Nasdaq Calypso

Zero Yield Curves

Version 18

Revision 2.0

November 2024

Approved

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Document History

Revision	Published	Summary of Changes
1.0	February 2024	First revision for version 18.
2.0	November 2024	Updates for monthly release. Added info about Priority.

This document describes how to create zero yield curves.

Zero yield curves can be used as discount curves and forecast curves.

Dependencies

A forecast curve and a discount curve can be independent from each other. A forecast curve can be dependent on a discount curve by attaching a discount curve to the forecast curve.

▶ See Curve Zero for details on creating such curves.

Multiple curves can be dependent on each other by using a multi-curve package.

▶ See Multi-curve Package for details on creating such curves.

The curve types, generation algorithms and interpolators are described in the *Calypso IRD Analytics* guide and *Calypso Yield Curves Generation* guide.

Table of Contents

1. Zero Curve

Zero curves can be created from offset points, derived from underlying instruments, or derived from underlying instruments with convexity adjustment to futures.

- Zero curve from offset points
- Zero curve from underlying instruments
- Blended zero curve
- Zero curve with convexity adjustments
- Agency option adjusted spread curve
- Pricer configuration

From the Calypso Navigator, navigate to **Market Data > Interest Rate Curves > Zero Yield Curve** (menu action `marketdata.CurveZeroWindow`).

1.1 General Curve Information

- The name of the curve is set upon saving. It will identify the curve throughout the system.
- The instance of the curve dictates the quote side of the underlying instruments to be used for generating the curve.
  - The CLOSE instance uses CLOSE quotes.
  - The LAST instance uses BID, MID, and ASK quotes.
  - The OPEN instance uses OPEN quotes.
- By default, the curve is saved as of the current date and time. You can clear the Current checkbox and change the curve date and time as needed.
- You can change the precision of the discount factors using **Utilities > Set Df Precision** - Default is 8.

Curve Update

You can use the scheduled task PROP_RATE_1BUSDAY to roll the quotes which are not liquid.

You can use the scheduled task GENERATE_CURVE to regenerate a curve as of the current valuation date.

Setup Information

The environment property INT_CURVE_INTERP_RATE_B impacts the zero curve.

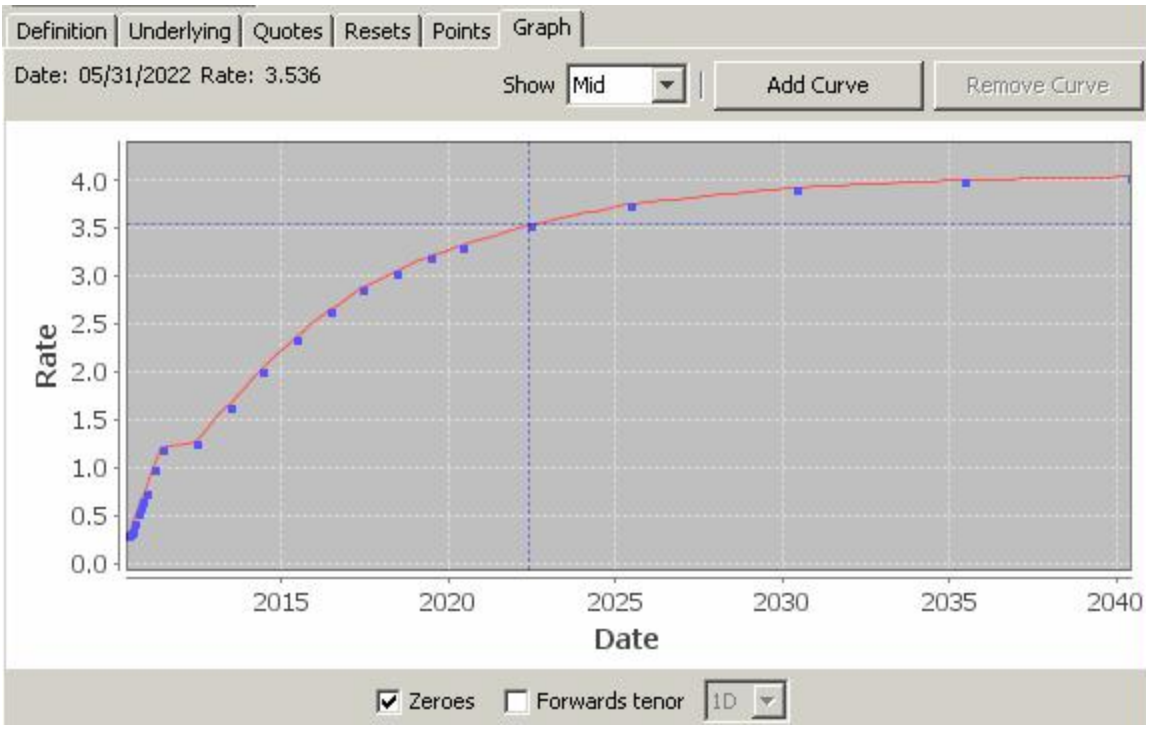
- If INT_CURVE_INTERP_RATE_B = Y (Default value), curves are interpolated on the zero rates.
- If INT_CURVE_INTERP_RATE_B = N, curves are interpolated on the discount factors.

However, you can override the interpolation space at the curve level using the "Interp As" field in the curve definition window:

- Default - Uses the value of environment property INT_CURVE_INTERP_RATE_B.
- Rate - Interpolates the curve on the zero rates, regardless of environment property INT_CURVE_INTERP_RATE_B.
- DiscountFactor - Interpolates the curves on the discount factors, regardless of environment property INT_CURVE_INTERP_RATE_B.

Graph Panel

Once a curve is generated, you can select the Graph panel to view the curve in graphical form.



Curve Generation Monitoring

The debug category "CurveGenInputs" logs the inputs passed to the curve generator from the curve (underlyings, generator parameters, quotes, points, underlying market data items) and some information from the pricing environment, such as quotes and pricing parameters.

This debug category is supported for all yield curve generators, and only for a few other generators (FXPoints, Probability).

1.2 Generating Zero Curves From Offsets

Zero Curve from Offsets Quick Reference

Configuration Requirements

- Rate Index Definition – From the Calypso Navigator, navigate to **Configuration > Interest Rates > Rate Index Definitions**.

Curve Generation

1. Click **New** to start a new curve.

2. Definition Panel — Select the following information to define the curve: currency, index, tenor, holidays, “Generate from instruments” should be unchecked, interpolator, interpolation space, generation algorithm, curve type set to “CurveZero”, Pricing Env.

3. Offsets Panel — Select the tenors and dates.

4. Points Panel — Click **Generate** to generate the points. Enter the zero rates.

5. Click **Save**, and enter a curve name.

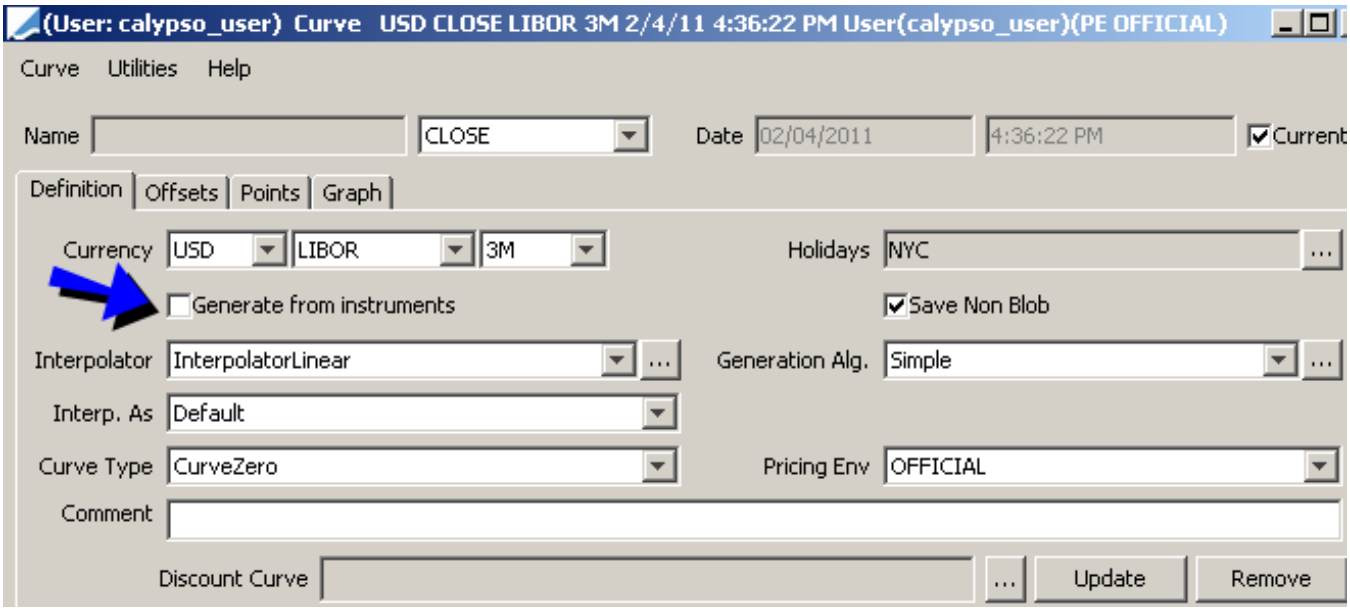
Pricer Configuration

Assign the zero curve from offsets as a discount curve and/or as a forecast curve.

1.2.1 Definition Panel

Click **New** to start a new curve.

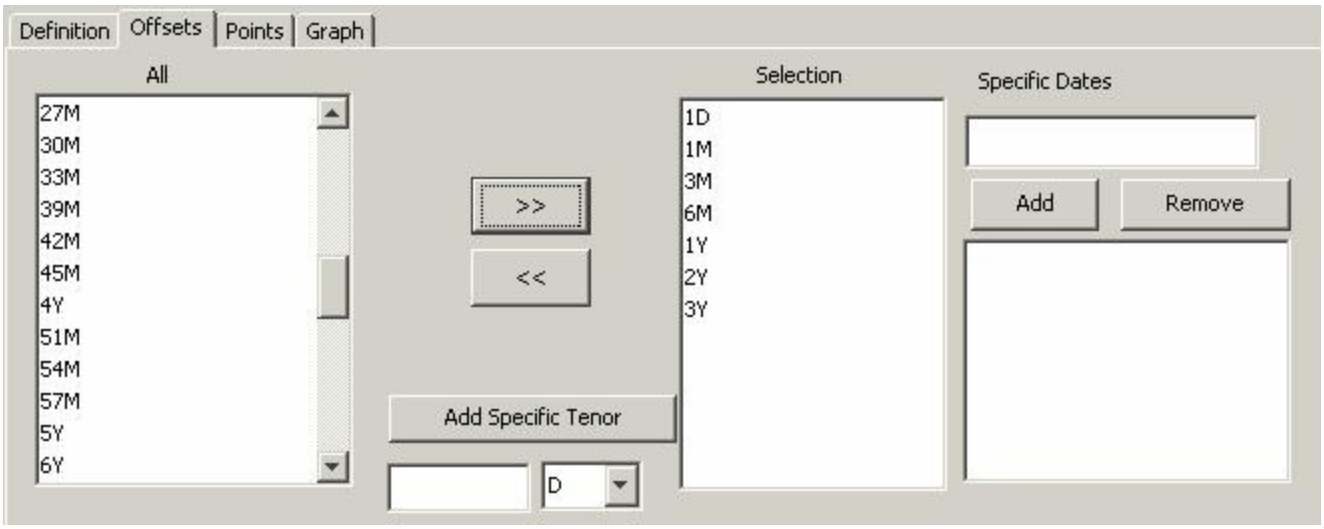
Select the following to define the curve: currency, index, tenor, holidays, “Generate from instruments” should be unchecked, interpolator, interpolation space, generation algorithm, curve type set to “CurveZero”, Pricing Env.



[NOTE: You can click ... next to the "Discount Curve" field to select a discount curve for retrieving the discount factors - The zero curve will only compute the forward points]

1.2.2 Offsets Panel

Click the Offset tab, and select tenors and dates.

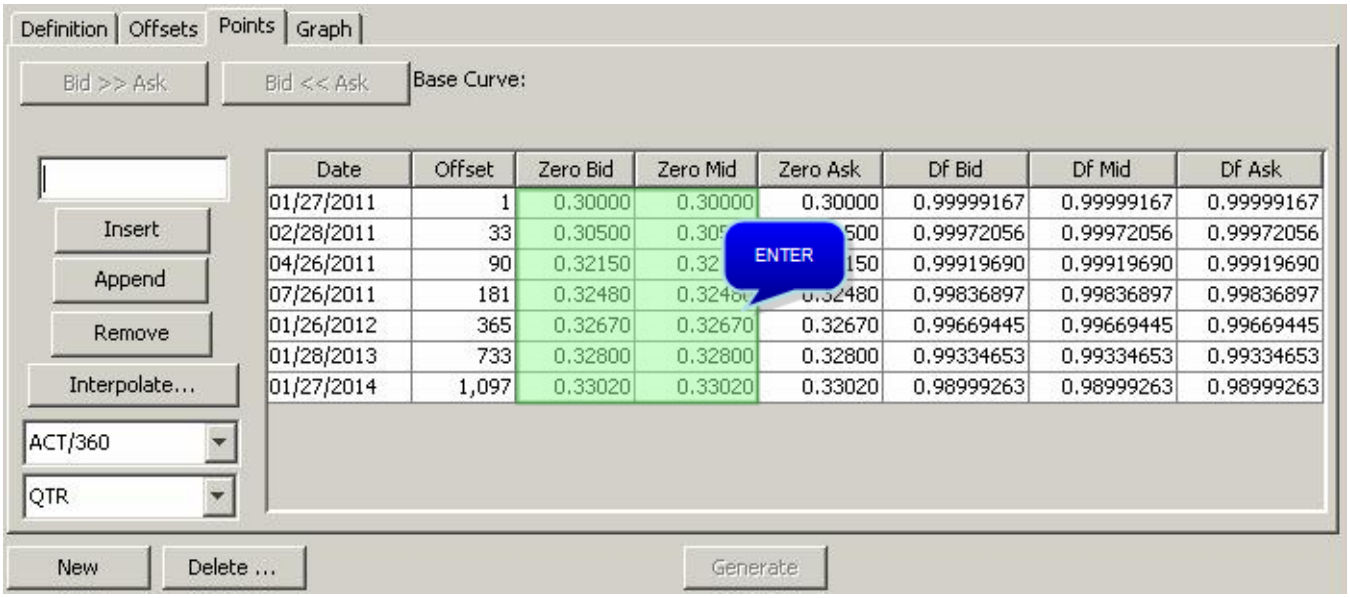


- Select the offsets in the left panel, and click **>>** to add them to the Selection panel.
- Specific Tenors - You can add specific tenors to the list. Enter the number, select the type of tenor, and click **Add Specific Tenor**.

» Specific Dates - Alternatively, you can enter specific dates for the offsets and click **Add** to list them in the panel below.

1.2.3 Points Panel

Click the Points tab, and click **Generate** to generate the point grid.



Date	Offset	Zero Bid	Zero Mid	Zero Ask	Df Bid	Df Mid	Df Ask
01/27/2011	1	0.30000	0.30000	0.30000	0.99999167	0.99999167	0.99999167
02/28/2011	33	0.30500	0.30	500	0.99972056	0.99972056	0.99972056
04/26/2011	90	0.32150	0.32	150	0.99919690	0.99919690	0.99919690
07/26/2011	181	0.32480	0.324	32480	0.99836897	0.99836897	0.99836897
01/26/2012	365	0.32670	0.32670	0.32670	0.99669445	0.99669445	0.99669445
01/28/2013	733	0.32800	0.32800	0.32800	0.99334653	0.99334653	0.99334653
01/27/2014	1,097	0.33020	0.33020	0.33020	0.98999263	0.98999263	0.98999263

» You can adjust the daycount and frequency as needed. The default values come from the selected rate index. You will be prompted to recalculate the zero rates or the discount factors.

» You can enter the zero rates manually, or copy and paste from an Excel spreadsheet.

1.2.4 Save Curve

Click **Save** at the bottom of the window to save the curve. You will be prompted to enter a curve name.

1.3 Generating Derived Zero Curves

Zero Curve from Underlying Instruments Quick Reference

Configuration Requirements

- Rate Index Definition – From the Calypso Navigator, navigate to **Configuration > Interest Rates > Rate Index Definitions**.

Curve Underlying Instruments

You can use the following types of underlying instruments for building zero curves: Money

Market, FRA, Future, Bond Future, Swap, Spread, Turn Rate, and Bond.

To define underlying instruments, navigate to **Configuration > Market Data > Curve Underlyings** from the Calypso Navigator, or click **New/Edit Underlying** in the Underlying panel of the Curve window.

Curve Generation

1. Click **New** to start a new curve.
2. Select the curve instance.
3. Definition Panel — Select the following information to define the curve: currency, index, tenor, “Generate from instruments” should be checked, interpolator, interpolation space, generation algorithm, curve type set to “CurveZero”, Pricing Env.
4. Underlying Panel — Select the underlying instruments.
5. Quotes Panel / Resets Panel — Enter / load quotes.
6. Points Panel — Click **Generate** to generate the points.
7. Click **Save**, and enter a curve name.

Pricer Configuration

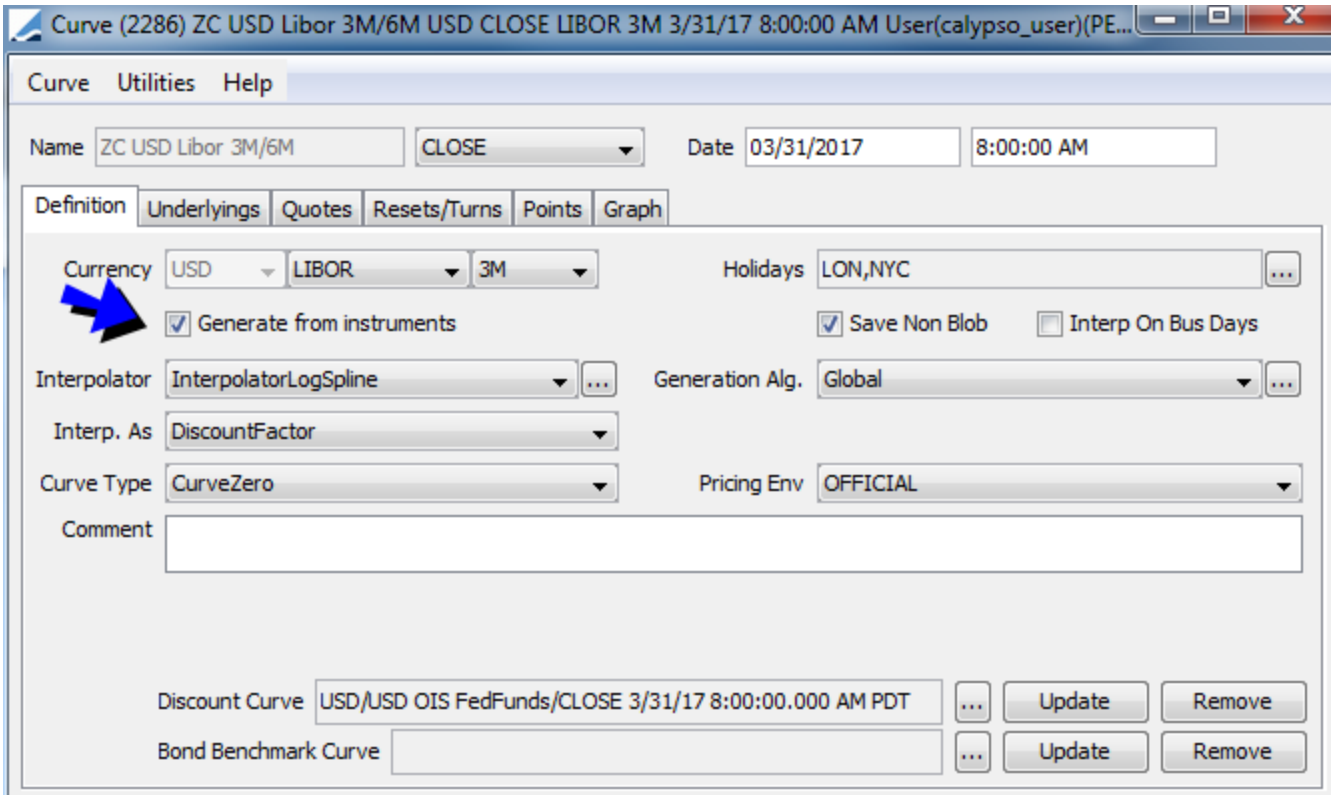
Assign the zero curve as a discount curve and/or forecast curve.

