Prepared for a Seminar Discussion at ISDA

8/14/2007

*The views expressed here are solely those of the author, and do not necessarily reflect the views of the Federal Reserve Board

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Agenda

1. Trading Book Capital Requirements
2. Counterparty Credit Risk
3. Economic Capital in Counterpary Credit Risk
4. Key Differences
5. Looking Forward

Market Risk in Trading Book

Risk-Based Capital Standards: Market Risk/Proposed Rules /Federal Register/ September 25, 2006

*The rule applies to a bank with worldwide, consolidated trading activity equal to at least **10 percent of total assets or $1 billion**.*

- The New Accord generally retains the approach contained in the MRA
- Improvement to the MRA, especially with respect to the treatment of specific risk
  - Market risk consists of general market risk and specific risk components
  - In trading book, specific risk ideally includes event and default risk as well as idiosyncratic variations
- The time horizon – ten business day movement in rates and prices
- Confidence level: 99 percent, one tailed confidence level

Market Risk - Modification in NPR

Revisions in Market Risk

- Risk Drivers/Factors
  - ***Credit Spread risk**** (New)
  - Interest rate risk
  - Equity price risk
  - Foreign exchange rate risk
  - Commodity price risk
- Prepayment Risk
  - VaR measure may not capture the full picture of prepayment risk based on a ten-day interest rate movement
  - A full prepayment model – credit scores, LTV, credit performance history, DTI, and etc.
  - Association between prepayment and credit risk in the remaining credit portfolio

Market Risk - Modification in NPR Continued

Revisions in Market Risk

- Expansion of VaR measure on
  - ***Residual securitization positions*** (trading assets or liabilities)
  - Repo, Reverse Repo, Security borrowing/lending*

- Enhancing Risk sensitivity
  - Reflecting the growth in traded credit products, such as credit default swaps and tranches of collateralized debt obligations, other structured products, and less liquid products

* Residual securitization and Repo-style transactions included in the VaR-based measure will continue to be subject to the credit risk capital requirement in order to capture counterparty credit risks

NPR - Specific Risk

- A bank may use one or more internal models to measure specific risk
- A bank's internal models would capture issuer specific event and default risk
  - Default risk
  - Event risk
    - Rating migration risk for debt positions
    - Large changes or jumps in prices for equity positions
  - Idiosyncratic variation
  - Concentrations
    - Magnitude and change in composition
  - Material basis risk
- Effective January 1, 2010,
  - Phase-out of partial modeling of specific risk
  - Either a complete modeling of specific risk capturing all material risks or standard specific risk add-on

NPR - Incremental Default Risk

- Incremental Default Risk reflects risk beyond a 10-business-day horizon and a 99 percent confidence level.
- A bank would measure Incremental Default Risk for both covered debt and equity positions
  - One-year time horizon
  - One-tailed 99.9% confidence level
- Adjustment of Increment Default Risk reflects
  - An appropriate liquidity horizon of a position or portfolio – including stressed market conditions
  - Concentrations - including name concentration and market concentration
  - Hedging – offsets of long and short positions in a single instrument
  - Optionality – Nonlinearity of options
- Effective January 1, 2010,
  - Either a complete internal modeling of Incremental Default risk or AIRB or standard specific risk add-on

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Regulatory Capital and Risk Weighted Assets

Similarities and Differences

Regulatory Capital – Market Risk

- Simulation
- RWA_{MR} = Market Risk Equivalent Assets = 12.5*Regulatory $Capital_{MR}$
- RC_{MR} = 3*$VaR_{10\text{-day},99\%}$ + Specific $VaR_{10\text{-day},99\%}$ + $IDRC_{1\text{-year, }99.9\%}$ + $RC_{\text{de minimis}}$
- RW_{mr}=12.5*8% = 100%

Regulatory Capital – Credit Risk

- Analytical
- RWA_{CR} = 12.5*Regulatory $Capital_{CR}$
- RC_{CR} = K*EAD
- RWA_{CR} = RW_{CR}*EAD and RW_{CR} = 12.5*K

K is risk-sensitive – affected by PD, LGD, M

Regulatory Capital Function – Credit Risk

$$\text{Capital Requirement}(K) = \left(LGD * N\left(\frac{N^{-1}(PD) + N^{-1}(0.999)\sqrt{R}}{\sqrt{1-R}}\right) - PD * LGD\right) \times \frac{1 + (M - 2.5)b}{1 - 1.5b}$$

