Introduction to CVA, DVA & FVA

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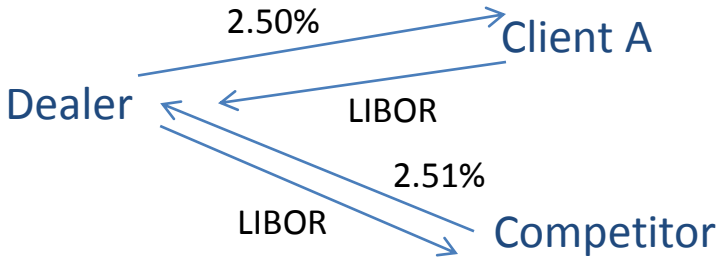
Example Interest Rate Swap Trades

- Dealer acts as market-maker in 10-year Interest Rate Swaps
  - Notional $100,000,000 DV01 $91,000. Dealer covers a client flow in inter-bank market.



- Interest Rates increase 10bps. P&L is maintained but
  - Dealer now has credit exposure to Client A
  - Competitor has credit exposure to dealer

T0:

Counterparty		MTM		Risk
Client A	$	91,000	$	91,000
Competitor	$	-	$	(91,000)
	$	91,000	$	-

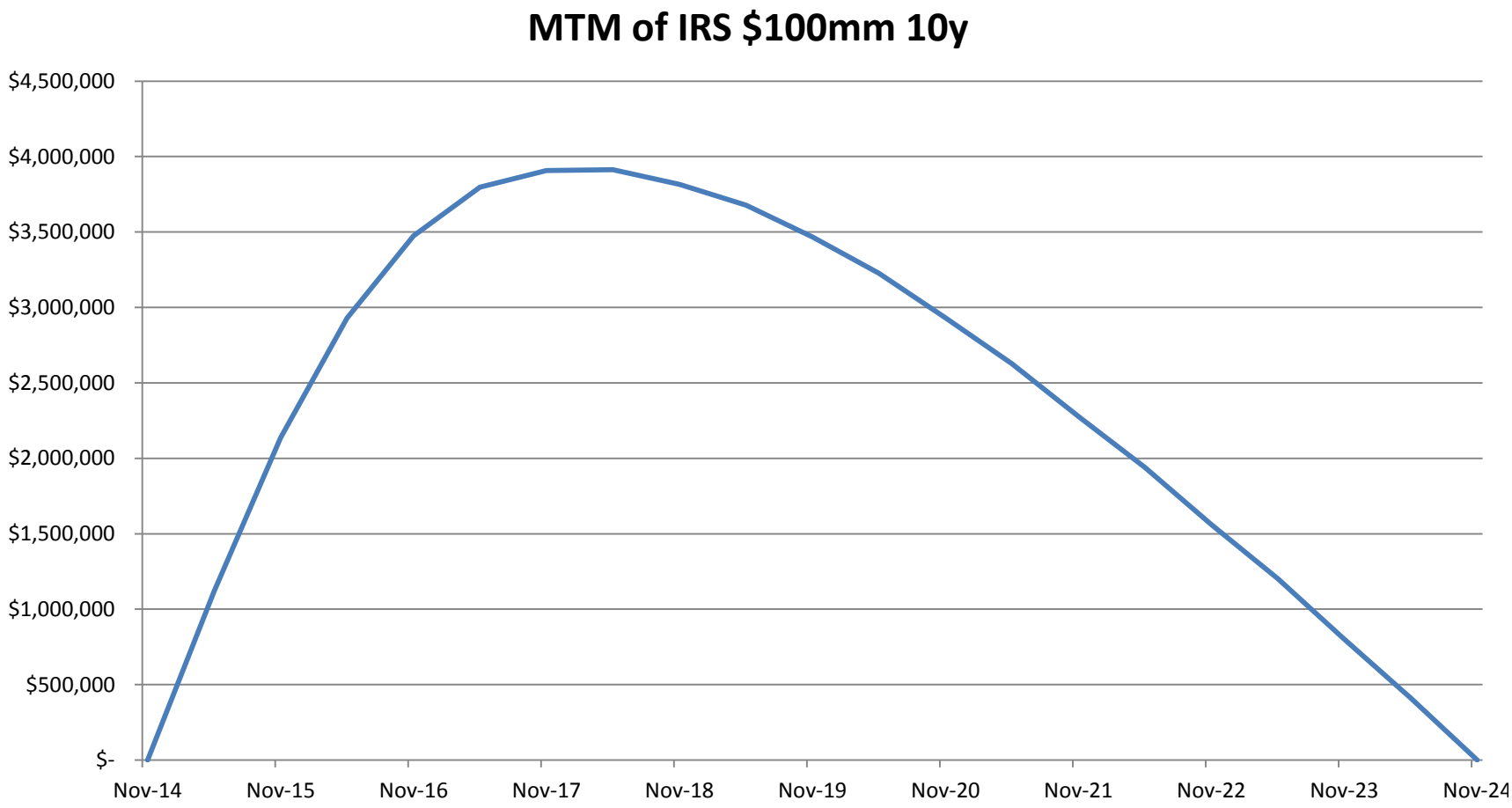
T1:

