

Findur Advanced Curve Analytics Update

Safe Harbor



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Agenda

- Monotone Convex Interpolation
 - Introduction and Methodology
 - Implementing through the Curve API extension
 - Results and Examples
- Multi-Curve Valuations
 - OIS curve setup and Configuration
 - OIS related LIBOR (Benchmark) curve
 - OIS related LIBOR Basis Curves
 - Currency Basis Curve
 - Multi-Curve Valuation Models

Multi-Curve Valuation



Background

- With emphasis on credit risk and push by regulations, OIS discounting has become the norm in the industry
- OIS methodologies and available market data have also become more standard
- OpenLink has a set of best practice recommendations and configurations that have been adopted by our clients
- Multi-Curve valuation models for available for a wide set of instruments

OIS Discounting Curve: Dual Curve Bootstrap

(Our previous recommendation)

- Building Blocks (USD example)
 - OIS Cash and quoted Swaps: Overnight to 5y
 - FF/LIBOR Basis Swaps: 7y – 20y
 - Extrapolated LIBOR/FF basis: 25y -40y
- Special Considerations
 - FedFund LIBOR Basis Swaps: Synthesize an (FF+Spd)/Fixed Swap from LIBOR Swap and LIBOR/FF basis.
 - Extrapolated LIBOR/FF: Assuming constant LIBOR/FF basis beyond last quoted (20y) basis swap

Grid Point ID 70 of Standard Official Index OIS.USD (ID 1022668 Version ID 10228...

File Help

	Value
Grid Point ID	70
Grid Point Label	4y
Ins Category	Bond / Swap
Priority Level	Eight (lowest)
Start Date	settle
End Date	4y
Effective Form	Rate
Input Format	Percent
Input Label	Rate
Input Min	-100.000000
Input Max	100.000000
Delta Shift	0.000100
Input Display	Show When Active
Epsilon	1.000000000000
Shared Ins #	0
MNO ID	None

Input Formula
 adj=grid_pt("4y", FED_FUNDS.USD");
 input=grid_pt("4y", "LIBOR3M.USD");

	Receive	Pay
Fixed/Float	Fixed	Float
Projection Idx		Current Index
Discounting Idx	Current Index	Current Index
Fix Rate/Flt Spd	input	adj
Std. Notnl	1,000,000.00	1,000,000.00
Index Tenor	n/a	1d
Yield Basis	30/360	Act/360
Reset Period		1d
Payment Period	6m	3m
Avg Period	n/a	3m
Comp Period	n/a	n/a
Averaging Type	Unweighted	Unweighted
Roll Convention	Normal - EOM	Normal - EOM

Input Field Label	Input Field Format	Input F
input	Percent	Yes
effective	Percent	No
change	Percent	No
close	Percent	No
spread	Percent	No
adj	Percent	No
bo_spd	Percent	Yes
beta	Percent	Yes
def_load	Percent	No
exp_load	Percent	No
lan	Percent	No

OIS Discounting Curve: Using Bloomberg Approximation (Updated alternative recommendation)

- Building Blocks (USD example)
 - OIS Cash and quoted swaps: overnight to 1y.
 - FF/LIBOR Basis Swaps: 7y – 30y
 - Extrapolated LIBOR/FF basis: 30y+ – 50y
- Special Considerations
 - FF LIBOR Basis Swaps: use a BBG curve formula to approximate OIS swap rate from LIBOR swap rates and LIBOR/FF basis
 - Extrapolated LIBOR/FF: Assuming constant LIBOR/FF basis beyond last quoted (20y) basis swap

The screenshot shows the 'Grid Point ID 19 of Standard Official Index OIS_Test.USD' window. The left pane lists various input fields for the instrument, including Grid Point Label (10y), Ins Category (Bond / Swap), Priority Level (Eight (lowest)), Start Date (settle), End Date (10y), Effective Form (Rate), Input Format (Percent), Input Label (Bond / Swap), Input Min (Unlimited Min), Input Max (Unlimited Max), Delta Shift (0.010000), Input Display (Show When Active), Epsilon (1.00000000000000), Shared Ins # (0), MDO ID (None), Trading Ins (No), and Sensitivity (Effective). The right pane shows the 'Input Formula' tab with a complex formula for calculating the OIS rate. Below the formula is a table with columns for 'Receive' and 'Pay' rates, and rows for various parameters like Fixed/Float, Projection Idx, Discounting Idx, Fix Rate/Flt Spd, Std. Notnl, Amortize Period, Index Tenor, Unit, and Yield Basis.

