Counterparty, Funding, and Wrong-Way Risks in derivatives markets

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Overview

- Counterparty risk and Credit Valuation Adjustment (CVA)
- Funding risk and Funding Valuation Adjustment (FVA)
- Wrong-Way Risk (WWR) in derivatives

- A simple trading-desk model of WWR in CVA and FVA
  - basic economics of WWR for FX
  - WWR for CVA and FVA

- Some thoughts about collective behaviour of financial markets
- Open questions
Counterparty risk before and after 2007

“I’m not so much concerned about the return on my money, but the return of my money.” Will Rogers

**before 2007**

- sovereign and bank credit risk was not on the agenda (not priced in)
- (for example, in 2006 Greece 5y CDS @ 12bps!!!)

\[
\text{CDS}_{\text{sovereign}} \ll \text{CDS}_{\text{bank}} \ll \text{CDS}_{\text{corporate}}
\]

- classic banking system allowing the flow of credit from banks to corporates, mainly corporate credit risk for loans and bonds is priced in

**after 2007**

- counterparty risk in OTC bank-to-bank and bank-to-corporate is a big concern

\[
\text{CDS}_{\text{sovereign}} \sim \text{CDS}_{\text{bank}} \sim \text{CDS}_{\text{corporate}}
\]

- regulatory measures (i.e. CVA VAR, capital ratios, etc) and funding pressures (via collateralisation or CCPs) assure no return to “classic banking system” in the near future
- Disintermediation of banks from loans
- more strongly coupled financial system, more WWR
Counterparty risk and CVA

- CVA is the cost of protection on the value of a derivative contract
  - formally \[ CVA = (1 - R) \int_0^T EE^+(t)dPD(0,t) \]
  - informally \[ CVA \approx CDS_{Counterparty} \times CallOptionPrice(MtMofDerivative) \]

- Counterparty risk viewed as a network problem

A. Fully Bilateral Network

B. Centrally Cleared Network
Funding risk and FVA

- Secured and unsecured markets
  - Basic funding cash securities
    - (a) secured covered bond
    - (b) unsecured standard bond
  - Derivatives – traded with or without collateralisation

- Money markets and derivatives markets
  - Short-dated (money markets) versus long-dated (derivatives markets)
  - Different markets strongly coupled via balance sheets of the firms

- FVA is the own cost of funding of the expected positive exposure of the derivative contract

\[ FVA = \text{Funding Spread} \times \text{Call Option Price (MtM of Derivative)} \]
Conversion of CVA into FVA

- General law of transformation of risks
  - The different type of risks do not disappear but transform into each other – not quite the law of the conservation of energy(risks)?

- Example of the risk transformation – make the contract collateralised
  - CVA transforms (mostly!) into FVA

- Central Counterparties - the push by regulators
  - CVA versus FVA - better or worse?
  - Encumbered assets
  - Bankruptcy(CVA and credit losses) versus solvency (FVA and funding squeeze)?
The consistent view of CVA+FVA?!

- No double counting
  - DVA (Debit Valuation Adjustment) is equivalent to FBA (Funding Benefit Adjustment)

- Deep re-examining of Black-Scholes framework/derivation
  - Theoretical arguments by J. Hull, A. White (2012) – “Is FVA a cost for Derivatives desks?”
    - FVA is not a cost – not charging funding on a corporate loan? ROE (return-on-equity) view from corporate finance
    - Assumptions of Black-Scholes derivation – liquidity of funding and hedging instruments not important?
  - CVA+FVA is derived from Black-Scholes equivalent framework – C. Burgard, M. Krjaer (2011)
  - The headlines debate - “Academics versus Bankers!”

- CVA/FVA - unique price or economic value for the firm?
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Wrong-way risk (real life examples)

Wrong-way risk is the tendency of both the exposure and the likelihood of default to increase at the same time

- The Bad WWR - Mortgages - mortgage lenders face WWR from borrowers. The more the borrower owes, the more likely he will default on its debt.

- The Good WWR - CEO’s compensation in company’s shares – CEO faces WWR. In the case of underperformance, CEO looses on the value of the shares and more likely to be fired/replaced/“defaulted”

- The Ugly WWR - Are Wrong-way or Right-way risks priced in practice?
“Exposure given default” Models

- for sovereign or corporate, FX example (A. Levy, 1999, JP Morgan)
- pricing in the Ccy devaluation scenario given the default
- calibration of Ccy devaluation amount is possible, if quanto CDS is quoted

Stochastic/Dynamic Credit Models (recent talks by T. Hulme, A. Green)

- assume stochastic dynamics for hazard rate
- pricing in the cross-gamma of the credit-’risk factor’ correlation
- many parameters not well-defined (credit-FX/rate correlations, credit vol too high, etc)

Joint distribution models

- Gaussian copula (Redon, Finger, Iacono, Buckley et al, Rosen, etc)
- not always easy to apply to a portfolio
- historical correlation? Correlation between time-to-default and exposure?
- Hazard rate as a function of exposure (Hull-White, 2011)
Emerging Markets – in financial crises and/or recessions, corporate and sovereign defaults as well as downgrades are accompanied by severe declines in local currency values

- numerous historical examples (South-East Asia, Russia, in 1998, 2007, etc)
- one-sided quite certain effect due to capital outflows reaction in the global financial system

Structural/institutional and specific counterparty risks can be wrong- or right-way risks
WWR for a sovereign counterparty

