Gaining From Your Own Default

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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?

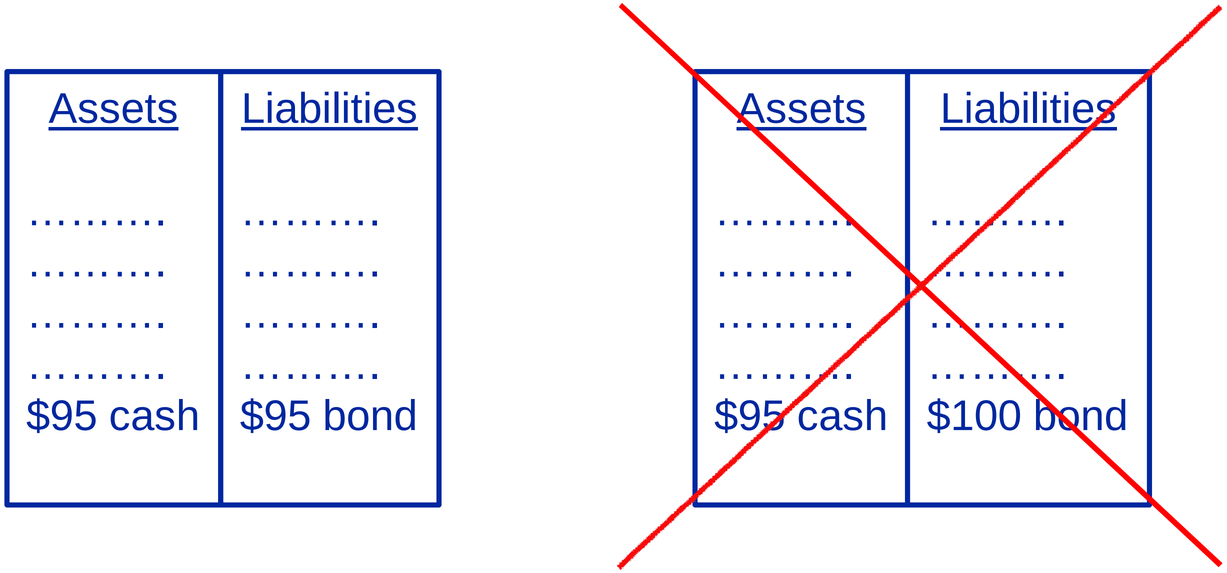
Regulation Is Easy (II)

- 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



Assets	Liabilities
……….	……….
……….	……….
……….	……….
……….	……….
$95 cash	$95 bond

~~Assets~~	~~Liabilities~~
~~……….~~	~~……….~~
~~……….~~	~~……….~~
~~……….~~	~~……….~~
~~……….~~	~~……….~~
~~$95 cash~~	~~$100 bond~~

