Nasdaq Calypso

Volatility Surfaces

Version 18

Revision 3.0

October 2024

Approved

1. Volatility Surfaces Overview

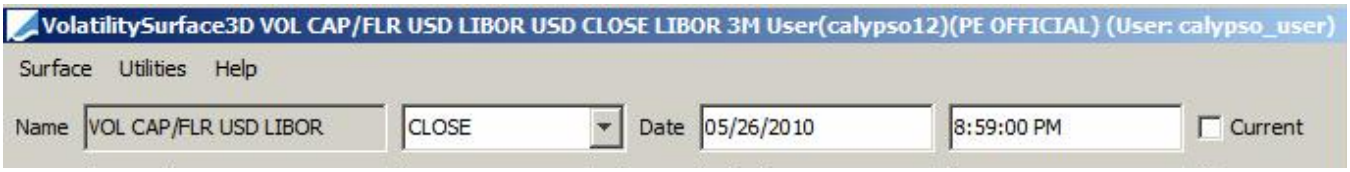
The following volatility surfaces can be built to support pricing for options:

- BOND volatility surface
- BONDFUTURE volatility surface
- BONDOPTION volatility surface
- COMMODITY volatility surface
- Proxy COMMODITY volatility surface
- CREDIT volatility surface
- EQUITY volatility surface
- MMFUTURE volatility surface
- RATE volatility surface
- Volatility surface charts

[NOTE: Curves and surfaces can be updated in real-time using the Market Data Server]

▶ Refer to *Calypso Market Data Server Documentation* for information on configuring and running the market data server.

1.1 General Volatility Surface Information



- The name of the volatility surface is set upon saving. It will identify the volatility surface throughout the system.
- The instance of the volatility surface dictates the quote side of the underlying instruments to be used for generating the volatility surface.
  - The CLOSE instance uses CLOSE quotes.
  - The LAST instance uses BID, MID, and ASK quotes.
  - The OPEN instance uses OPEN quotes.
- By default, the volatility surface is saved as of the current date and time. You can clear the Current checkbox and change the volatility surface date as needed.

Vol Model

The Vol Model allows converting volatilities between Black Vol, Bp Vol and Daily BE Vol (daily break even vol) as follows:

- Bp Vol = Daily BE Vol * Sqrt(252)
- Bp Vol = Forward Rate * Black Vol

Graph Panel

▶ See Volatility surface charts for details.

Underlying Instruments

▶ See Volatility Surface Underlying Instruments for details.

Volatility Surface 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_VOLSURF to regenerate a volatility surface as of the current valuation date.

Interpolator

Note that Interpolator3DLinearExtended is only used for FX Volatility surfaces.

▶ Refer to the *Calypso FX and MM Analytics Guide* for details.

2. BOND Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

BOND volatility surfaces can be created from offset points using the Default generation algorithm.

▶ See also Volatility Surface Overview.

BOND Volatility Surface from Offsets Quick Reference

Configuration Requirements

- Bond products are created using **Configuration > Fixed Income > Bond Product Definition** from the Calypso Navigator.

Surface Generation

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

2. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

3. Definition Panel — Select the following to define the surface: currency, volatility type "BOND", bond product, strike type, interpolator, vol model, the Derived checkbox should not be selected, Default generator, date-roll convention, holiday calendars, pricing environment.

4. Offsets Panel — Select expirations, and enter strikes.

5. Points Panel — Click **Generate** to generate the points. Enter the point values.

6. Click **Save**, enter a name for the surface, and click **OK**.

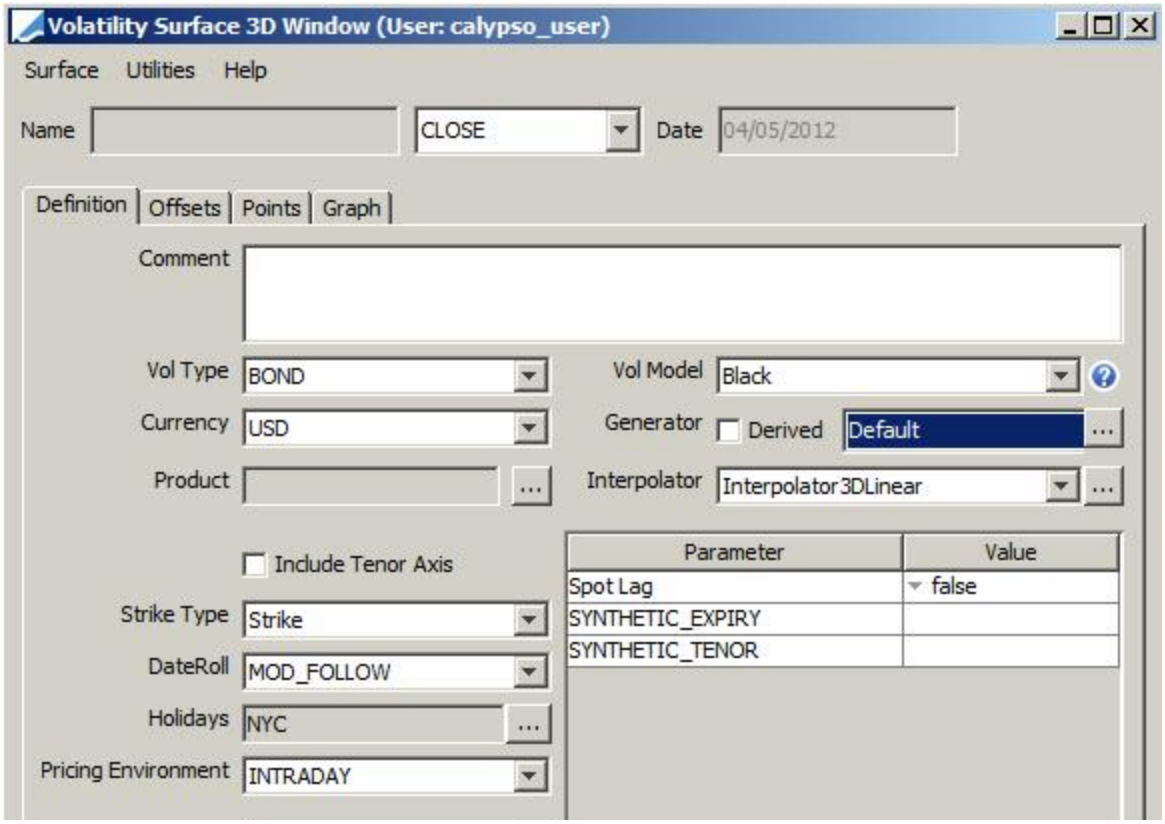
Pricer Configuration

A BOND volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the BOND volatility type and VOL usage.

2.1 Definition Panel

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

Select the following to define the surface: currency, volatility type "BOND", bond product, strike type, interpolator, vol model, the Derived checkbox should not be selected, Default generator, date-roll convention, holiday calendars, pricing environment.



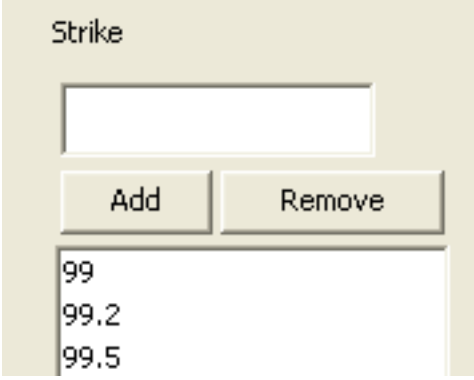
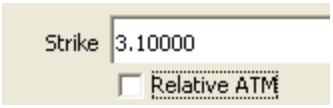
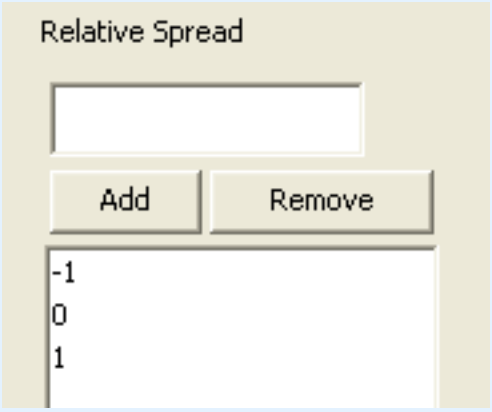
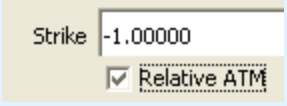
- Select the type of strike: Strike, Relative Spread, Strike Offsets BPs, or Relative % - They are described below.
- Select the "Default" generation algorithm.

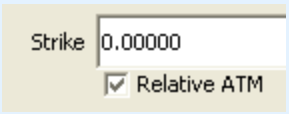
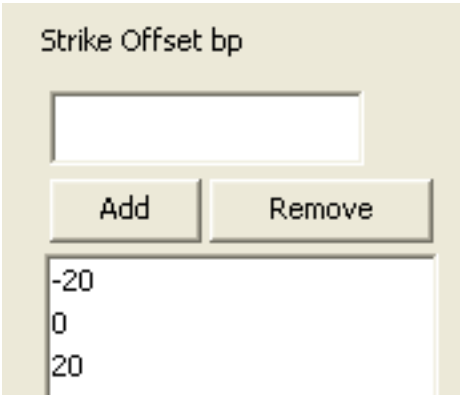
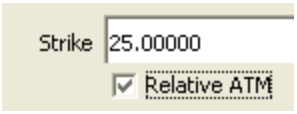
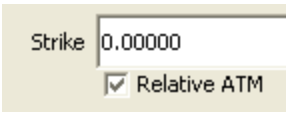
  If the spot lag parameter is set to true, the generated exercise dates are rolled using the conventions of the definition screen.

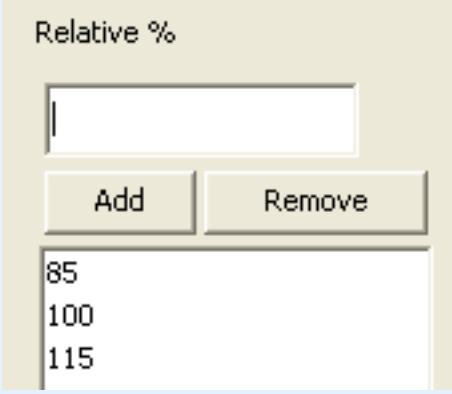
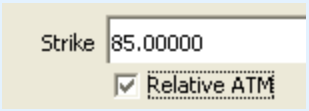
  Note that SYNTHETIC_EXPIRY and SYNTHETIC_TENOR are not currently used.

Strike Types Details

Surface Type	Definition
Strike	Absolute strike. ***Offset Points*** In the Offset panel, enter absolute strikes.

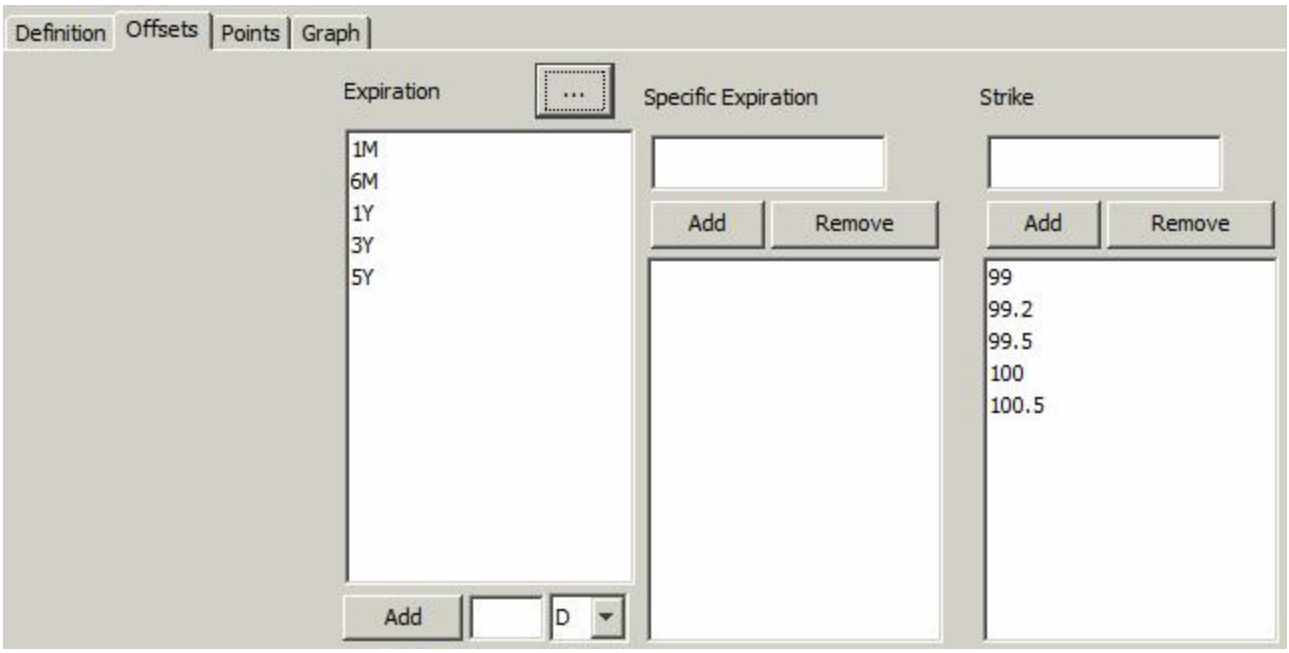
Surface Type	Definition
	 ***Underlying Instruments*** The underlying instruments must be specified using an absolute strike. 
Relative Spread	Current strike +/- spread minus ATM strike (in %). ***Offset Points*** In the Offset panel, enter relative spreads over the current strike in %. Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in %. In this example the relative strike is -1%.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0.

Surface Type	Definition
	
Strike Offset BPs	Current strike +/- offset minus ATM strike (in bp). ***Offset Points*** In the Offset panel, enter relative offset over the current strike in bp Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in bp. In this example the relative strike is +25bp.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0. 
Relative %	% (current strike) minus ATM strike. ***Offset Points*** In the Offset panel, enter a percentage of the current strike.

Surface Type	Definition
	 ***Underlying Instruments*** The underlying instrument must be specified using a percentage of the current strike. In this example, it is 85% of the current strike. 

2.2 Offsets Panel

Select the Offsets panel.

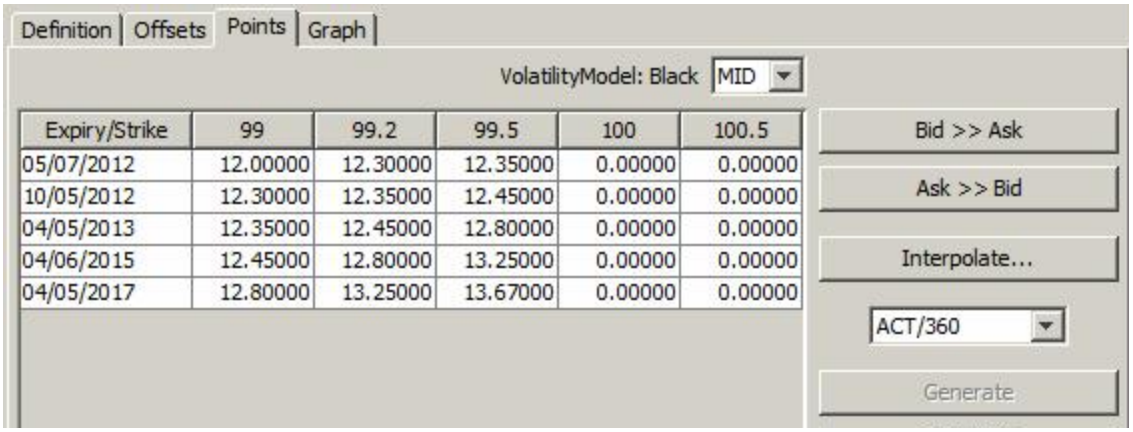


» Click ... to select expirations.

» Enter a strike and click **Add**. Repeat for each strike value.

2.3 Points Panel

Select the Points panel, and click **Generate** to generate the points.



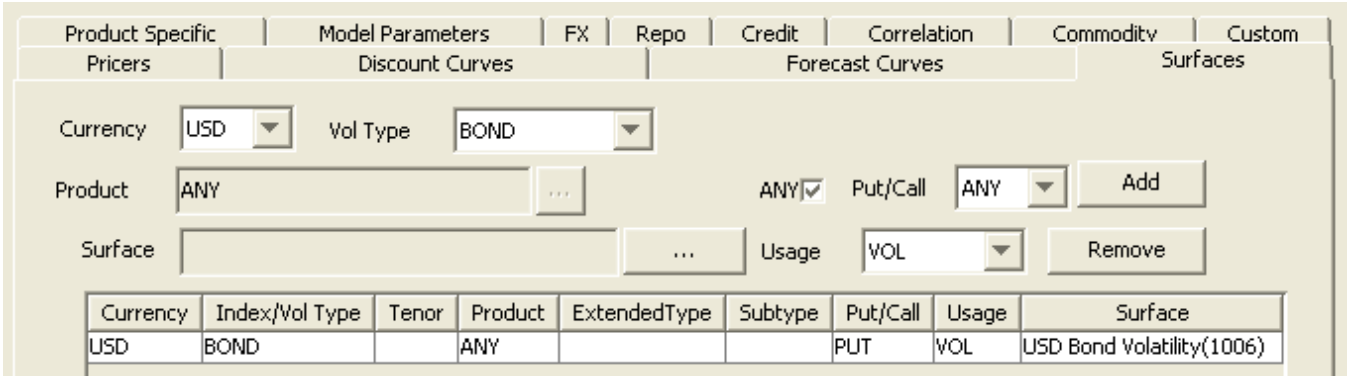
In this example, volatilities are entered manually. Volatilities can also be copied from Excel.

2.4 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

2.5 Pricer Configuration

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



» Select the currency and BOND volatility type.

» Select a product or click ANY, and select PUT / CALL / or ANY.

» Select the VOL usage.

- Click **...** to select the volatility surface.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

3. BOND FUTURE Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

BONDFUTURE volatility surfaces can be created from offset points using the Default generation algorithm.

▶ See also Volatility Surface Overview.

BONDFUTURE Volatility Surface Quick Reference

Configuration Requirements

- Bond futures are created using **Configuration > Listed Derivatives > Future contracts** from the Calypso Navigator.

Surface Generation

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

2. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

3. Definition Panel — Select the following to define the surface: currency, volatility type "BONDFUTURE", bond future product, strike type, interpolator, vol model, the Derived checkbox should not be selected, Default generator, date-roll convention, holiday calendars, pricing environment.

4. Offsets Panel — Select expirations, and enter strikes.

5. Points Panel — Click **Generate** to generate the points. Enter the point values.

6. Click **Save**, enter a name for the surface, and click **OK**.

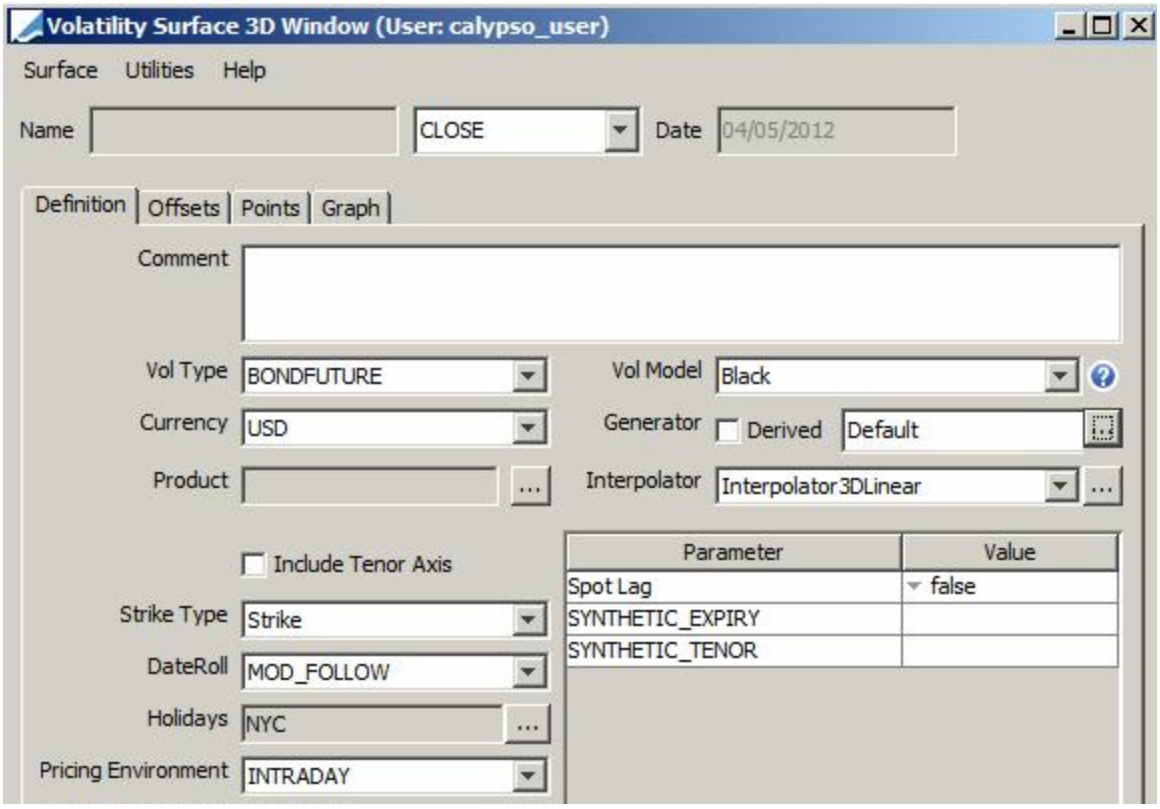
Pricer Configuration

A BONDFUTURE volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the BONDFUTURE volatility type and VOL usage.

3.1 Definition Panel

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

Select the following to define the surface: currency, volatility type "BONDFUTURE", bond future product, strike type, interpolator, vol model, the Derived checkbox should not be selected, Default generator, date-roll convention, holiday calendars, pricing environment.



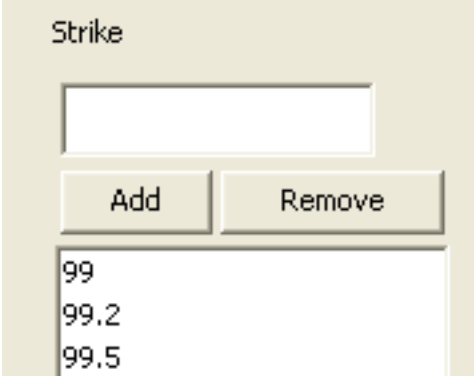
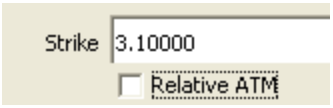
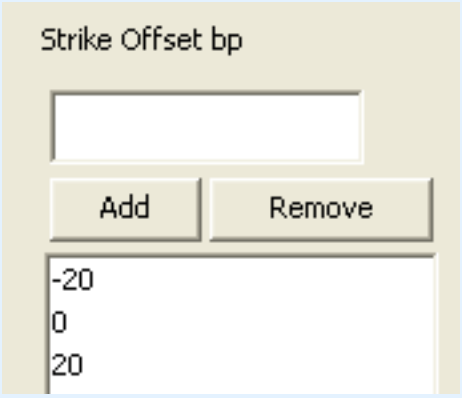
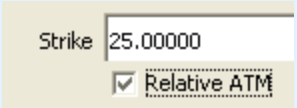
- Select the type of strike: Strike or Strike Offsets BPs - They are described below.
- Select the "Default" generation algorithm.

  If the spot lag parameter is set to true, the generated exercise dates are rolled using the conventions of the definition screen.

  Note that SYNTHETIC_EXPIRY and SYNTHETIC_TENOR are not currently used.

Strike Types Details

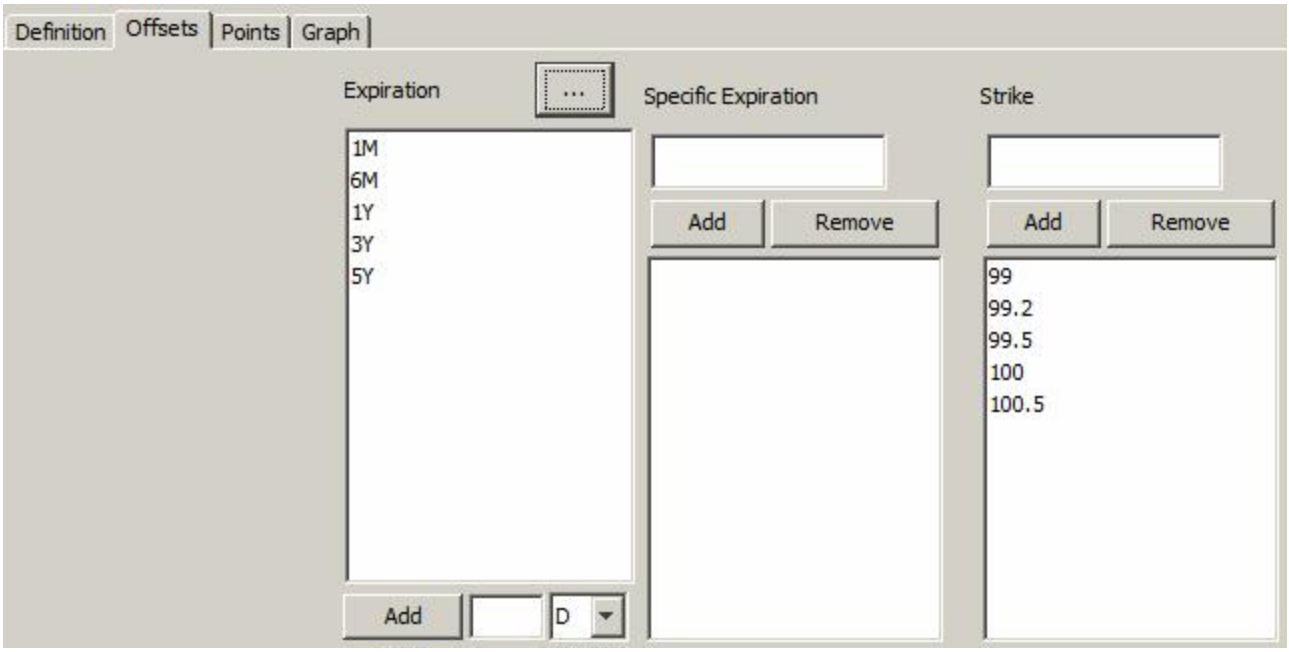
Surface Type	Definition
Strike	Absolute strike. ***Offset Points*** In the Offset panel, enter absolute strikes.

Surface Type	Definition
	 ***Underlying Instruments*** The underlying instruments must be specified using an absolute strike. 
Strike Offset BPs	Current strike +/- offset minus ATM strike (in bp). ***Offset Points*** In the Offset panel, enter relative offset over the current strike in bp Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in bp. In this example the relative strike is +25bp.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0.

Surface Type	Definition
	Strike 0.00000 Relative ATM

3.2 Offsets Panel

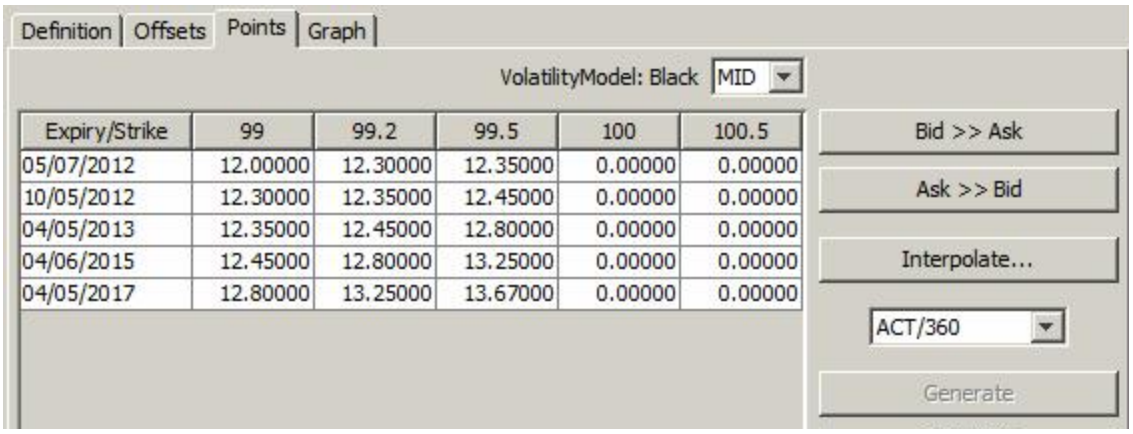
Select the Offsets panel.



- Click ... to select expirations.
- Enter a strike and click **Add**. Repeat for each strike value.

3.3 Points Panel

Select the Points panel, and click **Generate** to generate the points.



In this example, volatilities are entered manually. Volatilities can also be copied from Excel.

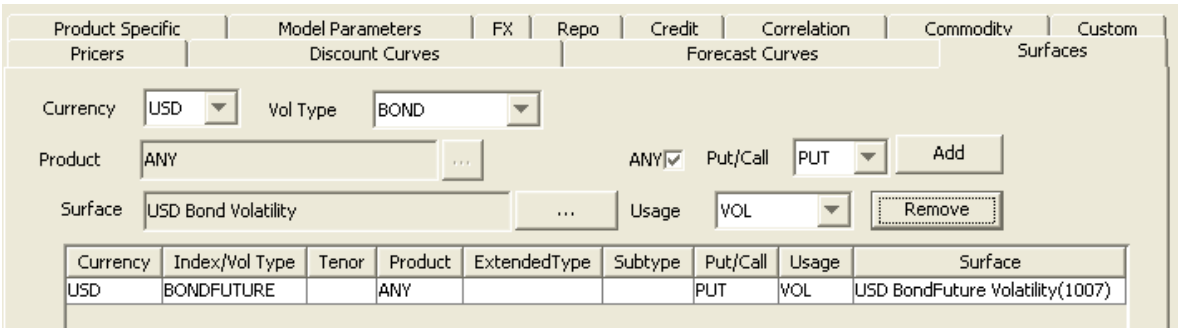
3.4 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

3.5 Pricer Configuration

From the Calypso Navigator, navigate to **Market Data > Pricing Environment > Pricer Configuration**.

- Click **Load**, select the pricer configuration name, and click **OK**.
- Click the Surfaces tab to bring it to the front.



- Select the currency and BONDFUTURE volatility type.
- Select a product or click ANY, and select PUT / CALL / or ANY.
- Select the VOL usage.
- Click **...** to select the volatility surface.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

4. BOND OPTION Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

Bond Option volatility surfaces are created by combining a volatility surface created from underlying instruments, and a volatility surface of coefficients for quadratic adjustments.

Follow the steps below to build the Bond Option volatility surface that will be used for pricing bond options.

▶ See also Volatility Surface Overview.

Bond Option Volatility Surface Quick Reference

Surface Generation

- Step 1 – Create a BondOption volatility surface from underlying instruments for ATM volatilities.
- Step 2 – Create a volatility surface for quadratic adjustments from offsets, using the generator QuadraticSmileParams.
- Step 3 – Create the final volatility surface by combining the surface previously created.

Pricer Configuration

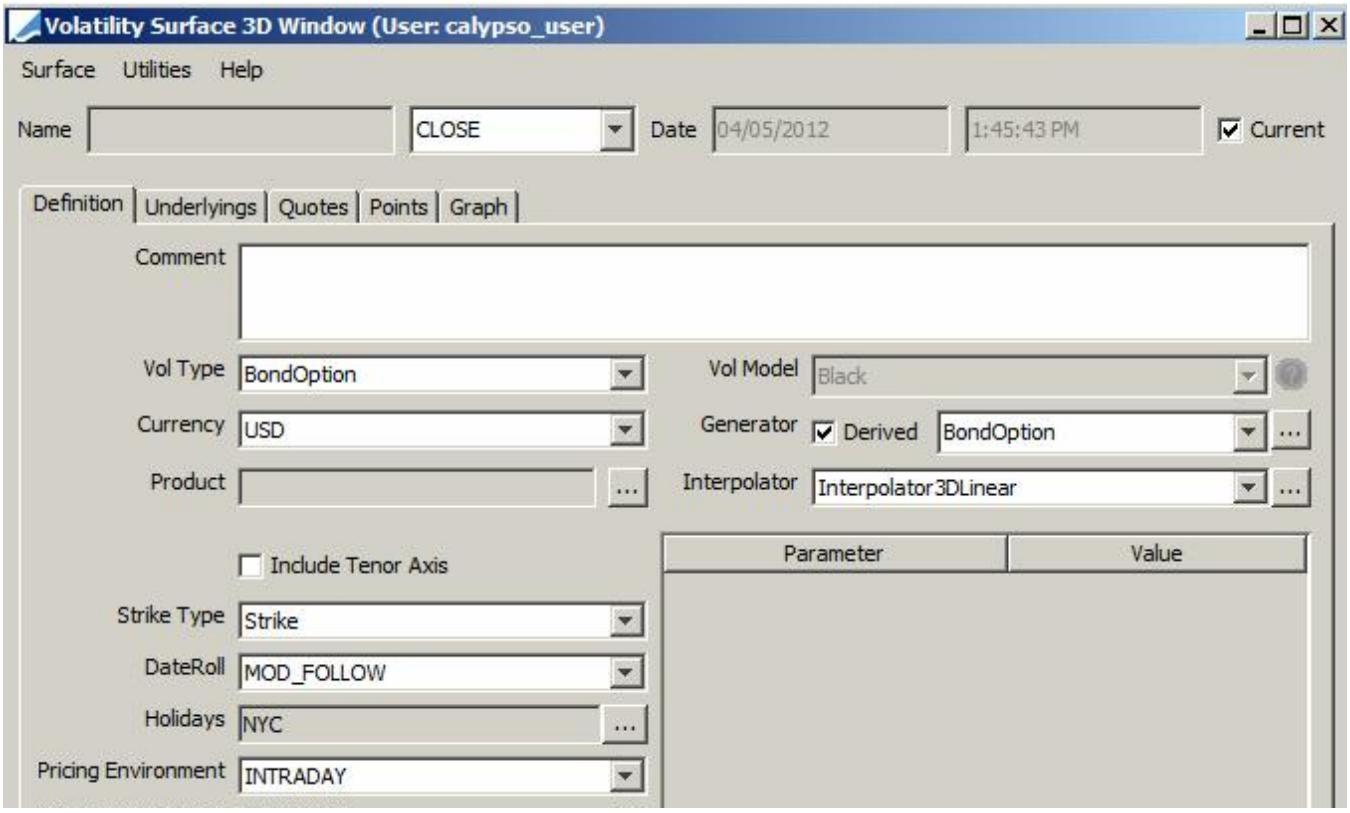
A BondOption volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the BondOption volatility type and VOL usage.

4.1 Step 1 - Volatility Surface from Bond Options

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

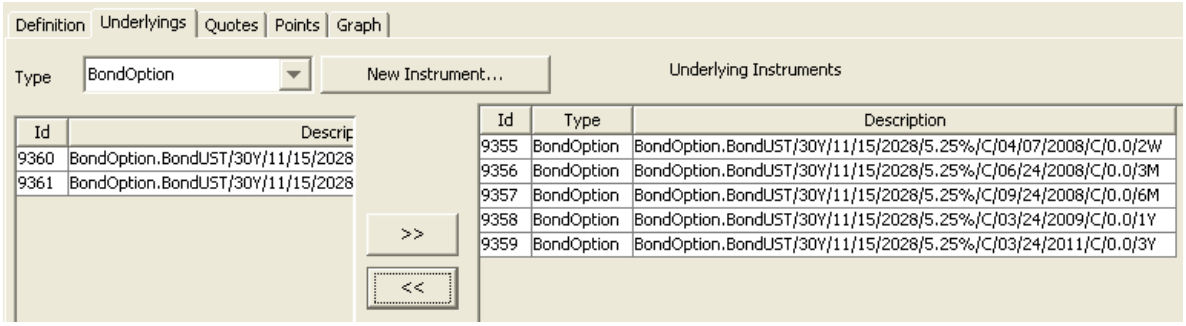
4.1.1 Definition Panel

Select the following to define the surface: currency, product, volatility type “BondOption”, strike type, interpolator, check the Derived checkbox, generator BondOption, date-roll convention, holiday calendars, pricing environment.



4.1.2 Underlyings Panel

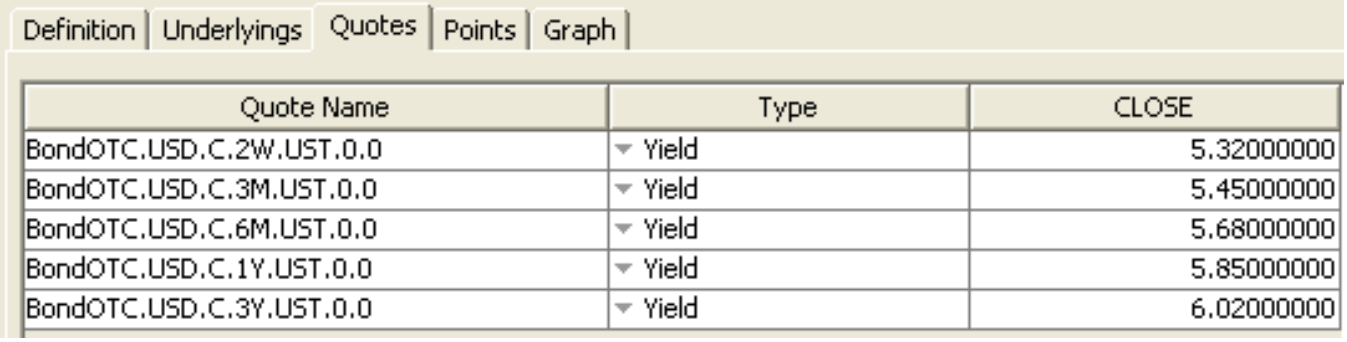
Select the Underlyings panel.



» Select BondOption from the Type field and select bond options, then click ... to add them to the list of underlying instruments.

4.1.3 Quotes Panel

Select the Quotes panel, and enter quotes for the underlying instruments as needed.

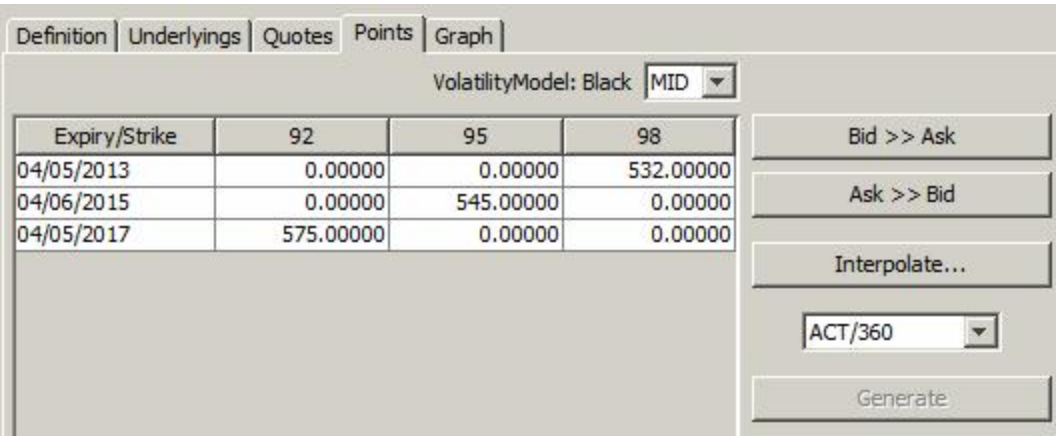


Quote Name	Type	CLOSE
BondOTC.USD.C.2W.UST.0.0	Yield	5.32000000
BondOTC.USD.C.3M.UST.0.0	Yield	5.45000000
BondOTC.USD.C.6M.UST.0.0	Yield	5.68000000
BondOTC.USD.C.1Y.UST.0.0	Yield	5.85000000
BondOTC.USD.C.3Y.UST.0.0	Yield	6.02000000

» You can click **Save Quotes** to save the quotes.

4.1.4 Points Panel

Select the Points panel. Click **Generate** to generate the points.



4.1.5 Save Surface

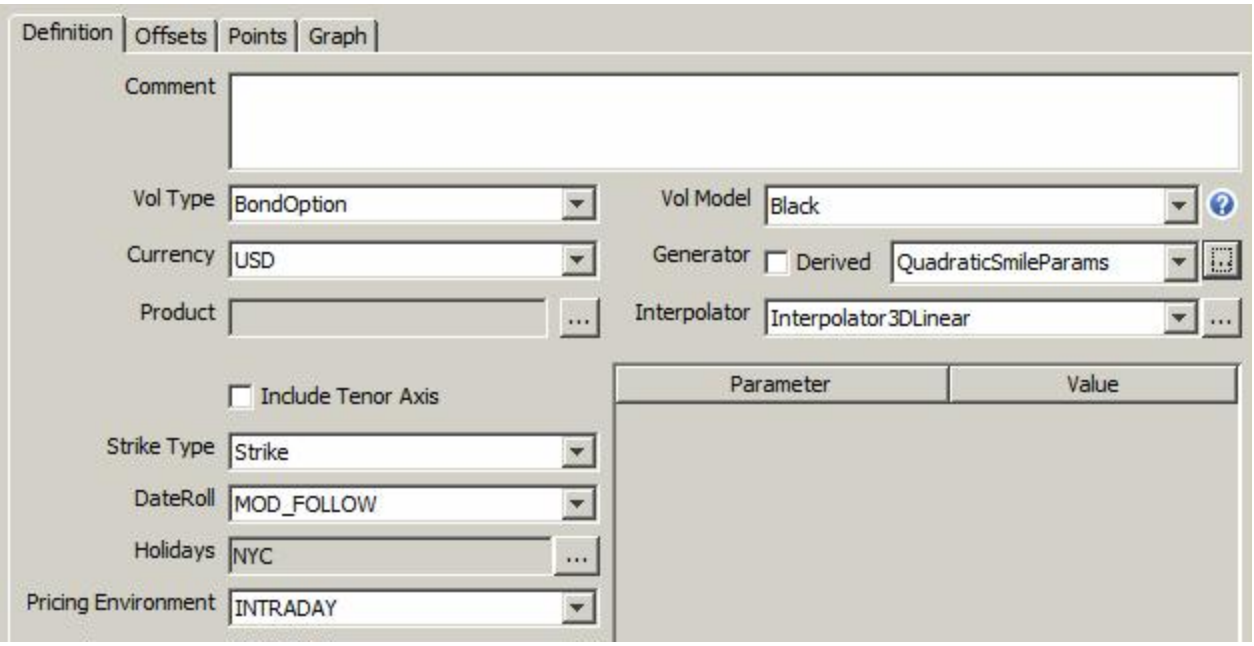
Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

4.2 Step 2 – Quadratic Adjustments Volatility Surface

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

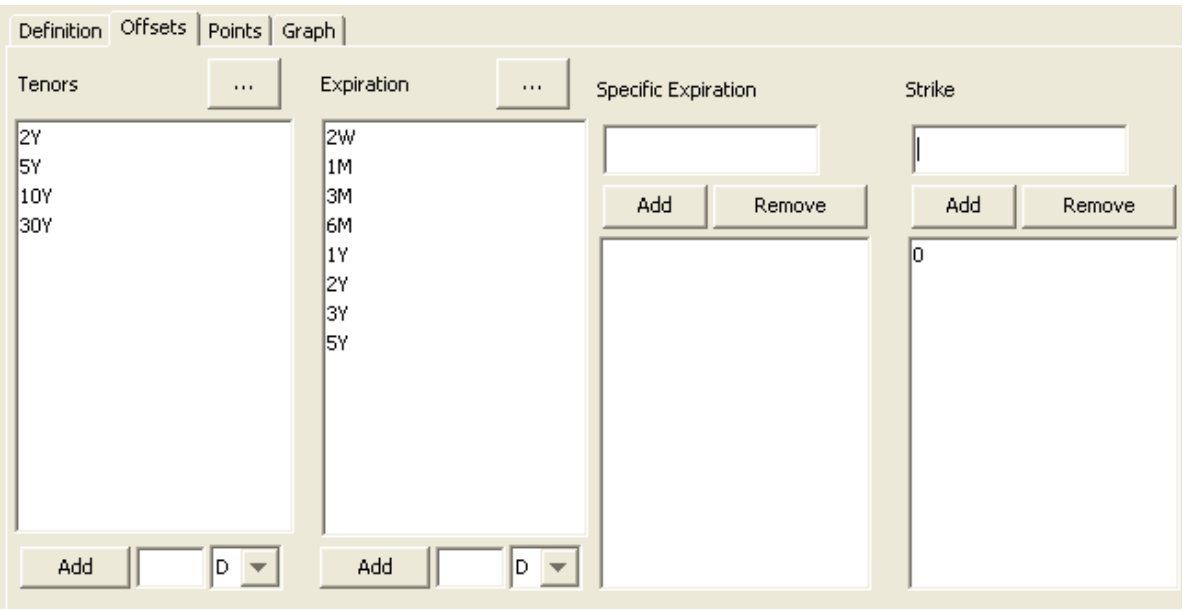
4.2.1 Definition Panel

Select the following to define the surface: currency, volatility type “BondOption”, bond product, strike type, interpolator, vol model, the Derived checkbox should not be checked, generator QuadraticSmileParams, date-roll convention, holiday calendars, pricing environment.



4.2.2 Offsets Panel

Select the Offsets panel.

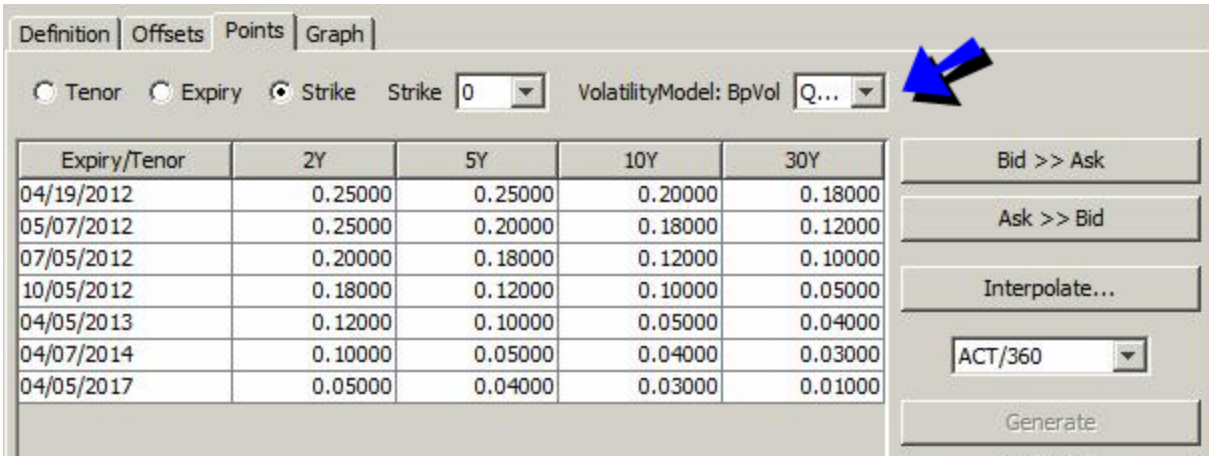


- Select the tenors and expirations.
- Enter 0 in the Strike field and click **Add**.

4.2.3 Points Panel

Select the Points panel, and click **Generate** to generate the points.

Select QuadAlpha / QuadBeta from the Volatility Model field, and enter the adjustments.



