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Hedging CVA

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CVA is very complex

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- **CVA is very hard to calculate (even for vanilla OTC derivatives)**
- **Exposure at default**
  - ✓ CVA is sensitive to volatility even where underlying is not
  - ✓ 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 many curves must be “mapped”
  - ✓ Curve shape can be an important aspect
  - ✓ Recovery rates uncertain
- **Wrong way risk**
  - ✓ Linkage between default probability and exposure at default
  - ✓ May be very subtle and not well suited to traditional approaches involving the word “correlation”

CVA trading is a challenge

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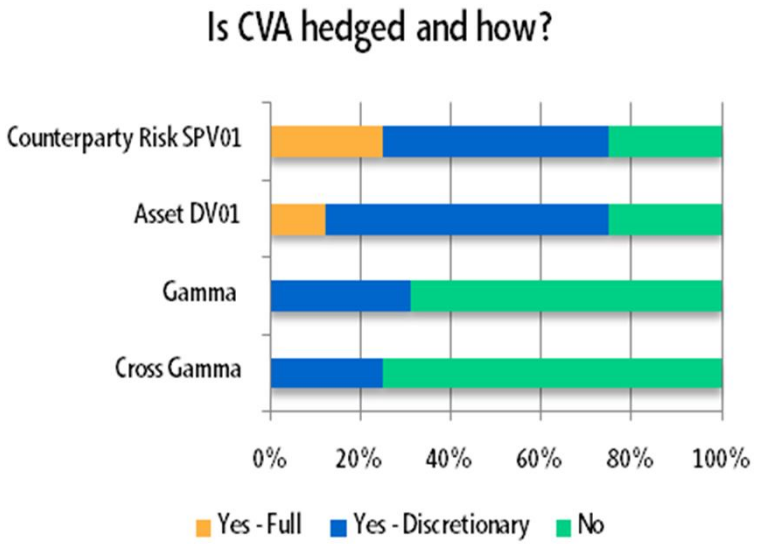
❑ Pricing

- ✓ 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 neg



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**
  - ✓ 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 potentially up to 40%)
  - ✓ DVA
  - ✓ Central counterparties
  - ✓ Use of historical or blended default probabilities (does this suggest that some banks prefer not to dynamically hedge CVA?)

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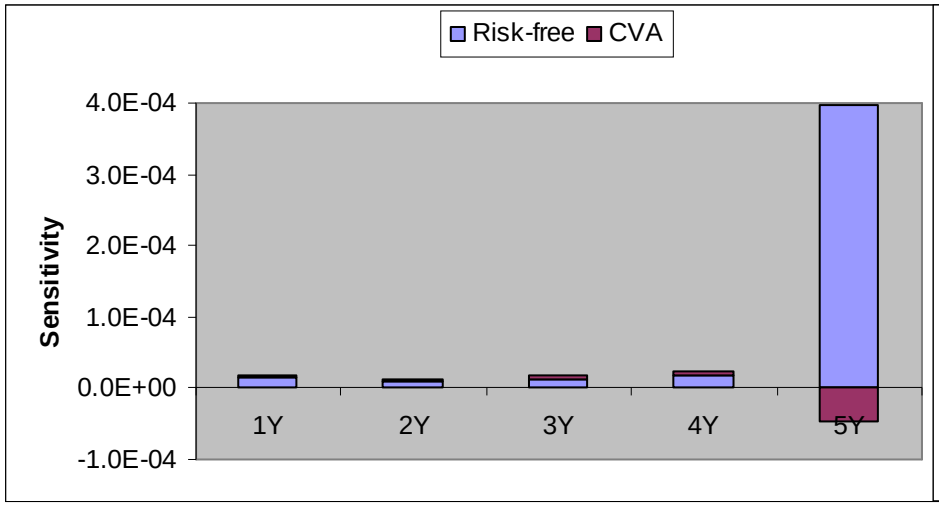
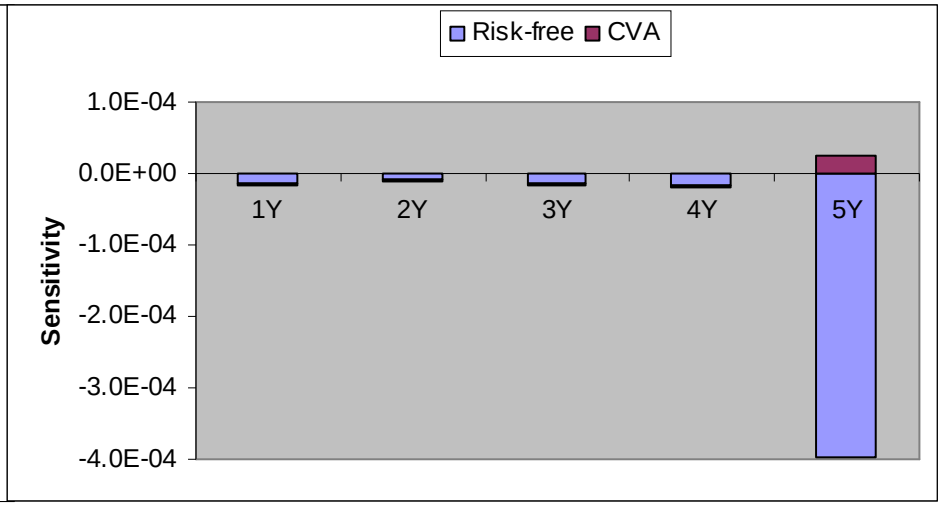
- **Examples consider 5-year interest rate swaps with an upwards sloping yield curve (payer swap has a larger CVA)**
  - ✓ CVA hedge involves “unwinding” some of the standard hedge
  - ✓ Payer swap has a greater EE (upwards sloping curve) so sensitivity is larger
  - ✓ Generally easy to hedge (at least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

