single variable (e.g. spread blowout)
  - Sudden change in co-dependency between variables (creating cross gamma issues)
  - At this point do we stop hedging bear the pain?

Regulation and the Difference Guises of CVA

Counterparty Credit Risk Capital Charges

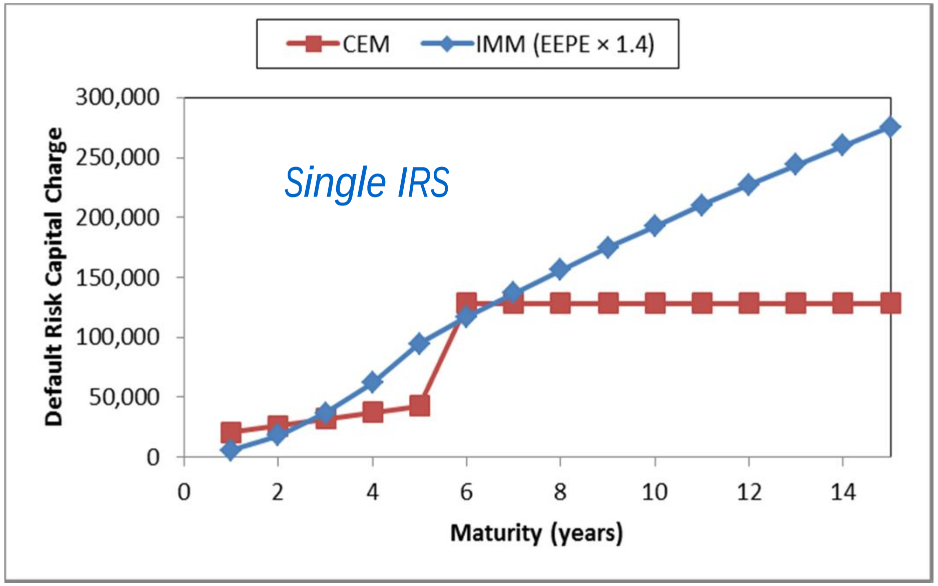
Analysis of the CVA Capital Charge

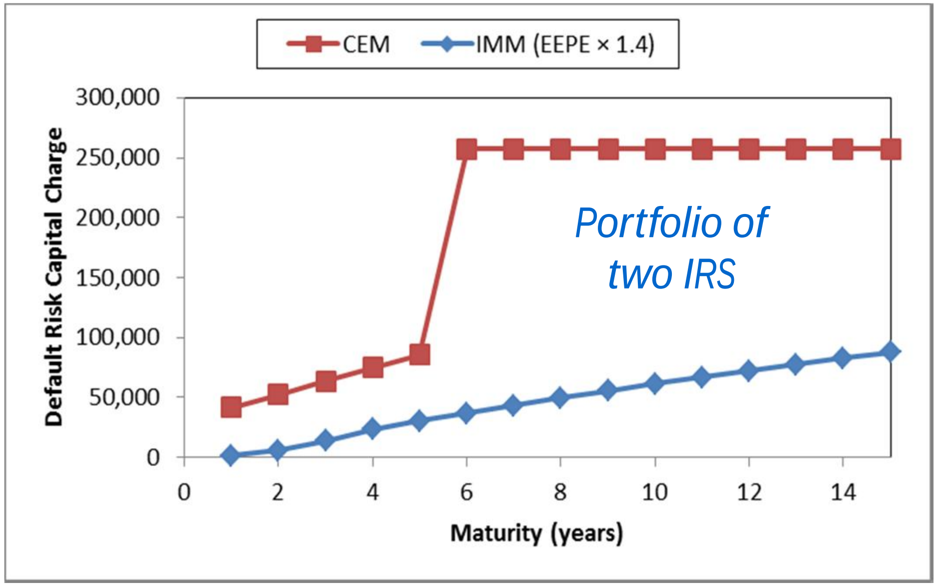
Impact of Central Clearing

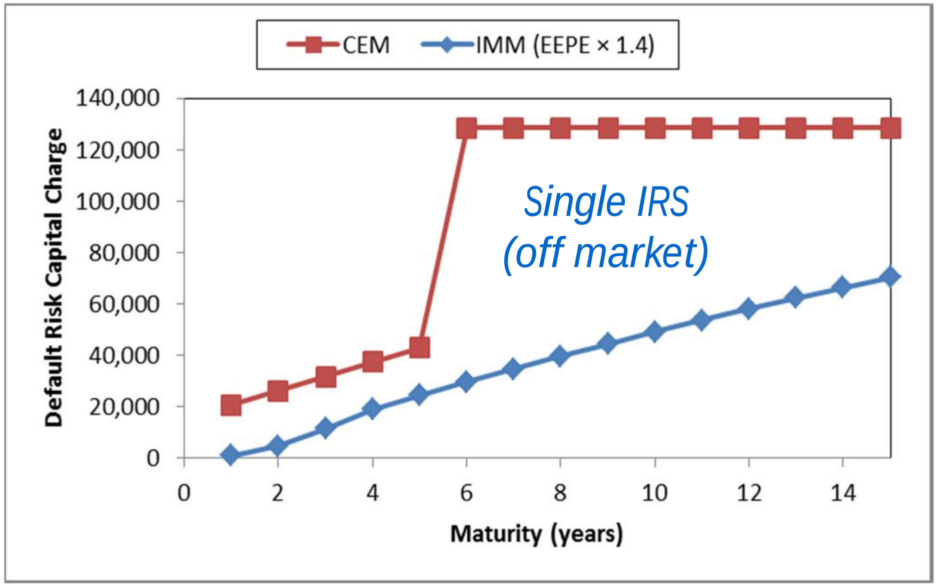
Overview of counterparty risk related capital charges

<table>
<tr><th></th><th>Default risk capital charge</th><th>CVA capital charge</th></tr>
<tr><td>IMM approval</td><td rowspan="2"><u>IMM method</u>
Higher of IMM capital charge based on EAD calculated with both standard and stressed calibrations
If approval exists for collateralised trades, then future collateral can be modelled.</td><td><u>Advanced method:</u>
Uses banks VAR model for bonds to model spread
Eligible hedges (single-name and index CDS) can be included
Sum of normal and stressed VAR</td></tr>
<tr><td>IMM approval only</td><td rowspan="2"><u>Standardised method:</u>
Simple variance formula driven by EAD
EAD defined according to default risk approval (CEM, IMM etc)
Hedges included but limited relief from indices</td></tr>
<tr><td>No approvals</td><td><u>Simple methods</u>
Current exposure method
Standardised method
Shortcut method (collateralized trades)</td></tr>
</table>