4.2.4 Save Surface

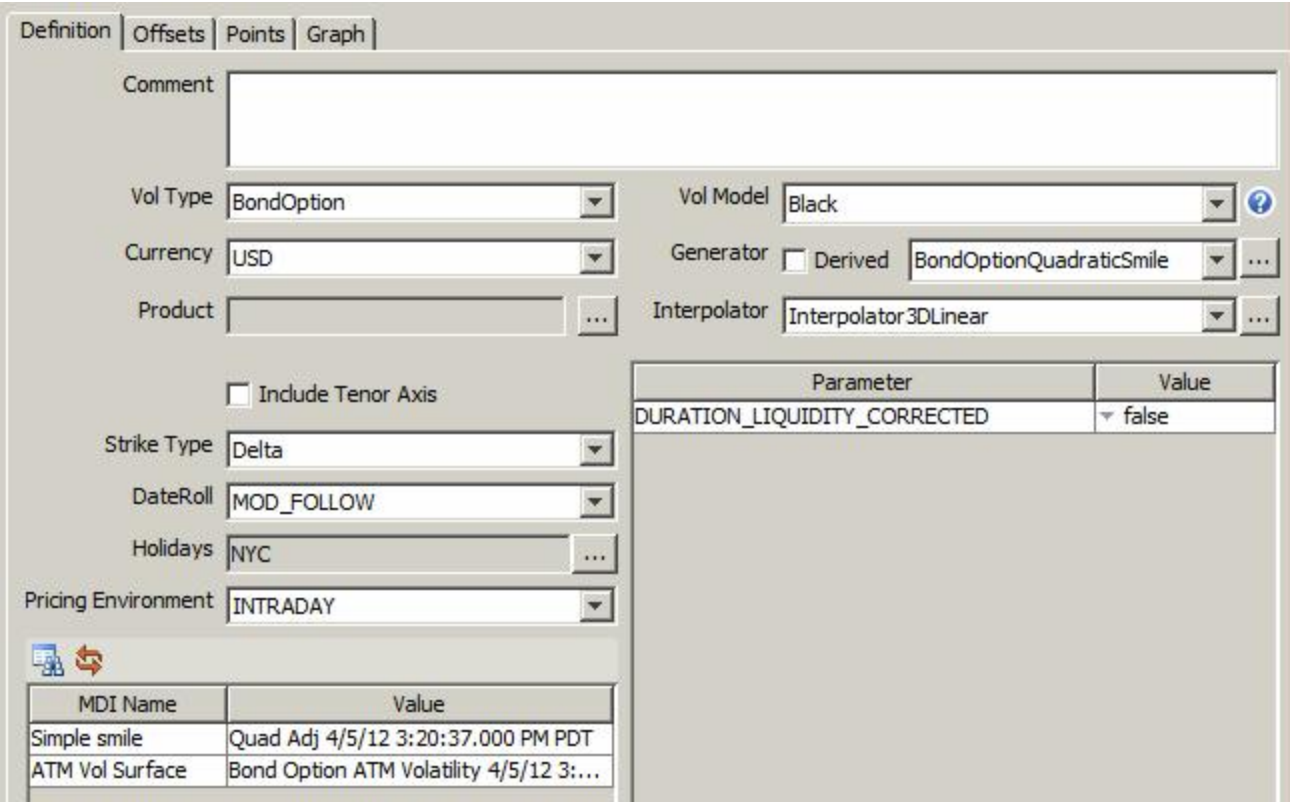
Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

4.3 Step 3 – Final Bond Option Volatility Surface

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

4.3.1 Definition Panel

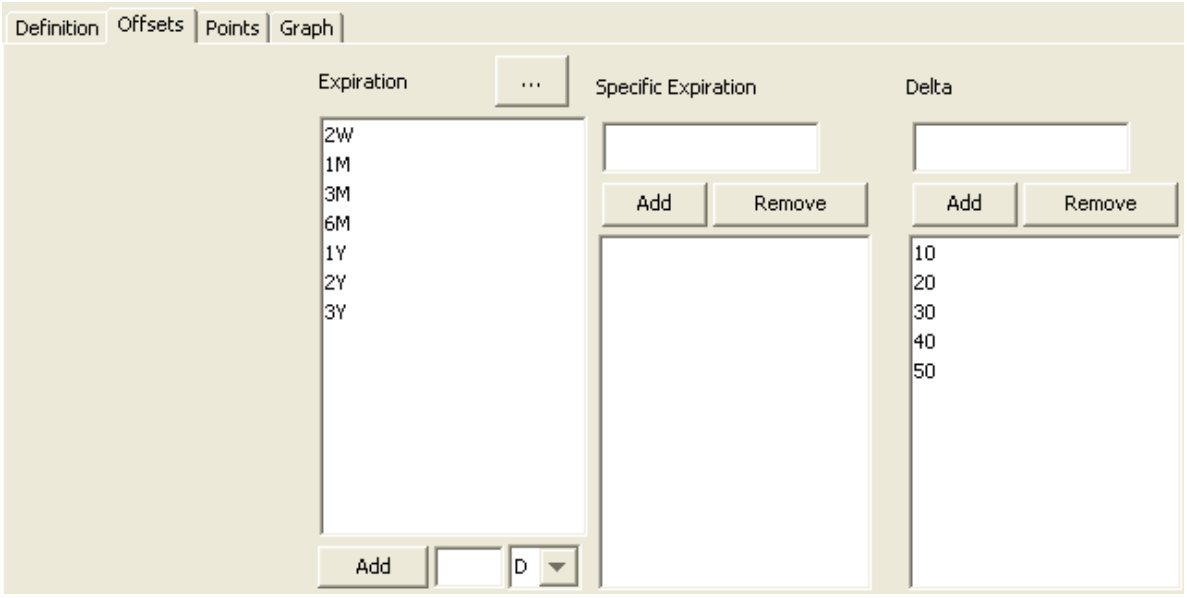
Select the following to define the surface: currency, volatility type “BondOption”, bond product, strike type Delta, interpolator, vol model, the Derived checkbox should not be checked, generator BondOptionQuadraticSmile, date-roll convention, holiday calendars, pricing environment.



» In the MDI area, select the quadratic adjustments volatility surface, and the ATM volatility surface.

4.3.2 Offsets Panel

Select the Offsets panel.



- Select the expirations.
- Enter the deltas.

4.3.3 Points Panel

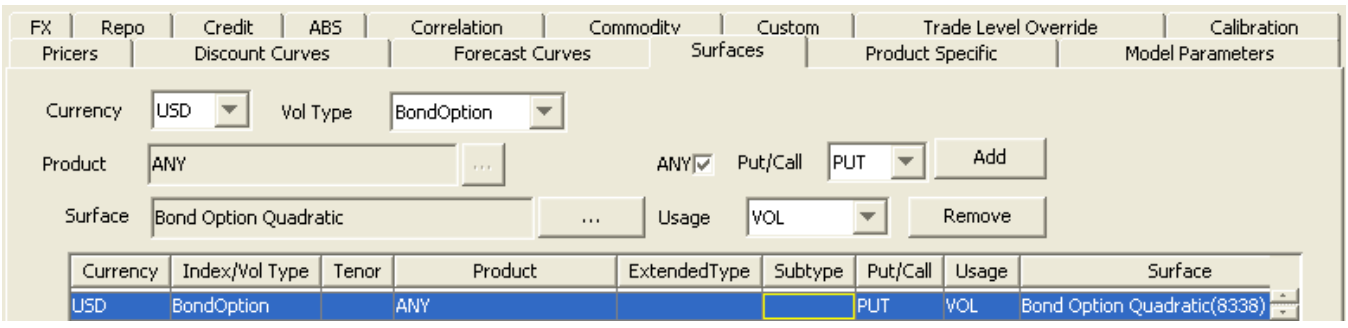
Select the Points panel, and click **Generate** to generate the points.

4.3.4 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

4.4 Pricer Configuration

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



- Select the currency and BondOption volatility type.

- Select a product or click ANY, and select PUT / CALL / or ANY.
- Select the VOL usage.
- Click **...** to select the volatility surface.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

5. COMMODITY Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

This page describes setting up:

- The COMMODITY volatility surface from offsets using this CommoditySimple generator
- The derived COMMODITY volatility surface using the Moneyness and CommodityDelta generator
- Pricer configuration

▶ See also Volatility Surface Overview.

5.1 Generating a COMMODITY Volatility Surface from Offsets

COMMODITY Volatility Surface from Offsets Quick Reference

Configuration Requirements

- Commodity Product – Define the commodity as a product in the system. From the Calypso Navigator, navigate to **Configuration > Commodities > Commodities**.

Surface Generation

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

2. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

3. Definition Panel — Select the following to define the surface: currency, volatility type “Commodity”, click **...** to select the commodity product, volatility quote type, “Derived” should not be selected so that you can create the surface from offsets, CommoditySimple generator.

4. Offsets Panel — Select the tenor and expirations. Enter the strikes or relative moneyness.

5. Points Panel — Click **Generate** to generate the points. Enter the market volatilities.

6. Click **Save**, enter a name for the surface, and click **OK**.

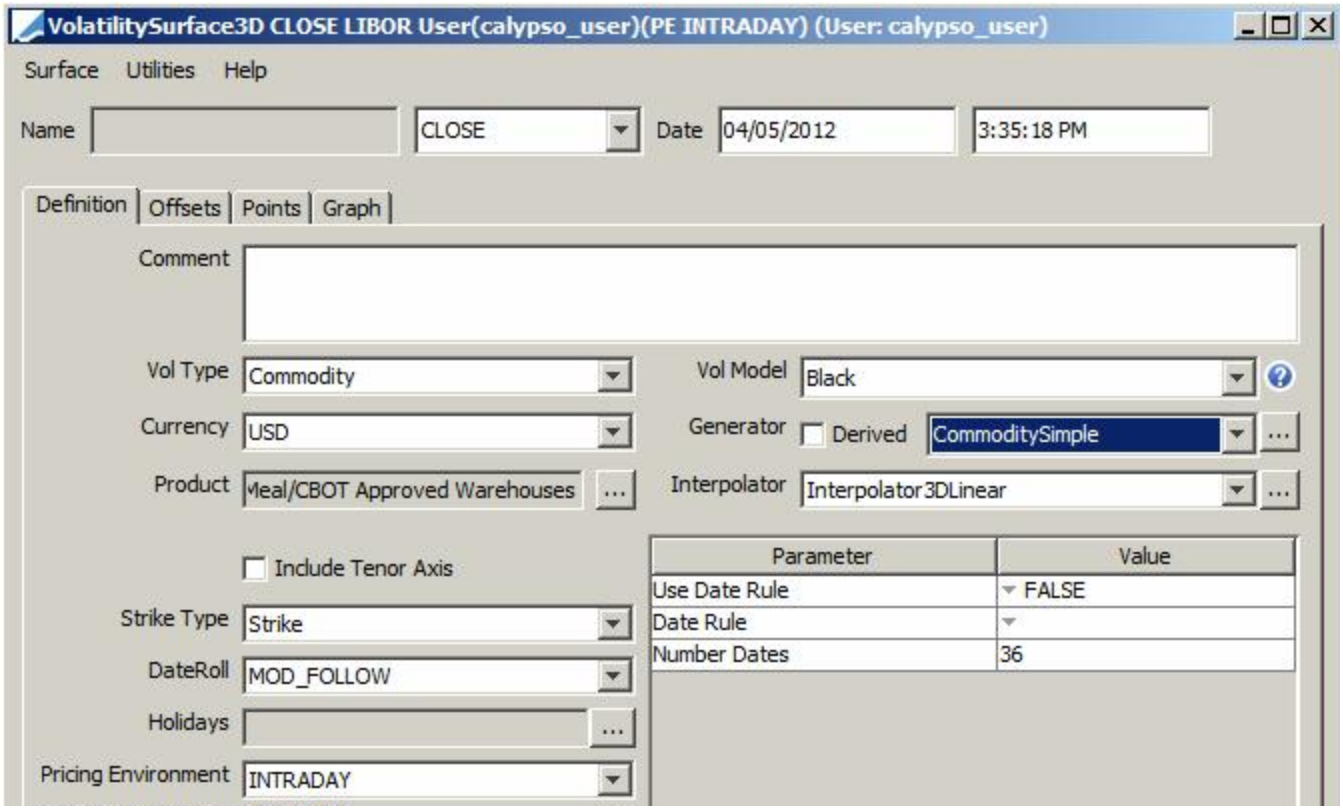
Pricer Configuration

A COMMODITY volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the volatility type Commodity and the usage VOL.

5.1.1 Definition Panel

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

Select the following to define the surface: currency, volatility type “Commodity”, click ... to select the commodity product, “Derived” should not be selected so that you can create the surface from offsets, select the CommoditySimple generator.

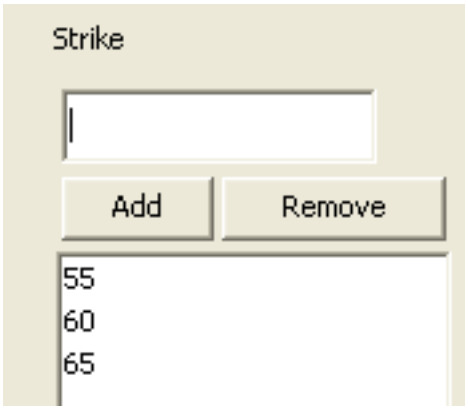
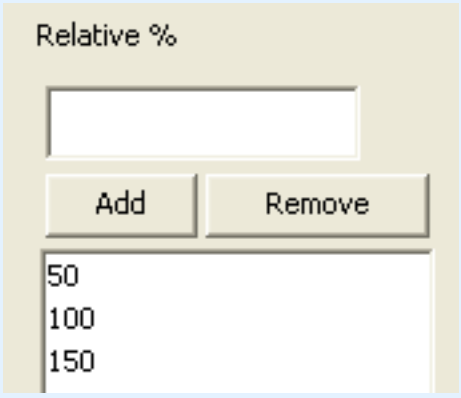


» You can set the following CommoditySimple generator parameters.

Parameter	Description
Use Date Rule	Set to "TRUE" to use a date rule to generate the dates, instead of selecting tenors in the Offset panel.
Date Rule	Select a date rule to generate the tenors. Create date rules using **Configuration > Definitions > Date Rule Definitions** from the Calypso Navigator.
Number Dates	Enter the number of dates you want to generate in the Number Dates parameter.

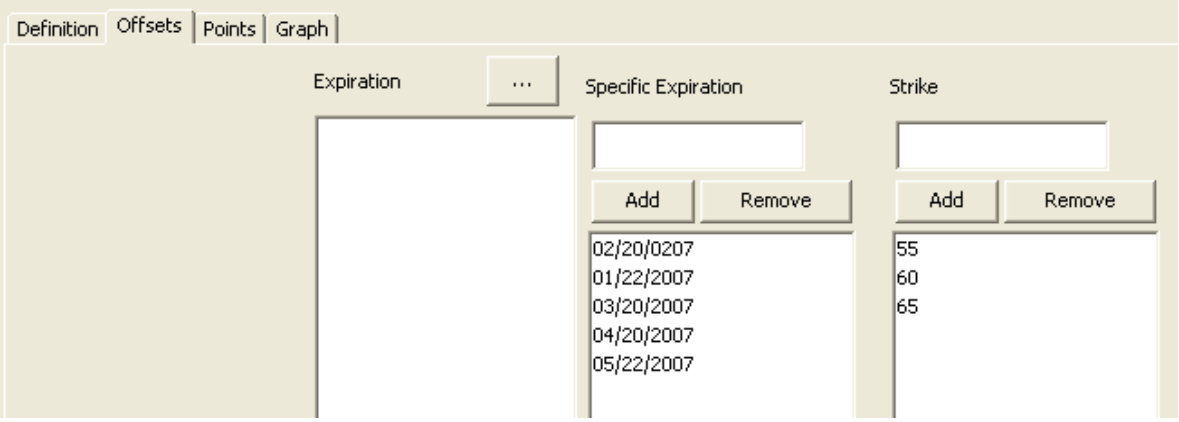
» Select the strike type: Strike or Relative %.

Surface Type	Definition
Strike	In the Offset panel, enter absolute strikes.

Surface Type	Definition
	
Relative %	In the Offset panel, enter relative moneyness. - 100% means the strike is equal to forward projected price - 50% means the strike is 50% of the forward projected price - 150% means the strike is 150% of the forward projected price 

5.1.2 Offsets Panel

Select the Offsets panel.



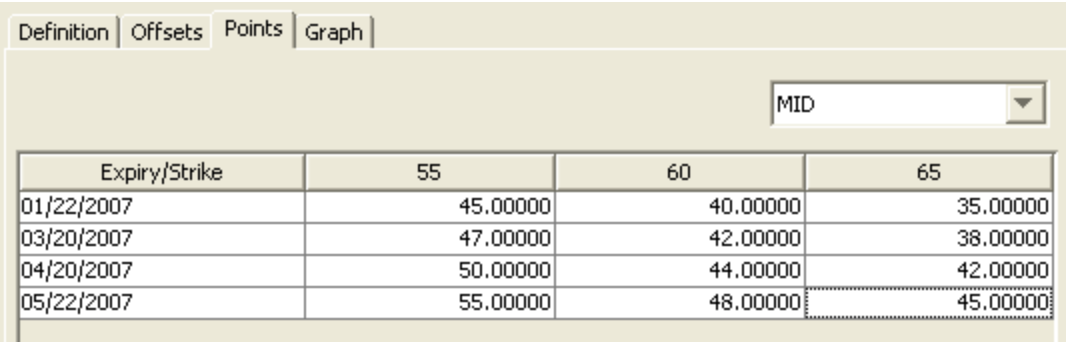
- Select the expirations. Click **...** to select the expirations by tenor. Alternatively, enter the specific dates for the expirations and click **Add** to add the dates to the panel below.

  [NOTE: If the generation parameter "Use Date Rule" is true, you only need to enter strikes or relative moneyness, the dates are automatically generated using the selected date rule.]

- Enter the strikes or relative moneyness and click **Add**. Repeat for each strike or relative moneyness.

5.1.3 Points Panel

Select the Points panel.



- Click **Generate** to generate the surface.
- Enter market volatilities.

5.1.4 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

5.2 Derived Commodity Volatility Surface Generator

5.2.1 Generating a Derived Delta based COMMODITY Volatility Surface

Commodity Volatility Surface from Underlying Instruments – CommodityDelta & CommodityVolatilitySpread Generators Quick Reference

Configuration Requirements

- Commodity Product – Define the commodity as a product in the system. From the Calypso Navigator, navigate to **Configuration > Commodities > Commodities**.

Surface Underlying Instruments

You can use Commodity Option underlying instruments. From the Calypso Navigator, navigate to **Configuration > Market Data > Volatility Surface Underlyings**, or in the surface application's Underlyings panel, click **New Instrument**.

Surface Generation

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

2. Select the quote instance to use in the surface generation (CLOSE, LAST, or OPEN).

3. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

4. Definition Panel — Select the following to define the surface: currency, volatility type "Commodity", click **...** to select the commodity product, "Derived" should be selected, select the "Delta" strike type, select the CommodityDelta or CommodityVolatilitySpread generator.

5. Underlyings Panel — Select the underlying instruments. For the CommodityVolatilitySpread generator, the spread underlying has to match that of the underlying surface.

6. Quotes Panel — Enter quotes manually, use quotes from the quote set, or use real-time quotes.

7. Points Panel — Click **Generate** to generate the points.

8. Click **Save**, enter a name for the surface, and click **OK**.

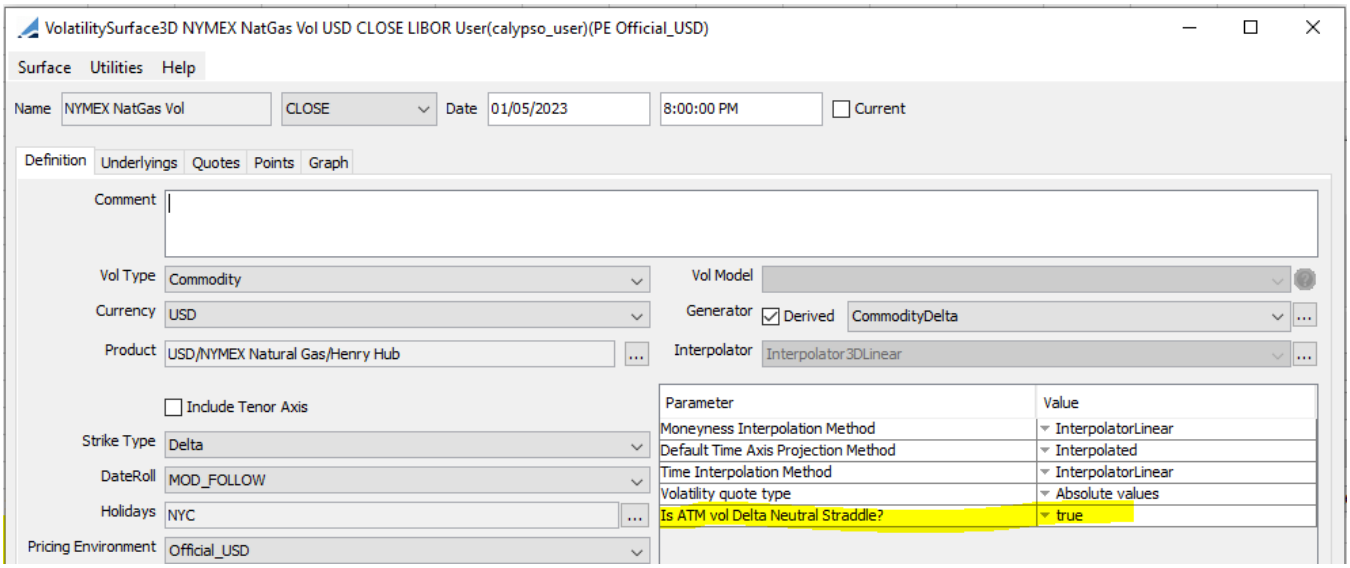
Pricer Configuration

- A COMMODITY volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the volatility type Commodity and the usage VOL.
- The VOLATILITY pricing parameter allows you to set a constant volatility for a given product, which allows you to price CMD products without the need to generate a vol surface. If your vol surface is in the pricing environment but not being picked up, check to see if this parameter is set in your pricing environment.

5.2.1.1 Definition Panel

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

Select the following to define the surface: currency, volatility type “Commodity”, click ... to select the commodity product, “Derived” should be selected, select the “Delta” surface type, select the CommodityDelta or CommodityVolatilitySpread generator (click ... to add the generator as needed).



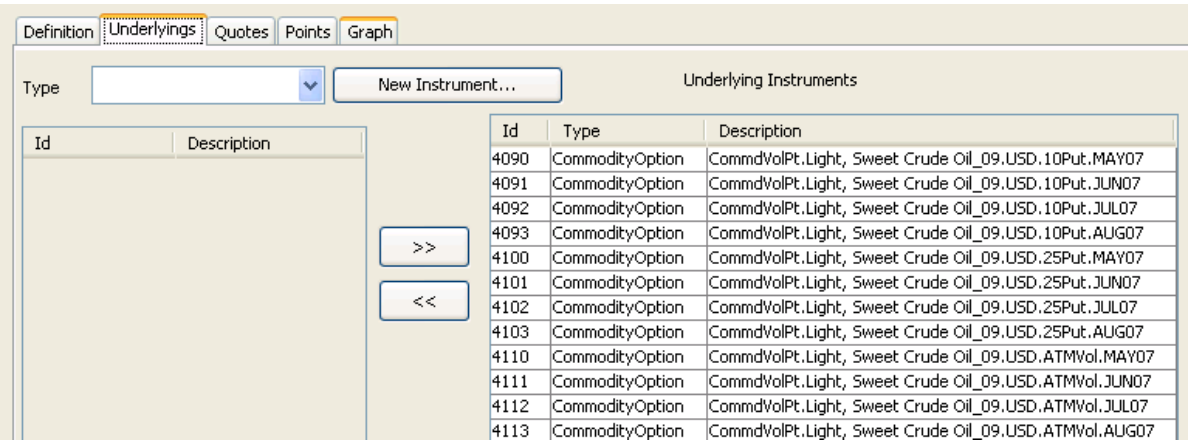
» You can set the following generator parameters as desired.

Parameter	Description
Moneyness Interpolation Method	You can select an interpolation method for the moneyness axis independently of the extrapolation method.
Default Time Axis Projection Method	You can select the projection method as Interpolated or Use Commodity Reset.
Time Interpolation Method	Can be selected as *InterpolatorLinear* or *InterpolatorPiecewiseConstantRight*. *InterpolatorLinear* interpolates for the trade option expiry from the vol surface expiry dates linearly. When using *InterpolatorPiecewiseConstantRight* interpolator, if the trade option expiry is greater than “an” expiry pillar of the vol surface, the interpolator will return the next expiry pillar’s volatility.
Is ATM vol Delta Neutral Straddle	To control whether the ATM vol corresponds to Moneyness as 1 (false) or to the delta neutral strike (true). Default value is false which keeps backward compatibility. Note: When Parameter is set to TRUE, ATM Vol would represent 50Delta. If FALSE, ATM Vol would represent Moneyness as 1.

Parameter	Description
Volatility quote type	Select the quote type for the quotes: • "Spread values relative to ATM", to set the quotes as spread values over the ATM volatility (quote type VolatilitySpread) • "Absolute values", to set the quotes as actual volatilities (quote type Volatility)

5.2.1.2 Underlyings Panel

Select the Underlyings panel.

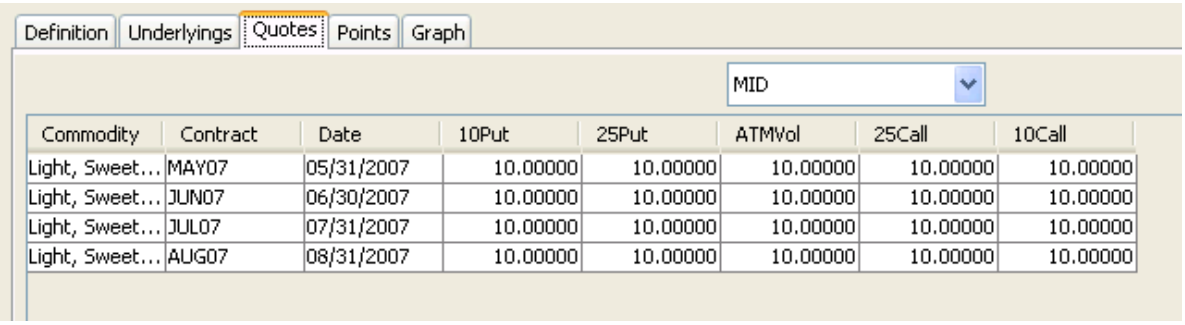


» Select the instrument type to display the list of available instruments. The panel is blank if you have not set up any instruments. Click **New Instruments** to create new instruments.

» Select instruments and click **>>** to add them to the instrument list in the right panel.

5.2.1.3 Quotes Panel

Select the Quotes panel. Enter quotes for the underlying instruments; enter the delta quotes as spreads over the ATM volatility or as absolute values depending on the "Volatility quote type" generator parameter. For example, the value entered for the 25 Delta Call is the difference between the volatility for a call with a 25% (forward) delta and the volatility of an ATM (forward) option.

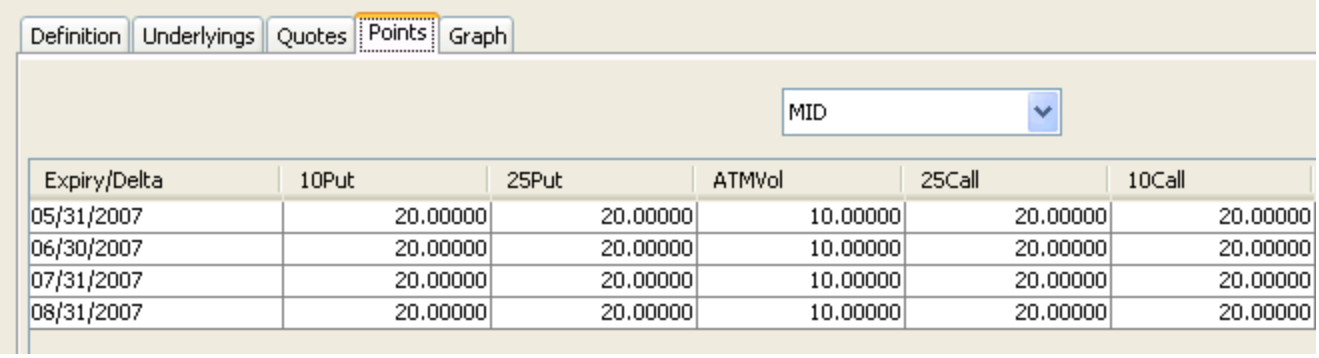


» You can click **Save Quotes** to save the quotes.

5.2.1.4 Points Panel

Select the Points panel, and click **Generate** to generate the points.

Change the drop-down menu value to view Pillar Dates vs. Volatilities or Pillar Dates vs. Moneyness.



Expiry/Delta	10Put	25Put	ATMVol	25Call	10Call
05/31/2007	20.00000	20.00000	10.00000	20.00000	20.00000
06/30/2007	20.00000	20.00000	10.00000	20.00000	20.00000
07/31/2007	20.00000	20.00000	10.00000	20.00000	20.00000
08/31/2007	20.00000	20.00000	10.00000	20.00000	20.00000

5.2.1.5 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

5.2.2 Generating a Derived Moneyness based COMMODITY Volatility Surface

Commodity Volatility Surface from Underlying Instruments – Commodity & CommodityVolatilitySpread Generators Quick Reference

Configuration Requirements

- Commodity Product – Define the commodity as a product in the system. From the Calypso Navigator, navigate to **Configuration > Commodities > Commodities**.

Surface Underlying Instruments

You can use OTC Commodity Option underlying instruments. From the Calypso Navigator, navigate to **Configuration > Market Data > Volatility Surface Underlyings**, or in the surface application's Underlyings panel, click **New Instrument**.

Surface Generation

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

2. Select the quote instance to use in the surface generation (CLOSE, LAST, or OPEN).

3. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

4. Definition Panel — Select the following to define the surface: currency, volatility type “Commodity”, click **...** to select the commodity product, “Derived” should be selected, select the “Relative %” strike type, select the Commodity or CommodityVolatilitySpread generator.

5. Underlyings Panel — Select the underlying instruments. For the CommodityVolatilitySpread generator, the spread underlying has to match that of the underlying surface.

6. Quotes Panel — Enter quotes manually, use quotes from the quote set, or use real-time quotes.

7. Points Panel — Click **Generate** to generate the points.

8. Click **Save**, enter a name for the surface, and click **OK**.

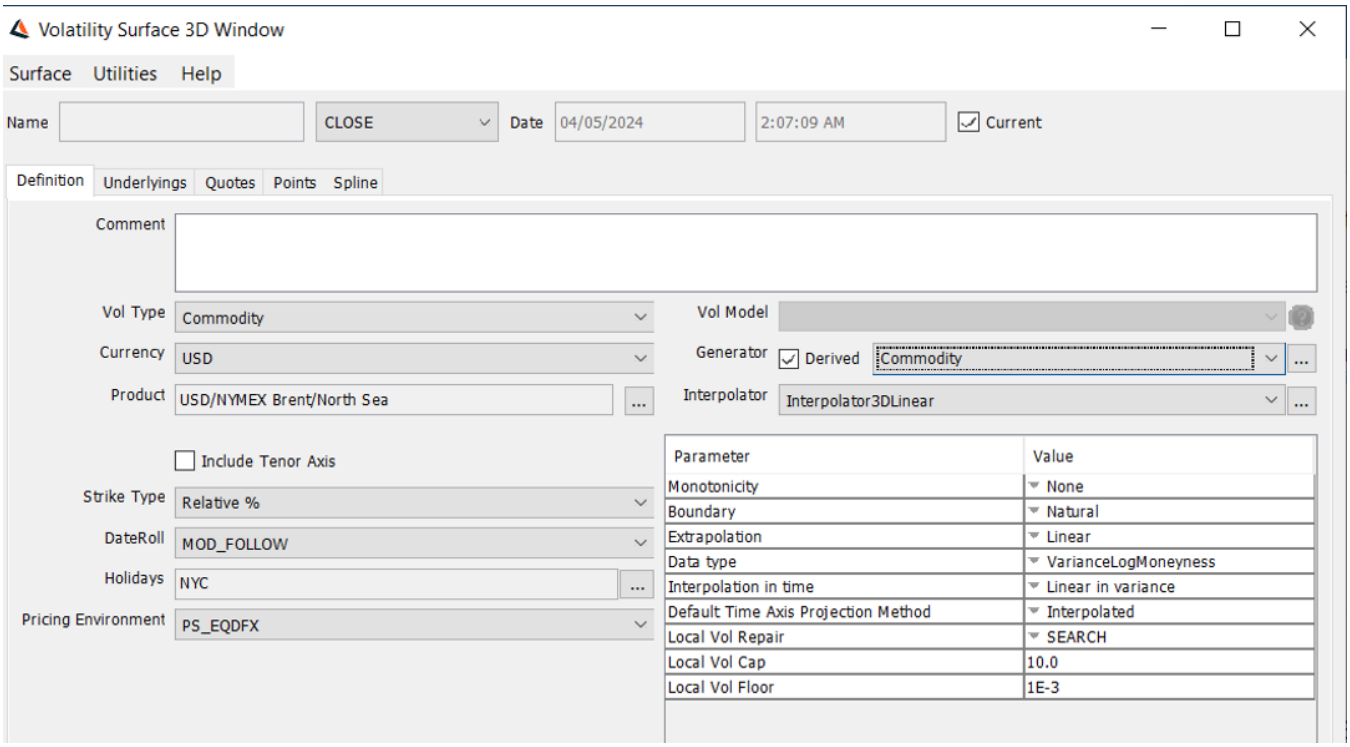
Pricer Configuration

- A COMMODITY volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the volatility type Commodity and the usage VOL.
- The VOLATILITY pricing parameter allows you to set a constant volatility for a given product, which allows you to price CMD products without the need to generate a vol surface. If your vol surface is in the pricing environment but not being picked up, check to see if this parameter is set in your pricing environment.

5.2.2.1 Definition Panel

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

Select the following to define the surface: currency, volatility type “Commodity”, click **...** to select the commodity product, “Derived” should be selected, select the “Relative%” surface type, select the Commodity or CommodityVolatilitySpread generator (click **...** to add the generator as needed).



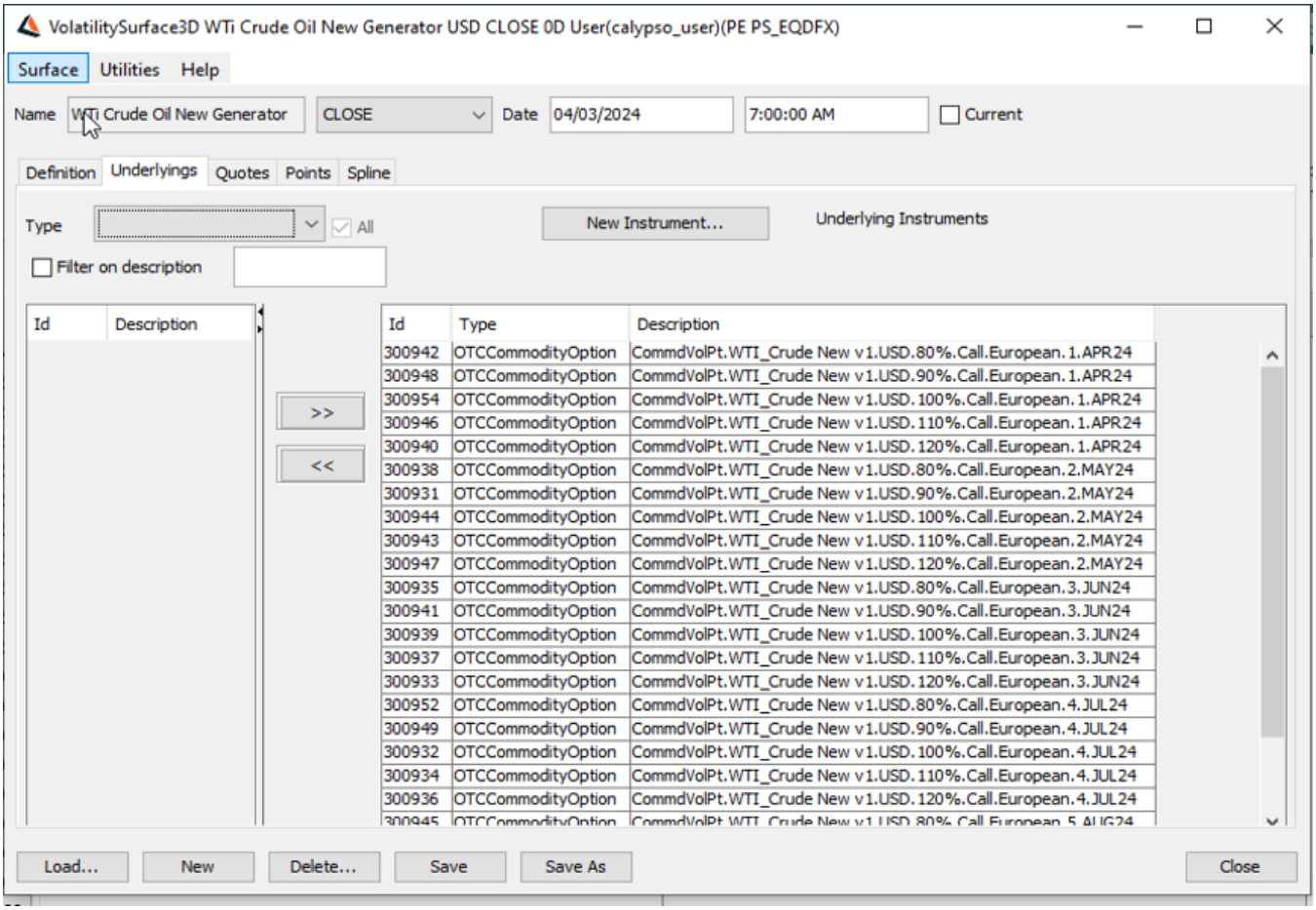
» You can set the following generator parameters as desired.

Parameter	Description
Monotonicity	This parameter offers the possibility to interpolate according to the monotonicity of the data, thereby removing the potential artificial oscillations stemming from cubic splines.
Default Time Axis Projection Method	You can select the projection method as Interpolated or Use Commodity Reset.
Extrapolation	This parameter controls the extrapolation in the strike space. Flat will flat extrapolate the volatilities. Linear will extrapolate linearly using the slope of the first and last cubic polynomials so that the slice stays C2 with natural boundary conditions. Note that if the data type is variance, the extrapolation will be linear in variance, which is typical of stochastic volatility models behavior (for example Heston). The extrapolation is floored to machine epsilon to avoid negative variance. In general, we recommend Linear as it will lead to a smooth implied volatility and therefore a smooth local volatility with Natural spline boundaries, around the extrapolation.
Data Type	This parameters controls which data the spline is applied to. Volatility means that the spline is built from strikes and volatilities, strikes being in the unity defined in the volatility surface (absolute, relative, Delta for SplineSimple). Variance means that the spline is built from strikes and the square of volatilities, strikes being in the unity

Parameter	Description
	defined in the volatility surface, and input volatilities being internally converted to variances. This is particularly interesting when combined with a linear extrapolation. VarianceLogMoneyness means that the is spline built from log-moneyness log (K/F) and variances σ^2, strikes are internally converted to log-moneyness.
Interpolation in Time	By default, the interpolation in time is in linear total variance across the axis (absolute strike, or relative strike or Delta). Through the generator parameter "Interpolation in time", it may be changed to "Linear in volatility", in which case the implied volatilities are interpolated in time across the natural axis of the volatility surface.
Local Vol Repair	This parameter is used when the generator is used with a Local volatility pricer such as PricerLocalVolatility1FFiniteDifference or PricerLocalVolatilityNFMonteCarloExotic.

5.2.2.2 Underlyings Panel

Select the Underlyings panel.

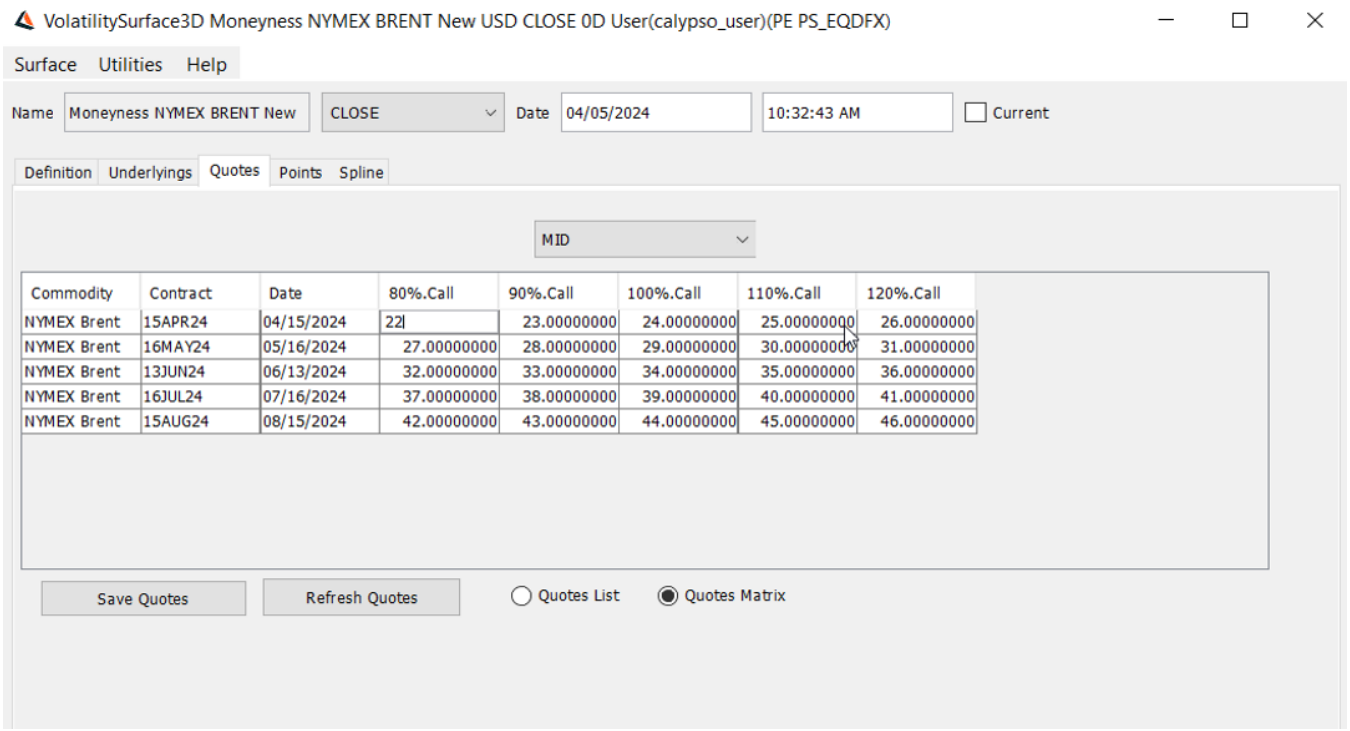


» Select the instrument type to display the list of available instruments. The panel is blank if you have not set up any instruments. Click **New Instruments** to create new instruments.

» Select instruments and click **>>** to add them to the instrument list in the right panel.

5.2.2.3 Quotes Panel

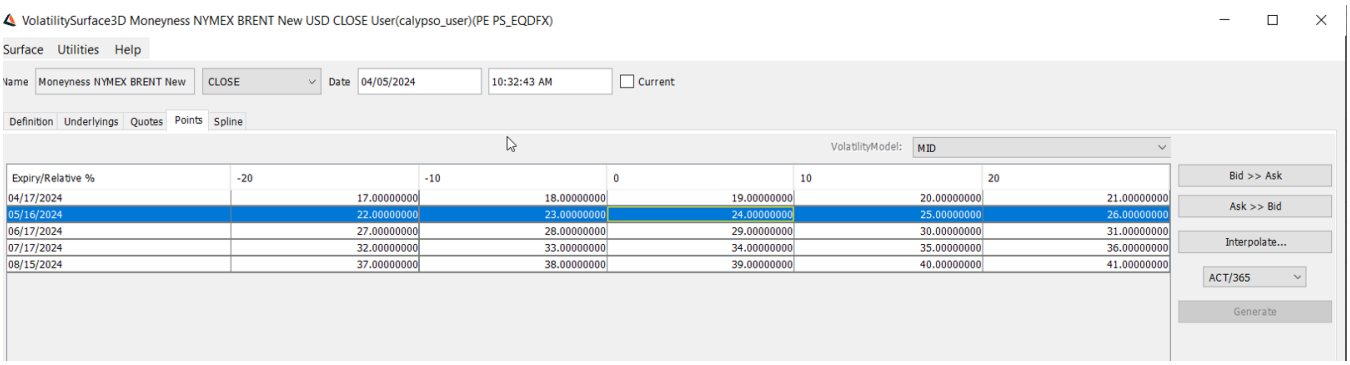
Select the Quotes panel. Enter quotes for the underlying instruments.



» You can click **Save Quotes** to save the quotes.

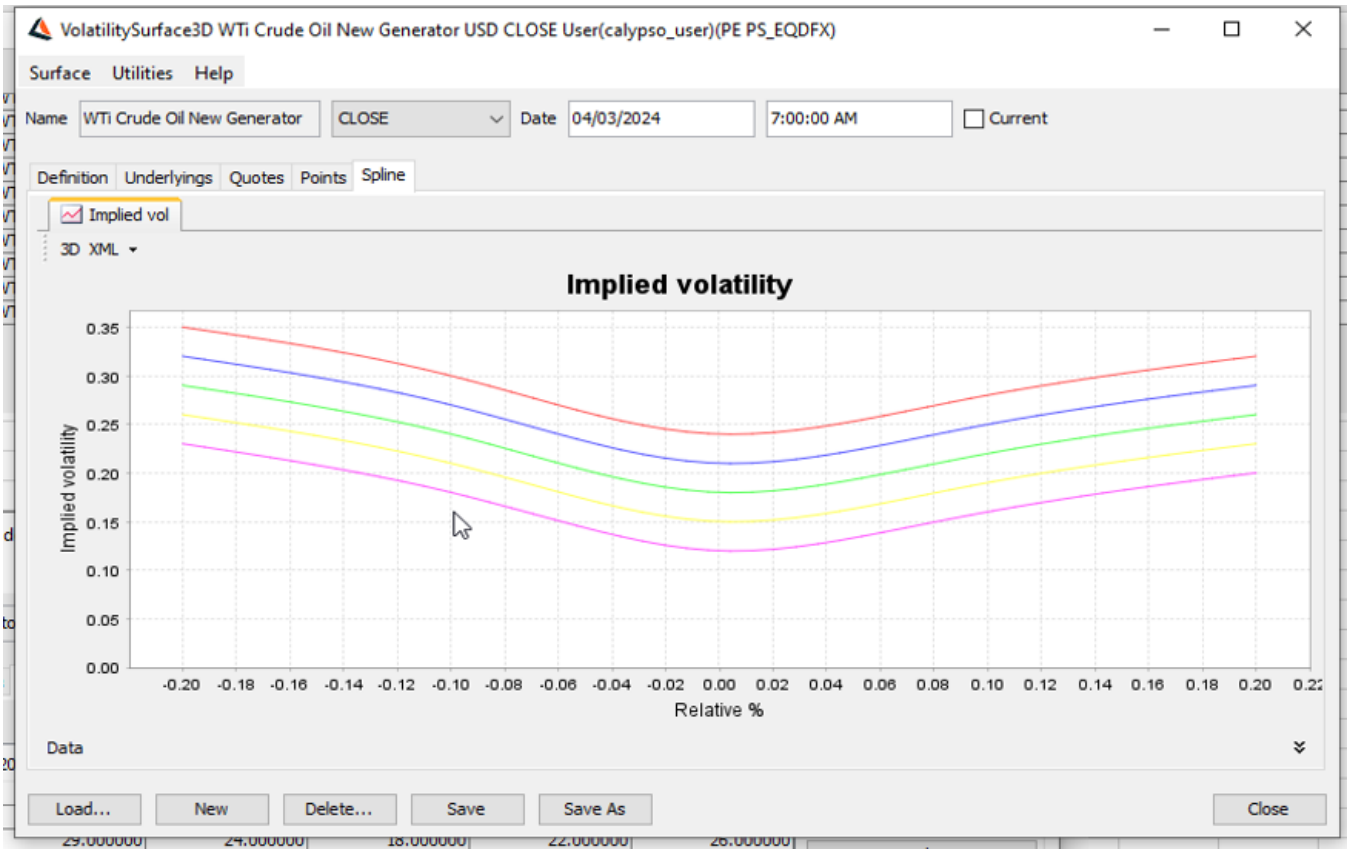
5.2.2.4 Points Panel

Select the Points panel, and click **Generate** to generate the points.



5.2.2.5 Spline Panel

Select the Spline panel, to generate the implied volatility with respect to relative %.



