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
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

*Is CVA hedged and how?*

*Counterparty Risk SPV01*
*Asset DV01*
*Gamma*
*Cross Gamma*

- Yes - Full
- Yes - Discretionary
- No

Solum CVA Survey July 2010
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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Credit and market greeks

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The unintended consequences of CVA

Pragmatic hedging of counterparty risk
Market Risk

- **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

- 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%
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\textsuperscript{TM}, Moody’s KMV\textsuperscript{TM}) – see, for example, Berndt et al. [2005]

Changes in credit spreads are not totally explained by credit risk factors

- R\textsuperscript{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
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

<table>
<thead>
<tr>
<th>No hedging</th>
<th>Full hedging</th>
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<tbody>
<tr>
<td><img src="image.png" alt="Graph" /></td>
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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?
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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 $\tau$ on an underlying (reverse) swap of maturity $T-\tau$

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

- 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?
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

**Linear sensitivities**

**Payer swap**

**Receiver swap**
Sensitivity is approximately the same for payer and receiver

- Swaptions are implicitly in and out of the money respectively
- Implicitly short vega on all positions
- Need to buy swaptions to hedge (potential short dated vs long dated problem)
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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Pragmatic hedging of counterparty risk
Definition of DVA

- Bilateral CVA considers also an institution’s own default
  - (this formula assumes independent of defaults)

\[
BCVA(t) = (1 - \delta_C) \int_t^T EE(u)[1 - PD_I(u)]dPD_C(u)
\]

\[
- (1 - \delta_I) \int_t^T NEE(u)[1 - PD_C(u)]dPD_I(u)
\]

- CVA
- DVA

Own percentage recovery value

Expected exposure
Probability we haven’t yet defaulted
Probability counterparty defaults

Negative expected exposure
Probability counterparty hasn’t yet defaulted
Probability we default
How to Monetise DVA

- 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!
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
Impact of DVA on CDS hedges

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

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**Diagram:**

- CDS Tenor:
  - 1Y
  - 2Y
  - 3Y
  - 4Y
  - 5Y

- CVA sensitivity:
  - Unilateral
  - Bilateral - counterparty
  - Bilateral - institution
$100m, Payer IRS, 5-year maturity

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

<table>
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<tr>
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<tr>
<td>CVA</td>
<td>77,566</td>
<td>47,215</td>
</tr>
<tr>
<td>DVA</td>
<td>-30,351</td>
<td></td>
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</tbody>
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Spreads widen ......

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

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<tr>
<td>CVA</td>
<td>86,292</td>
<td>46,900</td>
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<td>-39,392</td>
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</tbody>
</table>

Spreads widen proportionally

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

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<td>53,534</td>
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<td>DVA</td>
<td>-34,402</td>
<td></td>
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Hedge basis risk with index
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)
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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“… 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

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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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
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