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Managing CVA

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ICBI RiskMinds

Boston

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- ☐ Market approach to quantifying CVA
- ☐ Risk-neutral or real world?
- ☐ Credit and market greeks
- ☐ The role of DVA
- ☐ The unintended consequences of CVA
- ☐ Pragmatic hedging of counterparty risk

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
  - ✓ 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

- ❑ 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

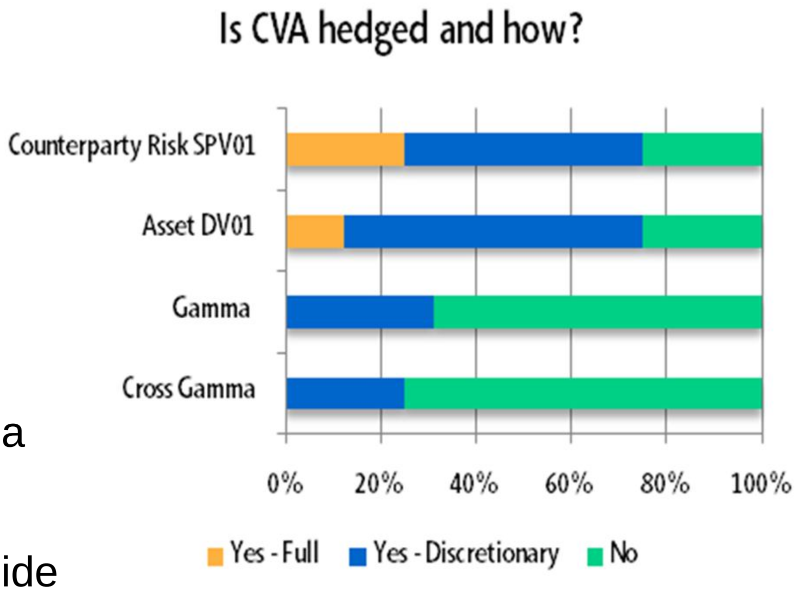
CVA trading is a challenge

❑ 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?)

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Market Risk

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- ❑ PFE (like VAR) is typically calculated with historical parameters
  - ✓ Historical volatility, correlation
  - ✓ Models typically fit current forward rates (i.e. they use market implied drift)
- ❑ CVA should be calculated with market implied parameters?
  - ✓ In theory, as it is a price, yes
  - ✓ However, accounting / regulatory capital rules are generally vague
  - ✓ Choice over using historical or market implied (e.g. volatility, correlation)
  - ✓ The advantage of using market implied data is that hedging is possible
  - ✓ Basel III rules do not require the modelling of the market risk aspect of CVA

Credit Risk

- Historical (real) probability of default
  - Generally always used in the past consistent with CVA being an expected loss and hence a reserve against counterparty risk
  - Gives much smaller CVA
  - Still used by many 2nd and 3rd tier banks
- Market implied (risk-neutral) from credit spreads
  - Has become more common in the last few years, especially by the large dealers
  - CVA is now the cost of hedging counterparty risk
  - What if we don’t know the credit spread? – can we revert to historic?
  - Accountancy rules do not specify directly
- However
  - However, Basel III document (Dec 2010) defines CVA with respect to credit spreads

