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Complexities in Managing CVA

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How to manage CVA

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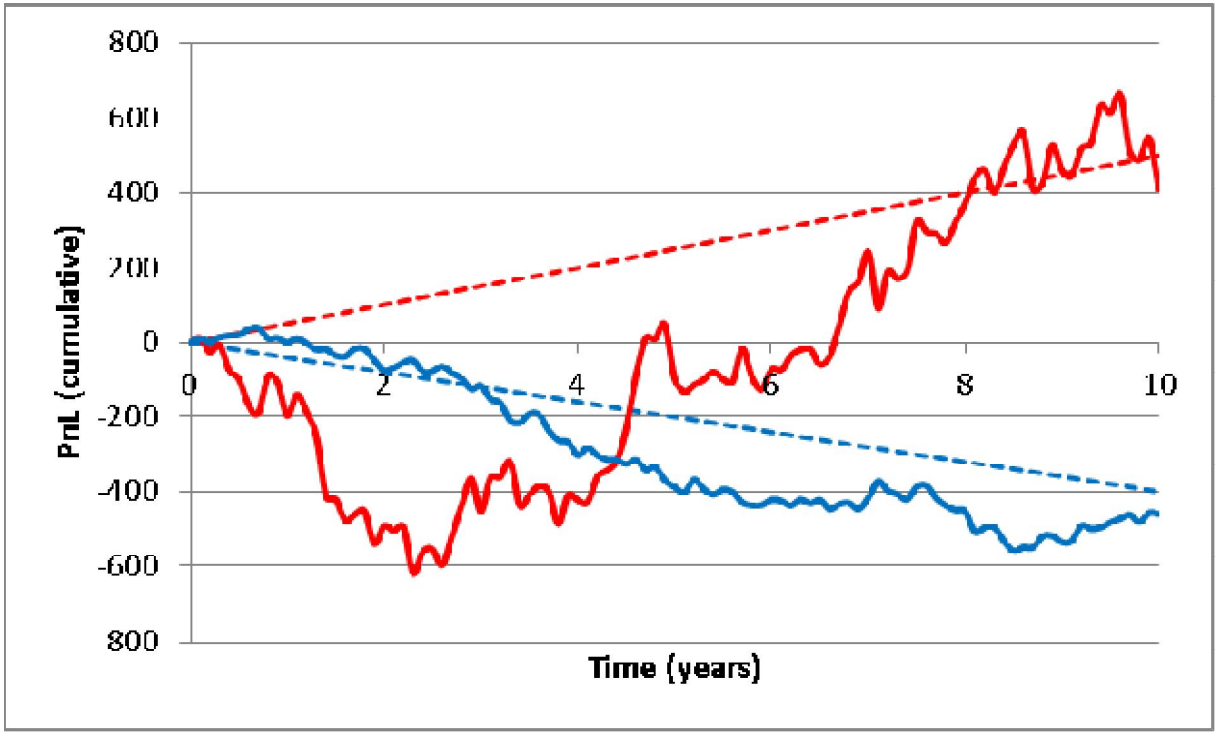
- CVA could be managed (priced?) in one of two ways
  - ✓ Actuarially, similar to loans held on the banking book
  - ✓ Similar to the treatment of the underlying derivatives, therefore implying that CVA will be dynamically hedged



No hedging

Full hedging

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- **Market approach to quantifying CVA**
- The mapping problem
- Hedging CVA and DVA
- The unintended consequences of CVA hedging
- Other methods of managing CVA
- Conclusion

The Birth of the CVA Desk

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- Requirements to mark-to-market CVA in all derivatives positions
- This creates two obvious key problems
  - ✓ How to allocate the CVA across businesses / trading desks
  - ✓ How to avoid the volatility of all the CVA due to market movements (especially specifically credit spreads and volatility)
- Creates the need for an institution to have a specialised group to tackle this across all businesses (the “CVA desk”)
  - ✓ But will banks be better off trying to hedge their CVA?
  - ✓ Basel III and future changes in accounting practices may make this argument somewhat academic

CVA is very complex

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- CVA is very hard to calculate (even for vanilla products)
- Credit exposure
  - ✓ CVA creates a short optionality in the underlying product
  - ✓ Netting means that correlation is an important variable (not just for the next 10 days)
- Default probability / recovery
  - ✓ Most names do not have a liquid CDS market so most curves must be “mapped” (proxies, indices, rating / sector / region)
  - ✓ Curve shape can be an important aspect
  - ✓ Recovery rates are uncertain and basis risk exists
- Wrong way risk
  - ✓ Linkage between default probability and exposure at default
  - ✓ May be very subtle and not well suited to traditional correlation approaches

CVA trading is a challenge

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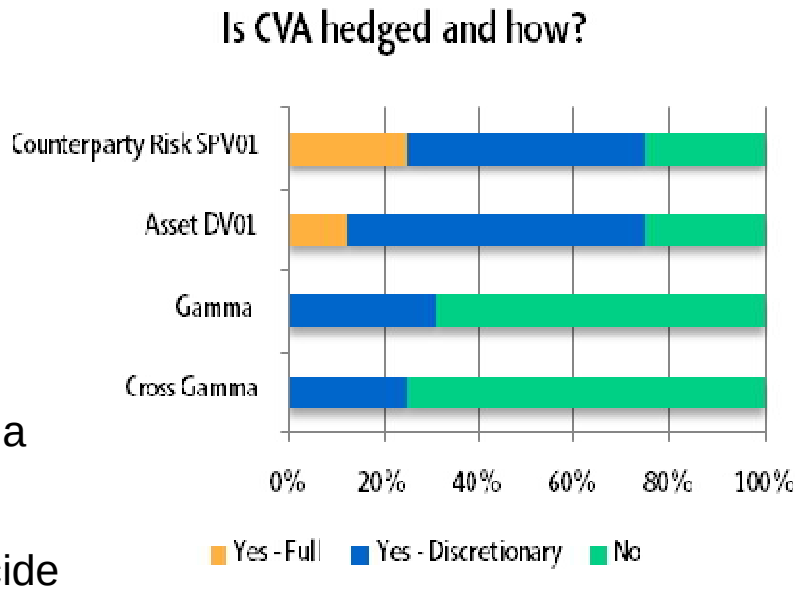
Pricing

- ✓ Must price via a transparent and industrialised methodology
- ✓ Cannot reject trades without strong justification
- ✓ Should give credit for all risk mitigants (netting, collateral, break clauses)

Hedging

- ✓ Management of a cross asset credit contingent book
- ✓ Trade on only one side of the market
- ✓ Some risks are not directly hedgeable
- ✓ Wrong way risk causes negative gamma problems
- ✓ RWAs and hedging aims may not coincide



Solum CVA Survey July 2010

CVA charges are too high

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- Most people would agree that a basic CVA calculation gives a “charge” that is simply too high
  - ✓ Corporate clients (for example) will not pay their entire credit spread in a CVA because banks have material credit spreads
  - ✓ Interbank market – cannot both charge for counterparty risk
- There are many ways in which the CVA is reduced
  - ✓ DVA
  - ✓ Ignoring CSA counterparties (CVA treated as zero even though it isn’t)
  - ✓ Use of a higher “ultimate” recovery (Lehman effect CDS auction recovery ~9%, ultimate recovery potentially up to 30-40%)
  - ✓ Central counterparties
  - ✓ Use of historical or blended default probabilities (does this suggest that some banks prefer not to dynamically hedge CVA?)