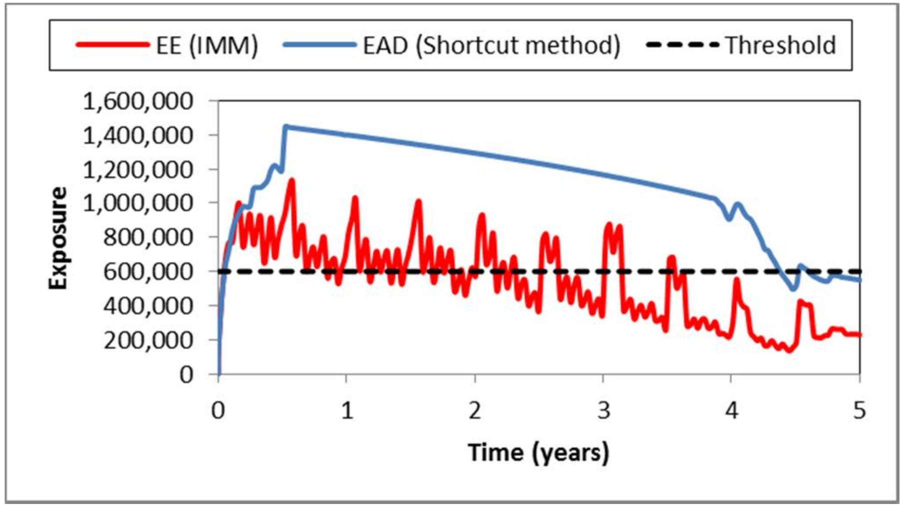
Comparison Between CEM and IMM







- **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

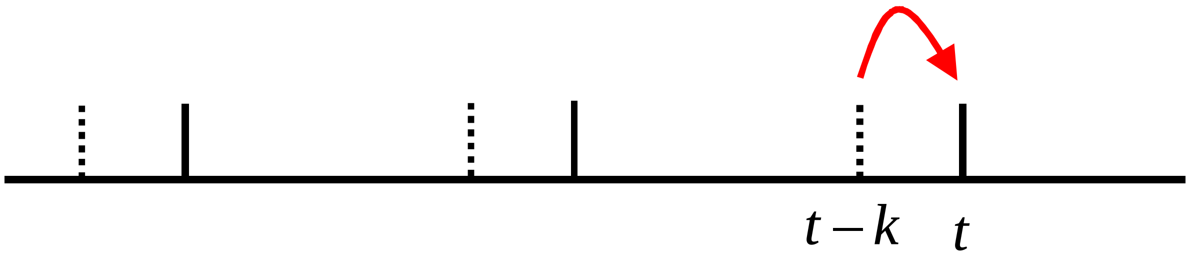


$$E_t = \max(V_t - C_{t-k}, 0)$$

Positive exposure at time t

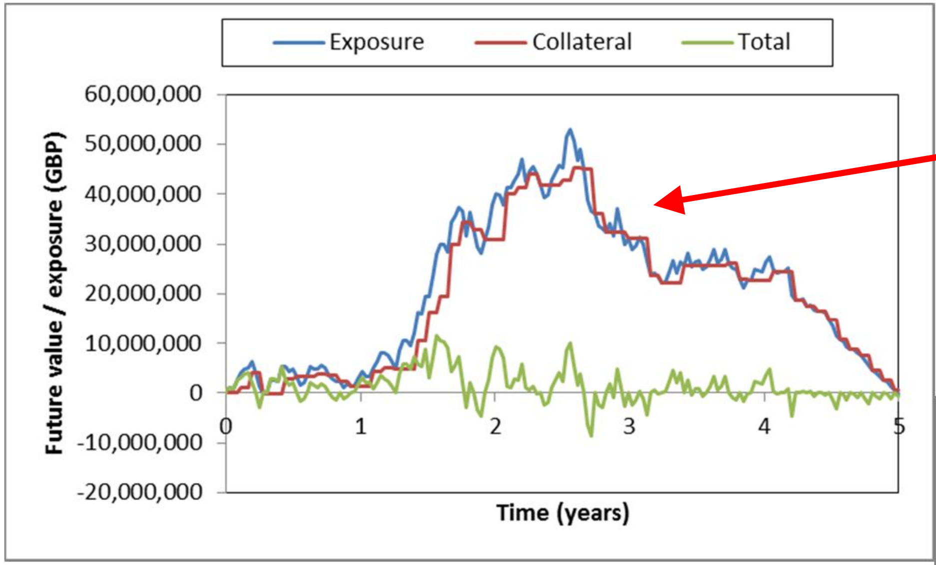
Future value at time t

Total collateral account k days ago



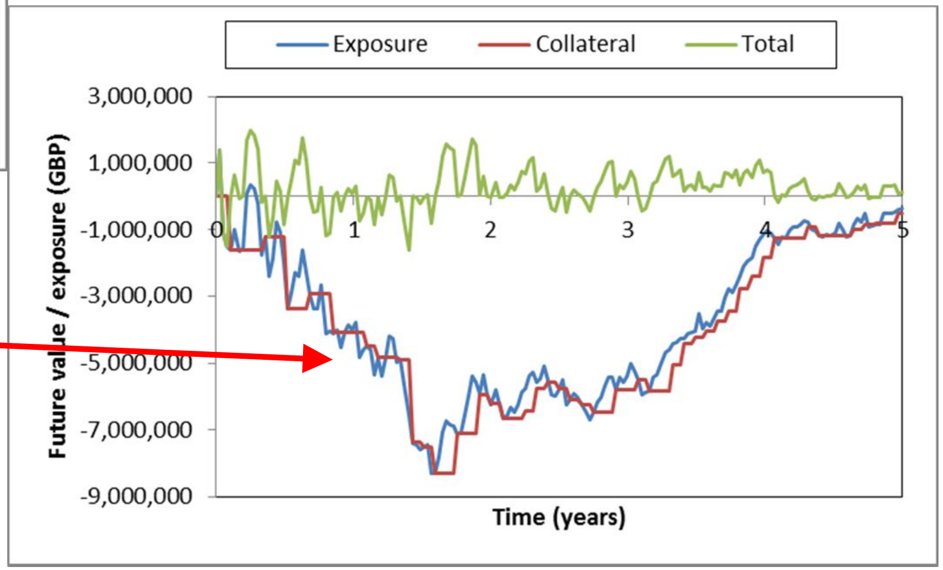
Margin Period of Risk

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

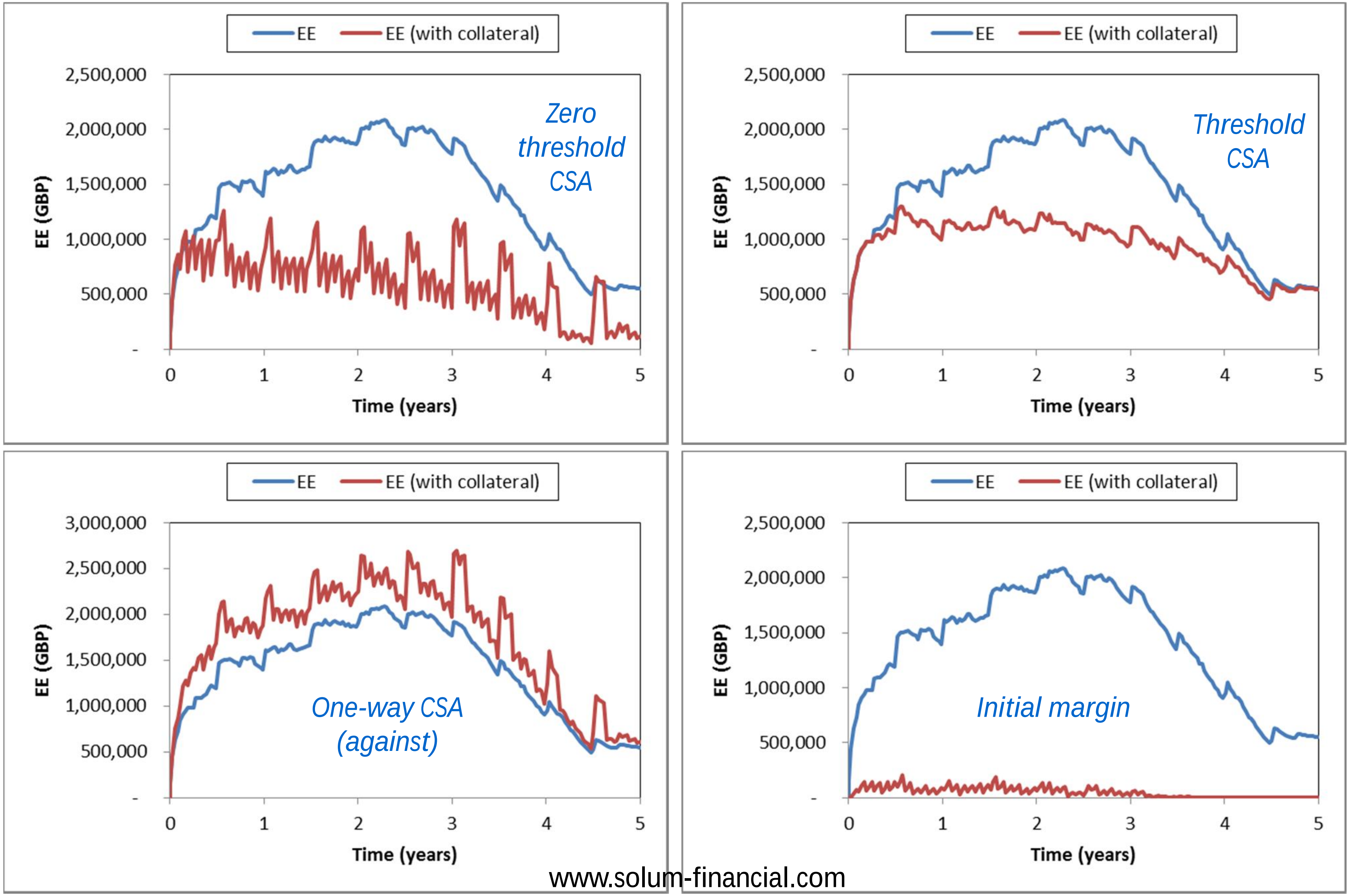


Imperfect receipt of collateral

Need to post collateral

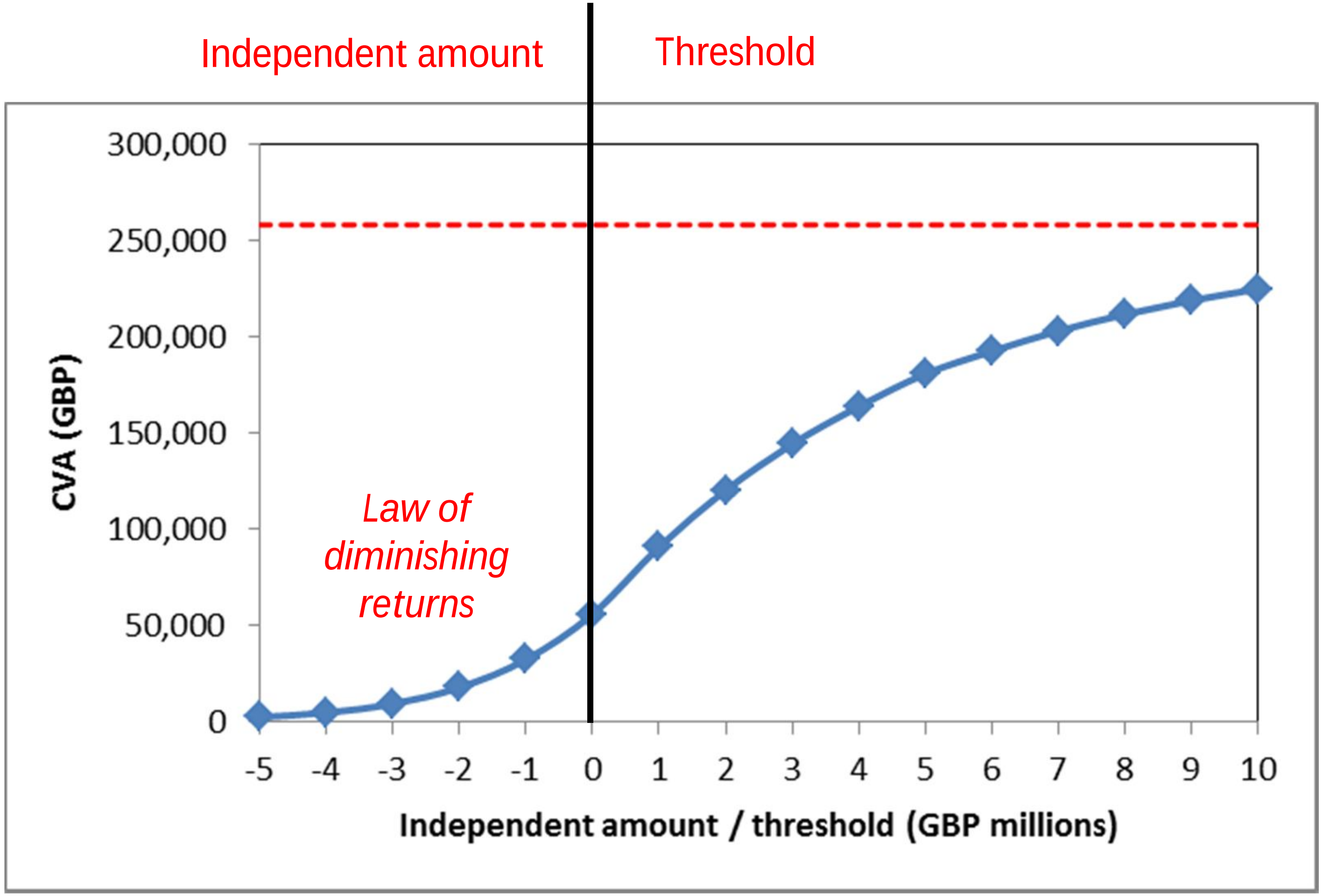


Impact of Collateral on Exposure



CVA with Independent Amount / Threshold

Zero threshold, 10 (business)-day margin period of risk



Regulation and the Difference Guises of CVA

Counterparty Credit Risk Capital Charges

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Impact of Central Clearing

Standardised Approach (I)

- **Normal distribution VAR approach based on the standard deviation of CVA**
  - 99% confidence level, 1-year time horizon
  - Included 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

Standardised Approach (II)

- **Index hedges (systematic risk) driven by a standard normal variable V_{ind} and each counterparty position is driven by another normal variable V_i:**

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

Note: this implies **counterparty-**counterparty spread correlation of ρ^2

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

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

Correlation parameter (50%)

Counterparty weight by rating

Single name hedged notional

  – Volatility (credit) represented by weights (*w*) via rating (or average rating for index hedges)

  AAA = 0.7%, AA = 0.7%, A = 0.8%, BBB = 1%, BB = 2%, B = 3%, CCC = 10%

Advanced Approach (I)