Market risk has focused on VaR, Specific Risk and Incremental Default Risk Estimation

Credit risk has focused on PD, LGD, EAD, and M estimation

Counterparty Credit Risk

Regulatory Capital Requirement

Regulatory Capital – Counterparty Credit Risk

- Analytical & Simulation
- $RWA_{CR} = 12.5 * \text{Regulatory Capital}_{CR}$
- $RC_{CR} = K * \mathbf{EAD}$
- $RWA_{CR} = RW_{CR} * EAD$ and $RW_{CR} = 12.5 * K$

OTC Derivatives

Current Exposure Method (CEM)

EAD= CMTM + Add-on

Difficulty Degree

Standardized Method (SM)

$$EAD = \beta * \max\left(CMV, \sum_j \left|\sum_i RP_{ij}\right| * CCF_j\right)$$

Internal Model Method (IMM)

EAD= α*Effective EPE

Regulatory Capital Function – Credit Risk

$$\text{Capital Requirement}(K) = \left(LGD * N\left(\frac{N^{-1}(PD) + N^{-1}(0.999) * \sqrt{R}}{\sqrt{1-R}}\right) - PD * LGD\right) * \frac{1 + (M - 2.5)b}{1 - 1.5b}$$

Exposure Framework of Counterparty Credit Risk

For the netting case:

$$EAD_{yj} = \max\left(0, \sum_i MtM_{yji}\right) + \sum_i \left(PFE_{it}\right)$$

where y = Counterparty y
j = netting set j
i = Individual contract

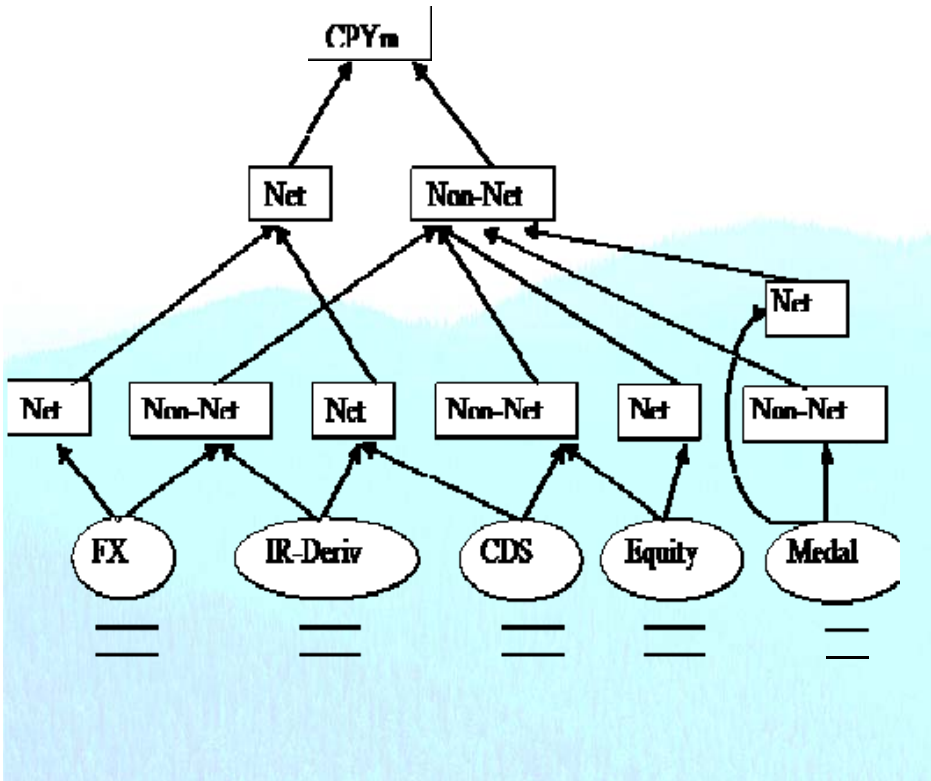
For the non-netting case:

$$EAD_{yq} = \sum_i \max\left(0, MtM_{yqt}\right) + \sum_i \left(PFE_{it}\right)$$

where y = Counterparty y
i = Individual contract

For counterparty y:

$$EAD_y = \sum_j EAD_{yj} + \sum_q EAD_{yq}$$



Current Exposure Method

- Not Risk Sensitive

1. No Netting Recognition

EAD = MtM + Add-on

Where

MtM = Replacement cost

Add-on =factor*notional

2. Partial Netting Recognition

EAD = MtM + Add-on

Where

Add-on(P) = $(0.4+0.6*NGR)*\Sigma Add\text{-}on_i$

NGR = $MtM_{full\ netting}/MtM_{no\ netting}$

3. Collateral

EAD = max[0, {MtM(P) – C_A}] + Add-on (P)