1.3.1 Definition Panel

Click **New** to start a new curve.

Select the following to define the curve: currency, index, tenor, holidays, “Generate from instruments” should be checked, interpolator, interpolation space, generation algorithm, curve type set to “CurveZero”, Pricing Env.

[NOTE: When a holiday calendar is set on the underlying instrument, the curve holiday calendar is ignored]



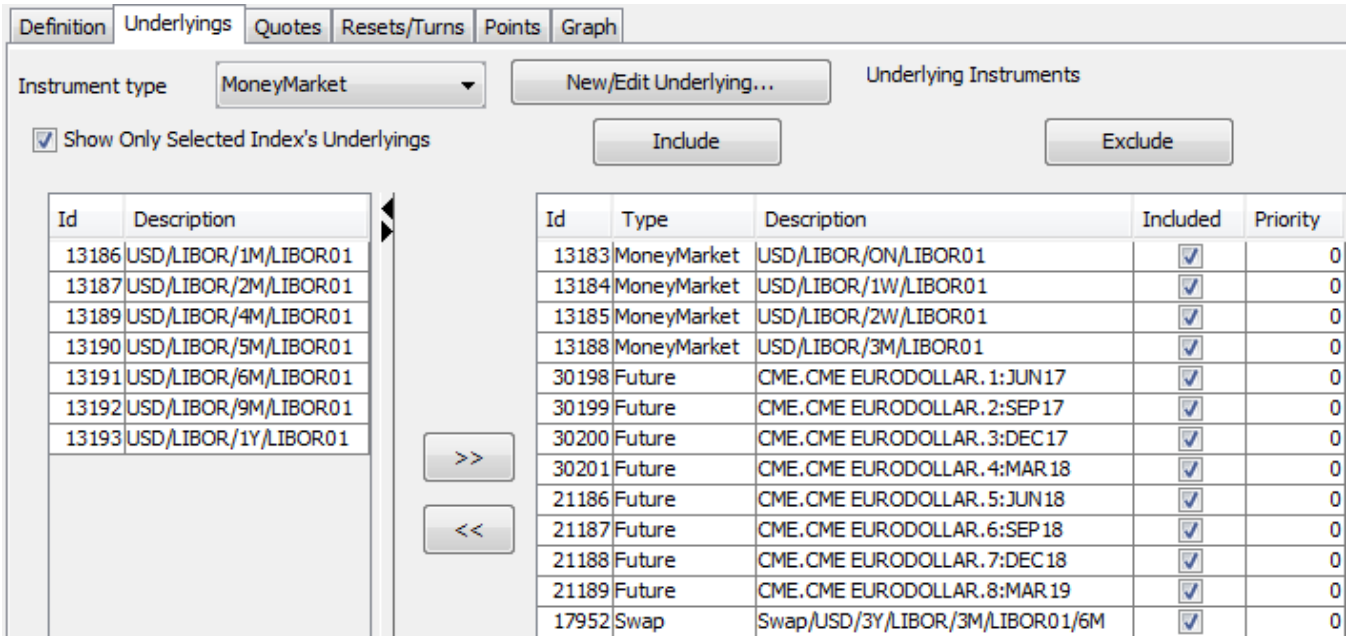
[NOTE: You can click ... next to the "Discount Curve" field to select a discount curve for retrieving the discount factors - The zero curve will only compute the forward points, and the discount curve will be used for discounting]

The generation algorithms are described in the *Calypso Yield Curves Generation* guide.

[NOTE: The yield curve generator BootstrapISDA replicates the ISDA C code discount factors to within 1.0e-9. With this curve generator, comparison with Markit is identical to 1 dollar. Because of rounding of cents may be different, sometimes Calypso results will round opposite to Markit and be off by Markit by 1 dollar, but usually the rounding is to the same number]

1.3.2 Underlying Panel

Click the Underlying tab, and select the underlying instruments.



» Select an instrument type to display the list of available instruments. If none appear, you can click **New/Edit Underlying** to create new instruments.

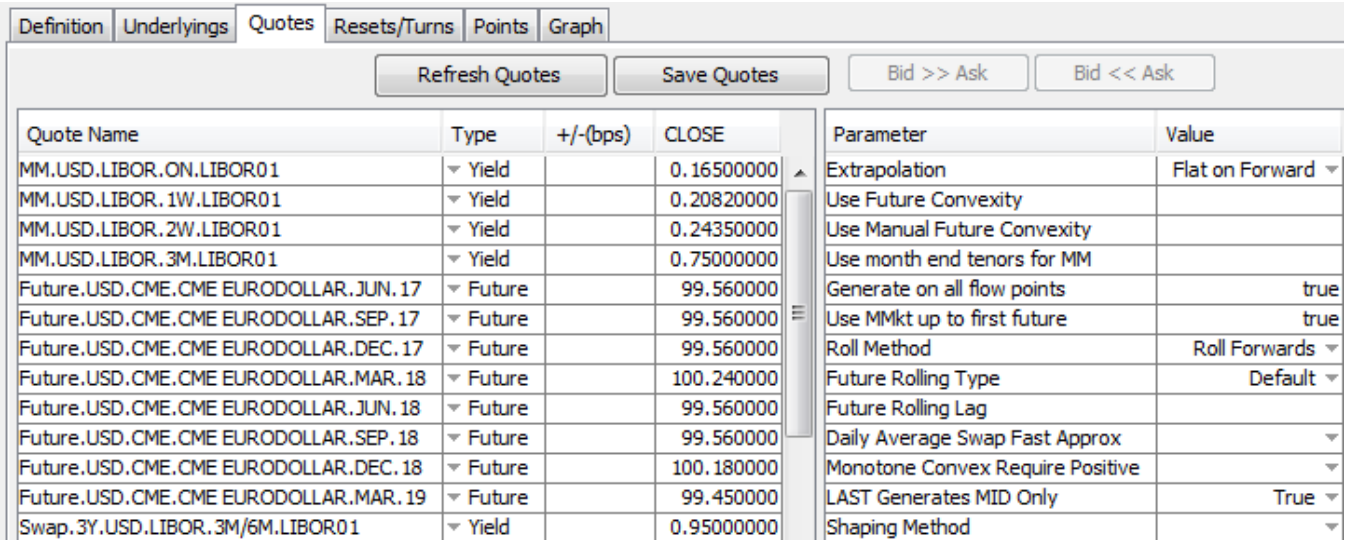
» Select instruments from the list of available instruments on the left-hand side, and click **>>** to add them to the list of selected instruments on the right-hand side.

You can exclude instruments from the curve generation if they are no longer needed.

You can set a priority when multiple instruments have the same maturity date. The lowest priority is 0. When two underlying instruments have the same end date, the one with the lowest priority is automatically removed, if the priority is set.

1.3.3 Quotes Panel

Click the Quotes tab.



» You can click **Refresh Quotes** to load the quotes from the pricing environment selected in the Definition panel. If your market data server is running, quotes will be updated in real-time.

» You can also enter the quotes manually, and save them to the pricing environment.

Quotes Parameters Details

Parameter	Description
Extrapolation	Select the method to extrapolate points outside of the curve. • Flat on Zero - The last known zero rate is kept constant • Flat on Forward - The last known forward rate is kept constant
Use Future Convexity	If set to True, the system uses a RATE volatility surface to compute the convexity adjustments when you generate the curve points. ▶ See Generating Zero Curves with Convexity Adjustments for details.
Use Manual Future Convexity	Set to True to manually set the convexity adjustment for futures. Another option is to set the environment property USE_QUOTE_ADJUSTMENT to False, and set specific spread quotes for the convexity adjustments. ▶ See Generating Zero Curves with Convexity Adjustments for details.
Use month end tenors for MM	If set to True, the following rules are applied in the curve generation: • If a swap underlying starts on the last business day of a month, we set the END_MONTH period rule on the swap. This is NOT applied if the underlying swap PeriodRule is “Unadjusted” or “Mat Unadjusted.” • If period rule is “Unadjusted,” end month date roll is not used. • If period rule is “Mat Unadjusted,” maturity date is not adjusted, but end month date roll

Parameter	Description
	is used to generate other payment dates. The default value is False.
Generate on all flow points	Set to True to generate curve points for each flow date of multi-period instruments, such as swaps.
Use MMkt up to first future	If set to True, money markets instruments with a maturity date after the first available future instrument, are not used in curve generation. The default value is False.
Roll Method	You can select the roll method. For example, you create a curve instance on T0. On T1 you price a trade. • Roll Forwards - Forward rates are unchanged between any two dates. In particular, when pricing on T1, the discount factor for pricing a cashflow is the same as the discount factor between T1 and T0 when obtained from the T0 curve. • Roll Points - Curve points are rolled forward when pricing. The points are the same on T1 as on T0. • Regenerate - Curve points are regenerated when rolled. The points are regenerated on T1 using quotes from T0.
Future Rolling Type Future Rolling Lag	You can select the rolling method for futures: • Default – Futures are rolled the day before the expiry day. • Last Trading Day – Futures are rolled on the last trading day. • Lag Days – Futures are rolled based on a user-defined number of days before the expiry day. Enter the number of days in Future Rolling Lag. ⓘ **[NOTE: This functionality is also compatible with FRA underlyings created from Date Rules. The default behavior for date-rule driven FRA underlyings is that they roll 1 day prior to expiry. You can use these parameters to specify a number of days the FRA underlyings roll before the expiry defined in the date rule.]**
Daily Average Swap Fast Approx	When True, a fast approximation is used when generating a curve with daily averaging MM futures (e.g. FedFunds futures). When False, the curve is calibrated exactly to the daily average MM futures. In case 1, performance is better than in case 2. In case 2, round-trip pricing of daily average MM futures is better than in case 1.
Use FX Reset	Only available when the generator is BasisGlobal. Indicates whether the Spot Alternative FX reset should be used instead of the FX spot rate. The generator parameter value will be False by default to retain current functionality.

Parameter	Description
	When set to True: • The generator will require an FX reset for the given currency pair whose FX Rate Definition has the "Spot Alternative" checkbox selected. • The Spot Alternative quote name for the FX Reset will appear in the Resets/Turns tab of the curve. • If a Spot Alternative FX reset for the given currency pair is not defined, the generator will throw an error and require the user to define the FX reset before generating the curve. ▶ For more details on Spot Alternative, see Defining FX Rate Fixings in the Calypso *Getting Started* documentation.

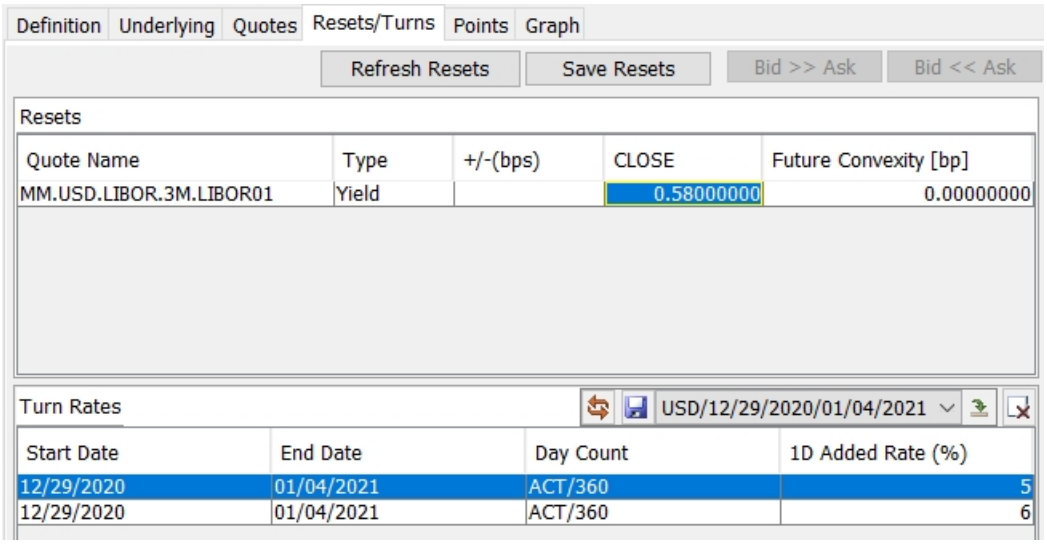
▶ The other parameters apply to the Global generator and are described in details in the *Calypso Yield Curve Generation* guide.

Resets Panel

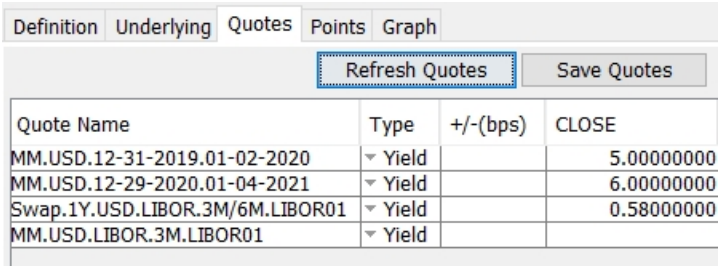
You can choose **Curve > Show Reset/Turn Tab** to display / hide the Resets/turns panel.

The Resets area panel shows manual resets requirements for underlying instruments (cash quotes associated with a given underlying instrument). This applies when "Manual First Reset" is checked in the definition of the underlying instrument.

In the Turn Rates area, you can select turn rates that you have defined as underlying instruments and click  to associate them with the curve. Then you can set the quotes and save.

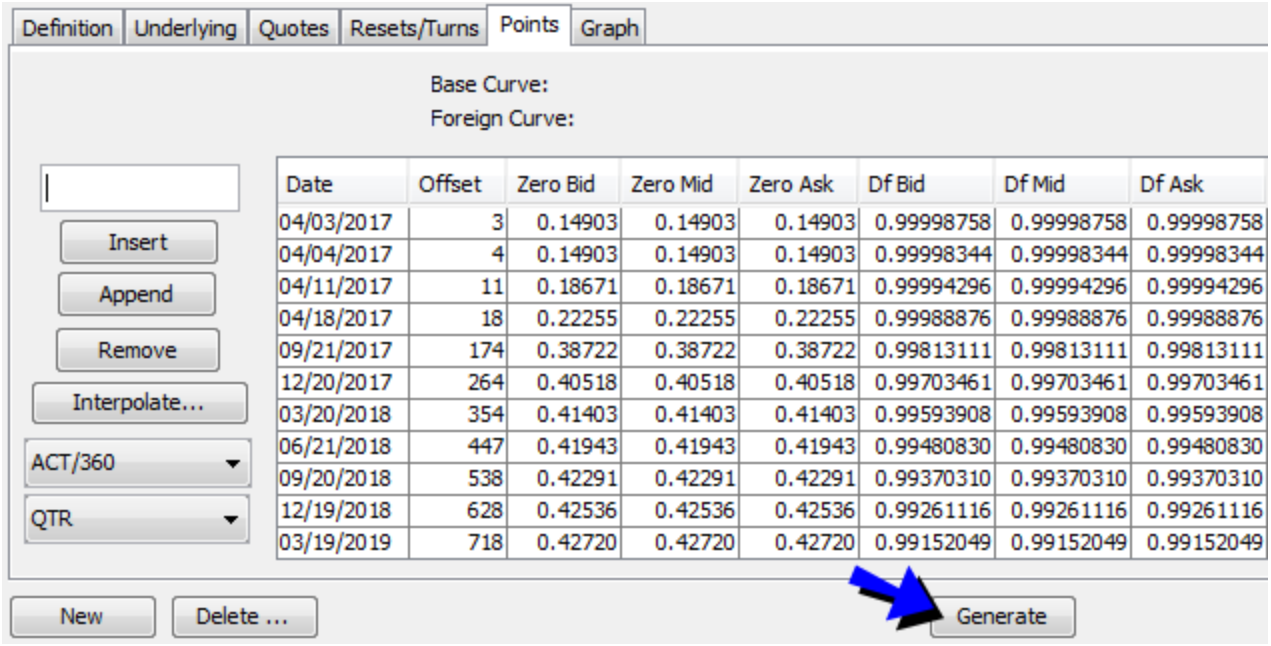


[NOTE: If you hide the Resets/Turns panel, the required quotes are displayed in the Underlying panel, along with the quotes of the underlying instruments - For Turn Rates however, you need to use the Resets/Turns panel to associate them with the curve]



1.3.4 Points Panel

Click the Points tab. Click **Generate** to view the generated zero rates and discount factors.



- You can adjust the daycount and frequency as needed. The default values come from the selected rate index. You will be prompted to recalculate the zero rates or the discount factors.
- You can modify the zero rates and discount factors.

1.3.5 Save Curve

Click **Save** at the bottom of the window to save the curve. You will be prompted to enter a curve name.

1.4 Generating Blended Zero Curves

Blended zero curves can be used for collateral pricing.

Collateral pricing is the ability to select the discount curve based on the collateral agreement's collateral policy instead of the trade currency.

Blended Zero Curve Quick Reference

You can build a cheapest-to-deliver collateral curve by blending up to three other collateral discount curves.

Curve Generation

1. Click **New** to start a new curve.

2. Definition Panel — Select the generation algorithm "CTDCollateral", and select the discount curves.

All the curves must be defined with the same currency but each curve can have underlying instruments in another currency.

