Welcome to Numerix Webinar Series

Collateral Management & CSA Discounting

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About Our Presenters

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We will provide the slides following the webinar to all attendees.
Agenda

- Collateral Management and optimization
  - Drivers and trends
  - Complexities and best practices
- CSA discounting primer
  - Pricing fully, partially, and non-collateralized deals
  - OIS and LIBOR discounting
  - CSAs and embedded optionality
  - Cheapest-to-Deliver (CTD)
  - Constructing CTD curves
- Case study
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Collateral Management – Drivers and Trends

Before:
• Mostly handled in the back office
• Low necessity of margin calls (high thresholds and min transfer amounts
• Few derivatives were collateralized

Now:
• Increased usage of collateral as a way to mitigate risk of counterparty default
• Regulation requirements – CCPs – Margin calls
• Divergence of rates after the crisis and complex CSAs
• Collateral shortage (high demand, rehypothecation)
• Equally important for sell-side and buy-side
• Choice of collateral significantly affects derivative pricing
• Push from traders and front-office – profit is the drive
Collateral Management – Complexities

- Front to end collateral management system (outsource vs. in-house)
- Each business – separate software system
- Significant IT implementation costs
  - Validation of all CSA agreements
  - New group to manage (front office or separate group?)
  - Big data input requirements to manage collateral across all entities
  - Manual collateral management processes
  - Many based on Excel spreadsheets
  - No company wide inventory of available assets
  - Outdated pricing libraries (e.g. OIS vs. LIBOR – curves, models, calibration)
  - No forecasting or what-if analysis
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Collateral Management – Trends

- **ISDA reports 8% increase** in exposure collateralization of bilateral CSAs
- Around **88%** collateral agreements are **bilateral** (4% increase with previous year)
- Around **73.7% of OTC derivatives** are subject to **collateral** agreements
- **Cash or Government securities** as collateral are dominant (**91.1%** out of which **80%** is cash)

**Cash collateral use because:**
- Aligning collateral flow with future swap cashflows
- Consistent with LCH
- Consistency with cleared vs. non-cleared swap market
- Aligning with variation margin requirements (in cash)

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*Source: ISDA Margin Survey, 2013*
Rehypothecation
In general SCSA and CSA include the right to re-use collateral unless specifically removed by the party that delivered collateral

* Source: ISDA Margin Survey, 2013
Stability in usage of collateral agreements due to:

- Clearing
- Consolidation of agreements against one counterparty (negotiation for better conditions)

<table>
<thead>
<tr>
<th>Counterparty Type</th>
<th>Unilateral Percentage</th>
<th>Bilateral Percentage</th>
<th>Total Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Banks/Broker-dealers</td>
<td>1.4%</td>
<td>21.3%</td>
<td>22.7%</td>
</tr>
<tr>
<td>Hedge funds</td>
<td>1.9%</td>
<td>14.7%</td>
<td>16.7%</td>
</tr>
<tr>
<td>Mutual funds</td>
<td>1.2%</td>
<td>26.9%</td>
<td>28.1%</td>
</tr>
<tr>
<td>Pension funds</td>
<td>0.1%</td>
<td>6.4%</td>
<td>6.5%</td>
</tr>
<tr>
<td>Insurance companies</td>
<td>0.2%</td>
<td>3.1%</td>
<td>3.3%</td>
</tr>
<tr>
<td>Energy/Commodity firm</td>
<td>0.4%</td>
<td>1.7%</td>
<td>2.1%</td>
</tr>
<tr>
<td>Non-financial corporations</td>
<td>2.3%</td>
<td>4.9%</td>
<td>7.2%</td>
</tr>
<tr>
<td>Special purpose vehicles (SPV)</td>
<td>1.2%</td>
<td>0.5%</td>
<td>1.7%</td>
</tr>
<tr>
<td>Supranationans</td>
<td>0.1%</td>
<td>0.2%</td>
<td>0.2%</td>
</tr>
<tr>
<td>Government-sponsored entities/Government Agencies</td>
<td>0.1%</td>
<td>0.9%</td>
<td>1.0%</td>
</tr>
<tr>
<td>Sovereign national governments</td>
<td>0.1%</td>
<td>0.2%</td>
<td>0.3%</td>
</tr>
<tr>
<td>Local or regional government entities</td>
<td>0.4%</td>
<td>0.7%</td>
<td>1.1%</td>
</tr>
<tr>
<td>Other</td>
<td>2.1%</td>
<td>7.2%</td>
<td>9.2%</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>11.5%</strong></td>
<td><strong>88.5%</strong></td>
<td><strong>100.0%</strong></td>
</tr>
</tbody>
</table>
Collateral Management - Requirements