	Receive	Pay
Fixed/Float	Fixed	
Projection Idx	Current Index	
Discounting Idx	Current Index	
Fix Rate/Flt Spd	input	
Std. Notnl	1,000,000.00	
Amortize Period		
Index Tenor	n/a	
Unit		
Yield Basis	Act/360	

Benchmark (LIBOR3M) Projection Curve with OIS Discounting

- Conventional LIBOR Index:
 - Used in both projection and Discounting together
 - For use in valuation of uncollateralized trades
- OIS based LIBOR Index
 - Used only for projection paired with OIS discounting
 - For use in valuation of collateralized trades
- Building Blocks for OIS based LIBOR:
 - same as conventional LIBOR, cash/future/swaps
- Special Considerations
 - Cash/futures: same as conventional
 - Swaps: OIS curve to be used as parent in discounting

Grid Point ID 39 of Standard Official Index LIBOR_OIS.USD (ID 1020309 Version ID 102...

File Help

Grid Point Id: 39

☒ Input Formula ☐ Alternate Formulas

input;

	Receive	Pay
Fixed/Float	Fixed	Float
Projection Idx	Current Index	Current Index
Discounting Idx	OIS_Test.USD	OIS_Test.USD
Fix Rate/Flt Spd	input	0
Std. Notnl	1,000,000.00	1,000,000.00
Amortize Period		
Index Tenor	n/a	3m
Unit		
Yield Basis	Act/360	Act/360
Reset Period	n/a	3m
Payment Period	1y	3m
Avg Period	n/a	n/a
Comp Period	n/a	3m
Averaging Type	Unweighted	Unweighted
Roll Convention	Normal - EOM	Normal - EOM
Profile Per End Date Adj		

	Format	Use
input	Percent	Yes
effective	Percent	No
change	Percent	No
close	Percent	No
spread	Percent	No
adj	Percent	No
bo_spd	Percent	Yes
beta	Decima	Yes
def_load	Decima	No
exp_load	Decima	No

Grid Point Label 1y

Ins Category Bond / Swap

Priority Level Seven

Start Date settle

End Date 1y

Start Time

End Time

Effective Form Rate

Input Format Percent

Input Label Rate

Input Min Unlimited Min

Input Max Unlimited Max

Delta Shift 0.010000

Input Display Show When Active

Epsilon 0.000010000000

Shared Ins # 0

MDO ID /BXSU/USSW1

Trading Ins

Sensitivity Effective

Basis Projection Curves with OIS Discounting

- Distinction from Conventional basis curves
 - Used only for projection paired with OIS discounting
 - For use in valuation of collateralized trades
- Building Blocks:
 - same as conventional basis curves: basis swaps
- Special Considerations
 - Basis Swaps: OIS Based LIBOR curve as projection
 - Basis Swaps: OIS curve to be used as parent in discounting

Grid Point ID 2 of Standard Official Index 1Mv3M_LIBOR_OIS.USD (ID 1020311 Version 1...

File Help

Grid Point Id: 2

☒ Input Formula ☐ Alternate Formulas

input;

	Receive	Pay
Fixed/Float	Float	Float
Projection Idx	LIBOR_OIS.U	Current Index
Discounting Idx	OIS_Test.USD	OIS_Test.USD
Fix Rate/Flt Spd	0	input
Std. Notnl	1,000,000.00	1,000,000.00
Amortize Period		
Index Tenor	3m	1m
Unit		
Yield Basis	Act/360	Act/360
Reset Period	3m	1m
Payment Period	3m	1m
Avg Period	n/a	n/a
Comp Period	3m	1m
Averaging Type	Unweighted	Unweighted
Roll Convention	Normal - EOM	Normal - EOM
Profile Per End Date Adj		