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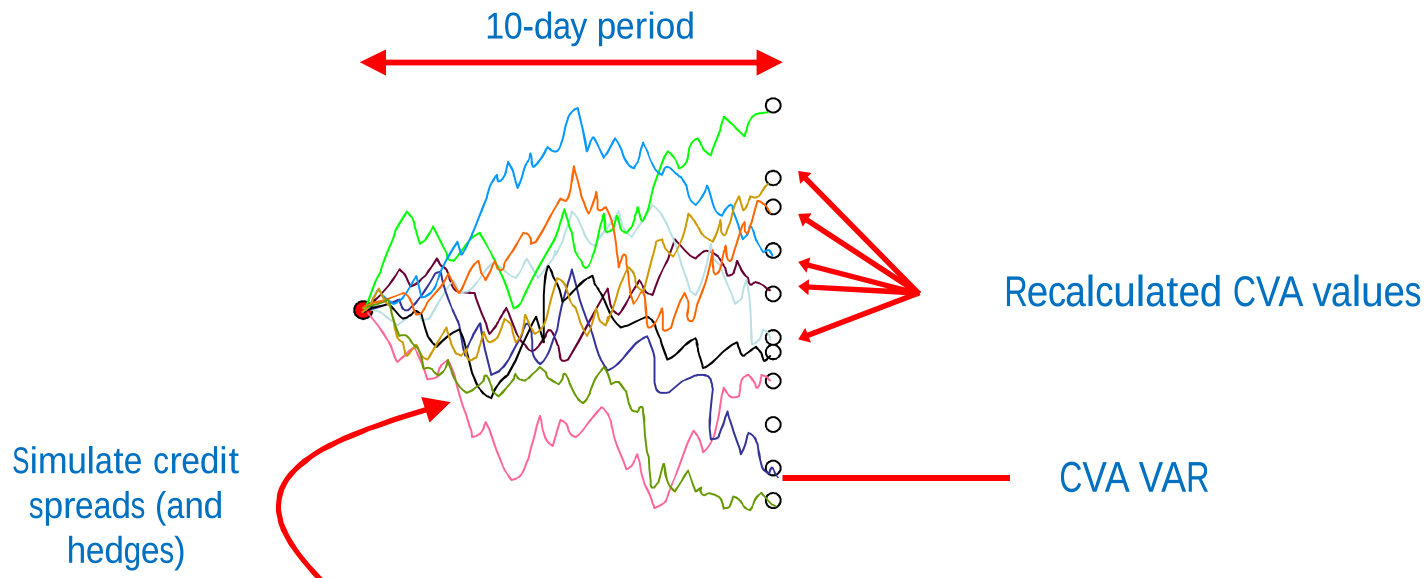
- **Bank can model the VAR with their own models with CVA defined by:**

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

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, 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 VAR multiplier of 3

Advanced Approach (II)



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

Capital Treatment of Hedges

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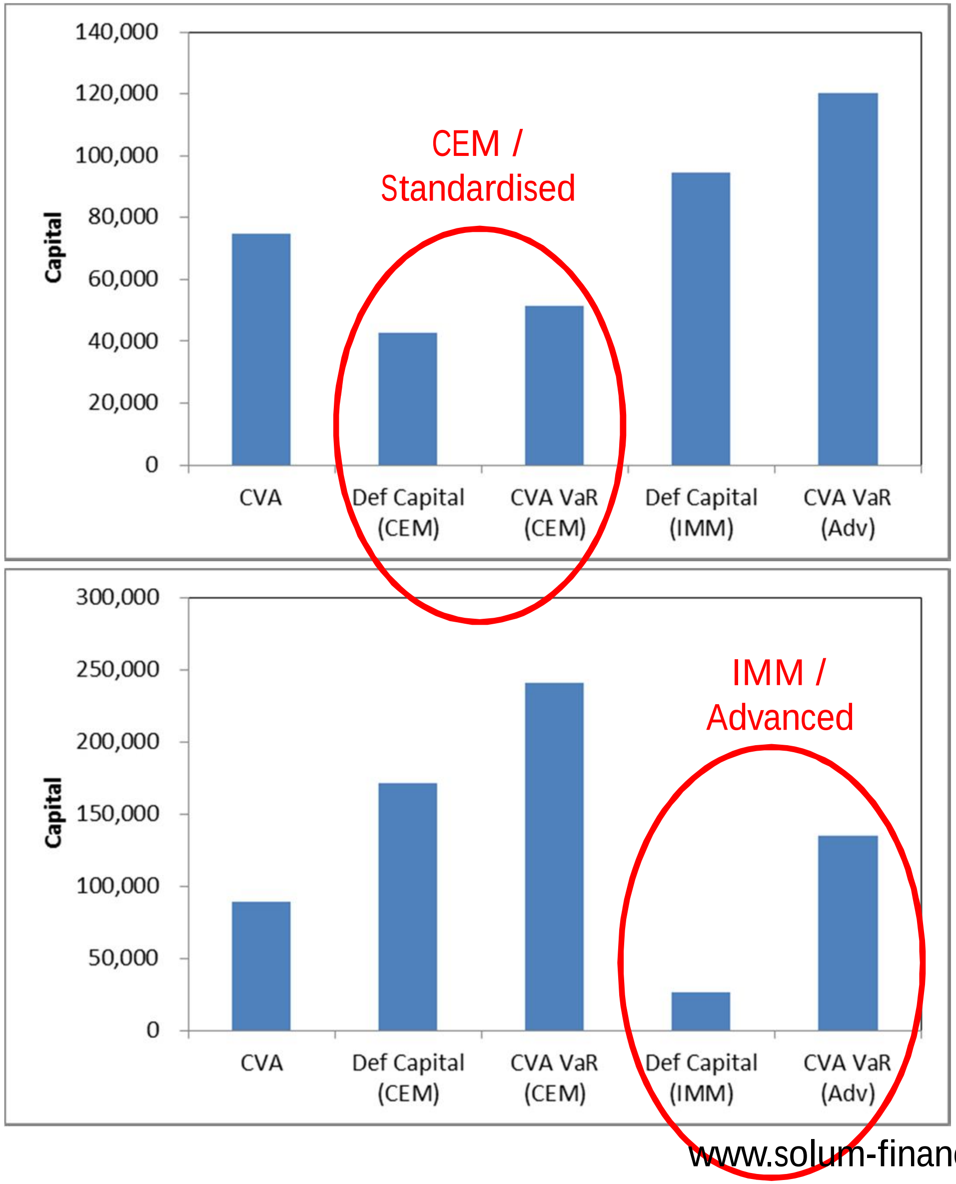
- **Single name CDS**
  - Standardised approach - offset according to EAD and maturity adjustment
  - Advanced approach - offset calculated within VAR simulation (delta neutral?)
  - <u>No relief for single-name proxy hedges</u>
- **Index CDS**
  - Standardised approach – as above but according to assumed 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 may increase capital!

Examples – Standardised vs. Advanced Capital Charges



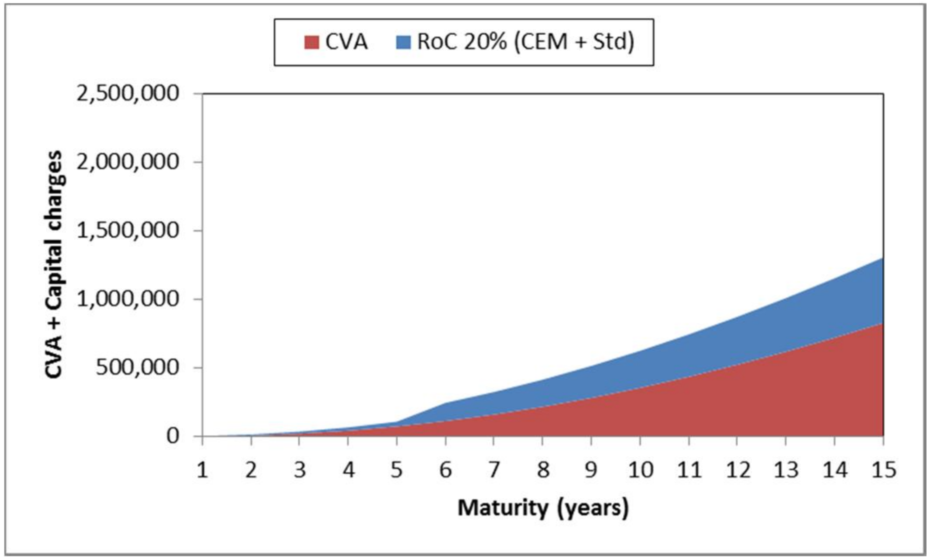
5-year swap. CEM approach gives relatively small exposure and much lower capital charge.