Default Probability and CVA

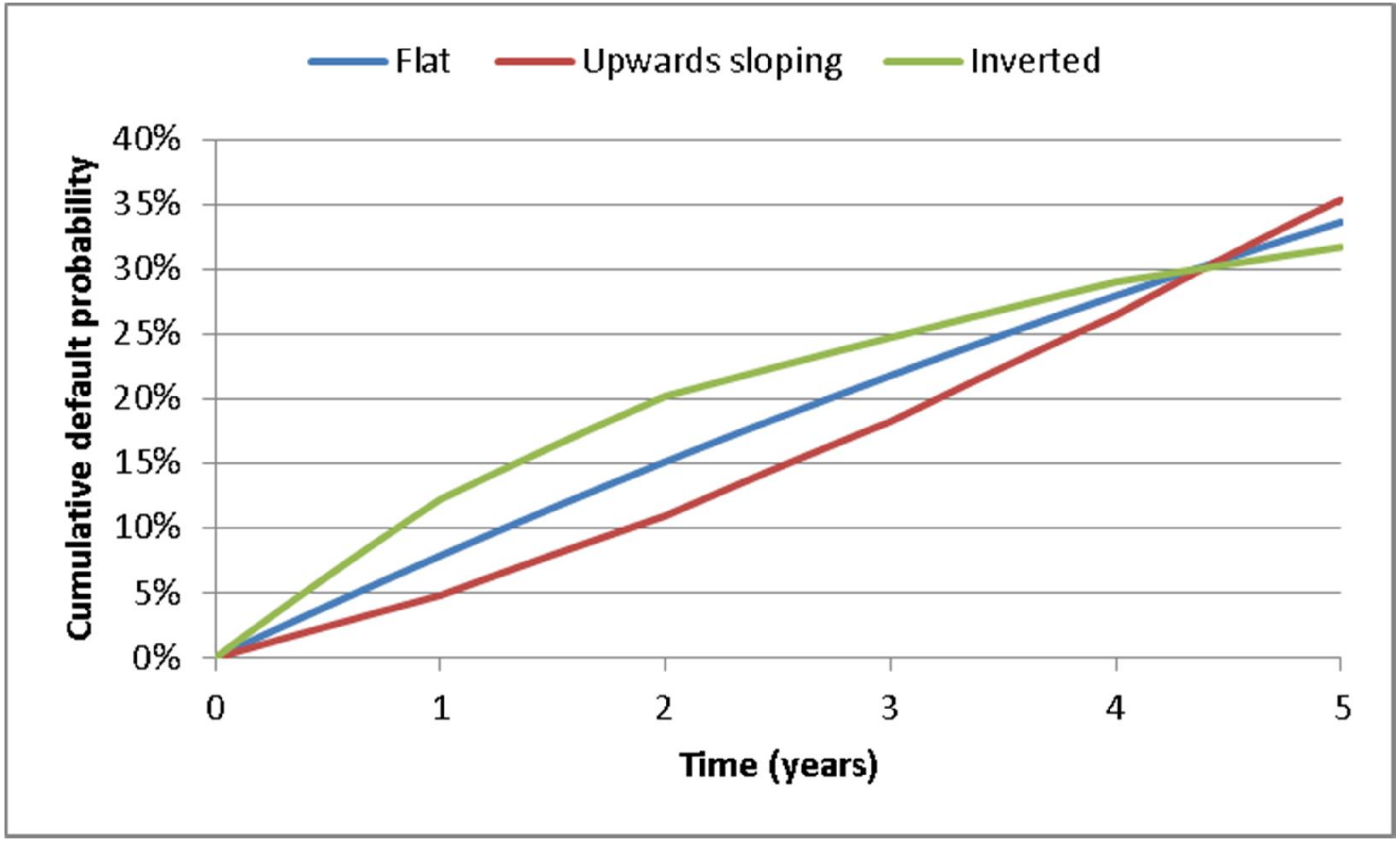
- ☐ Default probability - very challenging, general approaches are
- ☐ Observables and hedges
  - ✓ Liquid CDS market probably only covers a small percentage of total exposure
  - ✓ Even where there is a CDS market data exists, there may only be 1 liquid tenor (5Y)
- ☐ Semi-observables
  - ✓ Bonds or some appropriate proxy
- ☐ Non observables
  - ✓ No defined “credit spread”
  - ✓ Requires some mapping approach
  - ✓ Obvious categorisations are via rating, sector and region
  - ✓ Curve mapping methodology is a key challenge for CVA desks and corresponds to the majority of counterparties (90%+)

The Credit Mapping Problem

- ☐ 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?

Credit Curve Shape and CVA

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



Recovery Rates

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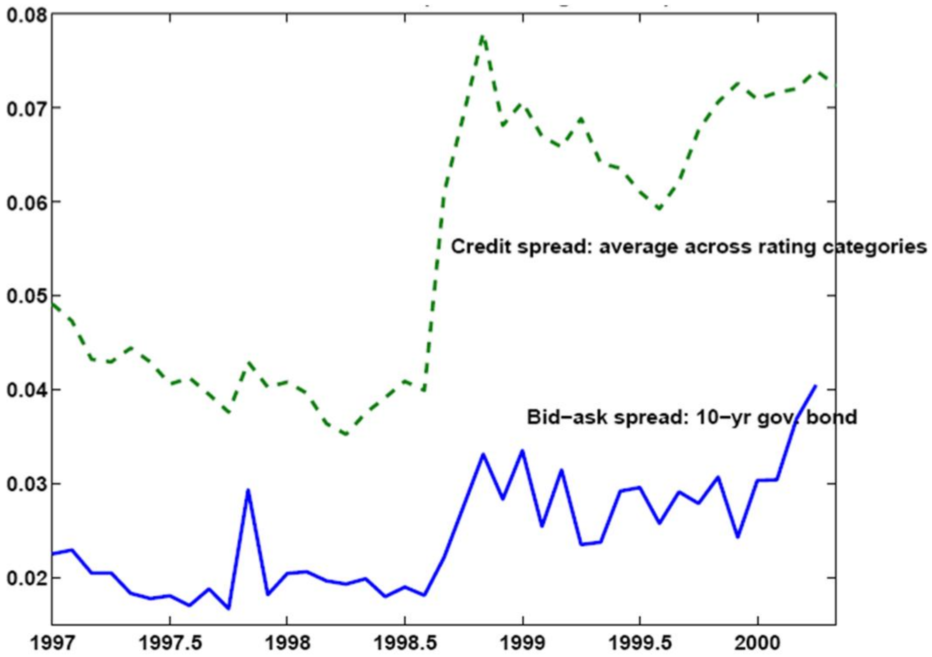
- ❑ Recovery tends to cancel out in pricing calculations
  - ✓ Average historical corporate recovery rate is approximately 40% with a large standard deviation
- ❑ Settled recovery
  - ✓ Recovery rate to imply default probability should be the one which CDS contracts would be settled at (usually in the 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%