Payer swap



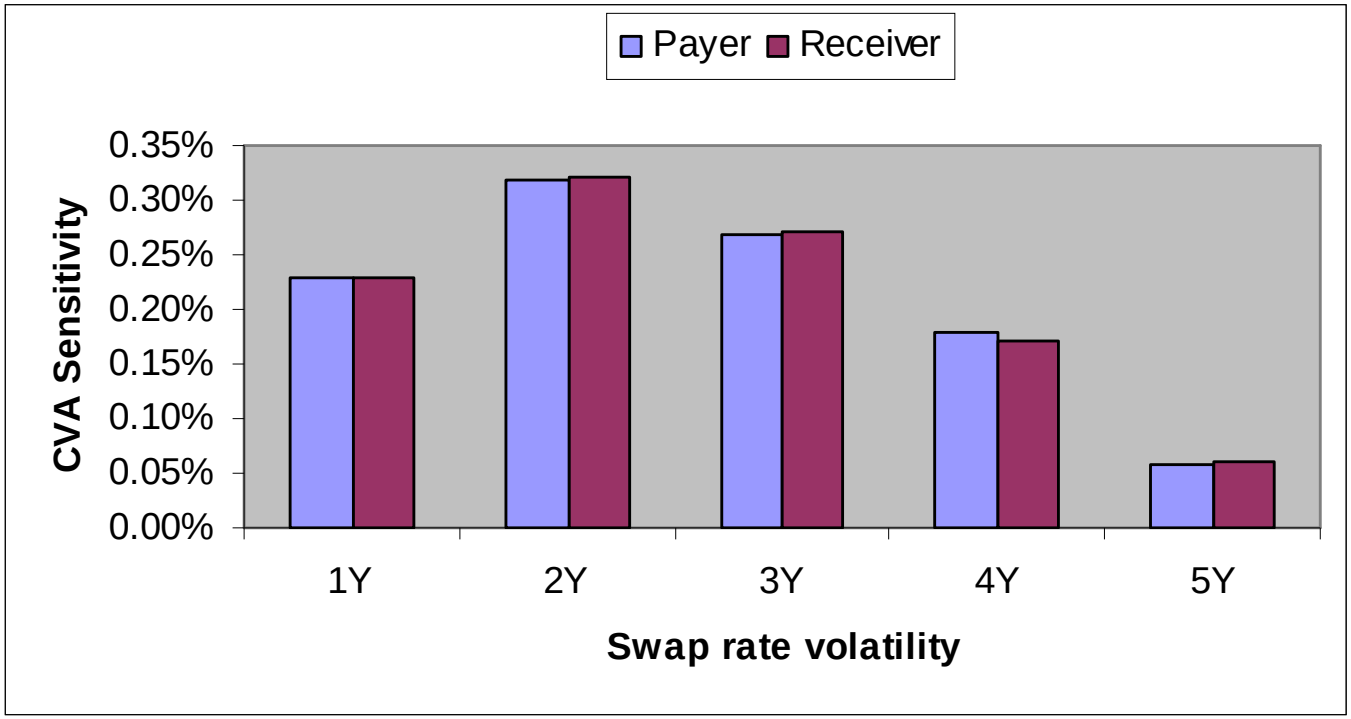
Receiver swap



Volatility

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