3. Click **Generate** to generate the points.

4. Click **Save**, and enter a curve name.

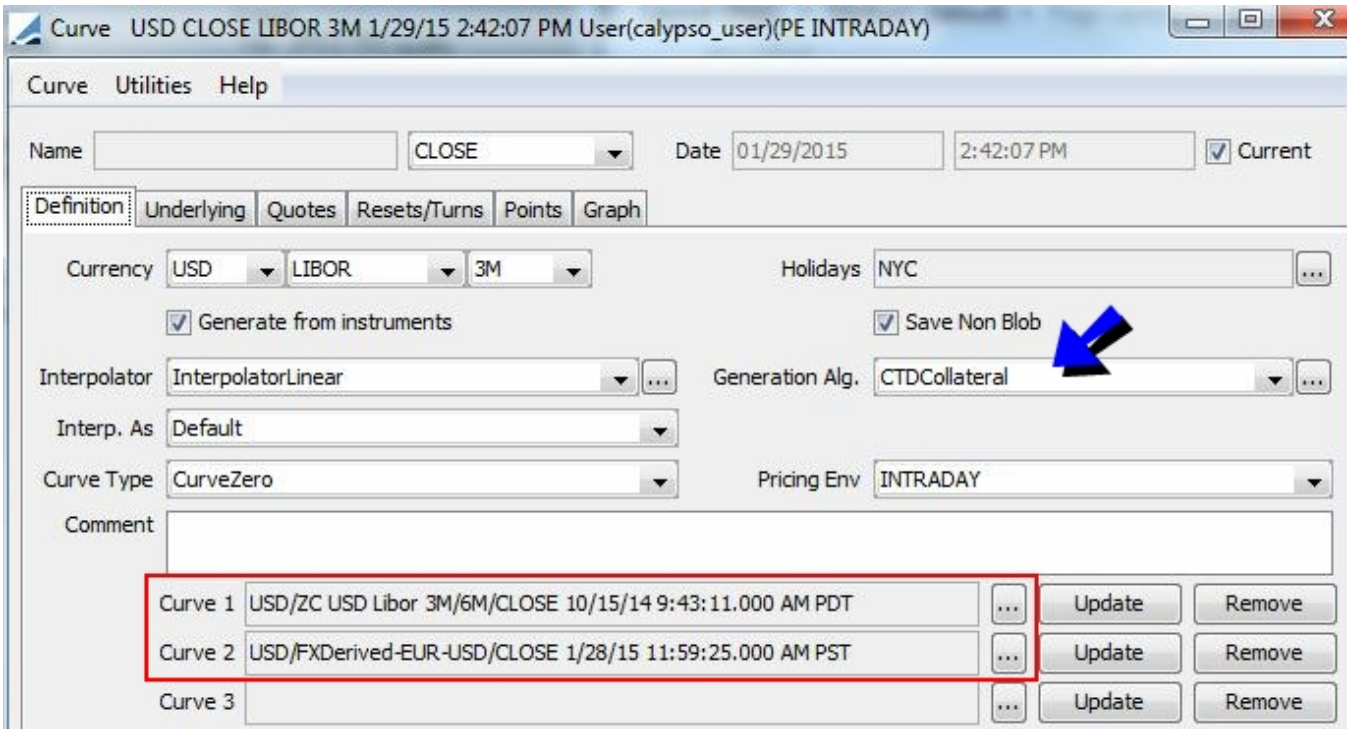
Pricer Configuration

Assign the zero curve as a discount curve with the appropriate collateral policy.

1.4.1 Definition Panel

Click **New** to start a new curve.

Select the following to define the curve: currency, index, tenor, holidays, “Generate from instruments”, interpolator, interpolation space, generation algorithm "CTDCollateral", curve type set to “CurveZero”, Pricing Env.



» Select Curve 1, Curve 2, and optionally Curve 3.

All the curves must be defined with the same currency but each curve can have underlying instruments in another currency.

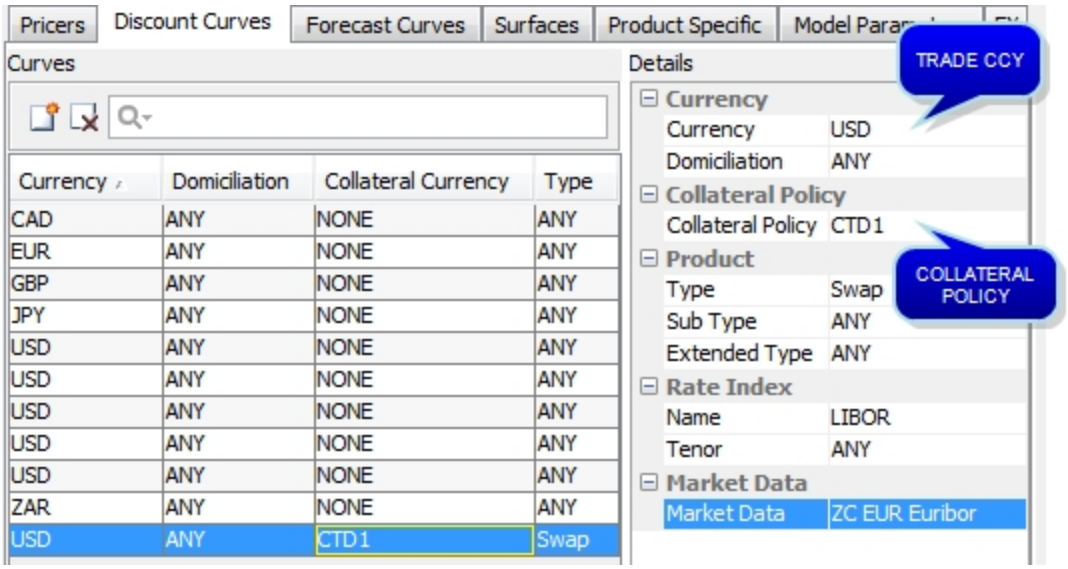
» Click **Generate** to generate the curve.

1.4.2 Save Curve

Click **Save** at the bottom of the window to save the curve. You will be prompted to enter a curve name.

1.4.3 Pricer Configuration

In the Discount Curves panel, select the trade currency, the collateral policy, and the other criteria as needed.



▶ Please refer to Calypso Collateral Pricing (Trade CSA) for complete setup details.

1.5 Generating Zero Curves with Convexity Adjustments

Zero Curve with Convexity Adjustments Quick Reference

You can perform convexity adjustment using one of the following methods:

- Load convexity adjustment values from a RATE volatility surface
- Manually set convexity adjustment values
- Use convexity spread quotes

These methods are described below in details.

Curve Generation

1. Generate a derived curve.

▶ See Generating Derived Zero Curves for details.

2. In the Quotes panel, select the type of convexity adjustment you want to perform, and enter / load the convexity adjustment values.

3. Click **Save**, and enter a name for the curve.

Pricer Configuration

Assign the zero curve as a discount/forecast curve.

1.5.1 Quotes Panel

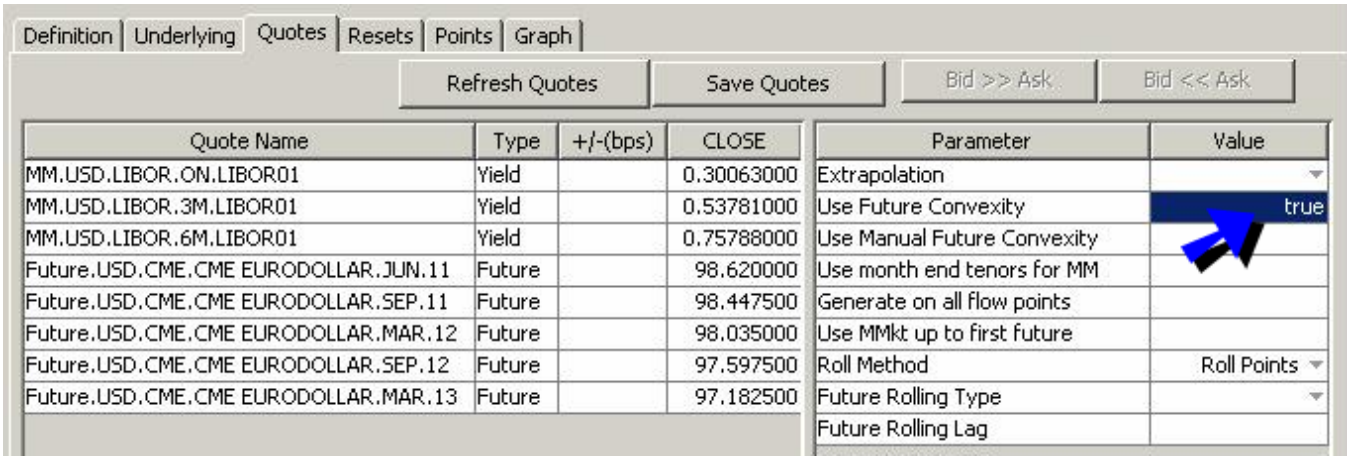
After you have defined a derived zero curve that contains future underlyings, click the Quotes tab. You can perform convexity adjustment using one of the following methods.

Convexity Adjustments from RATE Volatility Surface

Create a volatility surface for Future MM volatilities. The volatility surface may be a simple surface from offsets, using Black volatilities or basis point volatilities. From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface**.

Register the volatility surface in the Pricer Configuration - Product Specific panel using PricerFutureMM and/or PricerFutureOptionMM and the FUT_CONVEXITY usage.

In the Quotes panel, of the zero cuve, set the following parameter.



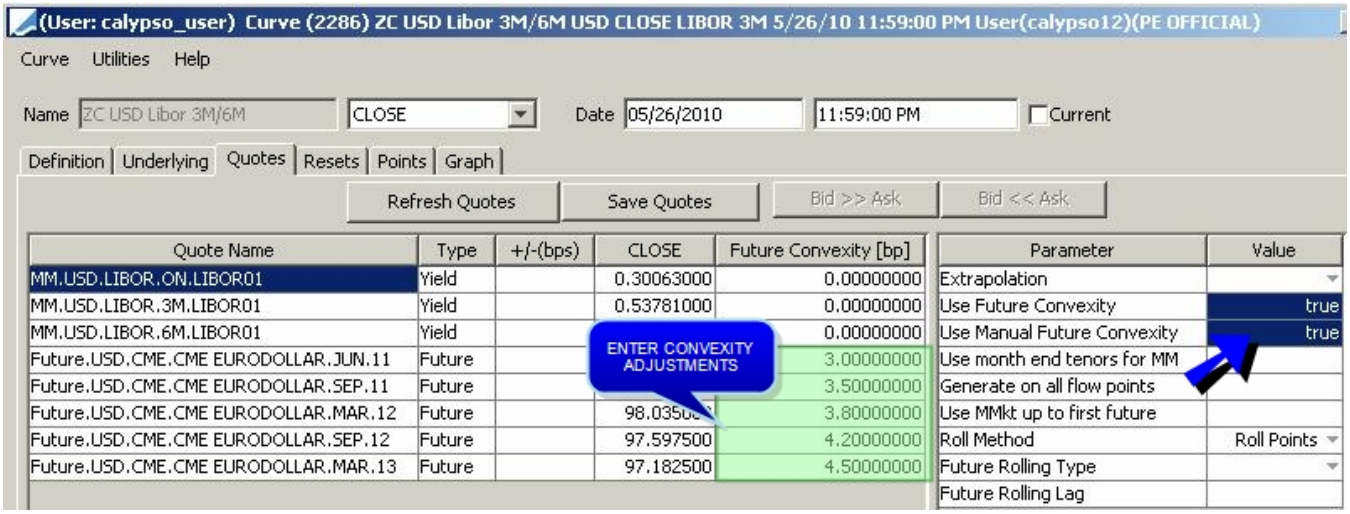
» Set the parameter “Use Future Convexity” to True. The system will use the assigned volatility surface to compute the convexity adjustments when you generate the curve points. You can see the convexity quotes in the Points panel.

Quotes | Resets | Points | Graph

Base Curve:

Date	Offset	Zero Bid	Zero Mid	Zero Ask	Df Bid	Df Mid	Df Ask	ConvexityBid	ConvexityMid
05/27/2010	1	0.30074	0.30074	0.30074	0.99999165	0.99999165	0.99999165	0.00000000	0.00000000
05/28/2010	2	0.30074	0.30074	0.30074	0.99998330	0.99998330	0.99998330	0.00000000	0.00000000
08/31/2010	97	0.53290	0.53290	0.53290	0.99856611	0.99856611	0.99856611	0.00000000	0.00000000
11/29/2010	187	0.75224	0.75224	0.75224	0.99610381	0.99610381	0.99610381	0.00000000	0.00000000
06/15/2011	385	0.87387	0.87387	0.87387	0.99070810	0.99070810	0.99070810	0.00000000	0.00000000
09/15/2011	477	0.97019	0.97019	0.97019	0.98724257	0.98724257	0.98724257	-0.63982753	-0.63982753
09/21/2011	483	0.97520	0.97520	0.97520	0.98701698	0.98701698	0.98701698	-0.63982753	-0.63982753
12/21/2011	574	1.06501	1.06501	1.06501	0.98318456	0.98318456	0.98318456	-1.04481070	-1.04481070
03/21/2012	665	1.13025	1.13025	1.13025	0.97936702	0.97936702	0.97936702	-1.04481070	-1.04481070
06/21/2012	757	1.22894	1.22894	1.22894	0.97452773	0.97452773	0.97452773	-2.18694851	-2.18694851
09/19/2012	847	1.30476	1.30476	1.30476	0.96981678	0.96981678	0.96981678	-2.18694851	-2.18694851
12/19/2012	938	1.40736	1.40736	1.40736	0.96405673	0.96405673	0.96405673	-3.88394001	-3.88394001
03/20/2013	1,029	1.49183	1.49183	1.49183	0.95833089	0.95833089	0.95833089	-3.88394001	-3.88394001
06/20/2013	1,121	1.59551	1.59551	1.59551	0.95162552	0.95162552	0.95162552	-6.02820812	-6.02820812

Manual Convexity Adjustments



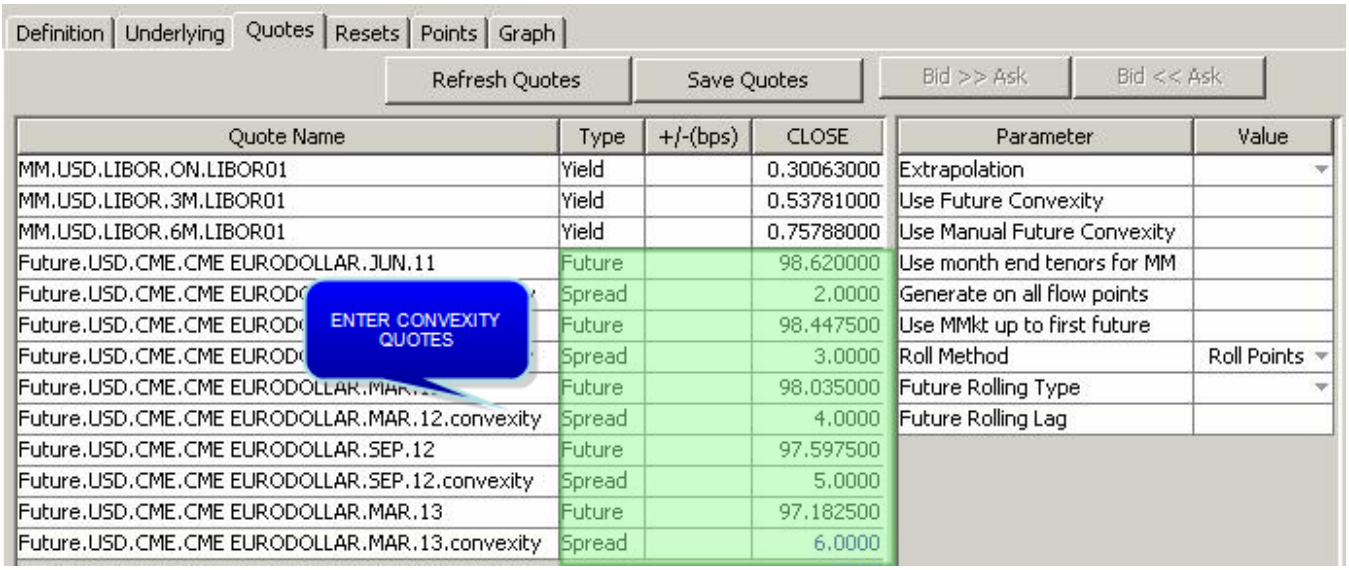
- Set the parameters “Use Future Convexity” AND “Use Manual Future Convexity" to true.
- Enter the future convexity adjustments in the field "Future Convexity". When you generate the curve, you can view the convexity quotes in the points panel.

Convexity Adjustments from Spread Quotes

You can also elect to directly enter the convexity quotes.

Set the environment property "USE_QUOTE_ADJUSTMENT" to False (default is True).

The convexity quotes are created by appending ".convexity" to the future quotes, for example "Future.USD.CME.EURODOLLLAR.DEC.06.convexity", and the quote type is a Spread expressed in basis points.



» Enter / load the convexity quotes.

1.5.2 Save Curve

Click **Save** at the bottom of the window to save the curve. You will be prompted to enter a curve name.

1.6 Generating Agency Option Adjusted Spread Curves

Agency Option Adjusted Spread (AOAS) curves are used to price European callable bonds.

AOAS Curve Quick Reference

Configuration Requirements

- Rate Index Definition – From the Calypso Navigator, navigate to **Configuration > Interest Rates > Rate Index Definitions**.

Curve Generation

1. Click **New** to start a new curve.

2. Definition Panel — Select the following information to define the curve: currency, index, tenor, holidays, "Generate from instruments" should be checked, interpolator, interpolation space, generation algorithm set to "AgencyBootStrap", curve type set to "CurveZero", Pricing Env.

3. Offsets Panel — Select the tenors and dates.

4. Points Panel — Click **Generate** to generate the points. Enter the zero rates.

5. Click **Save**, and enter a curve name.

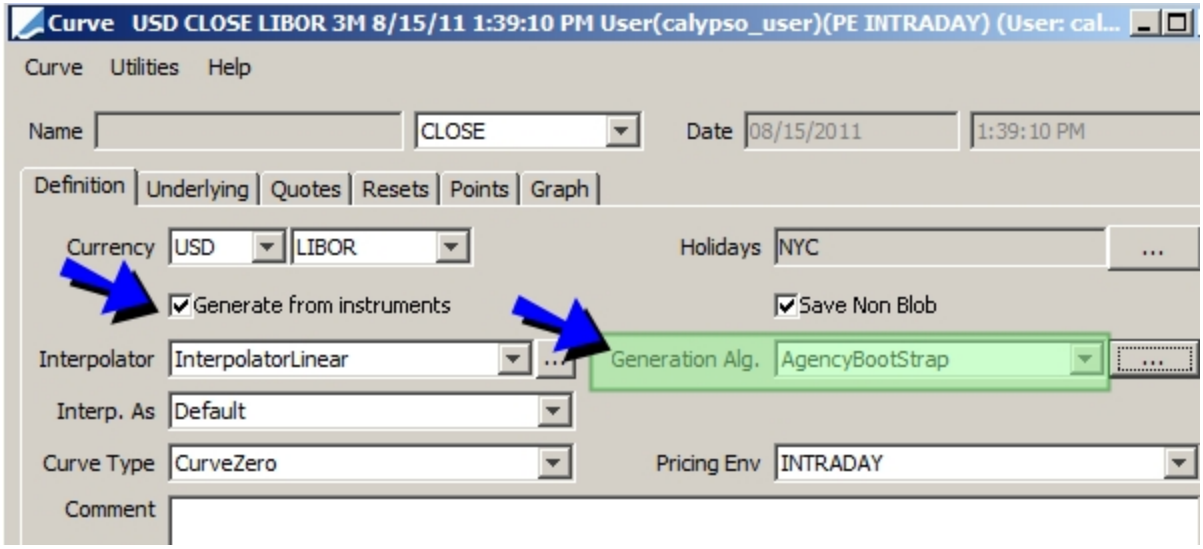
Pricer Configuration

Assign the AOAS curve as a forecast curve.

1.6.1 Definition Panel

Click **New** to start a new curve.

Select the following to define the curve: currency, index, tenor, holidays, “Generate from instruments” should be checked, interpolator, interpolation space, generation algorithm set to "AgencyBootStrap", curve type set to “CurveZero”, Pricing Env.