Counterparty		MTM		Risk
Client A	$	910,000	$	91,000
Competitor	$	(819,000)	$	(91,000)
	$	91,000	$	-

- What if Client A defaults?
- Exposure not as simple as a pure asset/liability, with a derivative can be +/- and fluid

Example Interest Rate Swap Trades

- Even without market moves, if forwards are followed, exposure evolves after T0
- Forward profile has expectation that MTM will be non-zero over time



Credit Support Annex ("CSA")

- Describes collateral arrangement between derivative counterparties
- Counterparty A w/ negative Mark to Market ("MTM") posts cash to Counterparty B
- Counterparty B pays interest on that cash to Counterparty A
- Net credit exposure changes with MTM of underlying derivatives
- Multiple trades are typically netted under a master ISDA
- Interdealer market typically OIS – zero thresholds ("standard CSA")
- Sometime currency optionality (can post EUR or USD)
- Customer trades may not be standard
  - Complete absence (legacy trades)
  - One way (only bank posts, govts, supranationals)
  - Thresholds
  - Rehypothecation
- Not natural for cash management for non-financial customers
- Sovereigns, Munis
- Even perfect CSAs have closeout risk (2 weeks – used in capital models)

- Expected return of the MTM of a cashflow determines discount rate
- Led to transition from LIBOR to OIS discounting

Credit Valuation Adjustment ("CVA") – In the Pricing/Value Sense

- Present value of expected losses on derivative MTM due to counterparty default
- Value of difference between Actual CSA and Standard CSA
- Captures expected cost of hedging counterparties' default risk
  - Typically exposure hedged at least partially with credit default swaps (CDS)
- If CDS/risky bonds not available, internal spread matrix based on ratings
- Always requires dynamic replication strategy
  - Credit exposure changes as the MTM of the underlying derivative

- Simple approaches are possible for non-banks ("current exposure" methods)
- Banks must use Expected Potential Exposure methods
- FAS 157 – included in earnings

CVA Credit Charge Pricing and Risk

- Simple products become complex
- American option style payout – contingent on credit
- Expected Positive Exposure ("EPE"), PD is default probability
- $CVA = (1 - Recovery) \int_{t=0}^{t=T} EPE(t) * PD(t,t+dt)\, dt$

- Short an option to your counterparty,
  - Counterparty can walk away from a negative derivative MTM at any future time
  - CVA is present value of that series of options, weighted by probability of c/p default in that interval
- Must be done in a portfolio context – netting sets, Monte Carlo

- These CVA charges change over time based on derivative and credit spreads
- Must be hedged
- Will generate deltas/vegas etc in the underlying risk factors
- Deep in-the money FX option with counterparty with a 50% default probability
- PV_riskfree = (FX – K)* RFDF, PV_risky = (FX – K)*RFDF*50%,
- Risky Foreign currency leg PV is 50% of the Risk Free PV, therefore the risky derivative should be hedged with approx half the notional of the same derivative with a risk-free counterparty (assuming no recovery)