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.

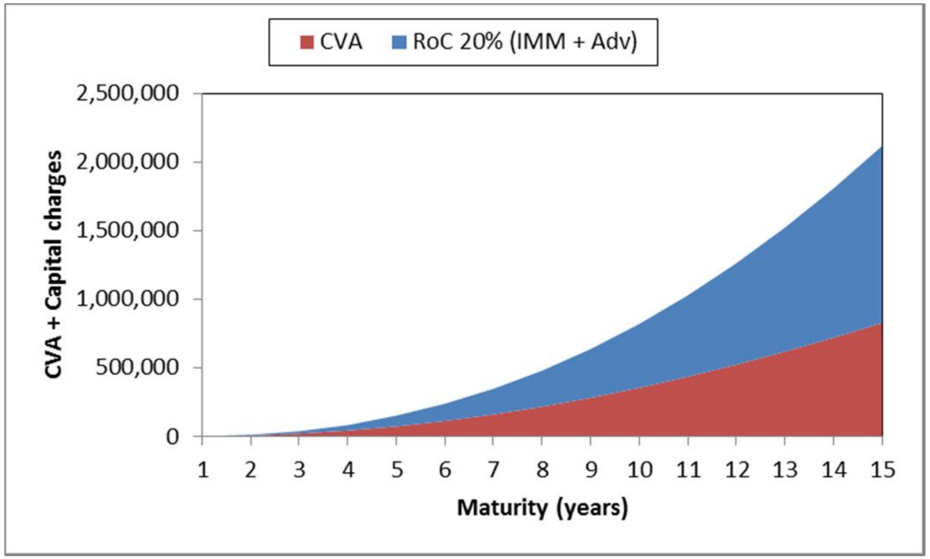
Return on Capital Analysis (single swap)

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



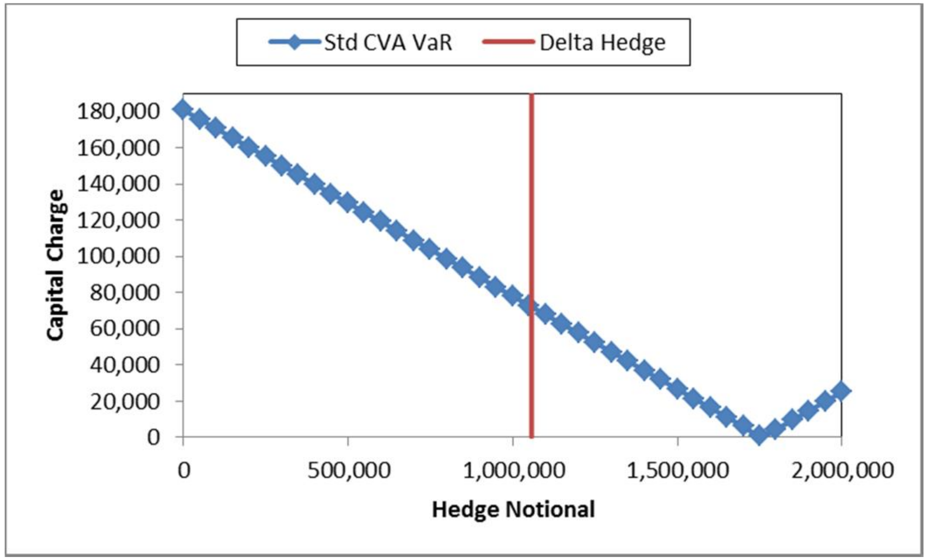
$$RoC = \frac{(Price - CVA)}{0.5 \times Regulatory\ Capital \times Maturity}$$

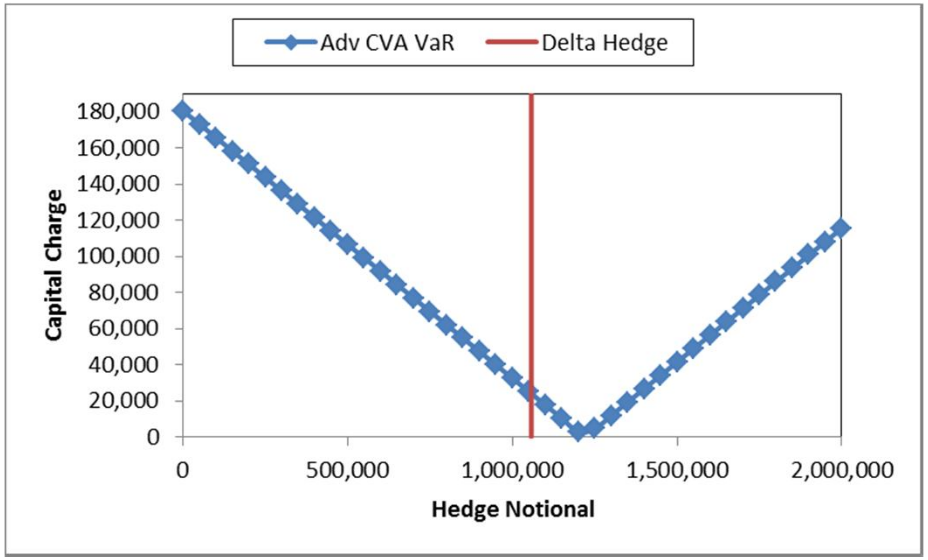
Approximately the same for 6-year swap. Advanced approach gives higher costs for longer maturities



Impact of Single Name Hedges

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





Standardised approach

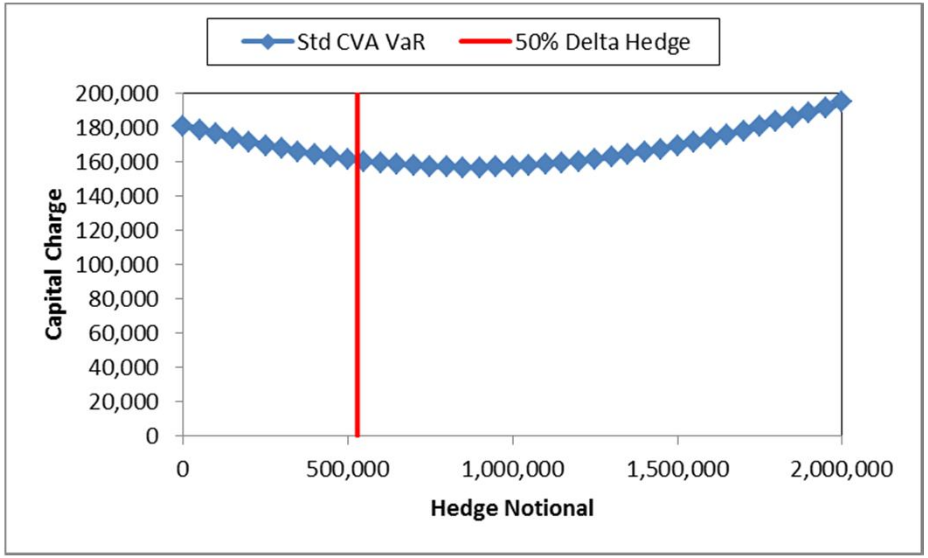
Delta hedge too small as EAD is relatively large under CEM approach. Capital relief very misaligned with CVA hedging.