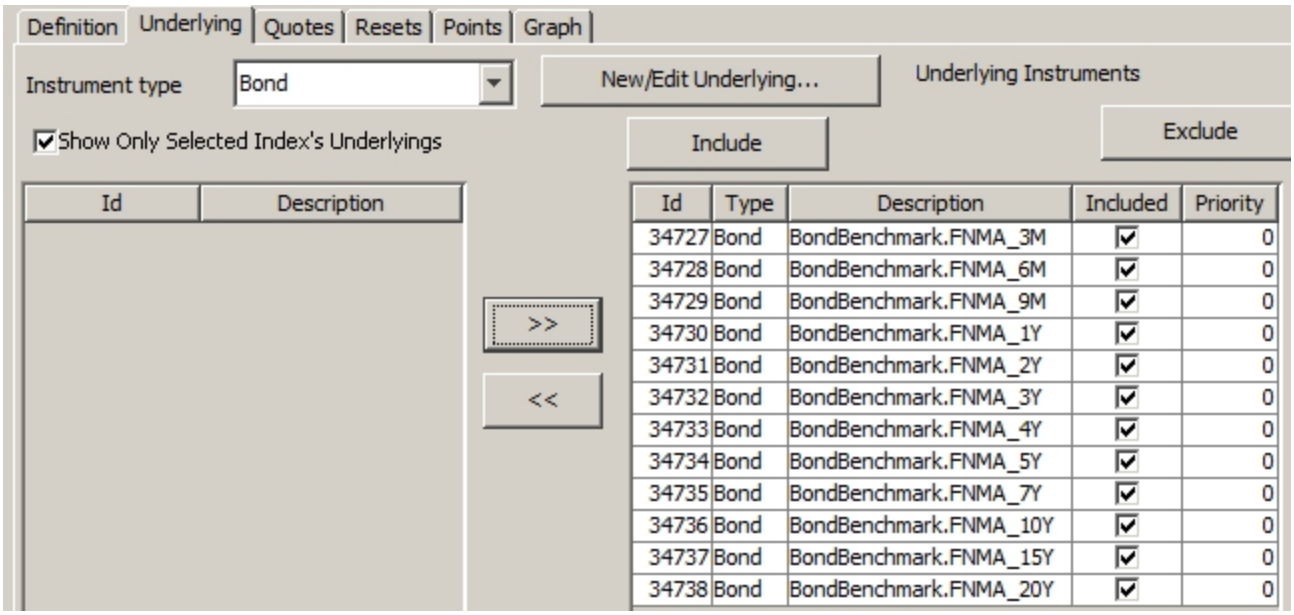


1.6.2 Underlying Panel

Click the Underlying tab, and select the underlying instruments: benchmark bonds.

Benchmark bonds are created using **Configuration > Fixed Income > Benchmarks** from the Calypso Navigator.

▶ Refer to Calypso Fixed Income documentation for information on creating benchmark bonds.



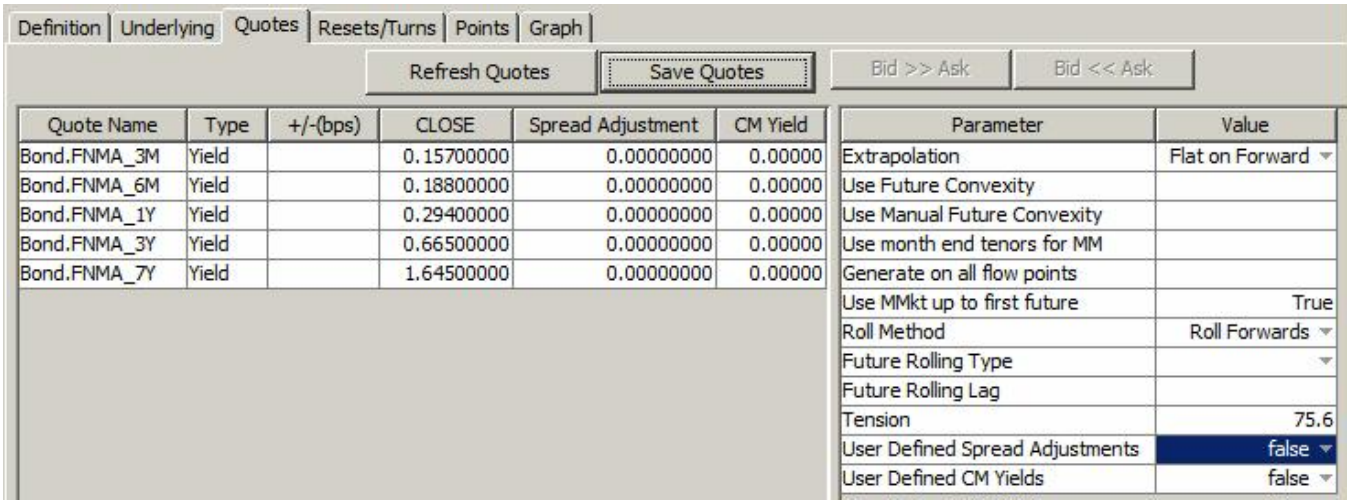
- Select instrument type "Bond" to display the list of available instruments. If none appear, you can click **New/Edit Underlying** to create new instruments.
- Select bond benchmarks from the list of available instruments on the left-hand side, and click **>>** to add them to the list of selected instruments on the right-hand side.

  You can exclude instruments from the curve generation if they are no longer needed.

  You can set a priority when multiple instruments have the same maturity date. The lowest priority is 0.

1.6.3 Quotes Panel

Click the Quotes tab.



- You can click **Refresh Quotes** to load the quotes from the pricing environment selected in the Definition panel. If your market data server is running, quotes will be updated in real-time.
- You can also enter the quotes manually, and save them to the pricing environment.

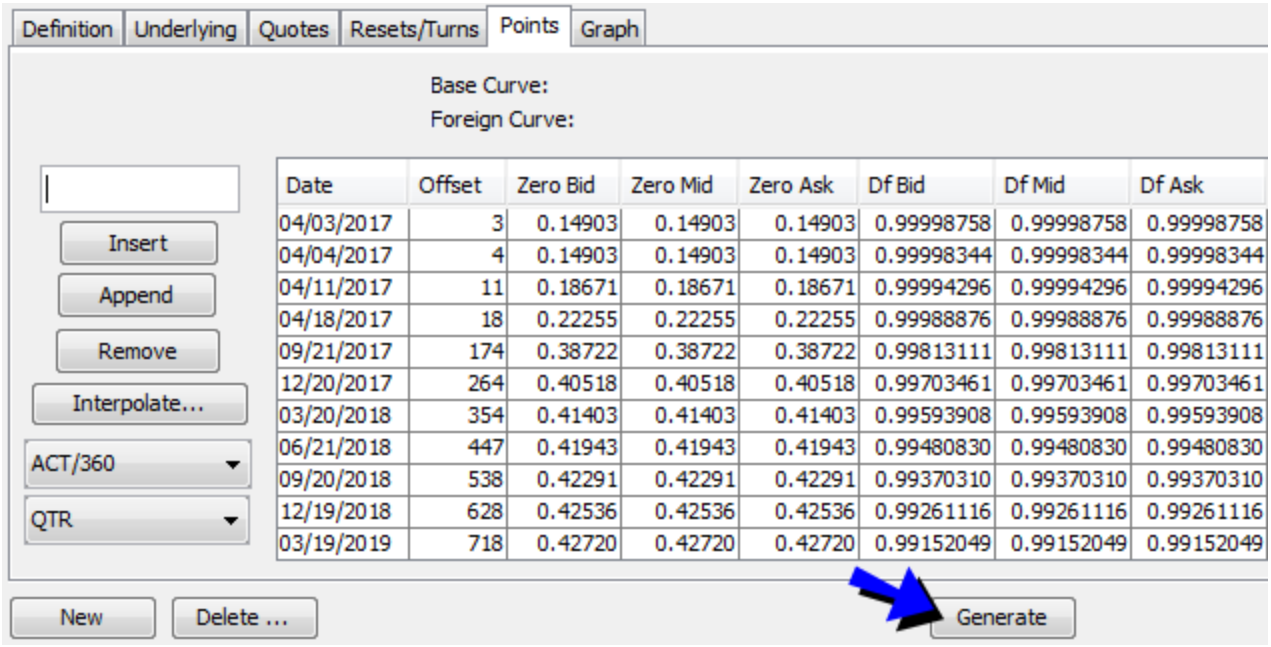
Quotes Parameters Details

▶ See Quotes Panel for details on the other parameters.

Parameter	Description
Tension	Should be set to "75.6" per SIFMA.
Use Defined Spread Adjustments	Set to True to enable the Spread Adjustments column in the Quotes panel.
User Defined CM Yields	Set to True to enable the Constant Maturity Yields column in the Quotes panel.

1.6.4 Points Panel

Click the Points tab. Click **Generate** to view the generated zero rates and discount factors.



Date	Offset	Zero Bid	Zero Mid	Zero Ask	Df Bid	Df Mid	Df Ask
04/03/2017	3	0.14903	0.14903	0.14903	0.99998758	0.99998758	0.99998758
04/04/2017	4	0.14903	0.14903	0.14903	0.99998344	0.99998344	0.99998344
04/11/2017	11	0.18671	0.18671	0.18671	0.99994296	0.99994296	0.99994296
04/18/2017	18	0.22255	0.22255	0.22255	0.99988876	0.99988876	0.99988876
09/21/2017	174	0.38722	0.38722	0.38722	0.99813111	0.99813111	0.99813111
12/20/2017	264	0.40518	0.40518	0.40518	0.99703461	0.99703461	0.99703461
03/20/2018	354	0.41403	0.41403	0.41403	0.99593908	0.99593908	0.99593908
06/21/2018	447	0.41943	0.41943	0.41943	0.99480830	0.99480830	0.99480830
09/20/2018	538	0.42291	0.42291	0.42291	0.99370310	0.99370310	0.99370310
12/19/2018	628	0.42536	0.42536	0.42536	0.99261116	0.99261116	0.99261116
03/19/2019	718	0.42720	0.42720	0.42720	0.99152049	0.99152049	0.99152049

- You can adjust the daycount and frequency as needed. The default values come from the selected rate index. You will be prompted to recalculate the zero rates or the discount factors.
- You can modify the zero rates and discount factors.

1.6.5 Save Curve

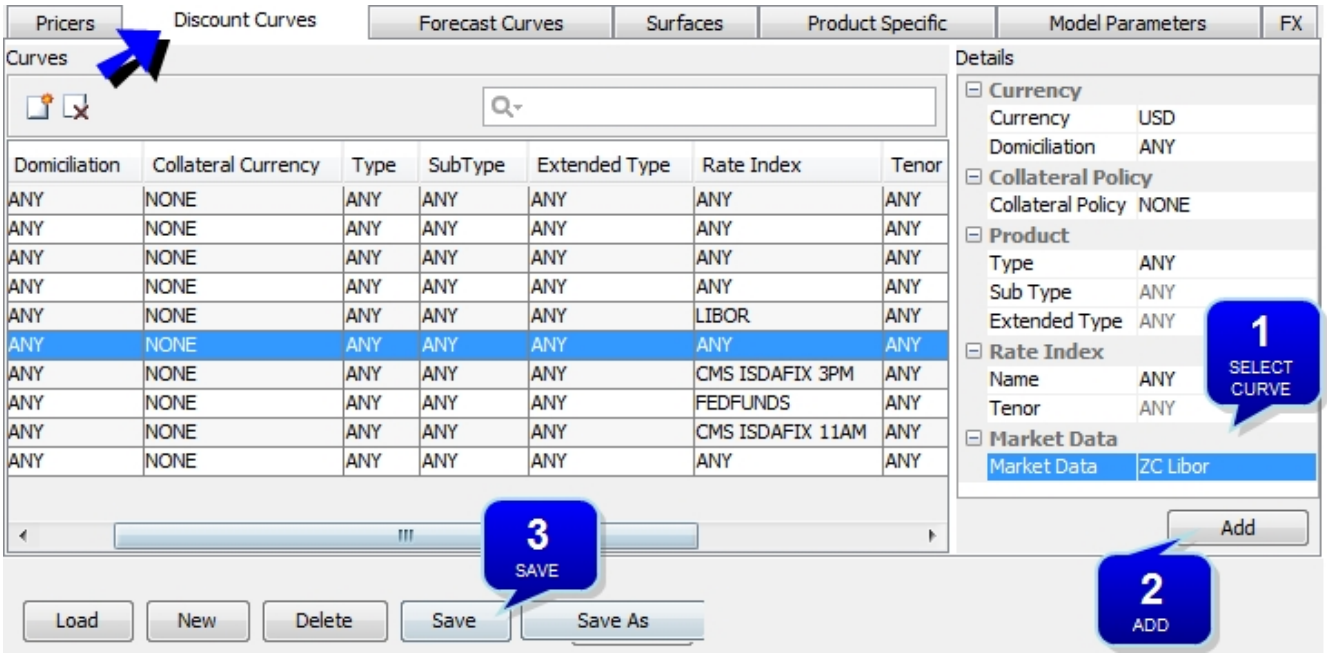
Click **Save** at the bottom of the window to save the curve. You will be prompted to enter a curve name.

1.7 Pricer Configuration

From the Calypso Navigator, navigate to **Market Data > Pricing Environment > Pricer Configuration**, and click **Load** to select a pricer configuration name.

1.7.1 Discount Curves

Click the "Discount Curves" tab.



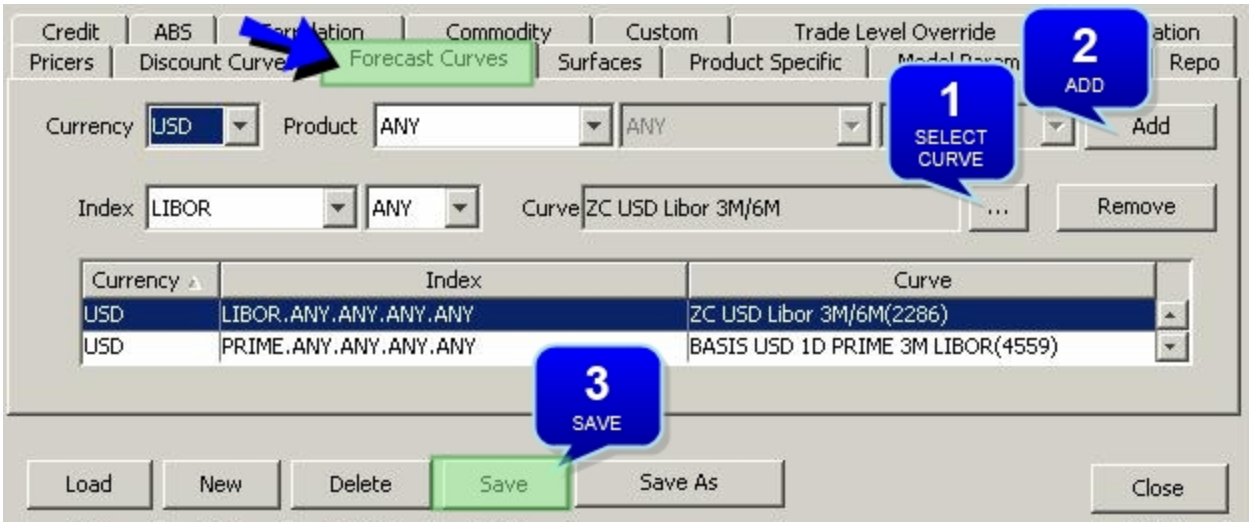
- Select the parameters for which the curve applies, and select the curve. The parameters are described below.
- Click **Add** to add the curve to the pricer configuration.
- Then click **Save** to save the pricer configuration.

Fields	Description
Currency	Select the currency for which the curve applies.
Domiciliation	Select the domiciliation for which the curve applies: • Onshore - Legal entity and currency specified as located inside the jurisdiction of its primary operations. Currency will link to a collateral currency.

Fields	Description
	• Offshore - Legal entity and currency specified as located outside the jurisdiction of its primary operations. Currency will link to a collateral currency. • ANY - Any domiciliation. The domiciliation is based on the book attribute "Domiciliation".
Collateral Policy	Select the collateral policy for which the curve applies if any, or select NONE otherwise. If the pricing parameter COLLATERALIZED_PRICING is set to true, the system checks if the trade is associated with a CSA agreement. If it is, the system uses the collateral policy of the CSA agreement to select the discount curve accordingly. If the collateral policy is not set on the CSA agreement, the trade currency is used to select the discount curve. If COLLATERALIZED_PRICING is set to false, the collateral policy is not used. ▶ Refer to Calypso Trade CSA documentation for more details.
Type	Select the product type for which the curve applies, or ANY.
Sub Type	Select the product subtype for which the curve applies, or ANY.
Extended Type	Select the extended type for which the curve applies, or ANY.
Rate Index	Select the rate index for which the curve applies, or ANY.
Tenor	Select the rate index tenor for which the curve applies, or ANY.
Market Data	Select the curve.

1.7.2 Forecast Curves

Click the "Forecast Curves" tab.



- Select a currency, a product or ANY, a subtype or ANY, an index, a tenor or ANY.
- Click **...** to select the curve.
- Click **Add** to add the curve to the pricer configuration.
- Click **Save** to save the pricer configuration.

Zero curves used for forecasting equity forward prices using non-linear pricers (for Equity Derivatives trades) may be mapped using the FWD_PRICE_FOR usage in the Product Specific panel of the pricer configuration.

2. Multi-curve Package

A multi-curve package allows creating a set of zero curves that are generated simultaneously using a multi-curve generator that generates and saves multiple curves at once.

The curves of a multi-curve package are always generated and saved together anywhere in the system where a zero curve is generated: pricing, risk analyses, the GENERATE_CURVE scheduled task, the market data manager, etc. However, they are associated to the pricer configuration independently.

To build a multi-curve package, you can either copy configurations from existing curves and rename them, or configure new curves for the package in the Multicurve Package Generation window itself.

[NOTE: The curves of a multi-curve package cannot be modified in the Curve window]

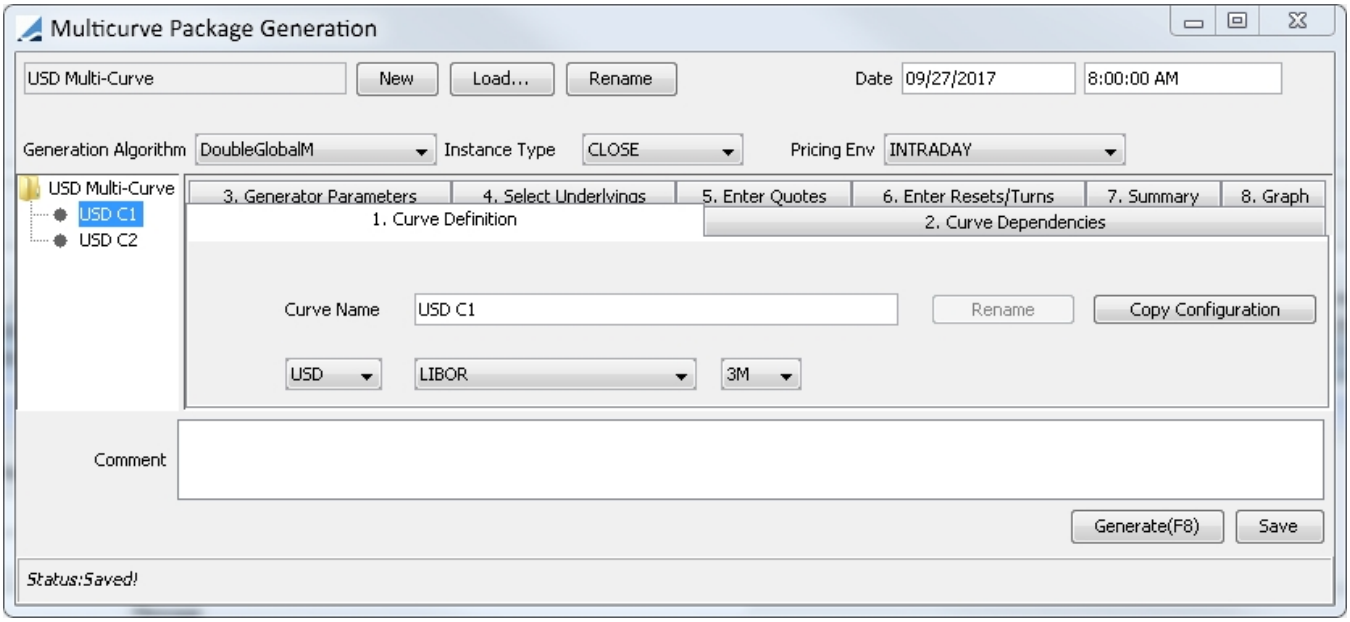
Before you begin

In addition to the access permissions related to market data, the following access permissions are required by the Multicurve window.