Where

C_A = Volatility Adjusted Collateral

	Interest Rate	FX and Gold	Equities	Precious Medals except Gold	Other Commodities
One year or less	0.0%	1.0%	6.0%	7.0%	10.0%
Over one year to five years	0.5%	5.0%	8.0%	7.0%	12.0%
Over five years	1.5%	7.5%	10.0%	8.0%	15.0%

Standardized Method (SM)

For the netting case:

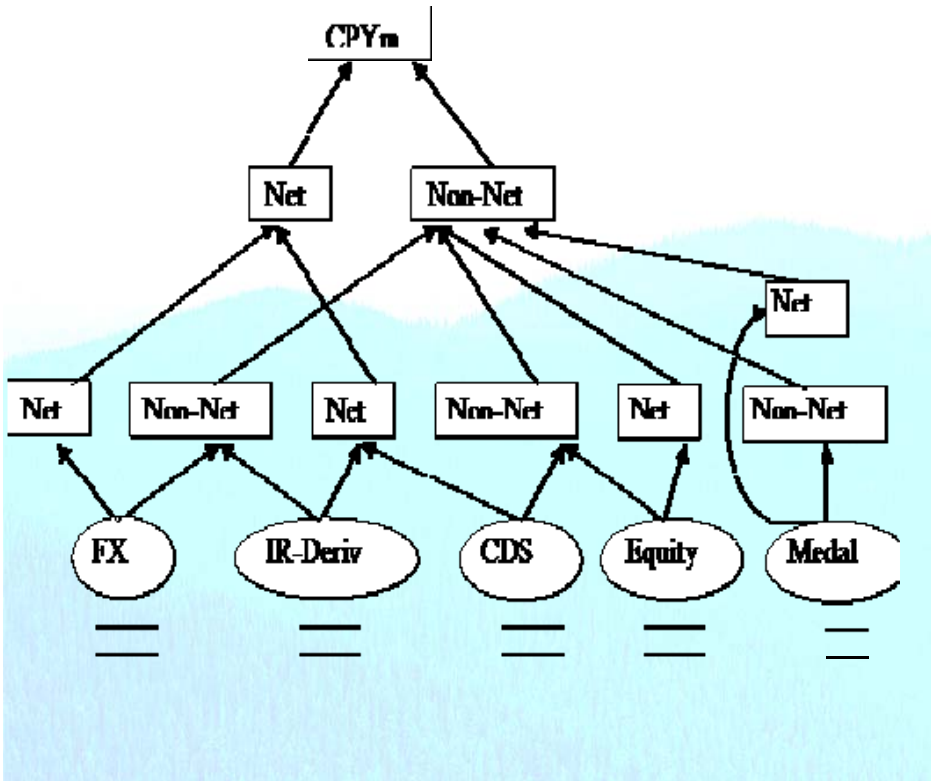
Where

CMV = Current Market Value
RP_{ij} = Risk position of Transaction i in hedging set j
CCF_j = Credit Conversion Factor for hedging set j
B = 1.4 (Scaling factor)

These conversion factors are derived based on more than 100 market rates, interest rate, bond and equity indexes, and credit spread studies:

- Three T-bill series
- Four S&P Indexes
- Six Lehman Bond indexes
- Twenty Bond series with different ratings
- 10 different currency series associated with various time horizons

$$EAD = \beta * \max\left(CMV, \sum_j \left|\sum_i RP_{ij}\right| * CCF_j\right)$$