Correlation Adjustment (1)

- Standard Intensity ("hazard rate") model
- Instantaneous default probability λ.
- Survival probability at time t: $S(t) = e^{-\lambda t}$ or $S(t) = e^{-\int_{u=0}^{u=t} \lambda(u)\, du}$
- Define Indicator function ① to be 0 if in default, 1 otherwise
- An expected cashflow V(S) from a risky counterparty becomes E[① * V(S)]
- Normal approach is to calibrate ① off of CDS prices and discount risky cashflows
- Does not work when value of cashflow V(S) and ① have covariance
- E[① * V(S)] ≠ E[①] * E[V(S)] when Cov (V(S), ①) ≠ 0
- Similar to "Quanto Adjustment"

- Substantially affects pricing complexity.
- How do you calibrate correlations?

Correlation Adjustment (2)

- "Right Way Risk"
  - Counterparty's spreads tighten in same environment when they owe you more money
  - Commodity deriv contract with an oil producer -- client sells calls on oil, buy the puts
  - Bank is owed money on the MTM of derivative when oil is higher (counterparty in good shape)
- "Wrong Way Risk"
  - Counterparty's spreads widen in same environment when they owe you more money
  - Costs more to buy more protection as derivative increase MTM
  - Cross currency swap receiving USD, paying RUB facing a Russian Bank
- Sometimes not clear whether "right way or wrong way"
  - Idiosyncratic credit event or market event
  - Large economic events disrupt underlying markets and credit risk simultaneously

- Beware of Brownian Motion Diffusion Models, market tends to gap in stress

CVA desk in practice

- Internal CVA desk assumes/manages contingent credit risk
- Natural offsets (one desk positive MTM, another negative to counterparty)
- Centralization of expertise, monitoring, reporting
- Data challenges – CSA terms, legal entities, netting sets, grace periods
- Attempt to hedge counterparty risk (via CDS and Securitization) where possible
- Residual market risk where possible
- Charges derivative trading desk a fee
- Fee then passed to customer
- If counterparty defaults, CVA desk pays derivative desk the MTM of the transaction
- Challenges: Liquidity/Availability of CDS is benign and stressed environment
- Unhedgeble correlation risks
- Need experienced traders, sometimes “right-way” or “wrong-way” not obvious

Capital Requirements for CVA (CVA VaR)

- Volatility of CVA during crisis (realized defaults + MTM volatility from credit spreads)
- Basel III – capital charge on CVA volatility
- CEM and EPE – Standardized or Monte Carlo approach
- Credit hedges “count” against charges but not market hedges
- PFE – based on tails of distribution (95% or 99% confidence interval)
  - Similar to VAR
  - Used for allocating capital, not pricing or risk management
  - Important for monitoring counterparty limits

- Basel “Advanced” Methodology

Industry Shift to Central Clearing

- LCH, CME
- Typically fully collateralized for variation margin with additional high initial margin
- Counterparty risk replaced by clearing house

- Required for many products (IRS, CDS) and counterparties (dealer to dealer)
- Only handles standard conventions
- Some corporates exempt
- Counterparty A w/ negative Mark to Market (“MTM”) posts cash to Clearing House
- CSA with clearing house “standard”, also has “initial amount”

Debit Valuation Adjustment ("DVA")

- Opposite of CVA – reflects risk of own default.
- Symmetrical Pricing (My DVA is your CVA) in theory (net of model diffs)
  - Same credit adjusted prices
  - Risk Free +DVA - CVA
- Structured Notes Under Fair Value Option
- Has perverse dynamic – gains when your credit is deteriorating, losses in improvement
- Tricky to hedge
  - Can't sell protection on yourself
  - Probably need the funding most when spreads are widening
  - Difficult to buyback debt (tenders, timing)
  - Could sell on peers but difficult in size, increased risk, Volker implications