	Format	Use
input	BPS	Yes
effective	Percen	No
change	Percen	No
close	Percen	No
spread	Percen	No
adj	Percen	No
bo_spd	BPS	Yes
beta	BPS	Yes
def_load	Decima	No
exp_load	Decima	No

Cross-Currency Swap Curves

- Constructed using Currency Basis Swap (Float/Float)
- Full controls of projection and discounting curves on both sides
- Standard Setup:
 - Proj Curves: Benchmark IR curves for both currencies
 - Disc Curve on USD side: OIS or LIBOR USD Curve
 - Disc Curve on Currency side : To be solved in bootstrap
- Internal consistency with standard and quoted deals

Grid Point ID 8 of Standard Official Index SWAP_CURVE.CAD (ID 1023046 Version ID 103...

File Help

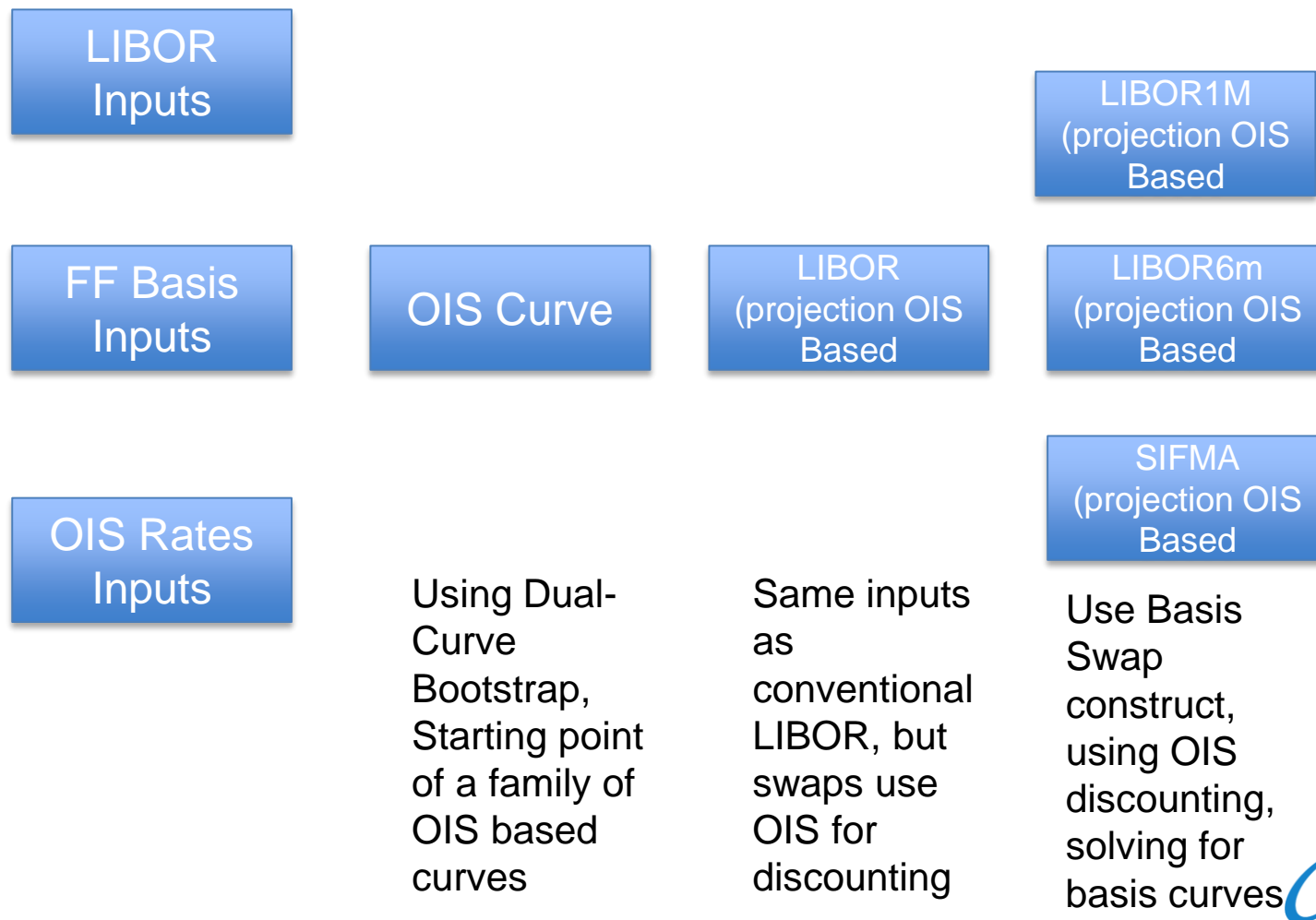
	Value
Grid Point ID	8
Grid Point Label	4y
Ins Category	Bond / Swap
Priority Level	Eight (lowest)
Start Date	settle
End Date	4y
Effective Form	Rate
Input Format	Percent
Input Label	Rate
Input Min	-100.000000
Input Max	100.000000
Delta Shift	0.010000
Input Display	Show When Active
Epsilon	1.000000000000
Shared Ins #	0
MDO ID	None
Sensitivity	Effective

