SwapClear Zero Coupon Rate Curve Construction Methodology

Initial Margin and Variation Margin Zero Coupon Rate Curve Assignments

August 2, 2013

Contents

Chapter 1

Introduction

This paper describes the methods used by LCH.Clearnet in the construction of zero coupon rate curves under a dual curve calibration approach. This paper will focus on the technical aspects of the curve construction process. It is not the intention of this paper to detail the theoretical background to all the stages in the zero coupon rate curve building process. LCH.Clearnet SwapClear Risk Management reserves the right to modify the zero coupon rate curve calibration methodology and/or constituent instruments as and when market conditions dictate.

1.1 Principles and Approach

SwapClear adopts the following general principles when deriving the zero coupon rate term structure:

- Determine the financial instruments that will provide the best indication of the zero coupon rate at each maturity point
- Determine the pricing function between the market price, or rate, of the instrument and the zero coupon rate
- Determine a functional form to be used to determine the zero coupon rate for maturities other than those specific to the financial instruments used within the calibration process

Based on the above general principles, SwapClear zero coupon rate curve construction methodology applies the following key elements:

- Primary financial instruments used are money market instruments, short term interest rate futures, forward rate agreements, single currency basis swaps, overnight index swaps and par interest rate swaps
- The zero coupon rate for the first short term interest rate future / forward rate agreement start date is determined by interpolating between the nearest zero coupon rate generated from the money market instrument strip

- A bootstrapping technique is used to calculate the zero coupon rates for the remaining short term interest rate future / forward rate agreement instruments
- Zero coupon rates are calculated for all money market instrument and par swap payment dates that lie between the first short term interest rate future / forward rate agreement start date and the last future / forward rate agreement end date using a predefined interpolation function
- The remaining zero coupon rates are bootstrapped from the par swap rates
- Zero coupon rates for maturities between available points are determined using linear interpolation
- Discount factors for maturities between available points are determined using the linearly interpolated zero coupon rate. These zero coupon rates are converted to discount factors based on an exponential rate quotation using an Actual/365 basis
- For initial margin calculations, SwapClear uses a single reference curve per currency for valuation and the calculation of risk for all non overnight index swap trades i.e. expected forward rates and discounting are all derived from the same curve
- For variation margin calculations (subject to individual markets exhibiting sufficient liquidity), SwapClear uses a separate single currency basis adjusted zero coupon rate curve for deriving expected forward rates and an overnight index swap zero coupon rate curve for discounting

Chapter 2

Zero Coupon Rate Curve Construction

SwapClear constructs zero coupon rate curves using an appropriate set of market instruments. Given a user-defined set of reference interest rate sensitive instruments (and market rates) with increasing expiry dates, it is possible to calculate the zero coupon rates corresponding to the expiry dates of each reference instrument.

The zero coupon curve is based on the principle that all instruments belonging to the zero coupon curve have a zero value if priced on the curve. Calculations of the zero coupon rates derived from the input cashflows are made using a Newton-Raphson method. This method is an iterative process starting from a seed zero coupon rates set. At each loop, the algorithm modifies the zero coupon rate set, converging to the unique solution which, given an interpolation formula, implies a zero value for all the instruments on the curve.

2.1 Calibration

For the purposes of calibration SwapClear Risk Management defines a family of instruments I_i which is represented by a set of cashflows $cf_{ij} : \{I_i\}_{1 \leq i \leq N} \equiv \{cf_{ij}\}_{1 \leq i \leq N; 1 \leq j \leq n}$

The zero coupon rate curve is based on the principle that all instruments belonging to the zero coupon rate curve have a zero value if priced on the curve i.e.

$$\sum_{j=1}^{n_i} cf_{ij}.P_{ij} = 0, \forall\, i \in \{1, ..., N\} \tag{2.1}$$

2.2 Definitions

2.2.1 Discount Factor Definition

$$P\,(t,T) = e^{-z(t,T)\tau(t,T)} \tag{2.2}$$

2.2.2 Cashflow Definition

$$cf\left(T_i^S, T_i^E\right) = N \cdot \ R \cdot \tau\left(T_i^S, T_i^E\right) \tag{2.3}$$