Regulatory Capital for CCR

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- Stressed EPE
  - ✓ IMM Banks must calculate exposures using stressed market data
- Wrong way risk
  - ✓ Must identify “general” WWR and assume a higher exposure for “specific” WWR
- Systemic risk
  - ✓ Correlation multiplier (1.25) for large regulated / unregulated financial firm exposure
- Collateral
  - ✓ A “margin period of risk” of 20 days must be applied for certain transactions
- Central counterparties
  - ✓ Risk weighting of 2% for CCPs which meet various rigorous conditions
- CVA VAR
  - ✓ Banks must hold additional capital to capture the volatility of CVA

CVA VAR (Basel III)

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- CVA definition is based on spreads NOT default probabilities

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

Default probability term

Exposure term

- What if we can't find the spread of a counterparty?
  - ✓ "*Whenever the CDS spread of the counterparty is available, this must be used. Whenever such a CDS spread is not available, the bank must use a proxy spread that is appropriate based on the rating, industry and region of the counterparty*."
  - ✓ This could become self-fulfilling when hedging with the index!

The Push to Risk-neutral CVA

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- The market has been moving towards a market implied or risk-neutral approach towards CVA
  - ✓ Accounting rules, practices of top tier banks, Basel III capital requirements
- This may sound obvious – however, there are counterarguments
  - ✓ Limited danger of being arbitraged in quoting CVA (more a winner's curse effect)
  - ✓ CVA hedging is much more complex than other "risk-neutral" trading functions
  - ✓ Cross asset credit contingent nature means heavy rebalancing cost
  - ✓ Avoid crowded trade effects, being crossed heavily on bid offer in blow up
- CVA may never be well-hedged?

Real World Default Risk

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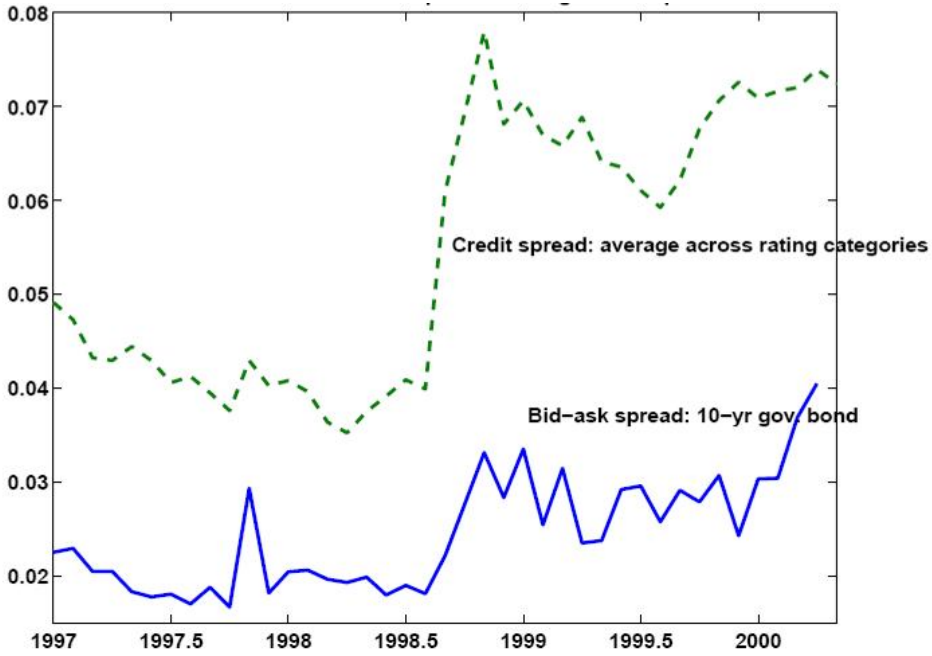
- Market credit spreads are too high compared to
  - ✓ Observed default rates and recoveries (e.g. Giesecke et al. [2010])
  - ✓ Merton type structural models of credit risk (CreditGrades™, Moody's KMV™) – see, for example, Berndt et al. [2005]
- Changes in credit spreads are not totally explained by credit risk factors
  - ✓ R^2 of only 30-40%, (for example see Collin-Dufresne, Goldstein and Martin [2001])
  - ✓ Credit spreads believed to be strongly driven by liquidity and risk premiums



Source: de Jong and Driessen [2005]

What's the Ratio?

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- Giesecke et al. [2010] "CORPORATE BOND DEFAULT RISK: A 150−YEAR PERSPECTIVE"
  - ✓ Analysis from 1866 – 2008
  - ✓ Average annual credit losses of 75 basis points per annum
  - ✓ Average credit spread of 153 basis points per annum
- Factor of two emerges

The Ratio by Credit Quality

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	Real world default intensity (bps)	Risk neutral default intensity	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, "The Relationship Between Credit Default Swap Spreads, Bond Yields, and Credit Rating Announcements", Journal of Banking and Finance, 28 (November) pp 2789-2811.

What's in a credit spread then?

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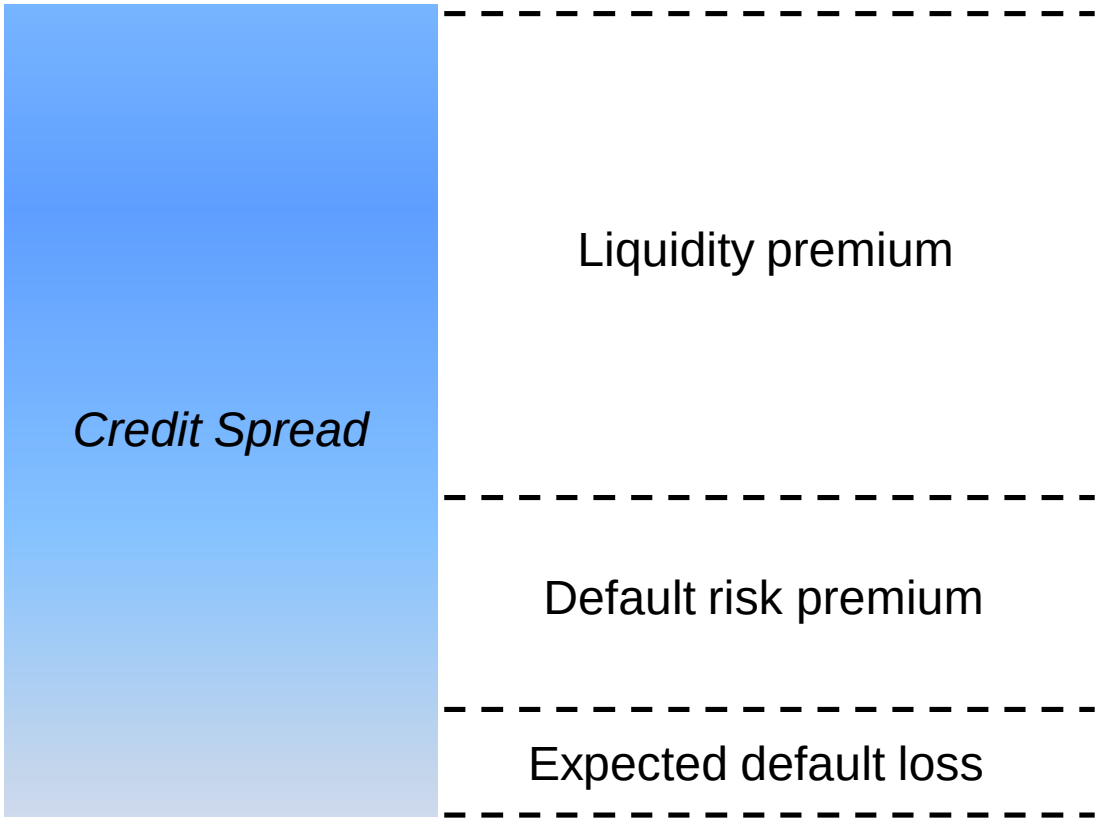
- Decomposition of a typical CDS spread
  - Hull et al. [2005], Elton et al. [2001], Driessen [2005]
  - Expected default loss is small especially for high good credits



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Deriving Default Probabilities

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- Default probability - very challenging, general approaches are

  - ✓ Observables
    - Liquid CDS market probably only covers a small percentage of total exposure
    - Even where there is a CDS market data exists, there may only be 1 liquid tenor (5Y)
  - ✓ Semi-observables
    - Bonds or some appropriate proxy
  - ✓ Non observables
    - No defined “credit spread”
    - Requires some mapping via rating, sector and region
    - Hedging via CDS indices - hedging accounting PnL but not economic risk?