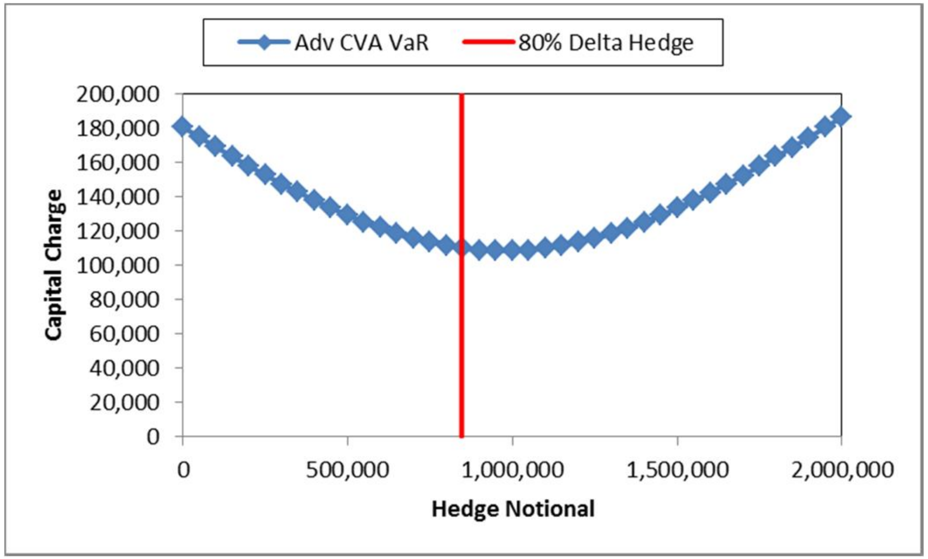
Advanced approach

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)





Standardised approach

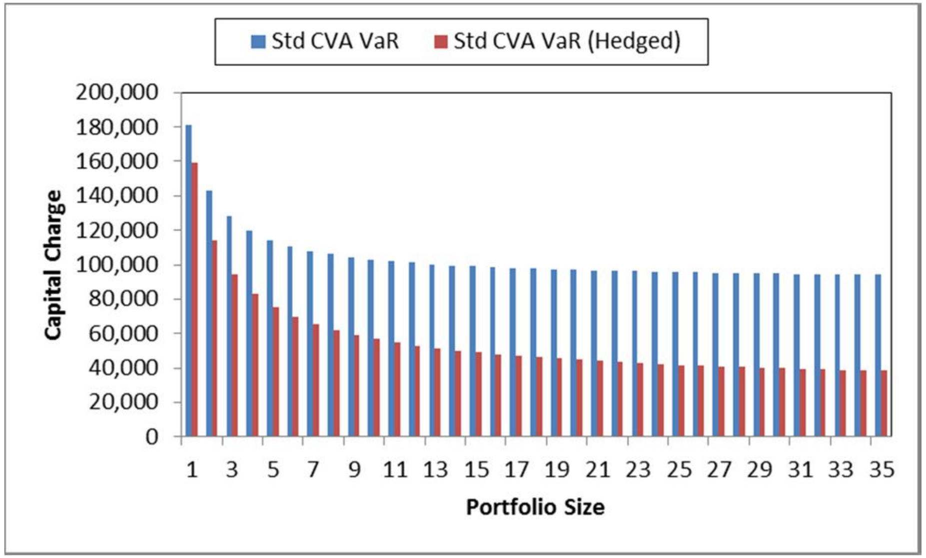
Capital relief poor due to misaligned delta and 50% correlation assumption.

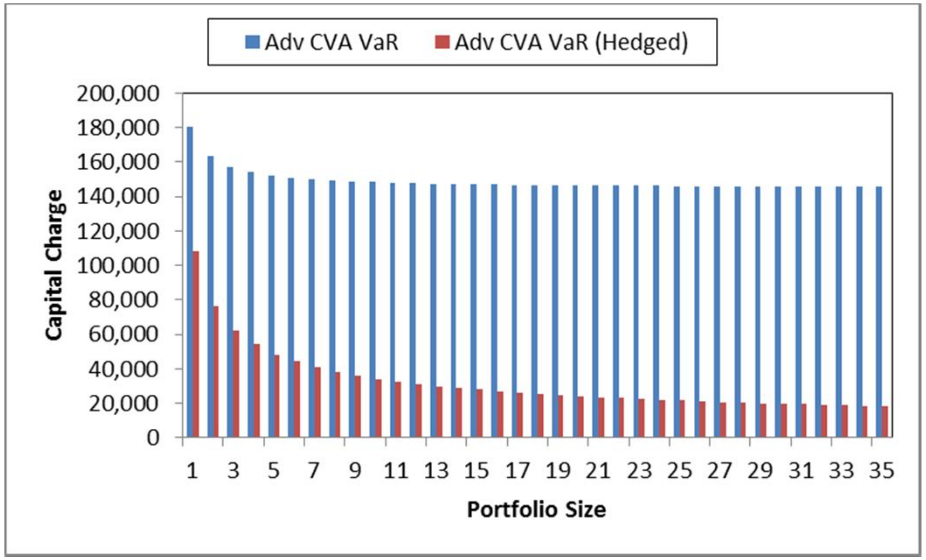
Advanced approach

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

Impact of Portfolio Effect

Impact of increasing number of counterparties





Standardised approach

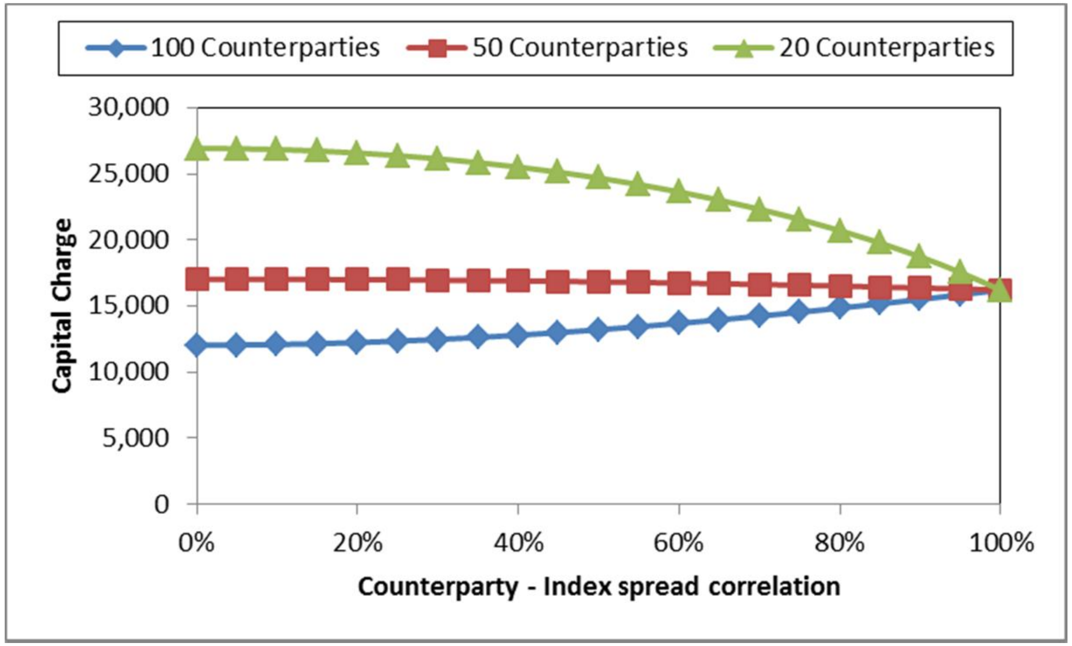
Significant portfolio effect. Hedging improves with size of portfolio. Idiosyncratic risk diversifies and systemic risk can be hedged.