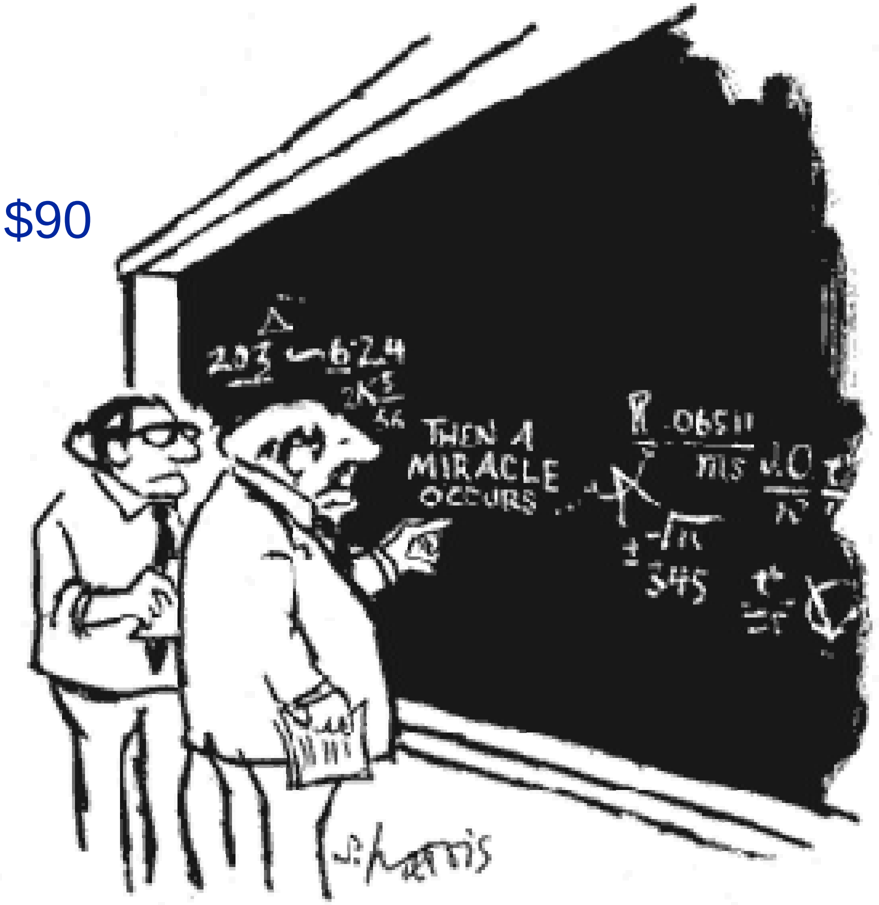
Jon Gregory (jon@oftraining.com)*, Quant Congress US, 14th July 2010*

Gaining from Your Own Default

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

Assets	Liabilities
……….	……….
……….	……….
……….	……….
……….	……….
$95 cash	$90 bond

18% of pre-tax income for JPM, MS, BoA and GS in second quarter



"I THINK YOU SHOULD BE MORE EXPLICIT HERE IN STEP TWO."

CVA (Credit Value Adjustment)

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

$$\text{Risky Derivative} = \text{Derivative} - \text{CVA}$$

- 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

	Credit Rating	**Credit spread (bps)**
Bank	Aa1/AA+	10-15
Corporate	A3/A-	200-300

- 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 postions 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 institutions own default (this formula assumes independent of defaults)

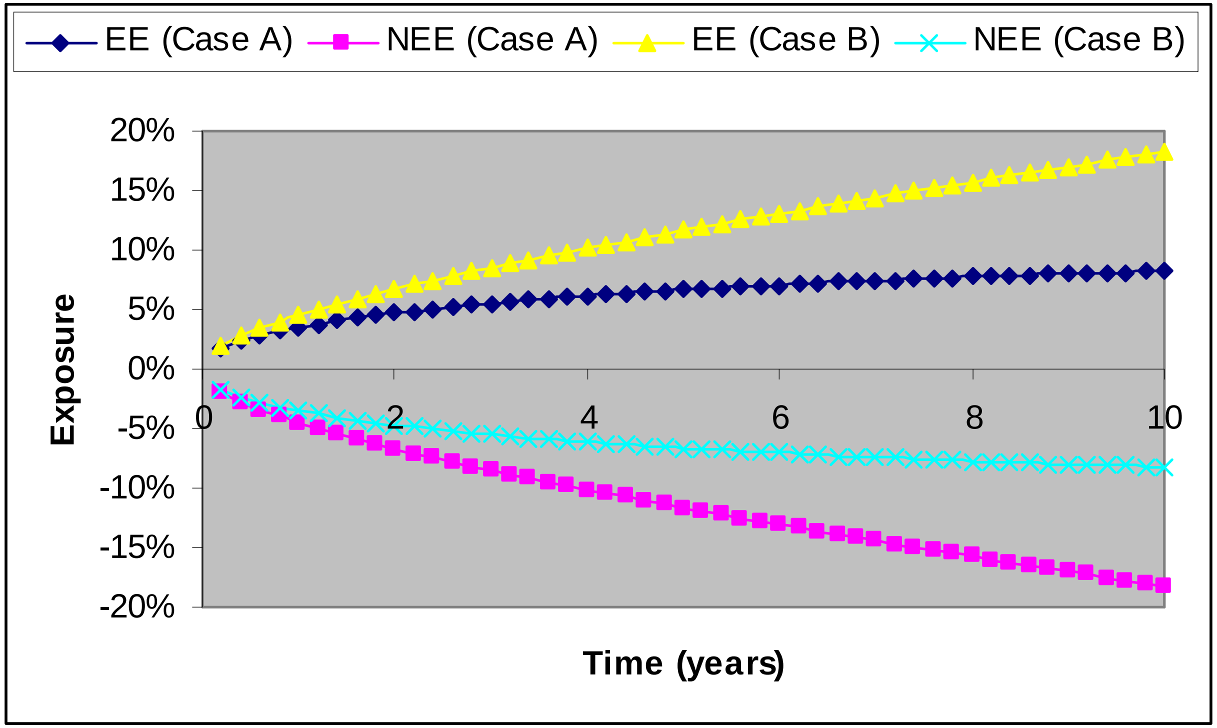
$$BCVA(t) = (1-\delta_C)\int_t^T \underbrace{EE(u)}_{\text{Expected exposure}}\underbrace{\left[1-PD_I(u)\right]}_{\text{Probability we haven't yet defaulted}}\underbrace{dPD_C(u)}_{\text{Probability counterparty defaults}} \qquad \text{CVA}$$