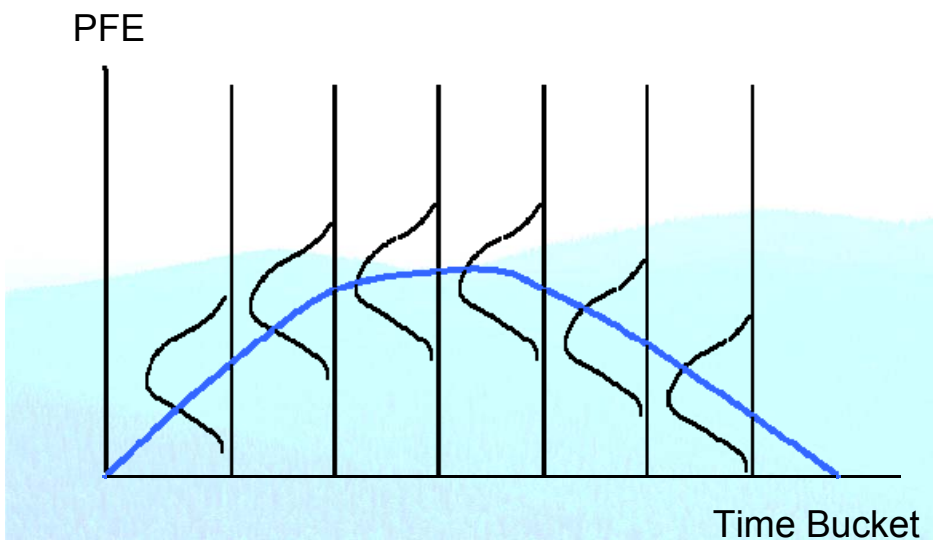


Internal Model Method (IMM)

EAD = α*Effective EPE

Key Risk Drivers:

- Market Conditions
- Counterparty Credit Conditions
- Interaction or correlation between market risk and credit risk
- This correlation may change conditional on credit deterioration, for example, Bear Stearns Exposure volatility



Expected Exposure (EE)

Effective Expected Exposure (EEE)

Expected Positive Exposure (EPE)

Effective Expected Positive Exposure (EEPE)

Security Financing Transactions (SFTs) - Repo-style

Five Different Ways:

1. The simple approach:

$$EAD = \left[(RC + add - on) - C_A \right]$$

where
RC = the replacement cost
add-on = the amount for PFE calculated under the 1988 Accord.
C_A = the volatility adjusted collateral amount under the comprehensive approach.

2. The comprehensive approach with supervisory haircuts

$$E^* = \max\left\{0, \left[(\Sigma E - \Sigma C) + \Sigma(E_s \times H_s) + \Sigma(E_{fx} \times H_{fx}) \right]\right\}$$

3. The comprehensive approach with own haircut:

$$H = H_M \sqrt{\frac{N_R + (T_M - 1)}{T_M}}$$

4. VaR

$$E^* = \max\left\{0, \left[(\Sigma E - \Sigma C) + (VaR \times multiplier) \right]\right\}$$