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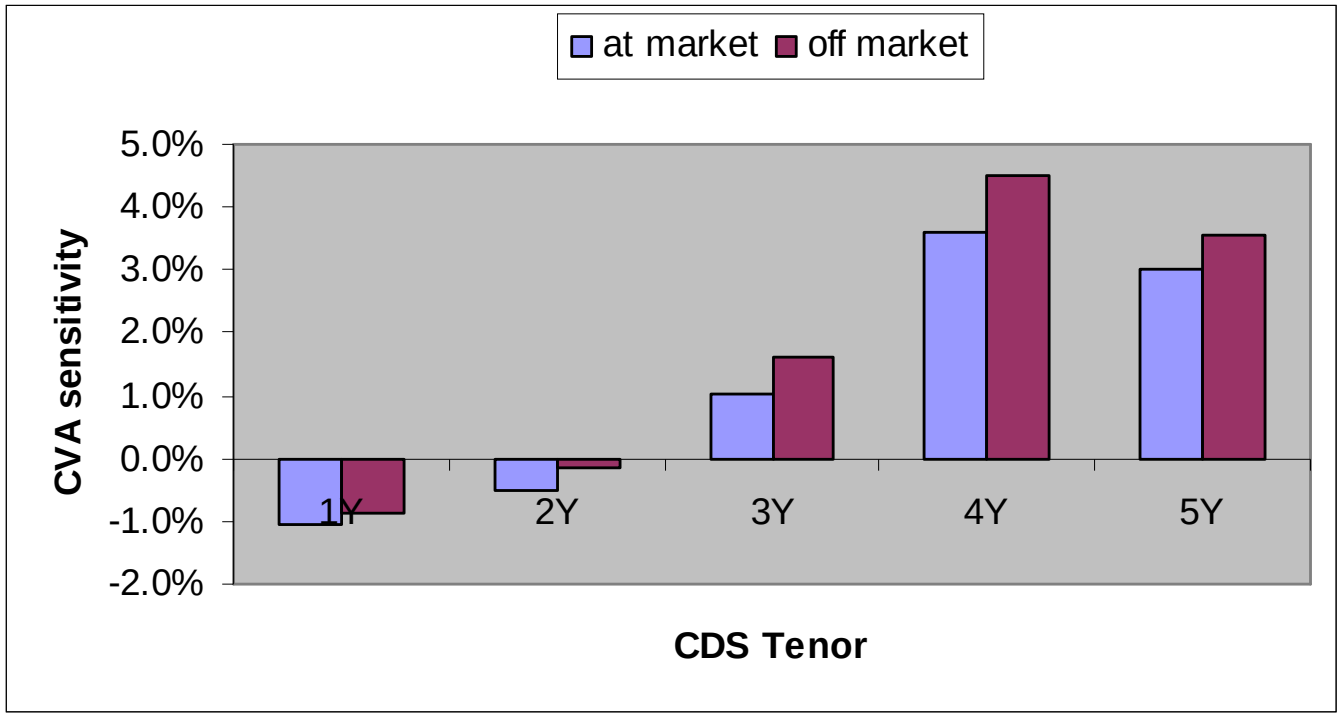
Buy CDS protection against CVA