Real World Default Risk

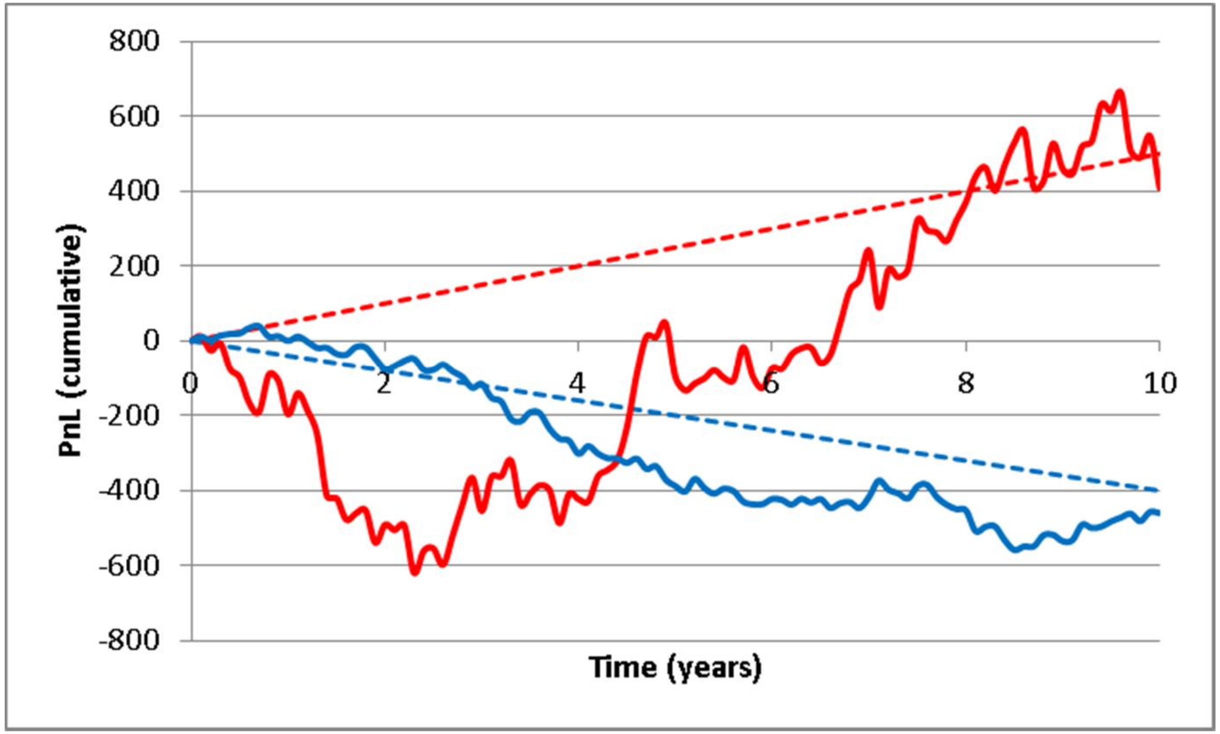
- Market credit spreads are too high compared to
  - Observed default rates and recoveries (e.g. Giesecke et al. [2010])
  - Merton type structural models of credit risk (CreditGrades^{TM}, Moody’s KMV^{TM}) – see, for example, Berndt et al. [2005]
- Changes in credit spreads are not totally explained 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]

How to manage CVA

- ☐ CVA could be managed (not 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

The Push to Risk-neutral CVA

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- ❑ 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?