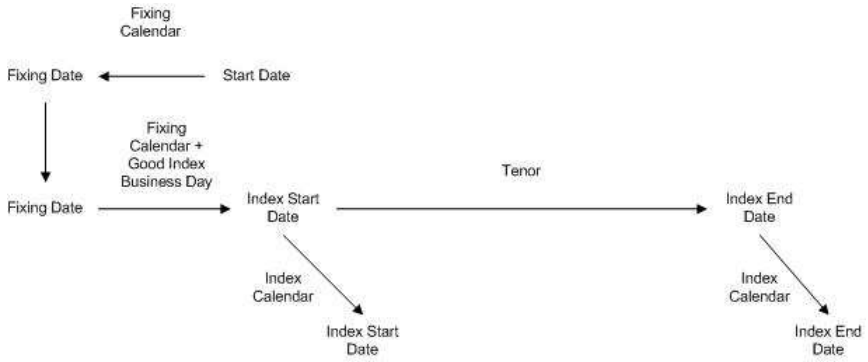
2.2.3 Discounted Cashflow Definition

$$PV\left(T_i^S, T_i^E; t, T_i^P\right) = cf\left(T_i^S, T_i^E\right) \cdot P_d\left(t, T_i^P\right) \tag{2.4}$$

2.2.4 Floating Index Rate Estimation

The floating rate index estimation start and end dates are determined using the following algorithm:

- The fixing date is derived from the fixing calendar of the floating rate index and the cashflow start date
- The fixing date, the floating rate index offset period along with the fixing calendar returns the floating rate index estimation start date. This date is checked against the union of the fixing and payment calendar to ensure it is an open business day
- Once the floating rate index start date is determined, the floating rate index rate reset frequency is applied to derive the floating rate index end date. The floating rate index end date is also checked against a combination of the fixing and payment calendar to ensure it is an open business day



Example

Consider the following example where the USD 3M LIBOR Index floating rate is required for a cashflow start date of 18/04/2014.

The 18/04/2014 is a good business day in New York but not London. According to the USD 3M LIBOR Index conventions together with the methodology outlined above, this implies a Fixing date of 16/04/2014. Again using the methodology above, this implies a floating rate index estimation start date of 22/04/2014 and a floating rate index estimation end date of 22/07/2014.

Floating Index Rate Estimation Definition

The floating index rate is defined as:

$$F(t,T_1,T_2) = \left(\frac{P(t,T_1)}{P(t,T_2)} - 1\right) / \tau(T_1,T_2) \tag{2.5}$$

2.3 Curve Instruments

2.3.1 Deposit Instruments

$$NPV = -N \cdot P\left(t_0,T_i^S\right) + N \cdot \left(1 + R \cdot \tau\left(T_i^S,T_i^E\right)\right) \cdot P\left(t_0,T_i^P\right) \tag{2.6}$$

2.3.2 Forward Rate Instruments

$$NPV = N \cdot (R - f) \cdot \tau\left(T_i^S,T_i^E\right) \cdot P_f\left(T_i^S,T_i^E\right) \cdot P_d\left(t,T_i^S\right) \tag{2.7}$$

2.3.3 Short Term Interest Rate Futures Instruments

$$NPV = -N \cdot P\left(t_0,T_i^S\right) + N \cdot \left(1 + R \cdot \tau\left(T_i^S,T_i^E\right)\right)^{\alpha} \cdot P\left(t_0,T_i^E\right) \tag{2.8}$$

where

$$\alpha = \frac{\tau_{IMM}\left(T_i^S,T_i^E\right)}{\tau_{Fwd}\left(T_i^S,T_i^E\right)} \tag{2.9}$$

For the purposes of zero coupon rate curve calibration, IMM periods are deemed to be contigious.