What is in collateral management system:

- Collateral agreements inventory
  - minimum transfer amounts, thresholds
  - collateral eligibility criteria and currency eligibility
  - haircuts, rating

- Collateral asset inventory
  - enterprise wide

- Collateral tracking
  - which was received or paid when

- Collateral optimization
  - cheapest to deliver collateral
  - rehypothecation
  - reallocation and substitution of collateral

- Front to back support – not only back office function anymore

- Flexibility (CSA changes to SCSA)

- Derivatives valuation
  - model calibration for both assets and collateral
  - hybrid model, for validation income margining
  - what if analysis, MC VAR for initial margin calculation, OIS discounting, CSA discounting
What is the purpose of central collateral management process & why identifying CTD is necessary:

- Profit
- Effectiveness
- Liquidity
- Beneficial to post CTD (cheapest-to-deliver)
- Minimize funding costs
- Maximize return
- Bigger choice of collateral
- Optimization – best use of existing assets within the firm
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### Derivatives valuation under different collateralization:

<table>
<thead>
<tr>
<th>Fully collateralized or cleared</th>
<th>Partially collateralized</th>
<th>Non-collateralized</th>
</tr>
</thead>
<tbody>
<tr>
<td>Almost “perfect” CSA</td>
<td>Imperfect CSA</td>
<td>No collateral</td>
</tr>
<tr>
<td>Cash Collateralized</td>
<td>Embedded optionality</td>
<td>Own funding cost</td>
</tr>
<tr>
<td>OIS Discounting</td>
<td>CSA Discounting</td>
<td>LIBOR/OIS+Spread</td>
</tr>
</tbody>
</table>
CSA Discounting

Current CSA discounting approach by asset class:

### Table 4.2: CSA discounting methodology, by products and geography

*Percentage of respondents that have implemented the respective discounting methodology*

<table>
<thead>
<tr>
<th>Product</th>
<th>Americas</th>
<th>Europe</th>
<th>Asia</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>LIBOR</td>
<td>OIS</td>
<td>CSA-Specific</td>
</tr>
<tr>
<td>Rates</td>
<td>30.2%</td>
<td>38.1%</td>
<td>31.7%</td>
</tr>
<tr>
<td>FX</td>
<td>48.3%</td>
<td>31.7%</td>
<td>20.0%</td>
</tr>
<tr>
<td>Credit</td>
<td>57.9%</td>
<td>21.1%</td>
<td>21.1%</td>
</tr>
<tr>
<td>Equities</td>
<td>65.5%</td>
<td>16.4%</td>
<td>18.2%</td>
</tr>
<tr>
<td>Mortgages</td>
<td>67.4%</td>
<td>16.3%</td>
<td>16.3%</td>
</tr>
<tr>
<td>Commodities</td>
<td>70.8%</td>
<td>14.6%</td>
<td>14.6%</td>
</tr>
<tr>
<td>Other</td>
<td>69.2%</td>
<td>15.4%</td>
<td>15.4%</td>
</tr>
</tbody>
</table>

### Table 3.3: Percentage of all trades subject to collateral agreements, by OTC derivatives product type

<table>
<thead>
<tr>
<th>Product</th>
<th>All, Average</th>
<th></th>
<th>Large, Average</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2013</td>
<td>2012</td>
<td>2013</td>
<td>2012</td>
</tr>
<tr>
<td>Fixed Income Derivatives</td>
<td>79.2%</td>
<td>78.1%</td>
<td>89.4%</td>
<td>89.9%</td>
</tr>
<tr>
<td>Credit Derivatives</td>
<td>83.0%</td>
<td>93.4%</td>
<td>96.3%</td>
<td>96.1%</td>
</tr>
<tr>
<td>FX Derivatives</td>
<td>52.0%</td>
<td>55.6%</td>
<td>67.9%</td>
<td>70.6%</td>
</tr>
<tr>
<td>Equity Derivatives</td>
<td>72.5%</td>
<td>72.7%</td>
<td>78.2%</td>
<td>85.3%</td>
</tr>
<tr>
<td>Commodities, including precious metals</td>
<td>48.3%</td>
<td>56.3%</td>
<td>54.5%</td>
<td>63.9%</td>
</tr>
<tr>
<td>All OTC Derivatives</td>
<td>73.7%</td>
<td>71.4%</td>
<td>80.7%</td>
<td>83.7%</td>
</tr>
</tbody>
</table>

* Source: ISDA Margin Survey, 2013*
What counts in CSA discounting:

1. Type of CSA (1way, 2way, non-collateralized )
2. Thresholds
3. Eligible collateral types
4. Eligible collateral currencies and optionality
5. Minimum transfer amounts
6. Rehypothecation
7. Credit triggers
There’s no consensus on market approach for non-collateralized derivatives.