- ☐ Market approach to quantifying CVA
- ☐ Risk-neutral or real world?
- ☐ **Credit and market greeks**
- ☐ The role of DVA
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Some intuition on hedging

- ☐ 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

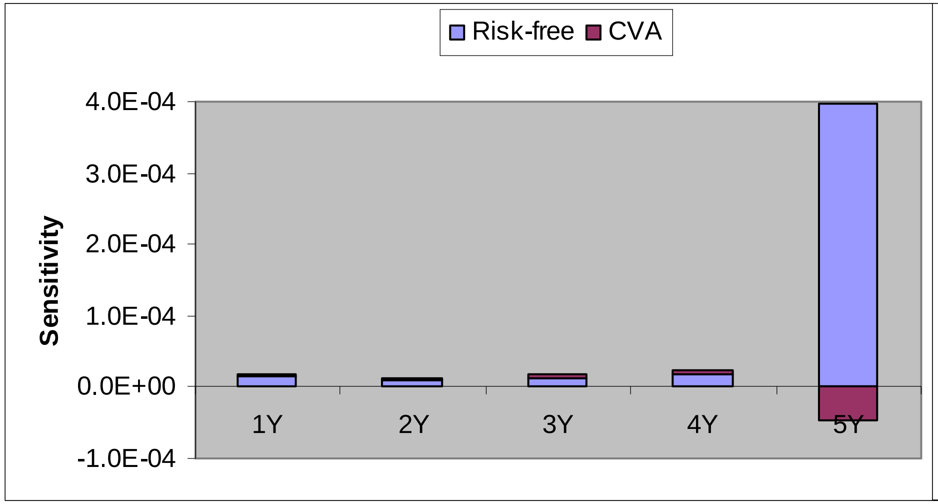
$$CVA_{swap} \approx (1-\mathrm{Rec})\sum_{j=1}^{n} \underbrace{PD(t_{j-1},t_j)}_{\text{Default probability}} V_{swaption}(\underbrace{t}_{\text{Swaption maturity}};\underbrace{t_j}_{\text{Swap maturity date}},T)$$

- ☐ 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?