5. Internal Modeling

EAD = α*Effective EPE

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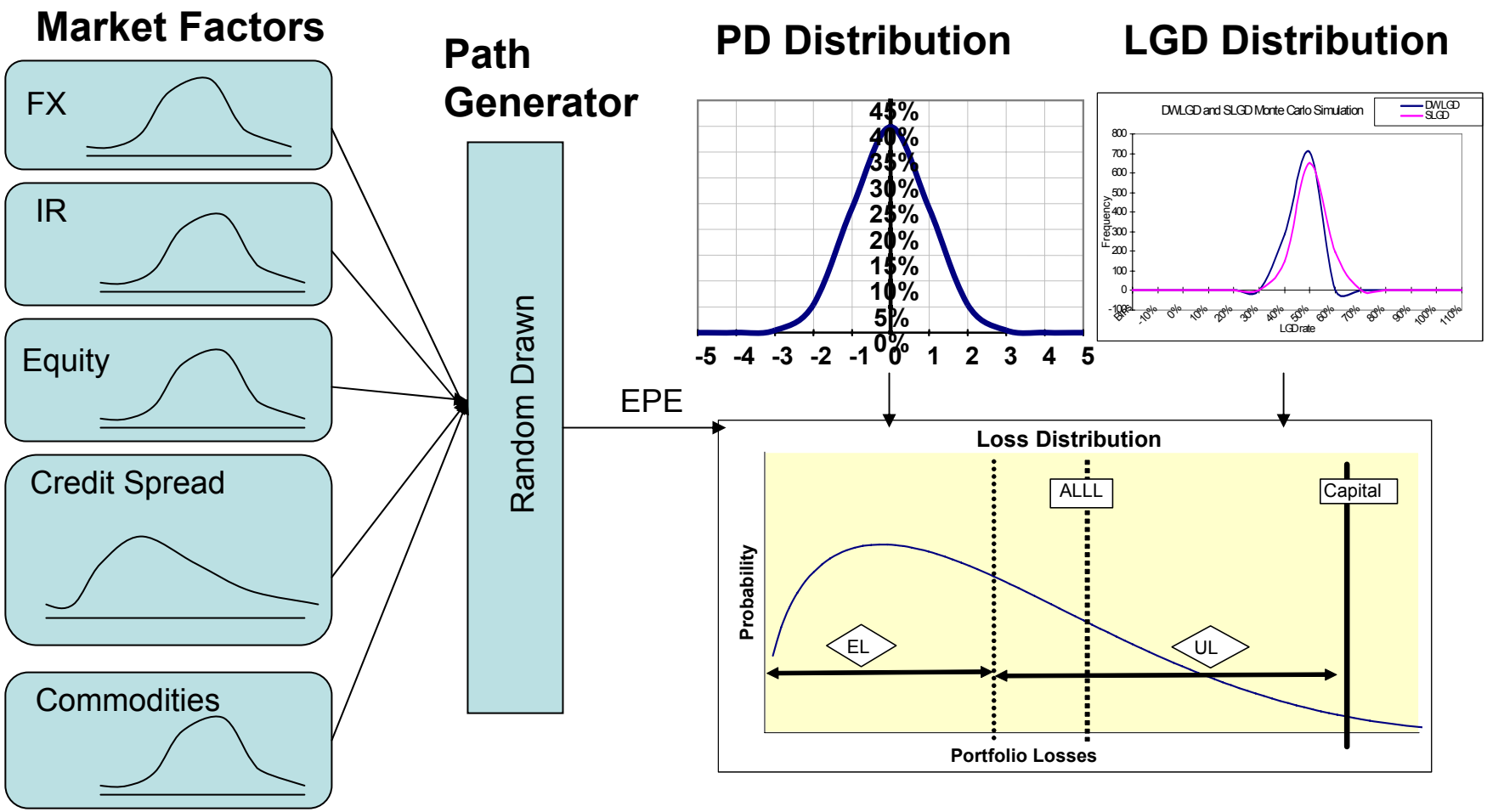
Economic Capital Framework



Risk Drivers of EC models

Counterparty credit quality indicators:

- ☞PD
- ☞EDF (Expected Default Frequency)
- ☞Rating agency risk rating grades
- ☞Internal Risk Rating Grades
- ☞Credit spread

Counterparty Exposure Indicators:

- ☞Products/Contract type
- ☞Netting Agreements
- ☞Margin Call/Collateral Agreements
- ☞LGD
- ☞EE, EEE, EPE, EEPE
- ☞M
- ☞Wrong way risk

Future market rates as well as their changes

- ☞Yield curve
- ☞Equity prices and volatilities
- ☞Commodity prices
- ☞FX movement
- ☞Credit spread: name specific with or without liquid market spread; without name specific spread

EC is heavily influenced by enormous quantity of underlying scenario assumptions and product-specific pricing model assumptions

Potential Future Exposure

PFE: Uncertainty and dependency on assumptions

- Current Exposure (CE)
  - the replacement cost of the contracts with the counterparty if the counterparty were to default on that day
  - Straight forward
- Potential Future Exposure (PFE)
  - Uncertainty about the future exposure which varies, not stable like buy-and-hold exposures in the banking book
  - Sensitive to simulation methods
  - Trade-off between accuracy and efficiency of simulations
  - Exposure threshold for future time buckets – 50 percentile, 75 percentile, or 95 percentile
  - A comfortable zone