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

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



	Case A	Case B
CVA	1.235%	3.480%
BCVA	-1.967%	1.967%

Default Correlation

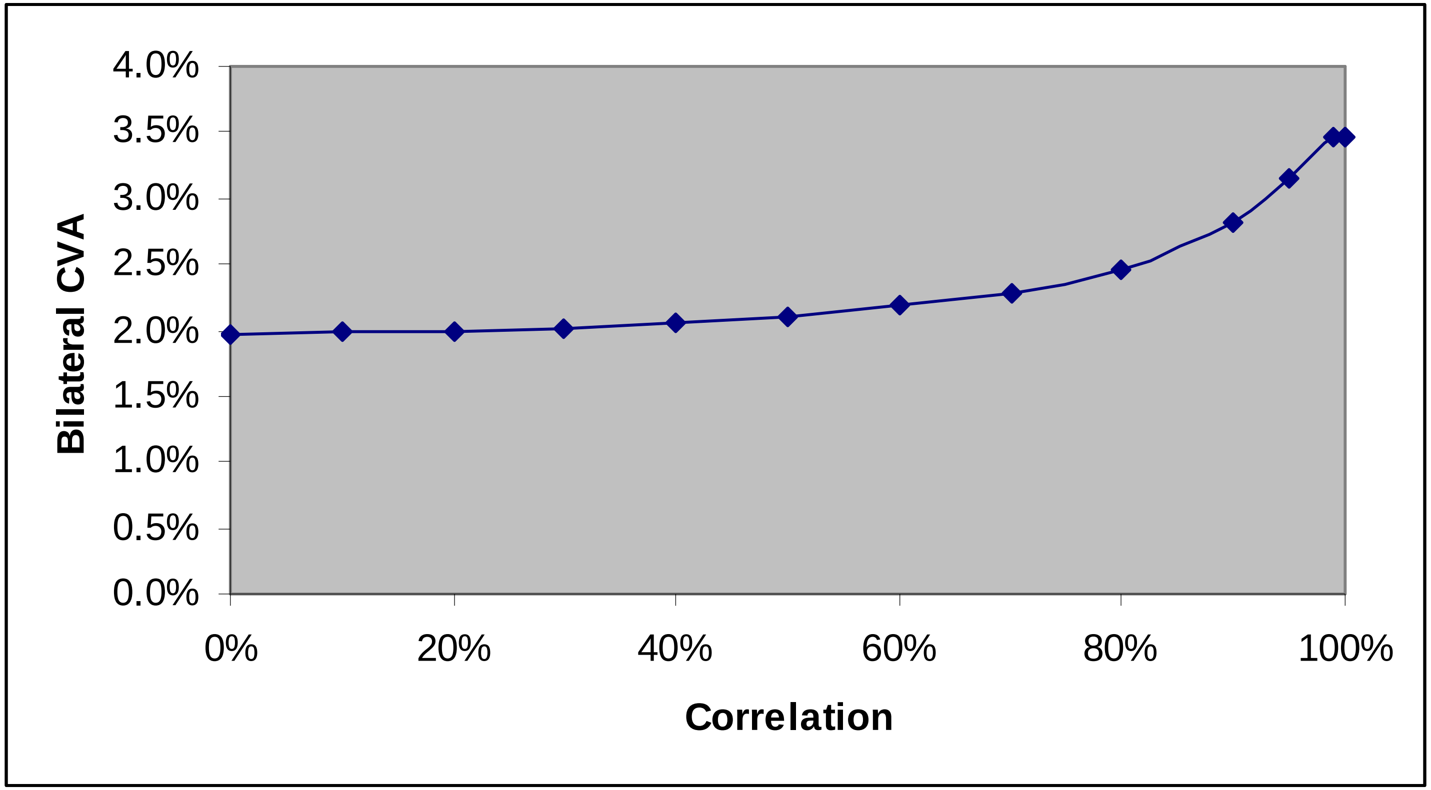
- Gaussian copula approach can be used to give simple tractable correlation between our own default and that of our counterparty
  - Just requires bivariate Gaussian distribution function
  - For example, probability our counterparty defaults in an interval but we don’t