Mapping Methods

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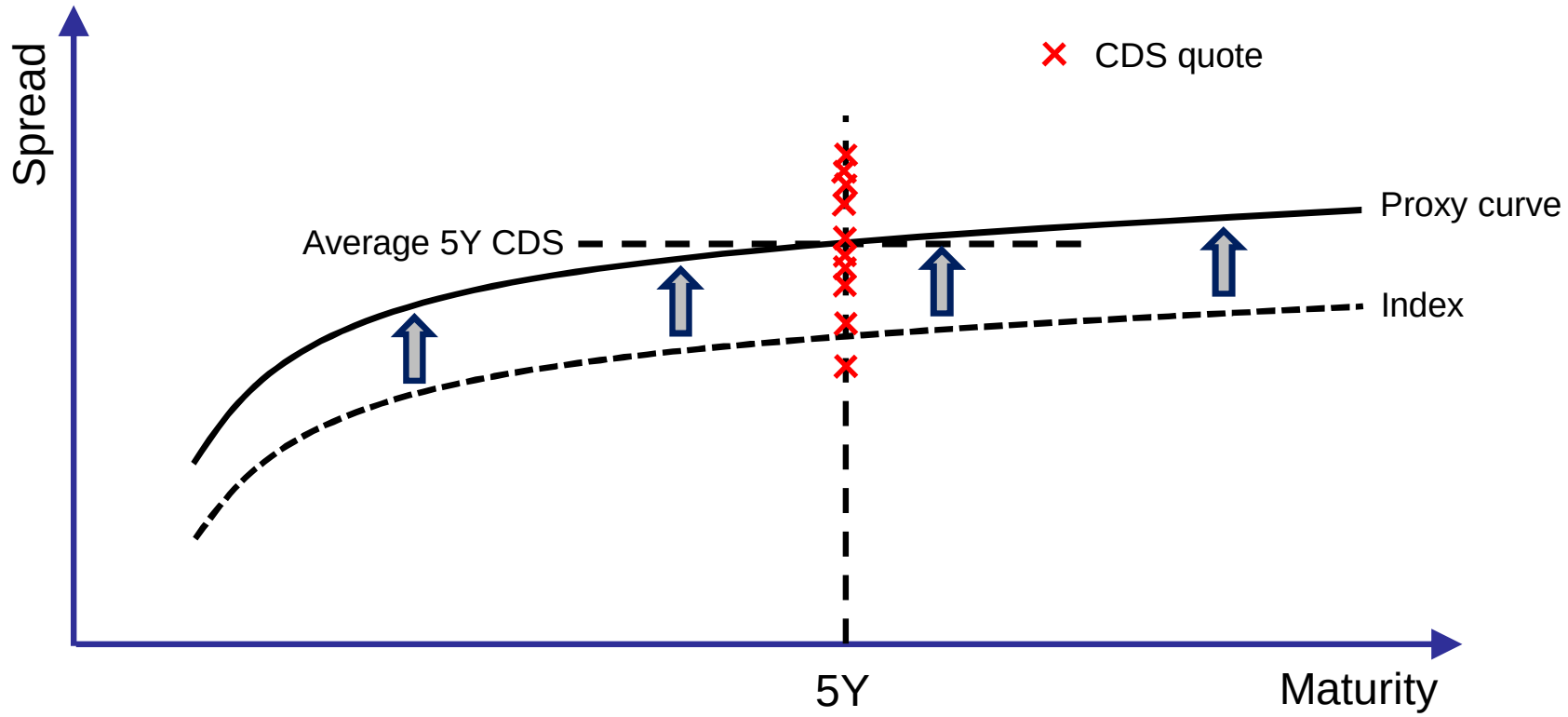
- **Mapping a curves from 5Y CDS quotes and index shape**



Mapping to Indices

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CDS	Region	Client	Rating	Index Name	Sector
CDS Index Proxy	EUR (all)	Multi-national Corp	BBB & above	Itraxx EUR Non-Financials	Financials, Govt, Basic Materials, Consumer Goods, Consumer Services, Health Care, Industrials, Oil & Gas, Technology, Telecoms, Utilities
			< BBB	Itraxx EUR Xover	
		Financials		Itraxx EUR SnrFin	
		Sovereigns		Itraxx SovX CEE	
				Itraxx SovX WE	
				Itraxx SovX AP	
	US			CDX IG	
				CDX HY	
Single name CDS proxy					
Single name CDS					

Credit Curve Shape and CVA

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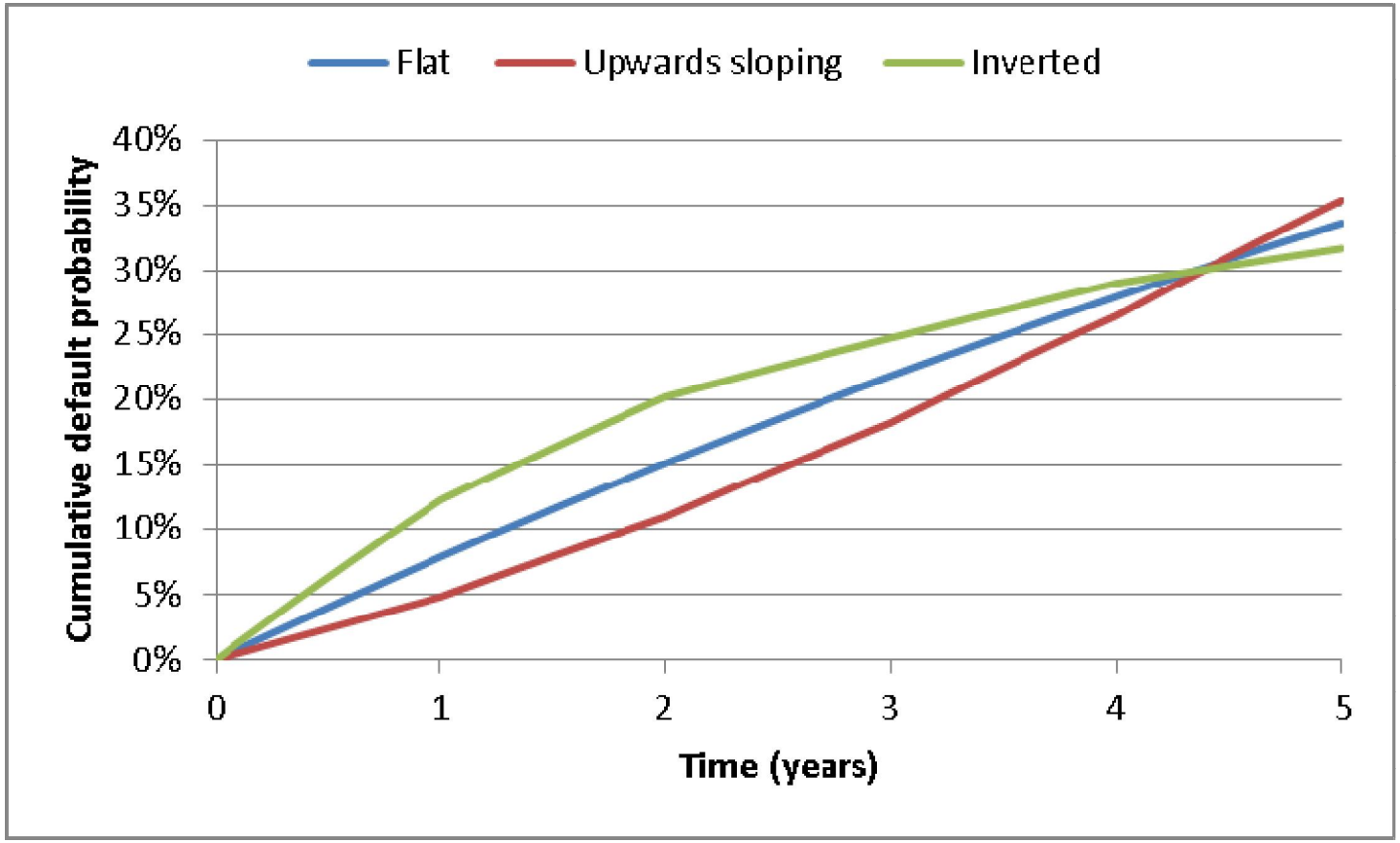
- **This can change the CVA of (for example) a CCS by 30-40%**