- CreateMulticurvePackage
- ModifyMulticurvePackage
- RemoveMulticurvePackage

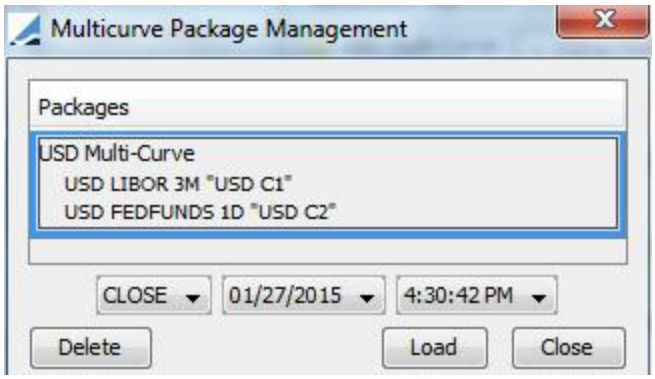
2.1 Defining a Multi-curve Package

From the Calypso Navigator, navigate to **Market Data > Multicurve Window** (menu action `marketdata.MultiCurvePackageGenerationWindow`) to define multi-curve packages.



» You can click **Load** to load an existing package.

The existing packages are displayed.



Select a package and click **Load**.

You can modify and generate the package as needed.

» To create a new package: Click **New** and enter the fields described below.

Then perform the following steps:

1. Select each curve under the Package Name label, and define it in the Curve Definition tab.
2. Define the dependency between the curves in the Curve Dependencies tab.
3. Define generator parameters for each curve as needed in the Generator Parameters tab.
4. Select underlying instruments for each curve in the Select Underlyings tab.
5. Enter / review quotes for each curve in the Enter Quotes tab.
6. Enter / review resets and turn rates as needed for each curve in the Enter Resets/Turns tab.
7. Click **Generate** to generate the curves. For a new package, you will be prompted to enter a package name.
   - You can view the package summary in the Summary tab.
   - You can click View for each curve to display the generated curve.
8. Click **Save** to save the package.

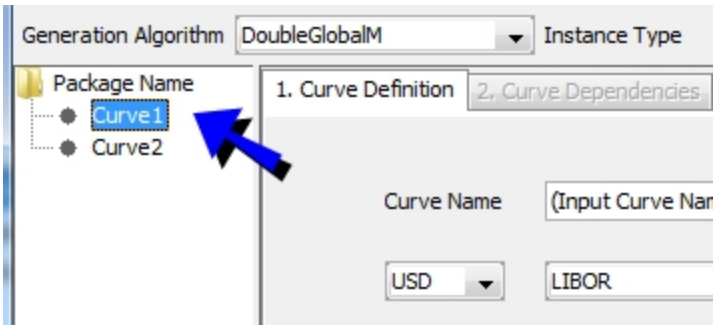
The steps are described below.

Package Definition

Parameter	Description
Current	By default, the curve is saved as of the current date and time. You can clear the Current checkbox and change the curve date and time as needed.
Generation Algorithm	Select a multi-curve generator. • "DoubleGlobalM" - Generates and saves both a discount curve and a forecast curve at once.

Parameter	Description
	• "TripleGlobal" - Generates three curves simultaneously for cross-currency swaps: two forward curves and one cross-currency curve. If the generator is not available for selection, please add it to the domain "MultiMDIGenerators". Make sure that this generator is also available in the domain for zero curve generators "CurveZero.gen".
Instance Type	Select the instance of the curve. It dictates the quote side of the underlying instruments to be used for generating the curve. • The CLOSE instance uses CLOSE quotes. • The LAST instance uses BID, MID, and ASK quotes. • The OPEN instance uses OPEN quotes.
Pricing Env	Select the Pricing Env to be used for retrieving market data.

Step 1 - Curve Definition tab - Select each curve under the Package Name label, and define it in the Curve Definition tab.



» Enter the curve name and the required information for each curve.

For new multi-curve packages, you can select the curve type: CurveZero or CurveBasis.

The CurveBasis acts as with a single curve, that is, it has one base curve over its entire length. You cannot have two basis curves where each has the other as base curve. There must always be a discount curve to spread from.

▶ See Generating Derived Zero Curves for details on zero curves.

▶ See Generating Basis Curves for details on basis curves.

» You can click **Copy Configuration** to copy the configuration from an existing curve. You will be prompted to select a curve.

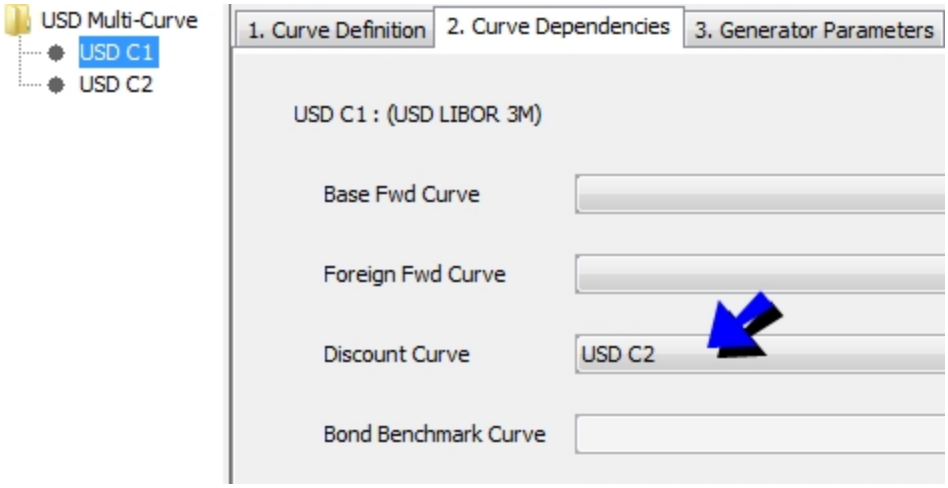
Step 2 - Curve Dependencies tab - Define the dependency between the curves in the package, or with curves outside of the package.

DoubleGlobalM Generator

For the DoubleGlobalM generator, the system generates and saves both a discount curve and a forecast curve.

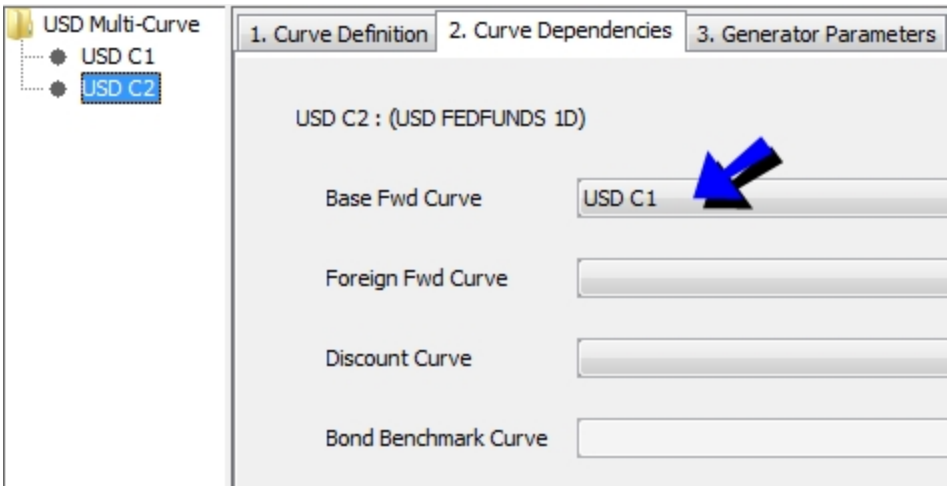
For the forecast curve, select the discount curve in the Discount Curve field. You can click ... to select a curve outside of the package.

You can also select a bond curve from the Bond Benchmark Curve field to be used with the SwapSpread curve underlying. The quote of the underlying (a spread) is added to the yield calculated from the bond curve and the benchmark bonds to get the swap quote.



For the discount curve, select the forecast curve in the Base Fwd Curve field. You can click ... to select a curve outside of the package.

[NOTE: Curves outside the package are NOT regenerated. They are only used by the package]



TripleGlobal Generator

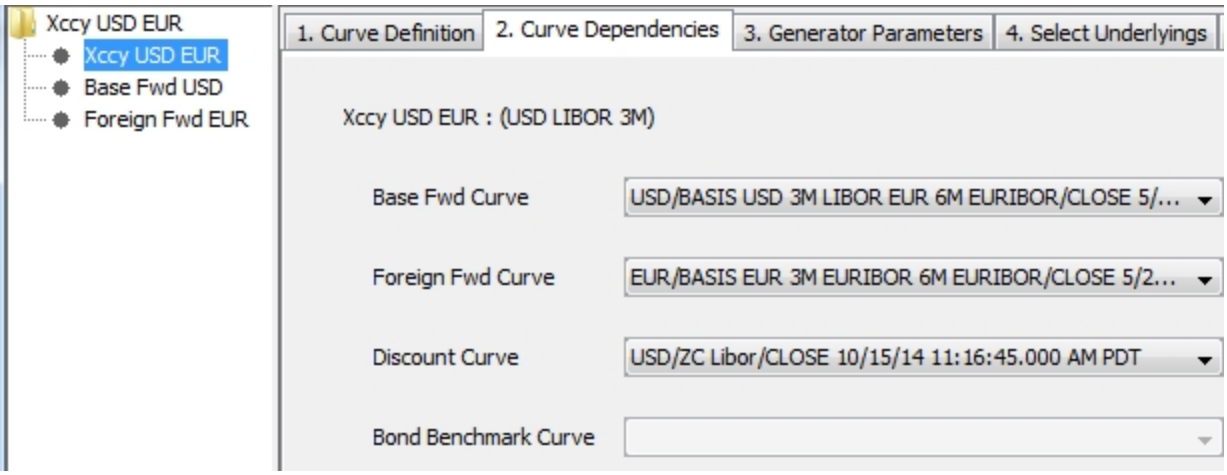
For the TripleGlobal generator, the system generates three curves simultaneously for cross-currency swaps: two forward curves and one cross-currency curve.

For the cross currency curve:

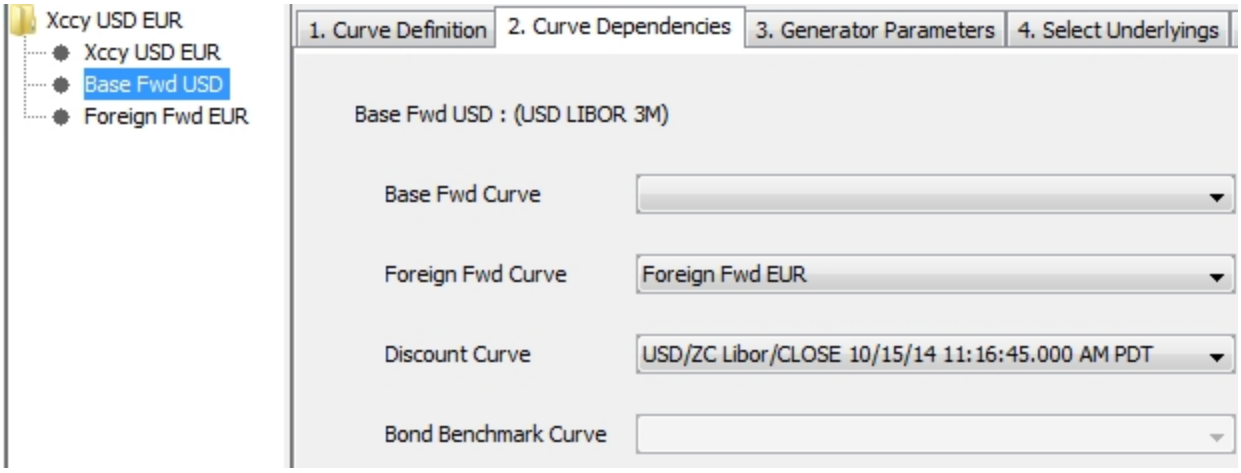
- Select a curve in base currency in the Base Fwd Curve field (it can be the forecast curve in base currency defined in the package).
- Select a curve in foreign currency in the Foreign Fwd Curve field (it can be the forecast curve in foreign currency defined in the package).
- Select a discount curve.

You can click ... to select a curve outside of the package.

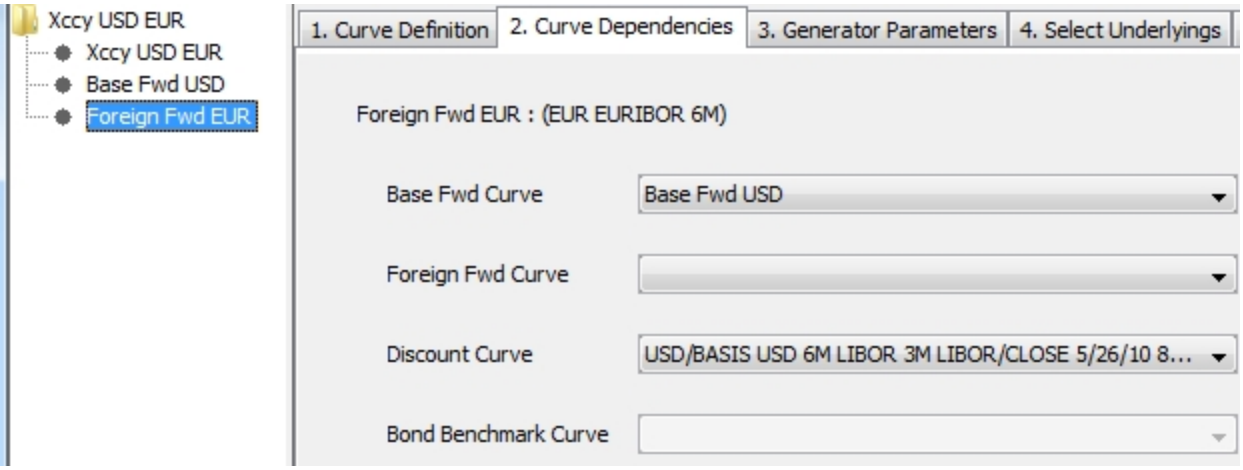
[NOTE: Curves outside the package are NOT regenerated. They are only used by the package]



For the forecast curve in base currency, select the forecast curve in foreign currency in the Foreign Fwd Curve field, and a discount curve in the Discount Curve field. You can click ... to select a curve outside of the package.



For the forecast curve in foreign currency, select the forecast curve in base currency in the Base Fwd Curve field, and a discount curve in the Discount Curve field. You can click ... to select a curve outside of the package.



Step 3 - Generator Parameters tab - Define generator parameters for each curve as needed.

- See Generating Derived Zero Curves for details on zero curves.
- See Generating Basis Curves for details on basis curves.

Only one curve in the package can use the shaping method "Daily Forwards Spread". Unlike for a single curve, in the multi-curve this spread method is computed for the entire curve (the "100Y" choice), regardless of the user's choice. Thus it cannot be applied to only parts of the curve, as it can in the single curve window.

Also, daily points are not stored on the curve. This decreases memory requirements of the curve and increases speed. Instead, the points seen on the curve will be the union of the maturity dates of the curve underlying and all the points calculated on the shaping curve (the curve to which the spreads are added). The shaping curve is specified by the generator parameter of that name, and has choices of Base and Discount.

Initial Guess Strategy (DoubleGlobalM Generator)

DoubleGlobalM generator generates two curves simultaneously, in two phases: in the initial guess phase, suitable trial curves are found for both curves, and in the optimization phase, the optimization algorithm is executed, using the trial curves from the initial phase as the initial guess.

This parameter adds flexibility to the initial guess phase. It can be set to: Single Trial Curve (default) or Distinct Trial Curves.

- Single Trial Curve - One single curve is bootstrapped and used as the initial trial curve for both curves in the package.
- The "Distinct Trial Curves" option introduces new behavior: two distinct trial curves are bootstrapped, one for each curve in the package. This option is not supported when the two curves in the package are Base Curve of

each other, in which case an exception is thrown, as this type of mutual dependency makes it impossible to bootstrap the curves independently of each other.

There is a performance trade-off between the 2 strategies:

- Single Trial Curve spends less time on the initial guess phase but since there is only one trial curve, it can happen that the initial guess is significantly off from the optimal curves, resulting in a longer optimization phase time.
- Distinct Trial Curves spends more time on the initial phase, but that will be partially offset by a faster optimization, since there is a good chance that the distinct trial curves are closer to the optimal curves than in the single curve case.

Step 4 - Select Underlyings tab- Select underlying instruments for each curve.

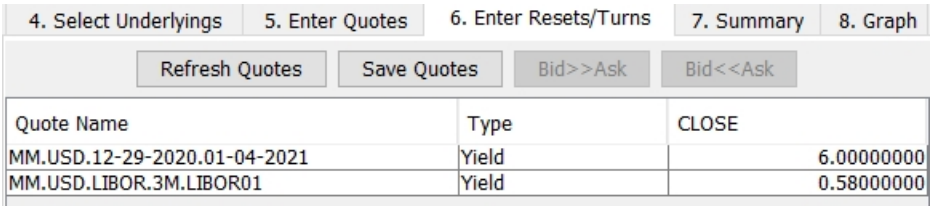
▶ See Generating Derived Zero Curves for details on zero curves.

▶ See Generating Basis Curves for details on basis curves.

TIP: To open any of the underlyings from the Select Underlyings tab, press Ctrl and double-click the underlying.

Step 5 - Enter Quotes tab - Enter / review quotes for each curve.

Step 6 - Enter Resets/Turns tab - Enter / review resets and turn rates for each curve as needed.

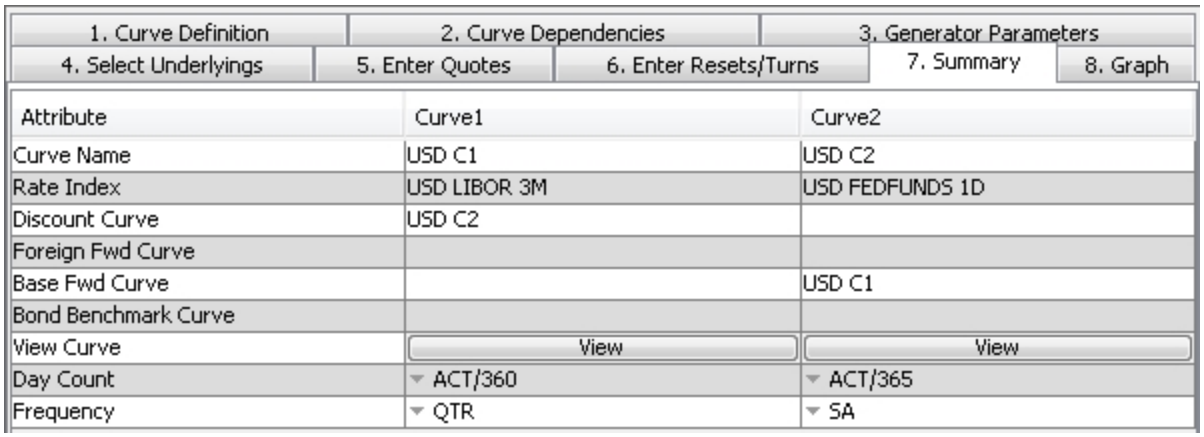


Step 7 - Generate the curves.