2.3.4 Interest Rate Swaps

$$NPV(t) = -NPV(t)_{fix} + NPV(t)_{flt} \tag{2.10}$$

$$NPV(t)_{fix} = \sum_{i=1}^{m} N \cdot R_{fix}\tau(T_i^S,T_i^E)P_d(t,T_i^P) \tag{2.11}$$

$$NPV(t)_{flt} = \sum_{j=1}^{n} N \cdot \left(F_f(t,T_j^S,T_j^E) + S\right)\tau(T_i^S,T_i^E)P_d(t,T_j^P) \tag{2.12}$$

2.4 Implied Interest Rate Swap Par Rate Construction

Where no liquid market exists, LCH.Clearnet SwapClear Risk Management adopts a portfolio approximation to derive implied par interest rate swap rates from the par interest rate swap and single currency basis swap market. The implied par interest rate swap rates are used directly in the zero coupon rate curve calibration methodology as described in section 3.1.
Illustration:

2Y USD LIBOR A 3M	1.3%
2Y USD LIBOR 1M 3M	7bps
2Y USD LIBOR A 1M	1.23%

2.5 Implied Overnight Index Swap Par Rate Construction

Where no liquid market exists, LCH.Clearnet SwapClear Risk Management adopts a portfolio approximation to derive implied par overnight index swap rates from the par interest rate swap, single currency basis swap and overnight index swap - basis swap market. The implied par overnight index swap rates are used directly in the zero coupon rate calibration methodology as described in section 3.1.
Illustration:

3Y EURIBOR A 6M	1.53%
3Y EURIBOR 6M 3M (2-swap basis)	16bps
3Y EUR EONIA A EURIBOR 3M	30bps
3Y EUR EONIA	1.07%

2.6 Revaluation Rate Curve Global Model Settings

Field	Single Currency Basis Adjusted Zero Coupon Rate Curves	Other Zero Coupon Rate Curves	Comment
Interpolation formula	Linear	Linear	
Value to interpolate	Zero coupon rate	Zero coupon rate	
Interpolation before first pillar	Flat	Flat	
Interpolation after last pillar	Flat	Flat	
Zero coupon rate convention	Exponential Actual/365	Exponential Actual/365	
Futures	No intermediate interpolation	No intermediate interpolation	Considers the final cashflow date as being the next contract maturity date
Blocks consistency	According to priorities on Maturity	According to priorities on First date	An instrument with lower priority is ignored if it is between two instruments with higher priorities
Ignore fixings	All	All	Interest rate fixings will always be ignored
Calibration	Standard	Standard	The interest rate swap cashflows based on floating rates are not estimated but replaced by two capital flows in the zero coupon rate computation
Maturity step out gap	8	8	7 days before the roll of a future at which the future will be automatically excluded from the curve
Calibration method	Global Newton	Global Newton	The curve is calibrated by minimising the absolute error on the sum of the NPV of all the instruments
Calibration tolerance	0.0001	0.0001	
Calibration iterations	30	30	
Accept zero rates	Yes	Yes	

Chapter 3

Appendix

3.1 Initial Margin Curve Assignment

3.1.1 Scope

The following initial margin rate curves are in scope for SwapClear Refresh:

- AUD BBSW (AUD :STD)
- CAD CDOR (CAD :STD)
- CHF LIBOR (CHF :STD)
- CZK PRIBOR (CZK: STD)
- DKK CIBOR (DKK: STD)
- EUR EURIBOR (EUR :STD)
- GBP LIBOR (GBP :STD)
- HKD HIBOR (HKD: STD)
- JPY LIBOR (JPY: STD)
- NOK NIBOR (NOK :STD)
- NZD BBR (NZD :STD)
- PLN WIBOR (PLN :STD)
- SEK STIBOR (SEK :STD)
- SGD SOR (SGD :STD)
- USD LIBOR (USD :STD)
- ZAR JIBAR (ZAR: STD)
- CAD CORRA
- CHF TOIS

- EUR EONIA
- GBP SONIA
- USD FEDFUND

Note that the above rate curves are used for deriving the expected forward rates and the discounting of future cashflows.