Most common pricing approach:
- Libor discounting
- Cost of funding – marked to own firm average cost of funding
- Libor or OIS adjusted by spread curves

Things to take into account when valuing:
- CVA
- DVA
- FVA
- Hedging Costs
- Fees and comissions
- Operation and legal costs
Which currency to use for valuing non-collateralized derivative where currency of the trade is different from the main funding currency of the firm?

- Use funding currency
- Use trade currency with XCCY basis spread adjustment
- Use trade currency

Uncertainty:

Valuation might be different from pricing when pricing non collateralized derivatives with counterparties due to different asymmetrical cost of funding

* Source: ISDA Margin Survey, 2013
Market is converging on CSA discounting for collateralized derivatives

Most common pricing approach:

- Use CTD currency for the entire life of the trade at spot
- Use blended CTD curve through the life of the trade at time of trade inception
- Incorporating optionality switch between collaterals with correlations and vols
- Still LIBOR or OIS
Use cases:

1. USD Swap collateralized in EUR cash
   - EONIA curve with XCCY adjustment

2. USD Swap collateralized in EUR or USD cash
   - Blended FedFunds+Eonia curve

3. USD Swap collateralized USD Corporate bonds, government bonds, cash
   - USD Corporate bonds – cheapest
   - Repo curve or LIBOR+Spread
### Table 4.1: Valuation of derivatives subject to collateral agreements

**Percentage of respondents that indicate the corresponding benchmark to be conceptually the most relevant valuation basis for each scenario**

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Rehypothecation Status</th>
<th>Firm’s own cost of funds</th>
<th>Asymmetric – OIS on payable, firm’s cost of funds on receivable</th>
<th>Discount curve constructed from cheapest-to-deliver collateral currency at each point, option adjusted</th>
<th>LIBOR</th>
<th>LIBOR + repo funding spread</th>
<th>OIS</th>
<th>OIS + repo funding spread</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Cash Only CSA – Single Currency or Multiple Aligned Currencies</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e.g. single-currency CSA, siloed CSA, Standard CSA or LCH-style CSA)</td>
<td>Permitted</td>
<td>6.6%</td>
<td>3.3%</td>
<td>4.9%</td>
<td>4.9%</td>
<td>N/A</td>
<td>80.3%</td>
<td>N/A</td>
</tr>
<tr>
<td>with interest at the relevant OIS rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not permitted or operationally impractical</td>
<td>17.2%</td>
<td>19.0%</td>
<td>5.2%</td>
<td>8.5%</td>
<td>N/A</td>
<td>50.0%</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Cash Only CSA – Multiple Currencies Non-Aligned</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(e.g. traditional CSA with multiple currencies of eligible cash collateral but no securities eligible as collateral)</td>
<td>Permitted</td>
<td>5.1%</td>
<td>0.0%</td>
<td>35.6%</td>
<td>8.5%</td>
<td>N/A</td>
<td>50.8%</td>
<td>N/A</td>
</tr>
<tr>
<td>with interest on cash at the relevant OIS rate</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Not permitted or operationally impractical</td>
<td>16.4%</td>
<td>16.4%</td>
<td>12.7%</td>
<td>10.9%</td>
<td>N/A</td>
<td>43.6%</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>CSA including cash (OIS interest rate) and government bonds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Permitted</td>
<td>3.4%</td>
<td>1.7%</td>
<td>25.9%</td>
<td>8.5%</td>
<td>1.7%</td>
<td>37.9%</td>
<td>20.7%</td>
</tr>
<tr>
<td></td>
<td>Not permitted or operationally impractical</td>
<td>14.0%</td>
<td>19.3%</td>
<td>8.8%</td>
<td>10.5%</td>
<td>3.5%</td>
<td>36.8%</td>
<td>7.0%</td>
</tr>
<tr>
<td><strong>CSA including cash (OIS interest rate) and agency bonds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Permitted</td>
<td>7.3%</td>
<td>1.8%</td>
<td>27.3%</td>
<td>5.5%</td>
<td>1.8%</td>
<td>36.4%</td>
<td>20.0%</td>
</tr>
<tr>
<td></td>
<td>Not permitted or operationally impractical</td>
<td>16.7%</td>
<td>20.4%</td>
<td>9.3%</td>
<td>9.3%</td>
<td>1.9%</td>
<td>33.3%</td>
<td>9.3%</td>
</tr>
<tr>
<td><strong>CSA including cash (OIS interest rate) and investment grade corporate bonds</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Permitted</td>
<td>5.5%</td>
<td>3.6%</td>
<td>27.3%</td>
<td>5.5%</td>
<td>3.6%</td>
<td>36.4%</td>
<td>18.2%</td>
</tr>
<tr>
<td></td>
<td>Not permitted or operationally impractical</td>
<td>15.1%</td>
<td>20.8%</td>
<td>9.4%</td>
<td>9.4%</td>
<td>1.9%</td>
<td>32.1%</td>
<td>11.3%</td>
</tr>
</tbody>
</table>