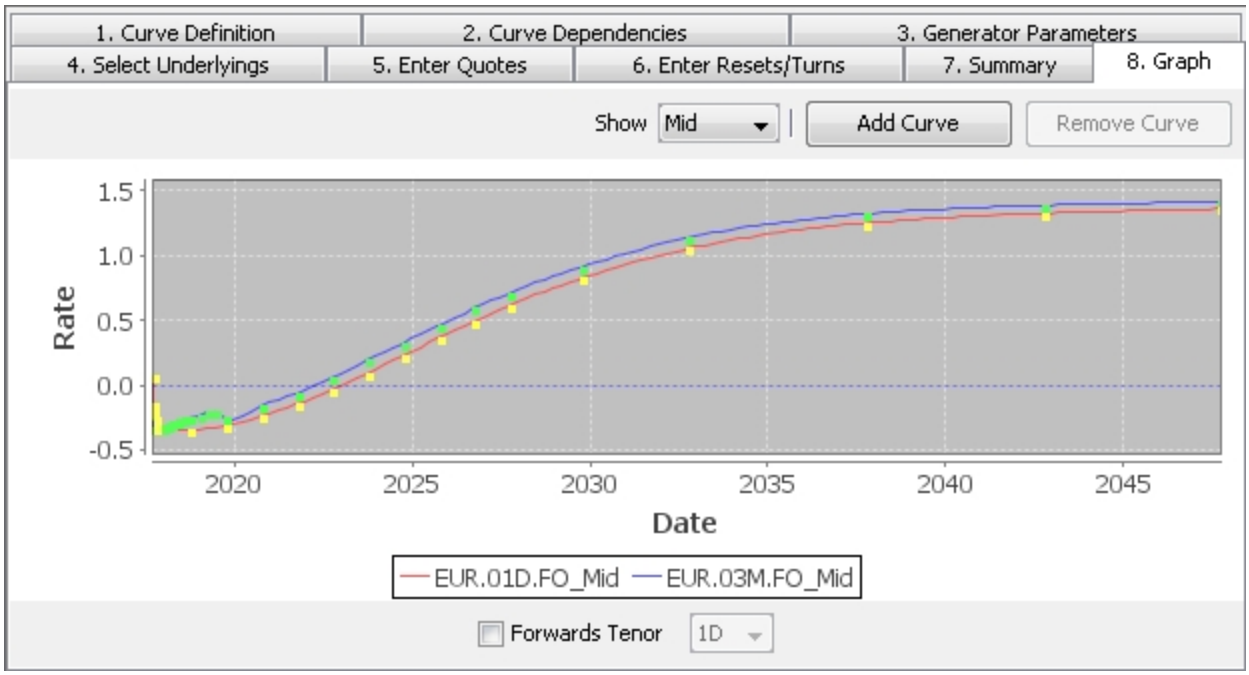
Click **Generate** to generate the curves. For a new package, you will be prompted to enter a package name.

- You can view the package summary in the Summary tab with the curve dependencies.

  Here you can also make Day Count and Frequency settings for each curve in the package. Different curves can use different settings.



- You can click **View** for each curve to display the generated curve.
- To see a graph of points plotted for all curves in the package, see the Graph tab.



  - Use the "Show" drop-down to select the quote type.
  - You can click **Add Curve** to manually load dependent curves. Click **Remove Curve** to remove any curve from the graph.
  - Select the "Forwards Tenor" checkbox to display forwards. When the checkbox is selected you can choose the tenor from the drop-down.

Step 8 - Save.

Click **Save** to save the package.

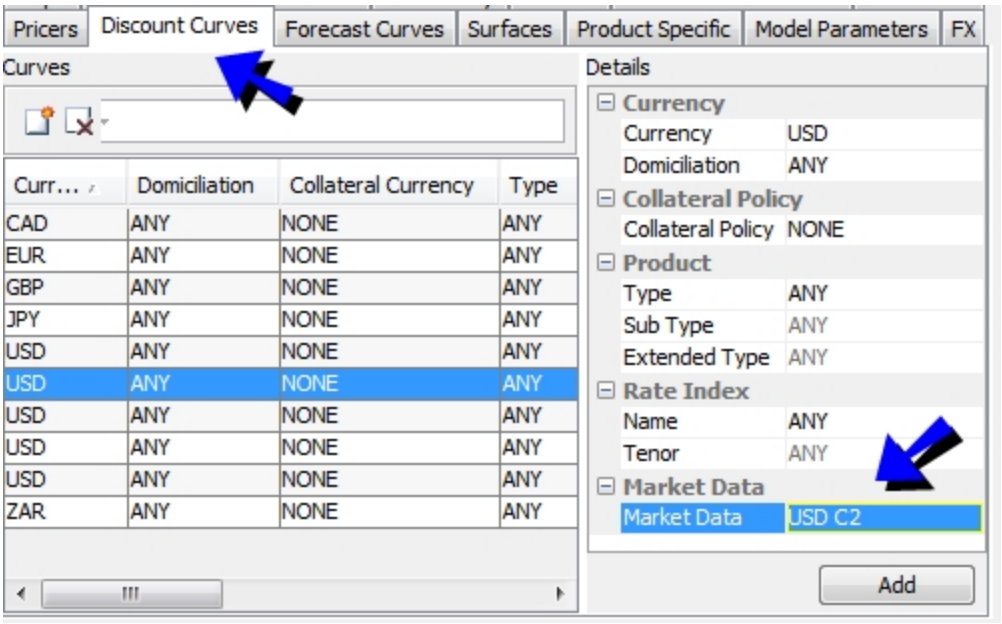
2.2 Pricer Configuration

You need to assign each curve defined in the multi-curve package to a pricer configuration.

From the Calypso Navigator, navigate to **Market Data > Pricing Environment > Pricer Configuration**, and click **Load** to select a pricer configuration name.

2.2.1 Discount Curves

Select the "Discount Curves" panel to assign the discount curves.

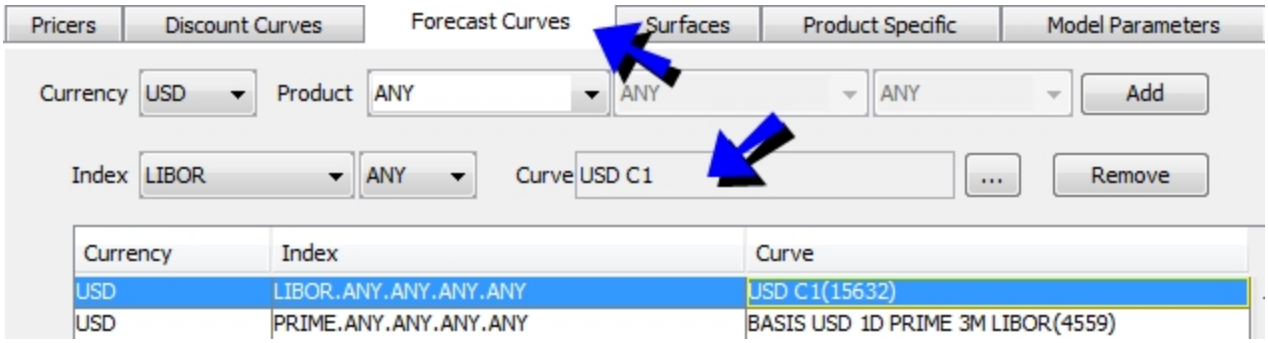


- Select the parameters for which the curve applies, and select the curve.
- Click **Add** to add the curve to the pricer configuration.
- Then click **Save** to save the pricer configuration.

▶ See Pricer Configuration for details on this panel.

2.2.2 Forecast Curves

Select the "Forecast Curves" panel to assign the forecast curves.



- Select a currency, a product or ANY, a subtype or ANY, an index, a tenor or ANY.
- Click **...** to select the curve.
- Click **Add** to add the curve to the pricer configuration.
- Click **Save** to save the pricer configuration.

▶ See Pricer Configuration for details on this panel.

3. Zero Curves Reports

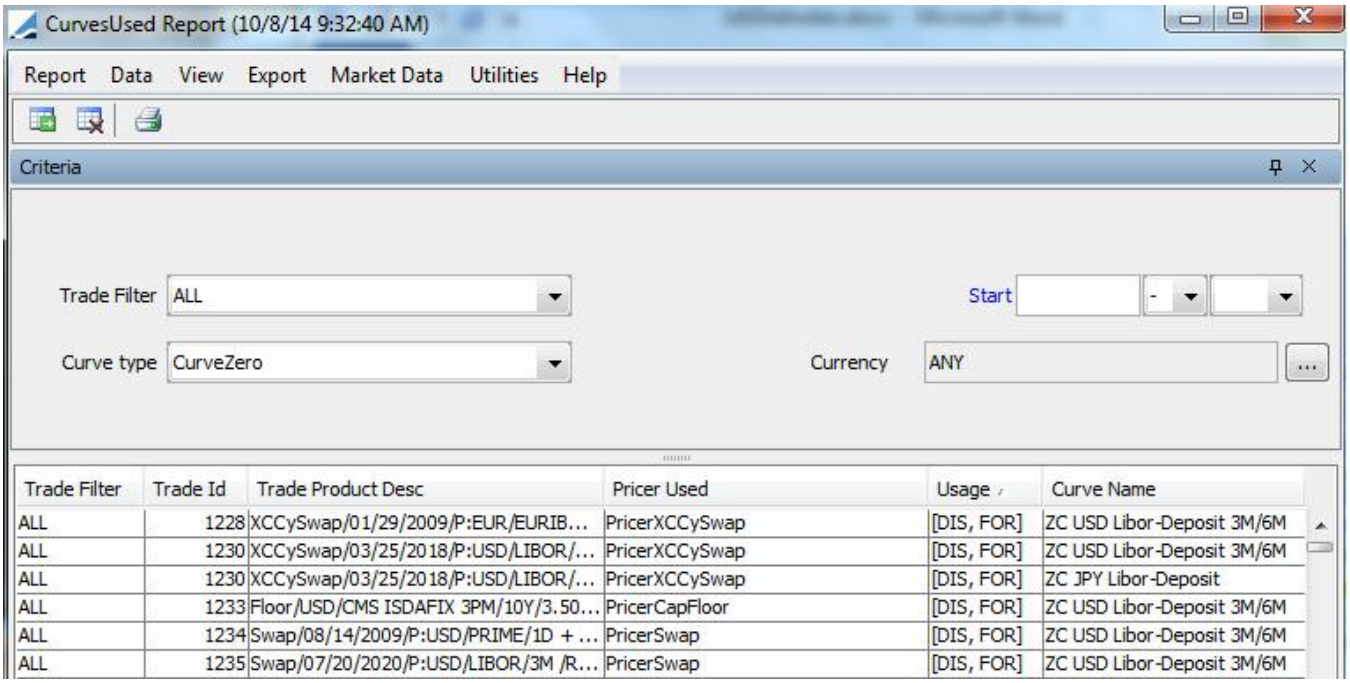
The following reports are available for zero curves.

- Curves Used
- Curves Points
- Daily Discount Factors

3.1 Curves Used

Add a menu item for action `reporting.ReportWindow$CurvesUsed`.

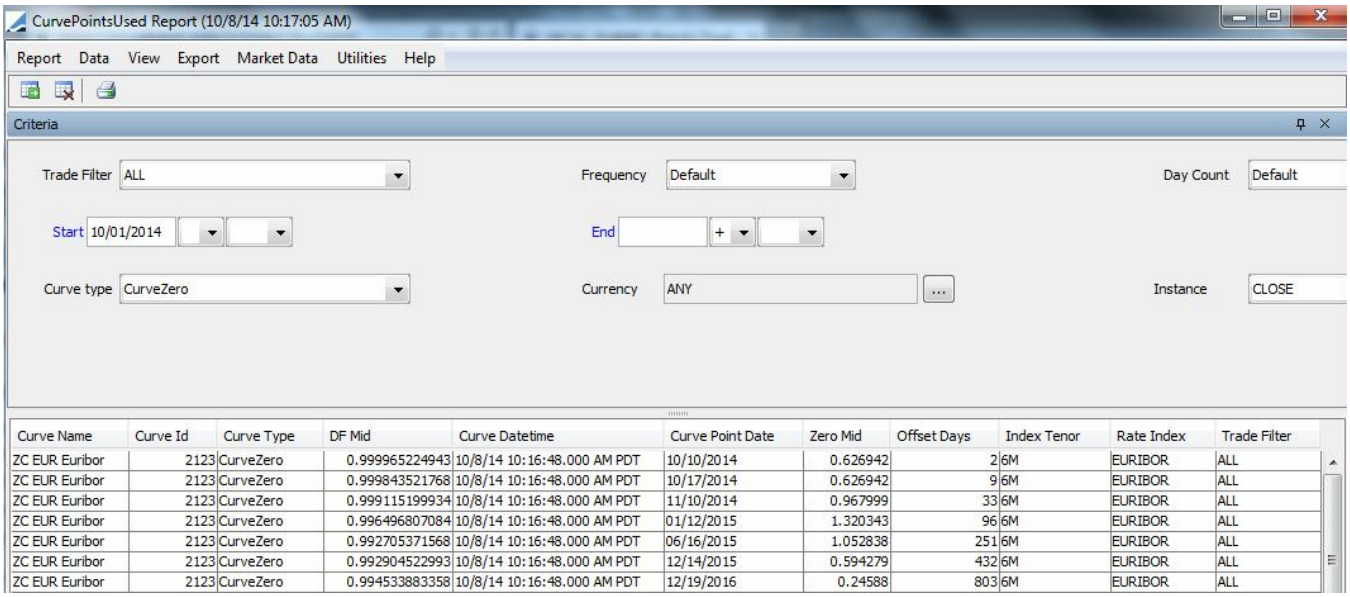
The Curves Used report allows viewing zero curves used for a given trade filter.



3.2 Curves Points

Add a menu item for action `reporting.ReportWindow$CurvePointsUsed`.

The Curves Points report allows viewing points of zero curves used for a given trade filter.



Curve Name	Curve Id	Curve Type	DF Mid	Curve Datetime	Curve Point Date	Zero Mid	Offset Days	Index Tenor	Rate Index	Trade Filter
ZC EUR Euribor	2123	CurveZero	0.999965224943	10/8/14 10:16:48.000 AM PDT	10/10/2014	0.626942	2	6M	EURIBOR	ALL
ZC EUR Euribor	2123	CurveZero	0.999843521768	10/8/14 10:16:48.000 AM PDT	10/17/2014	0.626942	9	6M	EURIBOR	ALL
ZC EUR Euribor	2123	CurveZero	0.999115199934	10/8/14 10:16:48.000 AM PDT	11/10/2014	0.967999	33	6M	EURIBOR	ALL
ZC EUR Euribor	2123	CurveZero	0.996496807084	10/8/14 10:16:48.000 AM PDT	01/12/2015	1.320343	96	6M	EURIBOR	ALL
ZC EUR Euribor	2123	CurveZero	0.992705371568	10/8/14 10:16:48.000 AM PDT	06/16/2015	1.052838	251	6M	EURIBOR	ALL
ZC EUR Euribor	2123	CurveZero	0.992904522993	10/8/14 10:16:48.000 AM PDT	12/14/2015	0.594279	432	6M	EURIBOR	ALL
ZC EUR Euribor	2123	CurveZero	0.994533883358	10/8/14 10:16:48.000 AM PDT	12/19/2016	0.24588	803	6M	EURIBOR	ALL

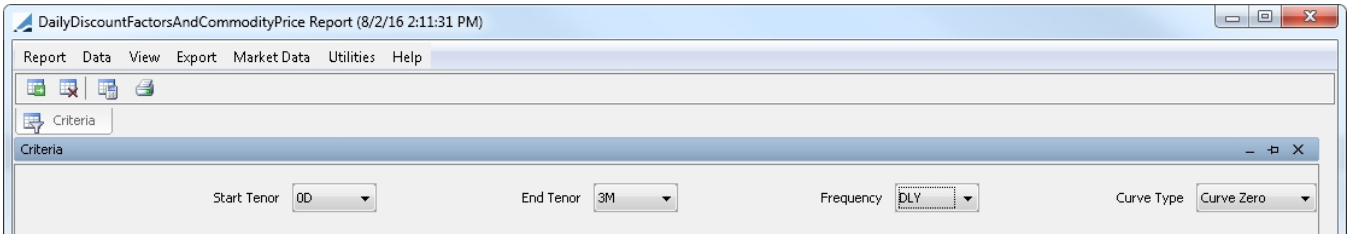
Make sure to select a start date.

3.3 Daily Discount Factors Report

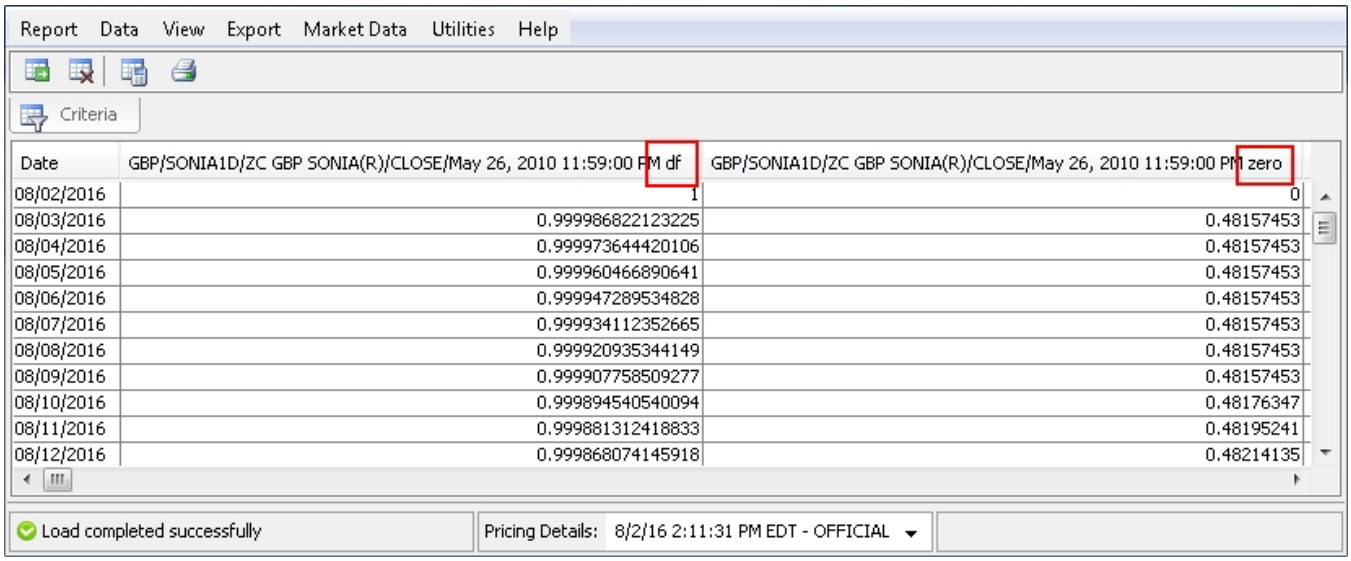
The Daily Discount Factors report displays daily discount factors and zero rates for all discount curves used in a particular pricing environment. The report exports curve points as they exist in the curve object based on selections made for start and end tenors and frequency.

The menu action to launch the report is `reporting.ReportWindow$DailyDiscountFactorsAndCommodityPrice`.

After you launch the report, click **Criteria** to make settings for the report output.



- Select a Start Tenor, End Tenor, and Frequency from the drop-down lists. Curve Zero is currently the only option for the Curve Type setting.
- Click  to load the report and view results.



  - The names of curves are listed horizontally at the tops of columns, and dates for curve points are listed vertically in the first column.
  - Each curve provides output in two columns to display both daily discount factors and zero rates.