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



DVA impact – vega hedges

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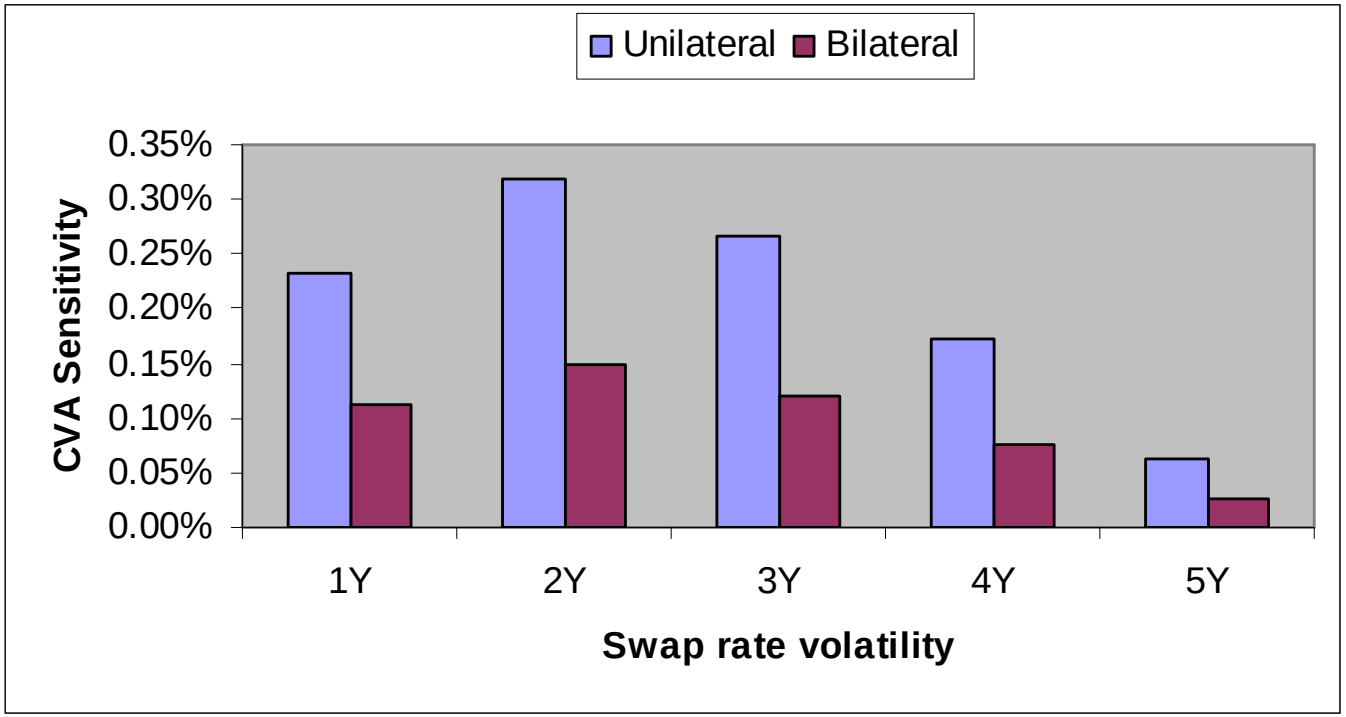
Sensitivity to volatility

