CVA
– What Does it Achieve?

Jon Gregory (jon@oftraining.com)
Motivation for using CVA

The uncertainty of CVA

Credit curve mapping

Challenging in hedging CVA

The impact of Basel III rules
Motivation for CVA

• Risk management need
  – An institution should consider counterparty risk as with other financial risks
  – CVA should be priced into trades to avoid adverse selection (traders find it more profitable to trade with weaker counterparties)
  – Trading should be judged on profit after CVA has been accounted for
  – But banks find it hard to lose PnL / franchise value

• Financial accounting
  – Periodic CVA calculation to quantify fair value of derivatives for accounting purposes
  – But precise calculation not well-defined, different standards exist (e.g. IAS39, FASB157..)

• Regulation
  – Achievement of optimum regulatory capital relief through good management of CVA
  – No ambiguity around the Basel 3 requirements (but depends on implementation process)
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CVA of a Swap

- 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 $T-\tau$

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

- Intuition
  - Short a series of swaptions with weights given by the forward default probabilities
  - Pricing the CVA of a swap has the complexity (at least) of pricing a swaption
Quantifying CVA is Very Complex

• CVA represents an option on an underlying derivative
  – Option is exotic even for a simple product like an interest rate swap

• Risk mitigants (netting, CSAs, break clauses)
  – Need to price all other trades with this counterparty as well as trade in question
  – All correlations (same asset class, cross-asset class must be known)
  – Now we are pricing a multidimensional exotic option

• Need the default probability (and recovery rate) of the counterparty
  – Often market implied probabilities not obvious (no CDS market)
  – Must look to bond spreads or some mapping procedure
  – Should we use DVA or not?

• Wrong way risk
  – Linkage between default probability and exposure at default
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CVA Risk Capital Charge (Basel III)

- CVA definition is based on spreads NOT default probabilities

\[
CVA \approx LGD_{mkt} \sum_{i=1}^{T} \max \left( 0, \exp\left( -\frac{S_{i-1}^{t-1}}{LGD_{mkt}} \right) - \exp\left( -\frac{S_{i}^{t}}{LGD_{mkt}} \right) \right) \left( \frac{EE_{i-1}D_{i-1} + EE_{i}D_{i}}{2} \right)
\]

- 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.”
Mapping Credit Spreads - Example

- Based on 5-year maturity CDS and index curve shape
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CVA Greeks

• Market risk components
  – Linear sensitivities (e.g. interest rate risk, FX risk) – reasonably easy to hedge
  – Vega – much more difficult long dated / out of the money problems
  – Correlation – generally unhedgeable so marked to historic

• Credit
  – Credit spread delta
  – Jump to default risk
  – Basic risk (single name hedges not available)

• For example for a single interest rate swap, theoretical hedge involves
  – CDS (to hedge credit spread and jump to default risk)
  – Interest-rate futures / FRAs (to hedge sensitivity of exposure to interest rates)
  – Interest rate swaptions (to hedge interest rate volatility)
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

![CVA sensitivity chart]

Unilateral  Bilateral - counterparty  Bilateral - institution

CDS Tenor

-2.0%  -1.0%  0.0%  1.0%  2.0%  3.0%  4.0%

1Y  2Y  3Y  4Y  5Y

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Basis Hedging and DVA

• $100m, Payer IRS, 5-year maturity
  – Counterparty spread = 500 bps, own spread = 250 bps

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<td>47,215</td>
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<tr>
<td>DVA</td>
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• Spreads widen ……
  – Counterparty spread = 600 bps, own spread = 350 bps

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<td>46,900</td>
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<tr>
<td>DVA</td>
<td>-39,392</td>
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• Spreads widen proportionally
  – Counterparty spread = 600 bps, own spread = 300 bps

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<td>87,937</td>
<td>53,534</td>
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<tr>
<td>DVA</td>
<td>-34,402</td>
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Hedge basis risk with index
Hedging With Indices (with 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)
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

- 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?
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Regulatory Reaction to Crisis (Basel 2.5 & 3)

- **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
What’s in a Credit Spread?

- 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

Credit Spread

- Liquidity premium
- Default risk premium
- Expected default loss
What Can We Do With CVA?

• Basel III forces banks to price / manage CVA actively - what can we 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 unhedgeable “gap risk”
  – Limitations over counterparties who can sign CSAs (e.g. corporates, sovereigns)

• Trade through central counterparties?
  – More funding requirements than CSAs – more funding liquidity risk
  – Creates more SIFIs
Conclusion

• Beware of attempts to hide CVA
  – Over collateralising positions (especially those with significant wrong way risk) creates significant other risks (funding liquidity risk, systemic risk)
  – These are almost impossible to quantify and control (helpful in the short term but potentially explosive in the longer term)

• Beware the mark-to-market approach towards CVA
  – Mapping of spreads is an art not a science
  – Capital relief achieved under Basel III via hedging with indices is linked to mapping becoming a self-fulfilling prophecy
  – DVA can be seen as a way to try and take us back to an actuarial style CVA
  – Hedging CVA is important but important to consider where is the CVA going?