Input Formula
input;

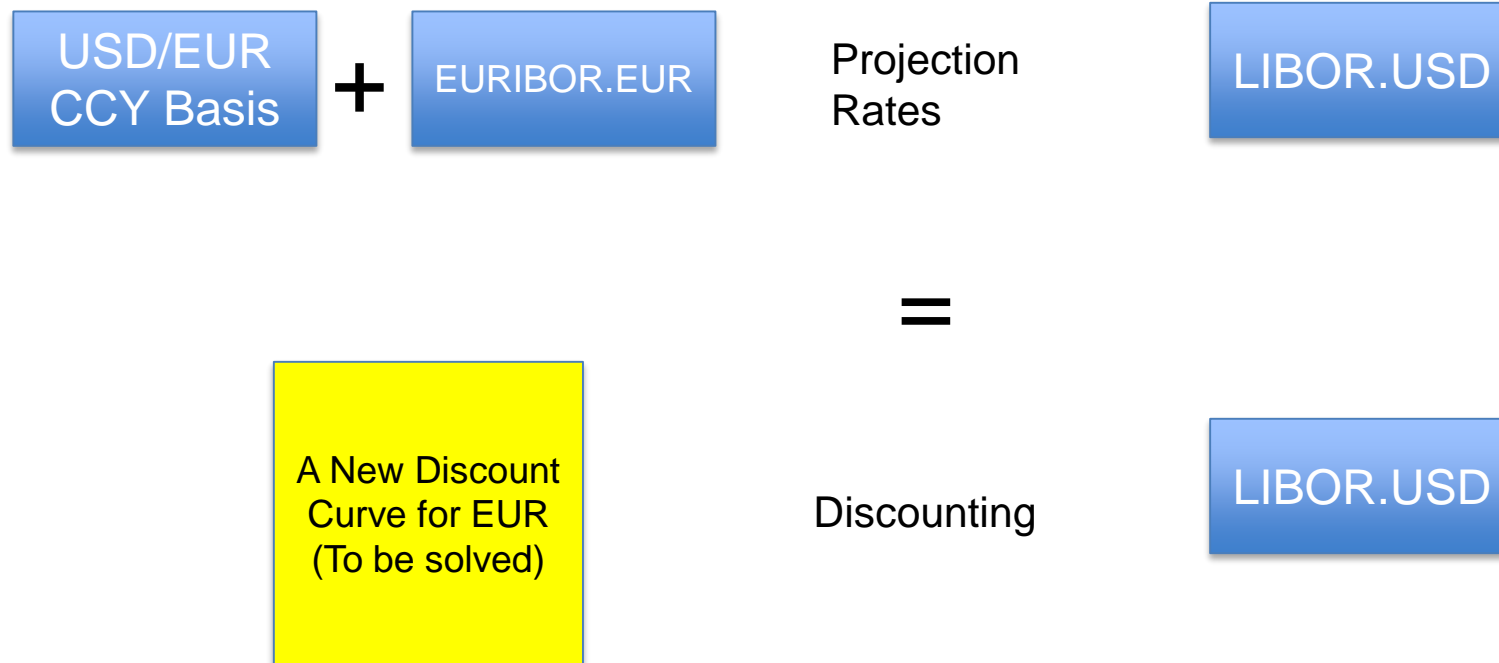
	Receive	Pay
Fixed/Float	Float	Float
Projection Idx	IR_SWAP.CAD	IR_SWAP.USD
Discounting Idx	Current Index	SWAP_CURVE.USD
Fix Rate/Flt Spd	input	0
Std. Notnl	1,000,000.00	1,000,000.00
Index Tenor	3m	3m
Yield Basis	Act/365 Fixed	Act/360
Reset Period	3m	3m
Payment Period	3m	3m
Avg Period	n/a	n/a
Comp Period	3m	3m
Averaging Type	Unweighted	Unweighted
Roll Convention	Normal - EOM	Normal - EOM
Reset Generator	Serial Shift	Serial Shift

