Gaining From Your Own Default

Jon Gregory

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Regulation Is Easy (I)

• What don’t I like as a regulator?

• Different institutions valuing assets differently
  – Institution A trades a derivative with institution B and they both book a profit!

• Institutions making profits based on “mark-to-model”
  – By the time we realize our model was wrong then bonuses have been paid……

• Balance sheets not being a zero sum game
  – For example, if a firm issues a bond do they mark its par value as a liability or its market value?
Regulation Is Easy (II)

• How to solve the problems?

• Different institutions valuing assets differently
  – Mark-to-market (fair value accounting)

• Institutions making profits based on “mark-to-model”
  – Mark-to-market

• Balance sheets not being a zero sum game
  – Mark-to-market (of own liabilities on balance sheet)
Pricing Liabilities With Your Own Credit Risk

• Suppose a firm issues a bond (par value $100) with a treasury like coupon
• The market will only pay $95 for this bond due to the firm’s credit risk
Gaining from Your Own Default

- The firm’s credit spread widens
- The market price of the bond is now $90
- Profit of $5

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>$95 cash</td>
<td>$90 bond</td>
</tr>
</tbody>
</table>

18% of pre-tax income for JPM, MS, BoA and GS in second quarter
CVA (Credit Value Adjustment)

- CVA is the price of counterparty risk (expected loss) and is a **cost**

Risky Derivative = Derivative - CVA

- Crucial to be able to separate valuation of derivatives and their CVA

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

- Percentage recovery value
- Expected exposure including discounting (how much we expect to lose)
- Default probability (how likely is counterparty to default at this time)
But CVA is Very Complex

• CVA represents an option on an underlying derivative
  – CVA calculation always harder than pricing the derivative itself
• Need the default probability (and recovery rate) of the counterparty
  – Often market implied probabilities are not known (no CDS market)
• Derivatives are subject to netting agreements
  – 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)
• Wrong way risk
  – Linkage between default probability and exposure at default
• Collateral agreements, break clauses etc
CVA – Risk-Neutral or Not?

• Actuarial
  – Consistent with loan book management
  – Insurance company style approach is easier
  – No hedging

• Risk-neutral
  – Consistent with derivatives valuation
  – But trading function for CVA is very difficult to run
  – Hedging is extremely difficult or impossible

• Regulators favour the risk-neutral (mark-to-market) approach
  – But recent problems with hedging in the turbulent Eurozone possibly question this
  – And loans are not treated this way (a derivative is essentially an exotic loan)
Unilateral CVA in the Old Days

<table>
<thead>
<tr>
<th>Credit Rating</th>
<th>Credit spread (bps)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bank Aa1/AA+</td>
<td>10-15</td>
</tr>
<tr>
<td>Corporate A3/A-</td>
<td>200-300</td>
</tr>
</tbody>
</table>

- Bank has no default risk
  - Bank charges corporate unilateral CVA
  - If corporate asks for banks default probability to be taken into account, they get laughed at
- No CVA charges in interbank market (collateralised, banks won’t default)
- When bank credit quality deteriorates, market becomes gridlocked
Bilateral CVA

- With unilateral CVA, everyone wants to charge each other for counterparty risk

- Solution: Bilateral CVA
- Taking into account an institution’s own default probability
- When default happens, institution (“we”) pay only a fraction of negative MtM of netted positions with each counterparty (negative exposure)
- But we still receive in full what we are owed (exposure)
- Hence we may “gain” where we have liabilities
Pricing Bilateral Counterparty Risk

- 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
Computing the Bilateral Price

• Bilateral CVA Example
  – Case A: Counterparty 250 bps CDS, Institution 500 bps CDS, EE < NEE
  – Case B: Counterparty 500 bps CDS, Institution 250 bps CDS, EE > NEE

<table>
<thead>
<tr>
<th></th>
<th>Case A</th>
<th>Case B</th>
</tr>
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<tbody>
<tr>
<td>CVA</td>
<td>1.235%</td>
<td>3.480%</td>
</tr>
<tr>
<td>BCVA</td>
<td>-1.967%</td>
<td>1.967%</td>
</tr>
</tbody>
</table>
Default Correlation