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

$$\approx \begin{bmatrix} \Phi_{2d}\left(\Phi^{-1}\left(Q(\tau_C > t_{i-1})\right), \Phi^{-1}\left(Q(\tau_I > t_i)\right); \rho\right) \\ -\Phi_{2d}\left(\Phi^{-1}\left(Q(\tau_C > t_i)\right), \Phi^{-1}\left(Q(\tau_I > t_i)\right); \rho\right) \end{bmatrix} Q(\tau_C > t_i)$$

Impact of Correlation on BCVA

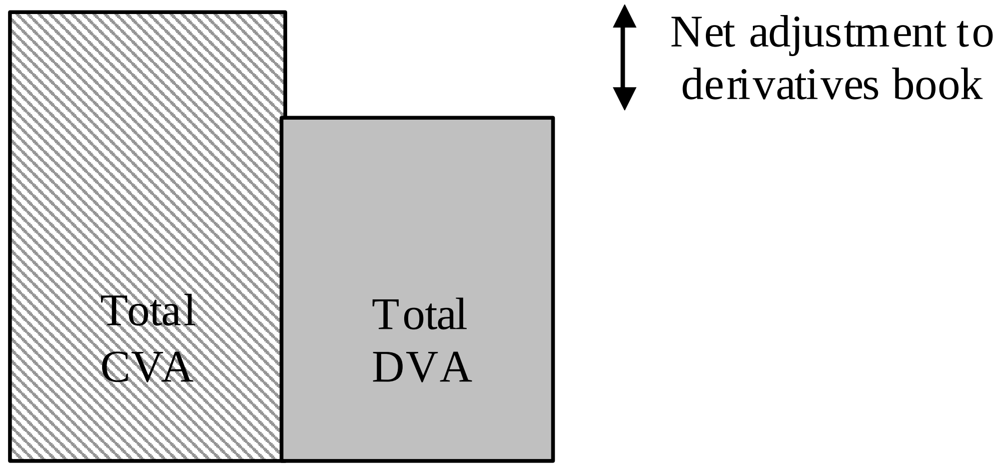
- Case B from previous example
  - Counterparty 500 bps CDS, Institution 250 bps CDS, EE > NEE



Base Case	
CVA	3.480%
BCVA	1.967%

Impact of DVA

$$\text{Bilateral CVA} \approx \underbrace{EPE \times \text{Counterparty spread}}_{\text{CVA}} - \underbrace{ENE \times \text{Institution spread}}_{\text{DVA}}$$



Total CVA

Total DVA

Net adjustment to derivatives book

Does Bilateral CVA Make Sense?