Input Field Label	Input Field Format	Input Field Is
input	Percent	Yes
effective	Percent	Yes
change	Percent	No
close	Percent	No
spread	Percent	No
adj	Percent	No
bo_spd	Percent	Yes
beta	Percent	Yes
def_load	Decimal	No
exp_load	Decimal	No
lag	Decimal	No

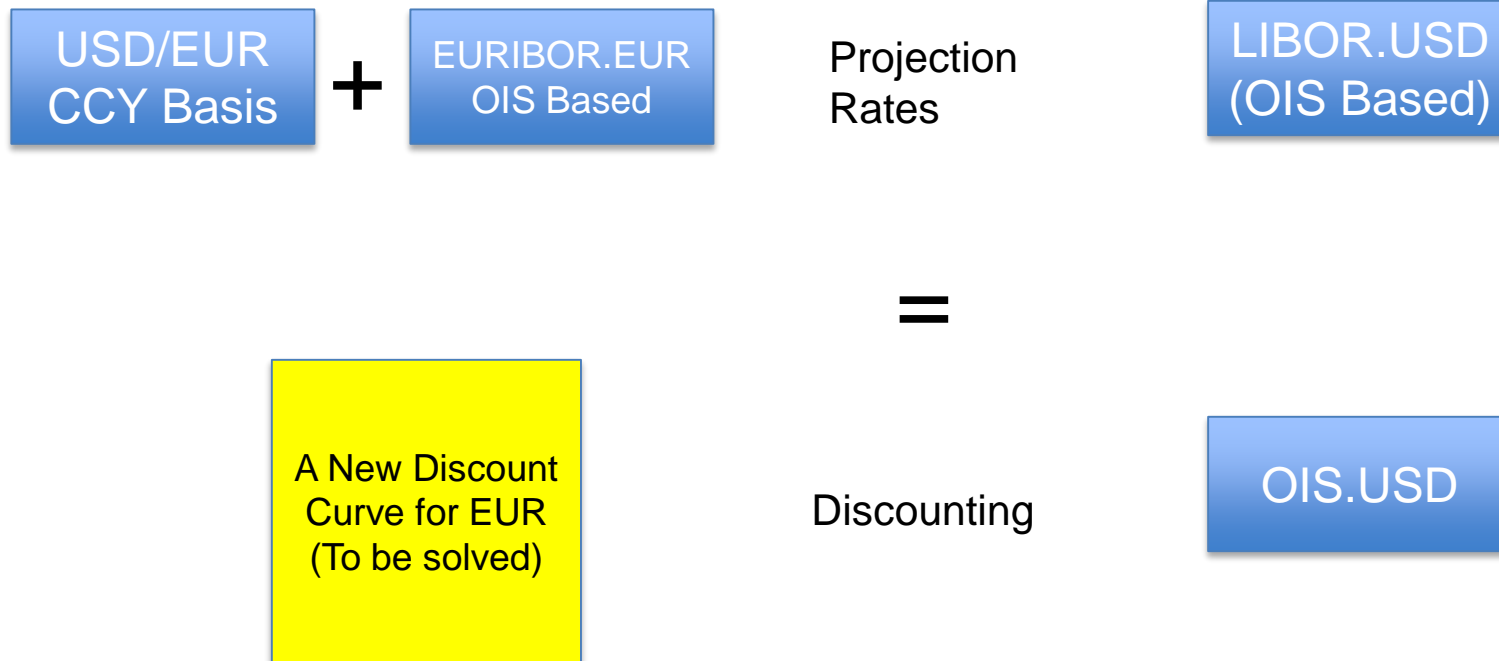
OIS Curve Structure for In-Currency Valuations