• Gaussian copula approach can be used to give simple tractable correlation between our own default and that of our counterparty
  – Just requires bivariate Gaussian distribution function
  – For example, probability our counterparty defaults in an interval but we don’t

\[ Q(\tau_C \in [t_{i-1}, t_i], \tau_I > t_i, \tau > t_i) = Q(\tau_C > t_{i-1}, \tau_I > t_i, \tau > t_i) - Q(\tau_C > t_i, \tau_I > t_i, \tau > t_i) \]

\[ \approx \left[ \Phi^{-1}_2 \left( \Phi^{-1}_1 (Q(\tau_C > t_{i-1})), \Phi^{-1}_1 (Q(\tau_I > t_i)); \rho \right) \right] Q(\tau_C > t_i) \]

\[ \approx \left[ -\Phi^{-1}_2 \left( \Phi^{-1}_1 (Q(\tau_C > t_i)), \Phi^{-1}_1 (Q(\tau_I > t_i)); \rho \right) \right] Q(\tau_C > t_i) \]
Impact of Correlation on BCVA

- Case B from previous example
  - Counterparty 500 bps CDS, Institution 250 bps CDS, EE > NEE

![Graph showing the impact of correlation on BCVA](image)

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Impact of DVA

Bilateral CVA \approx EPE \times \text{Counterparty spread} - ENE \times \text{Institution spread}

Net adjustment to derivatives book

Jon Gregory (jon@oftraining.com), Quant Congress US, 14th July 2010
Does Bilateral CVA Make Sense?

- Bilateral CVA has been widely adopted
  - Many banks base CVA on their own default
  - Accountancy rules require this (e.g. FAS 157)

- Bilateral CVA has some potentially unpleasant features
  - Total amount of CVA in the market sums to zero
  - Risky value may exceed risk-free value
  - Netting and collateral may increase CVA
  - Hedging this component is problematic

- How to monetise bilateral CVA to justify paying for counterparty risk?
How to Realise 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)

• Funding arguments
  – EE represents a long-termreceivable, NEE represents a long-term payable

• Hedging
  – DVA much harder to hedge than CVA - cannot sell CDS protection on yourself!
  – An institution might attempt to realise an increasing DVA by buying back their own debt but this cannot be a dynamic process and an institution may struggle to do this if their credit quality is declining
## Funding Costs and CVA / DVA

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<th>Default probability</th>
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<td>ENE</td>
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<td>ENE</td>
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*Double counting*
Double Counting of Funding

- **CVA of a single cashflow**

\[
CVA = E\left[ e^{-(r+X_I)T} 1_{\tau_C > T} \right] \\
= e^{-rT} \times e^{-X_I T} \times e^{-X_C T}
\]

\( X_I = \text{Funding spread} \)

- **DVA**

\[
DVA = E\left[ e^{-(r+X_I)T} 1_{\tau_I > T} \right] \\
= e^{-rT} \times e^{-X_I T} \times e^{-X_I T} = e^{-rT} \times e^{-2X_I T}
\]

\( \text{Funding cost} \quad \text{Default risk} \)

\( \text{Funding gain} \quad \text{Default risk (own)} \)
## Funding Costs Under Unilateral CVA

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Funding Costs Under Bilateral CVA

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Should you use DVA?

• On the one hand, firms need to use DVA
  – Reduces credit charges
  – Likely that both counterparties to a trade will agree on the credit charge
  – Reduces volatility of CVA desk’s book
  – Reduces hedging costs

• On the other hand
  – Has some unpleasant features
  – Does not encourage good practices for a CVA desk
  – For example, a firm going to default will need to sell more and more CDS protection
    (and more and more volatility)
Solutions to the Problem

• Do not invent regulation without understanding the likely impact
  – In particular, the imprecision of mark-to-market in some markets with the related need for banks to hedge their risk

• Ban DVA
  – It looks good in normal markets and causes problems in turbulent ones
  – This means everyone suffers a cost for every trade with counterparty risk? That’s life
  – The over-collateralisation that regulators want (central counterparties) is the same sort of thing as everyone having a CVA charge
  – If you think your debt is cheap then buy it back and make money

• Properly understand the link between pricing of derivatives and funding
  – OIS vs LIBOR discounting of collateralised trades
  – Funding costs and benefits of non-collateralised trades