5-year credit spread = 500 bps, recovery = 40%

The Credit Mapping Problem

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- What will be the impact of this on the hedging of CVA?
  - ✓ Hedging will certainly be possible using indices (providing some capital relief under Basel III)
  - ✓ But will we be hedging our real economic risk?

Recovery Rates

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- Recovery tends to cancel out in pricing calculations
  - ✓ Average historical corporate recovery rate is approximately 40% with a large standard deviation
- Settled recovery
  - ✓ Recovery rate to imply default probability should be the one which CDS contracts would be settled at (usually in the CDS auction)
  - ✓ Ultimate recovery
  - ✓ The recovery value received would be whatever we eventually get paid for our claim (unlike bonds, derivatives cannot be traded in the CDS auction)
- In the case of Lehman
  - ✓ Settled recovery (CDS auction) was 9.375%
  - ✓ Ultimate recoveries received to date (claims sold) have approached 40%

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Some intuition on hedging

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- Sorenson and Bollier, “Pricing swap risk”, 1994
- CVA for a swap (maturity T) can be constructed as a weighted series of
  - ✓ European swaptions with maturity of potential default time τ on an underlying (reverse) swap of maturity T-τ

$$CVA_{swap} \approx (1-\text{Rec})\sum_{j=1}^{n} PD(t_{j-1}, t_j) V_{swaption}(t; t_j, T)$$

Default probability

Swaption maturity

Swap maturity date

- Intuition
  - ✓ Short a series of swaptions with weights given by the forward default probabilities
  - ✓ Hedge must involve buying European swaptions?
  - ✓ What about (say) the 4.5 year swaption to enter into a 0.5 year swap in the above formula?

Linear sensitivities

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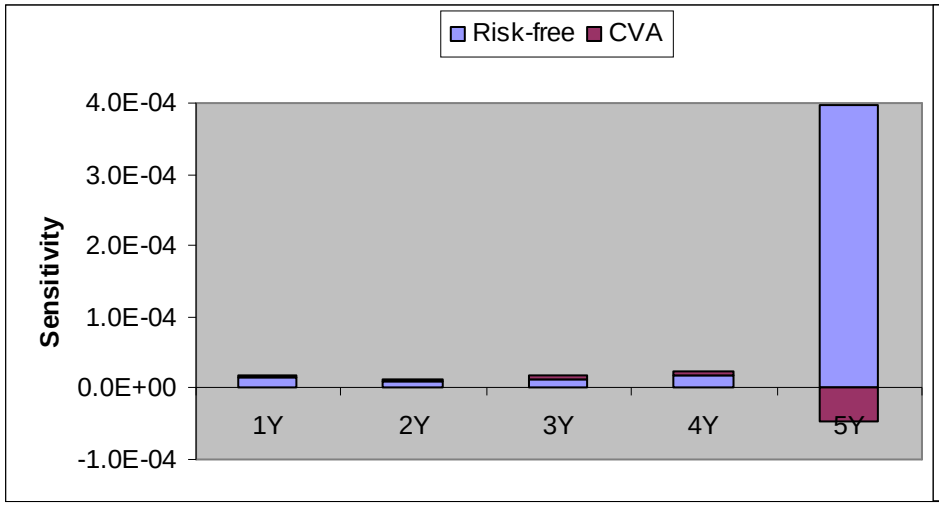
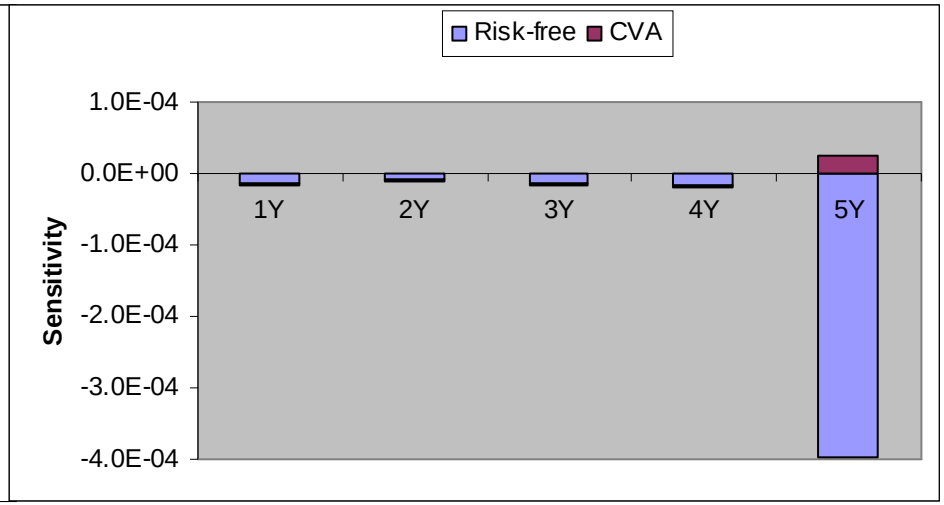
- **Examples consider 5-year interest rate swaps with an upwards sloping yield curve (payer swap has a larger CVA)**
  - ✓ CVA hedge involves “unwinding” some of the standard hedge
  - ✓ Payer swap has a greater EE (upwards sloping curve) so sensitivity is larger
  - ✓ Generally easy to hedge (at least for parallel shifts)
  - ✓ Similar results for FX etc