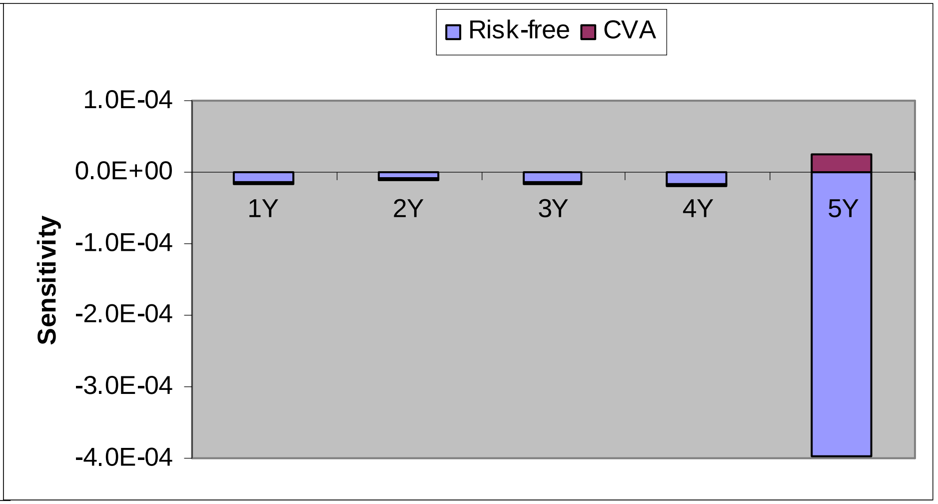
Linear sensitivities

- **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



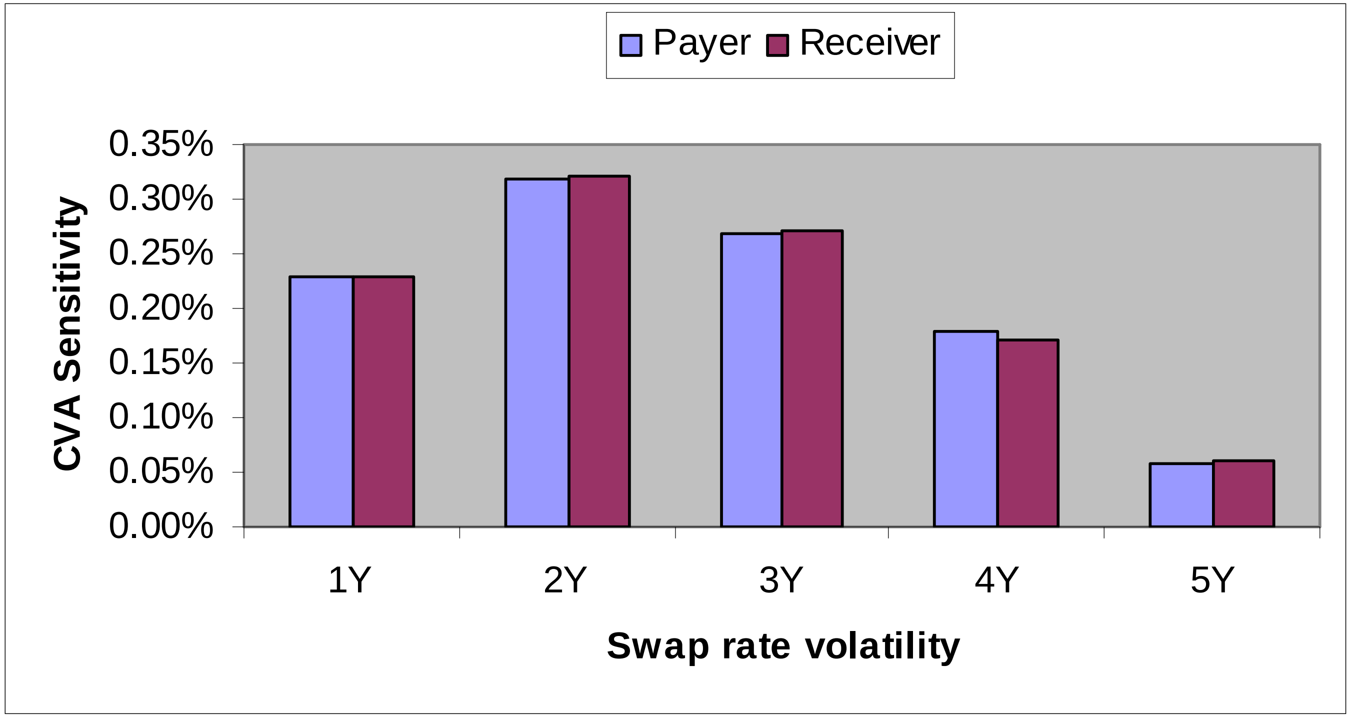
Receiver swap



Volatility

❑ Sensitivity is approximately the same for payer and receiver

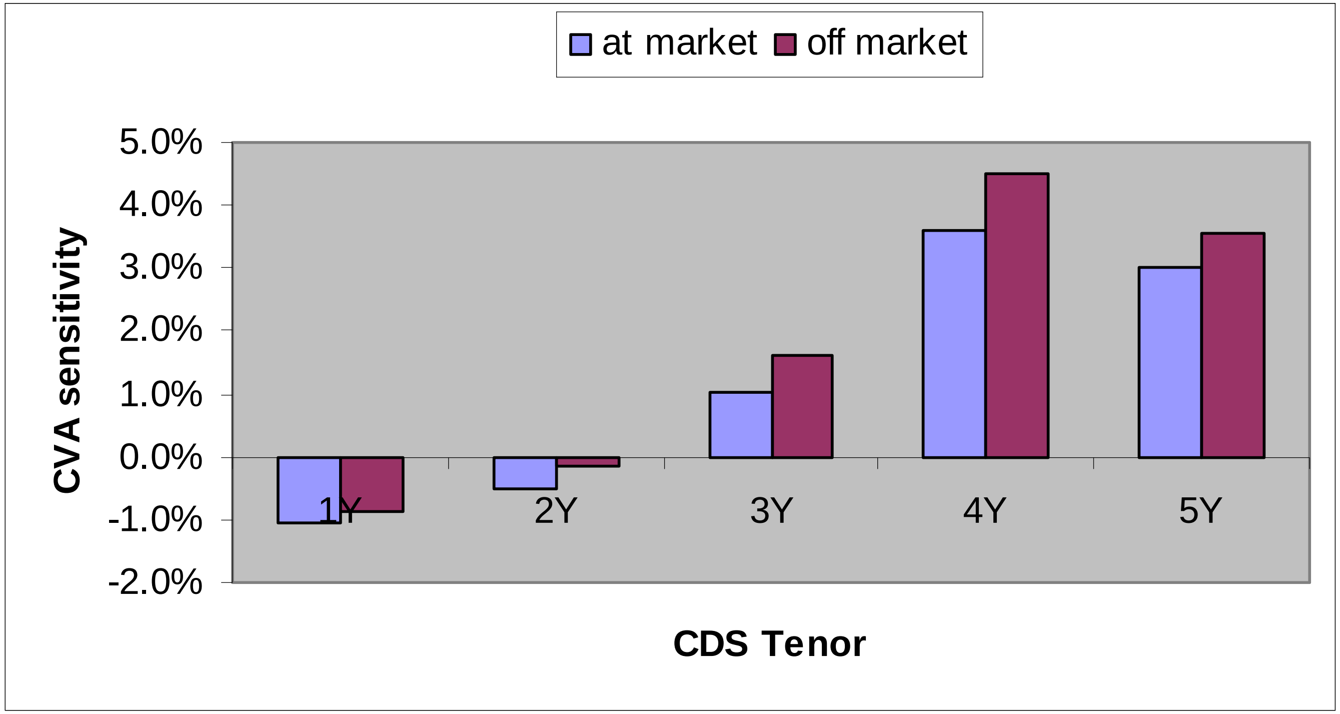
- ✓ Swaptions are implictly in and out of the money respectively
- ✓ Impicitly short vega on all positions
- ✓ Need to buy swaptions to hedge (potential short dated vs long dated problem)