3.1.2 Rate Curve Constituents

AUD BBSW (AUD:STD)

Priorities:

Priority	Instrument	Generator
1	Short Future	SFE BAB 90D
2	Swap	AUD BBSW Q 3M
3	Swap	AUD BBSW S 6M
4	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	SFE BAB 90D	...	...
Swap	AUD BBSW Q 3M	2Y	3Y
Swap	AUD BBSW S 6M	4Y	30Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

CAD CDOR (CAD:STD)

Priorities:

Priority	Instrument	Generator
1	Short Future	ME CDOR 3M
2	Swap	CAD CDOR S 3M
3	Deposit	CAD DEPOSIT

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CAD DEPOSIT	O/N	6M
Short Future	ME CDOR 3M	...	...
Swap	CAD CDOR S 3M	2Y	30Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

CHF LIBOR (CHF:STD)

Priorities:

Priority	Instrument	Generator
1	Short Future	LIFFE EURCHF 3M
2	Swap	CHF LIBOR A 6M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	LIFFE EURCHF 3M	...	...
Swap	CHF LIBOR A 6M	2Y	30Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

CZK PRIBOR (CZK:STD)

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 3M
3	Swap	CZK PRIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
FRA	FRA 3M	...	...
Swap	CZK PRIBOR A 6M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

DKK CIBOR (DKK:STD)

Priorities:

Priority	Instrument	Generator
1	Short Future	CSE CIBOR FRA 3M
2	Swap	DKK CIBOR A 6M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	CSE CIBOR FRA 3M	...	...
Swap	DKK CIBOR A 6M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

EUR EURIBOR (EUR:STD)

Priorities:

Priority	Instrument	Generator
1	Short Future	LIFFE EURIBOR 3M
2	Swap	EURIBOR A 6M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	LIFFE EURIBOR 3M	...	...
Swap	EURIBOR A 6M	2Y	50Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

GBP LIBOR (GBP:STD)

Priorities:

Priority	Instrument	Generator
1	Short Future	LIFFE EURGBP 3M
2	Swap	GBP LIBOR S 6M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	LIFFE EURGBP 3M	...	...
Swap	GBP LIBOR S 6M	2Y	50Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

HKD HIBOR (HKD:STD)

Priorities:

Priority	Instrument	Generator
1	Swap	HKD HIBOR Q 3M
2	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Swap	HKD HIBOR Q 3M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

HUF BUBOR (HUF:STD)

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 3M
3	Swap	HUF BUBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
FRA	FRA 3M	...	...
Swap	HUF BUBOR A 6M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

JPY LIBOR (JPY:STD)

Priorities:

Priority	Instrument	Generator
1	Swap	JPY LIBOR S 6M
2	Deposit	CASH
3	Deposit	JPY DEPOSIT (LIBOR)

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	T/N
FRA	JPY DEPOSIT (LIBOR)	1W	9M
Swap	JPY LIBOR S 6M	1Y	30Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

NOK NIBOR (NOK:STD)

Priorities:

Priority	Instrument	Generator
1	Short Future	OMX NIBOR FRA 3M
2	Swap	NOK NIBOR A 6M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	OMX NIBOR FRA 3M	...	...
Swap	NOK NIBOR A 6M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

NZD BBR (NZD:STD)

Priorities:

Priority	Instrument	Generator
1	Swap	NZD BKBM S 3M
2	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Swap	NZD BKBM S 3M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

PLN WIBOR (PLN:STD)

Priorities:

Priority	Instrument	Generator
1	FRA	FRA 3M
2	Swap	PLN WIBOR A 6M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	3M
FRA	FRA 3M	...	...
Swap	PLN WIBOR A 6M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

SEK STIBOR (SEK:STD)

Priorities:

Priority	Instrument	Generator
1	Swap	SEK STIBOR A 3M
2	Short Future	OMX STIBOR FRA 3M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	OMX STIBOR FRA 3M	...	...
Swap	SEK STIBOR A 3M	2Y	30Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

SGD SOR (SGD:STD)

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Swap	SGD SOR S 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Swap	SGD SOR S 6M	1Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

USD LIBOR (USD:STD)

Priorities:

Priority	Instrument	Generator
1	Swap	USD LIBOR A 3M
2	Short Future	CME EURUSD 3M
3	FRA	FRA 3M
4	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	6M
Short Future	CME EURUSD 3M	...	...
FRA	FRA 3M	...	...
Swap	USD LIBOR A 3M	2Y	50Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

ZAR JIBAR (ZAR:STD)

Priorities:

Priority	Instrument	Generator
1	FRA	FRA 3M
2	Swap	ZAR JIBAR Q 3M
3	Deposit	CASH

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	O/N	3M
FRA	FRA 3M	...	...
Swap	ZAR JIBAR Q 3M	2Y	10Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

CAD CORRA

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	2Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

CHF TOIS

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	2Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

EUR EONIA

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	2Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

GBP SONIA

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	2Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

USD FEDFUND

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	2Y

See REP00078 for a detailed breakdown of zero coupon rate curve constituents.