Payer swap



Receiver swap



Volatility

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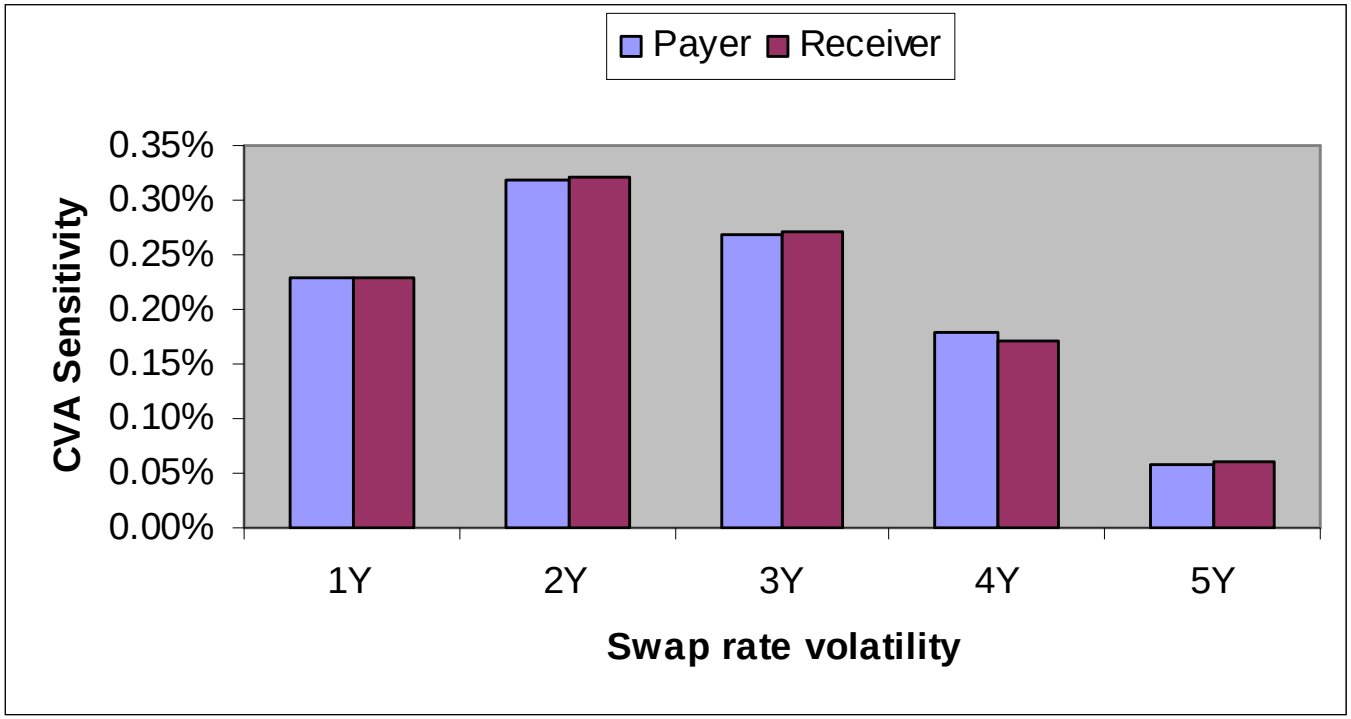
Sensitivity is approximately the same for payer and receiver

- ✓ Swaptions are implictly in and out of the money respectively
- ✓ Impicitly short vega on all positions
- ✓ Need to buy swaptions to hedge (potential short dated vs long dated problem)



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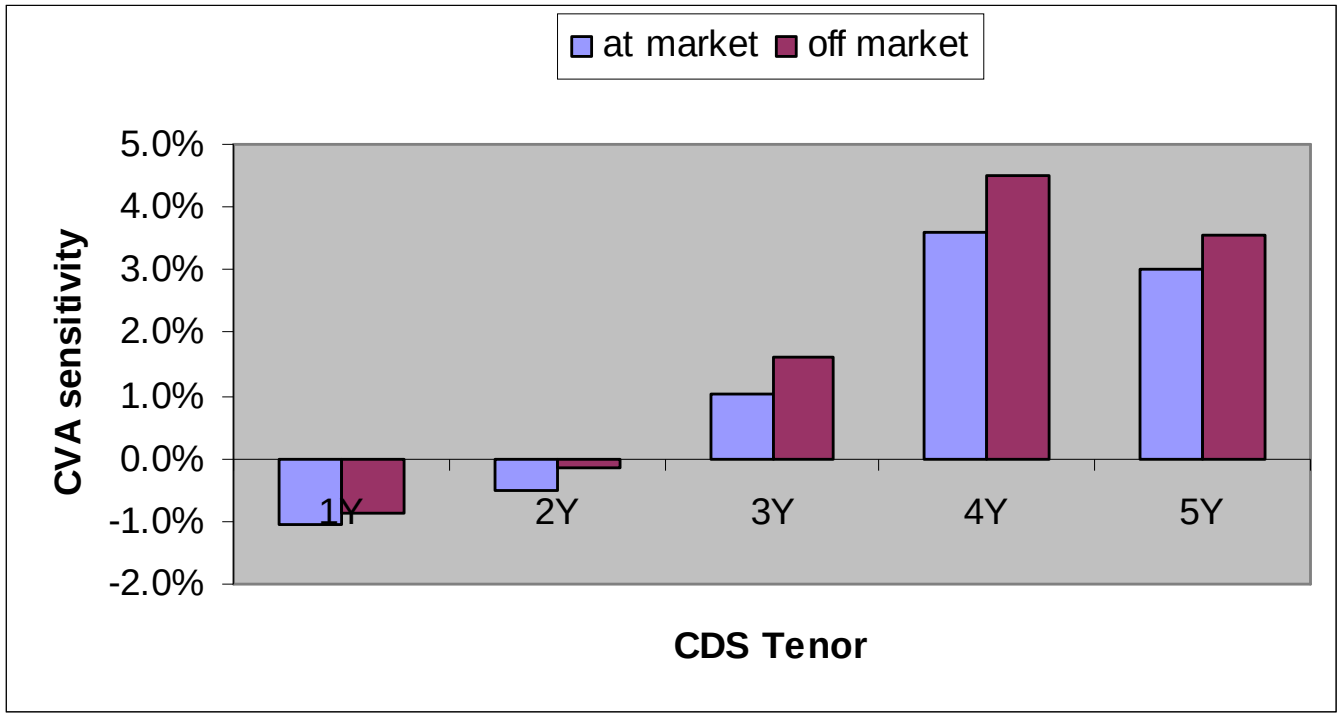
Buy CDS protection against CVA

- ✓ Ideally would require CDS of many maturities
- ✓ Note CDS hedge changes as exposure changes (at-market to off-market)



Definition of DVA

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- Bilateral CVA considers also an institutions own default
  - ✓ (this formula assumes independent of defaults)

$$BCVA(t) = (1-\delta_C)\int_t^T EE(u)\left[1-PD_I(u)\right]dPD_C(u) \qquad \text{CVA}$$

Expected exposure

Probability we haven't yet defaulted

Probability counterparty defaults

$$-(1-\delta_I)\int_t^T NEE(u)\left[1-PD_C(u)\right]dPD_I(u) \qquad \text{DVA}$$

Own percentage recovery value

Negative expected exposure

Probability counterparty hasn't yet defaulted

Probability we default

How to Monetise DVA

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- Go bankrupt
  - ✓ Usually not a popular choice
- Unwinds or novations
  - ✓ An institution may realise a DVA gain if a trade is unwound in the future (e.g. banks unwinding transactions with monolines)
- Hedging
  - ✓ DVA much harder to hedge than CVA - cannot sell CDS protection on yourself!
  - ✓ Buy back your own debt (not really a dynamic hedge) – do you have the cash?
  - ✓ Sell CDS on another counterparty (who is highly correlated with you) – give wrong-way risk to buyer of protection – careful who you choose (Lehman)
- Funding arguments
  - ✓ Double counting!