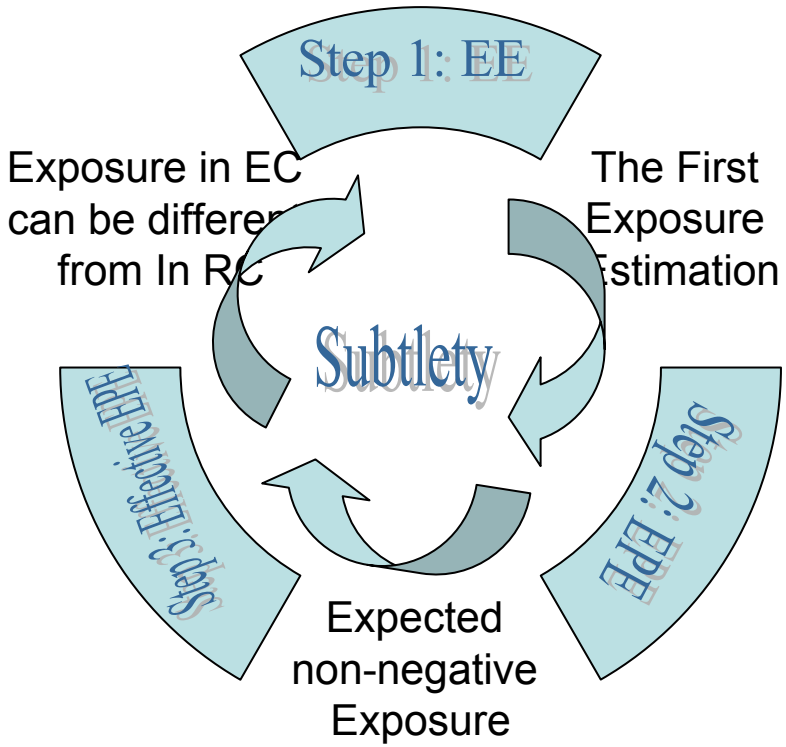
Potential Future Exposure Continued

Evan Picoult

"*The measure of the potential future credit exposure of a transaction, or a portfolio of transactions with a counterparty, requires that we simulate both the potential changes in market rates over a long time period and also the contractual setting of floating rates, the expiration of option and the settlement of cash flows over time.*"

Expected Exposure (EE) and Expected Positive Exposure (EPE)

- Step 1:
  - EE_t: a simple average of all Monte Carlo realizations of exposure for that day
  - Effective EE_t: $EE_t \geq EE_{t-1}$
  - Average EE = $\int_t EE_t dt$
- Step 2:
  - $EPE_t = \max(EE_t, 0)$
  - $EPE_t \geq EE_t$
- Step 3:
  - Average EPE = $\int_t EPE_t dt$
  - Effective EPE = $\int_t EPE_t \mid (EE_t \geq EE_{t-1})\, dt$



Scaling Factor Alpha

- EAD = α*Effective EPE
- α may depends on:
  - The number of market factors
  - The number of counterparties
  - Counterparty PD
- Relationships between PD and α and between correlation and α are not intuitive
  - PD↑→EAD↑→EC↑→α↑
  - R↓→EAD↓→EC↓→α↓

$$\alpha = \frac{EC_{with\ variale\ exposure}}{EC_{with\ fixed\ exposure}}$$

Tom Wilde, Evan Picoult, Eduardo Canabarro, Sept. 2003

Underlying Risk Drivers		α Sensitivity	
Wrong Way Risk	↑	3% - 11 %	↑
Concentration (# of CPYs)	↑	(-5%) - 16%	↑
# of Market Factors	↑	0% - (-2%)	↓
PD	↑	7% - (-4%)	↓
Correlation	↓	(-6%) – 31%	↑
Confidence Level	↑	0% - 1%	↑

Capital Aggregation/Allocation Factor

- Standalone loss standard deviation of exposure in the default mode

$$\sqrt{PD*(1-P)*LGD^2+PD*\sigma_{LGD}^2}$$

- Standalone capital in the default mode

$$Capital=\gamma*\sqrt{PD*(1-P)*LGD^2+PD*\sigma_{LGD}^2}$$

- γ – Risk based capital allocation factor: To allocate capital to credit exposure on daily basis
  - Correlation between individual exposure to portfolio exposure
    - Sector effect (region, country, industry)
  - Credit behavior – PD, LGD, EPE, M
  - Concentration

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Different Interpretation on EPE

? The interpretation of EPE matters

- Evan Picoult – Citigroup; Wilfried H. Paus – Deutshe Bank
  - Average positive exposure at a set of future dates t:

$$EPE_t = EE_t = \frac{1}{n}\sum_{i=1}^{n}\left(\max\left(Exposure_{path\,i,t},0\right)\right)$$

- *Michael Pyktin and Steven Zhu – Bank of America*

$$EE_t = \frac{1}{n}\sum_{i=1}^{n}\left(Exposure_{path\,i,t}\right)$$

- Potentially, EE may vary cross different institutions by different definition and interpretation