3.2 Variation Margin Curve Assignment

3.2.1 Scope: Single Currency Basis Adjusted Rate Curves

The following variation margin rate curves are in scope for SwapClear Refresh:

- AUD BBSW 3M
- AUD BBSW 6M
- CZK PRIBOR 3M
- CZK PRIBOR 6M
- DKK CIBOR 3M
- DKK CIBOR 6M
- CHF LIBOR 3M
- CHF LIBOR 6M
- CHF LIBOR 12M
- EUR EURIBOR 1M
- EUR EURIBOR 3M
- EUR EURIBOR 6M
- EUR EURIBOR 12M
- GBP LIBOR 1M
- GBP LIBOR 3M
- GBP LIBOR 6M
- GBP LIBOR 12M
- HUF BUBOR 3M
- HUF BUBOR 6M
- JPY LIBOR 3M
- JPY LIBOR 6M
- NOK NIBOR 3M
- NOK NIBOR 6M
- PLN WIBOR 3M
- PLN WIBOR 6M
- SEK STIBOR 3M
- SEK STIBOR 6M

- USD LIBOR 1M
- USD LIBOR 3M
- USD LIBOR 6M
- USD LIBOR 12M

Note that the above rate curves are used for deriving the expected forward rates only. Future cashflows are discounted using their respective overnight index rate curves (see section 3.2.3 for details).
LCH.Clearnet SwapClear Risk Management will at their discretion amend the currencies for single currency basis and overnight index swap discounting as liquidity becomes available.

3.2.2 Rate Curve Constituents: Single Currency Basis Adjusted Rate Curves

AUD BBSW 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Short Future	SFE BAB 90D
3	Swap	AUD BBSW 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	SFE BAB 90D	...	...
Swap	AUD BBSW 3M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

AUD BBSW 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Swap	AUD BBSW 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
Swap	AUD BBSW 6M	1Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

CZK PRIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	CZK 3M PRIBOR
3	Swap	CZK PRIBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
FRA	CZK 3M PRIBOR	...	...
Swap	CZK PRIBOR A 3M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

CZK PRIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	CZK 6M PRIBOR
3	Swap	CZK PRIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	CZK 6M PRIBOR	...	...
Swap	CZK PRIBOR A 6M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

CHF LIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Short Future	LIFFE EURCHF 3M
3	Swap	CHF LIBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	LIFFE EURCHF 3M	...	...
Swap	CHF LIBOR A 3M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

CHF LIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 6M
3	Swap	CHF LIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	FRA 6M	...	...
Swap	CHF LIBOR A 6M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

CHF LIBOR 12M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Swap	CHF LIBOR A 1Y

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	12M	...
Swap	CHF LIBOR A 1Y	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

DKK CIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Short Future	CSE CIBOR FRA 3M
3	Swap	DKK CIBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	CSE CIBOR FRA 3M	...	...
Swap	DKK CIBOR A 3M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

DKK CIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Swap	DKK CIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
Swap	DKK CIBOR A 6M	1Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

EUR EURIBOR 1M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 1M
3	Swap	EUR EURIBOR A 1M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	1M	...
FRA	FRA 1M	...	...
Swap	EUR EURIBOR A 1M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

EUR EURIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Short Future	LIFFE EURIBOR 3M
3	Swap	EUR EURIBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	LIFFE EURIBOR 3M	...	...
Swap	EUR EURIBOR A 3M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

EUR EURIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 6M
3	Swap	EUR EURIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	FRA 6M	...	...
Swap	EUR EURIBOR A 6M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

EUR EURIBOR 12M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 1Y
3	Swap	EUR EURIBOR A 1Y

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	12M	...
FRA	FRA 1Y	...	...
Swap	EUR EURIBOR A 1Y	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

GBP LIBOR 1M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 1M
3	Swap	GBP LIBOR S 1M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	1M	...
FRA	FRA 1M	...	...
Swap	GBP LIBOR S 1M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