5.2.2.6 Save Surface

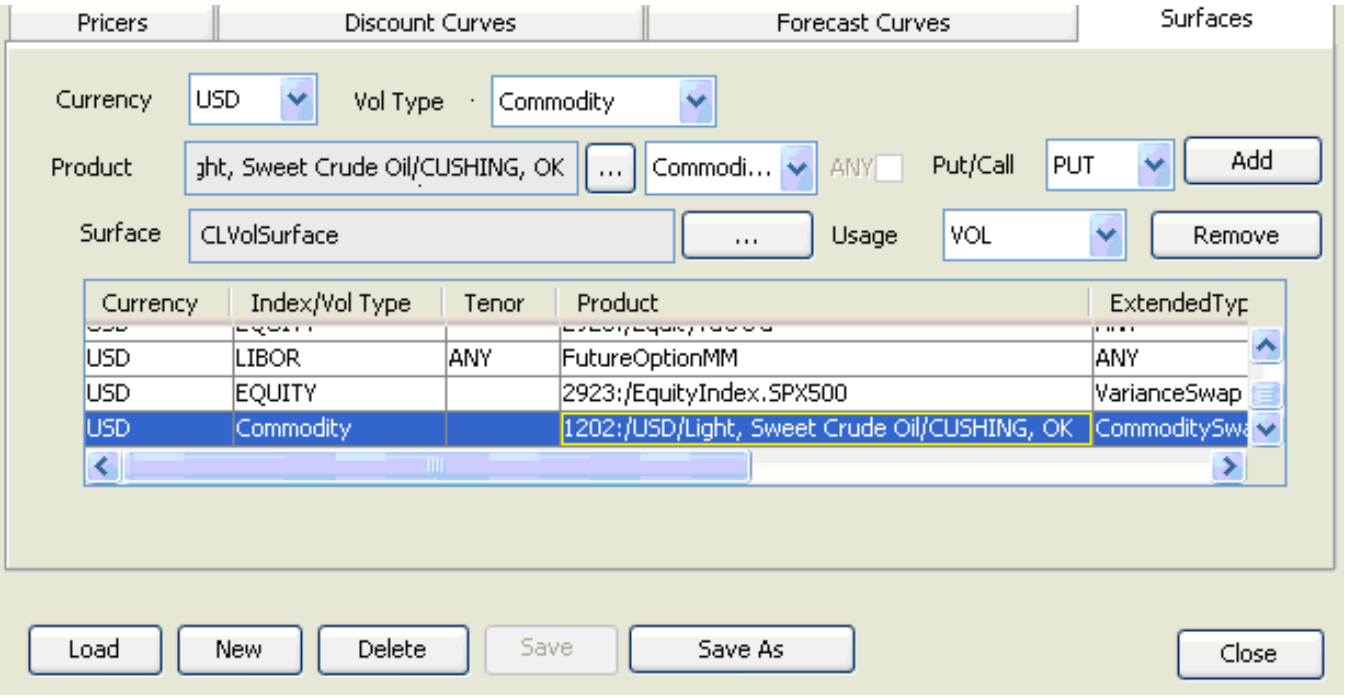
Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

5.3 Pricer Configuration

From the Calypso Navigator, navigate to **Market Data > Pricing Environment > Pricer Configuration**.

Click **Load**, and select a pricer configuration.

Click the Surfaces tab.



- Click ... to select the volatility surface.
- Select the currency, volatility type, product, type of commodity trade, put/call, and usage.
- Click ... to select the volatility surface.
- Select the surface in the Selection window and click **Load** to display the surface name in the pricer configuration.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

6. Proxy Commodity Volatility Surface

Commodities are traded globally. Commodity futures and Commodity options trading in different markets and countries are highly correlated. For portfolios consisting of such products in different markets and different currencies, there is a need to have cross volatility surface that is constructed with a more liquid but foreign currency based commodity volatility surface, FX volatility surface and correlation between these two assets. This volatility surface can then be used in risk decomposition.

For this purpose, it is possible to build the proxy commodity volatility surface in Calypso. This is useful in order to provide vega risk towards a foreign commodity future option when the local market futures options are not liquid enough.

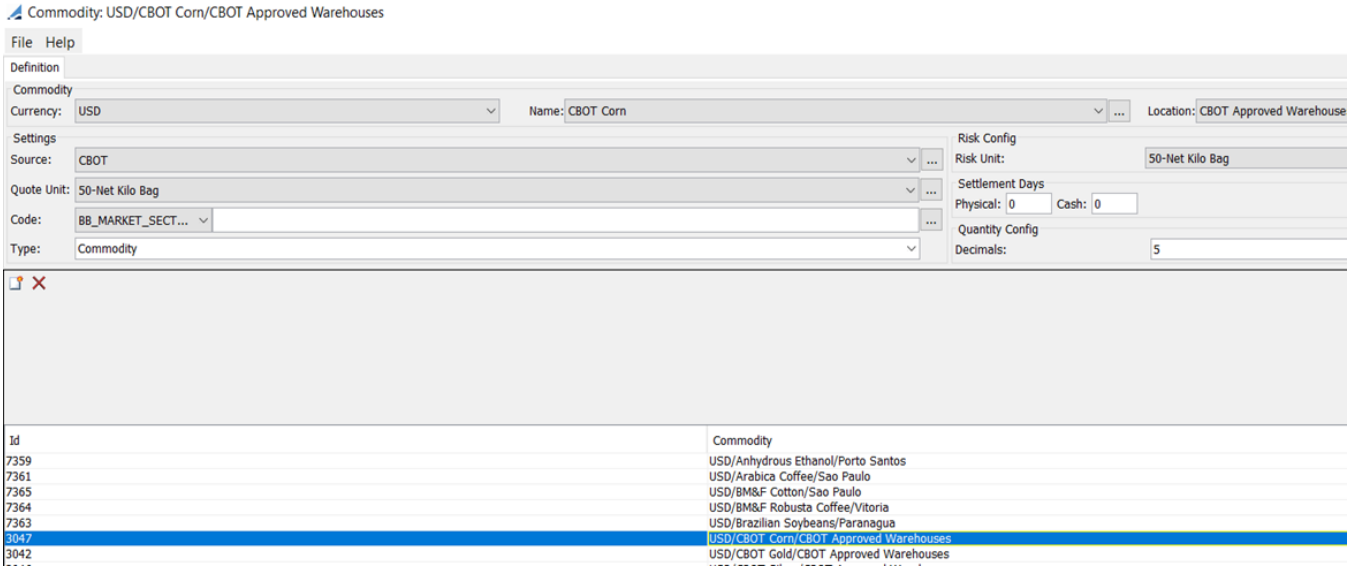
Below is a description of how to use proxy commodity volatility surface, which is created using the proxy volatility surface generator by capturing the commodity correlation such that commodity options can be priced using this proxy surface.

Base (foreign) commodity vol surface and FX vol surface along with the correlation matrix between commodity and FX is used to derive a proxy vol surface. In the example below, base (foreign) commodity is in USD, domestic commodity is in BRL. The proxy commodity vol surface is generated in BRL using base USD vol surface , USD/BRL FX vol surface and correlation between base commodity in USD and USD/BRL FX.

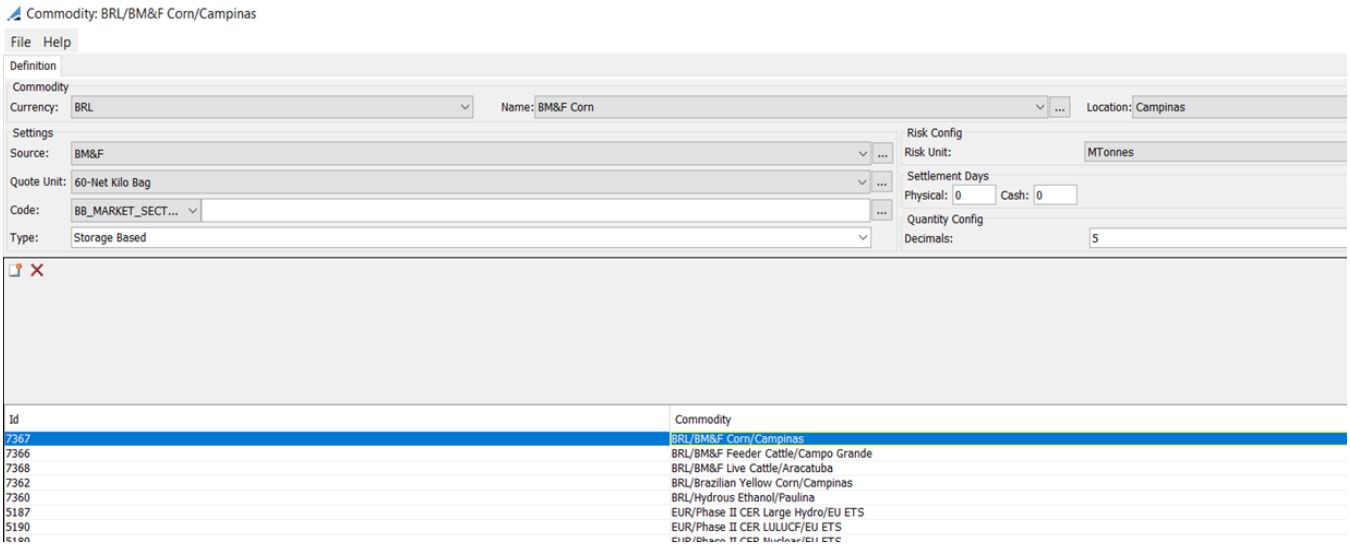
6.1 Defining Commodities

Define the commodity products by choosing **Configuration > Commodities > Commodities** from Calypso Navigator

▶ Refer to *Calypso Commodity Definitions Documentation* for more details.



Defining USD commodity



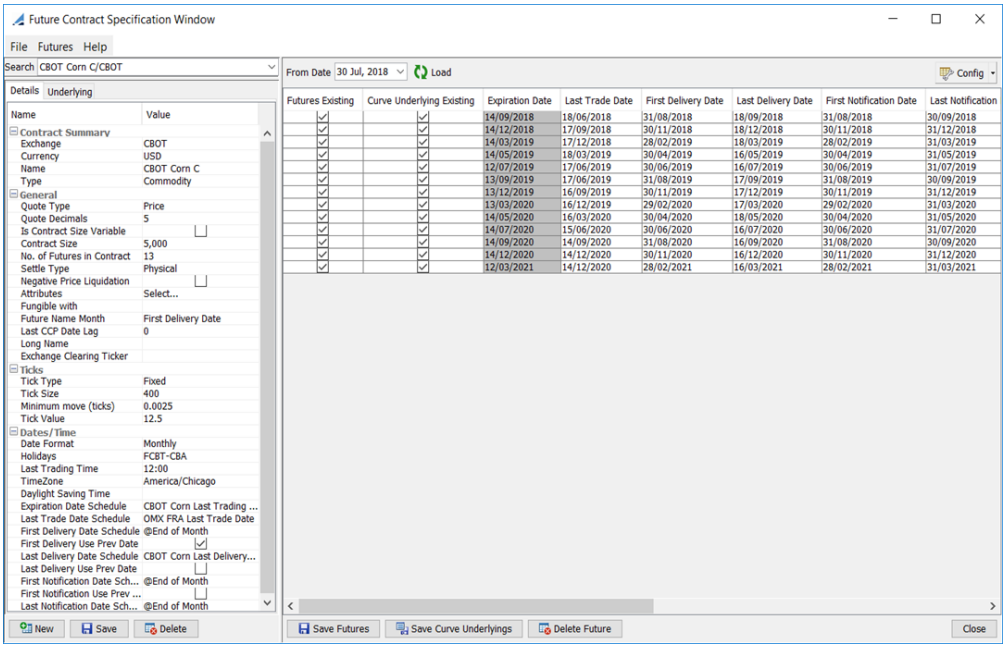
Defining BRL commodity

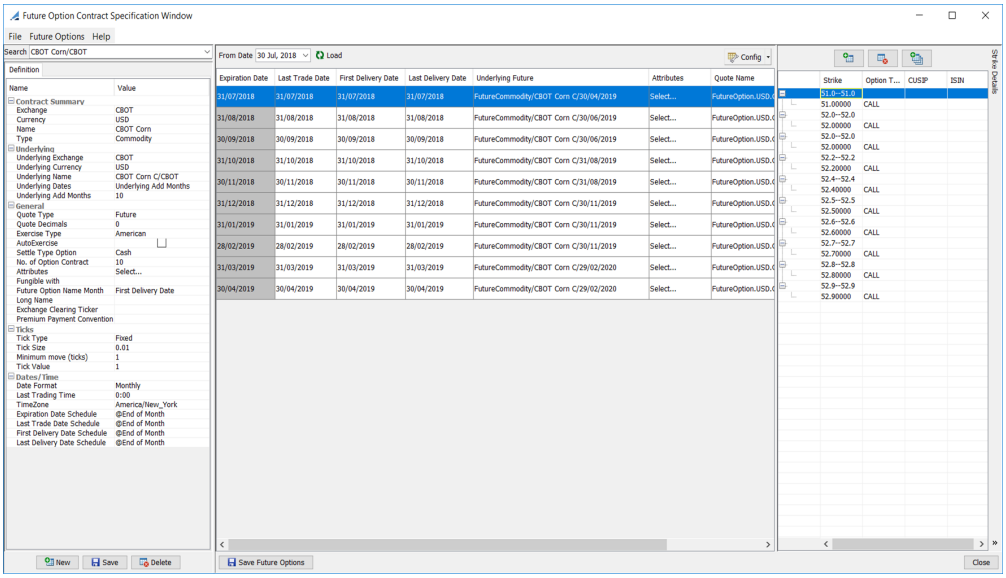
6.2 Defining Commodity Future and Option

Define the future and option contract by choosing **Configuration > Listed Derivatives > Future Contracts** and **Configuration > Listed Derivatives > Future Contracts Options** from Calypso Navigator respectively.

▶ Refer to *Calypso Capturing Commodities Documentation* for more details.

A detailed example of base USD commodity future and option definition is shown below.



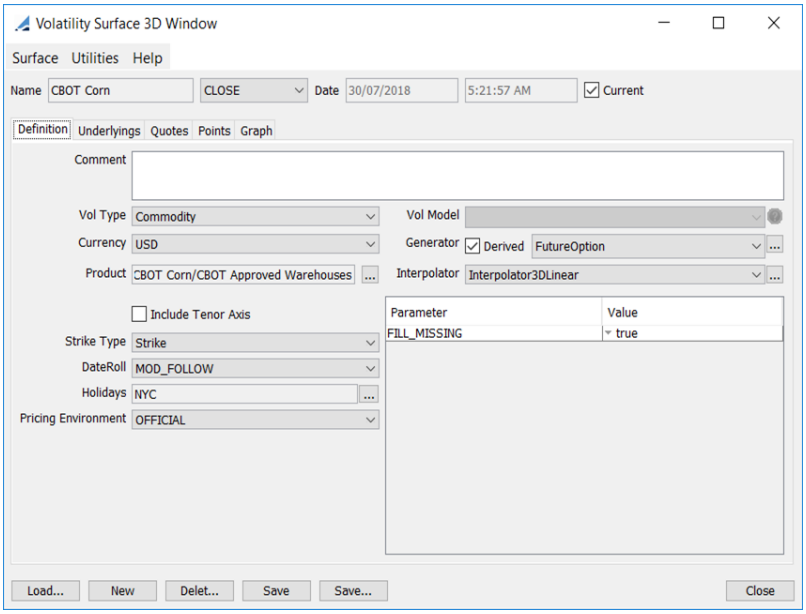


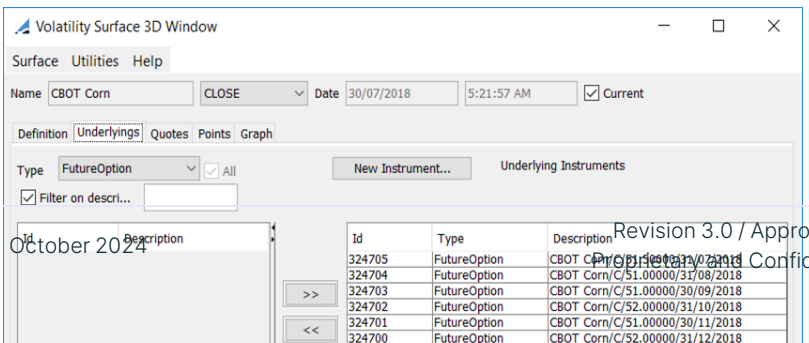
6.3 Defining Base (foreign) Volatility Surface

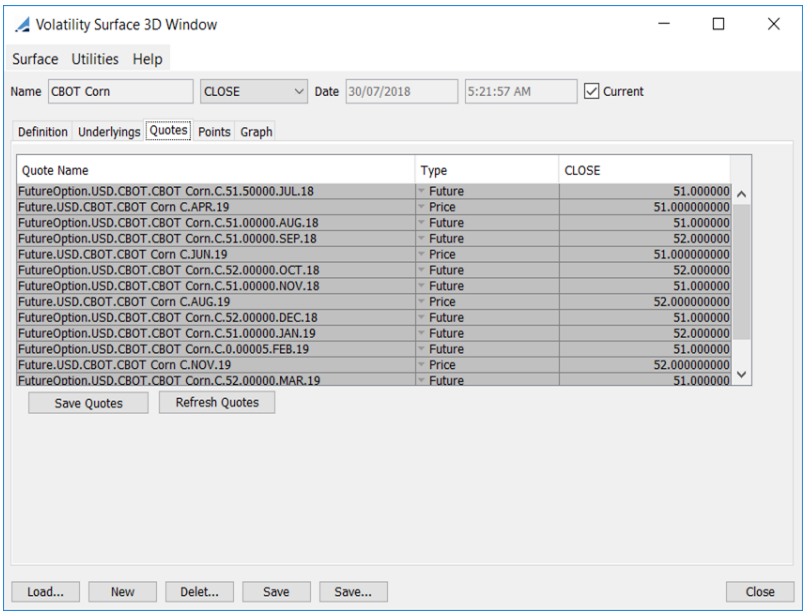
From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

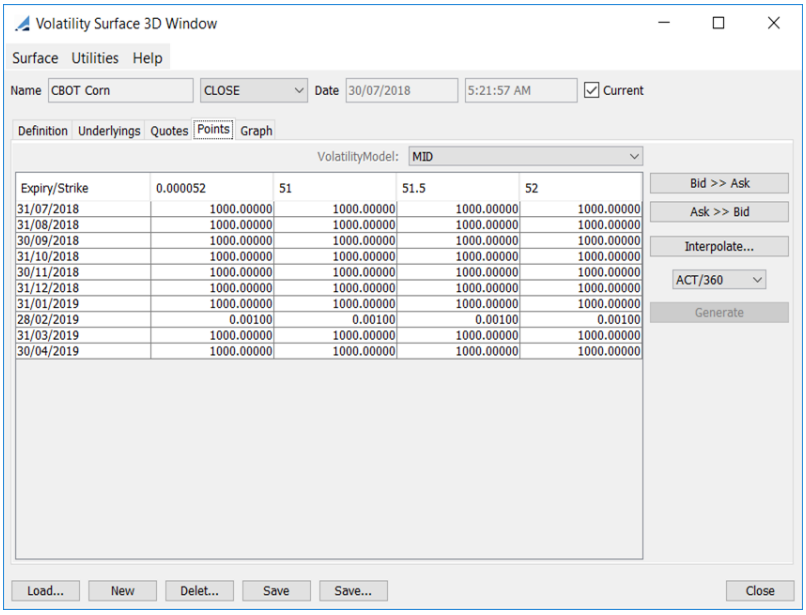
Create a USD commodity vol surface on product CBOT Corn commodity defined above.

▶ Refer to *Calypso Commodity Volatility Surface Documentation* for more details.









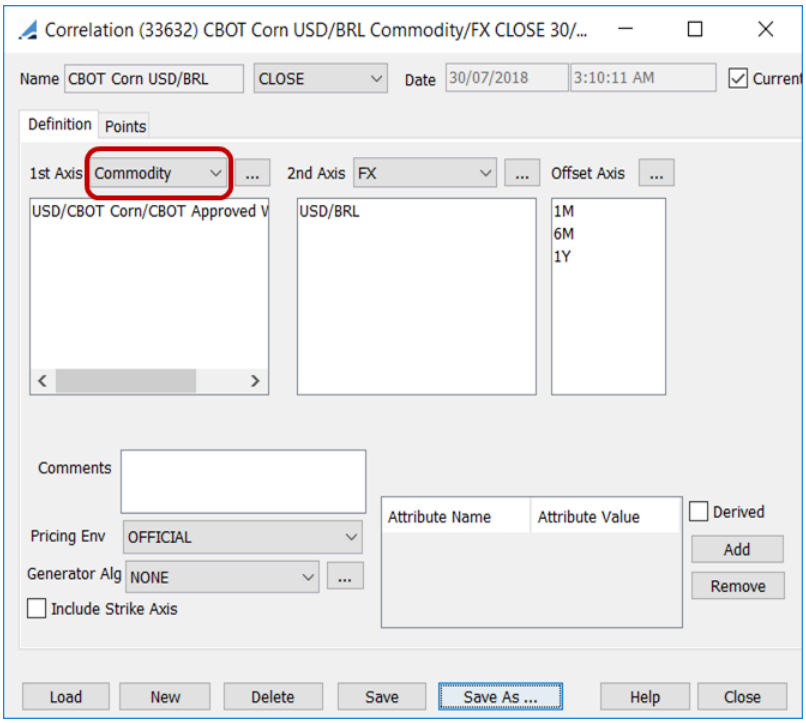
6.4 Defining Correlation Matrix

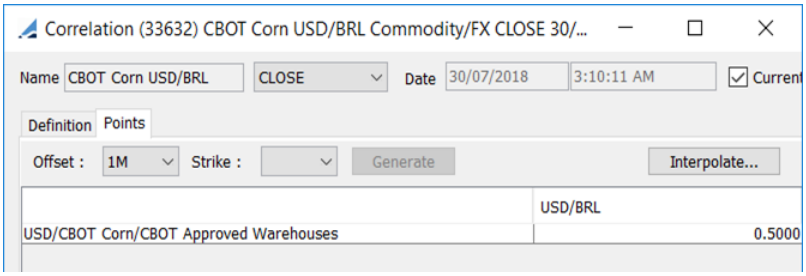
From the Calypso Navigator, navigate to **Market Data > Correlation & Covariance > Correlation Matrix** (menu action `marketdata.CorrelationMatrixWindow`).

A Commodity/Commodity Future axis should be used. For the same commodity future, the correlation is specific per futures maturity. The commodity future, including its expiry month is to be selected as a FutureCommodity instrument under first axis. Hence the maturity/tenor axis is not required. This will allow you to define a correlation matrix between FX rates and commodity futures.

When the first axis is selected as Commodity, the tenor axis can be used for defining the correlation of the commodity per tenor with FX. The correlation matrix window will look like the one shown below.

▶ Refer to *Calypso Correlation Matrix Documentation* for more details on defining a Correlation Matrix.



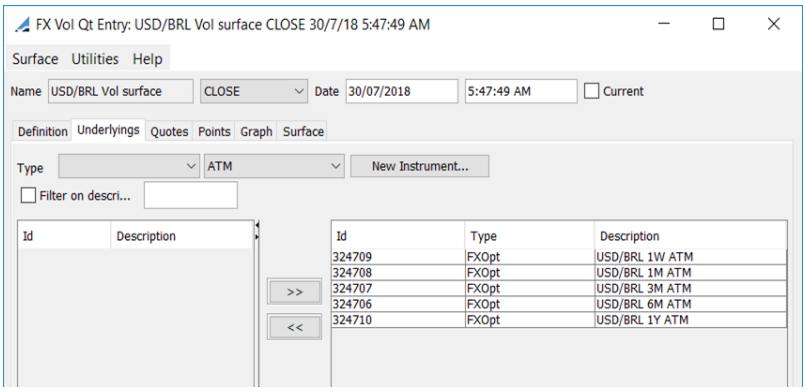


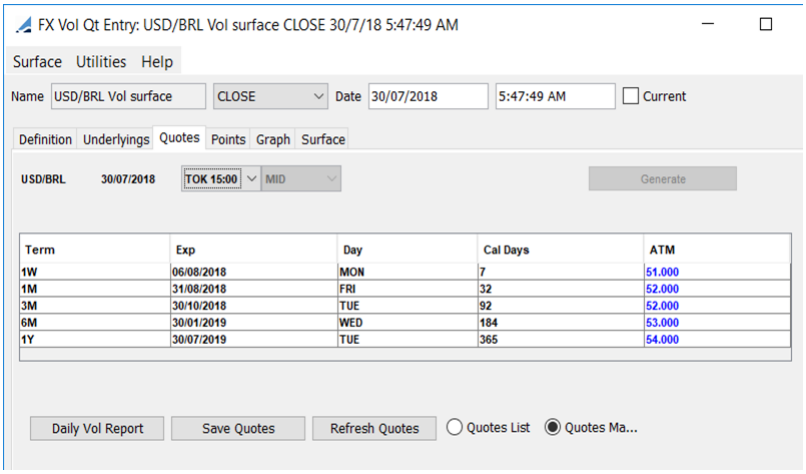
6.5 Defining FX Vol Surface

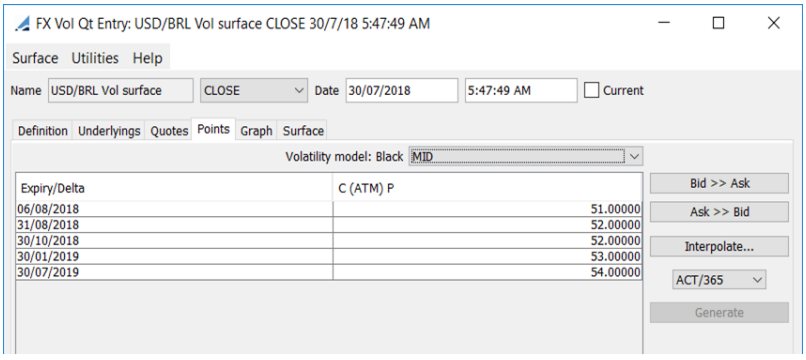
From Calypso Navigator, navigate to **Market Data > Volatilities > FX Volatility Surface** (menu action `marketdata.FXVolatilitySurfaceWindow`).

An FX volatility surface is created from FX Option underlying instruments, or from offsets. Create a FX vol surface as shown below.

▶ Refer to *Calypso FX Volatility Surface documentation* for more details.







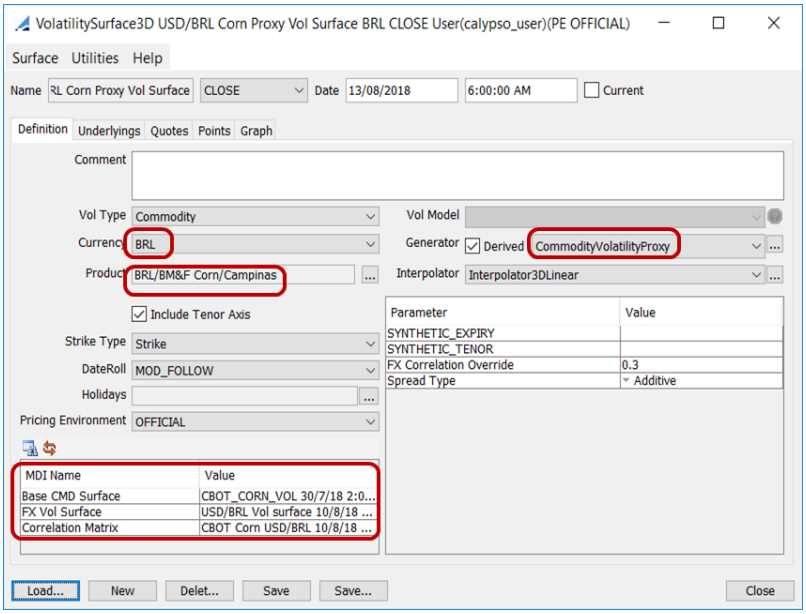
6.6 Defining Proxy Commodity Volatility Surface

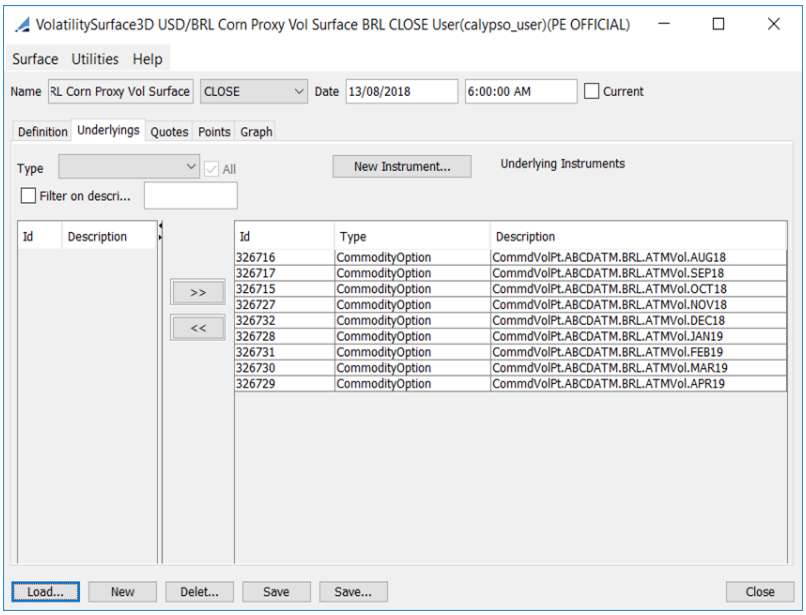
A Derived volatility surface generator called *CommodityVolatilityProxy* should be used.

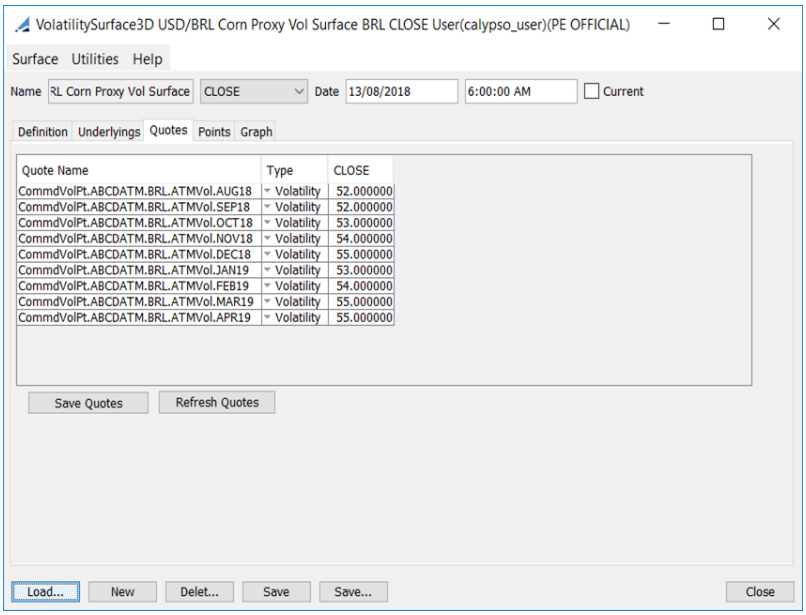
An example of proxy commodity vol surface with underlying commodity and domestic currency BRL as currency is shown below.

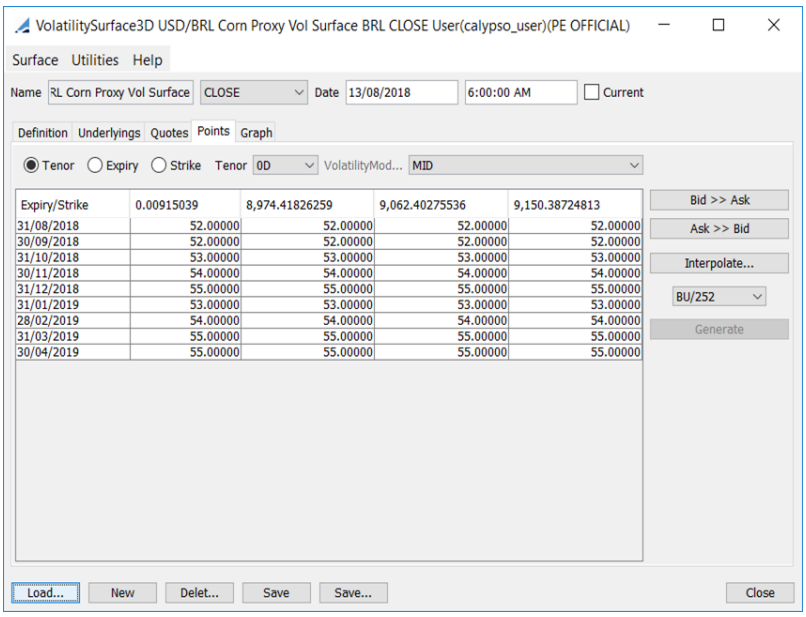
Additional dependent Market data Items (MDI): Base (Foreign) Vol Surface, FX Vol Surface, Correlation Matrix need to be added to the commodity vol surface screen when the generator is selected as *CommodityVolatilityProxy*.

In the Underlyings tab, it relies on two OTC domestic futures options underlyings corresponding to Call and Put At the money (ATM) per expiry.









On clicking **Generate**, the volatility points following the expiries and FX-adjusted strikes of the base(foreign) volatility surface are computed. USD is used in the example.

The volatility formula is as follows :

$$V_d^2 = V_f^2 + V_{fx}^2 - 2\,rho * V_f * V_{fx}$$

where,

Vd: The volatility of the commodity in domestic currency. The strike will be converted using FX rate.

Vf: The volatility of the commodity asset in foreign currency.

Vfx: The ATM volatility of FX with same maturity as the future option.

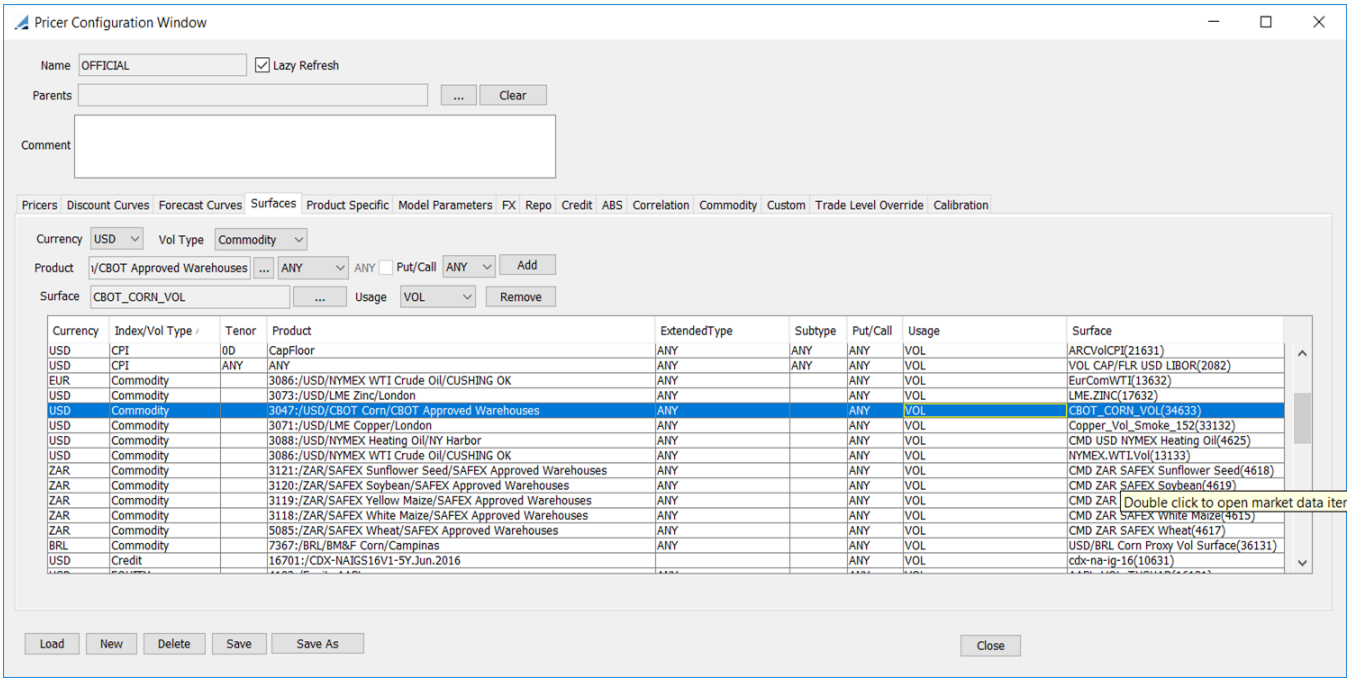
Rho: Correlation between foreign commodity and FX.

6.7 Pricer Configuration

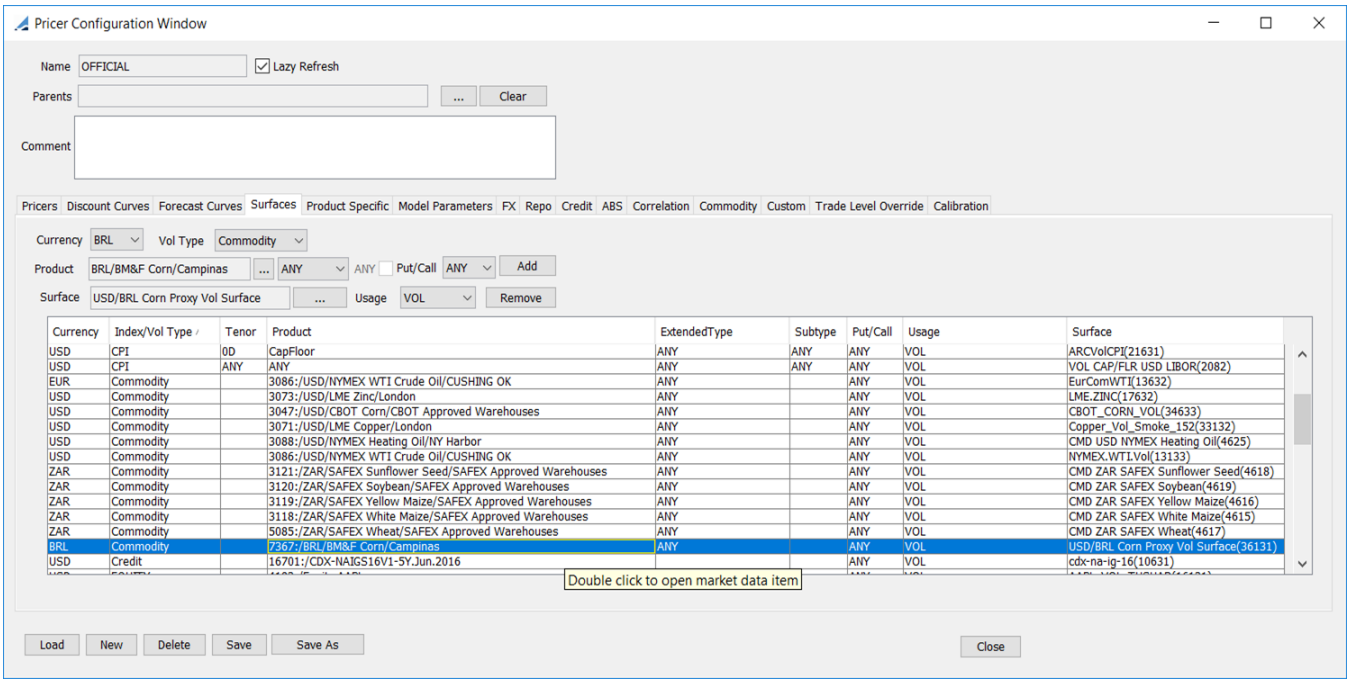
Make sure all the vol surfaces and correlation matrix is defined correctly in the pricer configuration. You can bring up the Pricer Configuration window from the Pricing Environment window, or navigate to **Market Data > Pricing Environment > Pricer Configuration** from the Calypso Navigator.

▶ Refer to *Calypso Pricer Configuration Documentation* for more details.

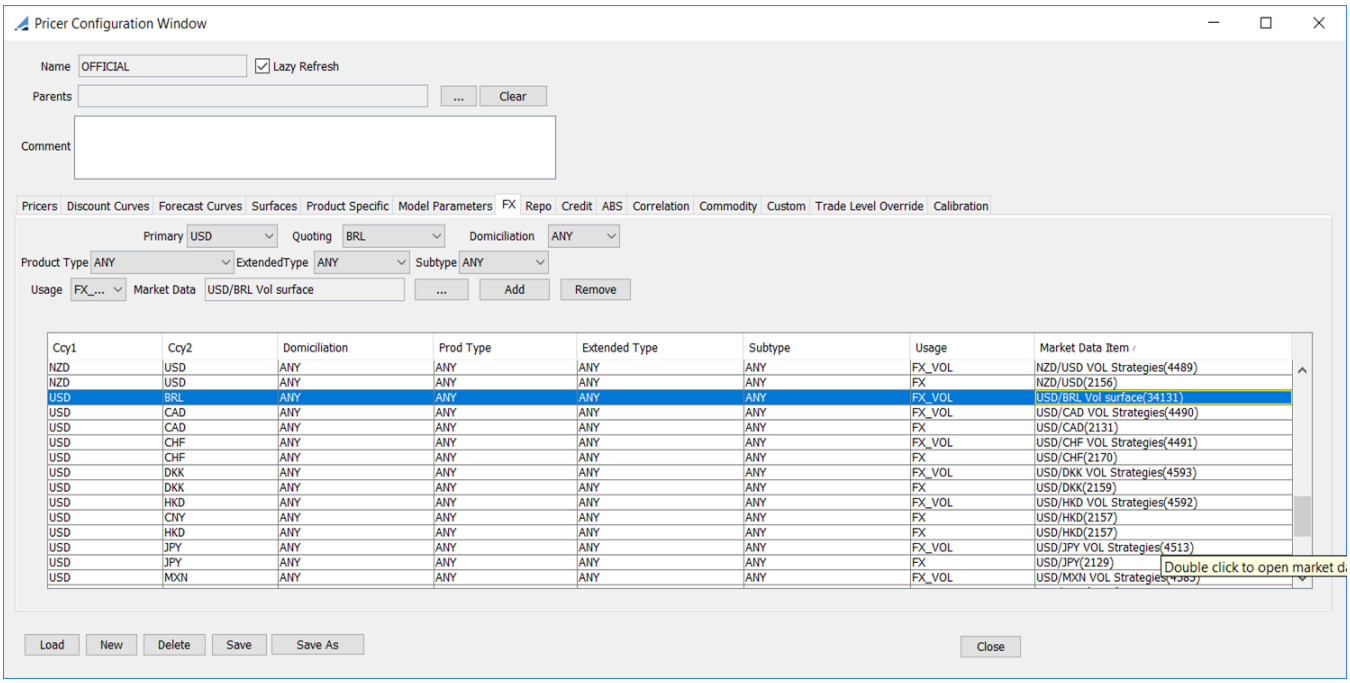
Examples of configuring base vol, proxy vol, FX vol and correlation is shown below.



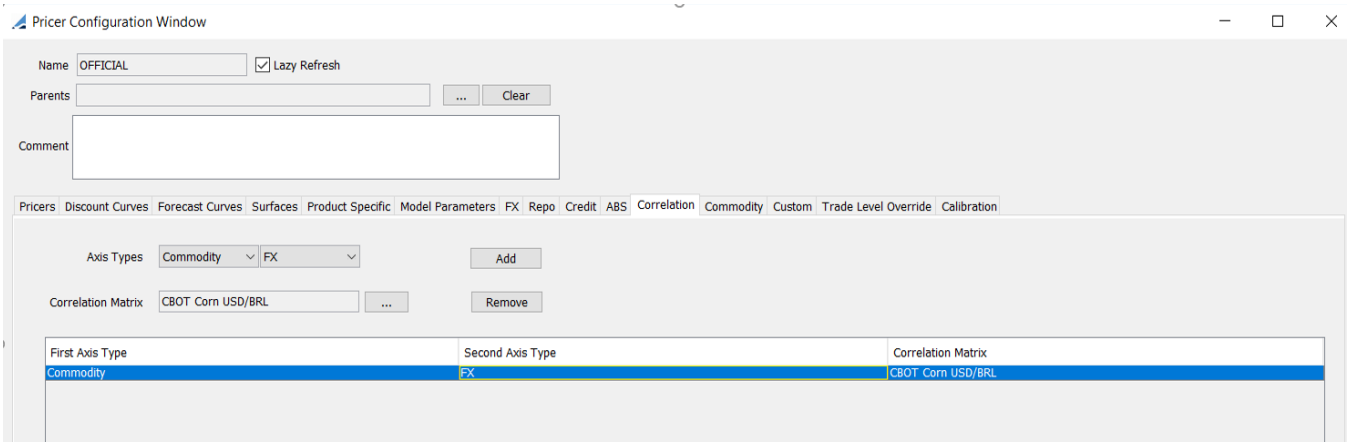
Base USD Vol in Pricer Config



Proxy Vol in Pricer Config



FX USD/BRL Vol in Pricer Config



Correlation Matrix in Pricer Config

7. CREDIT Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

CREDIT volatility surfaces can be created from offset points, or derived from underlying instruments.

- Surface from offset points
- Surface from underlying instruments
- Pricer configuration

Interpolation methods and generation algorithms are provided out-of-the-box. Refer to the Credit Derivatives Analytics documentation for details.

▶ See also Volatility Surface Overview.

7.1 Generating a CREDIT Volatility Surface from Offsets

CREDIT Volatility Surface from Offsets Quick Reference

Configuration Requirements

- Issuer Definition – From the Calypso Navigator, navigate to **Configuration > Legal Data > Legal Entity**.

Surface Generation

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

2. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

3. Definition Panel — Select the following to define the surface: currency, issuer / ticker / or basket, volatility type “Credit”, strike type, interpolator, the Derived checkbox should not be selected, generator, date-roll convention, holiday calendars, pricing environment.

4. Offsets Panel — Select the tenor and expirations. Enter the strikes.

5. Points Panel — Click **Generate** to generate the points. Enter the point values.

6. Click **Save**, enter a name for the surface, and click **OK**.

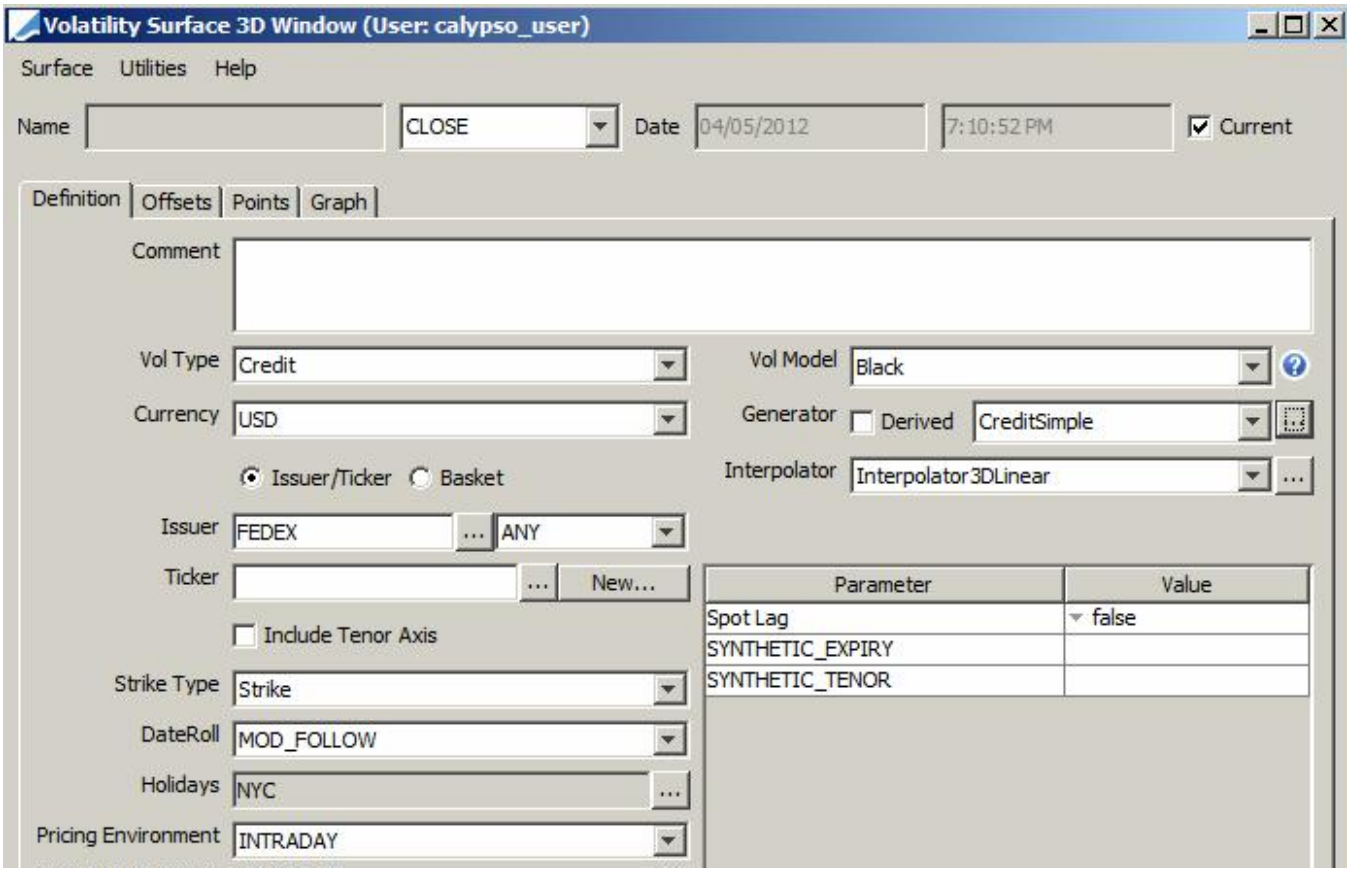
Pricer Configuration

A CREDIT volatility surface is associated with a pricing environment under the Credit panel of the pricer configuration for the VOL usage.