- Bilateral CVA has been widely adopted
  - Many banks base CVA on their own default
  - Accountancy rules **<u>require</u>** 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

CUTTING EDGE. CREDIT DERIVATIVES

Being two-faced over counterparty credit risk

A recent trend in quantifying counterparty credit risk for over-the-counter derivatives has involved taking into account the bilateral nature of the risk so that an institution would consider their counterparty risk to be reduced in line with their own default probability. This can cause a derivatives portfolio with counterparty risk to be more valuable than the equivalent risk-free positions. In this article, ***Jon Gregory*** *discusses the bilateral pricing of counterparty risk and presents a simple approach that accounts for default of both parties. He derives results and then argues that the full implications of pricing bilateral counterparty risk must be carefully considered before it is naively applied for risk quantification purposes*

Counterparty credit risk is the risk that a counterparty in a financial contract will default prior to the expiry of the contract and fail to make future payments. Counterparty risk is taken by each party in an over-the-counter derivatives contract and is present in all asset classes, including interest rates, foreign exchange, equity derivatives, commodities and credit derivatives. Given the recent decline in credit quality and heterogeneous concentration of credit exposure, the high-profile defaults of Enron, Parmalat, Bear Stearns and Lehman Brothers, and writedowns associated with insurance purchased from monoline insurance companies, the topic of counterparty risk management remains ever-important.

A typical financial institution, while making use of risk mitigants such as collateralisation and netting, will still take a significant amount of counterparty risk, which needs to be priced and risk-managed appropriately. Over the past decade, financial institutions have built up their capabilities for handling counterparty risk and active hedging has also become common, largely in the form of buying credit default swap (CDS) protection to mitigate large exposures (or future exposures). Some financial institutions have a dedicated unit that charges a premium to each business line and in return takes on the counterparty risk of each new trade, taking advantage of portfolio-level risk mitigants such as netting and collateralisation. Such units might operate partly on an actuarial basis, utilising the diversification benefits of the exposures, and partly on a risk-neutral basis, hedging key risks such as default and forex volatility.

A typical counterparty risk business line will have significant reserves held against some proportion of expected and unexpected losses, taking into account hedges. The recent significant increases in credit spreads, especially in the financial markets, will have increased such reserves and/or future hedging costs associated with counterparty risk. It is perhaps not surprising that many institutions, notably banks, are increasingly considering the two-sided or bilateral nature when quantifying counterparty risk. A clear advantage of doing this is that it will dampen the impact of credit spread increases by offsetting the associated increase in required reserves. However, it requires an institution to attach economic value to its own default, just as it may expect to make an economic loss when one of its counterparties defaults. While it is true that a corporation does 'gain' from its own default, it might at first glance appear unusual to price this component. In this article, we will make a quantitative analysis of the pricing of counterparty risk and use this to draw conclusions about the validity of bilateral pricing.

Unilateral counterparty risk

The reader is referred to Pykhtin & Zhu (2006) for an excellent overview of measuring counterparty risk. We denote by $V(s, T)$ the value at time s of a derivatives position with a final maturity date of T. The value of the position is known with certainty at the current time $t (< s \le T)$. We note that the analysis is general in the sense that $V(s, T)$ could indicate the value of a single derivatives position or a portfolio of netted positions[1], and could also incorporate effects such as collateralisation. In the event of default, an institution must consider the following two situations:

- $V(s, T) > 0$. In this case, since the netted trades are in the institution's favour (positive present value), it will close out the position but retrieve only a recovery value, $V(s, T)\delta_C$, with δ_C a percentage recovery fraction.
- $V(s, T) \le 0$. In this case, since the netted trades are valued against the institution, it is still obliged to settle the outstanding amount (it does not gain from the counterparty defaulting).

- 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-term receivable, 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

	Measure	Exposure	Default probability
Default	CVA	EPE	Counterparty credit spread
	DVA	ENE	Own credit spread
Funding	Funding cost	EPE	Own funding spread
	Funding benefit	ENE	Own funding spread

Double counting

Double Counting of Funding

- CVA of a single cashflow

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

$$= e^{-rT} \times \underbrace{e^{-X_I T}}_{\text{Funding cost}} \times \underbrace{e^{-X_C T}}_{\text{Default risk}}$$

X_I = Funding spread

- DVA

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

$$= e^{-rT} \times \underbrace{e^{-X_I T}}_{\text{Funding gain}} \times \underbrace{e^{-X_I T}}_{\text{Default risk (own)}} = e^{-rT} \times e^{-2X_I T}$$