- the exposure conditional on default

\[
B[FX(t)|\text{sovereign default}] = RV_c FX(t)
\]

- \(RV_c\) - residual value factor for the currency upon default

WWR for a corporate counterparty

- default under the condition of the unfavourable asset move in Merton’s bankruptcy model

\[
RV_c = 1 + \rho \sigma_{FX} N^{-1}(0.5Q_c(t))\sqrt{t}
\]

- \(t \leq 4y\) so that longer maturities have fixed reasonable

\(Q_c(t)\) is the default probability of the counterparty

\(\rho\) is the asset-FX correlation (use equity-FX correlation?)
The main assumption –
the stressed WWR scenario is mainly determined by the conditions of the sovereign default

Calculate EPE (expected positive exposure) including WWR

\[
EPE_{WWR} = P(sov|Cpty) \times EPE^{stressed} + (1 - P(sov|Cpty)) \times EPE
\]

\[
P(sov|Cpty) = \lambda P(sov)
\]
How to determine $P(sov|Cpty)$
(the reminder about Bayes’ theorem)

Bayes’ theorem
the relationship between conditional and unconditional probabilities

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

Apply Bayes’ theorem to counterparty’s default
- $P(Cpty), P(sov)$ unconditional probabilities determined from CDS quotes
- we are interested in the probability of the country’s default given the counterparty’s default

$$P(sov|Cpty) = \frac{P(Cpty|sov)P(sov)}{P(Cpty)}$$
Systematic coupling parameter to a sovereign

Let's define “systematic coupling parameter” between counterparty and its sovereign

\[ \lambda = \frac{P(Cpty|sov)}{P(Cpty)} \]

counterparties can be assigned this coefficient based on how systematically coupled to sovereign

- \( \lambda \ll 1 \) weakly coupled (sovereign’s counterparty’s defaults are independent)
- \( \lambda \gg 1 \) strongly coupled, systematic, but obviously \( \lambda P(sov) < 1 \)

the model is simple

\[ P(sov|Cpty) = \lambda P(sov) \]

- the stressed scenario of WWR occurs proportionally to time-dependent inferred from sovereign CDS \( P(sov) \)
- only one intuitive coupling parameter per counterparty (not a correlation parameter!)

\[ EPE_{WWR} = EPE + \lambda P(sov)(EPE_{stressed} - EPE) \]
Example: cross-currency swap

Exposure profiles
- assuming 30% currency devaluation
- CVA=24bps
- Xccy basis= -16bps (for comparison)

The (alpha) adjustment for WWR
- coupling coefficient beyond 1

WWR adjustment
- interestingly, in relative terms smaller for longer-dated maturities
WWR for FVA can be very important in the stress scenario
- collateralised exposures can cause large liquidity/funding stress

WWR for FVA - the same idea of pricing in the default scenario explicitly

\[ E_t[FundSpread \times fMtM] = FundSpread \times fMtM_t + \]

\[ \Delta P_t(sov) = (FundSpread^{forward} \times fMtM^{forward} - FundSpread \times fMtM)_t \]
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Collective behaviour of financial markets (1) - networks between optimizing but confused agents

- Networks view of financial markets (Andrew Haldane, Bank of England)
  - Rethinking the financial network (2009)
  - The dog and the frisbee (2012)

- Interesting comparisons of financial crises and their regulation with
  - SARS and various diseases epidemics

- Characteristics of the financial network
  - Complexity – simplify?
  - Connectivity
  - Feedback
  - Uncertainty
  - Homogeneity – harmful? Natural complex systems are multi-scale and heterogeneous

- Stable and not stable at the same time???
Financial crises are similar to collective phase transitions in physics

- **Trigger**
  - Physics – sources of condensation, dirt, impurities, etc
  - Finance – special event, coincidence of events
- **Strong interaction between agents/particles – the condition for a phase transition**
  - Physics – sufficiently strong interaction between particles versus thermal(or quantum) noise. For instance, in water freezing, interaction between water molecules versus the temperature/noise
  - Finance – strongly coupled (via leveraged obligations) counterparties versus natural activity/liquidity, i.e. Leverage in the system
Collective behaviour of financial markets (3) - simpler analogies from physics

- 1st type of phase transition – everybody having the same trouble
  - 2011 in Europe (1987, 1998, etc) – freezing of funding market

- 2nd type – everybody has opposite positions (MtM) and uncertainty
  - 2007 in USA and later all over the world – uncertain valuation of CDOs and strong network intercoupling
  - blocking of OTC market – spin-glass transition – everybody is uncertain and “frustrated”

- 3rd type – future crisis? Complex or simple crisis?
  - Central Counterparties and FVA
  - Intercoupling of Money Markets and Derivatives Markets
  - Intercoupling between Developed and Emerging Markets
Open questions

- Is CVA/FVA like a tax or a fair-value price?
- Does CVA change appropriately traders’ (market participants) behaviour?
  - reserving for counterparty losses, weakening the network links?
  - CVA hedging- feedback loops and strengthening the network links?
- Banking versus Shadow banking - regulations?
- Why is Financial system so complex?
- CVA or FVA? FVA to be regulated?
Summary

Only simple models in derivatives makes sense, especially after 2007
  ✓ Financial markets change faster than models and regulations

Big transformation is happening in derivatives markets
  ✓ Exciting and confusing time!

CVA and FVA are especially at the centre of controversy, conflicts, turbulence, regulations, and opportunities