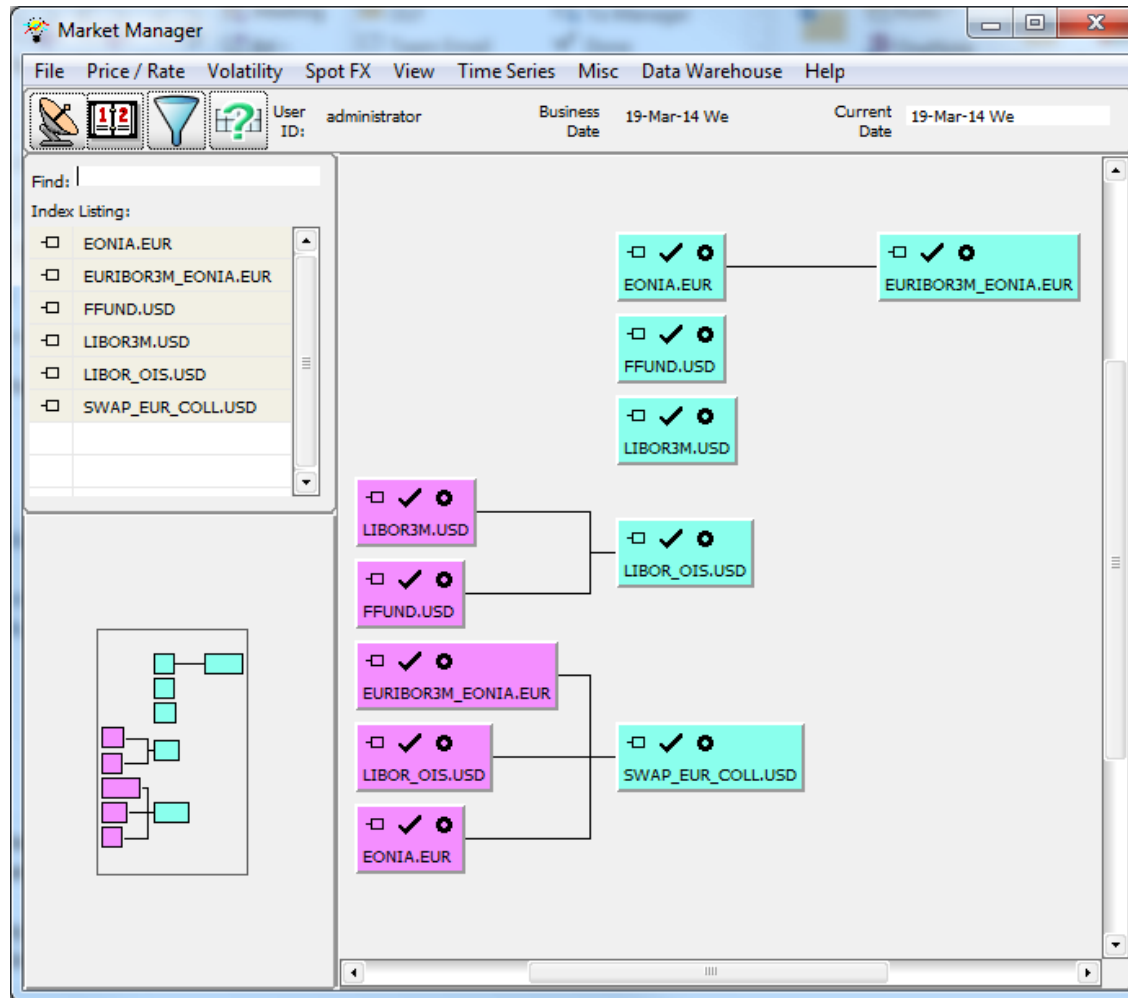
Cross Currency Curve Structure (Conventional)



Cross Currency Curve Structure (OIS Based)



Examples of Multi-Currency OIS setup



Idea here is that we want to set up a USD discount curve to value USD in-currency swaps but collateralized in EUR.