Credit

❑ Buy CDS protection against CVA

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



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Definition of DVA

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

$$BCVA(t) = (1-\delta_C)\int_t^T \underbrace{EE(u)}_{\text{Expected exposure}}\underbrace{\left[1-PD_I(u)\right]}_{\text{Probability we haven't yet defaulted}}\underbrace{dPD_C(u)}_{\text{Probability counterparty defaults}}$$

CVA

$$-(1-\delta_I)\int_t^T \underbrace{NEE(u)}_{\text{Negative expected exposure}}\underbrace{\left[1-PD_C(u)\right]}_{\text{Probability counterparty hasn't yet defaulted}}\underbrace{dPD_I(u)}_{\text{Probability we default}}$$

DVA

Own percentage recovery value

How to Monetise DVA

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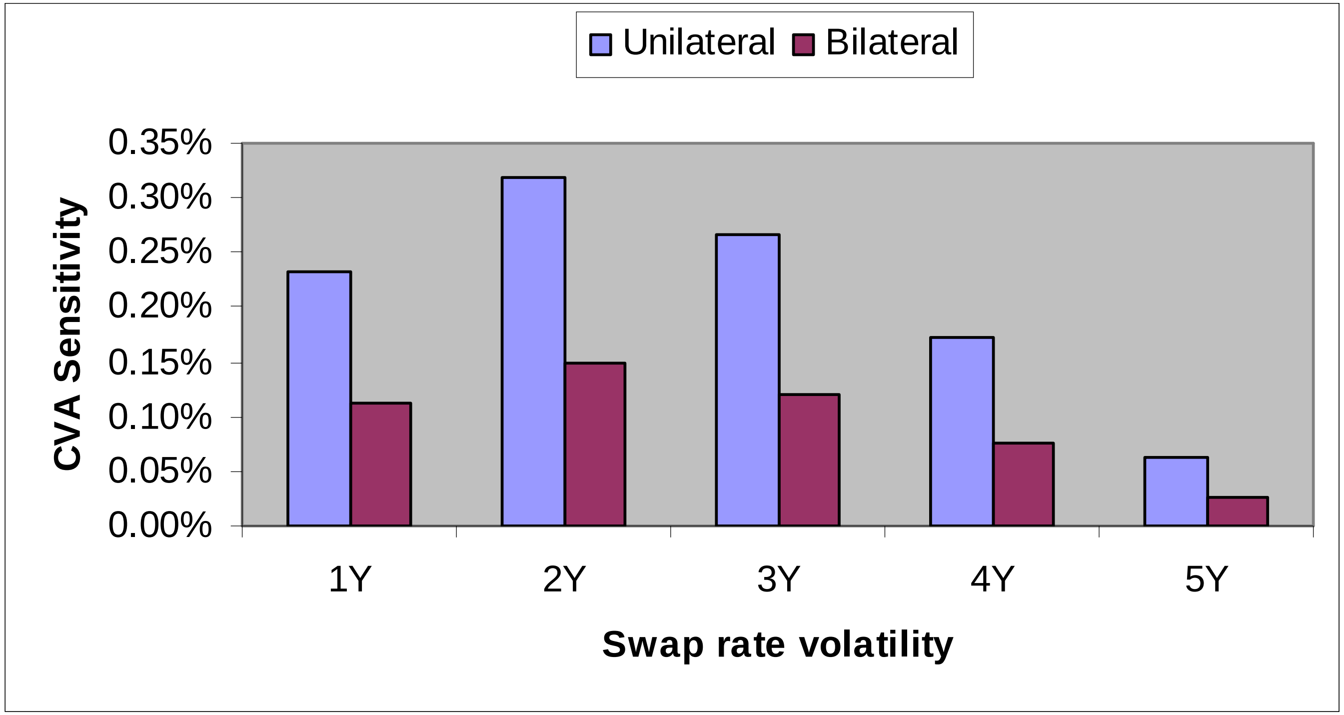
- ☐ Go bankrupt
  - ✓ Usually not a popular choice
- ☐ Unwinds or novations
  - ✓ An institution may realise a DVA gain if a trade is unwound in the future (e.g. banks unwinding transactions with monolines)
- ☐ Hedging
  - ✓ DVA much harder to hedge than CVA - cannot sell CDS protection on yourself!
  - ✓ 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

