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

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Overview

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- 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

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"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!!!)

$$CDS_{sovereign} \ll CDS_{bank} \ll CDS_{corporate}$$

- 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

$$CDS_{sovereign} \sim CDS_{bank} \sim CDS_{corporate}$$

- 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

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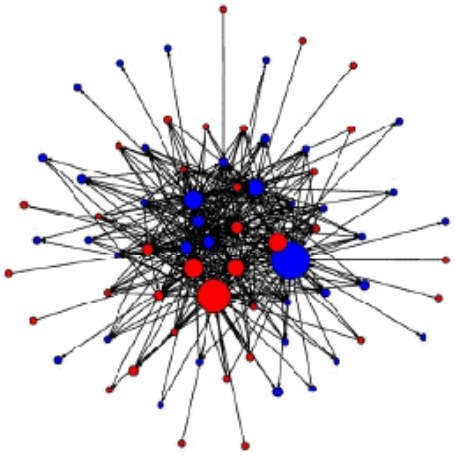
- CVA is the cost of protection on the value of a derivative contract
  - ✓ formally $CVA = (1 - R)\int_0^T EE^*(t)dPD(0,t)$
  - ✓ informally $CVA \sim CDS_{Counterparty} * CallOptionPrice(MtMofDerivative)$

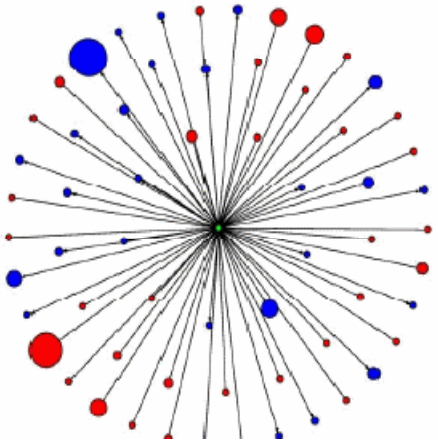
- Counterparty risk viewed as a network problem

A. Fully Bilateral Network



Basel 3

B. Centrally Cleared Network



Funding risk and FVA

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- 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

$$FVA \sim FundingSpread * CallOptionPrice(MtMofDerivative)$$

Conversion of CVA into FVA

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- 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?!

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- 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)

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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?**

WWR models: the review

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… many models already but not yet practical enough?!

“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)

Basic economics of WWR for FX (foreign exchange)

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

Exposure given default Model
(A. Levy, 1999, JP Morgan)

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WWR for a sovereign counterparty

- the exposure conditional on default

$$E[FX(t)|sovereign\ default] = RV_s\overline{FX(t)}$$

- RV_s - 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

ρ is the asset-FX correlation (use equity-FX correlation?)

RV_c

Exposure given default Model – new development (M.Turlakov, to be published in “RISK”, 2013)

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“Everything should be made as simple as possible, but not simpler” Albert Einstein

The main assumption –

the stressed WWR scenario is mainly determined by the conditions of the sovereign default

Calculate EPE (expected positive exposure) including WWR

$$EPE_{WWR} = P(sov|Cpty) * EPE^{stressed} + \left(1 - P(sov|Cpty)\right) * EPE$$

$$P(sov|Cpty) = \lambda P(sov)$$

How to determine $P(sov|Cpty)$ (the reminder about Bayes' theorem)

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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

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lets 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

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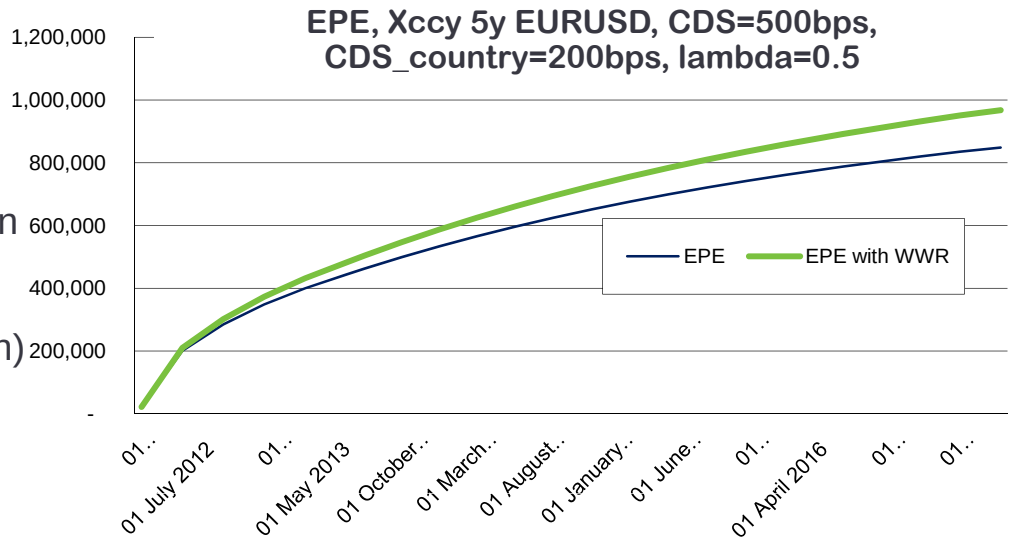
Exposure profiles

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

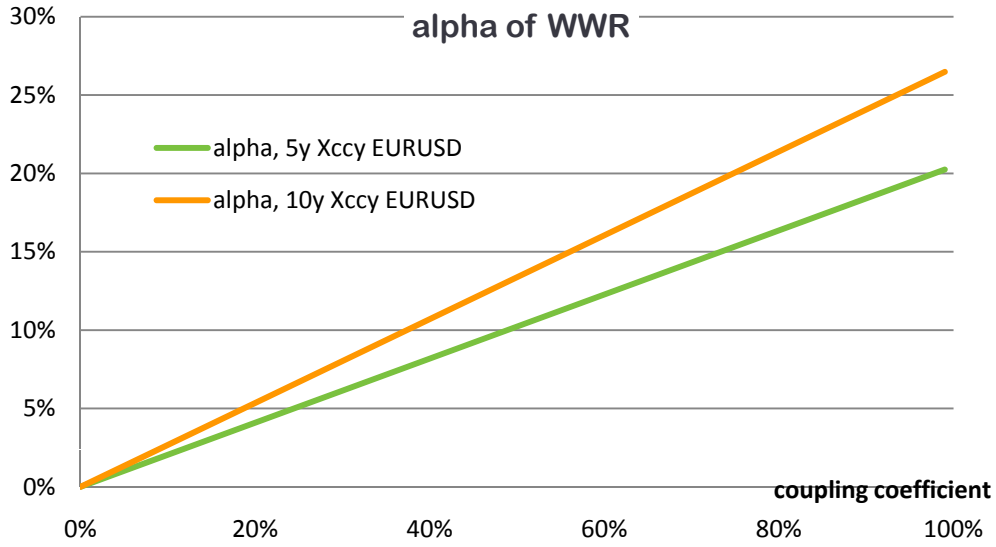


the (alpha) adjustment for WWR

- coupling coefficient beyond 1

WWR adjustment

- interestingly, in relative terms smaller for longer-dated maturities



WWR for FVA (funding valuation adjustment)

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Bilateral FVA assumed

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

$$E_t[FundSpread * fMtM] = FundSpread * fMtM_t +$$

$$\lambda P_t(sov) * (FundSpread^{stressed} * fMtM^{stressed} - FundSpread * fMtM)_t$$

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Collective behaviour of financial markets (1) - networks between optimizing but confused agents

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- 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???

Collective behaviour of financial markets (2) - simpler analogies from physics

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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

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- 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

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- 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

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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