GBP LIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Short Future	LIFFE EURGBP 3M
3	Swap	GBP LIBOR S 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	LIFFE EURGBP 3M	...	...
Swap	GBP LIBOR S 3M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

GBP LIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 6M
3	Swap	GBP LIBOR S 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	FRA 6M	...	...
Swap	GBP LIBOR S 6M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

GBP LIBOR 12M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 1Y
3	Swap	GBP LIBOR S 1Y

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	12M	...
FRA	FRA 1Y	...	...
Swap	GBP LIBOR S 1Y	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

HUF BUBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	HUF 3M BUBOR
3	Swap	HUF BUBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
FRA	HUF 3M BUBOR	...	...
Swap	HUF BUBOR A 3M	2Y	10Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

HUF BUBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	HUF 6M BUBOR
3	Swap	HUF BUBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	HUF 6M BUBOR	...	...
Swap	HUF BUBOR A 6M	2Y	10Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

JPY LIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 3M
3	Swap	JPY LIBOR S 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
FRA	FRA 3M	...	...
Swap	JPY LIBOR S 3M	2Y	40Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

JPY LIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 6M
3	Swap	JPY LIBOR S 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	FRA 6M	...	...
Swap	JPY LIBOR S 6M	2Y	40Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

NOK NIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Short Future	OMX NIBOR FRA 3M
3	Swap	NOK NIBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	OMX NIBOR FRA 3M	...	...
Swap	NOK NIBOR A 3M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

NOK NIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Swap	NOK NIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
Swap	NOK NIBOR A 6M	1Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

PLN WIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	PLN 3M WIBOR
3	Swap	PLN WIBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
FRA	PLN 3M WIBOR	...	...
Swap	PLN WIBOR A 3M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

PLN WIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	PLN 6M WIBOR
3	Swap	PLN WIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	PLN 6M WIBOR	...	...
Swap	PLN WIBOR A 6M	2Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

SEK STIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Short Future	OMX STIBOR FRA 3M
3	Swap	SEK STIBOR A 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	OMX STIBOR FRA 3M	...	...
Swap	SEK STIBOR A 3M	1Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

SEK STIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Swap	SEK STIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
Swap	SEK STIBOR A 6M	1Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

USD LIBOR 1M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 1M
3	Swap	USD LIBOR A 1M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	1M	...
FRA	FRA 1M	...	...
Swap	USD LIBOR A 1M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

USD LIBOR 3M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	Swap	USD LIBOR A 3M
3	Short Future	CME EURUSD 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	3M	...
Short Future	CME EURUSD 3M	...	...
Swap	USD LIBOR A 3M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

USD LIBOR 6M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 6M
3	Swap	USD LIBOR A 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	6M	...
FRA	FRA 6M	...	...
Swap	USD LIBOR A 6M	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

USD LIBOR 12M

Priorities:

Priority	Instrument	Generator
1	Deposit	CASH
2	FRA	FRA 1Y
3	Swap	USD LIBOR A 1Y

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	CASH	12M	...
FRA	FRA 1Y	...	...
Swap	USD LIBOR A 1Y	2Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

3.2.3 Scope: Overnight Index Rate Curves

The following variation margin rate curves are in scope for SwapClear Refresh:

- AUD AONIA
- CAD CORRA
- CHF TOIS
- EUR EONIA
- GBP SONIA
- JPY TONA
- USD FEDFUND

Note that the above rate curves are used for deriving the expected forward rates and the discounting of future cashflows for overnight index swaps. In addition, except for CAD, the above curves are used for the discounting of single currency basis adjusted cashflows.

3.2.4 Rate Curve Constituents: Overnight Index Rate Curves

AUD AONIA

Priorities:

Priority	Instrument	Generator
1	Deposit	AUD DEP A/365
2	Swap	AUD AONIA Q 3M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	AUD DEP A/365	O/N	2Y
Swap	AUD AONIA Q 3M	3Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

CAD CORRA

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS
2	Swap	CAD CORRA S 6M

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	2Y
Swap	CAD CORRA S 6M	3Y	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

CHF TOIS

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

EUR EONIA

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

GBP SONIA

Priorities:

Priority	Instrument	Generator
1	Swap	GBP SONIA S 6M
2	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	2Y
Swap	GBP SONIA S 6M	3Y	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

JPY TONA

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	30Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

USD FEDFUND

Priorities:

Priority	Instrument	Generator
1	Deposit	OIS

Zero coupon rate curve constituents:

Instrument	Generator	Expiry (First)	Expiry (Last)
Deposit	OIS	O/N	50Y

See REP00099 for a detailed breakdown of zero coupon rate curve constituents.