Diversified PD Approaches

- Multi-period PD – One year capital horizon with annualized short-term PDs

Michael Kalkbrener – Deutsche Bank

- Losses for one-month portfolio $\sum_{k=1}^{12} L_1(X_k)$
- Losses for two-month portfolio $\sum_{k=1}^{6} L_2(X_{2k-1} + X_{2k})$
- Losses for one-year portfolio $L_{12} \sum_{k=1}^{12} X_k$
- Total portfolio loss across all liquidity horizons

$$\sum_{k=1}^{12} L_1(X_k) + \sum_{k=1}^{6} L_2(X_{2k-1} + X_{2k}) + \cdots + L_{12} \sum_{k=1}^{12} X_k$$

Diversified PD Approach Continued

- Multi-period PD – One year capital horizon with annualized short-term PDs

Christoph K.J. Wagner – UniCredit MIB

- One period PD model (one year) $P(Y_1^i = K, Y_1^j = K \mid Y_0^i = k, Y_0^j = l)$
- Two period PD model (six months)

$$P(Y_1^i = K, Y_1^j = K \mid Y_0^i = k, Y_0^j = l) = \sum_{p,q} P(Y_1^i = K, Y_1^j = K \mid Y_{1/2}^i = p, Y_{1/2}^j = q) \times P(Y_{1/2}^i = p, Y_{1/2}^j = q \mid Y_0^i = k, Y_0^j = l)$$

  - Time-change Model
  - Hull-White Model
  - Migration Model
- Auto correlations are introduced explicitly to the time-change model
- Properties of inter-temporal and cross correlation in the model

Diversified PD Approach Continued

- PD retrieved from the Risk Rating System
  - Long run average including at least one economic downturn period
  - Data requirement: Minimum seven years of performance
  - Designed for buy-and-hold portfolios
- PD may vary to meet the different business purpose
  - TTC
  - PIT
  - Combination of TTC and PIT
- PD justification for liquid positions and portfolios
  - Liquidity horizon
  - Counterparty asset rebalancing
  - Portfolio rebalancing

EAD Estimation - Wrong Way /Righ Way Risk

EPE estimation process is independent from counterparty's credit deterioration/default behavior

- To model EAD by associating credit related behavior
  - Logistic Regression model on EAD

  Where BU stands for Balance Upsurge $\log it[P(BU)] = \ln\left(\frac{P(BU)}{1-P(BU)}\right) = \alpha + \beta' X$

- Restricted EAD Model

  EAD = $B_0 \mid$ *Balance >= Line or Available Line=0, or*

  EAD = [1- Prob(BU)] • B_0 + Prob(BU) • [B_0 + CCFp • ($L_0 - B_0$)]

  = B_0 + Prob(BU) • CCFp • ($L_0 - B_0$)

- Unrestricted EAD Model

  EAD = Prob(BU) • [B_0 + CCFp • ($L_0 - B_0$)] + [1- Prob(BU)] • [B_0 +CCFn • ($L_0 - B_0$)]

  = B_0 + Prob(BU) • CCFp • ($L_0 - B_0$) + [1- Prob(BU)] • CCFn • ($L_0 - B_0$)

- CCF – A multifactor model

EPE Estimation in Accordance with multi-period PDs

- At the beginning of each liquidity period, the rating is set to the initial rating (Michael Kalkbrener)
  - For example, the annualized PD for an one-month liquidity horizon
  - $1-(1-PD_{1m}(\text{initial rating}))^{12}$
  - In the end of liquidity horizon period, contracts with rating below the initial rating were replaced or renewed and new contracts commensurate with the initial rating
- Multi-Period Model with rebalancing at the asset level versus rebalancing at the portfolio level

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Exciting period for next three years

- Financial Times 7/19/2007

  "*Even sophisticated investors could fail to hedge properly and be left holding derivative products so complex no potential buyer could figure out whether they had any value.*"

- Numbers of senior professions get concerned about true values of illiquid, complex-structured, credit sensitive products in the market
- Exciting period for improving integration/interaction between market and credit risks
- Advanced/New directional modeling approaches towards PD and EPE estimations in counterparty credit risk
- EC and RC are getting closer to reflect true portfolio risk in which market and credit risks are imbedded

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Thank you for your time