7.1.1 Definition Panel

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

Select the following to define the surface: currency, volatility type “Credit”, issuer / ticker / or basket, strike type, interpolator, the Derived checkbox should not be selected, generator, date-roll convention, holiday calendars, pricing environment.



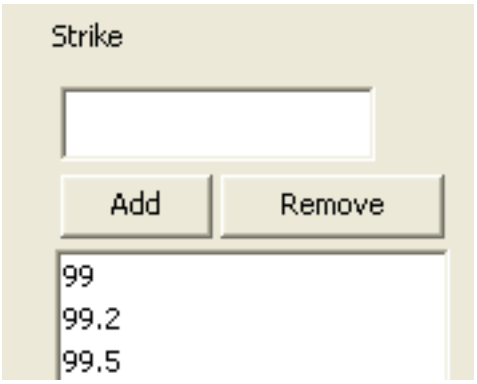
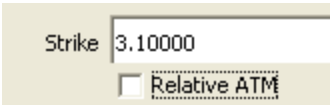
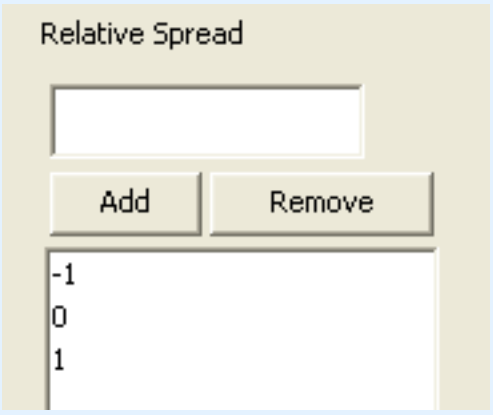
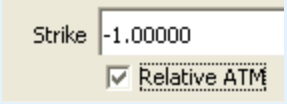
- Select the type of strike: Strike, Relative Spread, Strike Offsets BPs, or Relative % - They are described below.
- Select the generation algorithm: Default, or CreditSimple. You can set the following generator parameters.

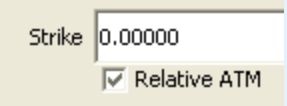
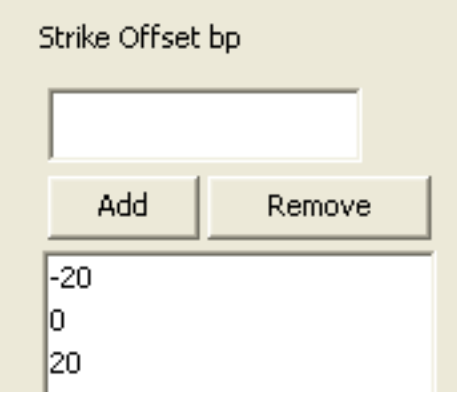
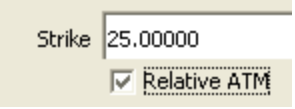
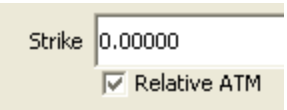
  If the spot lag parameter is set to true, the generated exercise dates are rolled using the conventions of the definition screen.

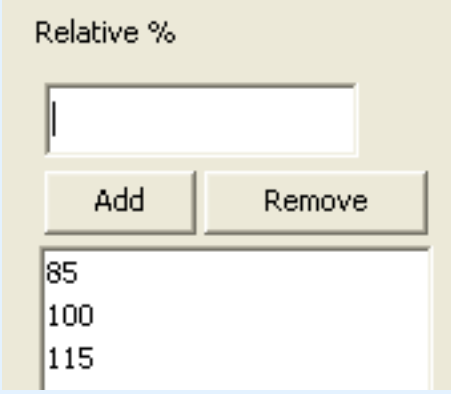
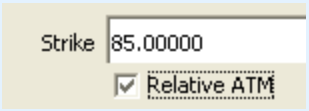
  Note that SYNTHETIC_EXPIRY and SYNTHETIC_TENOR are not currently used.

Strike Types Details

Surface Type	Definition
Strike	Absolute strike. ***Offset Points***

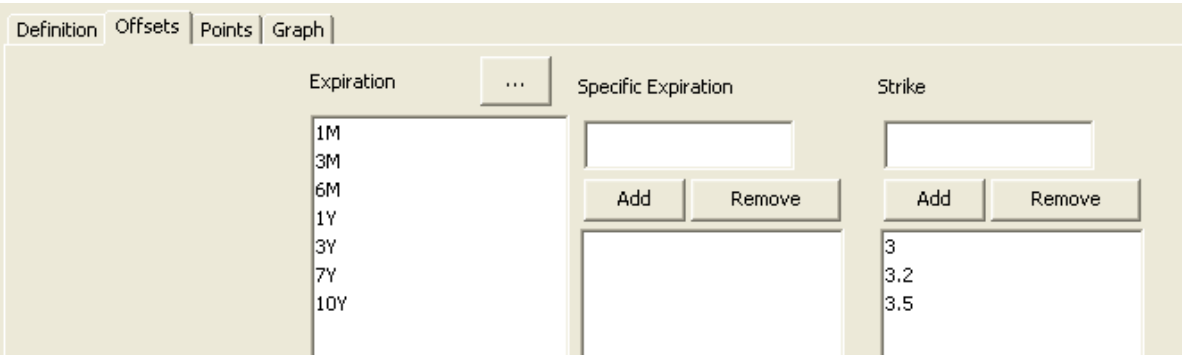
Surface Type	Definition
	In the Offset panel, enter absolute strikes.  ***Underlying Instruments*** The underlying instruments must be specified using an absolute strike. 
Relative Spread	Current strike +/- spread minus ATM strike (in %). ***Offset Points*** In the Offset panel, enter relative spreads over the current strike in %. Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in %. In this example the relative strike is -1%.  Note that when using a relative strike, one of the underlying instruments must be defined

Surface Type	Definition
	with a strike of 0. 
Strike Offset BPs	Current strike +/- offset minus ATM strike (in bp). ***Offset Points*** In the Offset panel, enter relative offset over the current strike in bp Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in bp. In this example the relative strike is +25bp.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0. 
Relative %	% (current strike) minus ATM strike. ***Offset Points*** In the Offset panel, enter a percentage of the current strike.

Surface Type	Definition
	 ***Underlying Instruments*** The underlying instrument must be specified using a percentage of the current strike. In this example, it is 85% of the current strike. 

7.1.2 Offsets Panel

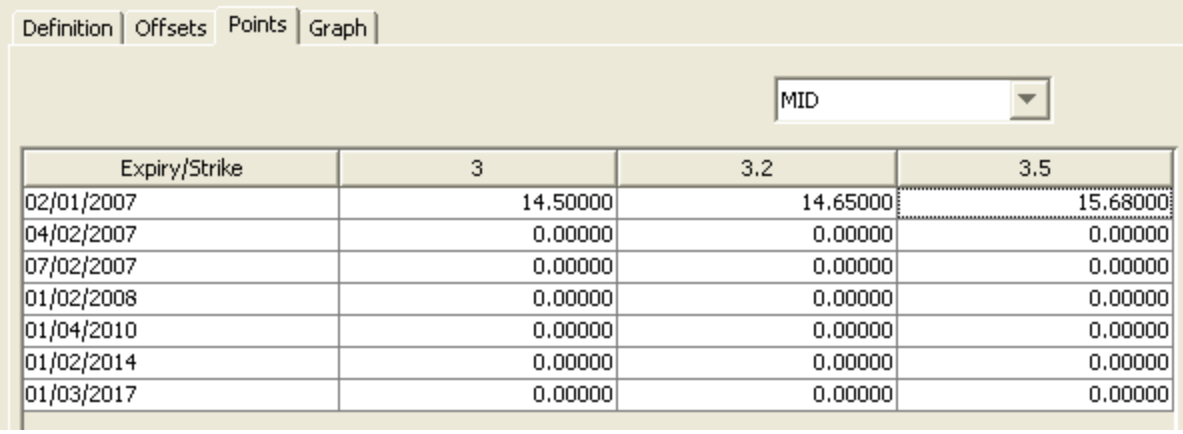
Select the Offsets panel.



- Click **...** to select expirations.
- Enter a strike and click **Add**. Repeat for each strike value.

7.1.3 Points Panel

Select the Points panel, and click **Generate** to generate the points.



Expiry/Strike	3	3.2	3.5
02/01/2007	14.50000	14.65000	15.68000
04/02/2007	0.00000	0.00000	0.00000
07/02/2007	0.00000	0.00000	0.00000
01/02/2008	0.00000	0.00000	0.00000
01/04/2010	0.00000	0.00000	0.00000
01/02/2014	0.00000	0.00000	0.00000
01/03/2017	0.00000	0.00000	0.00000

» Enter market volatilities for each expiration / strike.

7.1.4 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

7.2 Generating a Derived CREDIT Volatility Surface

Derived CREDIT Volatility Surface Quick Reference

Configuration Requirements

- Issuer Definition – From the Calypso Navigator, navigate to **Configuration > Legal Data > Legal Entity**.
- CDS Index Definition – From the Calypso Navigator, navigate to **Configuration > Credit Derivatives > CDS Index Definition**.
- You need a probability curve for the issuers in the basket, and a basket correlation matrix.

The upper bound volatility when solving for implied volatility is set to 1 (100%) by default. You can modify the upper bound volatility using the pricing parameter UPPER_BOUND_VOL_SURF. Set to 2 for example for 200%.

Surface Underlying Instruments

You can use CDS Index Option underlying instruments. From the Calypso Navigator, navigate to **Configuration > Market Data > Volatility Surface Underlyings**, or in the surface application's Underlyings panel, click **New Instrument**.

Surface Generation

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

2. Select the quote instance to use in the surface generation (CLOSE, LAST, or OPEN).

3. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

4. Definition Panel — Select the following to define the surface: currency, issuer / ticker / or basket, volatility type “Credit”, strike type, interpolator, select the Derived checkbox, CDSIndexOption generator, date-roll convention, holiday calendars, pricing environment.

5. Underlyings Panel — Select the underlying instruments.

6. Quotes Panel — Enter quotes manually, use quotes from the quote set, or use real-time quotes.

7. Points Panel — Click **Generate** to generate the points.

8. Click **Save**, enter a name for the surface, and click **OK**.

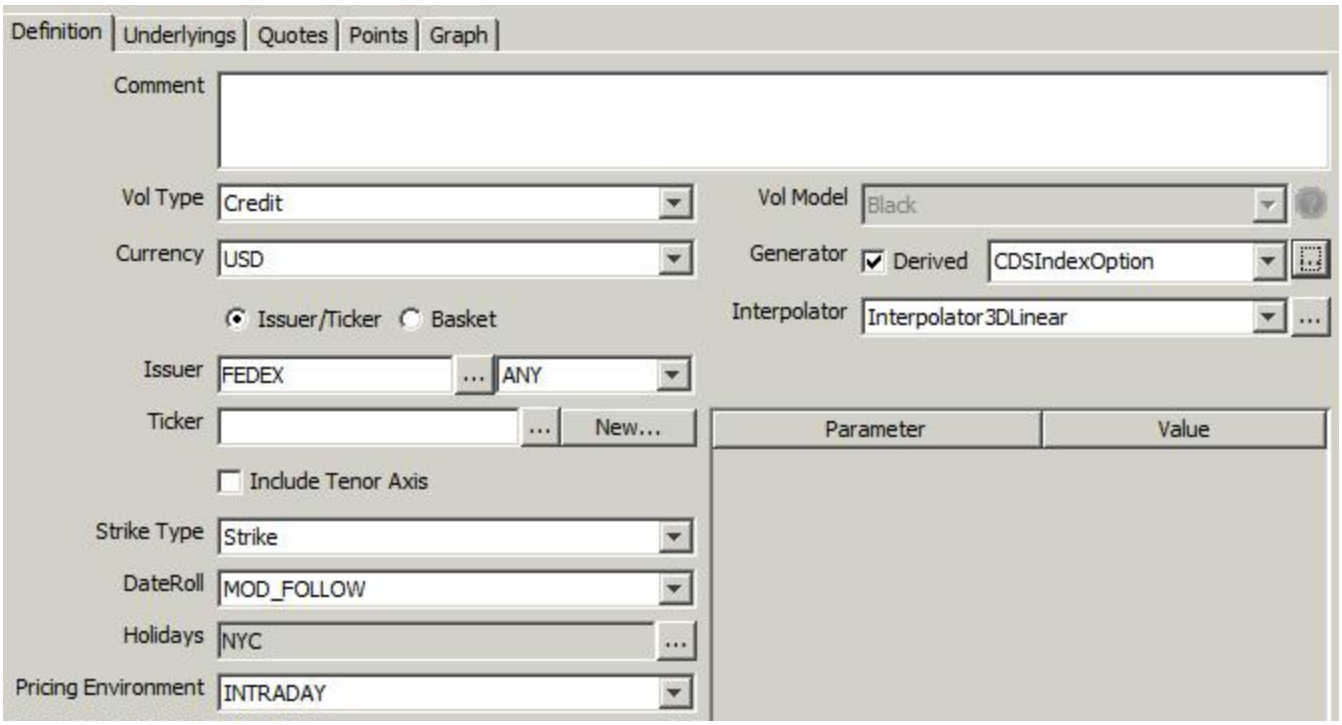
Pricer Configuration

A CREDIT volatility surface is associated with a pricing environment under the Credit panel of the pricer configuration for the VOL usage.

7.2.1 Definition Panel

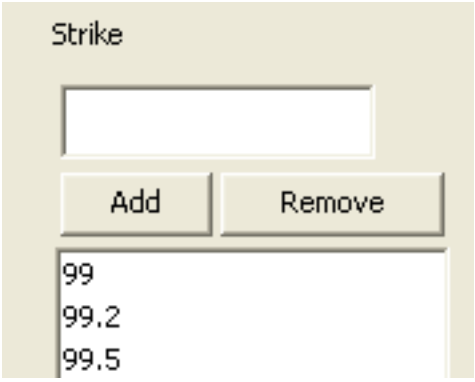
Click **New** to start a new surface.

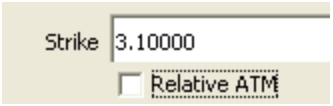
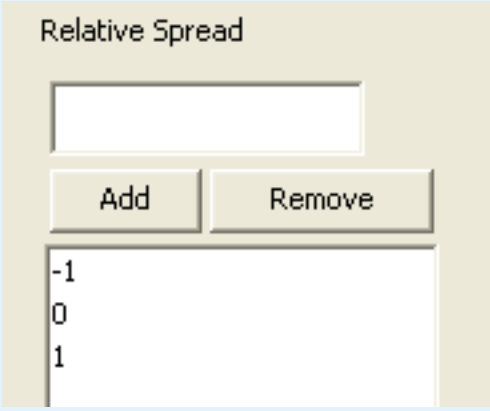
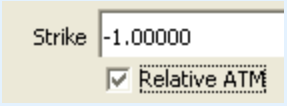
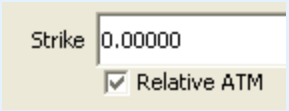
Select the following to define the surface: currency, issuer / ticker / or basket, volatility type “Credit”, strike type, interpolator, select the Derived checkbox, CDSIndexOption generator, date-roll convention, holiday calendars, pricing environment.

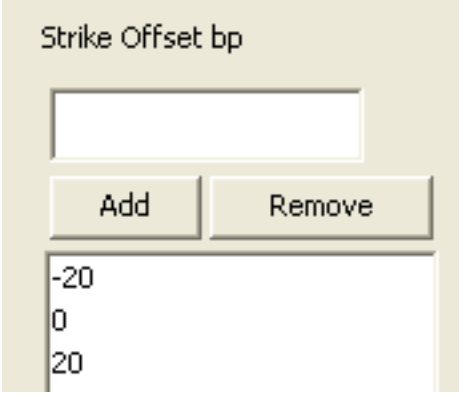
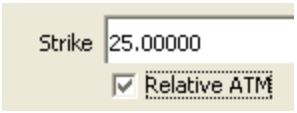
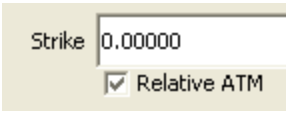
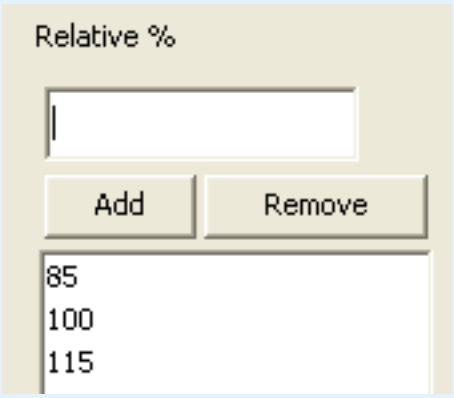


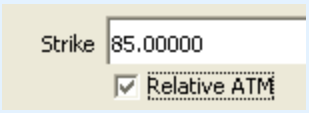
» Select the type of strike - They are described below.

Strike Types Details

Surface Type	Definition
Strike	Absolute strike. ***Offset Points*** In the Offset panel, enter absolute strikes.  ***Underlying Instruments*** The underlying instruments must be specified using an absolute strike.

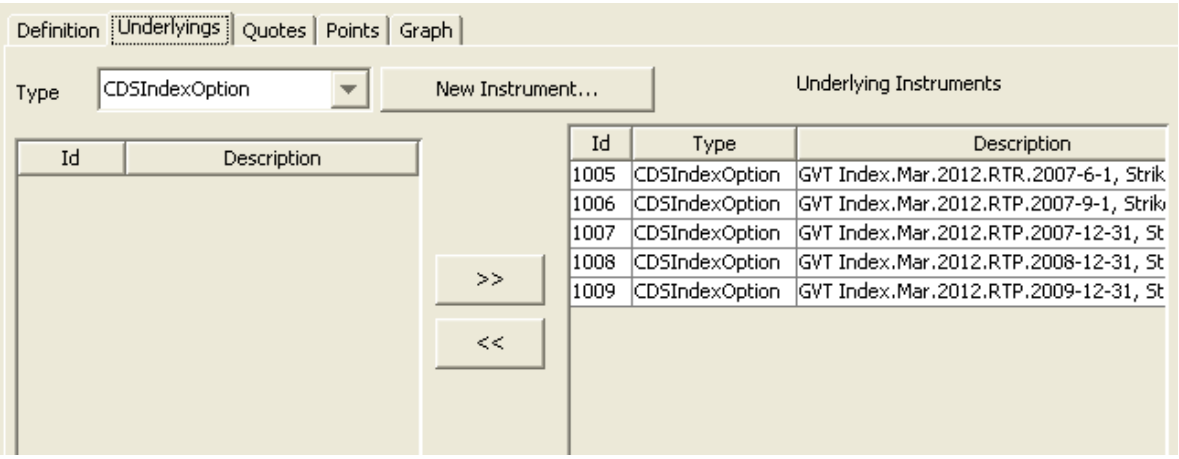
Surface Type	Definition
	
Relative Spread	Current strike +/- spread minus ATM strike (in %). ***Offset Points*** In the Offset panel, enter relative spreads over the current strike in %. Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in %. In this example the relative strike is -1%.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0. 
Strike Offset BPs	Current strike +/- offset minus ATM strike (in bp). ***Offset Points*** In the Offset panel, enter relative offset over the current strike in bp Make sure to add 0.

Surface Type	Definition
	 ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in bp. In this example the relative strike is +25bp.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0. 
Relative %	% (current strike) minus ATM strike. ***Offset Points*** In the Offset panel, enter a percentage of the current strike.  ***Underlying Instruments*** The underlying instrument must be specified using a percentage of the current strike. In this

Surface Type	Definition
	example, it is 85% of the current strike. 

7.2.2 Underlyings Panel

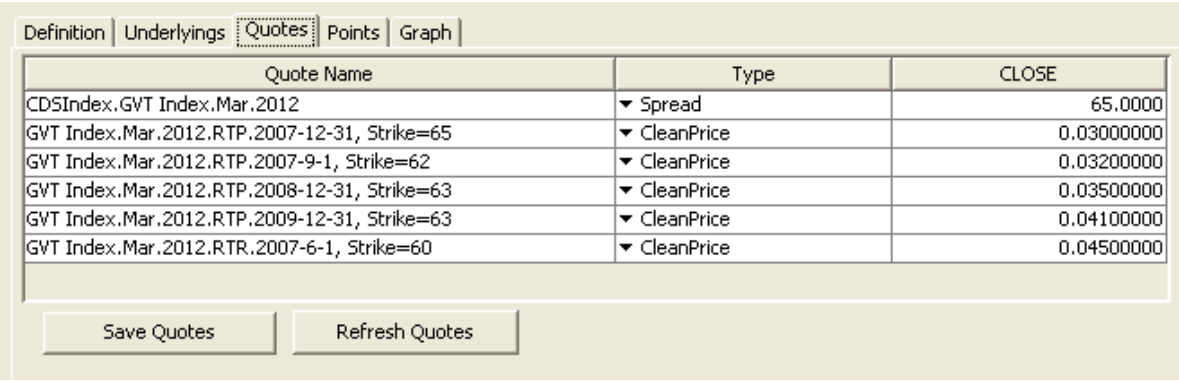
Select the Underlyings panel.



- Select the instrument type to display the list of available instruments. The panel is blank if you have not set up any instruments. Click **New Instruments** to create new instruments.
- Select instruments and click **>>** to add them to the instrument list in the right panel.

7.2.3 Quotes Panel

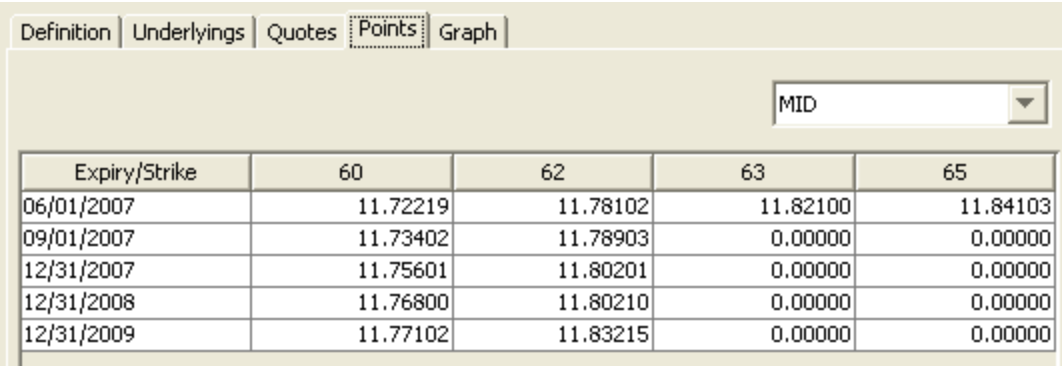
Select the Quotes panel. Enter quotes for the underlying instruments.



- You can click **Save Quotes** to save the quotes.

7.2.4 Points Panel

Select the Points panel, and click **Generate** to generate the points.



Expiry/Strike	60	62	63	65
06/01/2007	11.72219	11.78102	11.82100	11.84103
09/01/2007	11.73402	11.78903	0.00000	0.00000
12/31/2007	11.75601	11.80201	0.00000	0.00000
12/31/2008	11.76800	11.80210	0.00000	0.00000
12/31/2009	11.77102	11.83215	0.00000	0.00000

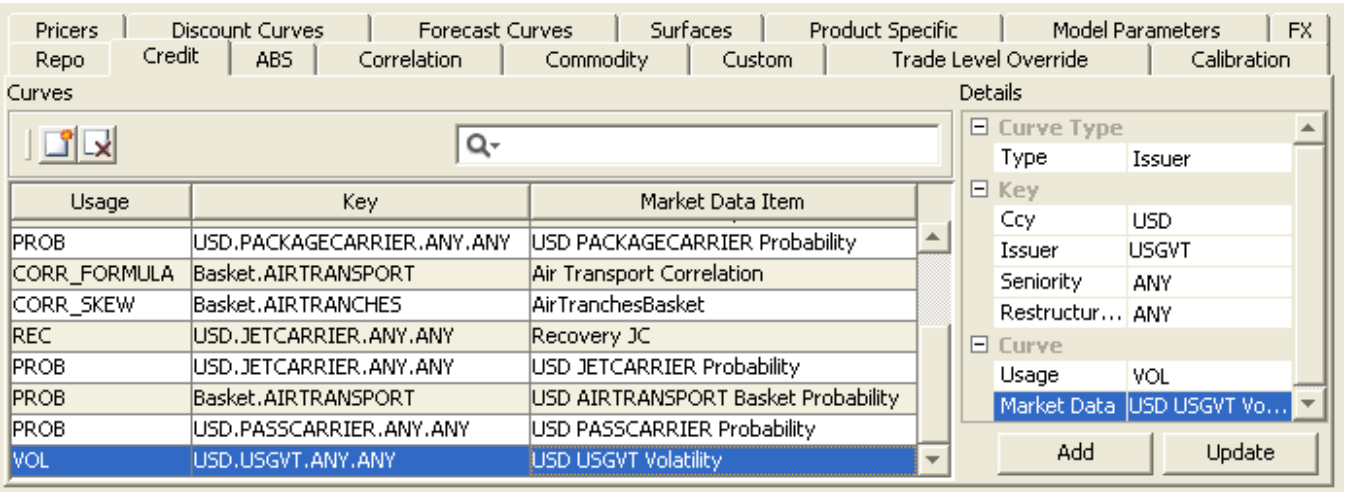
7.2.5 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

7.3 Pricer Configuration

From the Calypso Navigator, navigate to **Market Data > Pricing Environment > Pricer Configuration**.

Load a pricer configuration and select the Credit panel.



- Click to add market data.
- In the Details area, select the type of association you want to perform: Basket, Issuer, or Ticker. Then select the corresponding key for the selected type.

  For Basket, select a basket or ANY.

For Issuer, select a currency, an issuer, a seniority or ANY, and a restructuring type or ANY.

For Ticker, select a ticker – A ticker is a combination of currency, issuer, seniority and reference obligation – You can create tickers from the Credit Market Data window.

Select the VOL usage, and select a volatility surface from the Market Data field.

» Then click **Add**.

» Click **Save** to save the changes.

8. EQUITY Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

EQUITY volatility surfaces can be created from offset points, or derived from OTC Equity Option or Exchange Traded Option underlying instruments.

- Surface from offset points
- Surface from underlying instruments
- Pricer configuration

▶ See also Volatility Surface Overview.

8.1 Surface from Offsets

EQUITY Volatility Surface from Offsets Quick Reference

Configuration Requirements

- You can create equity products using **Configuration > Equity > Equity** from the Calypso Navigator.

Surface Generation

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

2. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

3. Definition Panel — Select the following to define the surface: currency, volatility type "EQUITY", equity product, strike type, interpolator, the Derived checkbox should not be selected, generator, date-roll convention, holiday calendars, pricing environment.

4. Offsets Panel — Select the tenor and expirations. Enter the strikes / delta values.

5. Points Panel — Click **Generate** to generate the points. Enter the point values.

6. Click **Save**, enter a name for the surface, and click **OK**.

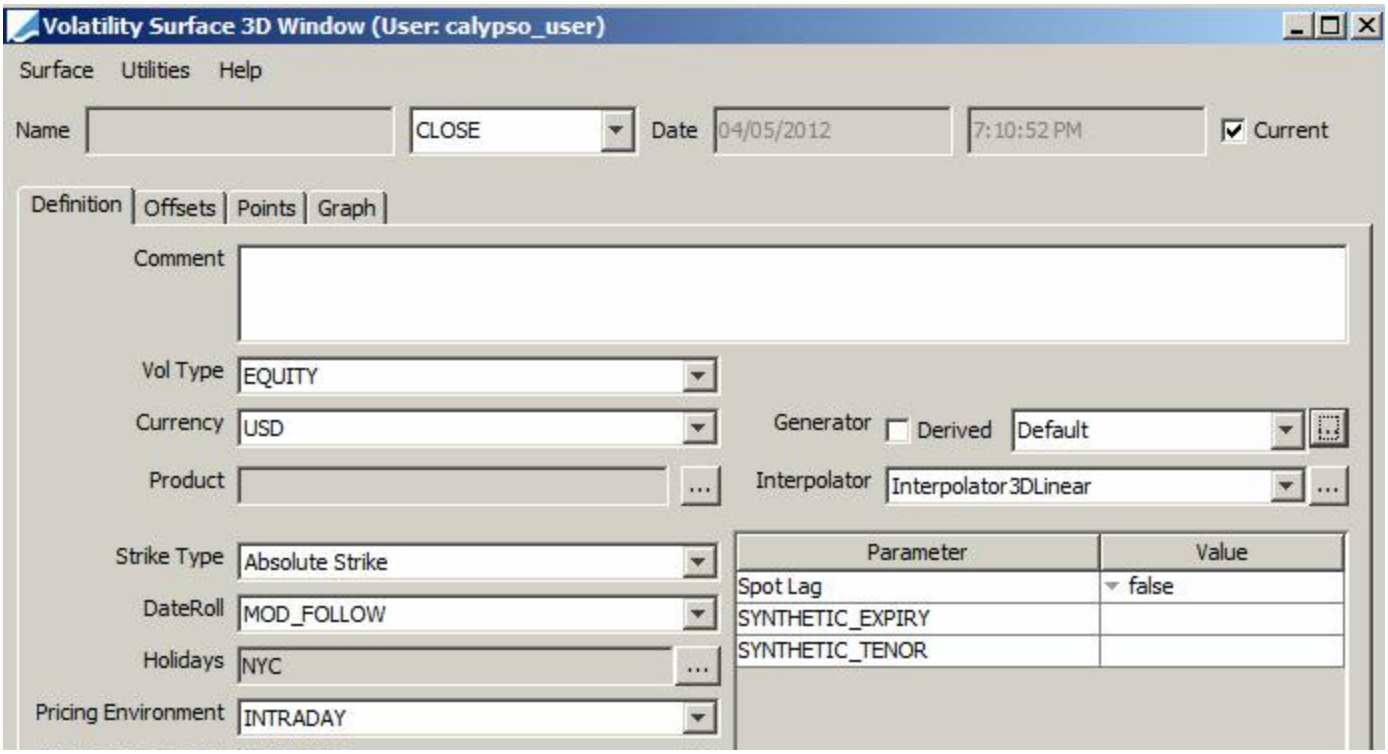
Pricer Configuration

An EQUITY volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the volatility type EQUITY and the VOL usage.

8.1.1 Definition Panel

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

Select the following to define the surface: currency, volatility type "EQUITY", equity product, strike type, interpolator, the Derived checkbox should not be selected, generator, date-roll convention, holiday calendars, pricing environment.



- Select the type of strike : Strike, Delta, or Relative % - They are described below.
- Select the generation algorithm: Default, SVISimple, or SplineSimple.

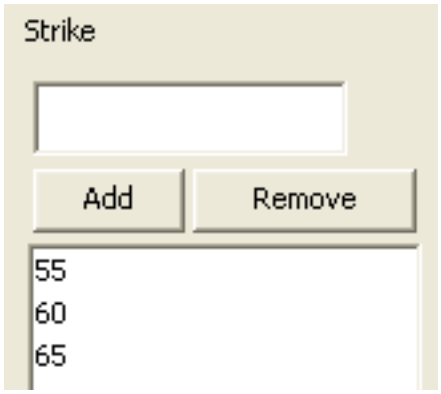
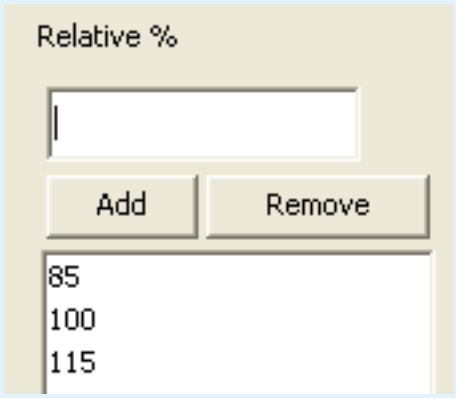
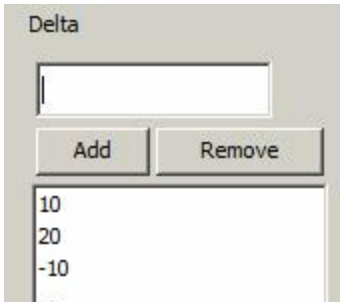
  Default generator - You can set the following generator parameters:

  - If the spot lag parameter is set to true, the generated exercise dates are rolled using the conventions of the definition screen.
  - Note that SYNTHETIC_EXPIRY and SYNTHETIC_TENOR are not currently used.

  SVISimple generator - Support for local volatility model using the SVI methodology, for pricing and risk.

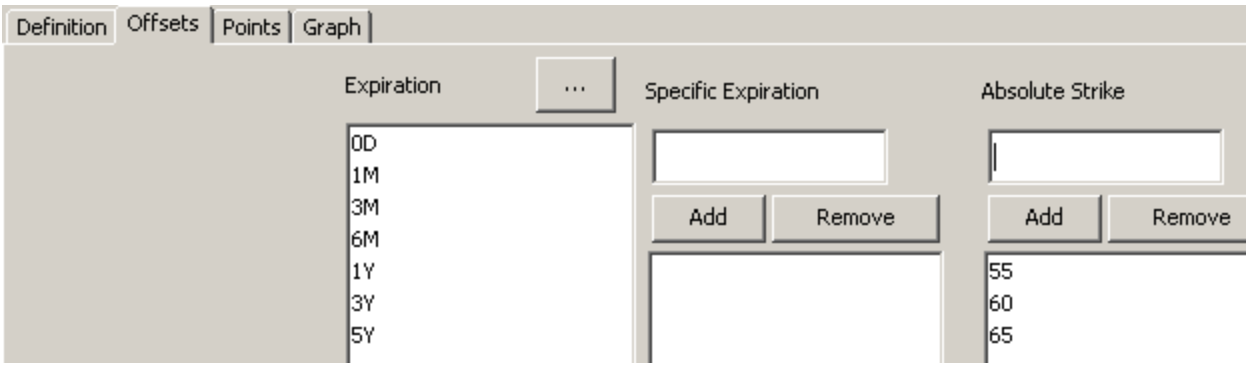
  SplineSimple generator - Generation of volatility surface based on delta.

Surface Type	Description
Strike	In the Offset panel, enter absolute strikes.

Surface Type	Description
	
Relative %	In the Offset panel, enter a percentage of the current spot. **Note: 0% = ATM for offset based relative vol surface & 100%= ATM for derived relative vol surface.** 
Delta	In the Offset panel, enter delta values. 

8.1.2 Offsets Panel

Select the Offsets panel.

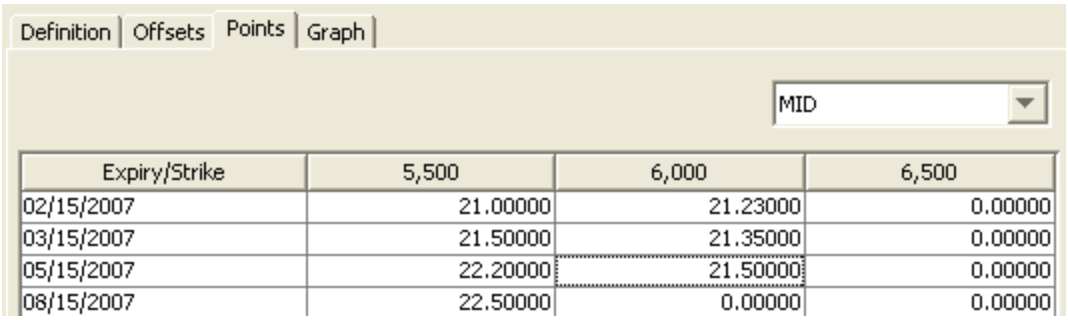


» Click ... to select expirations.

» Enter a strike and click **Add**. Repeat for each strike value.

8.1.3 Points Panel

Select the Points panel, and click **Generate** to generate the points.



Expiry/Strike	5,500	6,000	6,500
02/15/2007	21.00000	21.23000	0.00000
03/15/2007	21.50000	21.35000	0.00000
05/15/2007	22.20000	21.50000	0.00000
08/15/2007	22.50000	0.00000	0.00000

» Enter market volatilities for each expiration / strike.

8.1.4 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

8.2 Surface from Underlying Instruments

EQUITY Volatility Surface from Underlying Instruments – Quick Reference

Configuration Requirements

- You can create equity products using **Configuration > Equity > Equity** from the Calypso Navigator.
- You need a dividend curve for the equity in the pricing environment.

Surface Underlying Instruments

You can use ETOs, Equity OTC Option and warrants underlying instruments. From the Calypso Navigator, navigate to **Configuration > Market Data > Volatility Surface Underlyings**, or in the surface application's Underlyings panel, click **New Instrument**.

Surface Generation

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

2. Select the quote instance to use in the surface generation (CLOSE, LAST, or OPEN).

3. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

4. Definition Panel — Select the following to define the surface: currency, volatility type "EQUITY", equity product, strike type, interpolator, select the Derived checkbox, generator, date-roll convention, holiday calendars, pricing environment.

5. Underlyings Panel — Select the underlying instruments.

6. Quotes Panel — Enter quotes manually, use quotes from the quote set, or use real-time quotes.

7. Points Panel — Click **Generate** to generate the points.

8. Click **Save**, enter a name for the surface, and click **OK**.

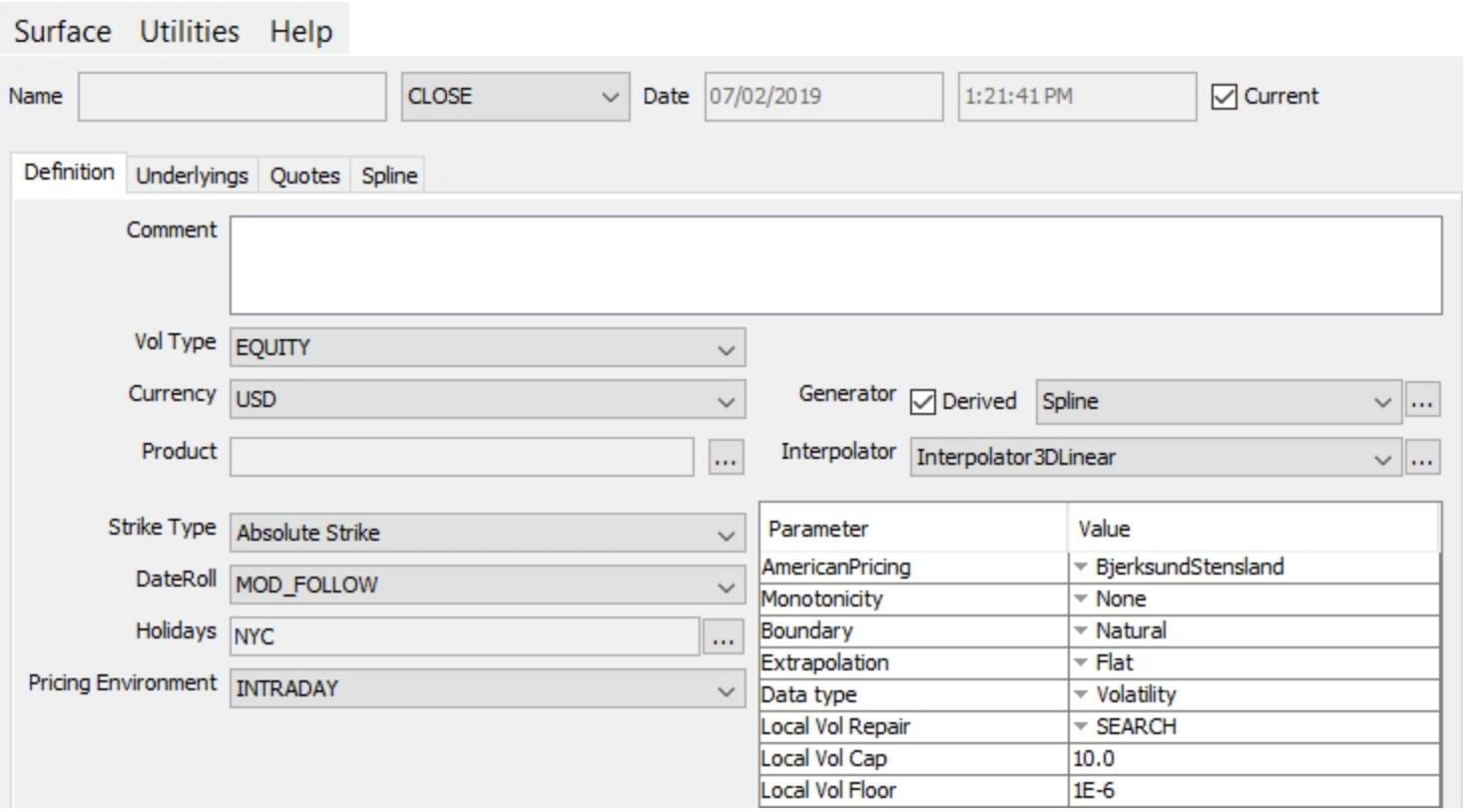
Pricer Configuration

An EQUITY volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the volatility type EQUITY and the VOL usage.

8.2.1 Definition Panel

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

Select the following to define the surface: currency, issuer / ticker / or basket, volatility type "EQUITY", strike type, interpolator, select the Derived checkbox, generator, date-roll convention, holiday calendars, pricing environment.



» Select the type of strike:

Surface Type	Description
Strike	Absolute strike. The underlying instruments must be specified using an absolute strike. 
Relative %	% (current strike). The underlying instrument must be specified using a percentage of the current strike. In this example, it is 85% of the current strike. 

» Select the generator:

- The SVI generator allows support for the local volatility model, using the SVI methodology, for pricing and risk. Local volatility surface can be derived from ETO or OTC instruments.
- The Spline generator allows generating a volatility surface from warrants.

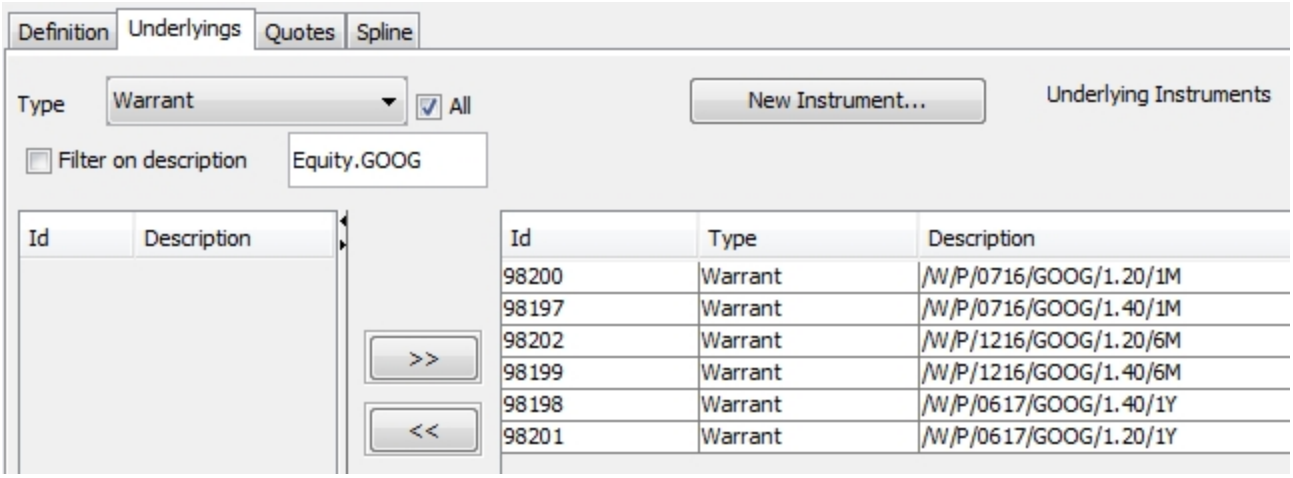
» You can set the following generator parameters as desired.

Parameter	Description
AmericanPricing	The default value is BjerksundStensland. This parameter defines the method used to invert

Parameter	Description
	American option prices (when the quotes are in price and not in volatility). As of today this is the only supported value. In the future we plan to support the Finite difference method, also used in the Calypso price PricerBlack1FFiniteDifference. The inversion is done with a Brent solver. To invert European option prices, the implied volatility is computed from option prices using P. Jäckel's method.
Monotonicity	This parameter offers the possibility to interpolate according to the monotonicity of the data, thereby removing the potential artificial oscillations stemming from cubic splines. None corresponds to the standard cubic spline, no monotonicity constraint is enforced. Hyman83 will apply the monotonicity constraints of Hyman. Hyman89 will apply the less strict monotonicity constraints of Dougherty et al. Note that applying monotonicity constraints means that the interpolant will be only C1 where monotonicity is violated.
Extrapolation	This parameter controls the extrapolation in the strike space. Flat will flat extrapolate the volatilities. Linear will extrapolate linearly using the slope of the first and last cubic polynomials so that the slice stays C2 with natural boundary conditions. Note that if the data type is variance, the extrapolation will be linear in variance, which is typical of stochastic volatility models behavior (for example Heston). The extrapolation is floored to machine epsilon to avoid negative variance. In general, we recommend Linear as it will lead to a smooth implied volatility and therefore a smooth local volatility with Natural spline boundaries, around the extrapolation.
Data Type	This parameters controls which data the spline is applied to. Volatility means that the spline is built from strikes and volatilities, strikes being in the unity defined in the volatility surface (absolute, relative, Delta for SplineSimple). Variance means that the spline is built from strikes and the square of volatilities, strikes being in the unity defined in the volatility surface, and input volatilities being internally converted to variances. This is particularly interesting when combined with a linear extrapolation. VarianceLogMoneyness means that the is spline built from log-moneyness log (K/F) and variances σ^2, strikes are internally converted to log-moneyness.
Local Vol Repair	This parameter is used when the generator is used with a Local volatility pricer such as PricerLocalVolatility1FFiniteDifference or PricerLocalVolatilityNFMonteCarloExotic. In general we recommend the use of the SVI generator for local volatility, as it is much more robust against arbitrage, but if the quotes are of very good quality then it can make sense to use the Spline generator directly. SEARCH will search for a defined local volatility towards the moneyness and stop at the moneyness, it will then revert to CAP_FLOOR. CAP_FLOOR will use the Cap value if there is a butterfly spread arbitrage (or equivalently, when the local variance denominator becomes negative), it will use the Floor value if there is a calendar spread arbitrage (or equivalently, when the local variance numerator is negative). If Cap and Floor are blank, nothing is done. If only Floor is set and Cap is blank, the local volatility will be floored, even in presence of butterfly spread arbitrage.

8.2.2 Underlyings Panel

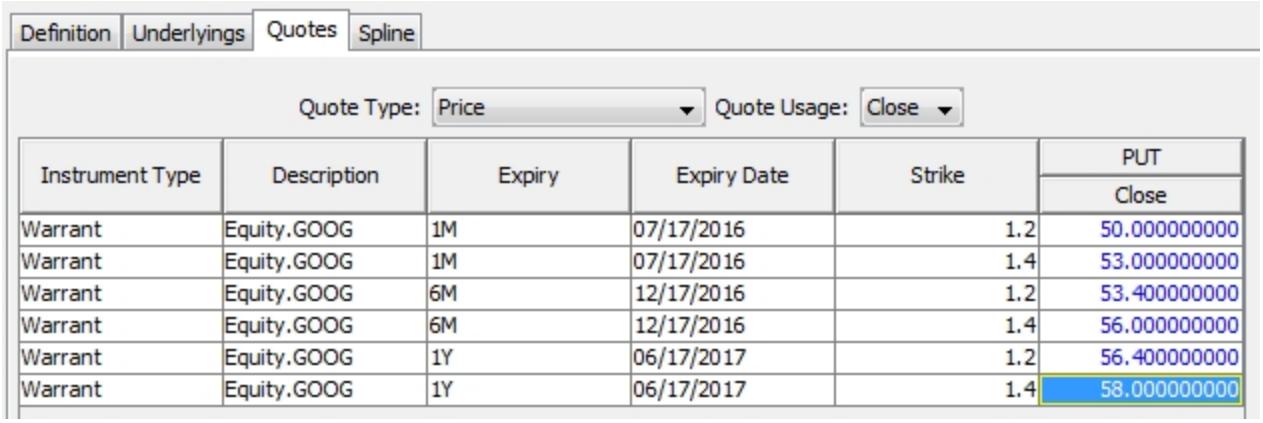
Select the Underlyings panel.