DVA impact – vega hedges

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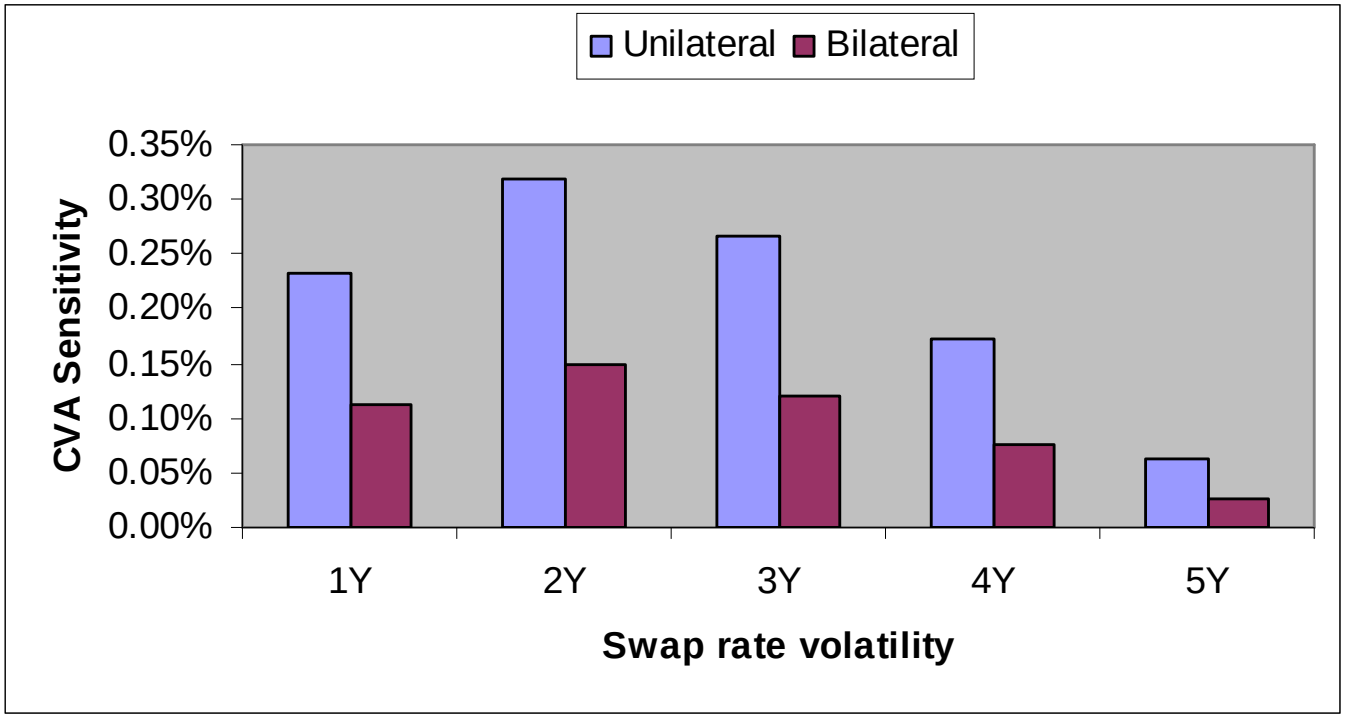
Sensitivity to volatility

- ✓ Long and short swaptions will cancel
- ✓ In this case we are half as risky as counterparty (CDS = 250 bps vs 500 bps)
- ✓ Sensitivity is approximately halved



DVA impact – credit hedges

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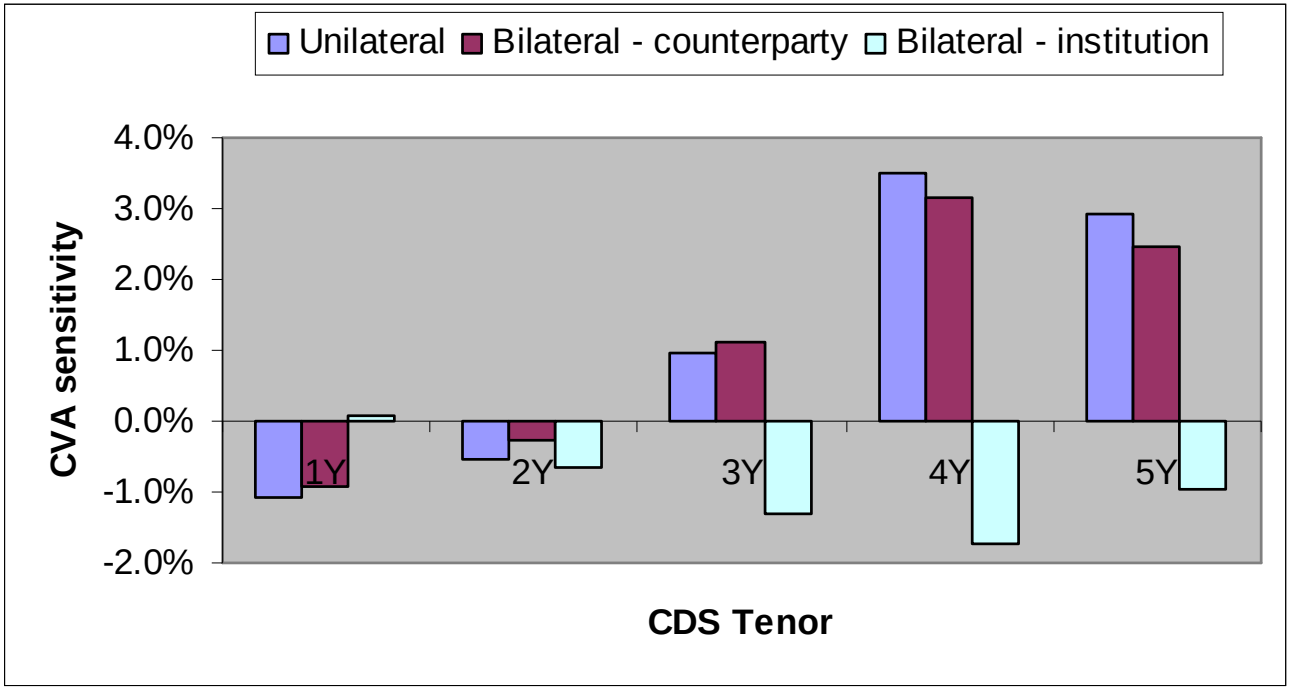
Impact of DVA on CDS hedges

- ✓ Buy slightly less protection on counterparty (due to possibility of self defaulting first)
- ✓ Sell protection on oneself ☺



Basis Hedging and DVA - Example

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$100m, Payer IRS, 5-year maturity

- ✓ Counterparty spread = 500 bps, own spread = 250 bps

CVA	77,566	Total	47,215
DVA	-30,351		

Spreads widen ……

- ✓ Counterparty spread = 600 bps, own spread = 350 bps

CVA	86,292	Total	46,900
DVA	-39,392		

Spreads widen proportionally

- ✓ Counterparty spread = 600 bps, own spread = 300 bps

CVA	87,937	Total	53,534
DVA	-34,402		

Hedge basis risk with index

Basis Hedging and DVA

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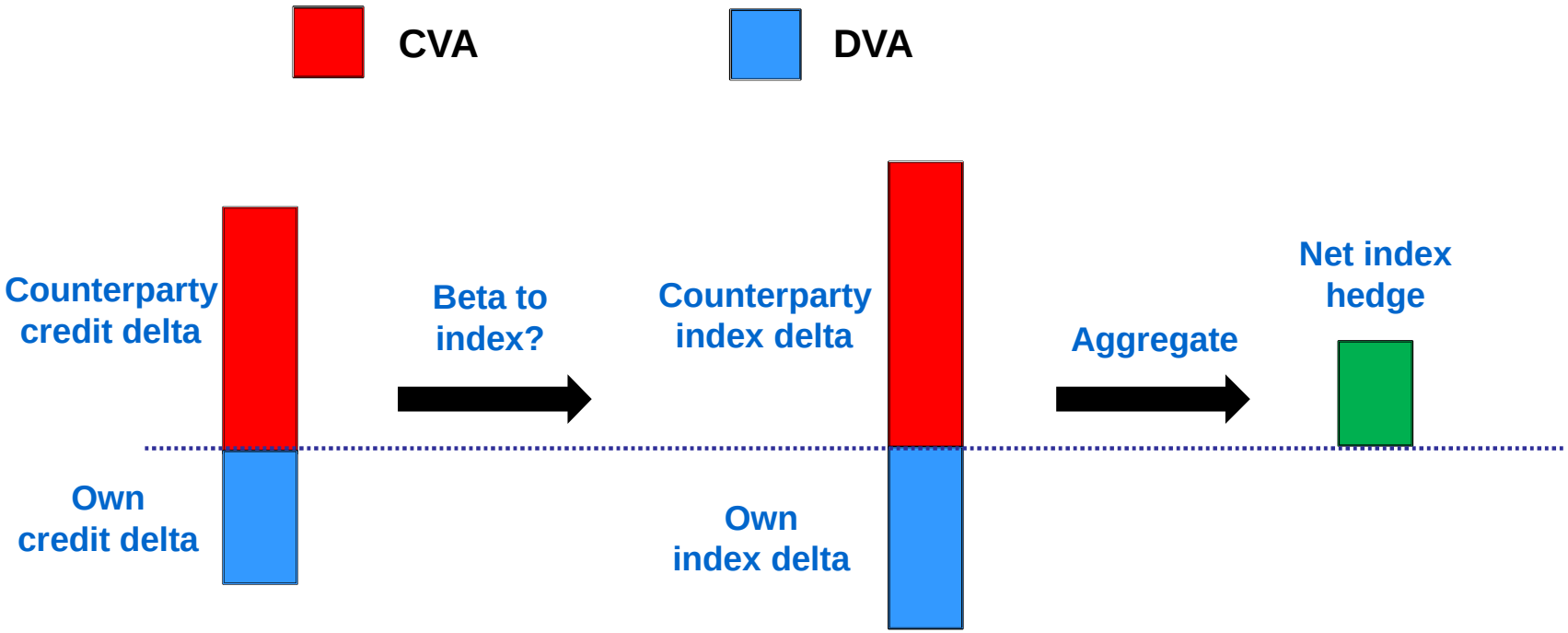