❑ Sensitivity to volatility

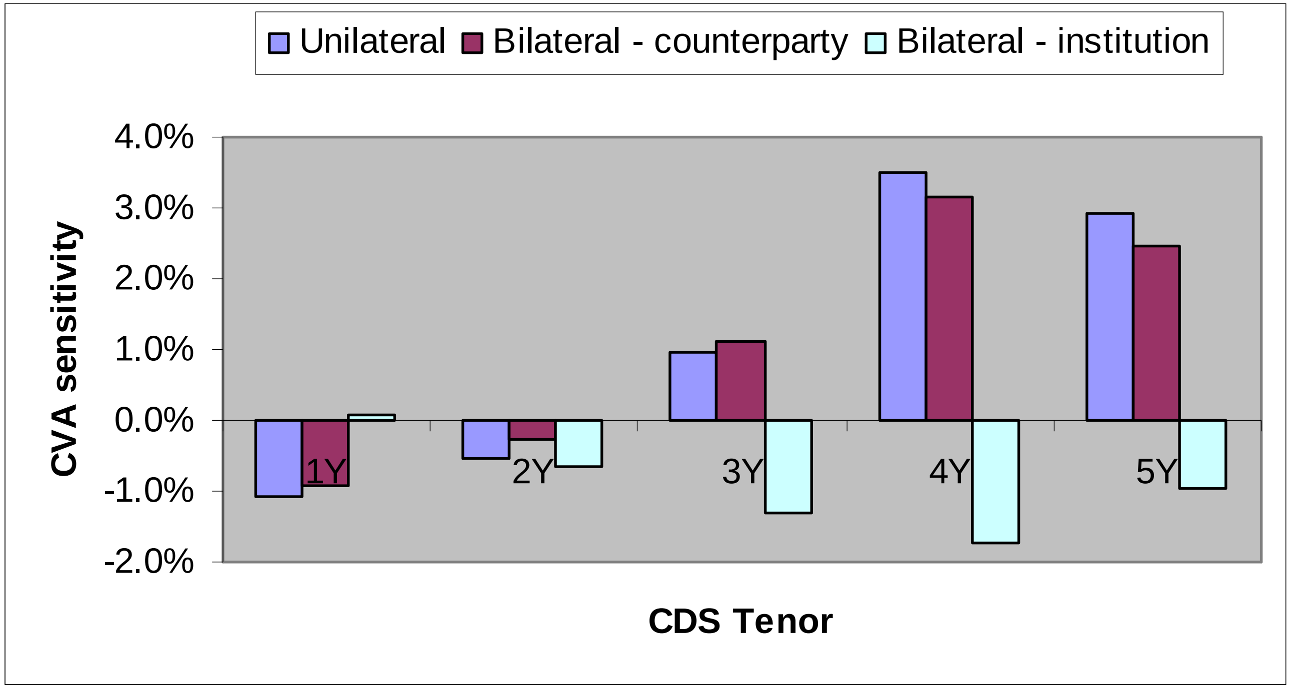
- ✓ Long and short swaptions will cancel
- ✓ In this case we are half as risky as counterparty (CDS = 250 bps vs 500 bps)
- ✓ Sensitivity is approximately halved