- Select the instrument type to display the list of available instruments. The panel is blank if you have not set up any instruments. Click **New Instruments** to create new instruments.
- Select instruments and click **>>** to add them to the instrument list in the right panel.

8.2.3 Quotes Panel

Select the Quotes panel. Enter quotes for the underlying instruments.

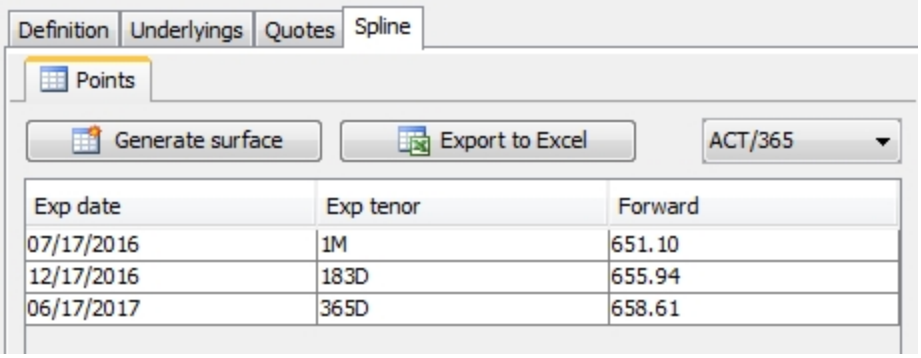


Instrument Type	Description	Expiry	Expiry Date	Strike	PUT Close
Warrant	Equity.GOOG	1M	07/17/2016	1.2	50.000000000
Warrant	Equity.GOOG	1M	07/17/2016	1.4	53.000000000
Warrant	Equity.GOOG	6M	12/17/2016	1.2	53.400000000
Warrant	Equity.GOOG	6M	12/17/2016	1.4	56.000000000
Warrant	Equity.GOOG	1Y	06/17/2017	1.2	56.400000000
Warrant	Equity.GOOG	1Y	06/17/2017	1.4	58.000000000

- You can click **Save Quotes** to save the quotes.
- You can choose to display the quotes in a as shown above, or as a list.

8.2.4 Spline Panel

Select the Spline panel, and click **Generate** to generate the points.



8.2.5 Save Surface

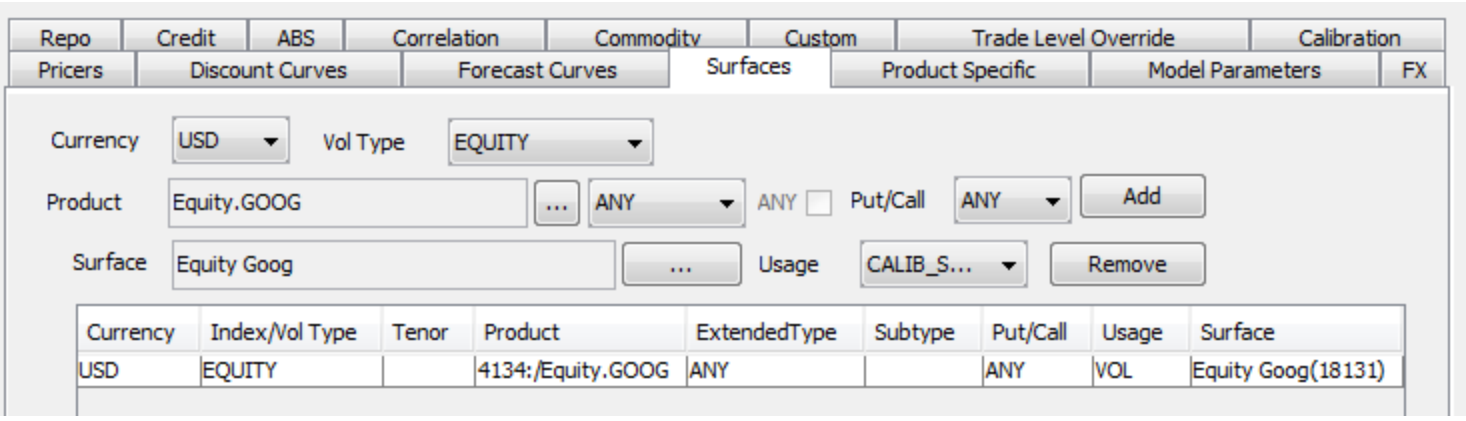
Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

8.3 Pricer Configuration

From the Calypso Navigator, navigate to **Market Data > Pricing Environment > Pricer Configuration**.

Click **Load**, and select a pricer configuration.

Select the Surfaces panel.



- Select the volatility type EQUITY, select an equity product or ANY.
- Click **...** to select the volatility surface.
- Select the VOL usage.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

9. MMFUTURE Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

MMFUTURE volatility surfaces can be derived from underlying instruments.

Interpolation methods and generation algorithms are provided out-of-the-box. Refer to the *Interest Rate Derivatives Analytics* documentation for details.

▶ See also Volatility Surface Overview.

Derived MMFUTURE Volatility Surface Quick Reference

Configuration Requirements

- MM Futures – From the Calypso Navigator, navigate to **Configuration > Listed Derivatives > Future Contracts**.

Surface Underlying Instruments

You can use FutureOption underlying instruments. From the Calypso Navigator, navigate to **Configuration > Market Data > Volatility Surface Underlyings**, or in the surface application's Underlyings panel, click **New Instrument**.

Surface Generation

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

2. Select the quote instance to use in the surface generation (CLOSE, LAST, or OPEN).

3. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

4. Definition Panel — Select the following to define the surface: currency, index, and tenor, volatility type "MMFUTURE", strike type, interpolator, select the Derived checkbox, generator "FutureOption", date-roll convention, holiday calendars, pricing environment.

To price Eurodollar future options with pricer PricerFutureOptionMMBpVol, you need to use the FutureOptionBpVol generator.

5. Underlyings Panel — Select the underlying instruments.

6. Quotes Panel — Enter quotes manually, use quotes from the quote set, or use real-time quotes.

7. Points Panel — Click **Generate** to generate the points.

8. Click **Save**, enter a name for the surface, and click **OK**.

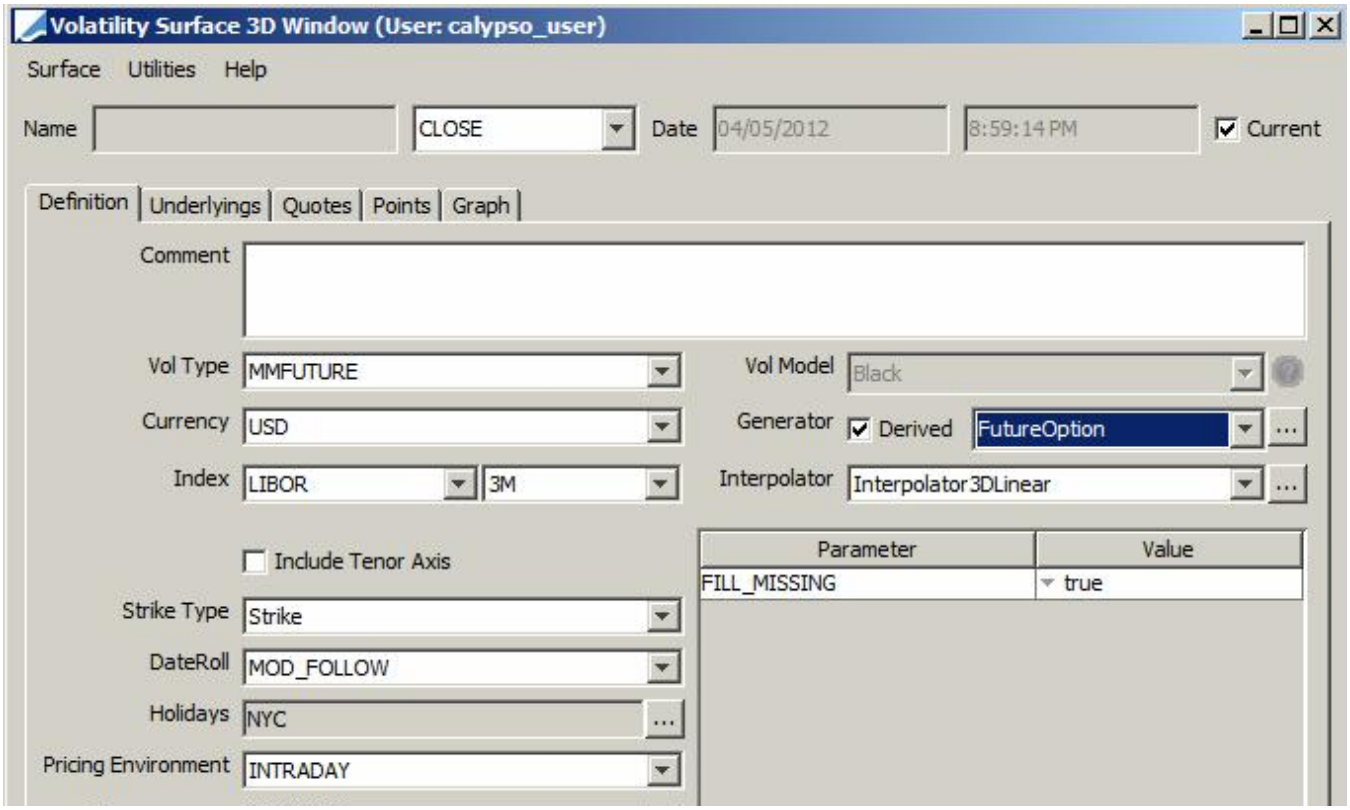
Pricer Configuration

A MMFUTURE volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the MMFUTURE volatility type and VOL usage.

9.1 Definition Panel

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

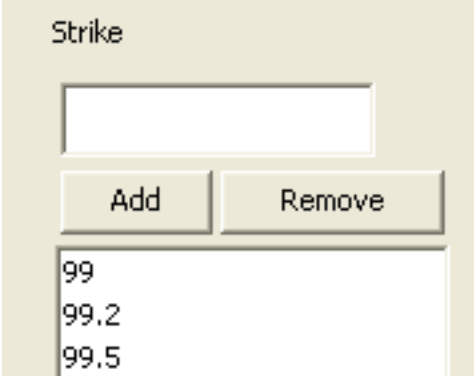
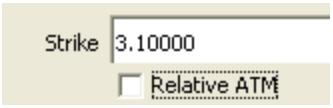
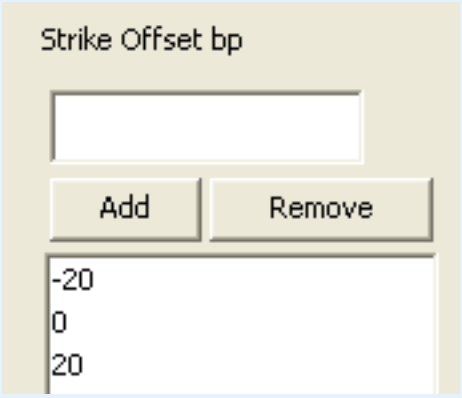
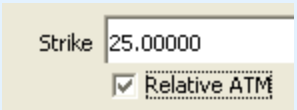
Select the following to define the surface: currency, index, and tenor, volatility type “MMFUTURE”, strike type, interpolator, select the Derived checkbox, generator “FutureOption”, date-roll convention, holiday calendars, pricing environment.

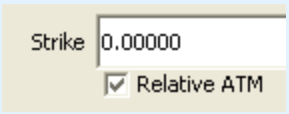


» Select the type of strike: Strike or Strike Offset BPs - They are described below.

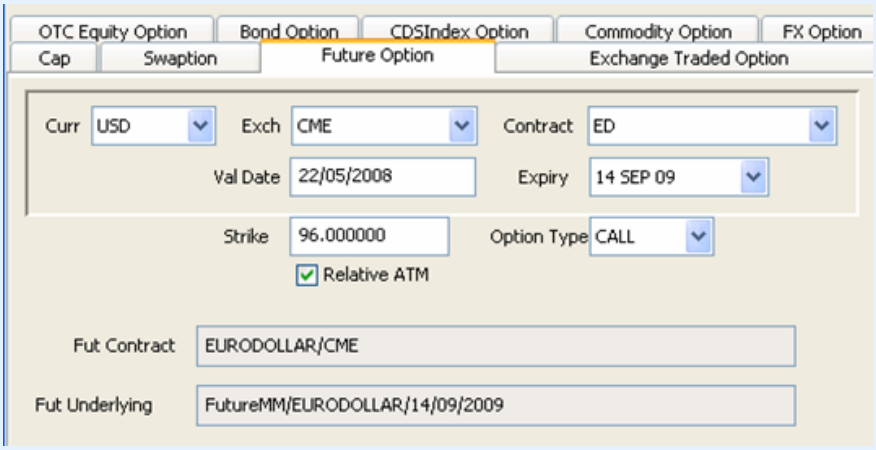
Strike Types Details

Surface Type	Definition
Strike	Absolute strike. ***Offset Points*** In the Offset panel, enter absolute strikes.

Surface Type	Definition
	 ***Underlying Instruments*** The underlying instruments must be specified using an absolute strike. 
Strike Offset BPs	Current strike +/- offset minus ATM strike (in bp). ***Offset Points*** In the Offset panel, enter relative offset over the current strike in bp Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in bp. In this example the relative strike is +25bp.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0.

Surface Type	Definition
	

» Select the generation algorithm - It controls the type of underlying instruments that you can select:

Generation Algorithm	Description
FutureOption	Generates and stores volatilities where the underlyings are options on futures.
FutureOptionBpVol	To price Eurodollar future options with pricer PricerFutureOptionMMBpVol. You can set the TRANSFORMATION_METHOD generator parameter in the Definition panel. The default value is EXACT. See below for details. Sample Eurodollar future option underlying. 

» Set the generator parameter as applicable.

When FILL_MISSING is true (default value) the missing points are filled using linear interpolation in the strike axis, more specifically, InterpolatorLinear is used on all quotes for a particular expiry to fill any missing point. Otherwise, 0 points are generated.

Transformation Methods Details

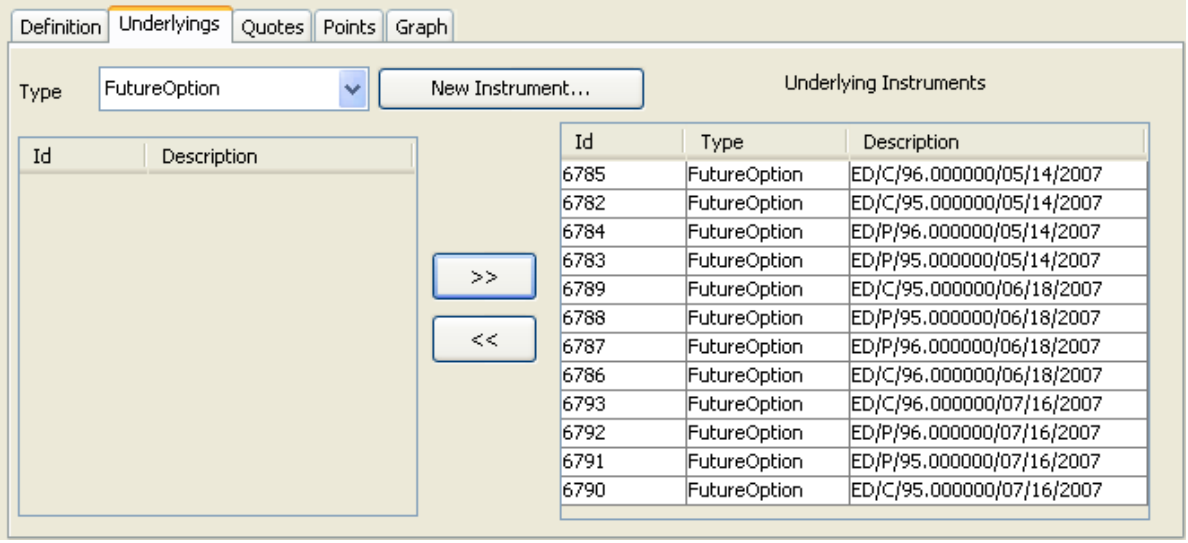
The transformation method allows converting between normal / lognormal vols as needed.

Name	Transformation
EXACT	$\sigma = f^{-1}(\upsilon)$

Name	Transformation
ANDERSON_RATCLIFFE_LN	$\nu = \frac{\ln(F/K)}{F-K}\sigma - \frac{\ln(F/K)}{(F-K)^3}\ln\left(\frac{\ln(F/K)}{F-K}\sqrt{FK}\right)\sigma^3 T$
ANDERSON_RATCLIFFE_N	$\sigma = \frac{F-K}{\ln(F/K)}\nu - \frac{F-K}{\ln(F/K)^3}\ln\left(\frac{F-K}{\ln(F/K)}\sqrt{FK}\right)\nu^3 T$
HAGAN_APPROX	$\upsilon = \frac{2\sigma}{(F+K)}\left(1+\frac{1}{3}\left(\frac{F-K}{F+K}\right)^2+\frac{1}{6}\left(\frac{\sigma^2 T}{(F+K)^2}\right)+\cdots\right)$
STREET_PROXY1	$\sigma = \sqrt{FK}\upsilon$
STREET_PROXY2	$\sigma = \upsilon\sqrt{\frac{1}{2}(F^2+K^2)}$
STREET_PROXY3	$\sigma = \upsilon F(1-\frac{1}{24}\upsilon^2 T)$
STREET_PROXY4	$\sigma = F\upsilon$
STREET_PROXY5	$\sigma = K\upsilon$

9.2 Underlyings Panel

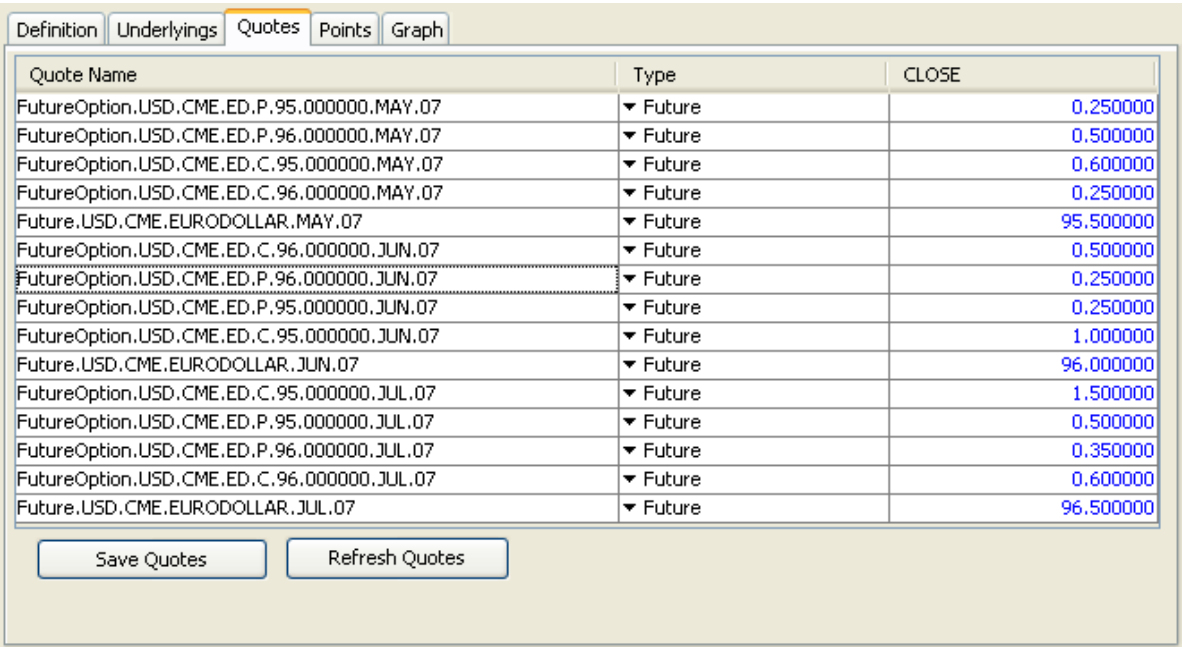
Select the Underlyings panel.



- Select the instrument type, and the panel below displays the list of available instruments. The panel is blank if you have not set up any instruments. Click **New Instrument** to create new instruments.
- Select instruments and click **>>** to add them to the instrument list in the right panel.

9.3 Quotes Panel

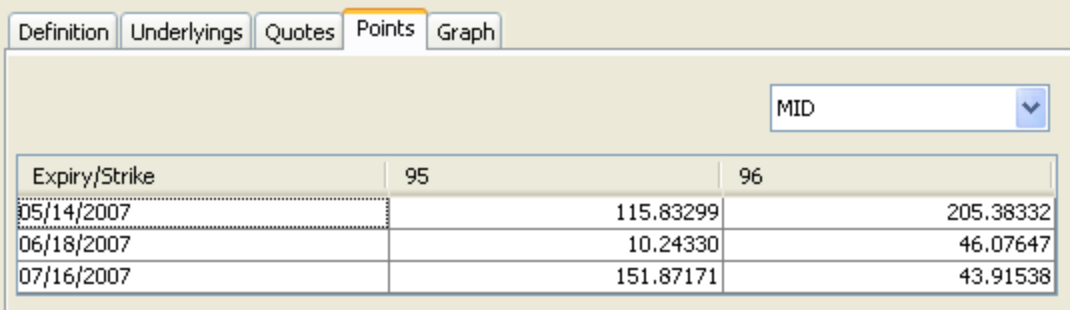
Select the Quotes panel. Enter quotes for the underlying instruments.



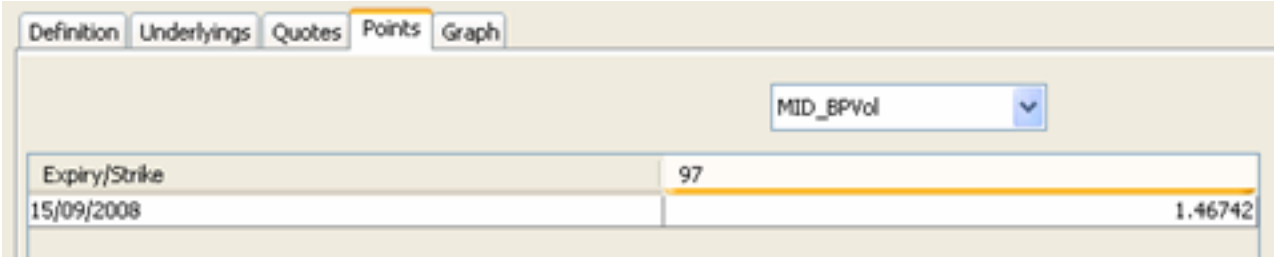
- You can click **Save Quotes** to save the quotes.

9.4 Points Panel

Click the Points tab. Click **Generate** to generate the points.



- You can view the points for each combination of expiry and strike (and tenor).
- For the FutureOptionBpVol generator, you can select MID_BPVol, BID_BPVol, or ASK_BPVol to view the bp vol points.

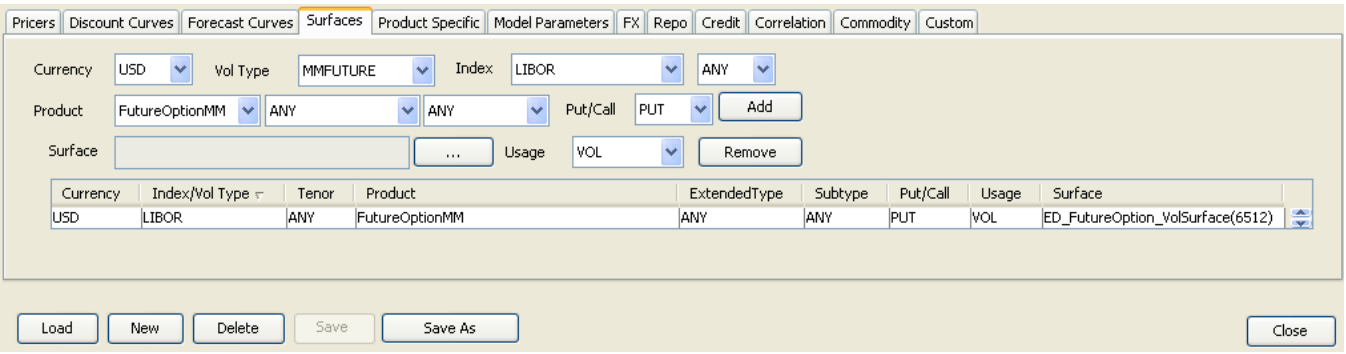


9.5 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

9.6 Pricer Configuration

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



- Select the currency, volatility type, index, and tenor.

- Select the product type, extended type or ANY, subtype or ANY, PUT or CALL.
- Click **...** to select the volatility surface. Select the surface in the Selection window and click **Load** to display the surface name in the pricer configuration.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

10. RATE Volatility Surface

From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

RATE volatility surfaces can be created from offset points, or derived from underlying instruments.

Interpolation methods and generation algorithms are provided out-of-the-box. Refer to the Interest Rate Derivatives Analytics documentation for details.

- Surface from offset points
- Surface from underlying instruments
- Pricer configuration

▶ See also Volatility Surface Overview.

10.1 RATE Volatility Surface from Offsets

RATE Volatility Surface from Offsets Quick Reference

Surface Generation

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

2. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

3. Definition Panel — Select the following to define the surface: currency, index, and tenor, volatility type "RATE", strike type, interpolator, the Derived checkbox should not be selected, generator, date-roll convention, holiday calendars, pricing environment.

4. Offsets Panel — Select the tenor and expirations. Enter the strikes.

5. Points Panel — Click **Generate** to generate the points. Enter the point values.

6. Click **Save**, enter a name for the surface, and click **OK**.

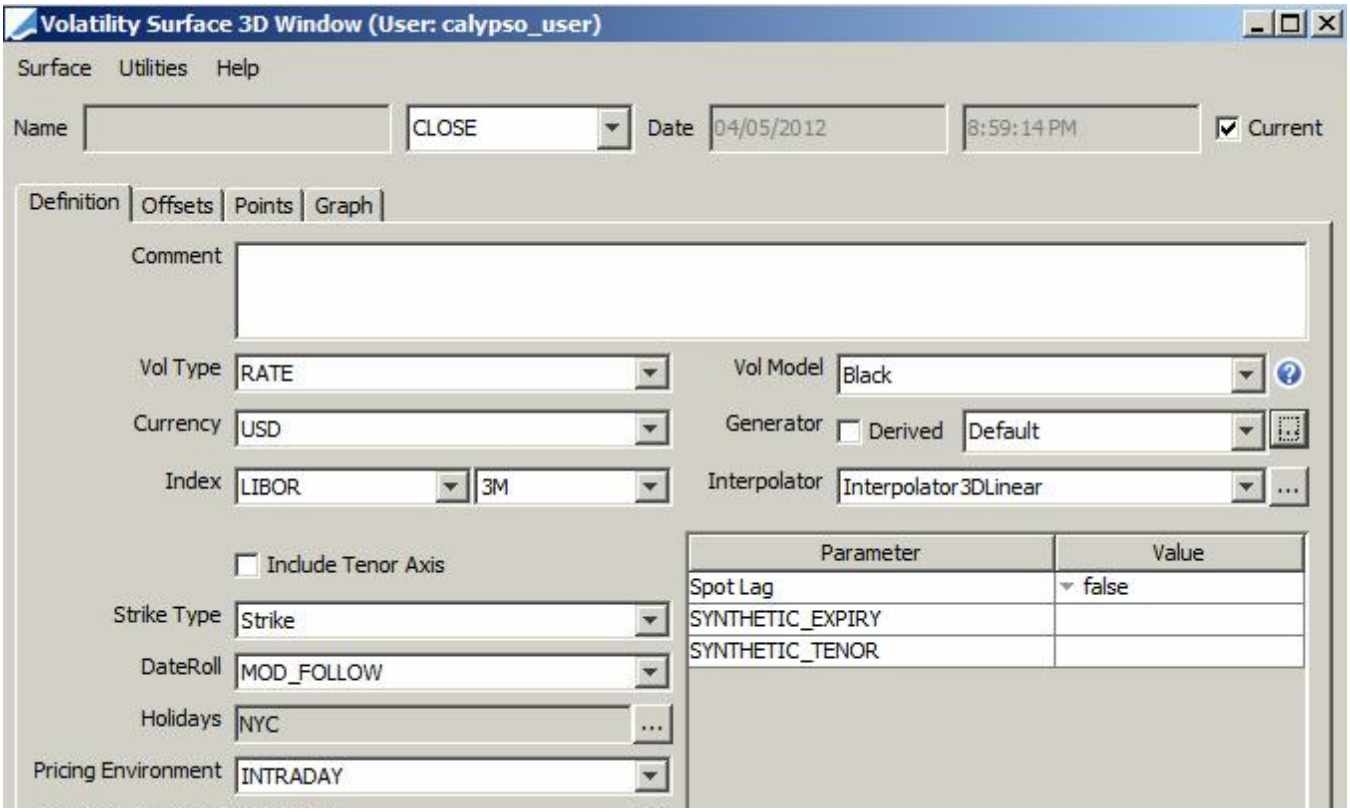
Pricer Configuration

A RATE volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the RATE volatility type and VOL usage.

10.1.1 Definition Panel

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

Select the following to define the surface: currency, index, and tenor, volatility type “RATE”, strike type, interpolator, the Derived checkbox should not be selected, generator, date-roll convention, holiday calendars, pricing environment.



- Select the type of strike: Strike, Relative Spread, Strike Offsets BPs, or Relative % - They are described below.
- Select the generation algorithm - They are described below.
- "Include Axis Tenor" - There are circumstances where pricing requires a Tenor axis on top of the regular Strike and Maturity; such as pricing for Swaptions.

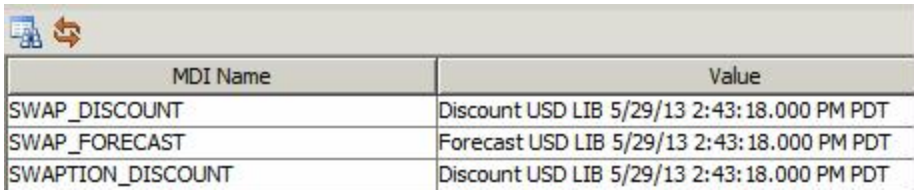
  The default volatility surface setup in Calypso is for Maturity vs. Strike on a 2D graph. Selecting "Include Tenor Axis" gives us a 3D graph where necessary.

  When you select "Include Tenor Axis", you can select a point underlying.

  The point underlying option is an option that has been added for use with the LGMM pricers where we need to calibrate Bermudan swaptions to vanilla swaption NPVs. The structure of the underlying swap in the calibration swaption is taken in the circumstance that Point Underlying = Swap. When Point Underlying = None the surface cannot be used for LGMM pricers but can still be used for any other applicable product type.

  When selecting "Swap", you can click **Set Underlying Vol Point** to define the swap.

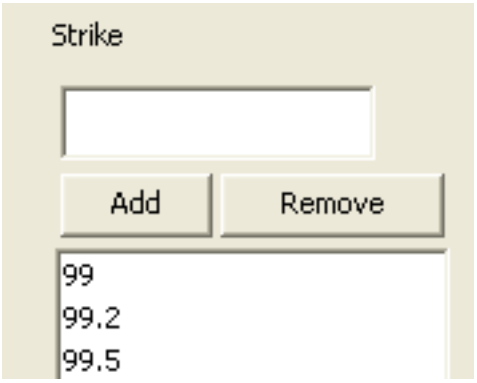
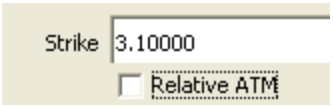
Once the swap is defined, you can select additional curves for calibration:

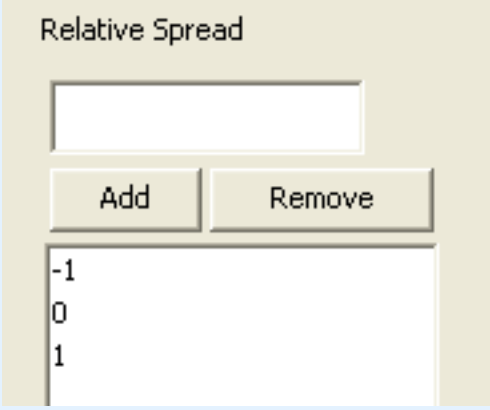
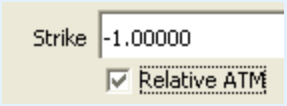
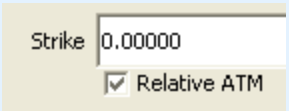
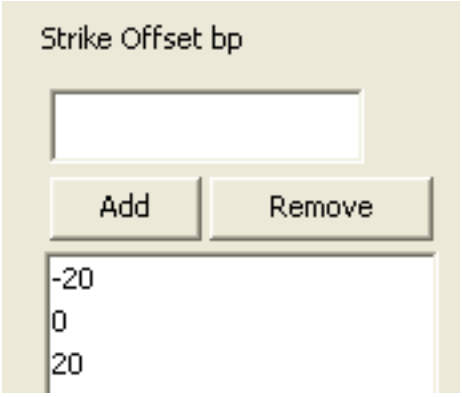


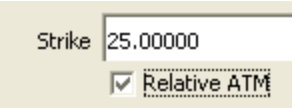
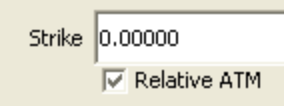
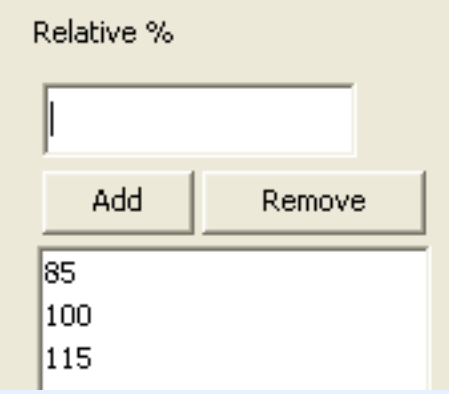
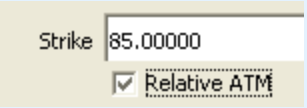
MDI Name	Value
SWAP_DISCOUNT	Discount USD LIB 5/29/13 2:43:18.000 PM PDT
SWAP_FORECAST	Forecast USD LIB 5/29/13 2:43:18.000 PM PDT
SWAPTION_DISCOUNT	Discount USD LIB 5/29/13 2:43:18.000 PM PDT

You can double-click the Value field to select a curve.

Strike Types Details

Surface Type	Definition
Strike	Absolute strike. ***Offset Points*** In the Offset panel, enter absolute strikes.  ***Underlying Instruments*** The underlying instruments must be specified using an absolute strike. 
Relative Spread	Current strike +/- spread minus ATM strike (in %). ***Offset Points*** In the Offset panel, enter relative spreads over the current strike in %. Make sure to add 0.

Surface Type	Definition
	 ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in %. In this example the relative strike is -1%.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0. 
Strike Offset BPs	Current strike +/- offset minus ATM strike (in bp). ***Offset Points*** In the Offset panel, enter relative offset over the current strike in bp Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in bp. In this example

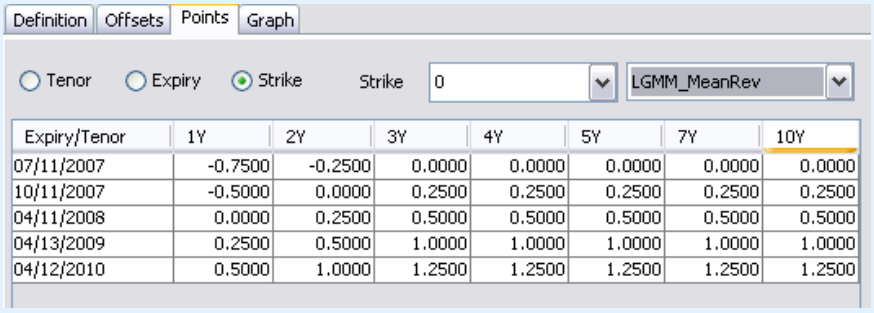
Surface Type	Definition
	the relative strike is +25bp.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0. 
Relative %	% (current strike) minus ATM strike. ***Offset Points*** In the Offset panel, enter a percentage of the current strike.  ***Underlying Instruments*** The underlying instrument must be specified using a percentage of the current strike. In this example, it is 85% of the current strike. 

Generation Algorithms

Generation Algorithms	Definition
NONE	You can select "NONE" for the most "simple" generator from offsets.
Default	Can be used for caps, swaptions, bond options, etc. If the spot lag parameter is set to true, the generated exercise dates are rolled using the conventions of the definition screen.

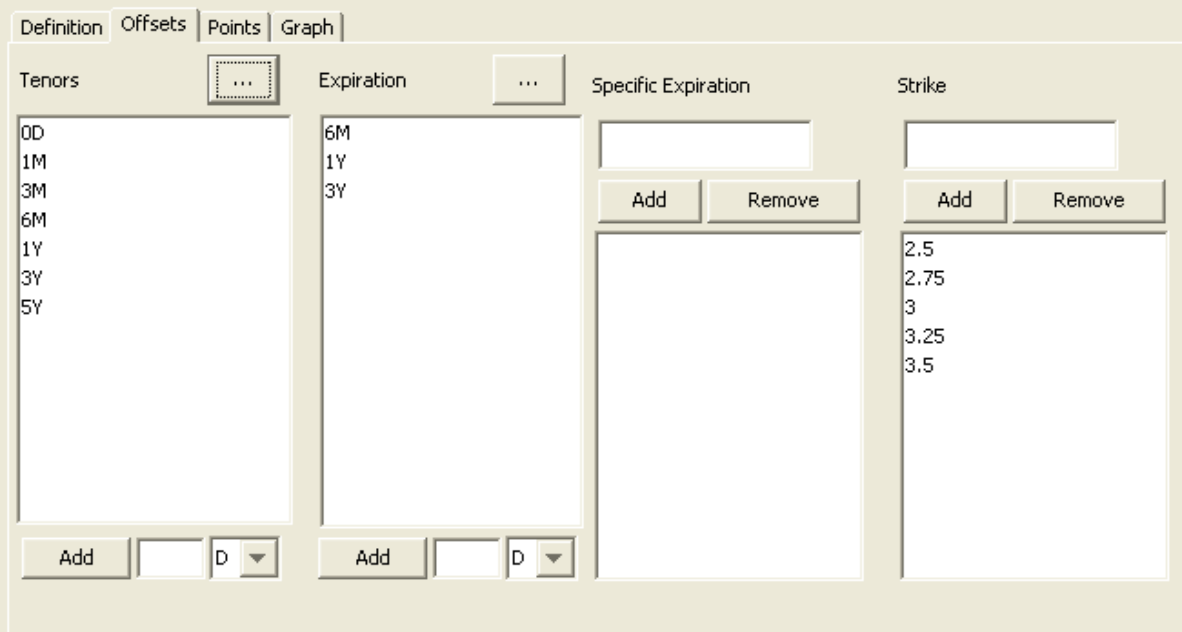
<table>
<tr><th>Generation Algorithms</th><th>Definition</th></tr>
<tr><td></td><td>
<table>
<tr><th>Parameter</th><th>Value</th></tr>
<tr><td>Spot Lag</td><td>false</td></tr>
<tr><td>SYNTHETIC_EXPIRY</td><td></td></tr>
<tr><td>SYNTHETIC_TENOR</td><td></td></tr>
</table>

Note that SYNTHETIC_EXPIRY and SYNTHETIC_TENOR are not currently used.
</td></tr>
<tr><td colspan="2">Swaption Generators</td></tr>
<tr><td>CEVSimple</td><td>CEV stands for constant elasticity of variance. A key feature of the model is that given the parameters of the model, the entire smile can be determined analytically; that is, for a given strike one can analytically determine the correct Black-Scholes volatility to ‘plug into’ the usual Black-Scholes model to determine the premium of the option under the assumptions of the CEV model.
$$dF = \alpha F^{\beta} dW$$
where Beta (β) controls the distribution and Alpha (α) is intimately related to the overall level of volatility.</td></tr>
<tr><td>CMSBasisAdjSimple</td><td>Used to store CMS volatility basis adjustments on the volatility surface.</td></tr>
<tr><td>LGMMeanRev</td><td>The Linear Gauss Markov Model is really the Hull-White one factor model reset in the Heath-Jarrow-Morton framework for Bermudan Swaptions. This alternative characterization greatly helps with calibration and trade valuation.
Calibration
The calibration is stored in a layer of a volatility surface on the Points panel. The generator takes a list of ATM swaption volatilities as inputs and creates an empty container for the mean reversion values. In the case of this model, these values change very infrequently and so it is reasonable that they would remain their original values for the better part of a year. For this reason we have separated the volatility surface that the model requires from the mean reversion parameters that it also requires. This enables the volatility surface to change and be regenerated daily whereas the mean reversion values can remain constant.
Calibration Matrix
In the Points panel of a volatility surface generated with the (simple) LGMMMeanRev generator, there is a layer created titled LGMM_MeanRev. This is where the user is required to key in the values, possibly calculated on a spreadsheet, and then save the surface.</td></tr>
</table>

Generation Algorithms	Definition
	
SABRDirect	Similar to SABRSimple, except you input the ATM volatilities as MID point adjustments rather than link to another volatility surface to get the ATM volatilities as in SABRSimple. MDI is not required. You ca set the generator parameter "Calibrate SABR values" to true. In that case: • You can input ATM bpVol Quotes only using 3M Caplets as underlying instruments. • You can input rho, nu, beta values directly in the SABR Points tab and Generate a SABR surface.
SABRSimple	Deprecated - It is recommended to use Swaption, SwaptionDerived or Default instead. Used to create the implied smile along the strike axis. ATM Black volatilities are the input and the model parameters alpha, beta, rho, nu create the implied smile that is applied to the volatility surface.

10.1.2 Offsets Panel

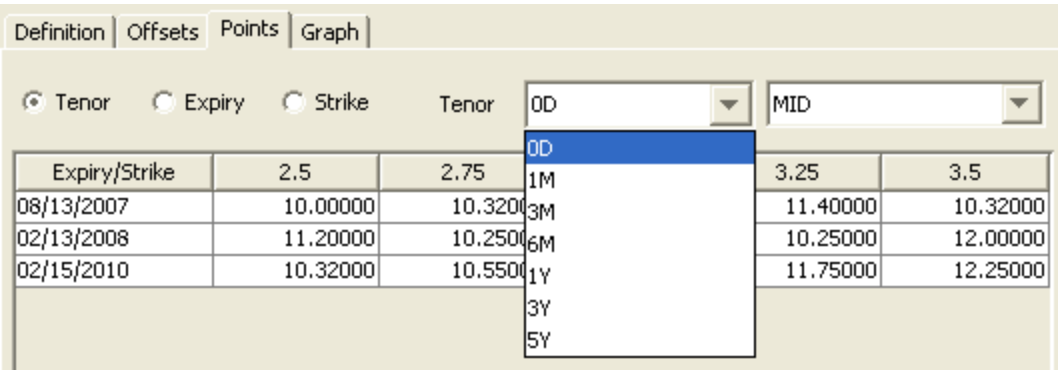
Select the Offsets panel.



- Click ... to select tenors and expirations.
- Enter a strike and click **Add**. Repeat for each strike value.

10.1.3 Points Panel

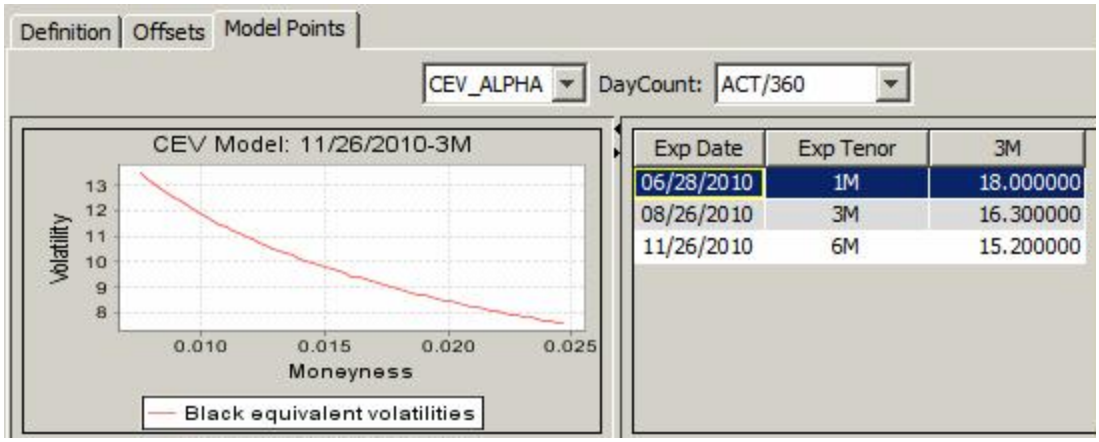
- Select the Points panel, and click **Generate** to generate the points.



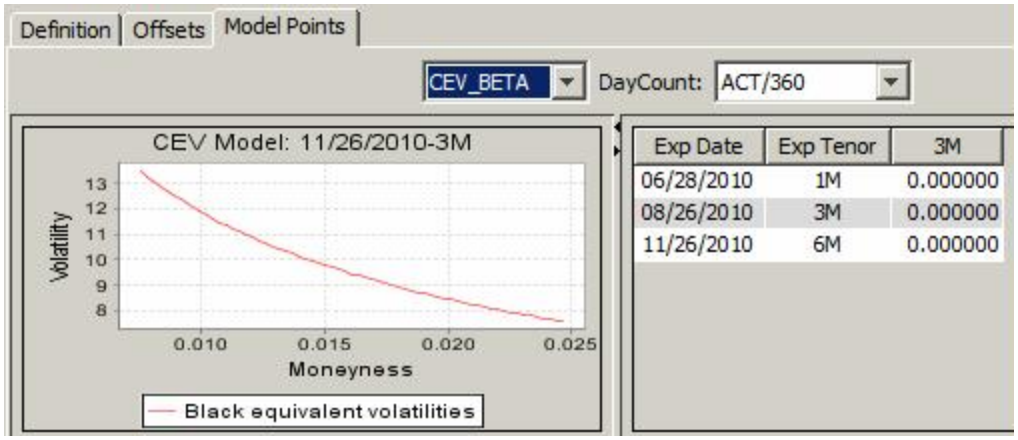
In this example, volatilities are entered manually. Volatilities can also be copied from Excel.

For the CEVSimple generator, you can set:

- CEV_ALPHA points



» CEV_BETA points



10.1.4 Save Surface

Click **Save** at the bottom of the surface window. Enter a name for the surface, and click **OK**.

10.2 RATE Volatility Surface from Underlying Instruments

RATE Volatility Surface from Underlying Instruments Quick Reference

Surface Underlying Instruments

You can use Cap or Swaption underlying instruments for the respective product type. From the Calypso Navigator, navigate to **Configuration > Market Data > Volatility Surface Underlyings**, or in the surface application's Underlyings panel, click **New Instrument**.

Surface Generation

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

2. Select the quote instance to use in the surface generation (CLOSE, LAST, or OPEN).

3. The Current checkbox is selected by default, meaning that when you save the surface, the system timestamps the surface with the current date and time. Clear the Current checkbox to enter a back-dated surface. You can modify the date and time fields.

4. Definition Panel — Select the following to define the surface: currency, index, and tenor, volatility type “RATE”, strike type, interpolator, select the Derived checkbox, generator, date-roll convention, holiday calendars, pricing environment.