❑ Trading your own credit via the index?

- ✓ But since the hedge is aggregated it doesn't look as bad!
- ✓ Works well as long as the betas are correct (or are consistently wrong)
- ✓ Net index hedge can be short protection (DVA dominates CVA)

Hedging DVA via an Index

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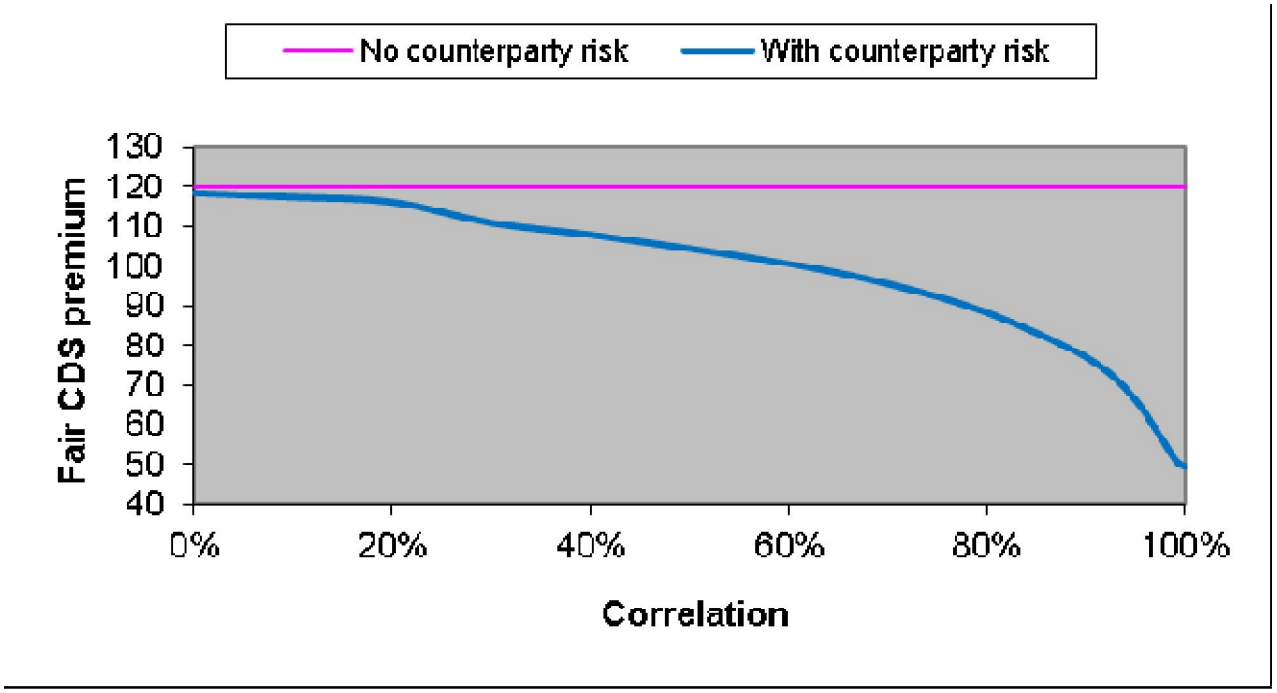
- We want the index to be highly correlated with our own spread
  - ✓ Example of buying index protection from a counterparty with spread at 240 bps



  - ✓ So to put it a different way, we want to give the buyer of protection as much wrong-way risk as possible

Hedging in Practice (I)

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❑ Linear sensitivities

- ✓ Some may be quite small due to limited trading volume and natural offsetting of positions, others may be large due to structural positions of banks (e.g. long dated receiver positions)
- ✓ Generally quite easy to hedge with respect to parallel shifts, more complex curve positions can be harder to quantify and neutralise
- ✓ DVA actually increases sensitivity

❑ Volatility

- ✓ Need to buy optionality against all CVA positions, long dated volatility hard to access for products such as cross currency swaps
- ✓ DVA reduces this sensitivity
- ✓ An alternative is to mark to historical volatility

Hedging in Practice (2)

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Correlation

- ✓ Limited availability via a few quanto and basket products
- ✓ Hence, generally mark to historic
- ✓ Unlike VAR (for example), we not only have the problem that our correlations today may be wrong or mis-specified but also that they are surely time dependent

Credit

- ✓ Most counterparties not directly hedgeable via single-name CDS
- ✓ Curve hedges / jump-to-default even less practical
- ✓ Most credit curves are mapped via some rating / region / sector approach and macro hedged via the index
- ✓ DVA reduces the sensitivity (if we believe we can monetise our own default) – the CVA + DVA represents a basis book
- ✓ Again, marking to historic data partially solves the problems
- ✓ Recovery risk impossible to hedge

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Unintended consequences of CVA

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"… 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) – wrong way risk in practice
- ✓ At this point do we stop hedging bear the pain?

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Benefits of Collateral

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- Collateral agreements (CSAs) reduce CVA
- However they create further issues
  - ✓ Close-out periods are significant (~10 days) therefore some residual CVA exists
  - ✓ OTC derivatives are now more funding intensive
  - ✓ Cheapest to deliver collateral optimisation is necessary
  - ✓ Cannot change CSA terms easily (e.g. charge larger haircuts on sovereign debt)

Central Counterparties

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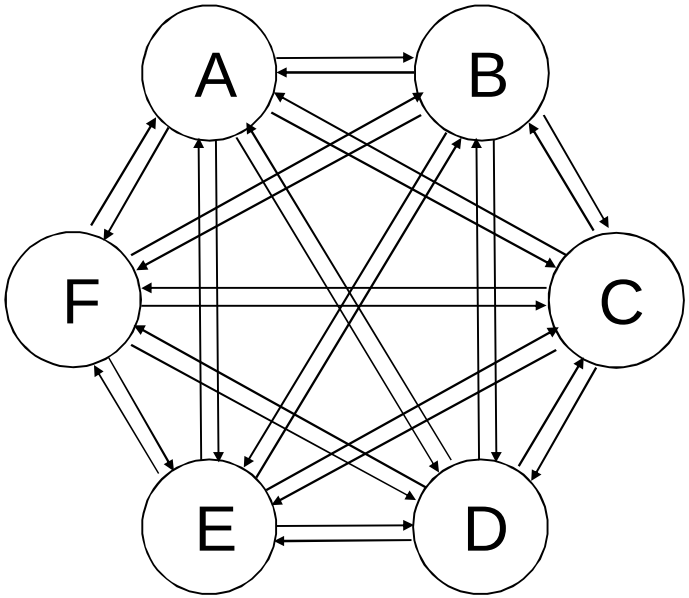

