

Technical Notes: Rates and FX Derivatives Pricing & Exposure Computation

The pricing and counterparty exposure computation for Rates and FX derivative products involves building a robust, scalable, and accurate framework that handles trade valuation, exposure calculations, and counterparty risk metrics.

1. Rates Products

1.1 Interest Rate Swaps

- **NPV Calculation**
 - Floating leg: Forward rate projection using relevant curve
 - Fixed leg: Discounted cashflows using OIS curve
 - Consideration of multi-curve framework post-2008

1.2 Cross Currency Swaps

- **Key Components**
 - Basis spread adjustment
 - FX forward rates integration
 - Quanto adjustment for cross-currency basis

1.3 Swaptions

- **Pricing Methods**
 - Black-76 model for European swaptions
 - Hull-White for Bermudan swaptions
 - SABR calibration for volatility smile

2. FX Products

2.1 FX Forwards

- **Valuation Factors**
 - Spot rate
 - Interest rate differential
 - Forward points calculation

2.2 FX Options

- **Models**
 - Garman-Kohlhagen model
 - Local volatility for exotic options

- FX volatility surface construction

2.3 FX Swaps

- **Components**
 - Near leg (spot)
 - Far leg (forward)
 - Swap points consideration

3. Exposure Computation

3.1 Potential Future Exposure (PFE)

- **Calculation Methods**
 - Monte Carlo simulation
 - Grid-based approach
 - Risk factor evolution models

3.2 Expected Positive Exposure (EPE)

- **Key Elements**
 - Time buckets definition
 - Netting agreements impact
 - Collateral modeling

3.3 Credit Valuation Adjustment (CVA)

- **Components**
 - Default probability term structure
 - Loss Given Default (LGD)
 - Wrong-way risk consideration

4. Risk Factor Modeling

4.1 Interest Rates

- **Term Structure Models**
 - Short rate models (Hull-White, CIR)
 - Forward rate models (HJM framework)
 - Multiple curve bootstrapping

4.2 FX Rates

- **Evolution Models**
 - Geometric Brownian Motion
 - Jump diffusion models
 - Stochastic volatility considerations

4.3 Volatility

- **Surface Construction**
 - SABR parameterization
 - Local volatility calibration
 - Volatility cube building

5. Market Data Requirements

5.1 Curves Construction

- **Data Points**
 - Cash rates
 - Futures prices
 - Swap rates
 - Basis spreads

5.2 Volatility Data

- **Sources**
 - ATM volatilities
 - Risk reversals
 - Butterflies
 - Historical calibration

6. Risk Measures

6.1 Greeks Calculation

- **First Order**
 - Delta
 - Vega
 - Rho
 - Theta

- **Second Order**
 - Gamma
 - Vanna
 - Volga

6.2 Scenario Analysis

- **Stress Testing**
 - Historical scenarios
 - Hypothetical scenarios
 - Correlation breakdown scenarios

7. Numerical Methods

7.1 Integration Techniques

- Gauss-Legendre quadrature
- Adaptive Simpson's method
- Monte Carlo integration

7.2 Interpolation Methods

- Cubic spline
- Linear interpolation
- Monotone convex interpolation

8. System Requirements

8.1 Performance Considerations

- Real-time pricing capability
- Grid computing for exposure
- Cache management

8.2 Data Management

- Market data validation
- Curve versioning
- Calibration parameter storage

9. Model Validation

9.1 Testing Framework

- Unit testing
- Integration testing
- Regression testing

9.2 Benchmarking

- Market prices comparison
- Model comparison
- Stress scenario validation

10. Regulatory Considerations

10.1 Basel Requirements

- Capital calculation
- Exposure measurement
- Model validation standards

10.2 Documentation

- Model documentation
- Validation reports
- Regular review process