5. Underlyings Panel — Select the underlying instruments.

6. Quotes Panel — Enter quotes manually, use quotes from the quote set, or use real-time quotes.

7. Points Panel — Click **Generate** to generate the points.

8. Click **Save**, enter a name for the surface, and click **OK**.

Pricer Configuration

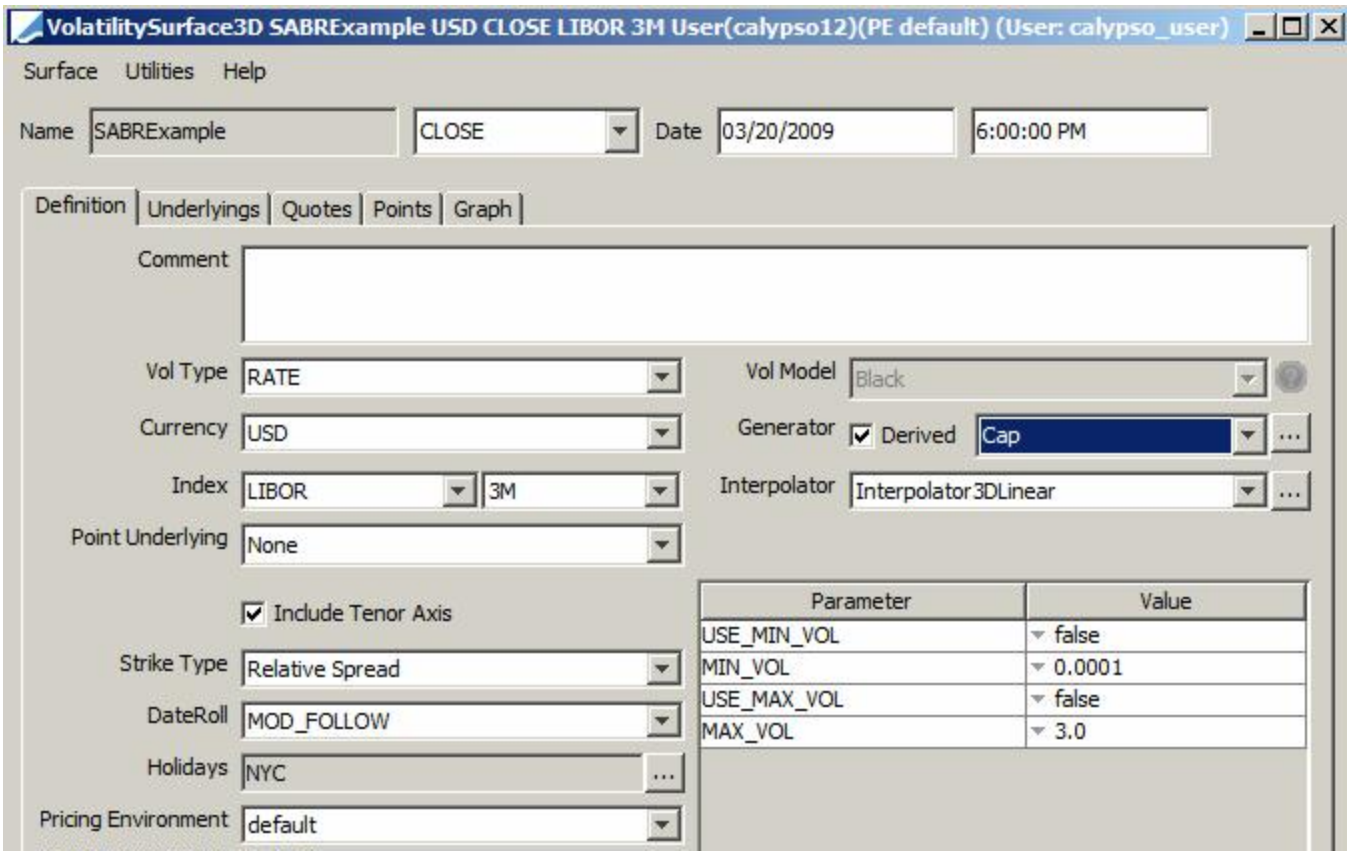
A RATE volatility surface is associated with a pricing environment under the Surfaces panel of the pricer configuration for the RATE volatility type and VOL usage.

A RATE volatility surface generated with LGMM2FMultiStartBestFit is associated with a pricing environment under the Product Specific panel of the pricer configuration for the GLOBAL_LGMM2F usage.

10.2.1 Definition Panel

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

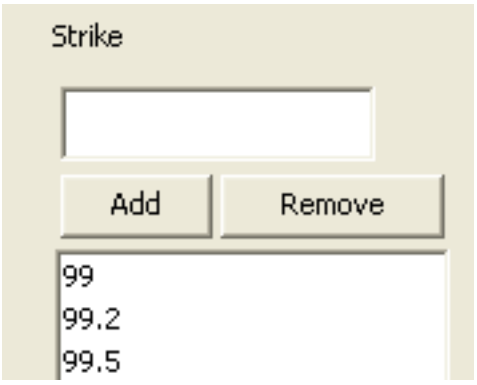
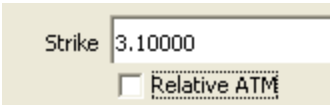
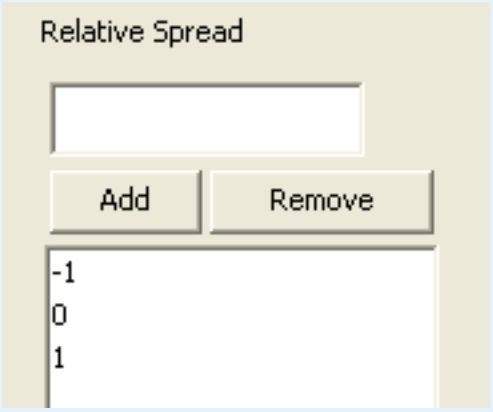
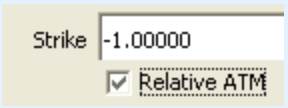
Select the following to define the surface: currency, index, and tenor, volatility type “RATE”, strike type, interpolator, select the Derived checkbox, generator, date-roll convention, holiday calendars, pricing environment.

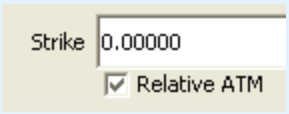
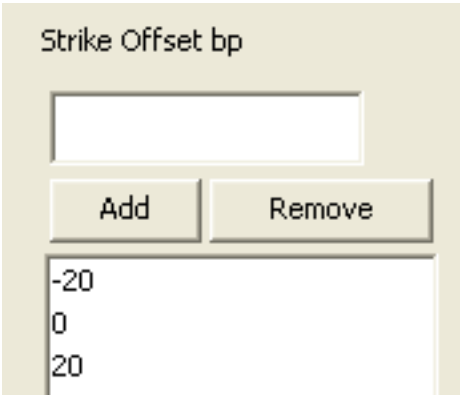
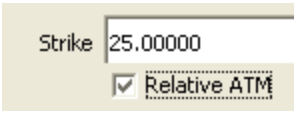
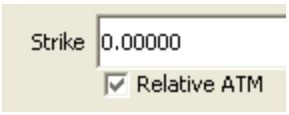


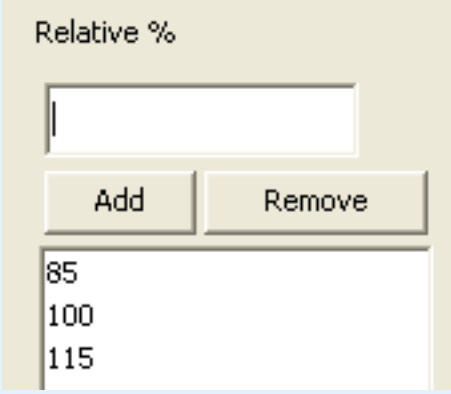
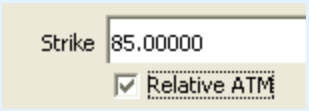
- Select the type of strike - They are described below.
- Select the generation algorithm - It controls the type of underlying instruments that you can select - They are described below.

Strike Types Details

Surface Type	Definition
Strike	Absolute strike. ***Offset Points*** In the Offset panel, enter absolute strikes.

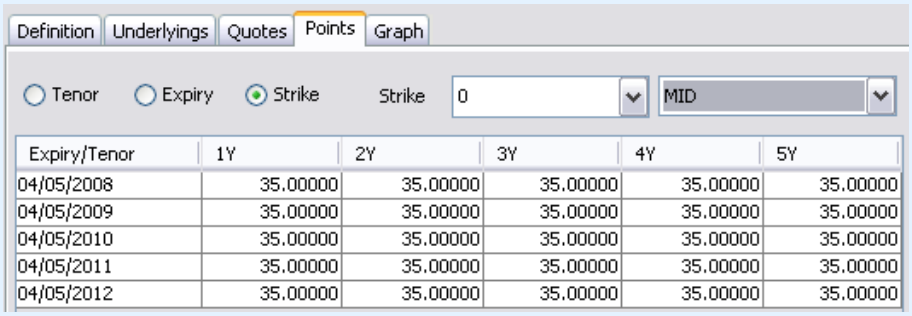
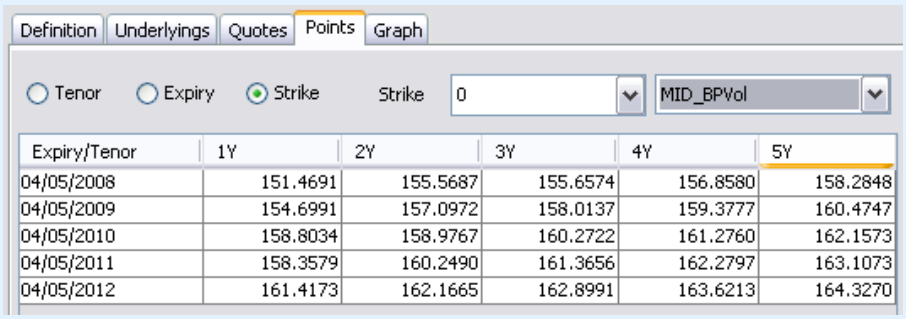
Surface Type	Definition
	 ***Underlying Instruments*** The underlying instruments must be specified using an absolute strike. 
Relative Spread	Current strike +/- spread minus ATM strike (in %). ***Offset Points*** In the Offset panel, enter relative spreads over the current strike in %. Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in %. In this example the relative strike is -1%.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0.

Surface Type	Definition
	
Strike Offset BPs	Current strike +/- offset minus ATM strike (in bp). ***Offset Points*** In the Offset panel, enter relative offset over the current strike in bp Make sure to add 0.  ***Underlying Instruments*** The underlying instruments must be specified using a relative strike in bp. In this example the relative strike is +25bp.  Note that when using a relative strike, one of the underlying instruments must be defined with a strike of 0. 
Relative %	% (current strike) minus ATM strike. ***Offset Points*** In the Offset panel, enter a percentage of the current strike.

Surface Type	Definition
	 ***Underlying Instruments*** The underlying instrument must be specified using a percentage of the current strike. In this example, it is 85% of the current strike. 

Generation Algorithms

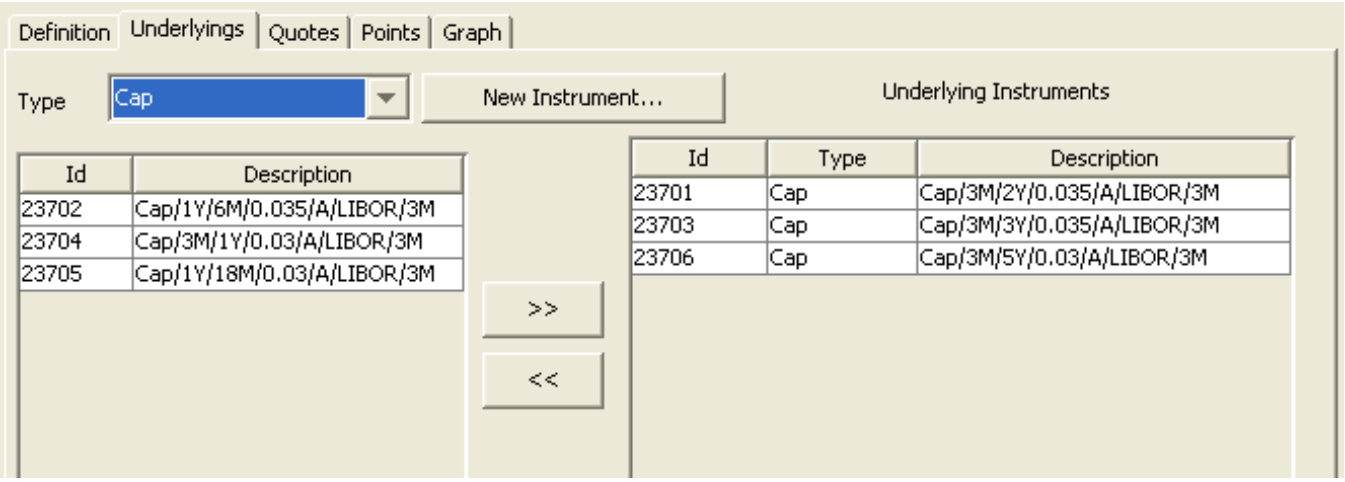
Generation Algorithms	Definition
Cap Generators	
Cap	Generates a volatility surface from caps/floors using the standard Black model.
CapBpVols	The bootstrapping algorithm is using the BpVol (a.k.a. Normal) model to generate forward volatilities. Volatility surfaces built using this generator can then expose Black or BpVol volatilities to pricers. The settings are similar to the configuration of the CapBlack generator, in particular the pricing parameters are the same. ▶ Please refer to the Calypso Analytics Library guide for complete setup details.
CapShiftedLognormal	This generator computes the forward caplet volatilities from the market quoted Cap volatilities. ▶ Please refer to the Calypso Analytics Library guide for complete setup details.
CapTerm	Used for storing cap volatilities in a surface. The points are linked to specific underlying volatilities. The surface points have the same maturity, strike, rate index tenor, and volatility as the underlying cap.
Swaption Generators	

Generation Algorithms	Definition
CMSBasisAdjSimple	Used to store CMS volatility basis adjustments on the volatility surface.
LGMM2FMultiStartBestFit	Used to price multi-index TARN bonds using PricerBondLGMM2F. This generator calibrates in a best fit sense ATM swaptions. Typically, one calibrates to the entire ATM vol surface. This can take several minutes, depending on the number of quotes in the surface. The solution is a set of model parameters, kappa1, kappa2, sigma1, sigma2, rho. The quotes for the ATM swaptions are the volatilities.
Swaption	Generates and stores volatilities on a surface according to market quoted volatilities from underlying European swaptions. A basic volatility surface.
SwaptionBpVols	The generator SwaptionsBpVols uses underlying swaptions to produce a volatility surface. The main advantage of this generator is that it can take a mixture of points, some quoted in Black volatility (or Yield Quote Type) and others quoted in basis point volatility (or BpVol Quote Type) and then the generator will perform all the necessary conversions to get a surface layer all in Black Volatilities and another surface layer all in basis point volatilities. The pricers can then use the black layer if they require Black volatilities, or use the basis point layer if they require basis point volatilities and both layers are on the same surface. ***Black Volatilities*** Black volatilities are constructed in the MID layer in the Points panel.  Definition Underlyings Quotes Points Graph Tenor Expiry Strike Strike 0 MID Expiry/Tenor 1Y 2Y 3Y 4Y 5Y 04/05/2008 35.00000 35.00000 35.00000 35.00000 35.00000 04/05/2009 35.00000 35.00000 35.00000 35.00000 35.00000 04/05/2010 35.00000 35.00000 35.00000 35.00000 35.00000 04/05/2011 35.00000 35.00000 35.00000 35.00000 35.00000 04/05/2012 35.00000 35.00000 35.00000 35.00000 35.00000 ***Basis Point Volatilities*** Basis Point volatilities are constructed in the MID_BPVol layer in the Points panel.  Definition Underlyings Quotes Points Graph Tenor Expiry Strike Strike 0 MID_BPVol Expiry/Tenor 1Y 2Y 3Y 4Y 5Y 04/05/2008 151.4691 155.5687 155.6574 156.8580 158.2848 04/05/2009 154.6991 157.0972 158.0137 159.3777 160.4747 04/05/2010 158.8034 158.9767 160.2722 161.2760 162.1573 04/05/2011 158.3579 160.2490 161.3656 162.2797 163.1073 04/05/2012 161.4173 162.1665 162.8991 163.6213 164.3270

Generation Algorithms	Definition
	Generator Parameters • TRANSFORMATION_METHOD - The only supported transformation method is EXACT. • FAIL_FOR_NEGATIVE_STRIKES - Default is false. When set to true and the strike is negative, if the input is black vol, return NaN for both black and bpvol. If the input is bp vol, return NaN for black vol and correct bp vol.
SwaptionSABR	Deprecated - It is recommended to use SwaptionSABRDerived instead. Used to create the implied smile on a set of Swaption underlyings by setting the model parameters alpha, beta, rho, and nu.
SwaptionSABRDerived	Please refer to the Calypso Analytics Library Guide (CALIB) for complete setup details.
Future Option Generator	
FutureOption	Generates and stores volatilities where the underlyings are options on futures. This only applies if the quote type of the future is rate. If the quote type of the future is price, use instead the MMFUTUTE volatility type and the FutureOption generator.

10.2.2 Underlyings Panel

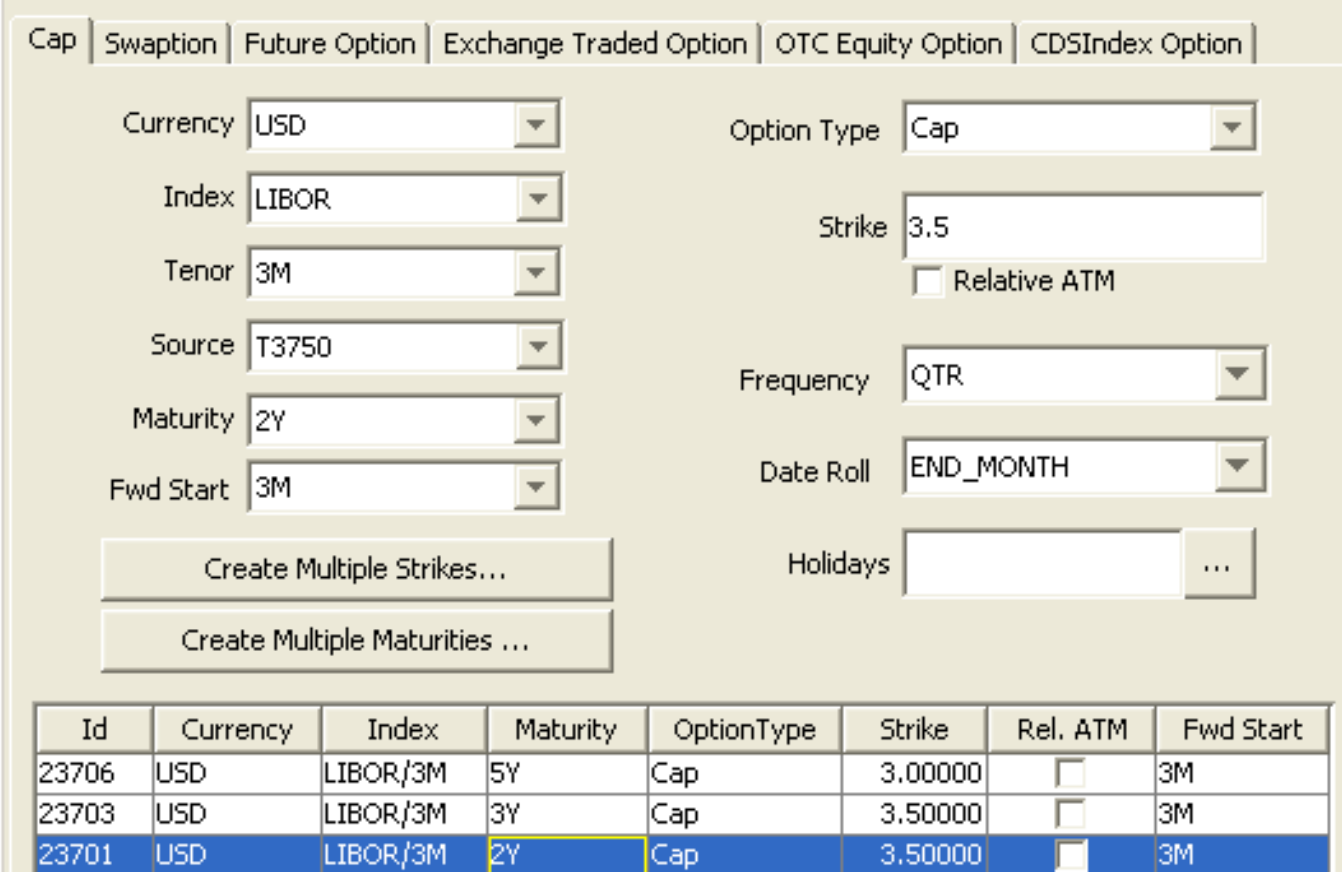
Select the Underlyings panel.



» Select the instrument type, and the panel below displays the list of available instruments. The panel is blank if you have not set up any instruments. Click **New Instrument** to create new instruments.

» Select instruments and click **>>** to add them to the instrument list in the right panel.

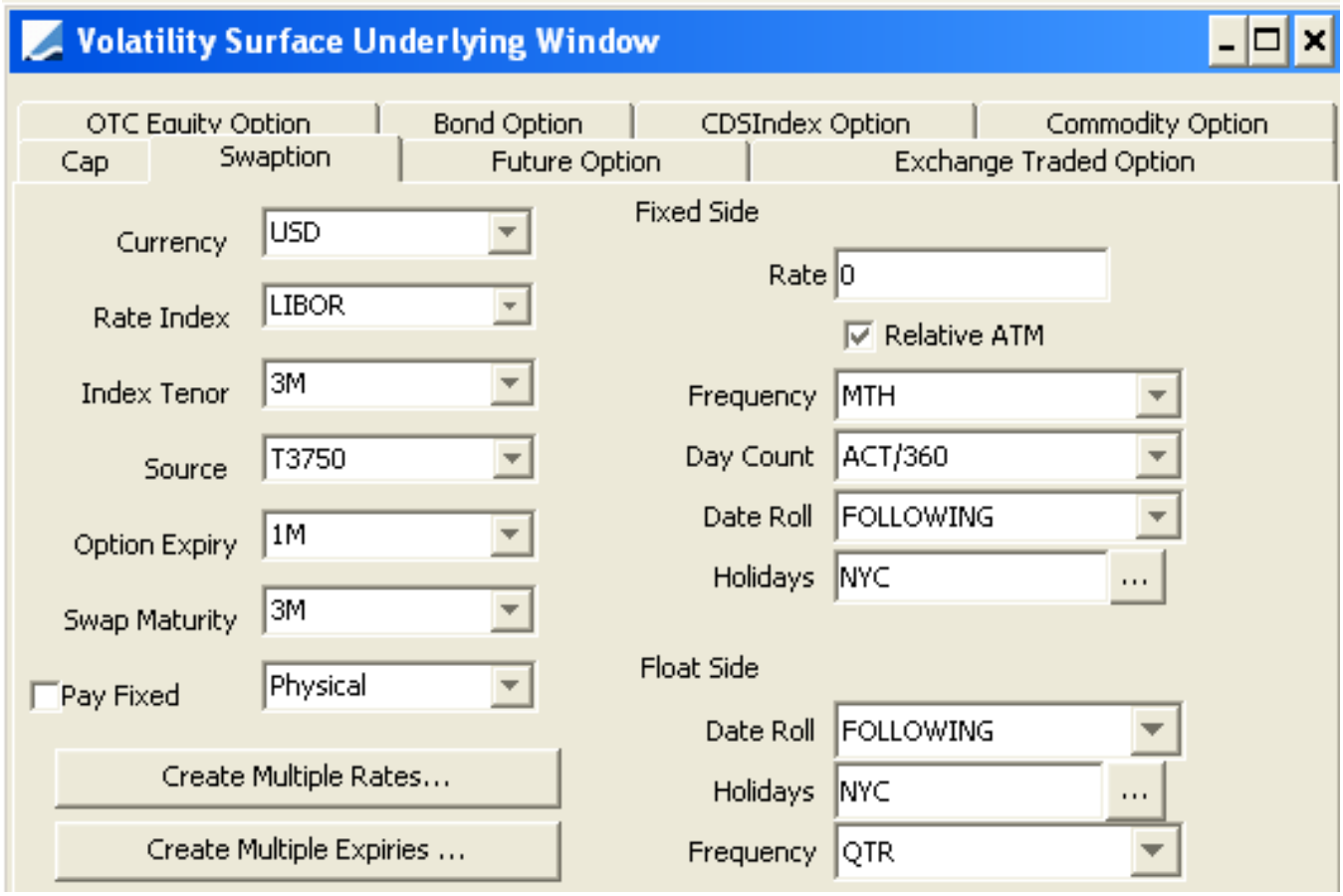
For the cap/floor underlying instruments you can either use only caplets/floorlets (they all contain one cashflow only), or only cap/floors (they all contain multiple cashflows).



» Click **Create Multiple Strikes** or **Create Multiple Maturities** to create multiple instruments.

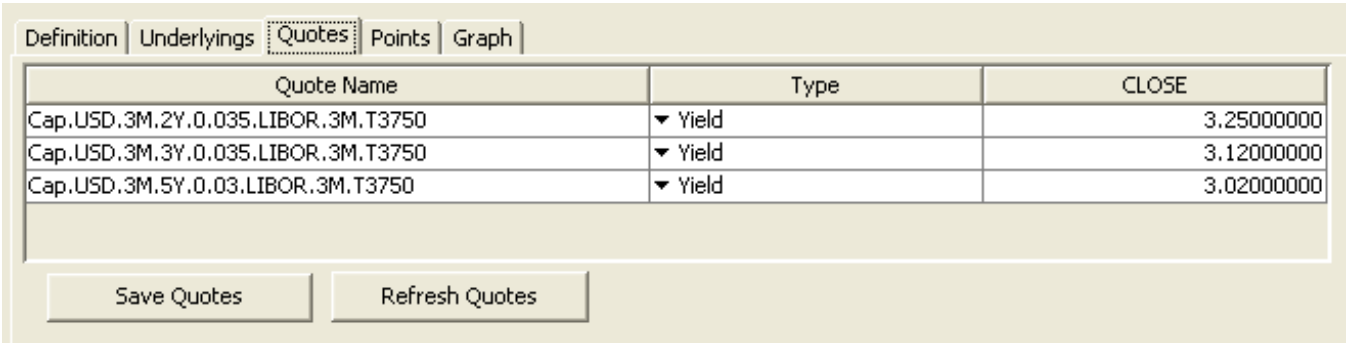
Sample underlying ATM swaption.

[NOTE: For a given surface with swaption underlyings, you can only use ATM swaptions (underlying ending with "/A") OR relative swaptions (underlying ending with "/R"), you cannot mix both]



10.2.3 Quotes Panel

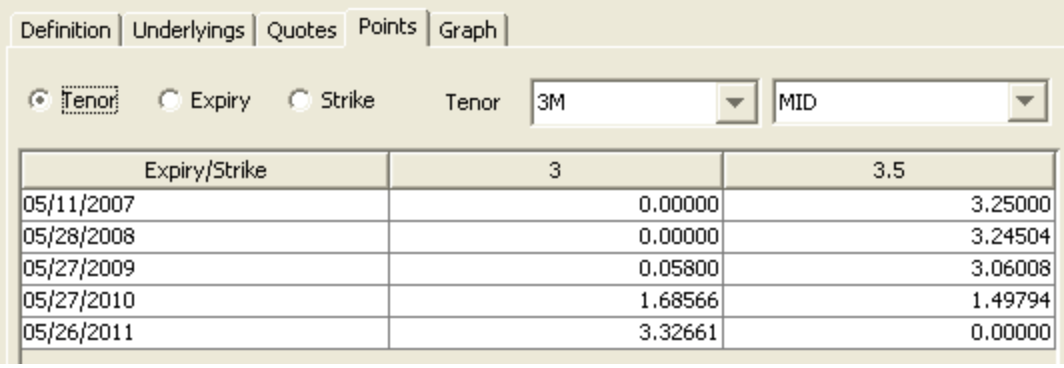
Select the Quotes panel. Enter quotes for the underlying instruments.



» You can click **Save Quotes** to save the quotes.

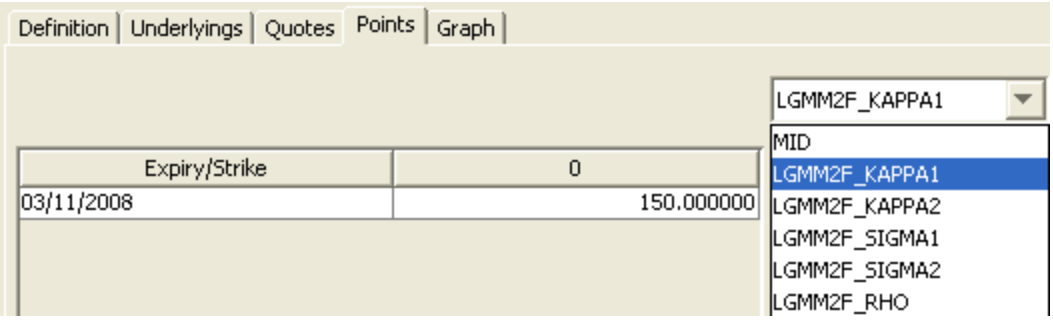
10.2.4 Points Panel

Click the Points tab. Click **Generate** to generate the points.



» You can view the points for each combination of tenor, expiry and strike.

For the LGMM2FMultiStartBestFit generator, you can view all the generated parameters.

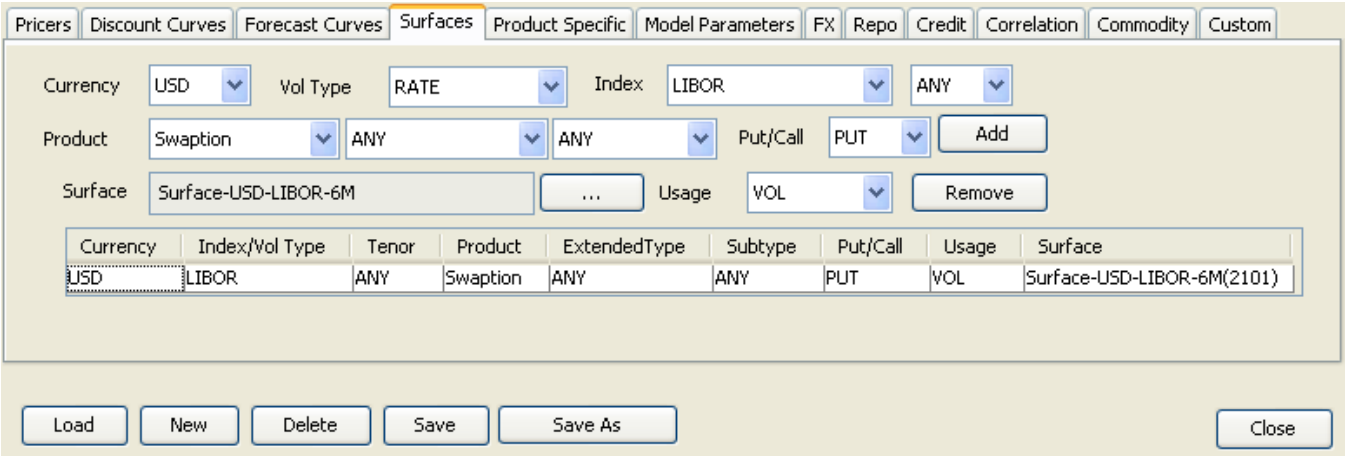


10.2.5 Save Surface

Click **Save** in the bottom of the surface window. Enter a name for the surface, and click **OK**.

10.3 Pricer Configuration

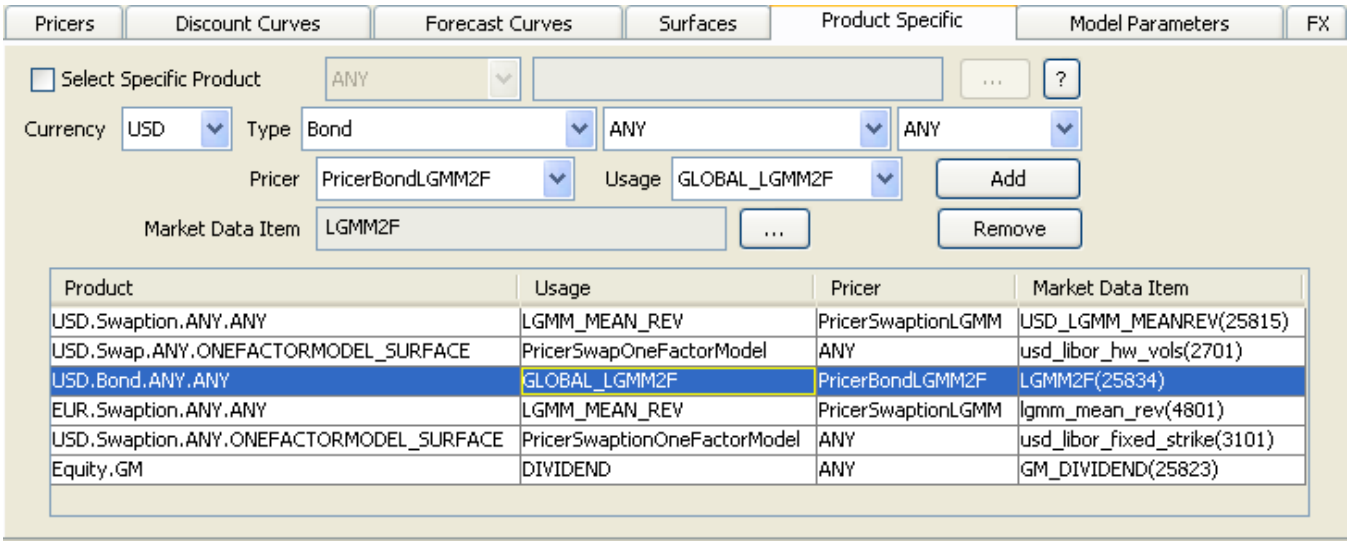
From the Calypso Navigator, navigate to **Market Data > Pricing Environment > Pricer Configuration**. Load a pricer configuration and select the Surfaces panel.



- Select the currency, volatility type, index, and tenor.
- Select the product type, extended type or ANY, subtype or ANY, PUT or CALL.
- Click **...** to select the volatility surface. Select the surface in the Selection window and click **Load** to display the surface name in the pricer configuration.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

10.3.1 RATE Volatility Surface Generated with LGMM2FMultiStartBestFit Generator

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



- Select the pricer PricerBondLGMM2F and the usage GLOBAL_LGMM2F.

- Click **...** to select the volatility surface.
- Click **Add** to add the surface to the list.
- Click **Save** to save the pricer configuration.

11. Surface Charts

This topic describes how you can view and use surface charts in the Graph panel of the Volatility Surface window.

11.1 Before you Begin

The Graph panel requires the installation of the Vecmath library. It can be downloaded as part of Java 3D at the following link: http://java3d.java.net/binary-builds.html

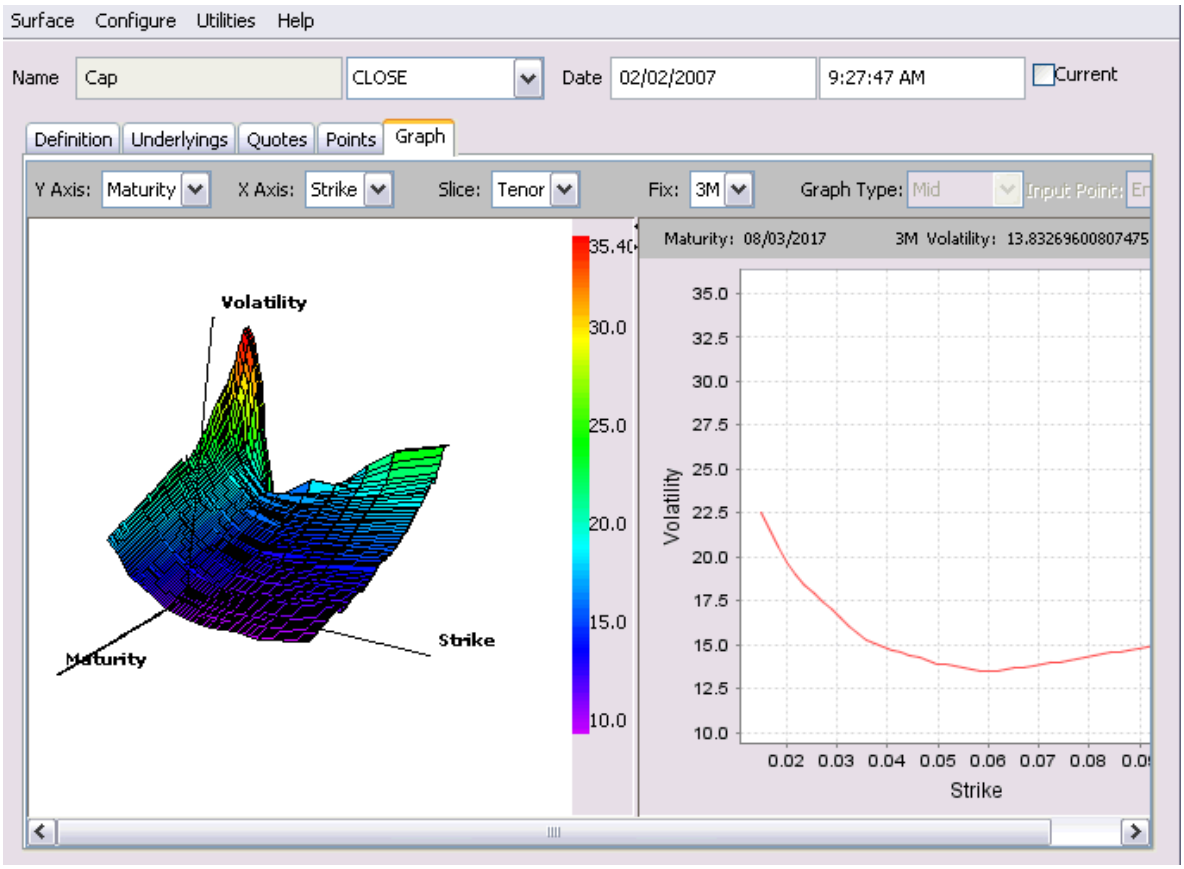
You need to add the following jar to the Libraries (Jar files) of the Calypso Installer - "Common Third Party Libraries & Extension":

- vecmath.jar

[NOTE: The Calypso License to use this Calypso integration does not include a license to the actual third-party library - Clients are responsible for contracting with the appropriate third-party provider prior to using this Calypso integration]

11.2 Graph Panel

The surface chart has two halves: a 3D graph on the left and a line chart on the right. The line chart shows details from the 3D graph.



11.2.1 Axes

Most volatility surfaces have 3 dimensions: maturity, strike and volatility. In such cases, the default setup for the 3D graph has the strike on the x-axis and maturity on the y-axis. Swaption volatility surfaces may have a fourth dimension: the tenor of the underlying swap. The default setup for 4D surfaces has tenor on the x-axis of the graph and maturity on the y-axis.

You can change the axes using the combo-boxes above the graph.

11.2.2 3D Graph

The 3D graph is divided into colored sections. The color of a section denotes the volatility for the corresponding strike and maturity. The hotter or redder the color, the higher the volatility; the cooler or more blue/violet the color, the lower the volatility.

There may be many strikes for a given tenor and maturity, but the system has to pick one to use for the color setting. By default, this will be the middle strike in the list because this is often the ATM strike. The user can have the colors represent the volatility at a different strike by changing the value of the “Fix” combo box.

11.2.3 Line Chart

If you click on the 3D graph, a maturity is selected and the line chart on the right will show the volatilities for all the strikes at that maturity (and tenor, where applicable). You can inspect any smile or skew.

The line chart is drawn by interpolating values for 50 evenly spaced strikes. By clicking on the 3D graph, you can see the precise volatility for the closest strike to your mouse position.

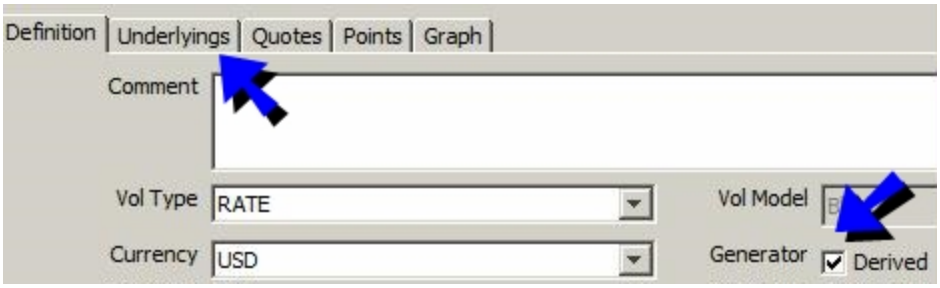
On a swaption surface, the line chart will also show points representing the volatilities of the underlying swaptions that were used to generate the surface. (These points will not be shown for a cap surface because the cap surface represents forward volatilities whereas the underlying caps' quotes are flat volatilities).

To compare the displayed skew with the skew at a second maturity, hold down the Control key and select the other maturity on the 3D graph. A line will be added to the line chart for each selected maturity.

12. Volatility Surface Underlying Overview

You can set up underlying instruments before creating the volatility surface using **Configuration > Market Data > Volatility Surface Underlyings** from the Calypso Navigator, or while you are creating the volatility surface. When you save an underlying instrument, the system automatically creates a quote name for that instrument.

To use the instruments in building the surface, check “Derived” in the volatility surface window. The window then displays the Underlyings panel where you can select the underlying instruments.



The following types of underlying instruments are available.

Bond Option - Vol Surface Underlying

Cap - Vol Surface Underlying

CDS Index Option - Vol Surface Underlying

Commodity Option - Vol Surface Underlying

Exchange Traded Option - Vol Surface Underlying

Future Option - Vol Surface Underlying

FX Option - Vol Surface Underlying

OTC Equity Option - Vol Surface Underlying

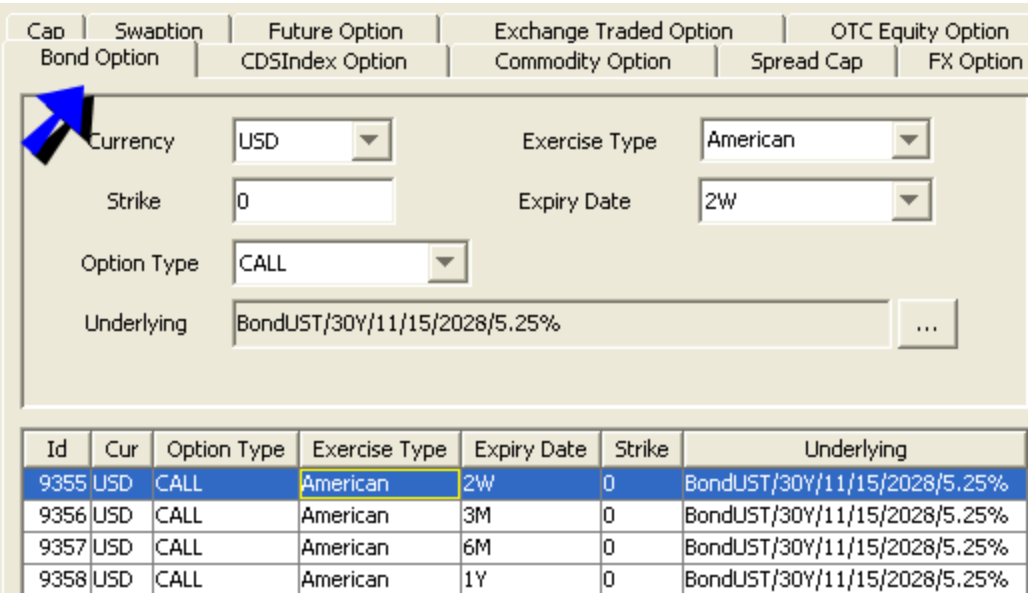
Spread Cap - Vol Surface Underlying

Swaption - Vol Surface Underlying

Warrant - Vol Surface Underlying

13. Bond Option - Vol Surface Underlying

Bond option underlying instruments are used to create Bond Option volatility surfaces. They are created for ATM volatilities.



- Select the details as described in the table below.
- Set the strike to 0.
- Then click **Save**.
- You can change any field and click **Save As New** to create additional underlying instruments.

The system creates quotes like: "`BondOTC.<currency>.<option type>.<expiry>.<bond quote name>`", type = PriceVol.

Example "`BondOTC.USD.C.2W.UST.11-15-2028.5.25000.0.0`"

Fields Details

Field	Description
Currency	Select the currency of the underlying bond.
Exercise Type	Select the exercise type (American or European).
Strike	Enter the strike for the bond option.

Field	Description
Expiry Date	Select the expiry date of the option.
Option Type	Select the option type (PUT or CALL).
Underlying	Click ... to select the underling bond product in the Product Chooser Window.
Id	Displays the system assigned unique identifier for the Bond Option volatility surface underlying.

14. Cap - Vol Surface Underlying

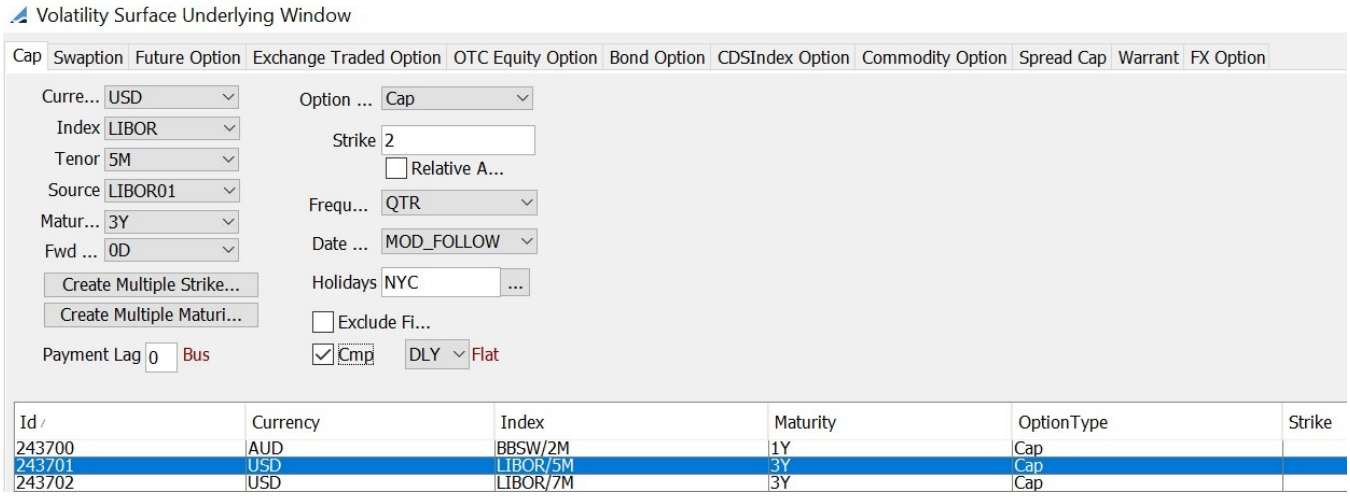
The Cap underlying can be used in construction of the RATE volatility surface.

Cap Configuration

- Create the Rate Index Definition using **Configuration > Interest Rates > Rate Index Definitions** from the Calypso Navigator.

14.1 Cap Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, Cap panel.



» Click **New** to create new volatility surface underlying.

Select the details as described in the table below.

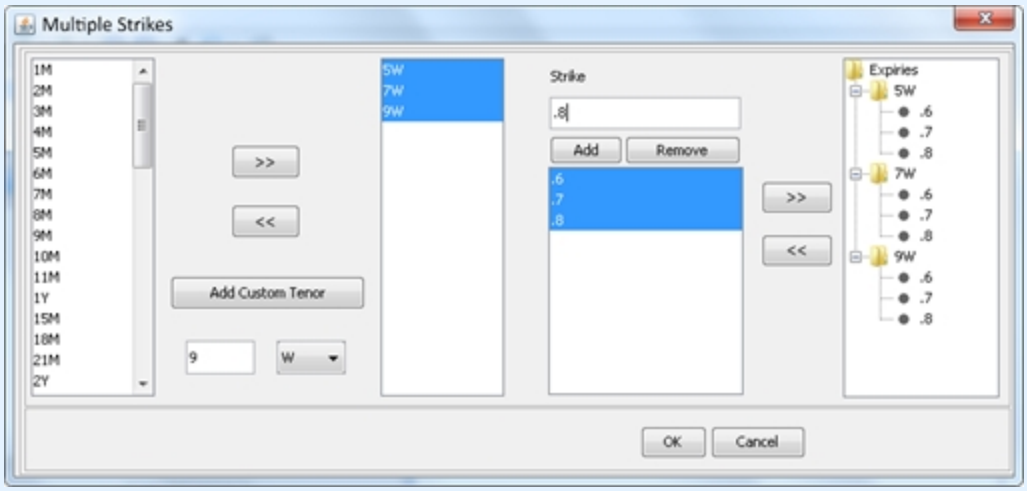
» Click **Save** to create the underlying. They appear in the table below.