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)*

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Central Clearing Overview

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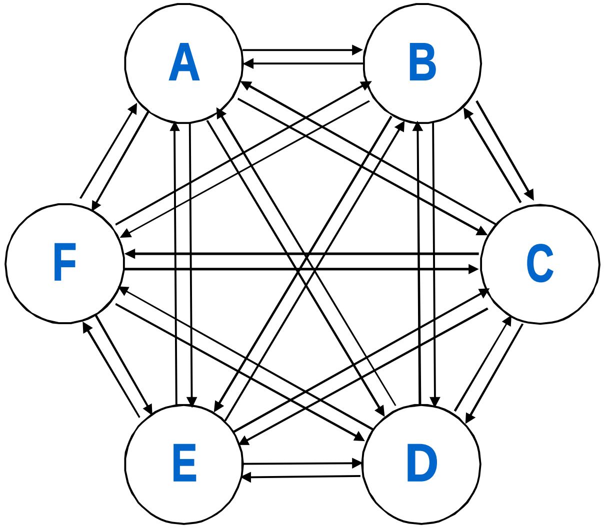
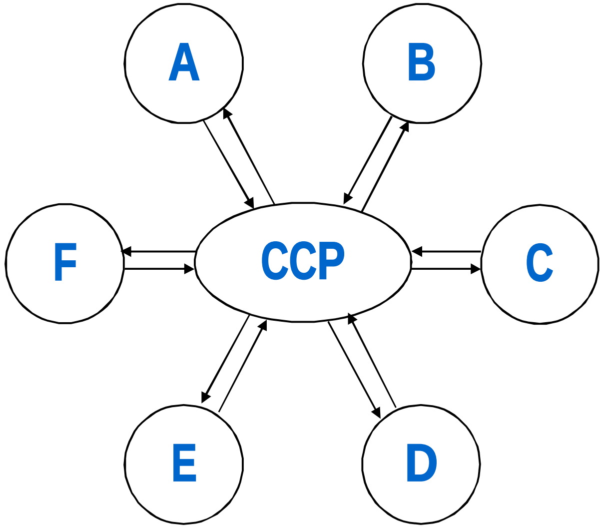
Bilateral market



CCP market



CCP Loss Waterfall

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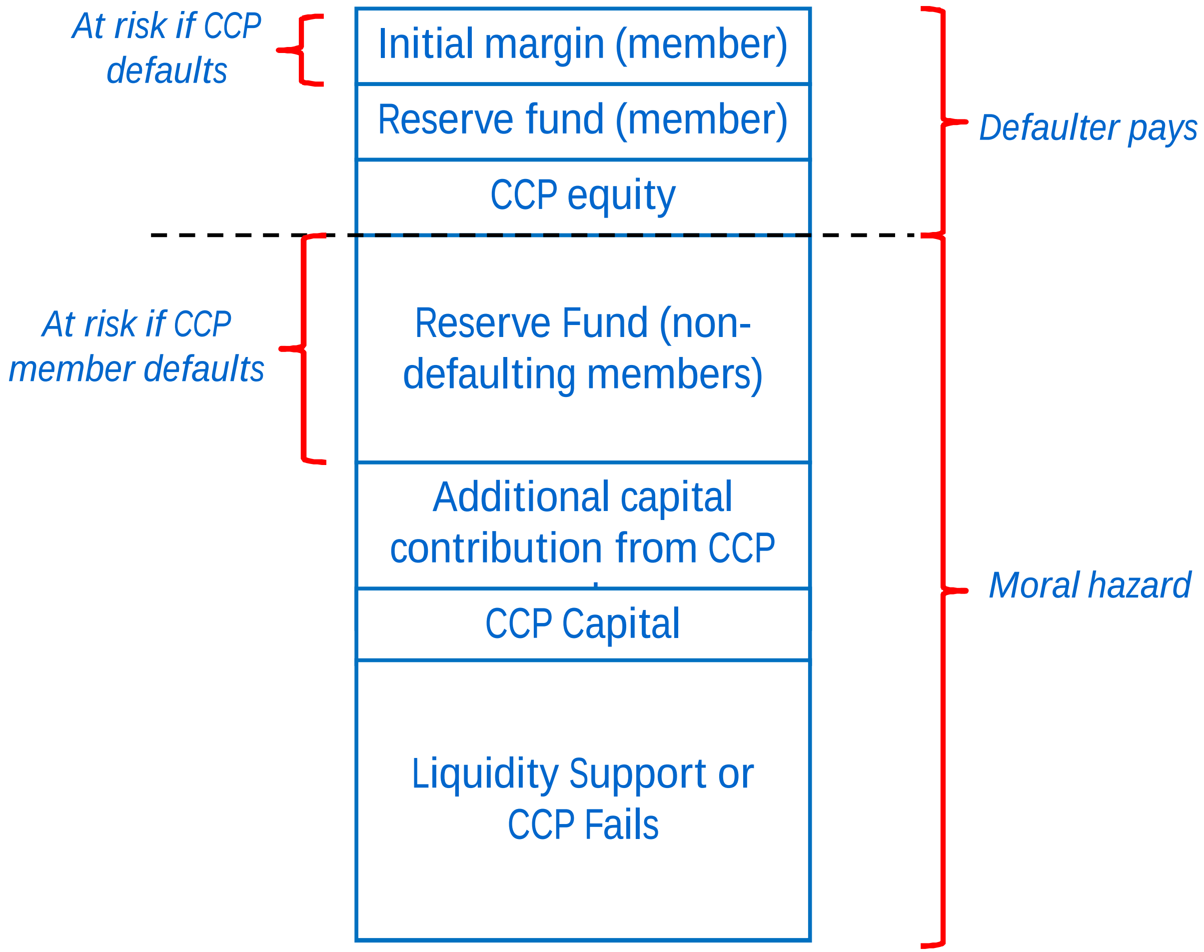
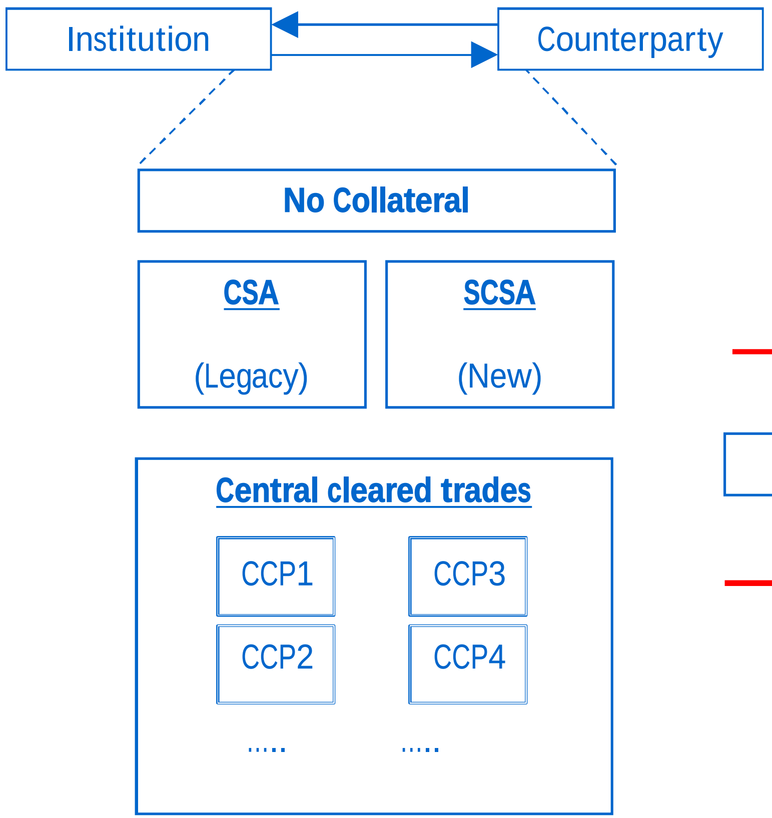
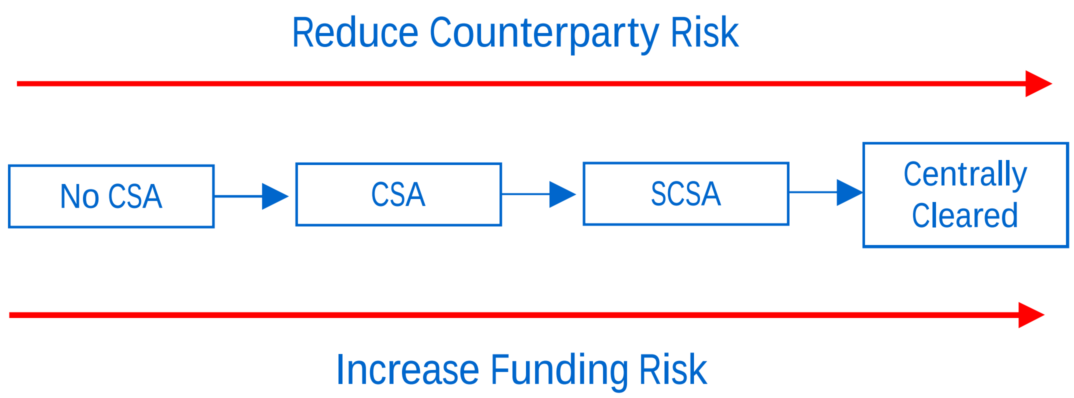
- **Allocation of losses after CCP has closed out trades and liquidated variation margin**