Market Quotes used are:

- USD Fed Fund / OIS Rates
- USD and Futures Rates
- EONIA Rates
- EONIA – EURIBOR Basis
- EURIBOR Swap Rates

Construction sequence:

1. USD FedFund and EONIA curves (they can be achieved independently and/or through dual-curve)
2. LIBOR and EURIBOR Curves (achieved based on given OIS curves)
3. USD Discounting for EUR collateralization (based on LIBOR/EURIBOR and EONIA)

Examples of Multi-Currency OIS setup

Standard Official Index SWAP_EUR_COLLUSD (ID 1022562 Version ID 1022567)

File View Configure Tools Help

Index Name	Value
Label	SWAP_EUR_COLLUSD
Market	Fixed Income
Group	Swap
Sub Group	Basis Curves
Format	DF
Purpose	Trading
Class	Date-base Fwd
Secured Index	No
Delivery Unit	Currency
Price Unit	Currency
Base Currency	USD
Holiday Schedule	USANYK
Days Delayed	2
Contract Size	1,000,000.00
Gamma Factor	1.000000
Std Tenor	n/a
Date Sequence	imm
Option Date Seq	imm
Payment Convention	Mod. Follow
Yield Basis	Act/360
Conversion Factor	1.000000

Parent Indexes

Parent Index
1 EURIBOR3M_EONIA.EUR
2 LIBOR_OIS.USD
3 EONIA.EUR

Description

Grid Point ID	Grid Point Label	Ins Category	Priority Level	Start Date	End
1	O/N	Bond / Swap	Eight (lowest)	current	next
2	T/N	Bond / Swap	Eight (lowest)	next	settle
3	3m	Bond / Swap	Eight (lowest)	settle	3m
4	6m	Bond / Swap	Eight (lowest)	settle	6m
5	9m	Bond / Swap	Eight (lowest)	settle	9m
6	1y	Bond / Swap	Eight (lowest)	settle	1y
7	18m	Bond / Swap	Eight (lowest)	settle	18m
8	2y	Bond / Swap	Eight (lowest)	settle	2y
9	3y	Bond / Swap	Eight (lowest)	settle	3y
10	4y	Bond / Swap	Eight (lowest)	settle	4y

For USD Discounting Curve for EUR collateralized trades

- Use known and already solved curves of EURIBOR, LIBOR, and EONIA
- Use EONIA for discounting on the EUR side and solve the target curve which is the discounting on the USD side

Grid Point ID 10 of Standard Official Index SWAP_EUR_COLLUSD (ID 1022562 Version ID 1022567)

File Help

Grid Point ID	Value
Grid Point ID	10
Grid Point Label	4y
Ins Category	Bond / Swap
Priority Level	Eight (lowest)
Start Date	settle
End Date	4y
Effective Form	Rate
Input Format	BPS
Input Label	Bond / Swap
Input Min	Unlimited Min
Input Max	Unlimited Max
Delta Shift	1.000000
Input Display	Show When Active
Epsilon	1.00000000000000
Shared Ins #	0

Input Formula
result = input;

	Receive	Pay
Fixed/Float	Float	Float
Projection Idx	LIBOR_OIS.USD	EURIBOR3M_EONIA.EUR
Discounting Idx	Current Index	EONIA.EUR
Fix Rate/Fit Spd	0	input
Std. Notnl	1,000,000.00	1,000,000.00
Index Tenor	3m	3m
Yield Basis	Act/360	Act/360
Reset Period	3m	3m
Payment Period	3m	3m
Avg Period	n/a	n/a
Comp Period	3m	3m
Averaging Type	Unweighted	Unweighted
Roll Convention	Normal - EOM	Normal - EOM

Input Field Label	Input Field Format	Input
input	BPS	Yes
effective	BPS	No
change	Percent	No
close	Percent	No
spread	Percent	No
adj	Percent	No
bo_spd	BPS	Yes
beta	BPS	Yes
all-in rate	Decimal	No
exp_load	Decimal	No



Thank you