- ✓ 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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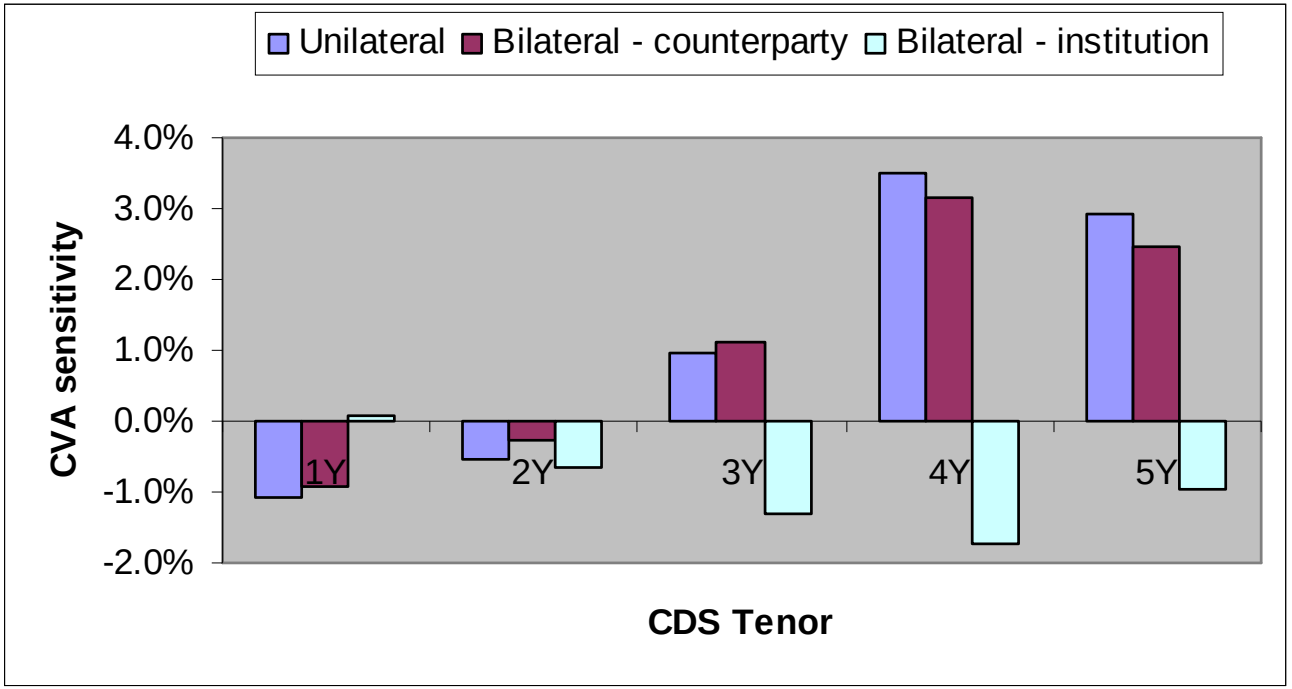
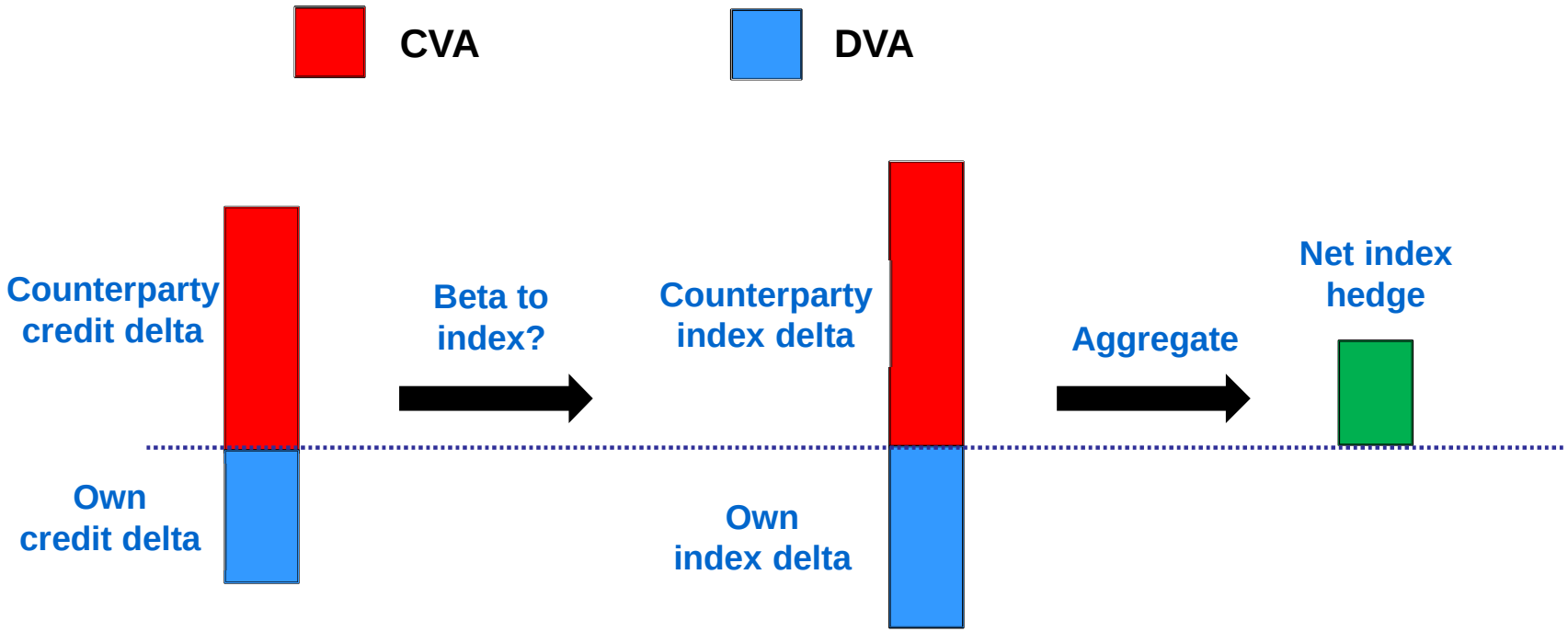
Impact of DVA on CDS hedges