- Affect earnings, Excluded from Capital

Funding Value Adjustment ("FVA") Defined

- Suppose an uncollateralized trade with a client is hedged with a collateralized street facing trade
- If MTM of hedge becomes negative:
  - Dealer must post collateral to street counterparty,
  - Does not receive collateral from client
- What is the cost to fund that collateral?
  - Collateral will return OIS, but cannot be raised at OIS, raised at average cost of funds
- Implicitly it is a loan to the client (direction could be reversed be a deposit)
- Incremental to CVA because dealer must raise cash and buy default protection on client

- FVA = Adjustment to derivative price which reflects the economic value of funding

- At what price should a dealer trade an uncollateralized derivative with implied funding?
- Funding costs must be considered, or could end up with a large and expensive funding requirement

- Two different banks will have different prices for the same derivative, depending on funding costs

FVA in theory

- Still widely debated in both academia and industry
- How to separate funding component from expected default component.
- How to combine consistently with CVA/DVA and avoid double counting?
  - Especially difficult with DVA, DVA+FVA should not exceed total spread on debt.
  - Which default occurs first?
- The banks credit worthiness is a function of the quality of its assets.
- Suppose bank has only one derivative asset, bank's credit should equal counterparty's. The cost of the bank's debt would include CVA=FVA and so counterparty would get double CVA.
- Should corporation's own debt be discounted risk free? The risk free PV of its extra expense over risk free is not NPV on balance sheet?
- Should a risky corporation lend money a less risky counterparty?
- A corporate bond held in a bank's asset portfolio would not have funding risk valued.
- Why is a derivative receivable different?
- Mathematically complex to have unified framework
- Theoretical arguments based on trading in ones own debt -- not practical
  - Tender requirements, blackout, regulatory, liquidity/funding plans
  - Benchmark size, Investor expectations of issuance pattern

FVA in practice

- Some banks have made one-time adjustments for net derivative receivable positions (JP Morgan Q4 2013)

- No prescriptive accounting standard

- How to avoid double counting and price competitively?
- Reducing volatility in earnings (diversifies) DVA
  - Typical FVA position is long receivables from uncollateralized clients
  - DVA typically the reverse (net liability position from structured notes under FVO).
  - Seen in initial disclosures (losses) when FVA switch is “turned on” (e.g., JPM 4q 2013)
- Effective lifetime also important
  - Unwinds and restructuring of client trades
- Portfolio effects – need centralized desk
- How to separate funding from default risk? (bond / cds basis?)
  - CDS illiquidity/volatility makes this of little practical use

- Alignment with Funds Transfer Pricing (static net funding req vs term structure)
- FVA benefit not a stable source of funds or accretive to regulatory metrics

FVA – Counterarguments

- Hull and White (U. of Toronto)
- Their position – FVA should be ignored in pricing/valuations
- Risk free rate is not used because assumption banks can fund at risk free rate
  - Used because risk-neutral valuation requires it
  - RN valuation gives correct value adjusting for hedgeable market risks
- FVA – Asymmetric nature
  - Two banks give different price for same uncollateralized derivative depending on banks funding costs
  - Permits arbitrage
- Should corporation's own debt be discounted risk free? No.
- Should a risky corporation lend money a less risky counterparty?
  - Analogy, should banks give a loan at a price that reflects clients creditworthiness only?
  - If not then never would lend to a better credit at any rate.
- Is it automatically in the price? FVA is the incremental DVA issued to fund collateral
- Decision to hedge shouldn't affect valuations.
- Corporate Finance Principle: pricing separate from funding

References and Further Reading

- "The FVA Debate", Hull and White
- "Is FVA a Cost for Derivatives Desks?", Hull and White
- "FVA – Putting Funding into the Equation", KPMG
- "Credit Value Adjustment and Funding Value Adjustment All Together", Lu and Juan
- "CVA, DVA & Bank Earnings", Kelly and Pugachevsky
- "The Impact of FVA on swaps: A primer", Pugachevsky
- "Managing the Complexities of CVA, DVA and FVA", Pugachevsky
- "The FVA-DVA Puzzle: Risk Management and Collateral Trading Strategies", Albanese and Iabichino
- "Credit valuation adjustments for derivative contracts", Ernst & Young
- "Yes, FVA is a Cost for Derivatives Desk", Castagna
- "Counterparty Risk FAQ:", Brigo