» You can click to clear items in the report panel and any templates that were used to generate results.

» You can select a template and click to display the number of objects that will be loaded from the database before loading the report.

» You can click to print the report results.

» You can also click the down arrow in the Pricing Details field to change the valuation date and select a different pricing environment.

4. Market Data Smoothness Report

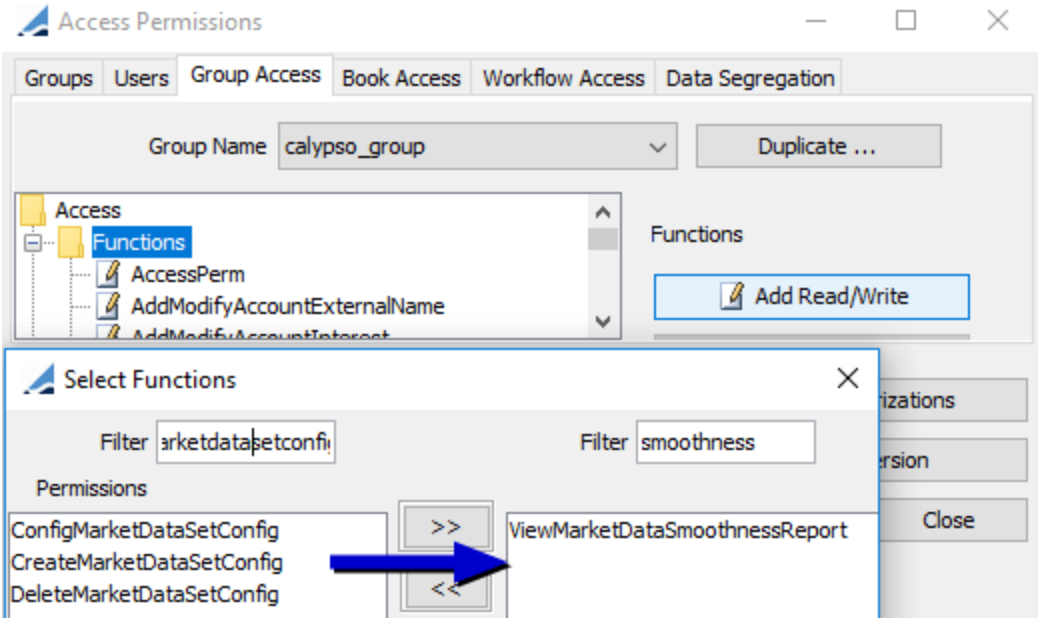
Market data smoothness report allows you to review the smoothness of the interest rate zero curves, forward curves as well as vol surfaces. This report helps in highlighting any steep jumps in the market data like interest rate curves and vol surfaces. This report will enable you to identify any inconsistent points and capture any false market data moves.

It will run on persisted market data only. Currently there is no support for any real-time updates however it will be possible to manually refresh the report to pick up any newly updated and saved market data instances.

Before you Begin

You will need to specify the following access permissions to be able to view the market data smoothness report as well as create, configure and delete a market data set.

- CreateMarketDataSetConfig
- ConfigMarketDataSetConfig
- DeleteMarketDataSetConfig
- ViewMarketDataSmoothnessReport



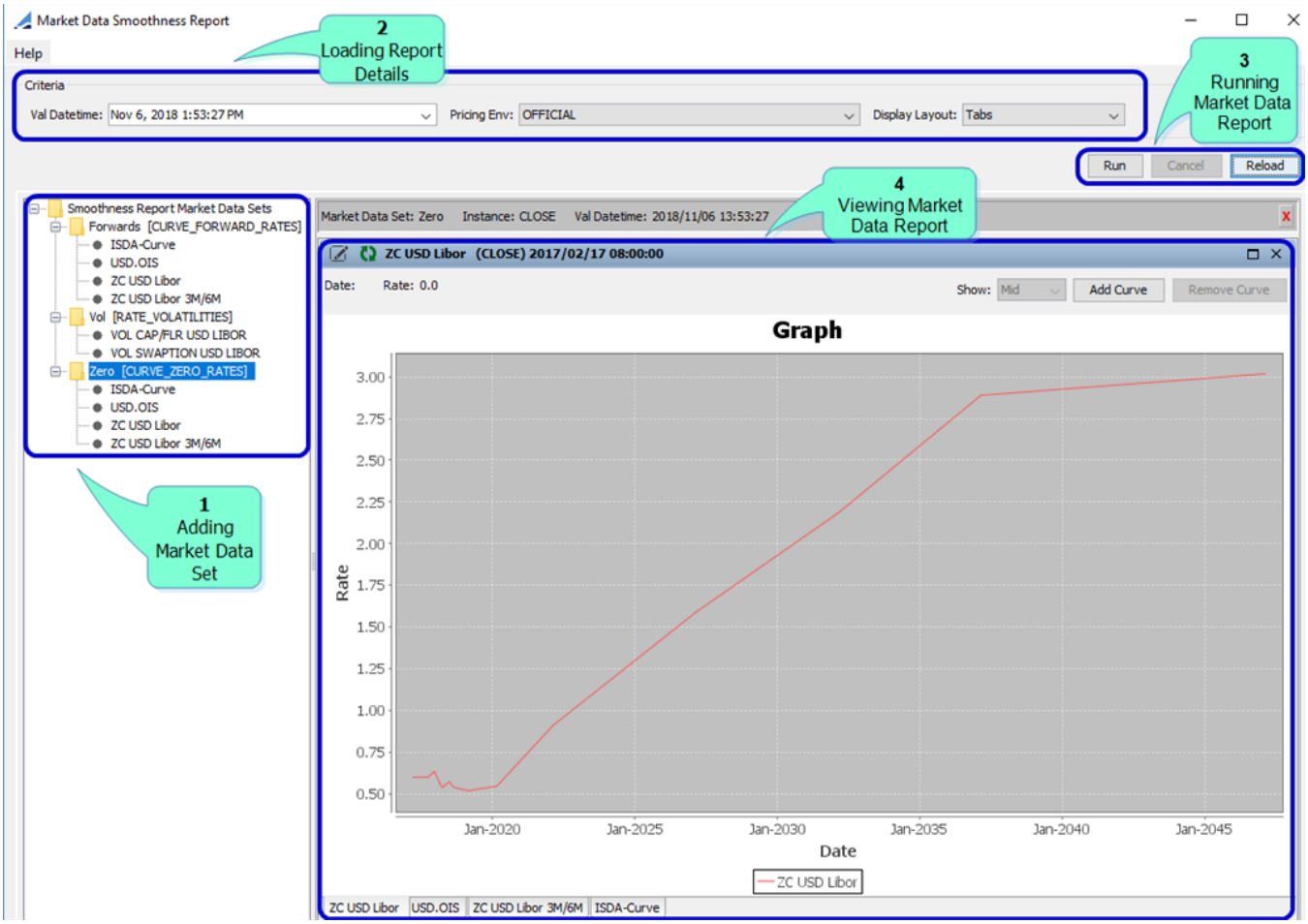
You need to create a menu item for the Market Data Smoothness Report using menu action `marketdata.reports.MDSmoothnessReportFrame`.

4.1 Supported Market Data

The Market Data Smoothness Report currently supports the market data of type:

- CurveZero
- CurveBasis
- CurveZero or CurveBasis generated via Multicurve Package (Please refer to the *Calypso Multicurve Package* documentation for more details)
- VolSurface3D of Type = RATE

4.2 Tour of market data smoothness report

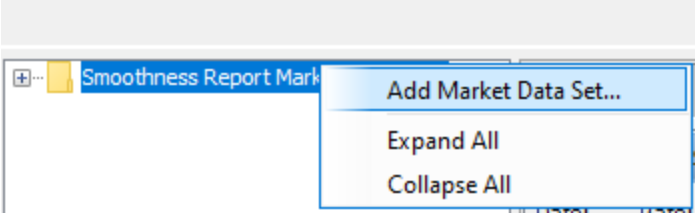


Sample of a Zero Curve Market Data Report in tab view mode

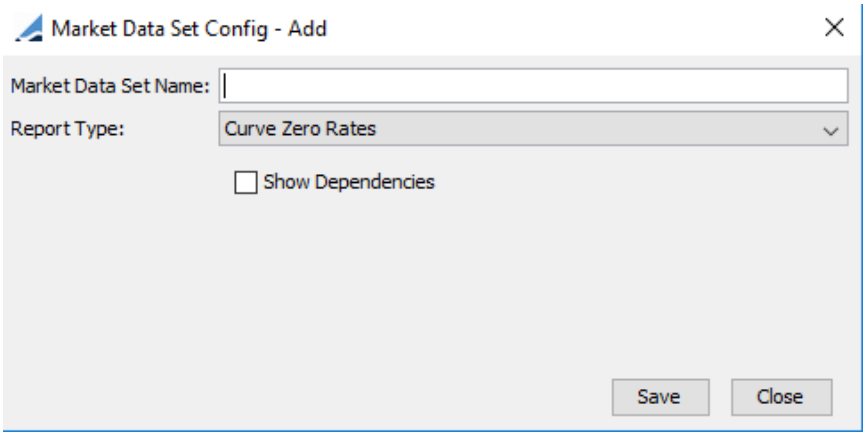
4.2.1 Adding Market Data Set

Market data set will contain the name of the market data set, report type and configured market data.

Step 1: Right click on the folder *Smoothness Report market Data Set*to add the market data set. It will open up a pop-up as shown below.

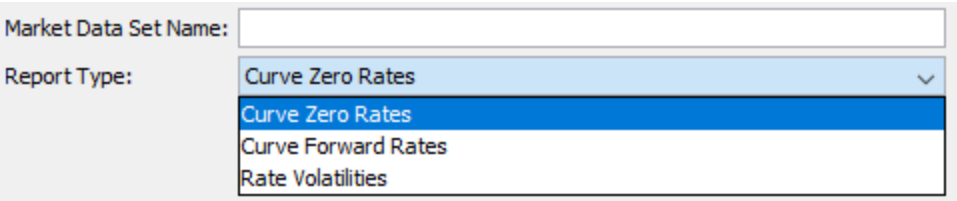


Step 2: Click on the **Add Market Data Set** and that will open another pop-up *Market Data Set Config*.



» Market Data Set Name - Enter the name of the market data set.

» Report Type - Enter the type of market data that can be selected in the market data set. Click **Save**. Possible options are Curve Zero Rates, Curve Forward Rates and Rate Volatilities.



- Curve Zero Rates - Displays graphs of zero rates for selected curves. This includes Curve Zero, CurveBasis using standard and multicurve generators.

  Additional Options :

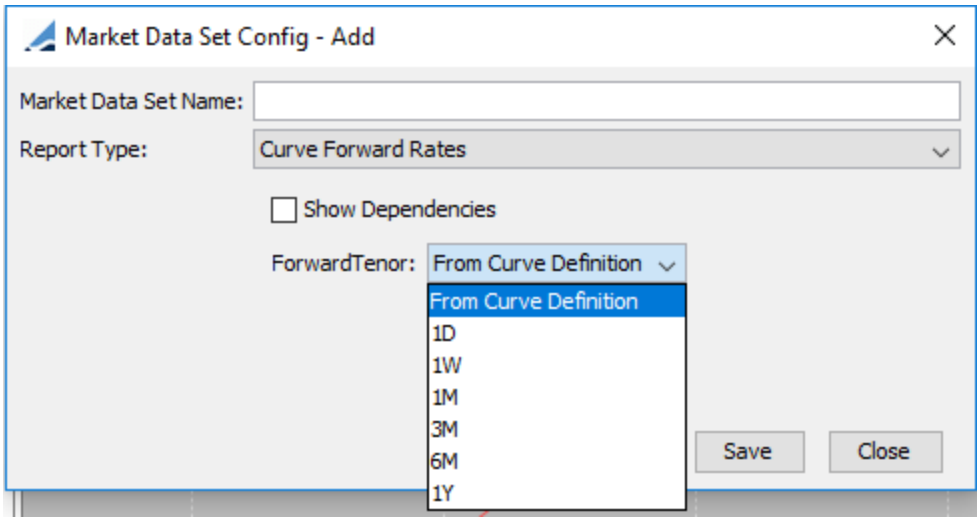
  – Show Dependencies : A boolean flag with default value as FALSE when unchecked. If TRUE when checked, then the dependent curves(if any) will be graphed along with the selected curve.

- Curve Forward Rates - Displays graphs of forward rates for selected curves. This includes CurveZero, CurveBasis using standard and multicurve generators.

  Additional Options :

- Show Dependencies : A boolean flag with default value as FALSE when unchecked. If TRUE when checked, then the dependent curves(if any) will be graphed along with the selected curve.
- Forward Tenor Selection : A drop down list with the following hard coded values; "From Curve Definition", 1D, 1W, 1M, 3M, 6M, 1Y.

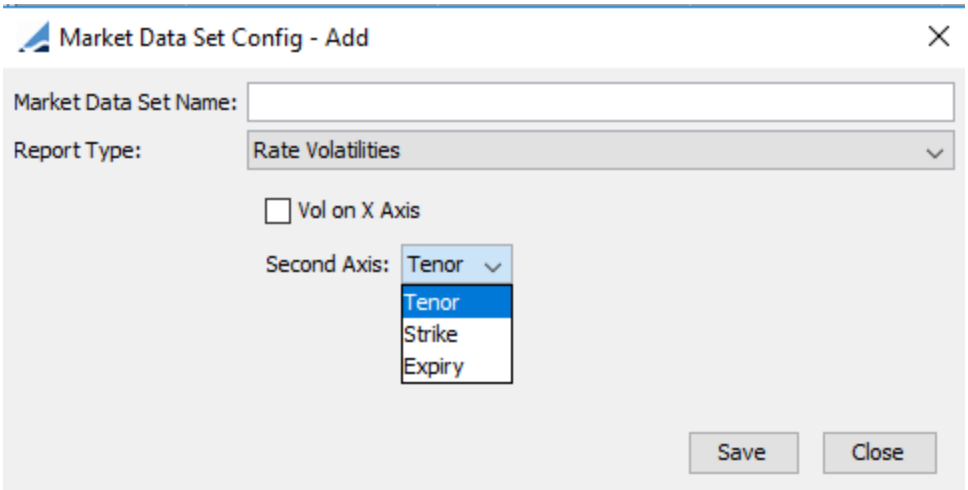
  Default value is "From Curve Definition" meaning the Rate Index Tenor is selected from the curve definition tab. If the Rate Index Tenor is blank, it falls back to 1D.



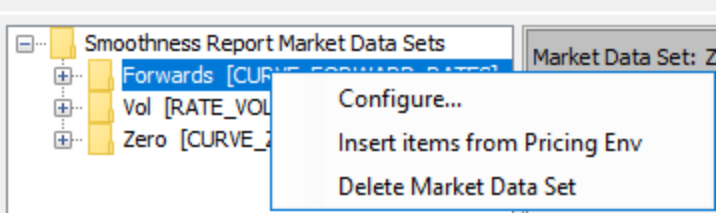
- Rate Volatilities - Displays 2D graphs of implied volatilities and selected axis. It includes VolSurface3D of Type = RATE.

  Additional Options :

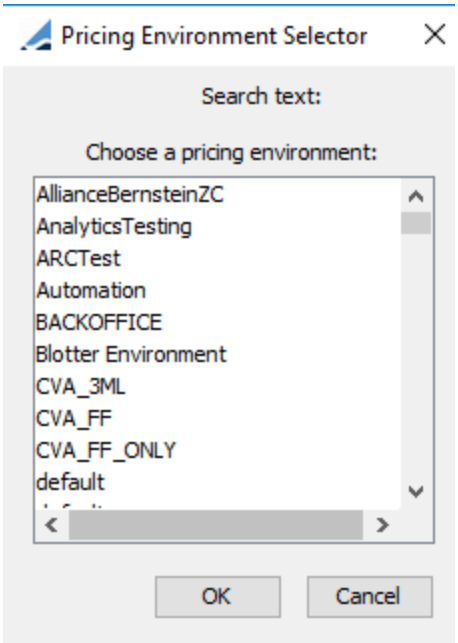
  - Vol on X-axis : A boolean flag with a default value as FALSE when unchecked. If checked it means, the vol will be displayed on the X axis. The implied vol is graphed on the Y axis by default.
  - Second Axis : A drop down list which enables you to select Tenor, Strike or Expiry to be graphed on the second axis.



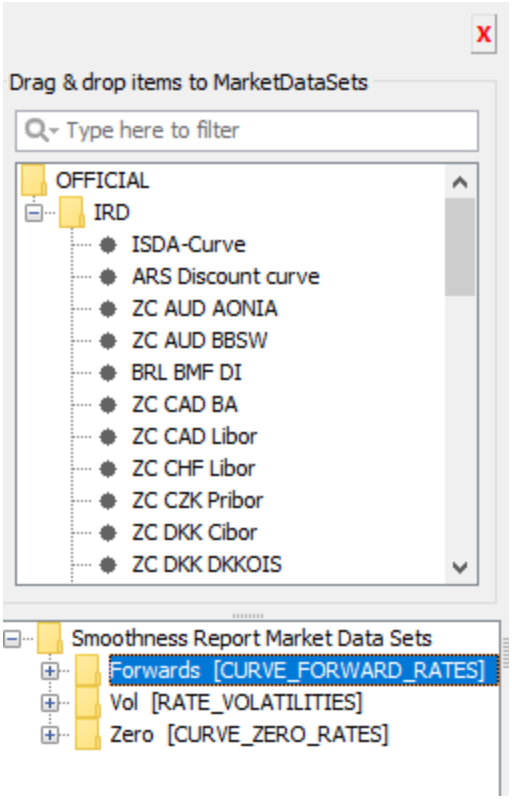
Step 3 : A market data set node is added to the tree panel under the main folder *Smoothness Report Market Data Sets* once its added as described above. Right click on the added market data set node. That will open up a pop up as shown below.



- Configure - The configure option will open up the *Market Data Set Config* as described in **Step 2**.
- Insert Items from Pricing Env - Click to open the pricing environment selector.

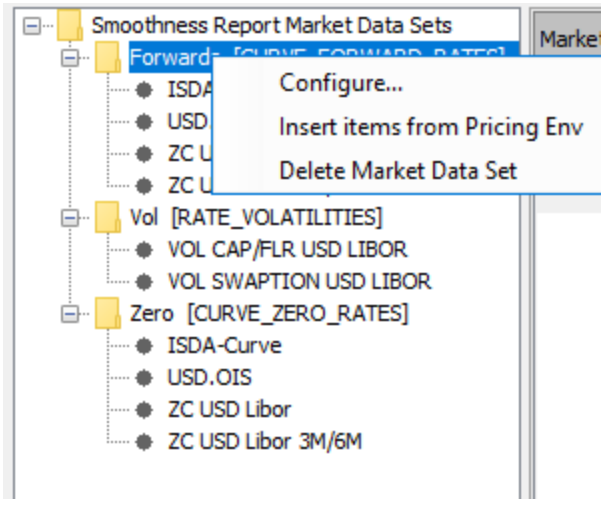


Click on the pricing environment of interest and click **OK**. That will open up a pop up window with list of configured market data filtered for the report type on the selected node. If the report type is "CurveZero Rates" only the curve types falling under zero category will be displayed in the pop up window for the selected pricing environment.



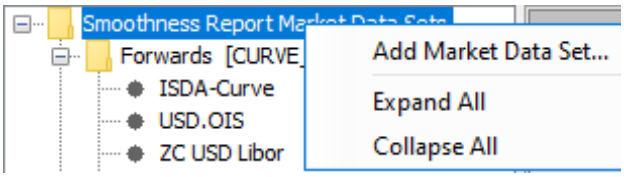
You should be able to drag and drop single or multiple selections to Market Data Set nodes. It is also possible to filter on name, currency as an example using the filter as shown above.