The system creates quotes like: "`Cap.<currency>.<expiry>.<rate expiry>.<strike>.<rate index>`".

Example "`Cap.JPY.2D.1Y.0.05.LIBOR.6M.T3750`".

Fields Details

Field	Description
Currency	Reference index currency.
Index	Name of the reference index.

Field	Description
Tenor	Tenor for the reference index.
Source	Source for publishing the reference index.
Maturity	Cap/Floor maturity tenor.
Fwd Start	Start tenor.
Option Type	Type of option, such as Cap or Floor.
Strike	Strike in percentage.
Relative ATM	Select if relative ATM is used.
Frequency	Frequency code such as QTR, WK, SA.
Date Roll	Type of date roll such as MOD_FOLLOWING, FOLLOWING.
Holidays	Calendar used for Holidays.
Exclude First	Check to exclude the first caplet. It is included by default.
Create Multiple Strikes	You can click **Create Multiple Strikes** to create multiple instruments at once by using the Multiple Strikes window.  » Select one or more tenors and move them to the tenor field to the right. To create custom tenors, add a number in the text field, select either Day, Week, Month, or Year in the drop-down list, and click **Add Custom Tenor**. The tenors are added to the tenor field. » Under "Strike," add a value and click **Add** to move the value to the Strike field below. » To create multiple strikes, select and highlight the preferred tenors and strikes added in steps above, then use the arrow button to move them into the Expiries structure. When the structure is complete, click **OK**. The multiple strikes are added to the list of underlying instruments on the Cap panel. **[NOTE: before creating multiple strikes, make sure to specify other relevant**

Field	Description
	information - such as currency, index, source, option type, date roll, and holidays - on the Cap panel.]
Create Multiple Maturities	You can click **Create Multiple Maturities** to create multiple instruments. » Select the frequency, date roll method, and holiday calendars for calculating the dates.
Payment Lag	Enter the number of days between the interest date and the payment date, and specify Business or Calendar.
Cmp	Check the Cmp checkbox to enable interest compounding. » Select the DLY from the adjacent field. » Double-click the Flat label to toggle between: – Flat — Flat compounding. – Spread — Does not apply to fixed rates, only to floating rates. – SimpleSpread - Does not apply to fixed rates, only to floating rates. – NoCmp — A cashflow is created at the compounding period without actually compounding the interest. There is no compounding otherwise.
Id	Displays the system assigned unique identifier for the Cap volatility surface underlying.

15. CDS Index Option - Vol Surface Underlying

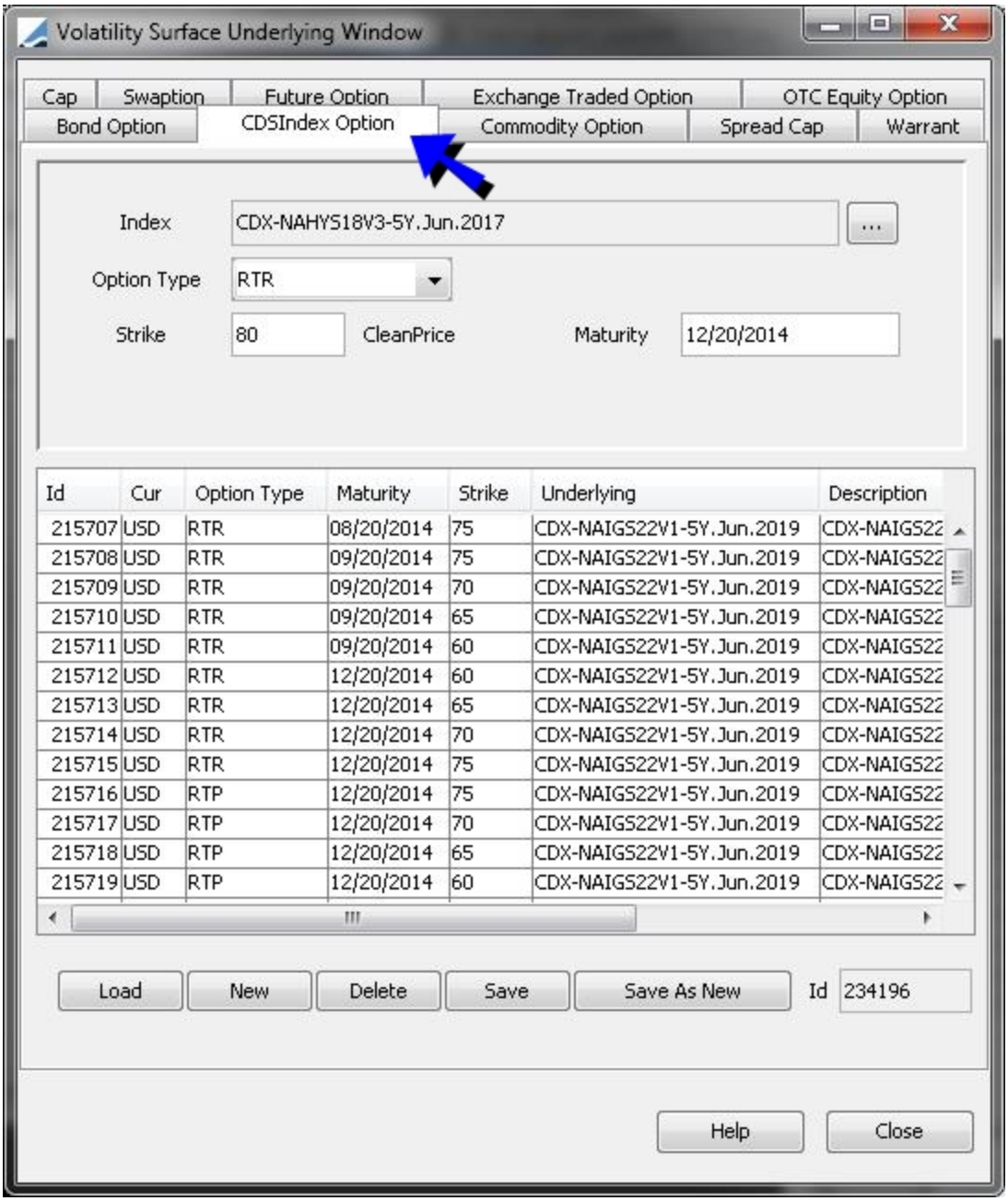
The CDS Index Option underlying can be used in construction of the CREDIT volatility surface.

CDS Index Configuration

- Create the CDS Index using **Configuration > Credit Derivatives > CDS Index Definition** from the Calypso Navigator.

15.1 CDS Index Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, CDSIndex Option panel.



- Click **New** to create new volatility surface underlying.

  Complete the details as described in the table below.
- Click **Save** to create the underlying. They appear in the table below.

The system creates quotes like in the following example.

Quote Name	Type
CDSIndex.CDX.NA.IG..6-V1 5Y.Jun.2011	Spread
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-12-20, Strike=39	CleanPrice
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-12-20, Strike=41	CleanPrice
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-12-20, Strike=43	CleanPrice
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-12-20, Strike=45	CleanPrice
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-9-20, Strike=36	CleanPrice
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-9-20, Strike=38	CleanPrice
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-9-20, Strike=40	CleanPrice
CDX.NA.IG..6-V1 5Y.Jun.2011.RTR.2006-9-20, Strike=42	CleanPrice

Fields Details

Field	Description
Strike	Enter the strike in percentage. The strike is displayed in the quote type defined in the index definition.
Maturity	Maturity date and time.
Option Type	Select the Option Type: RTR (right to sell credit protection) or RTR (right to buy credit protection).
Index	Click ... to select the CDS Index.
Id	Displays the system assigned unique identifier for the CDS Index volatility surface underlying.

16. Commodity Option - Vol Surface Underlying

The commodity option underlying can be used in construction of the COMMODITY volatility surface.

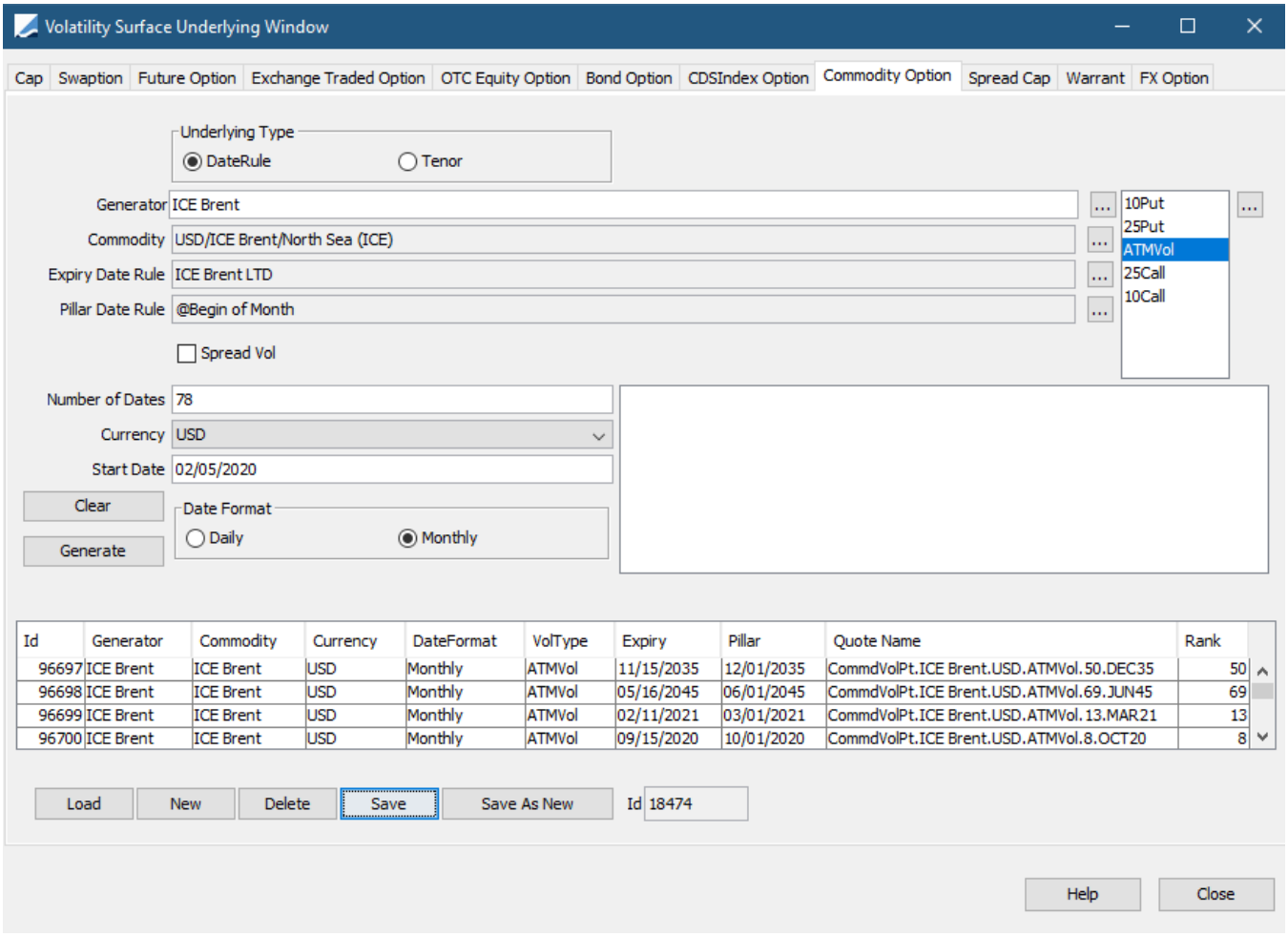
Commodity Option Configuration

- Create the commodity product using **Configuration > Commodities > Commodities** from the Calypso Navigator.
- Create the date rules using **Configuration > Definitions > Date Rule Definitions** from the Calypso Navigator.
- Run the GENERATE_COMM_VOL_POINTS scheduled task once to create the commodity vol surface underlyings. From that point on, only the GENERATE_COMM_VOL_POINTS_QUOTES should be used to create quote names for rolled commodity vol surface underlyings as of the val date when the scheduled task is executed, creating quote names for the new expiry.

  ▶ Refer to Calypso Scheduled Tasks documentation for details.

16.1 Delta based Volatility Surface Underlying

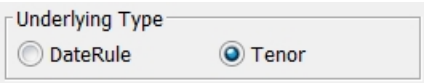
Create Delta based underlying instruments in Volatility Surface Underlying Window using 'Commodity Option' panel. The Delta based Volatility Surface Underlings are supported by Commodity Delta generator while generating Commodity Volatility Surface.



- Click **New** to create new volatility surface underlyings.

  Complete the details as described in the table below.
- Click **Generate** to create a list of underlying instruments. A preview is displayed.
- Click **Save** to create the underlyings. They appear in the table below.

The Underlying Type can be either DateRule or Tenor based.



A DateRule based underlying is configured with a specific expiry date and specific pillar date. With a Tenor based underlying, the user can map the tenors against a live feed to capture quotes. This eliminates the need to recreate new underlyings with new expiry and pillar dates as well as eliminating the need to enter quotes manually.

Quotes using a DateRule underlying use the following naming convention: *CommdVoltPt.VolPtGeneratorName.Currency.VolType.Expiry* as in the example below.

CommdVolPt.ICE Brent.USD.ATMVol.01JAN18

CommdVolPt.ICE Brent.USD.ATMVol.01FEB18

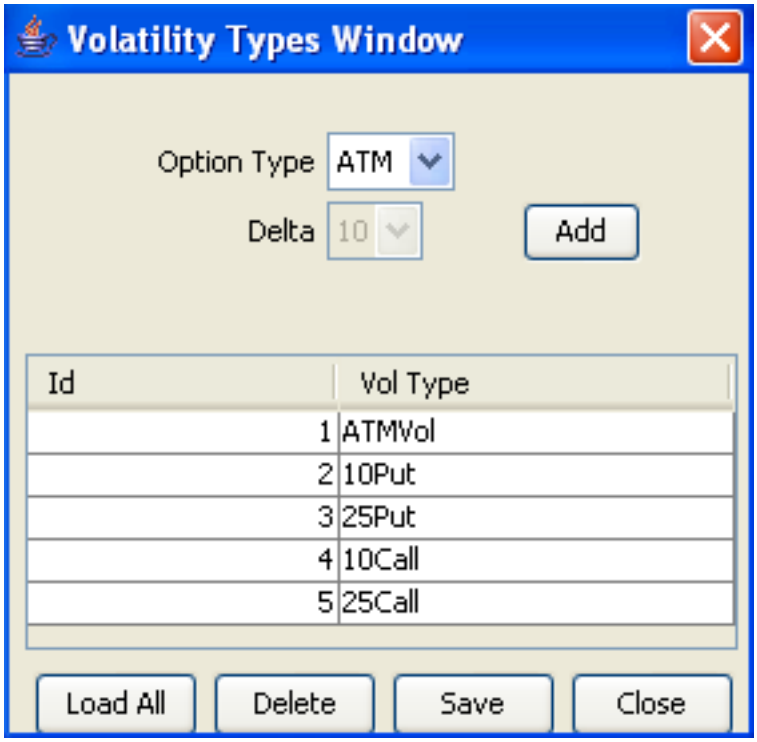
Quotes using a Tenor underlying use the following naming convention: *CommdVolPt.VolPtGeneratorName.Currency.VolType.Tenor* as in the example below.

CommdVol.Pt.LME Tin.USD.25Put.3D

CommdVol.Pt.LME Tin.USD.25Put.5D

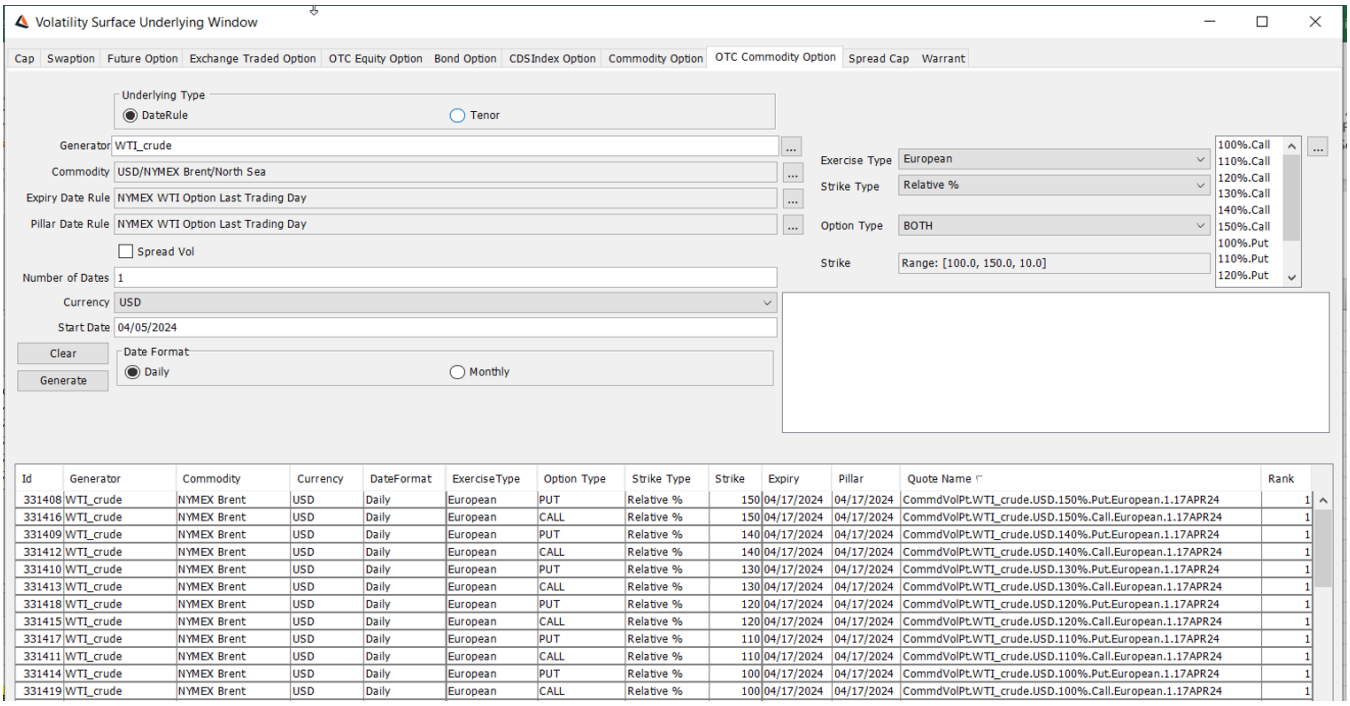
Fields Details

Field	Description
Generator	Enter a generator name for the volatility surface.
Commodity	Displays the associated commodity product if any. You can click ... to select the underlying commodity product.
Expiry Date Rule / Expiry Tenor	Displays the expiry date rule or tenors of the commodity product by default. Click ... to select the date rule or tenors to generate the expiry for each underlying.
Pillar Date Rule / Expiry Tenor	Displays the pillar date rule or tenors of the commodity product by default. Click ... to select the date rule to generate the pillar dates. Note: When using the *Tenor* Underlying Type, this field is automatically populated with the same tenors selected for the Expiry Tenor.
Volatility Types	Select the volatilities for which you want to generate underlyings. You can click ... to add new volatility types.

Field	Description
	 » Click **Load All** to display existing volatility types. » You can select ATM and click **Save** to add the ATM volatility, or select PUT/CALL and a Delta value, and click **Save** to add a PUT/CALL volatility. » You can click **Add** to add Delta values as needed.
Spread Vol	Check to indicate that the underlying is a volatility spread, to be used for the volatility surfaces generated with the *CommodityVolatilitySpread* generator.
Number of Dates	Enter the number of dates that you want to generate.
Currency	Select the reference currency for the underlyings.
Start Date	Enter the start date from which the underlyings will be generated.
Date Format	Select a date format for the underlying according to the market convention: • Daily — Includes the date, month, and year in the underlying quote name. Use the daily format when generating multiple underlying in the same month. • Monthly — Includes the month name and year in the underlying quote name.
Id	Displays the system assigned unique identifier.

16.2 Commodity Volatility Surface Underlying

Create Strike, Relative% and Delta based underlying instruments in Volatility Surface Underlying Window using 'OTC Commodity Option' panel. Currently the Moneyness based i.e., Relative% Volatility Surface Underlings are supported by **Commodity** generator while generating Commodity Volatility Surface.



Id	Generator	Commodity	Currency	DateFormat	ExerciseType	Option Type	Strike Type	Strike	Expiry	Pillar	Quote Name	Rank
331408	WTI_crude	NYMEX Brent	USD	Daily	European	PUT	Relative %	150	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.150%.Put.European.1.17APR24	1
331416	WTI_crude	NYMEX Brent	USD	Daily	European	CALL	Relative %	150	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.150%.Call.European.1.17APR24	1
331409	WTI_crude	NYMEX Brent	USD	Daily	European	PUT	Relative %	140	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.140%.Put.European.1.17APR24	1
331412	WTI_crude	NYMEX Brent	USD	Daily	European	CALL	Relative %	140	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.140%.Call.European.1.17APR24	1
331410	WTI_crude	NYMEX Brent	USD	Daily	European	PUT	Relative %	130	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.130%.Put.European.1.17APR24	1
331413	WTI_crude	NYMEX Brent	USD	Daily	European	CALL	Relative %	130	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.130%.Call.European.1.17APR24	1
331418	WTI_crude	NYMEX Brent	USD	Daily	European	PUT	Relative %	120	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.120%.Put.European.1.17APR24	1
331415	WTI_crude	NYMEX Brent	USD	Daily	European	CALL	Relative %	120	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.120%.Call.European.1.17APR24	1
331417	WTI_crude	NYMEX Brent	USD	Daily	European	PUT	Relative %	110	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.110%.Put.European.1.17APR24	1
331411	WTI_crude	NYMEX Brent	USD	Daily	European	CALL	Relative %	110	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.110%.Call.European.1.17APR24	1
331414	WTI_crude	NYMEX Brent	USD	Daily	European	PUT	Relative %	100	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.100%.Put.European.1.17APR24	1
331419	WTI_crude	NYMEX Brent	USD	Daily	European	CALL	Relative %	100	04/17/2024	04/17/2024	CommdVolPt.WTI_crude.USD.100%.Call.European.1.17APR24	1

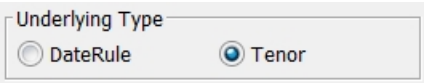
» Click **New** to create new volatility surface underlyings.

Complete the details as described in the table below.

» Click **Generate** to create a list of underlying instruments. A preview is displayed.

» Click **Save** to create the underlyings. They appear in the table below.

The Underlying Type can be either DateRule or Tenor based.



A DateRule based underlying is configured with a specific expiry date and specific pillar date. With a Tenor based underlying, the user can map the tenors against a live feed to capture quotes. This eliminates the need to recreate new underlyings with new expiry and pillar dates as well as eliminating the need to enter quotes manually.

- Quotes using a DateRule underlying use the following naming convention:

CommdVoltPt.VolPtGeneratorName.Currency.StrikeType.OptionType.ExerciseType.Rank.Expiry as in the example below:

Strike type - Strike

CommdVolPt.WTI_crude.USD.64.Call.European.1.Nov22

CommdVolPt.WTI_crude.USD.72.Call.European.1.Nov22

Strike type - Relative%

CommdVolPt.WTI_crude.USD.80%.Call.European.1.Nov22

CommdVolPt.WTI_crude.USD.90%.Call.European.1.Nov22

Strike type - Delta

CommdVolPt.WTI_crude.USD.40Delta.Call.European.1.Nov22

CommdVolPt.WTI_crude.USD.ATMDelta.European.1.Nov22

- Quotes using a Tenor underlying use the following naming convention:

CommdVoltPt.VolPtGeneratorName.Currency.StrikeType.OptionType.ExerciseType.Tenor as in the example below:

Strike type - Strike

CommdVolPt.WTI_crude.USD.64.Call.European.1M

CommdVolPt.WTI_crude.USD.72.Call.European.1M

Strike type - Relative%

CommdVolPt.WTI_crude.USD.80%.Call.European.1M

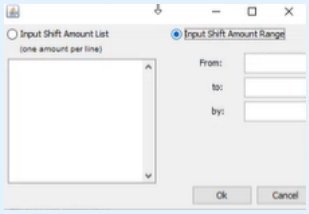
CommdVolPt.WTI_crude.USD.90%.Call.European.1M

Strike type - Delta

CommdVolPt.WTI_crude.USD.40Delta.Call.European.2M

CommdVolPt.WTI_crude.USD.ATMDelta.European.2M

Fields Details

Field	Description
Generator	Enter a generator name for the volatility surface.
Commodity	Displays the associated commodity product if any. You can click ... to select the underlying commodity product.
Expiry Date Rule / Expiry Tenor	Displays the expiry date rule or tenors of the commodity product by default. Click ... to select the date rule or tenors to generate the expiry for each underlying.
Pillar Date Rule / Expiry Tenor	Displays the pillar date rule or tenors of the commodity product by default. Click ... to select the date rule to generate the pillar dates. Note: When using the *Tenor* Underlying Type, this field is automatically populated with the same tenors selected for the Expiry Tenor.
Spread Vol	Check to indicate that the underlying is a volatility spread, to be used for the volatility surfaces generated with the *CommodityVolatilitySpread* generator.
Number of Dates	Enter the number of dates that you want to generate.
Currency	Select the reference currency for the underlyings.
Start Date	Enter the start date from which the underlyings will be generated.
Date Format	Select a date format for the underlying according to the market convention: • Daily — Includes the date, month, and year in the underlying quote name. Use the daily format when generating multiple underlying in the same month. • Monthly — Includes the month name and year in the underlying quote name.
Id	Displays the system assigned unique identifier.
Exercise Type	Select Exercise Type from American and European.
Strike Type	Select from Strike, Relative %, and Delta.
Option Type	Select Options from CALL, PUT, BOTH.
Strike	Click ... to select the Strike to Input from Shift Amount List or Shift Amount Range. 

17. Exchange Traded Option - Vol Surface Underlying

The Equity ETO underlying can be used in construction of the EQUITY volatility surface.

Exchange Traded Option Configuration

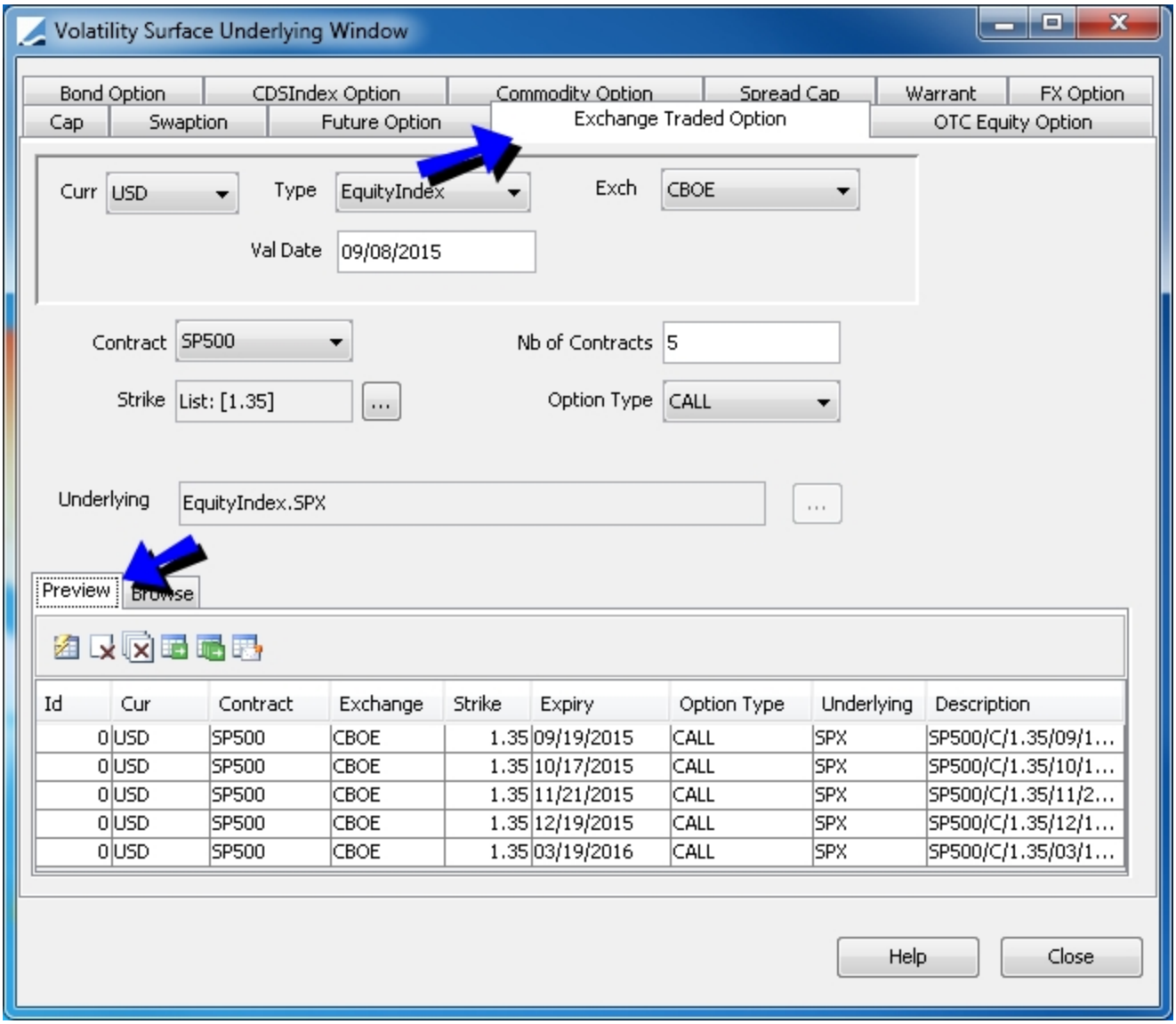
- Create the ETO contracts using **Configuration > Listed Derivatives > Options Contracts** from the Calypso Navigator.

17.1 Exchange Traded Option Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, Exchange Traded Option panel.

You can select the Browse tab to load existing underlying instruments.

Otherwise, select the Preview tab to create new underlying instruments.



- Complete the details as described in the table below.
- Click to generate the underlying instruments.
- Then select rows and click to save the selected rows, or click to save all rows.
- Click to save the quote names.

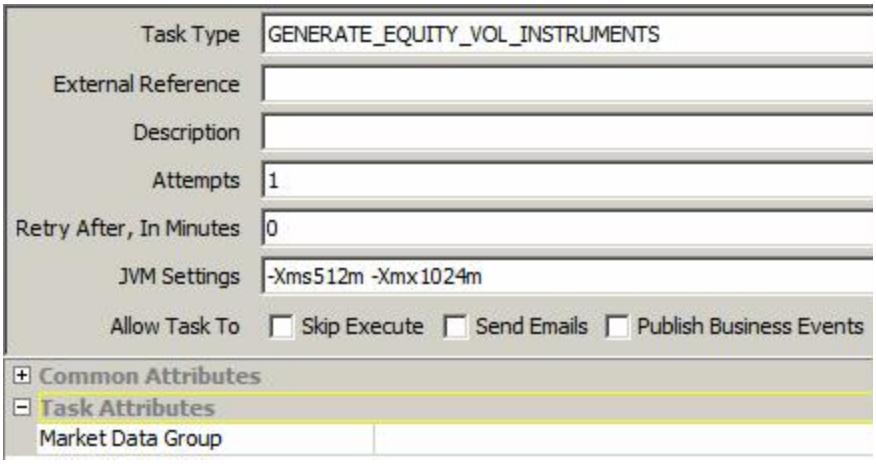
The system creates quotes like in the following example: "`ETOEquityIndex.SPX.SP500.C.1.35.APR.14`", type = Price

Fields Details

Fields	Description
Curr	Select the currency of the underlying.
Type	Select the type of ETO (Commodity, FX, Equity, Equity Index).
Exch	Select the exchange where the contract is listed. The application then loads the available contracts.
Val Date	Valuation date. It defaults to the current date.
Contract	Select the ETO contract. The application automatically displays the corresponding underlying products.
Nb of contracts	Enter the number of products traded in the contract.
Strike	Click ... to set a list of strikes.
Option Type	Select the option type: CALL, PUT, or BOTH.
Underlying	Displays the underlying product of the selected contract.

17.2 Automatic Creation of Underlying Instruments

The scheduled task GENERATE_EQUITY_VOL_INSTRUMENTS creates underlying instruments as of the scheduled task value date. The scheduled task also creates the corresponding Quote Names in the Quote Set.



The scheduled task uses the information of the ETO contract (Expiration date rule, Number of. Contracts) and of the Volatility Surface Underlying window (Strikes) to create the missing ETO underlying instruments. It creates all underlying instruments with Strikes and Expiries that do not exist yet in the database. The number of Expiries (per Strike) is limited to the value of the field “No. Contracts”, with respect to the Value Date of the scheduled task.

18. Future Option - Vol Surface Underlying

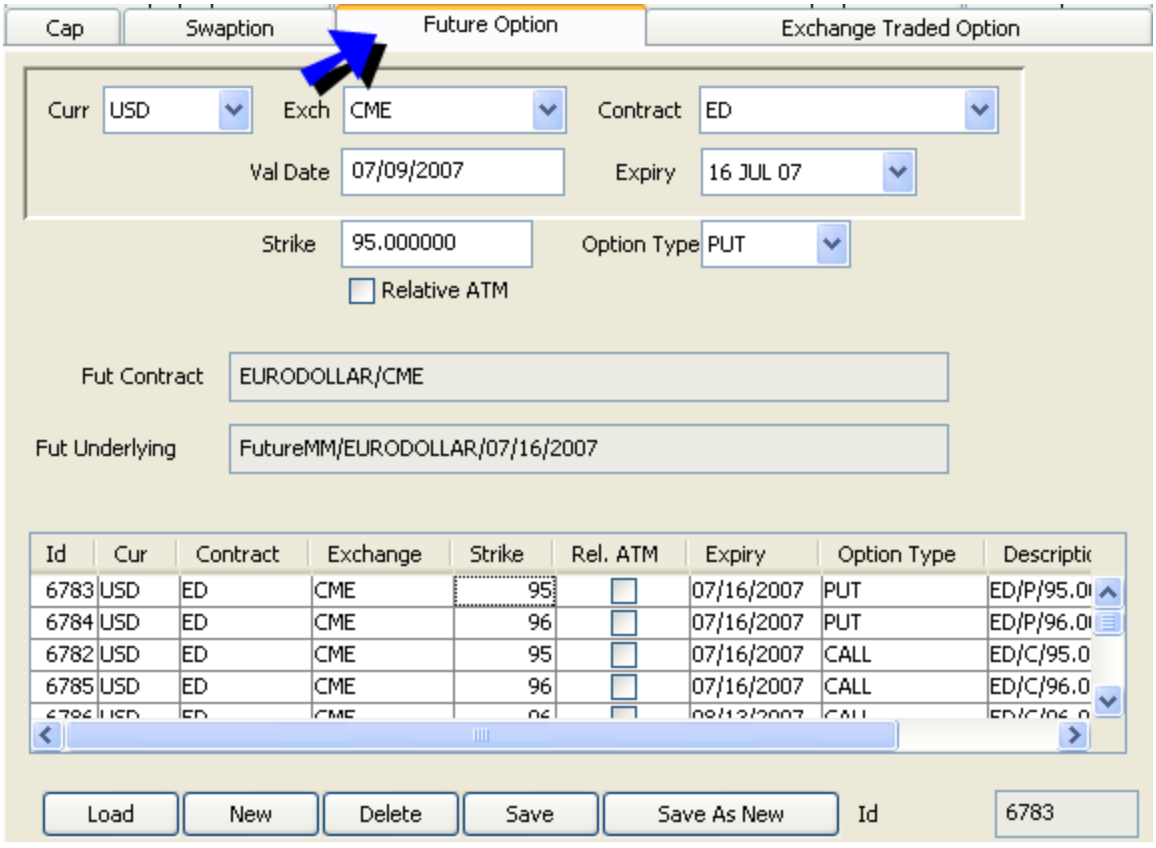
The Future Option underlying can be used in construction of the MMFUTURE and RATE volatility surface.

Future Option Configuration

- Create the Future Contract and Futures using **Configuration > Listed Derivatives > Future Contracts** from the Calypso Navigator.
- Create the Future Options Contract and Future Options using **Configuration > Listed Derivatives > Future Contracts Options** from the Calypso Navigator.

18.1 Future Option Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, Future Option panel.



» Click **New** to create new volatility surface underlying.

Select the currency and exchange. The application then loads the available contracts.

Select the contract, expiry, enter the strike, and select the option type.

» Click **Save** to create the underlying. They appear in the table below.

The system creates quotes like in the following example.

Quote Name	Quote Type
FutureOption.USD.CME.ED.C.95.000000.JUL.07	Price
FutureOption.USD.CME.ED.C.95.000000.JUN.07	Price
FutureOption.USD.CME.ED.C.95.000000.MAY.07	Price
FutureOption.USD.CME.ED.C.96.000000.JUL.07	Price
FutureOption.USD.CME.ED.C.96.000000.JUN.07	Price
FutureOption.USD.CME.ED.P.90.000000.JUL.07	Price
FutureOption.USD.CME.ED.P.95.000000.MAY.07	Price
FutureOption.USD.CME.ED.P.96.000000.MAY.07	Price

Fields Details

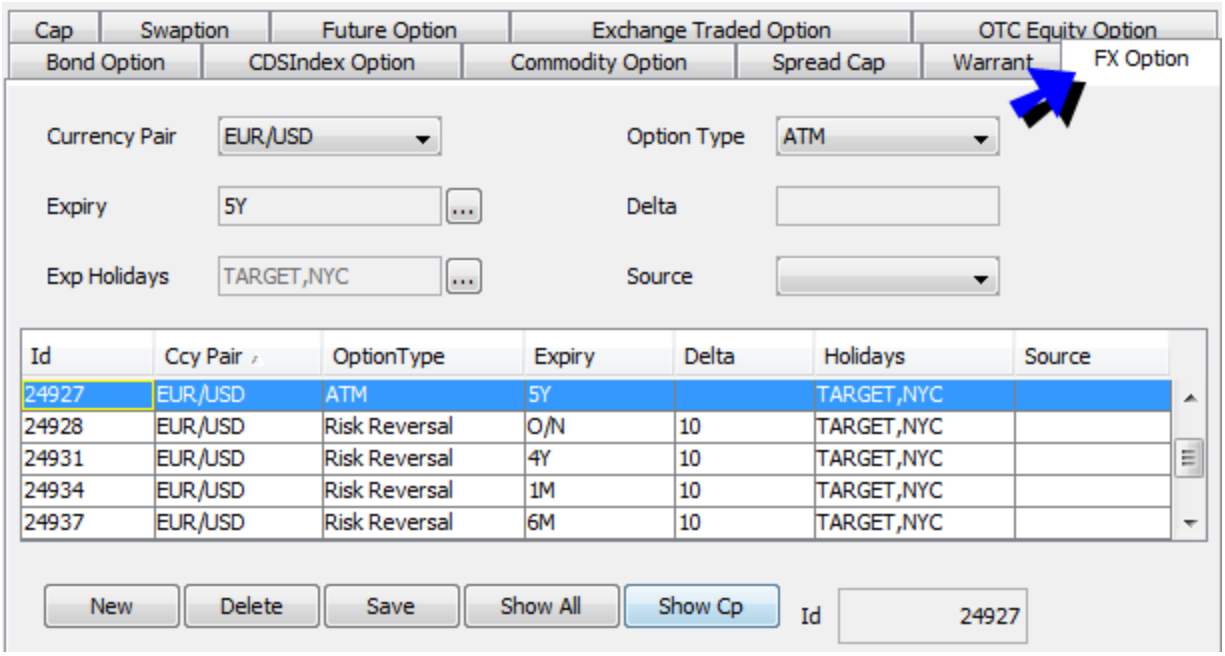
Field	Description
Curr	Select the currency of the underlying.
Exch	Select the exchange where the contract is listed. The application then loads the available contracts.
Contract	Select the Future Option contract.
Val Date	Valuation date. It defaults to the current date.
Expiry	Select the expiry for the option.
Strike	Enter the strike.
Relative ATM	Select if the strike is relative at-the-money.
Option Type	Select the option type: CALL or PUT.
Fut Contract	Displays the details of the future contract.
Fut Underlying	Displays the details of the contract's underlying product.
Id	Displays the system assigned unique identifier for the Future Option volatility surface underlying.

19. FX Option - Vol Surface Underlying

The FX Option underlying can be used in construction of the FX OPTION volatility surface.

19.1 FX Option Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, FX Option panel.

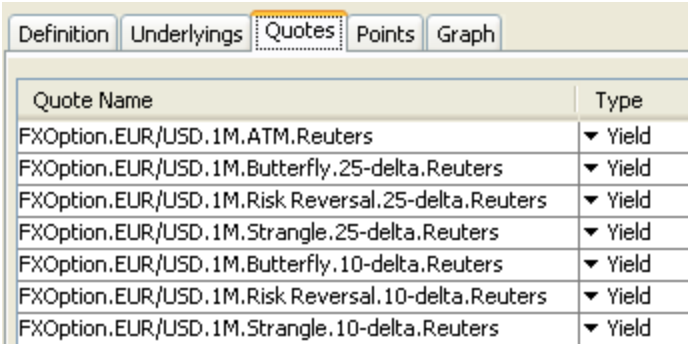


- You can click **Show All** to view all existing instruments. You can also select a currency pair, and click **Show Cp** to view the existing instruments for that currency pair.
- Click **New** to create new volatility surface underlyings, and enter the fields described below.
- Click **Save** to create the instruments. They appear in the table below.

The system creates quotes like in the following example.

Quote Name	Quote Type
FXOption.EUR/USD.1M.ATM	Yield
FXOption.EUR/USD.1M.Butterfly.10-delta	Yield
FXOption.EUR/USD.1M.Butterfly.25-delta	Yield
FXOption.EUR/USD.1M.Risk Reversal.10-delta	Yield
FXOption.EUR/USD.1M.Risk Reversal.25-delta	Yield
FXOption.EUR/USD.1M.Strangle.10-delta	Yield
FXOption.EUR/USD.1M.Strangle.25-delta	Yield

Sample quotes with source name.



Fields Details

Fields	Description
Currency Pair	Select the currency pair for the FX Option from the drop-down menu. You can click **Show Cp** to display existing instruments for this currency pair.
Option Type	Select one of the following option types: • ATM — An at-the-money (ATM) option has a 50 delta. There is no need to select the delta, so the application disables the Delta drop-down menu when you select ATM. • Risk Reversal — A combination of a long out-of-the-money call and a short out-of-the-money put at the same delta. The volatility of the risk reversal is the absolute value of the volatility of the call minus the volatility of the put. Vreversal = |Vcall – Vput| • Butterfly — The spread between a strangle and a straddle. The volatility of the butterfly is the average of the volatility of the call and put options minus the volatility of the at-the-money option. Vbutterfly = 0.5 * (Vcall + Vput) – Vatm • Strangle — A long out-of-the-money call and a long out-of-the-money put at the same delta. The volatility of the strangle is the average of the volatility of the call and put options. Vstrangle = 0.5 * (Vcall + Vput) • Vanilla.
Expiry	Use this feature to create multiple instruments with different maturities. The application creates an instrument for each maturity that you select. For example, create ATM options with a maturity of 1D, 1W, 2W, and so on. Click ... to open the selector window.
Delta	Not applicable for ATM options.

Fields	Description
	Enter the delta for the instruments. You can enter a list of comma-separated deltas.
Exp Holidays	Currently not used. The default value is to use the calendar(s) specified in the currency defaults when calculating the expiration dates of the underlying instruments. Do not specify any holiday calendar(s) on the underlying instruments.
Source	Optional. Select the source for the volatilities as applicable. If specified, it is added to the quote name. Sources can be added to the domain "FXOptVolSurfUndSource".

20. OTC Equity Option - Vol Surface Underlying

The OTC Equity Option underlying can be used in construction of the EQUITY volatility surface.

OTC Equity Option Configuration

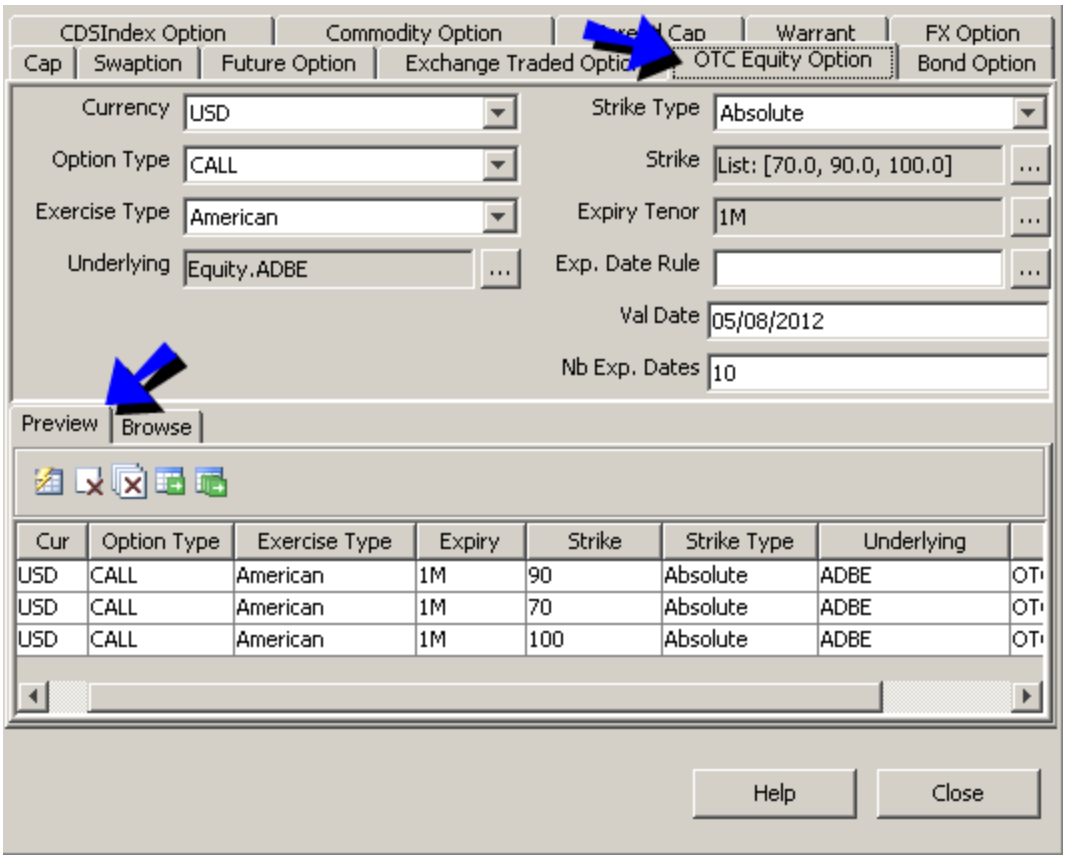
- Create equity products using **Configuration > Equity > Equity** from the Calypso Navigator.

20.1 OTC Equity Option Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, OTC Equity Option panel.

You can select the Browse tab to load existing underlying instruments.

Otherwise, select the Preview tab to create new underlying instruments.

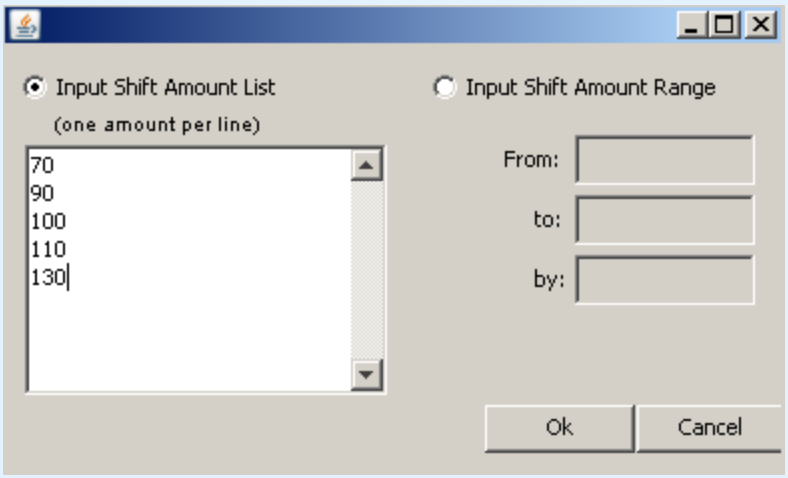


» Complete the details as described in the table below.

» Click to generate the underlying instruments.