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



Hedging and DVA



❑ 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 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 vol 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-defaut 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

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?

How expensive is credit hedging?

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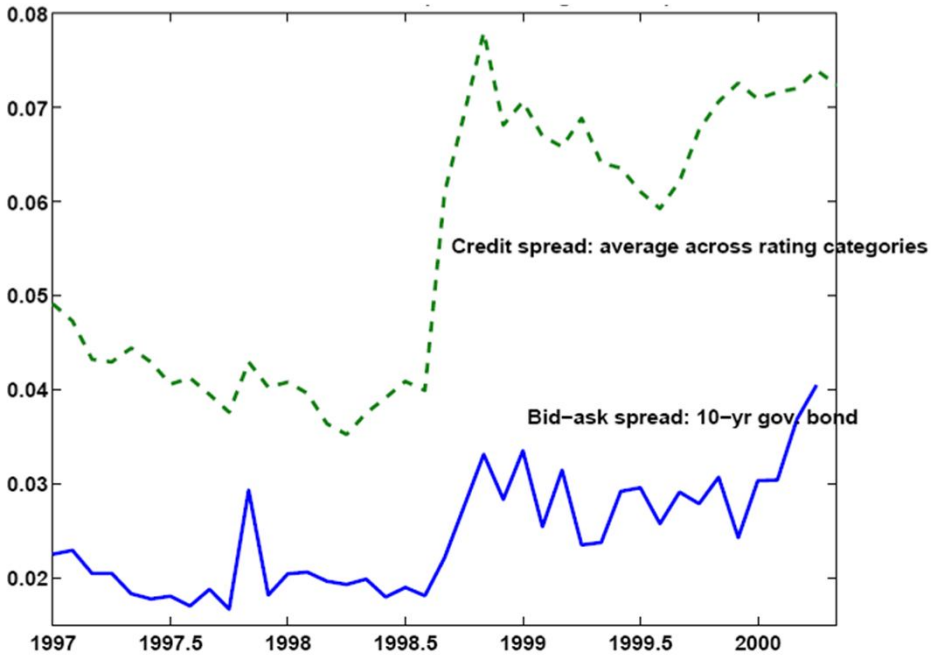
- **Market credit spreads are too high compared to**
  - ✓ Observed default rates and recoveries
  - ✓ Merton type structural models of credit risk (CreditGrades™, Moody's KMV™)
- **Changes in credit spreads are not totally explained by credit risk factors**
  - ✓ R^2 of only 30-40%, (for example see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



Source: de Jong and Driessen [2005]

What is 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**
  - ✓ Note that this is very much a long term average and across all credit quality states

The Ratio by Seniority

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	Real world default intensity (bps)	Risk neutral default intensity	Ratio
Aaa		67	
Aa		78	
A		128	
Baa		238	
Ba		507	
B		902	
Caa		2130	

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.

To hedge or not to hedge?