DVA impact – credit hedges

❑ 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

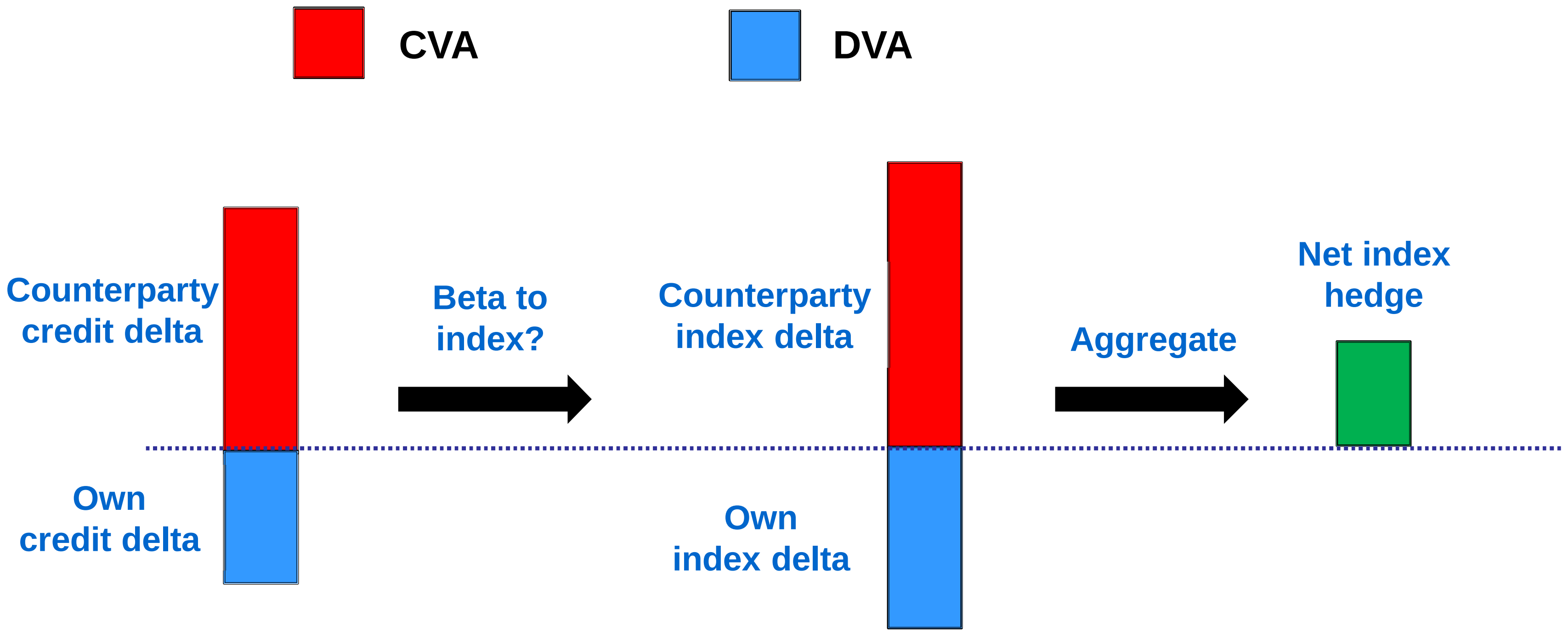
CVA	86,292	Total	46,900
DVA	-39,392		

- ☐ **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

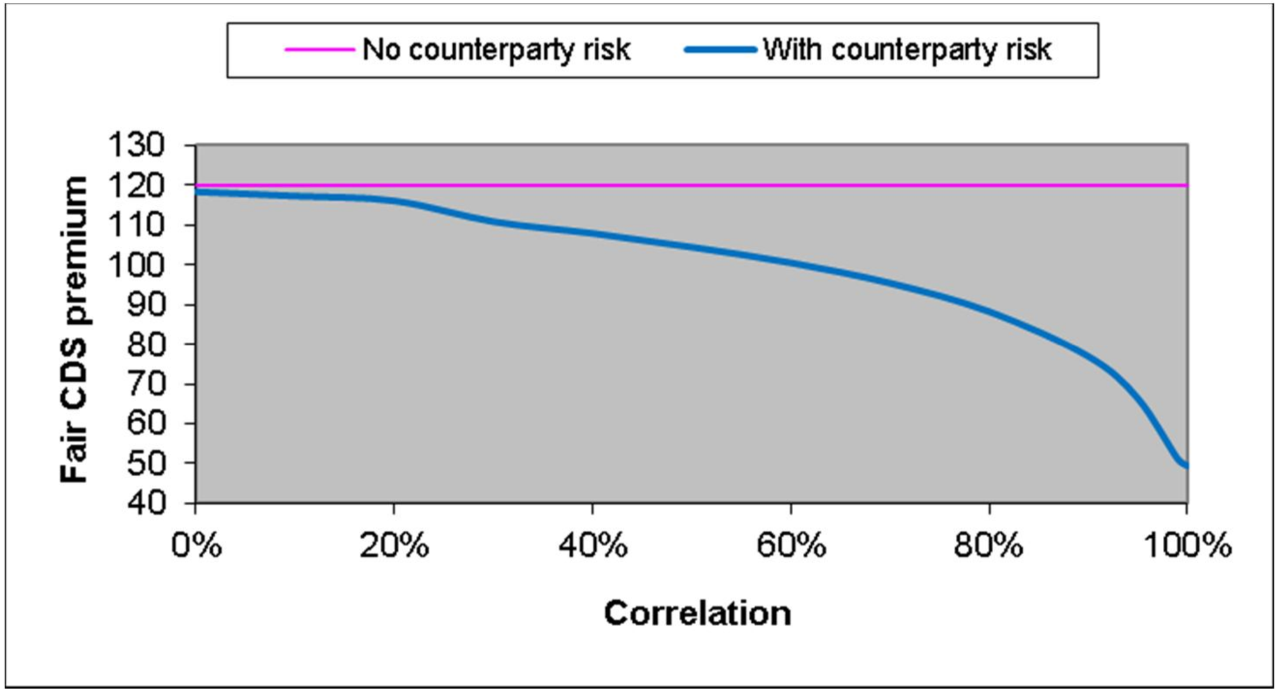


❑ Trading your own credit via the index?

- ✓ 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

- ☐ 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

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Unintended consequences of CVA

"… 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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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)

☐ 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

Conclusions

- ☐ CVA hedging does not fit the mould of classic derivatives hedging
  - ✓ Very complex underlying cross asset credit contingent
  - ✓ Some parameters difficult or impossible to hedge (especially credit spreads)
- ☐ CVA may never be well-hedged
  - ✓ Best approach is the correct combination of dynamic hedging and portfolio theory
  - ✓ 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