3.2.5 Scope: Other Rate Curves

The following variation margin rate curves are in scope for SwapClear Refresh:

- AUD BBSW (AUD :STD)
- CAD CDOR (CAD :STD)
- CHF LIBOR (CHF :STD)
- CZK PRIBOR (CZK :STD)
- DKK CIBOR (DKK: STD)

- EUR EURIBOR (EUR :STD)
- GBP LIBOR (GBP :STD)
- HKD HIBOR (HKD: STD)
- HUF BUBOR (HUF: STD)
- JPY LIBOR (JPY: STD)
- NOK NIBOR (NOK :STD)
- NZD BBR (NZD :STD)
- PLN WIBOR (PLN :STD)
- SEK STIBOR (SEK :STD)
- SGD SOR (SGD :STD)
- USD LIBOR (USD :STD)
- ZAR JIBAR (ZAR: STD)

Note that the above rate curves are used for deriving the expected forward rates and the discounting of future cashflows.
See section 3.1.2 for a summary of the rate curve constituents.

3.3 SwapClear Grid Points on Initial Margin Curves

The SwapClear Initial Margin IRS and OIS Curves are interpolated to a fixed grid. The predefined grid points are currency dependent. Initial Margin IRS Curve grid points are defined as below:

Pillar	Days	AUD	CAD	CHF	CZK	DKK	EUR	GBP	HKD	HUF	JPY	NOK	NZD	PLN	SEK	SGD	USD	ZAR
O/N	1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
1W	7	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
1M	30	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2M	60	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3M	91	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6M	182	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9M	273	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
1Y	365	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
18M	547	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
2Y	730	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
3Y	1095	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
4Y	1460	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
5Y	1825	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
6Y	2190	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
7Y	2555	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
8Y	2920	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
9Y	3285	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
10Y	3650	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
12Y	4380	x	x	x			x	x			x		x		x		x	
15Y	5475	x	x	x			x	x			x		x		x		x	
20Y	7300	x	x	x			x	x			x				x		x	
25Y	9125	x	x	x			x	x			x				x		x	
30Y	10950	x	x	x			x	x			x				x		x	
35Y	12775						x	x									x	
40Y	14600						x	x			x						x	
45Y	16425						x	x									x	
50Y	18250						x	x									x	

Initial Margin OIS Curve grid points are defined as below:

Pillar	Days	CAD CORRA	CHF TOIS	EUR EONIA	GBP SONIA	USD Fed Fund
O/N	1	x	x	x	x	x
1W	7	x	x	x	x	x
2W	14	x	x	x	x	x
3W	21	x	x	x	x	x
1M	30	x	x	x	x	x
2M	60	x	x	x	x	x
3M	91	x	x	x	x	x
4M	121	x	x	x	x	x
5M	152	x	x	x	x	x
6M	182	x	x	x	x	x
7M	212	x	x	x	x	x
8M	243	x	x	x	x	x
9M	273	x	x	x	x	x
10M	304	x	x	x	x	x
11M	334	x	x	x	x	x
1Y	365	x	x	x	x	x
15M	456	x	x	x	x	
18M	547	x	x	x	x	x
21M	638	x	x	x	x	
2Y	730	x	x	x	x	x
3Y	1095			x	x	x
4Y	1460			x	x	x
5Y	1825			x	x	x
6Y	2190			x	x	x
7Y	2555			x	x	x
8Y	2920			x	x	x
9Y	3285			x	x	x
10Y	3650			x	x	x
12Y	4380			x	x	x
15Y	5475			x	x	x
20Y	7300			x	x	x
25Y	9125			x	x	x
30Y	10950			x	x	x
35Y	12775			x	x	x
40Y	14600			x	x	x
45Y	16425			x	x	x
50Y	18250			x	x	x