* Source: ISDA Margin Survey, 2013
Cheapest-to-deliver (CTD) curve

Current approaches:

1. Use CTD currency for the entire life of the trade at spot
   - pick one now and apply

2. Use blended CTD curve through the life of the trade at time of trade inception
   - construct blended curve now and apply

3. Incorporating optionality switch between collaterals with correlations and vols
   - model the curve under hybrid framework
Construction of OIS for various currencies:

<table>
<thead>
<tr>
<th></th>
<th>USD</th>
<th>EUR</th>
<th>JPY</th>
<th>GBP</th>
<th>AUD</th>
<th>CAD</th>
<th>CHF</th>
</tr>
</thead>
<tbody>
<tr>
<td>O/N Rate</td>
<td>O/N Rate</td>
<td>O/N Rate</td>
<td>O/N Rate</td>
<td>O/N Rate</td>
<td>O/N Rate</td>
<td>O/N Rate</td>
<td>O/N Rate</td>
</tr>
<tr>
<td>OIS Swap Rates</td>
<td>OIS Swap Rates</td>
<td>OIS Swap Rates</td>
<td>OIS Swap Rates</td>
<td>OIS Swap Rates</td>
<td>OIS Swap Rates</td>
<td>OIS Swap Rates</td>
<td></td>
</tr>
<tr>
<td>FedFunds Futures</td>
<td>FRAs</td>
<td>OIS Libor Basis, Tenor Basis Swaps</td>
<td>OIS/LIBOR Flat spread extrapolation</td>
<td>OIS Libor Basis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>OIS Libor Basis Swaps</td>
<td>XCCY Basis Swaps</td>
<td>XCCY Basis Swaps</td>
<td>XCCY Basis Swaps</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If OIS is not liquid:
1. Flat spread extrapolation
2. Implied XCCY from USD
3. Basis swaps

* For more details, please, refer to Numerix Webinar Series: “Advanced OIS Discounting - Building Proxy OIS Curves When OIS Markets are Illiquid or Nonexistent” on November 6, 2013
How to construct CTD?

Steps:

1. Construct appropriate curves – OIS, Swap, Basis Curves, XCCY curves
2. Translate curves in different currencies to the trade currency
3. Pick cheapest throughout the life of the trade
4. Construct blended CTD curve
5. Discount cash flows with CTD curve

EASY?

!!! 3 Currencies = 15 curves!!!
TEDIOUS!
How to construct CTD?

Collateral: Cash
Currencies: USD, EUR, GBP, JPY, CHF, CAD

!!! 6 cash collateral currencies = 29 Curves to build !!!
Incorporating optionality switch between collaterals with correlations and vols with thresholds and min transfer amounts:

• Requires stochastic models

• Requires hybrid model

• Requires computation of kernel exposures

• Requires modeling stochastic spread – HOW
Workflow:

1. Create multifactor hybrid framework for simulating portfolio
2. Add a credit process for Counterparty
3. Add a credit process for Self
4. Add curves for collateralized, unsecured and funding
5. Add Netting Conditions
6. Model CSA Conditions (min transfer amounts, thresholds, CTD, etc.)
7. Compute Exposures (both for trades and collateral assets)
8. Compute CVA, DVA, BCVA, FVA using Forward or Backward propagation on exposure cubes