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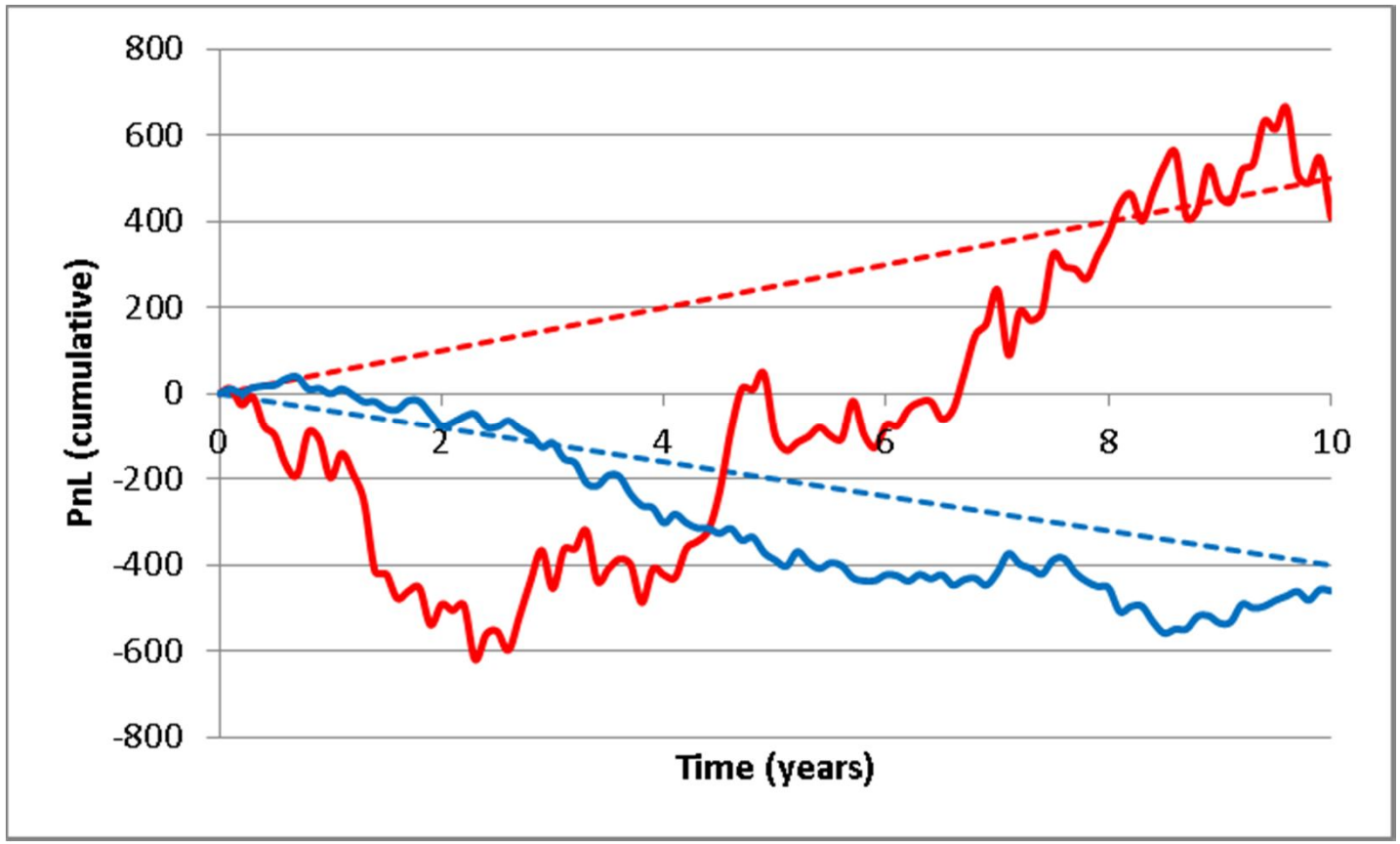

No hedging

Full hedging

Conclusions

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❑ CVA could be treated 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

❑ The market has been moving towards the second approach

- ✓ Accounting rules, practices of top tier banks, Basel III capital requirements

❑ 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

- ✓ Best approach is the correct combination of dynamic hedging and portfolio theory