Market Data Tree Panel

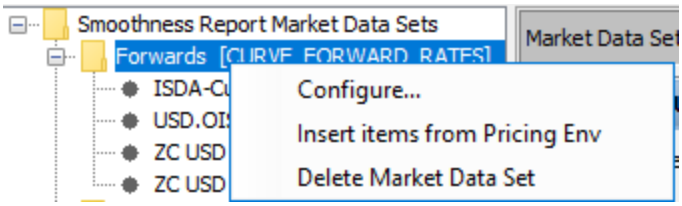


On the left side of the Market Data Smoothness Report, there is a tree panel that gets added after you follow steps described above. The hierarchy is as follows:

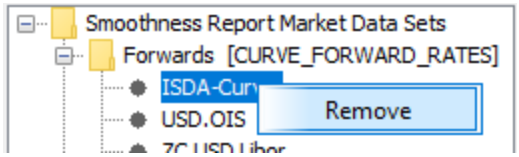
Main node - Smoothness Report Market Data Sets. When you right click on this node, you can Add a market data set. You can expand to the lowest market data dependency node. You can also collapse to market data sets node.



Secondary node- Configured report type . When you right click on this node, you can configure and add market data items to the market data set.



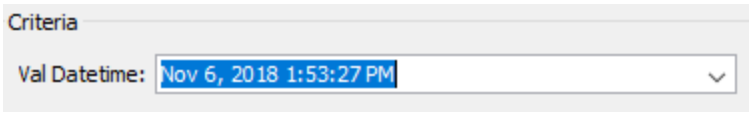
Tertiary node - Items inserted by dragging and dropping from the pricing environment pop up. When you click on this node, you can delete or remove the market data item added.



4.2.2 Loading Report Details

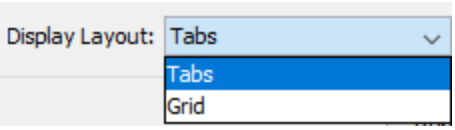
The system will allow you to enter the following input parameters for generating the report.

- Val Datetime - Enter valuation date and time for which you want to run the report. The report will run as of this date and time. It loads the latest market data instances as of this date for the market data specified in the market data set. Default is current date and time.

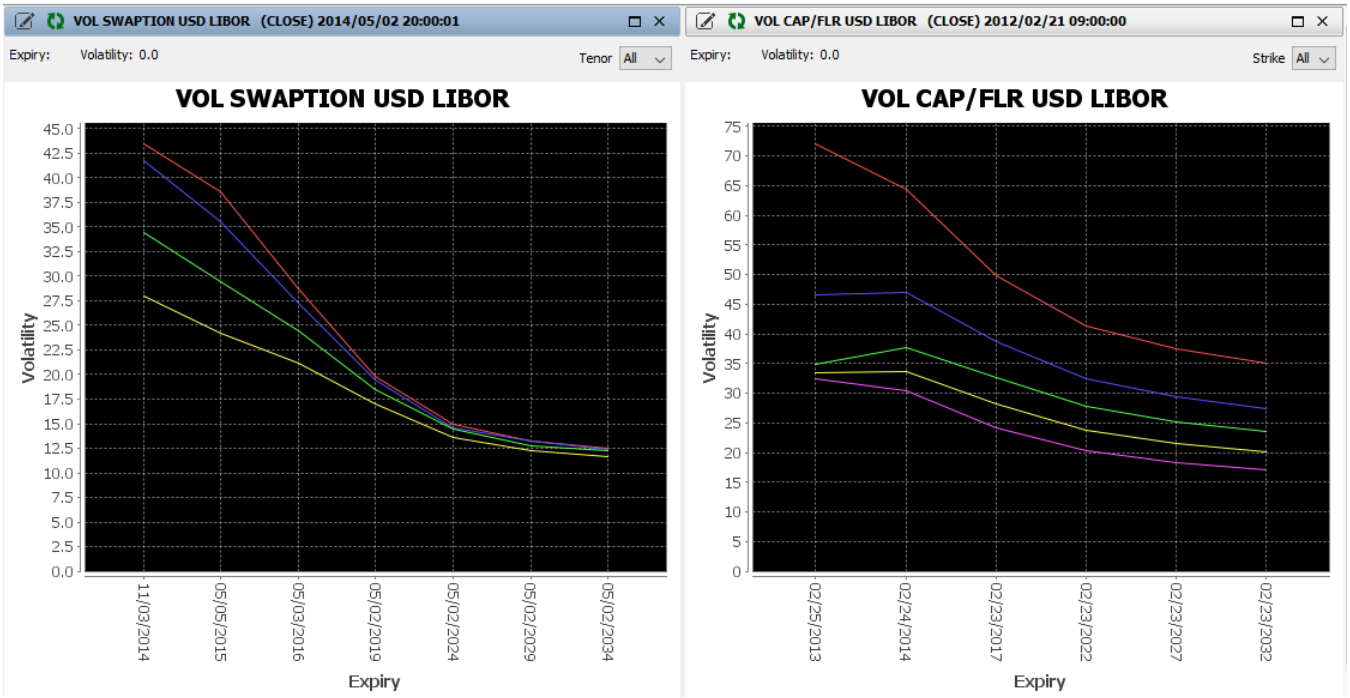


- Pricing Env - Enter the pricing environment which determines the instance type of market data to be loaded (CLOSE, LAST, OPEN). It also supplies the time zone for comparing the Val Date and Market data instance dates.

- Display Layout - Grid and Tabs



Grid - All market data graph panels will be displayed as a grid.



An example of swaption and cap/floor vol surfaces in grid view mode

Tab - All market data graph panels will be displayed as tabs so only the first graph is visible and you must tab through to see the remaining panels.

[Note: You need to re-run the report when you change the view from tab to grid or vice-versa]

4.2.3 Running market data report

Click on the market data set node in the tree panel on the left side of the smoothness report. You can perform the following actions:

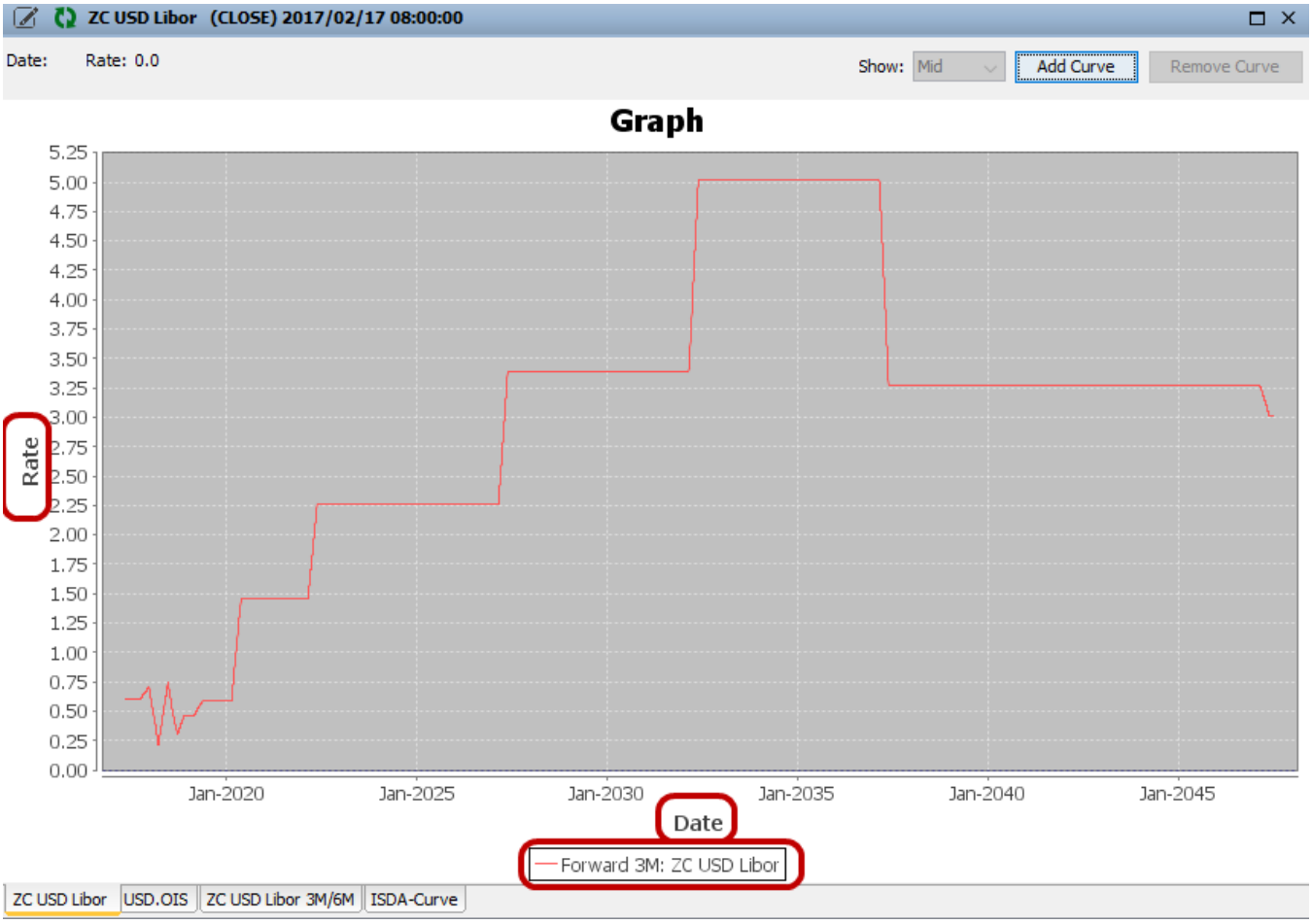
- Run - Click on the **Run** to execute the report. A graph will be displayed on the screen based on the market data set selected as of the val date, time and pricing environment entered on the top of the report.
- Cancel - Click on **Cancel** to stop loading the report.

- Reload - Click on **Reload** to reload the entire report or individual market data graphs. The button will reload the whole report and pick up any newly saved instances of market data since the last run.

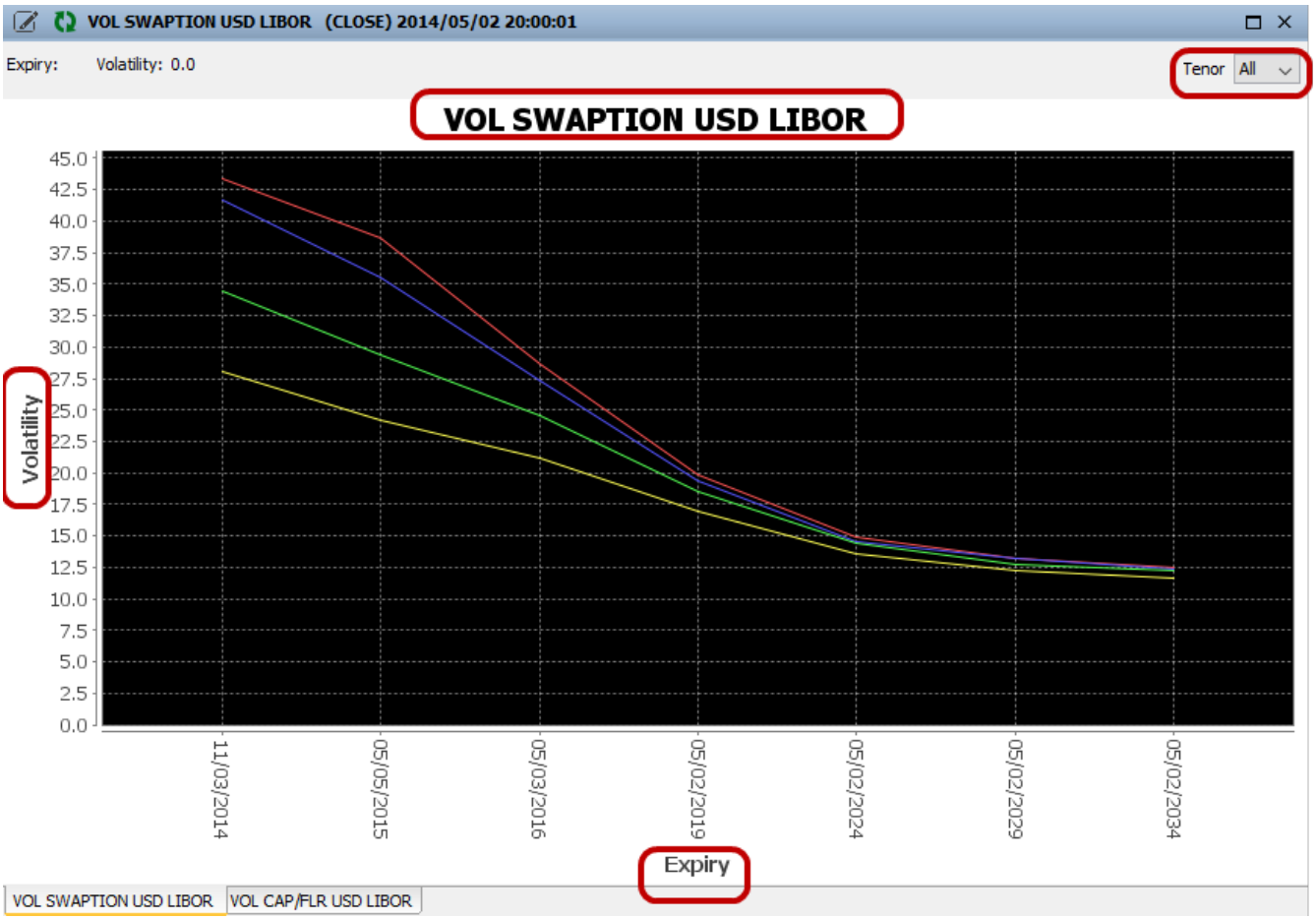
4.2.4 Viewing Market Data report

Graph panel comprises of the following :

- Graph - All graphs will be 2D graphs. For curves, the axes are always Rate (Y axis) by Date (X axis). Based on the configuration, it can either be zero rates or forward rates. For vols, the Y axis is implied volatility and X axis is driven by you based on your selection in the market data set config window. By default, the report always displays "Mid" data.



An example of forward rate curve

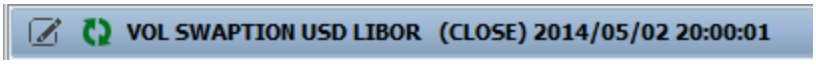


An example of swaption vol surface

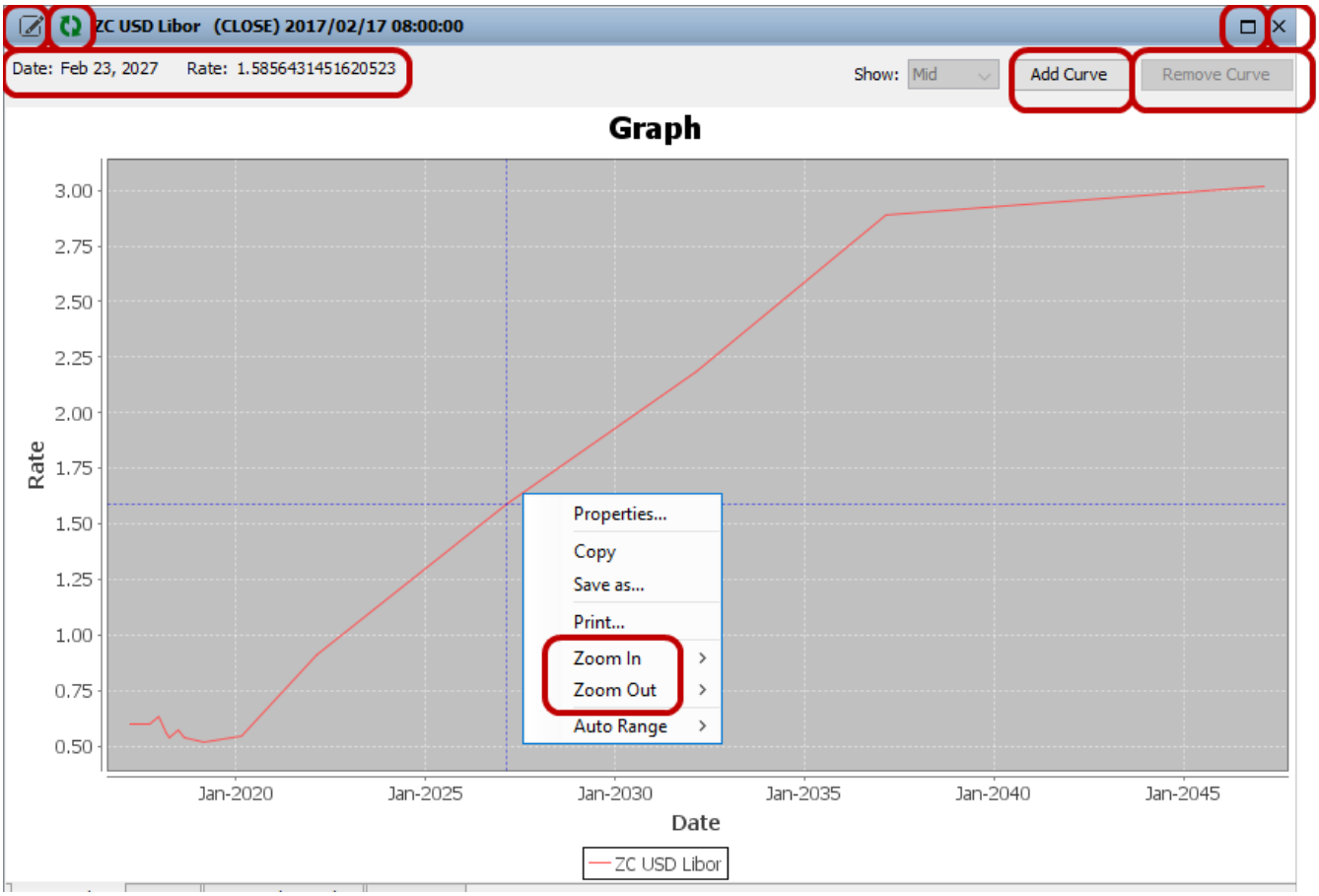
For the Vol surface, there is a third data set displayed as a slice. When the vol graph is first opened, the slice drop down uses "ALL" by default. You can filter on individual slice values as desired. The example above has expiry on the X second axis.

- Labels - The graph axes are labeled with Rate, Date, Expiry Volatility, Tenor, Strike based on the selection made in the market data set config. It also displays the headings of the market data items selected in the market data set.

- Market Data Information - The graph panel top heading includes a market data name, market data instance (CLOSE, LAST, OPEN) and market data instance Datetime.



- Interactions -



An example of a zero rate curve opened in tab view

Once the report is loaded, you can interact with the output in the following ways:

- Zoom : Provides the ability to zoom in and zoom out of the graph.
- Show Data : Clicking on any part of the graph will give detailed data regarding the point on the graph. For curves, the detailed data shows Date and Rate. For vols, the detailed data shows Tenor, Strike, Expiry and Volatility depending upon what is selected in the market data set.
- Add/Remove Curve - You can add a curve to the selected graph however this selection is only valid for the current session. When you reload the report, all adhoc curves that were added will be lost.
- Refresh/Reload Market Data - You can refresh any specific graph panel. In this case, the latest persisted instance of the market data will be retrieved and re-graphed.
- Open Market Data Window - You can open the market data window associated with the given graph panel. This helps in investigating any issues with market data items for unexpected results.

- Maximize and Close Panel - You can temporarily maximize any single graph panel to the size of the overall report window. This is applicable when the display layout is grid. For both tab and grid views, there is an to close any panel.