* Source: Numerix
Modeling CSA - requirements

- Calibrate individual models
- Specify Joint calibration matrix across all risk factors
- Calibrate new hybrid model across all risk factors
- Deterministic spread approach (Libor/OIS)

* For more details, please, refer to Numerix Webinar Series: “Modeling the CSA for Valuation & Risk Assessment” on May 8, 2013
Types of collateral and how to approximate

Collateral types and corresponding curves:

<table>
<thead>
<tr>
<th>Collateral</th>
<th>Curve</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash</td>
<td>OIS Curve</td>
</tr>
<tr>
<td>Treasury Bonds</td>
<td>Repo Curve</td>
</tr>
<tr>
<td>Corporate Bonds</td>
<td>Libor + Spread</td>
</tr>
</tbody>
</table>

Steps:

1. Construct appropriate curves – OIS, Swap, Basis Curves, XCCY curves
2. Translate curves in different currencies to the trade currency
3. Pick cheapest throughout the life of the trade
4. Construct blended CTD curve
Curve construction

1. Construct appropriate curves – OIS, Swap, Basis Curves, XCCY curves
2. Translate curves in different currencies to the trade currency
3. Pick cheapest through out the life of the trade
4. Construct blended CTD curve
# Cross Currency Curve Construction – Multi-Curve

## Instruments to bootstrap the curve:

<table>
<thead>
<tr>
<th>FX Forwards</th>
<th>USD/JPY (up to 5y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>CC basis swap quoted as spread</td>
<td>3m USD Libor vs 3m JPY Libor + Spread (up to 30y)</td>
</tr>
</tbody>
</table>

## Steps:

<table>
<thead>
<tr>
<th>Steps</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Get domestic OIS curve</td>
<td>1. OIS FedFunds Curve</td>
</tr>
<tr>
<td>2. Get domestic projection curve</td>
<td>2. 3m USD Libor Curve (OIS FedFunds Curve)</td>
</tr>
<tr>
<td>3. Get domestic projection curve for the underlying tenor</td>
<td>3. n/a</td>
</tr>
<tr>
<td>4. Get foreign OIS curve</td>
<td>4. OIS Mutan Curve</td>
</tr>
<tr>
<td>5. Get foreign projection curve</td>
<td>5. 6m JPY Libor Curve (OIS Mutan Curve)</td>
</tr>
<tr>
<td>6. Get foreign projection curve for the underlying tenor</td>
<td>6. 3m JPY Libor Curve (JPY Basis swaps &amp; OIS Mutan Curve)</td>
</tr>
<tr>
<td>7. Solve for implied foreign basis discount curve given FX Forwards,</td>
<td>7. Solve for implied foreign basis discount curve given FX Forwards, CC</td>
</tr>
<tr>
<td>CC Basis Swaps, 1,3 (if n/a then 2), 6 (if n/a then 5)</td>
<td>Basis Swaps, 1,3 (if n/a then 2), 6 (if n/a then 5)</td>
</tr>
</tbody>
</table>

* For more details, please, refer to Numerix Primers: “Curve stripping with full collateralization” by Alan Brace, April 30, 2013
What does your CTD tell you?

- Deterministic
- Unique for each trade
- Snapshot as of today
- Frequency window – how often do you switch collateral
- Analysis tool to identify cheapest collateral

- Value the trade with collateral switch assumption
- Match counterparty
- Doesn’t take into account minimum threshold, margin, min transfer amount
CSA Discounting – Summary

Implementation:
- Partially implemented (outsourcing vs in-house)
- Step wise starting with IR→CR→EQ→FX→CMDTY→Others
- Multi-curve valuation libraries

Risk Measurements:
- Basis risk (basis spreads, XCCY spreads)
- Stress testing gamma and cross gamma risk
- P&L explanation

Challenges:
- Volatility for basis spreads (LIBOR/OIS)
- Valuation of exotic derivatives
- OIS curves liquidity (Proxies for not that liquid currencies + Sensitive to interpolation and smoothing)

Disputes:
- CSA rehypothecation
- CSA discounting in other asset classes than rates
- Optimization of various collaterals across the firm
- Uncollateralized deals
- Cost of funding and asymmetrical in pricing derivatives
Agenda

- Collateral Management and optimization
  - Drivers and trends
  - Complexities and best practices
- CSA discounting primer
  - Pricing fully, partially, and non-collateralized deals
  - OIS and LIBOR discounting
  - CSAs and embedded optionality
  - Cheapest-to-Deliver (CTD)
  - Constructing CTD curves
- Case study
**Case Study: IR Par Swaps USD**