Funding Costs Under Unilateral CVA

	Measure	**Exposure**	**Default probability**
Default	CVA	EPE	Counterparty credit spread
	DVA	-	-
Funding	Funding cost	EPE	Own asset funding spread
	Funding benefit	ENE	Own liability funding spread

Funding Costs Under Bilateral CVA

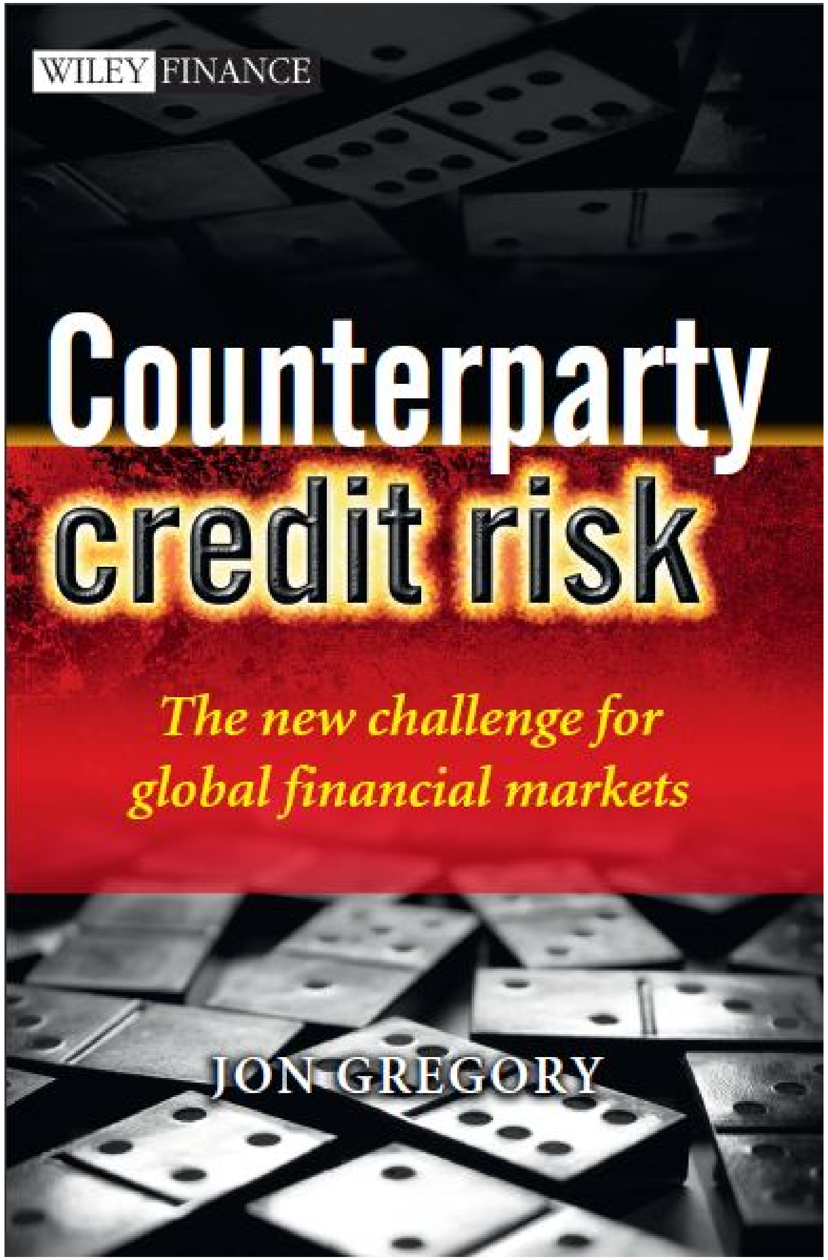
	Measure	**Exposure**	**Default probability**
Default	CVA	EPE	Counterparty credit spread
	DVA	ENE	Own credit spread
Funding	Funding cost	EPE	Own asset funding spread
	Funding benefit	-	-

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


WILEY FINANCE
Counterparty credit risk
The new challenge for global financial markets
JON GREGORY