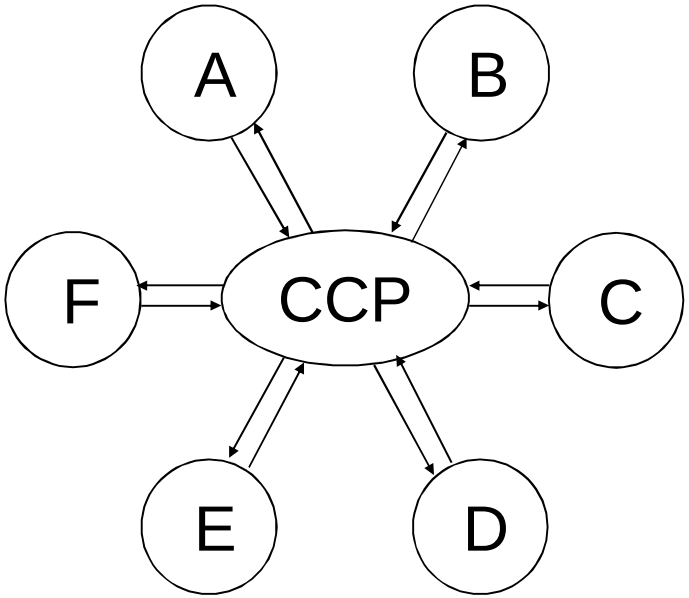

Functions of a CCP

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- Pricing, market data
  - ✓ CCPs provide the valuation of the relevant the OTC derivatives
  - ✓ This limits the complexity of the derivative
- Netting / trade compression
  - ✓ CCPs can give lower margin requirements for offsetting trades
- Collateral management
  - ✓ A CCP performs the collateral management function by making margin calls
- Insurance / Mutualisation
  - ✓ A CCP provides insurance via loss mutualisation process where any loss caused by the default of a CCP member is absorbed by all other CCP members
- Auction process
  - ✓ In the event of default of a member, a CCP will auction their positions
  - ✓ CCP members are normally required to participate in this auction

Can a CCP fail?

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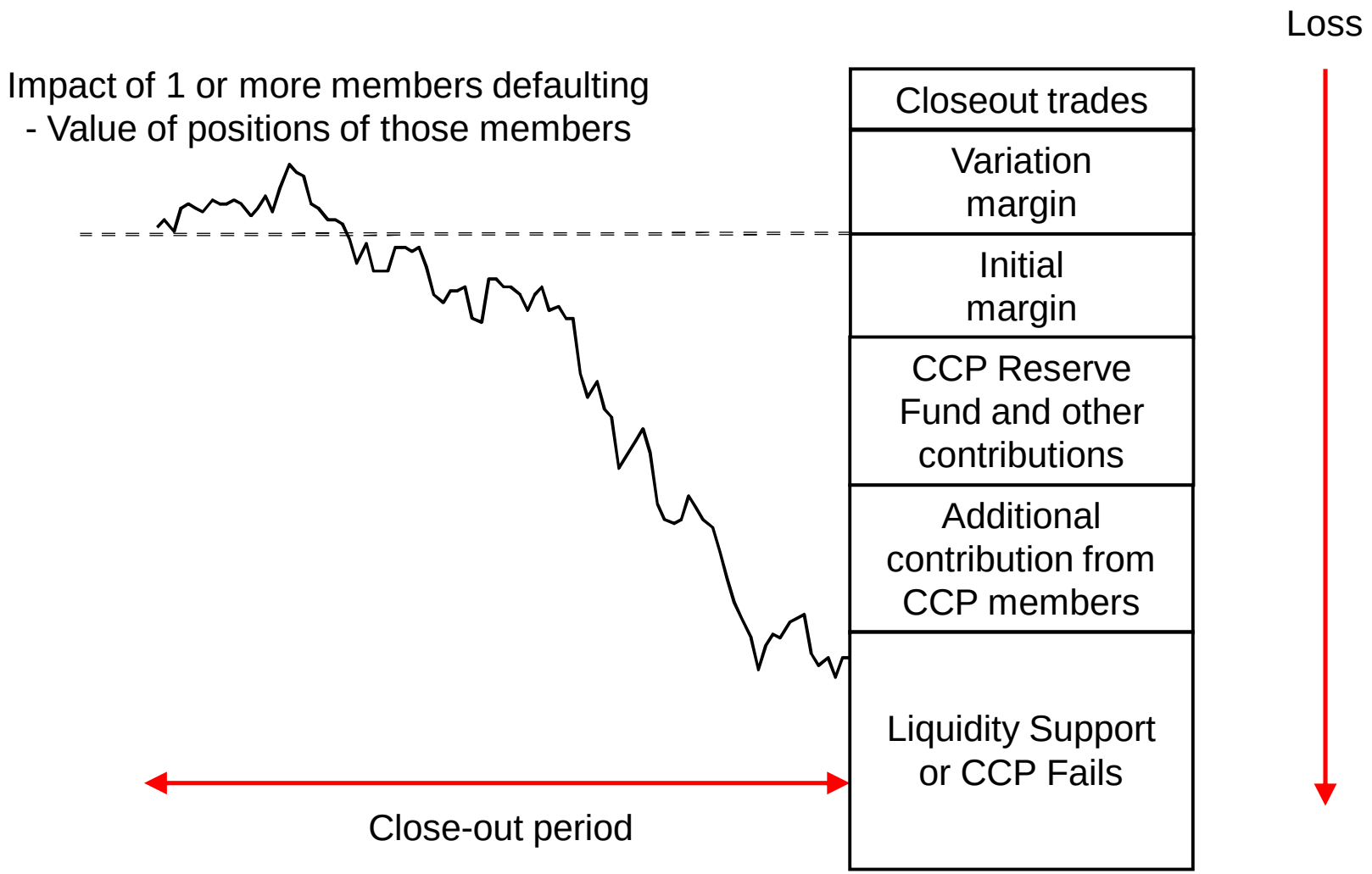

Effectiveness of CSAs and CCPs

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	Uncollateralised (No CSA)	Collateralized (2-way CSA)	Overcollateralized (CCP)
CVA	←	←	←
DVA	→	→	→
Funding	→	→	→
Regulatory Capital	←	←	←

What can we do with CVA?

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- Basel III forces banks to price and manage CVA actively - what can you do?
- Trade out of CVA?
  - ✓ Hedging - possible but limited single name CDS market makes this difficult
  - ✓ Securitize it – might not be an easy idea to sell to the regulators
- Take more collateral?
  - ✓ Converts CVA into funding liquidity risk and residual unhedgeble “gap risk”
  - ✓ Limitations over counterparties who can sign CSAs (e.g. corporates, sovereigns)
- Trade through central counterparties?
  - ✓ More funding requirements than CSAs
  - ✓ Then the CCPs take all the CVA and creates a new too big to fail problem

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Conclusions

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- CVA hedging does not fit the mould of classic derivatives hedging
  - ✓ Very complex underlying cross asset credit contingent risks
  - ✓ Some parameters difficult or impossible to hedge (especially credit spreads)
- CVA may never be well-hedged
  - ✓ Banks know that not hedging CVA is likely to be most profitable in the long run
  - ✓ But regulation (Basel III) and short-term needs may lead to excess hedging of CVA
  - ✓ Unintended consequences, market dislocations and crises are therefore likely
  - ✓ Hedging according to Basel III, CSAs and Central Counterparties all convert CVA into other risks (funding, liquidity, gap, systemic, ……)
- Key focus will be on balancing reg cap reduction and the best economic management of CVA
  - ✓ Current regulation does not obviously bring these components together