**Setup:**

<table>
<thead>
<tr>
<th>Value Date</th>
<th>Trade Currency</th>
</tr>
</thead>
<tbody>
<tr>
<td>21-Aug-12</td>
<td>USD</td>
</tr>
</tbody>
</table>

**Collateral Type/Currency**

<table>
<thead>
<tr>
<th>USD</th>
<th>EUR</th>
<th>JPY</th>
<th>GBP</th>
<th>CHF</th>
<th>CAD</th>
</tr>
</thead>
<tbody>
<tr>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>

**Cash/Treasury**

<table>
<thead>
<tr>
<th>Corporate Bonds</th>
</tr>
</thead>
<tbody>
<tr>
<td>USD</td>
</tr>
</tbody>
</table>

**Implied Curves**

<table>
<thead>
<tr>
<th>OIS</th>
<th>USD_OIS</th>
<th>EUR_EONIA</th>
<th>JPY_TONAR</th>
<th>GBP_SONI</th>
<th>CHF_TOIS</th>
<th>CAD_OIS</th>
<th>CTD_CURVE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIBOR</td>
<td>USD_OIS</td>
<td>EUR_EONIA</td>
<td>JPY_TONAR</td>
<td>GBP_SONI</td>
<td>CHF_TOIS</td>
<td>CAD_OIS</td>
<td>CTD_CURVE</td>
</tr>
</tbody>
</table>

**Par interest rate swaps:**

<table>
<thead>
<tr>
<th>ID</th>
<th>Instrument</th>
<th>Currency</th>
<th>Pay/Receive</th>
<th>Effective Date</th>
<th>Maturity</th>
<th>Rate %</th>
<th>Notional $</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>FixFloat Par Swap</td>
<td>USD</td>
<td>Pay 3m LIBOR</td>
<td>23-Aug-12</td>
<td>5y</td>
<td>0.7158%</td>
<td>100,000,000.00</td>
</tr>
<tr>
<td>2</td>
<td>FixFloat Par Swap</td>
<td>USD</td>
<td>Pay 3m LIBOR</td>
<td>23-Aug-12</td>
<td>10y</td>
<td>1.6509%</td>
<td>100,000,000.00</td>
</tr>
<tr>
<td>3</td>
<td>FixFloat Par Swap</td>
<td>USD</td>
<td>Pay 3m LIBOR</td>
<td>23-Aug-12</td>
<td>15y</td>
<td>2.1182%</td>
<td>100,000,000.00</td>
</tr>
<tr>
<td>4</td>
<td>FixFloat Par Swap</td>
<td>USD</td>
<td>Pay 3m LIBOR</td>
<td>23-Aug-12</td>
<td>20y</td>
<td>2.3075%</td>
<td>100,000,000.00</td>
</tr>
<tr>
<td>5</td>
<td>FixFloat Par Swap</td>
<td>USD</td>
<td>Pay 3m LIBOR</td>
<td>23-Aug-12</td>
<td>30y</td>
<td>2.4702%</td>
<td>100,000,000.00</td>
</tr>
</tbody>
</table>
Case Study: IR Par Swaps USD

Price par swaps with different cash collateral assumptions + CTD:

- Pricing to par under USD cash collateral (FedFunds curve)
- Significant difference for longer maturity swaps
- Range from 0-3bps running and 0-72bps upfront
- Largest difference for CTD (highest forward rates, lowest discount factors)
Choice of collateral significantly affects valuation of the trade

Helps to analyze counterparty numbers & assumptions

Pricing with CTD = assumption that counterparty posts always cheapest collateral

Pricing with deterministic CTD = assumption no costs, thresholds, min transfer amounts, etc.

CSA modeling complications = deterministic spread approach for LIBOR/OIS Spread

Market risk became more complicated and less transparent due complexities in valuations
Conclusion

- CSA Discounting will continue to become the market standard for valuation
  - Deterministic CTD (currency of the trade with XCCY adjustment or blended) emerging as the standard approach
    - However, this does not incorporate optionality within the CSA
  - Stochastic modelling computationally expensive and best done at portfolio level
- OIS & CSA Discounting implementation in Stress testing, VAR, PFE and Economic Capital computations further lag valuation processes
  - Non LIBOR discounting risk sensitivities explicit in interest rate products
Submit Your Questions Now....

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We will provide the slides following the webinar to all attendees.
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