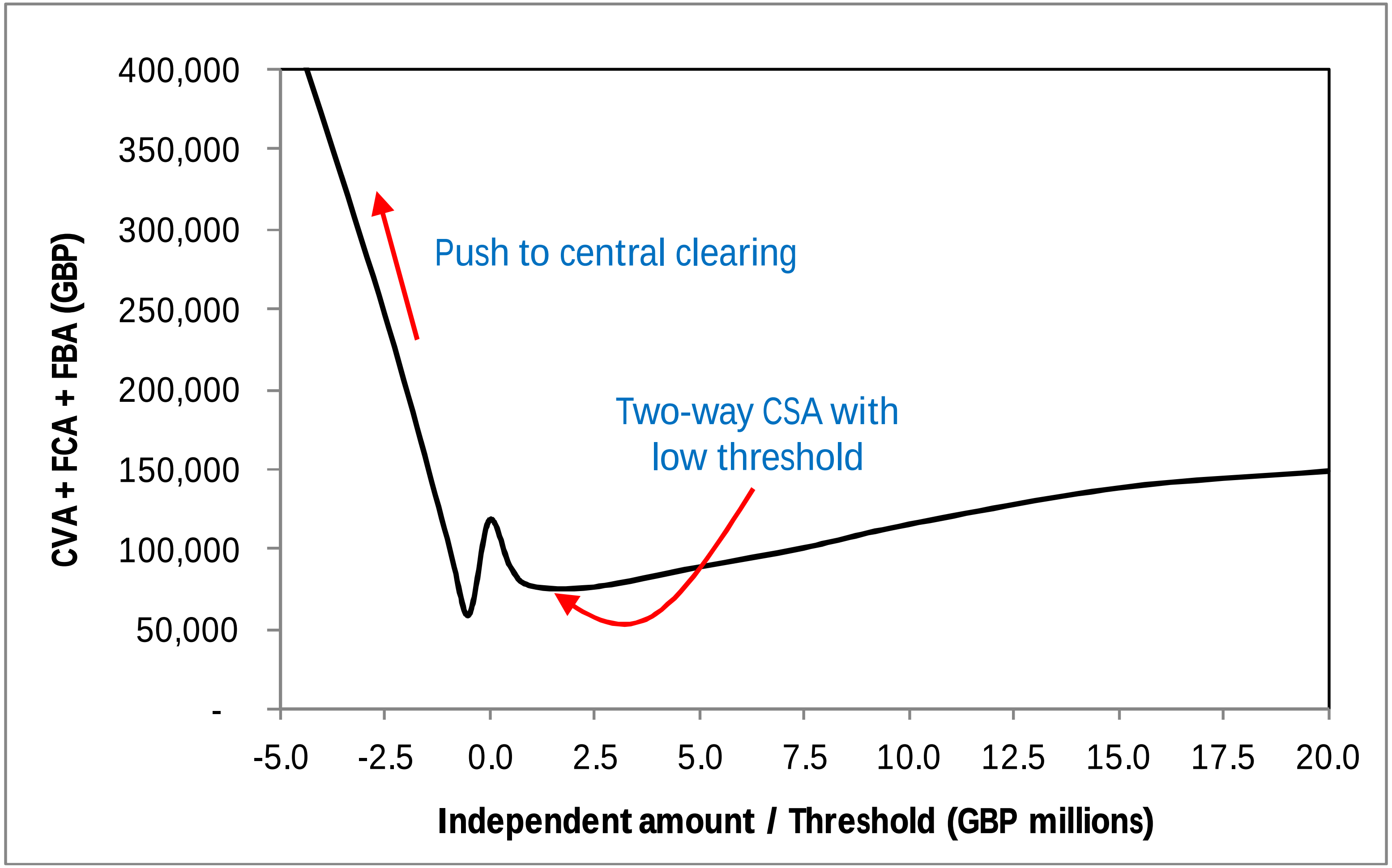


The Impact of Counterparty Risk Reduction





Overall Impact of CVA, DVA and Funding Costs



Conclusions

- CVA capital charge is flawed
  - Need to map huge universe of illiquid counterparties
  - Even when counterparty is liquid, single-name hedging can create “doom loop” and regulators are clearly aware of this (exemptions / no capital relief for single-name proxies)
  - Standardised vs. advanced approach are very different and not obvious which is favourable
  - Not clear on the incentive or benefit when hedging with indices
- Exemptions
  - Within the context of the CVA capital charge, no economic rationale to exempt the very obvious CVA components (sovereigns, corporates …..)
- Impact of collateral
  - More focus on CVA for collateralised transactions
  - Assessment of opaque risk to central counterparties is very difficult
  - Central clearing is extremely expensive due to the law of diminishing returns in reducing CVA