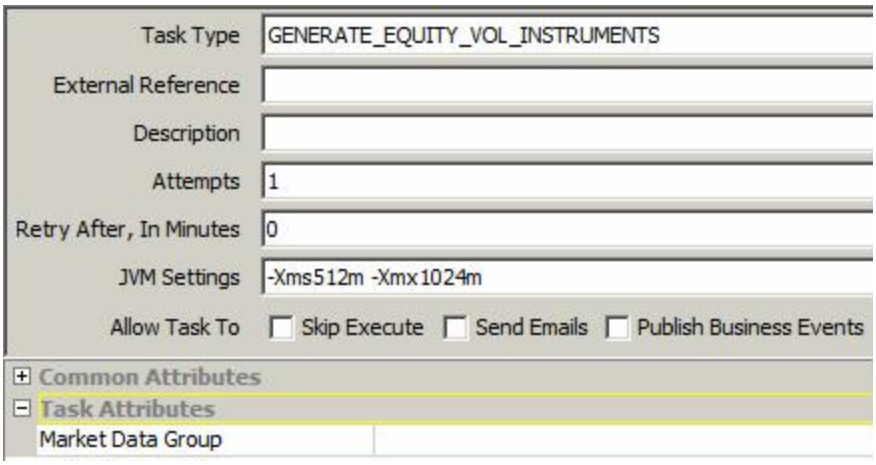
» Then select rows and click to save the selected rows, or click to save all rows.

Fields Details

Field	Description
Currency	Select the currency of the underlying.
Option Type	Select the option type: PUT, CALL, or BOTH.
Exercise Type	Select the exercise type: American or European.
Underlying	Click ... and select an Equity or Equity Index.
Strike Type	Select the strike type: Absolute or Relative (%)
Strike	Click ... and enter a list or range of strike amounts. 
Expiry Tenor Exp. Date Rule	Click ... to select a set of expiry tenors, or select a date rule to generate the tenors.
Val Date	Enter the generation start date.
Nb Exp. Dates	Enter the number of expiry dates to be generated.

20.2 Automatic Creation of Underlying Instruments

The scheduled task GENERATE_EQUITY_VOL_INSTRUMENTS creates underlying instruments as of the scheduled task value date. The scheduled task also creates the corresponding Quote Names in the Quote Set.



The scheduled task GENERATE_EQUITY_VOL_INSTRUMENTS will use the information stored in the Volatility Underlying Definition window to create the missing instruments. It will create all underlying instruments with Strikes and Expiries that do not exist yet in the database. For the instruments with Expiries based on a date rule, the number of Expiries (per Strike) will be limited to the value in the “Number of Expiry Dates” field , with respect to the Value Date of the scheduled task.

21. Spread Cap - Vol Surface Underlying

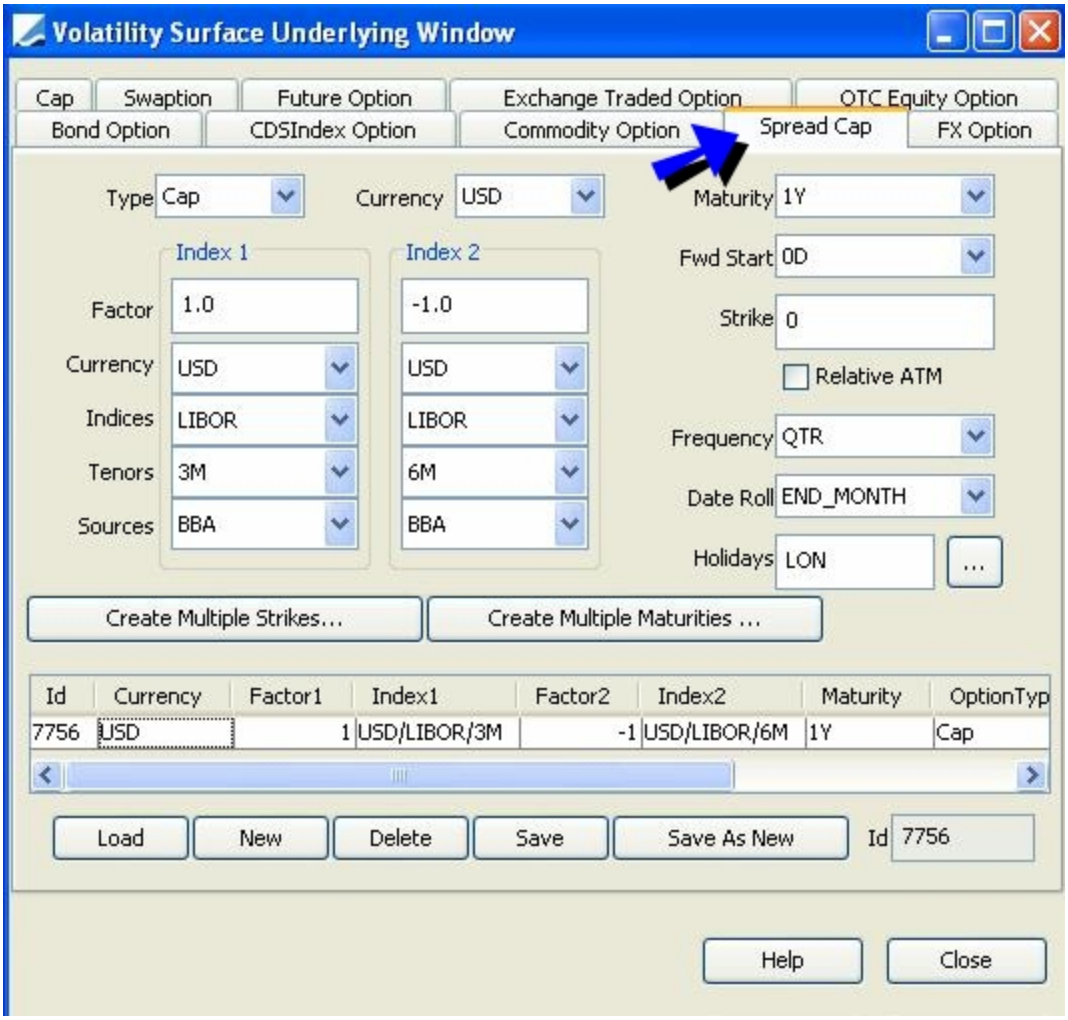
The Spread Cap underlying can be used in construction of the RATE volatility surfaces using the SpreadCap generator, and as calibration instruments.

Spread Cap Configuration

- Create the Rate Index Definition using **Configuration > Interest Rates > Rate Index Definitions** from the Calypso Navigator.

21.1 Spread Cap Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, Spread Cap panel.

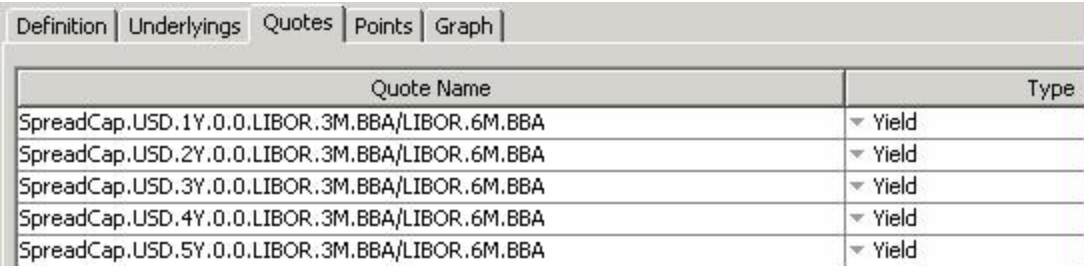


» Click **New** to create new volatility surface underlying.

Complete the details as described in the table below.

» Click **Save** to create the underlying. They appear in the table below.

The system creates quotes like in the following example.



Fields Details

Field	Description
Type	Cap or Floor.
Currency	Cap currency.
Index 1 / Index 2	
Factor	Factor for the index.
Currency	Underlying currency for the index.
Indices	Select the name of the index.
Tenors	Tenor for the index.
Sources	Sources for the index.
Other Details	
Maturity	Maturity for the spread cap.
Fwd Start	Start tenor.
Strike	Strike in percentage.
Relative ATM	Select for relative at-the-money.
Frequency	Frequency code such as QTR, WK, SA.
Date Roll	Type of date roll such as MOD_FOLLOWING, FOLLOWING.
Holidays	Calendar used for Holidays.
Create Multiple Rates / Create Multiple Expiries	You can click **Create Multiple Rates** and **Create Multiple Expiries** to create multiple instruments.

Field	Description
Id	Displays the system assigned unique identifier for the Spread Cap volatility surface underlying.

22. Swaption - Vol Surface Underlying

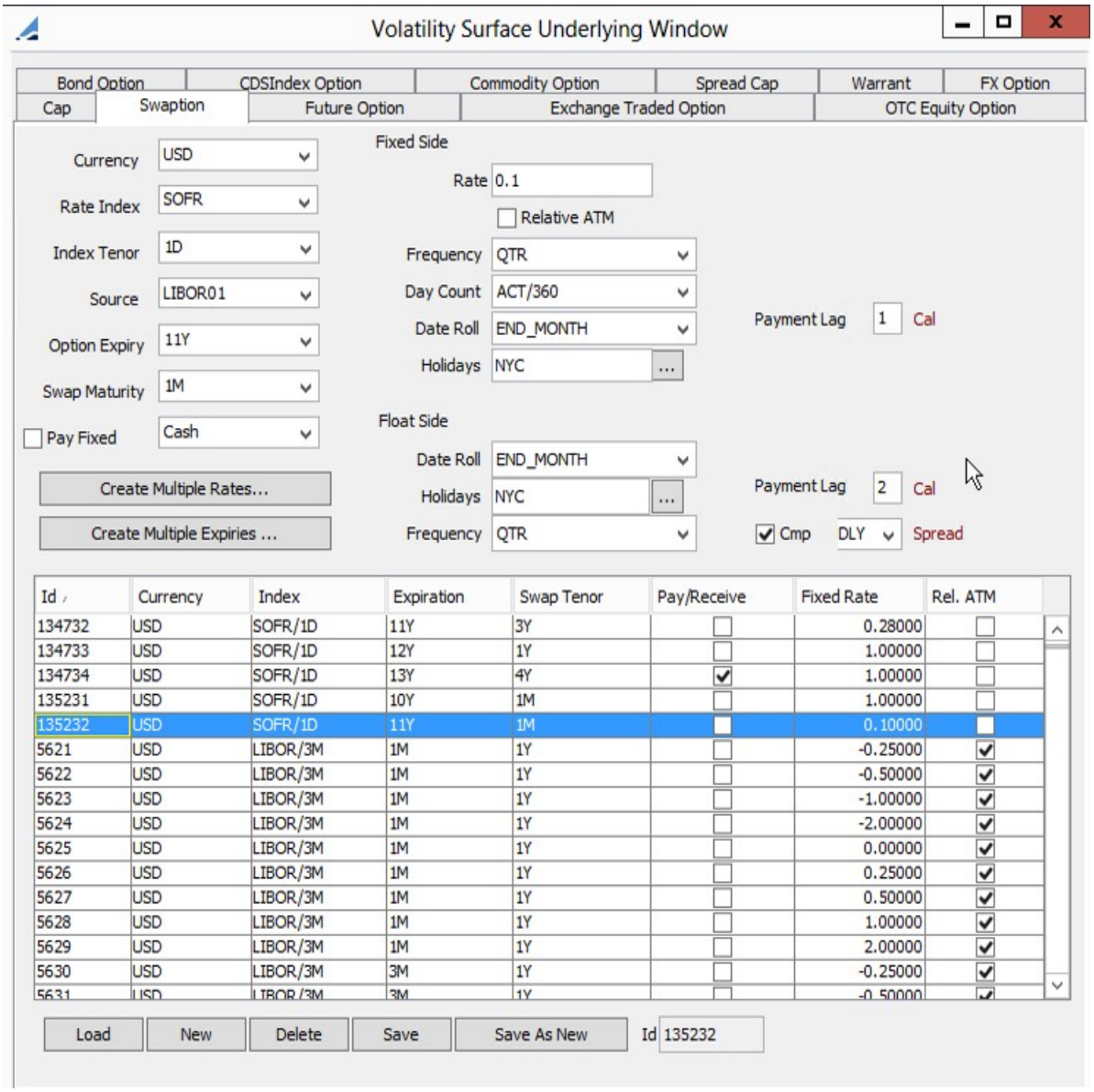
The Swaption underlying can be used in construction of the RATE volatility surfaces.

Swaption Configuration

- Create the Rate Index Definition in **Configuration > Interest Rates > Rate Index Definitions** from the Calypso Navigator.

22.1 Swaption Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, Swaption panel.



» Click **New** to create new volatility surface underlying.

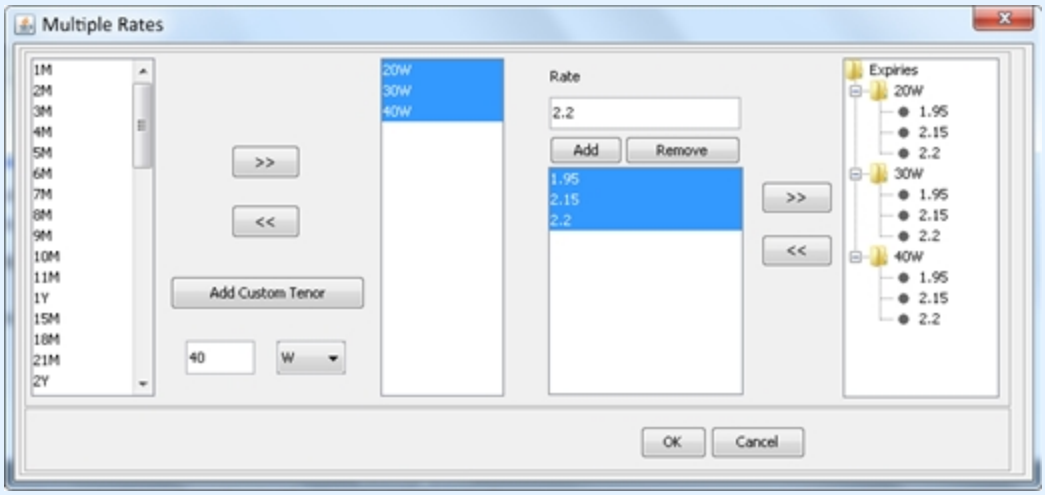
Complete the details as described in the table below.

» Click **Save** to create the underlying. They appear in the table below.

The system creates quotes like in the following example.

Quote Name	Quote Type
SWAPTION.USD.Pay.5Y.5Y.LIBOR.6M.T3750.0.04	Yield

Fields Details

Field	Description
Currency	Base currency selected in the Currency drop-down list in the bottom of the window.
Rate Index	Select the rate index.
Index Tenor	Tenor for the index.
Source	Quoting source for the index.
Option Expiry	Tenor for the option expiry.
Swap Maturity	Maturity for the swap.
Pay Fixed	Select the cash settlement method in order to affect the calculation of the value of the underlying when generating the surface.
Create Multiple Rates	You can click **Create Multiple Rates** to create multiple rates for instruments in the Multiple Rates window.  » Select one or more tenors and move them to the tenor field to the right. To create custom tenors, add a number in the text field, select either Day, Week, Month, or Year in the drop-down list, and click **Add Custom Tenor**. The tenors are added to the tenor field. » Under "Rate," add a value and click **Add** to move the value to the Rate field below. » To create multiple rates, select and highlight the preferred tenors and rates added in steps above, then use the arrow button to move them into the Expiries structure. When the structure is complete, click **OK**. The multiple rates are added to the list of underlying instruments on the Swaption panel. **[NOTE: before creating multiple rates, make sure to specify other relevant information for the fixed and float side - such as currency, rate index, source, date roll, and holidays - on the Swaption panel.]**

Field	Description
Create Multiple Expiries	You can click **Create Multiple Expiries** to create multiple instruments associated with the specified expiries.
Payment Lag	Enter the number of days between the interest date and the payment date, and specify Business or Calendar.
Cmp	Check the Cmp checkbox to enable interest compounding. » Select the DLY from the adjacent field. » Double-click the Flat label to toggle between: – Flat — Flat compounding. – Spread — Does not apply to fixed rates, only to floating rates. – SimpleSpread - Does not apply to fixed rates, only to floating rates. – NoCmp — A cashflow is created at the compounding period without actually compounding the interest. There is no compounding otherwise.
Fixed Side	
Rate	Enter the fixed interest rate in percentage.
Relative ATM	Select for relative at-the-money.
Frequency	Payment frequency.
Day Count	Select the daycount convention used for determining the periods.
Date Roll	Select the date roll convention to use when the date falls on a non-business day.
Holidays	Holiday calendars used in calculating the pay dates.
Float Side	
Date Roll	Select the date roll convention to use when the date falls on a non-business day.
Holidays	Holiday calendars used in calculating the pay dates.
Frequency	Payment frequency.
Other Details	
Id	Displays the system assigned unique identifier for the Swaption volatility surface underlying.

23. Warrant - Vol Surface Underlying

The Warrant underlying can be used in construction of the Equity volatility surface with the Spline generator.

Underlying Configuration

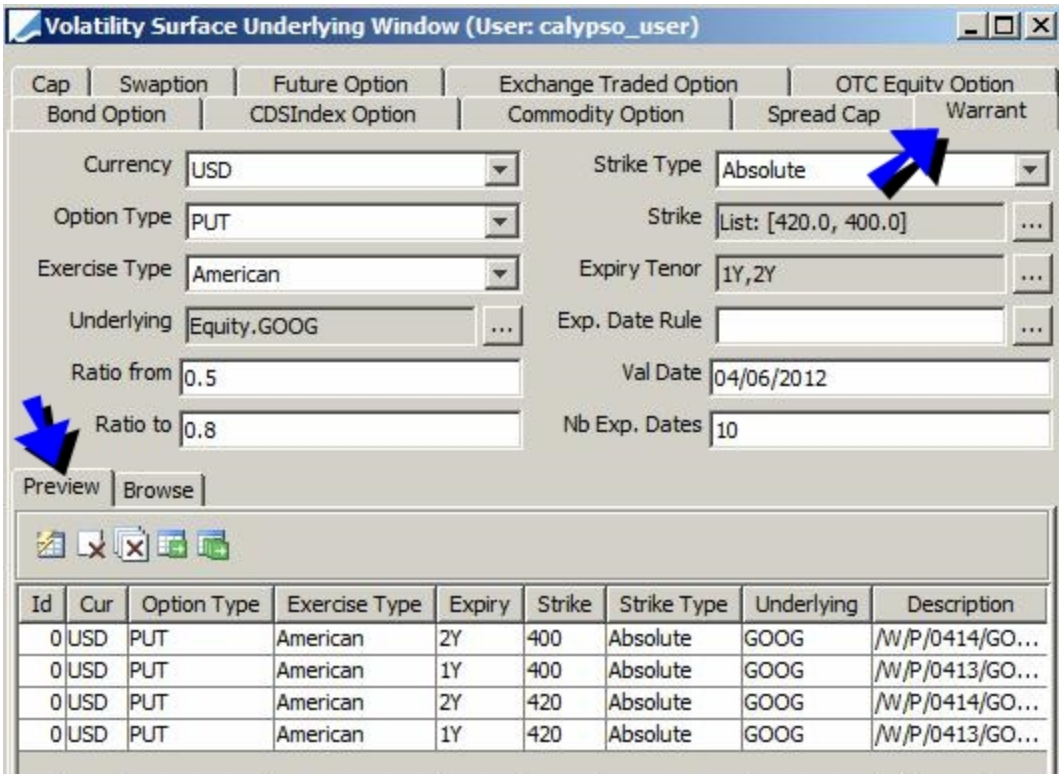
- Create equity products using **Configuration > Equity > Equity** from the Calypso Navigator.
- Create equity indices using **Configuration > Equity > Equity Indexes** from the Calypso Navigator.

23.1 Warrant Volatility Surface Underlying

Create the underlying instruments in the Volatility Surface Underlying Window, Warrant panel.

You can select the Browse tab to load existing underlying instruments.

Otherwise, select the Preview tab to create new underlying instruments.



» Enter the parameters to define the warrant, the fields are described below.

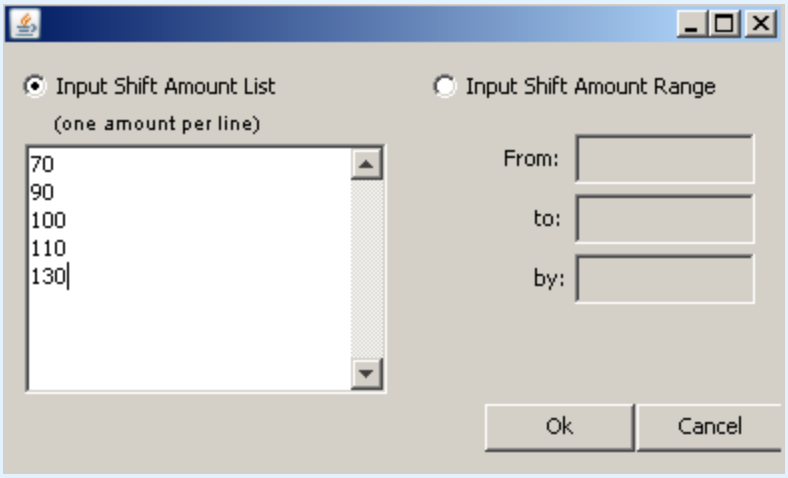
» Click to generate the underlying instruments.

» Then select rows and click to save the selected rows, or click to save all rows.

The system creates quotes like in the following example.

Quote Name	Type
Warrant./W/P/0511/GOOG/400.00	Price
Warrant./W/P/0511/GOOG/420.00	Price
Warrant./W/P/0512/GOOG/400.00	Price
Warrant./W/P/0512/GOOG/420.00	Price

Fields Details

Fields	Description
Currency	Select the warrant currency.
Option Type	Select PUT, CALL, or BOTH.
Exercise Type	Select the type of exercise: *American* or *European*.
Underlying	Click ... to select the underlying product.
Ratio from Ratio to	Select the quantity of warrant to exercise (Ratio from) to obtain a quantity of underlying (Ratio to).
fixed FX Rate	If the warrant currency is different from the underlying currency, enter an FX rate. The warrant will be generated as a quanto using this FX rate.
Strike Type	Select the strike type: Absolute or Relative %.
Strike	Click ... and enter a list or range of strike amounts. 
Expiry Tenor Exp. Date Rule	Click ... to select a set of expiry tenors, or select a date rule to generate the tenors.
Val Date	Enter the generation start date.
Nb Exp. Dates	Enter the number of expiry dates to be generated.

24. Proxy Commodity Volatility Surface

Commodities are traded globally. Commodity futures and Commodity options trading in different markets and countries are highly correlated. For portfolios consisting of such products in different markets and different currencies, there is a need to have cross volatility surface that is constructed with a more liquid but foreign currency based commodity volatility surface, FX volatility surface and correlation between these two assets. This volatility surface can then be used in risk decomposition.

For this purpose, it is possible to build the proxy commodity volatility surface in Calypso. This is useful in order to provide vega risk towards a foreign commodity future option when the local market futures options are not liquid enough.

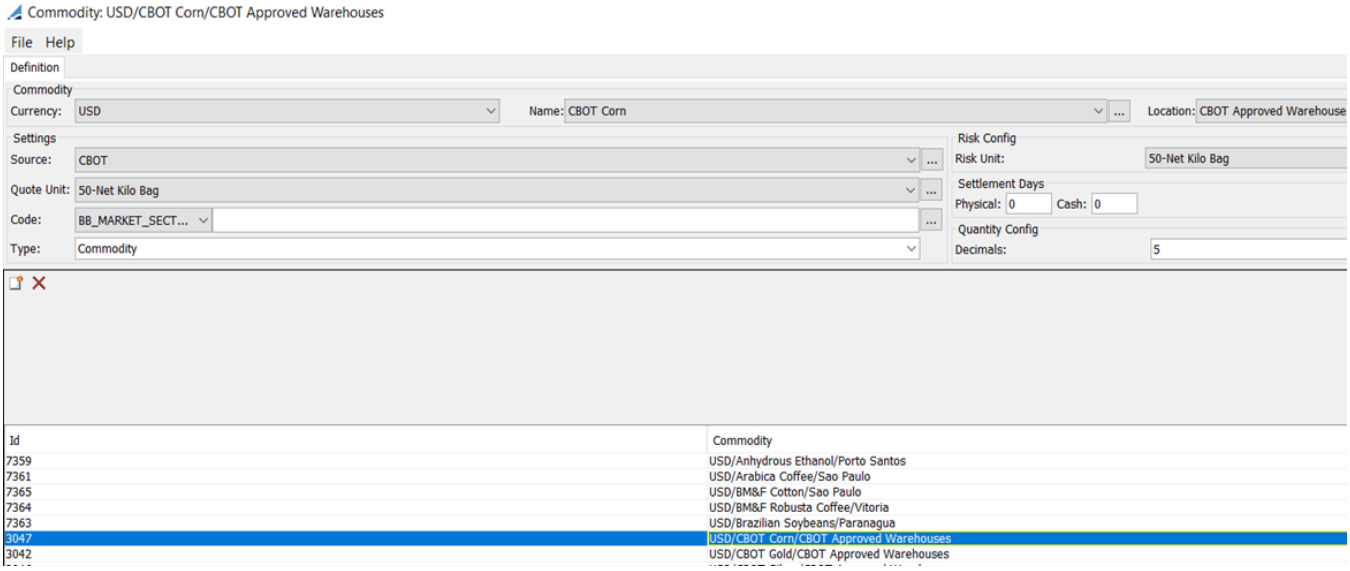
Below is a description of how to use proxy commodity volatility surface, which is created using the proxy volatility surface generator by capturing the commodity correlation such that commodity options can be priced using this proxy surface.

Base (foreign) commodity vol surface and FX vol surface along with the correlation matrix between commodity and FX is used to derive a proxy vol surface. In the example below, base (foreign) commodity is in USD, domestic commodity is in BRL. The proxy commodity vol surface is generated in BRL using base USD vol surface , USD/BRL FX vol surface and correlation between base commodity in USD and USD/BRL FX.

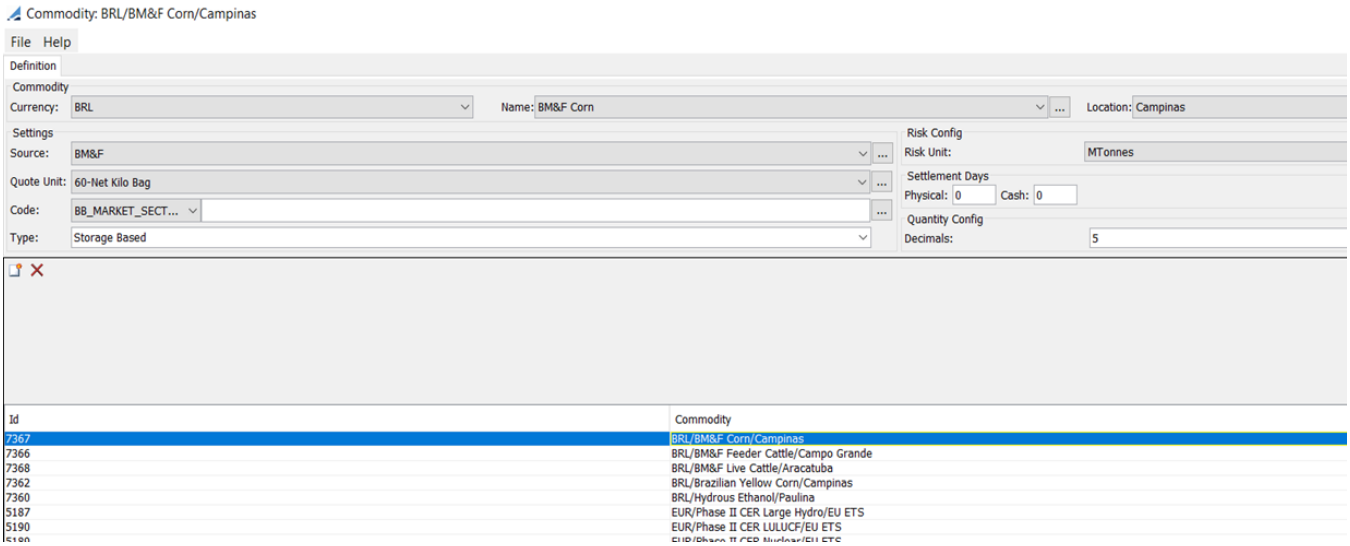
24.1 Defining Commodities

Define the commodity products by choosing **Configuration > Commodities > Commodities** from Calypso Navigator

▶ Refer to *Calypso Commodity Definitions Documentation* for more details.



Defining USD commodity



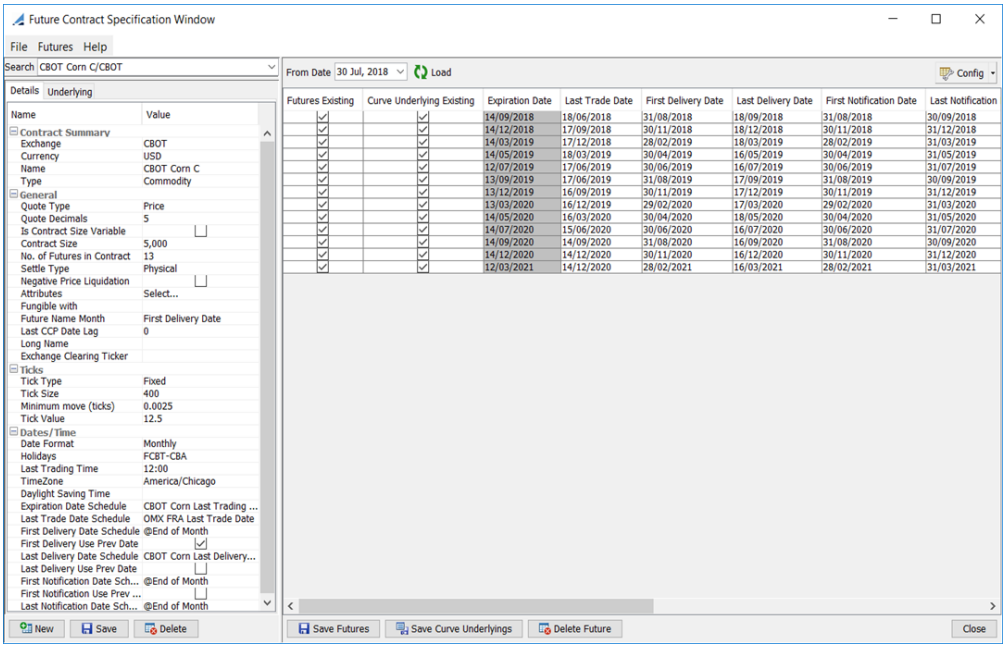
Defining BRL commodity

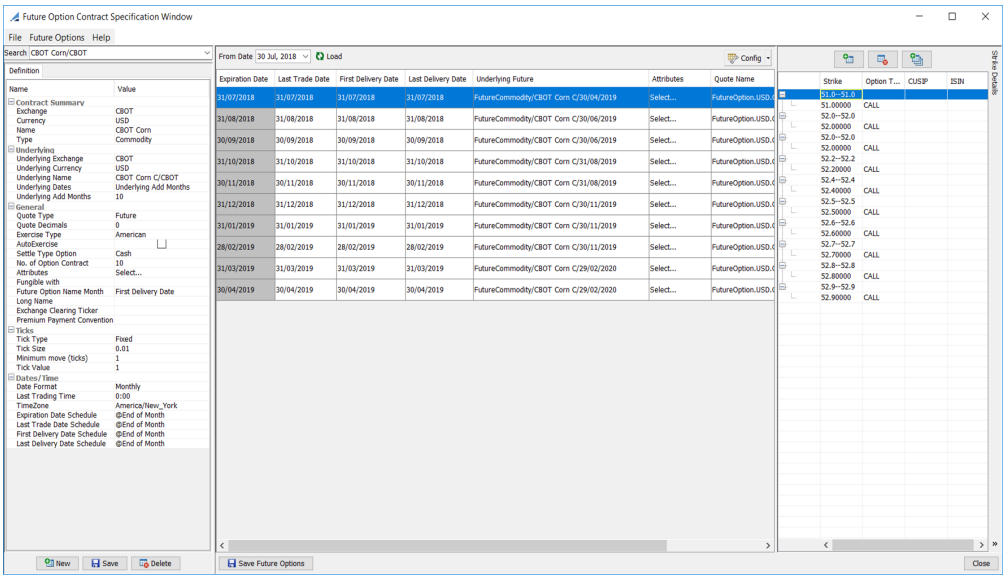
24.2 Defining Commodity Future and Option

Define the future and option contract by choosing **Configuration > Listed Derivatives > Future Contracts** and **Configuration > Listed Derivatives > Future Contracts Options** from Calypso Navigator respectively.

▶ Refer to *Calypso Capturing Commodities Documentation* for more details.

A detailed example of base USD commodity future and option definition is shown below.



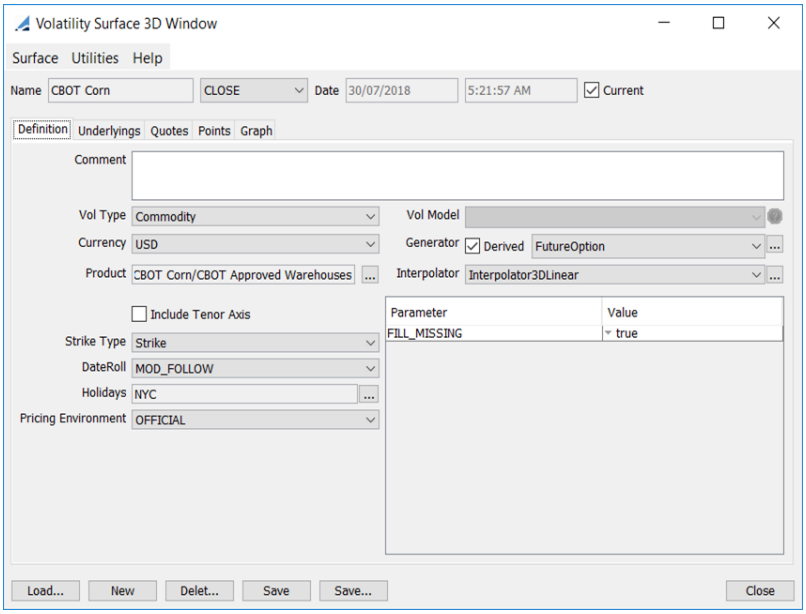


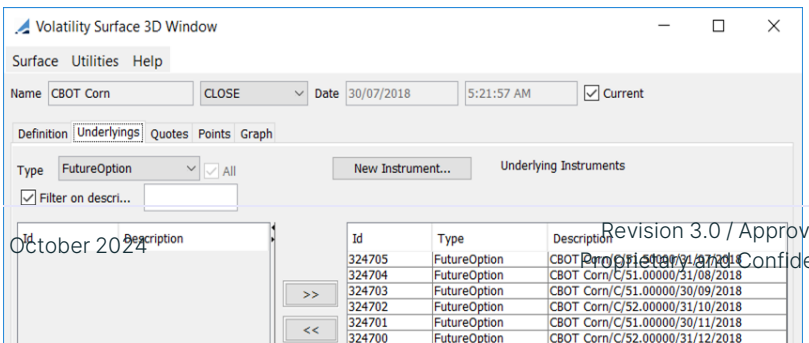
24.3 Defining Base (foreign) Volatility Surface

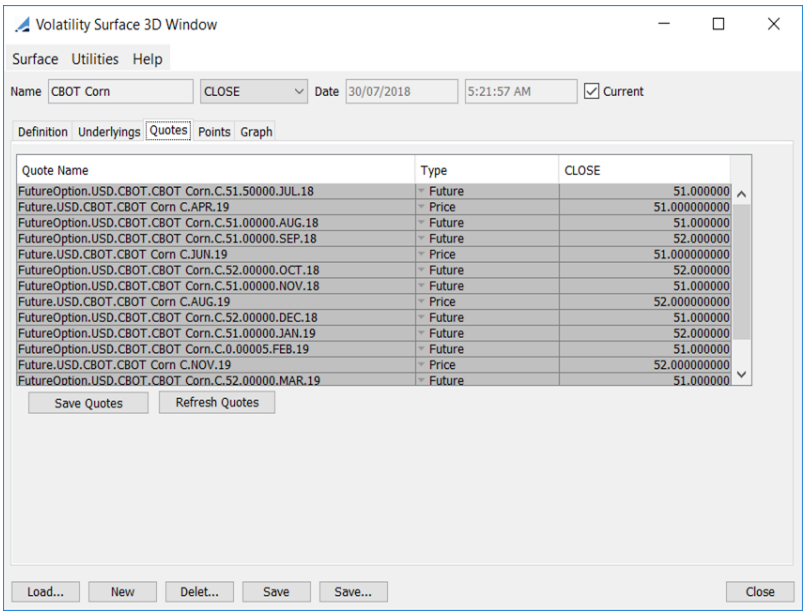
From the Calypso Navigator, navigate to **Market Data > Volatilities > Volatility Surface** (menu action `marketdata.VolatilitySurface3DWindow`).

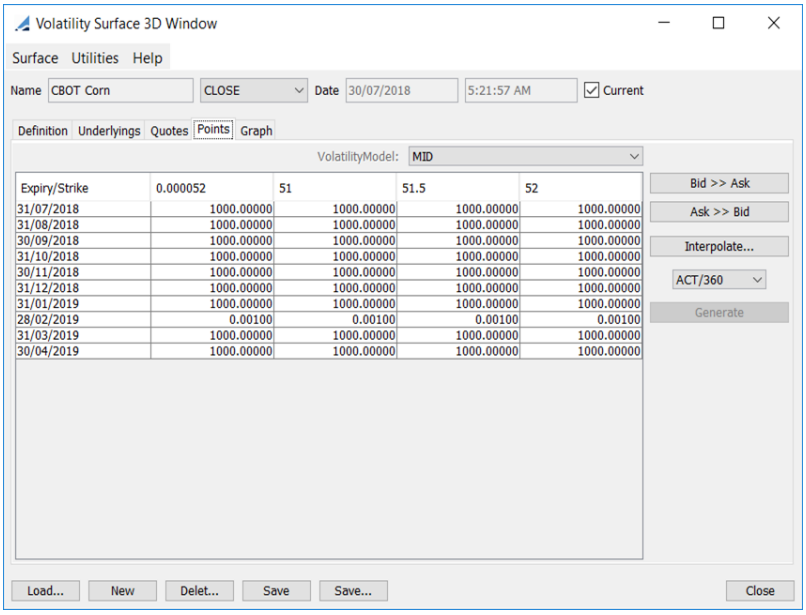
Create a USD commodity vol surface on product CBOT Corn commodity defined above.

▶ Refer to *Calypso Commodity Volatility Surface Documentation* for more details.









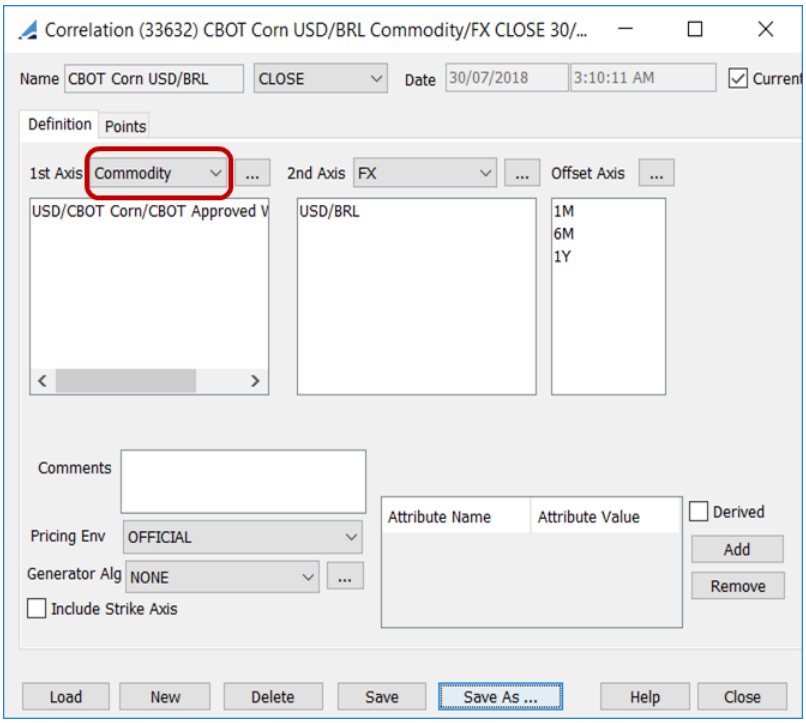
24.4 Defining Correlation Matrix

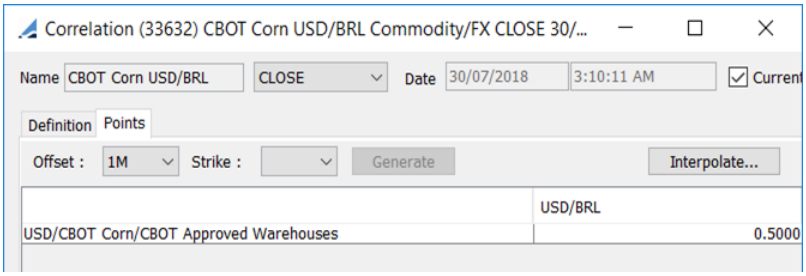
From the Calypso Navigator, navigate to **Market Data > Correlation & Covariance > Correlation Matrix** (menu action `marketdata.CorrelationMatrixWindow`).

A Commodity/Commodity Future axis should be used. For the same commodity future, the correlation is specific per futures maturity. The commodity future, including its expiry month is to be selected as a FutureCommodity instrument under first axis. Hence the maturity/tenor axis is not required. This will allow you to define a correlation matrix between FX rates and commodity futures.

When the first axis is selected as Commodity, the tenor axis can be used for defining the correlation of the commodity per tenor with FX. The correlation matrix window will look like the one shown below.

▶ Refer to *Calypso Correlation Matrix Documentation* for more details on defining a Correlation Matrix.



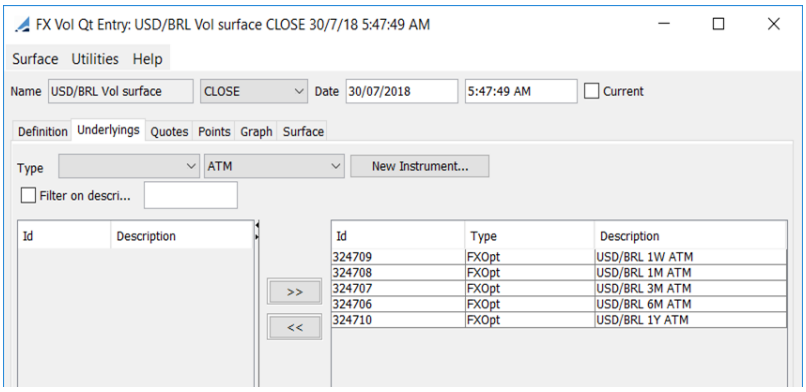


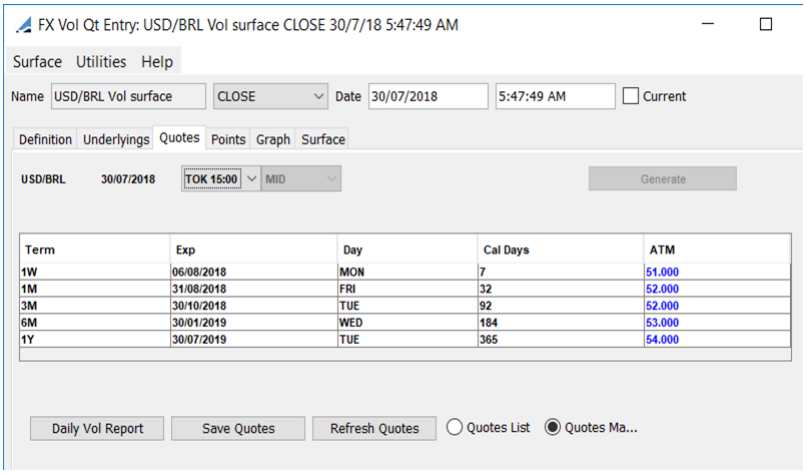
24.5 Defining FX Vol Surface

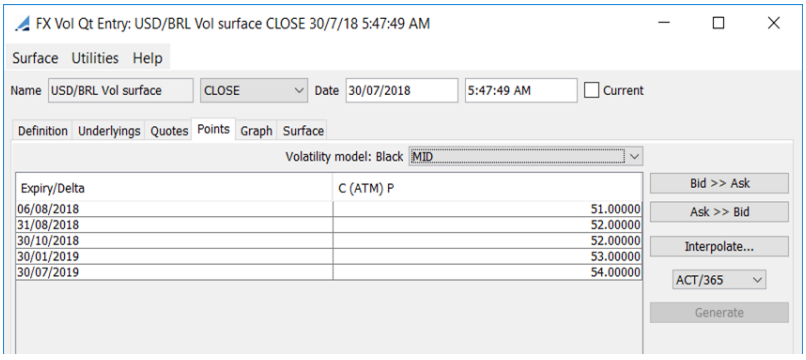
From Calypso Navigator, navigate to **Market Data > Volatilities > FX Volatility Surface** (menu action `marketdata.FXVolatilitySurfaceWindow`).

An FX volatility surface is created from FX Option underlying instruments, or from offsets. Create a FX vol surface as shown below.

▶ Refer to *Calypso FX Volatility Surface documentation* for more details.







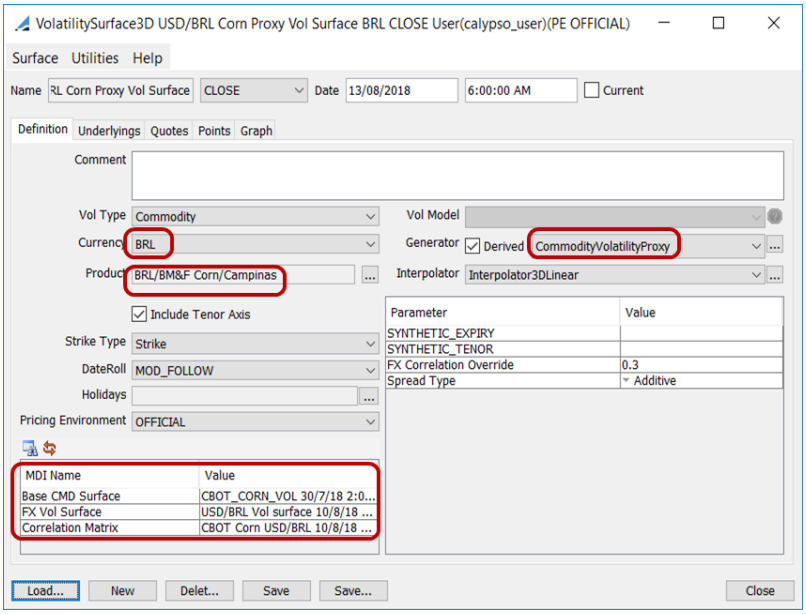
24.6 Defining Proxy Commodity Volatility Surface

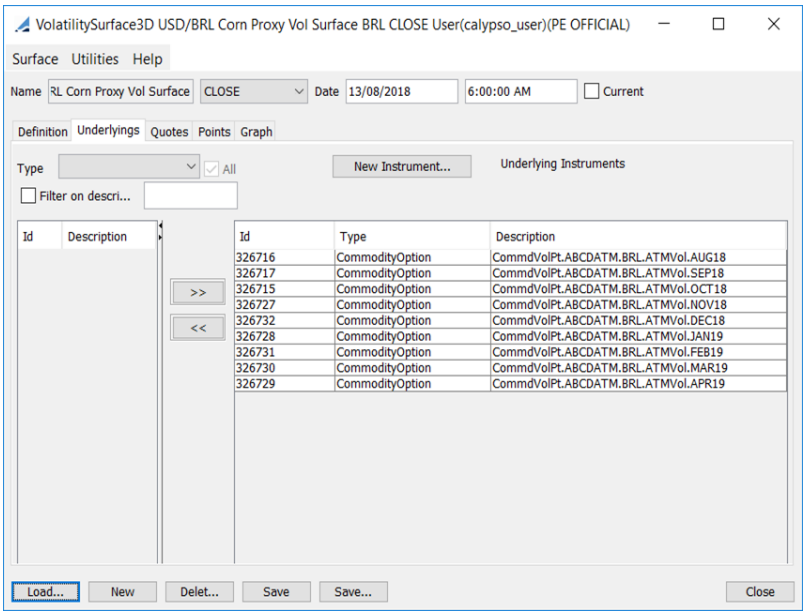
A Derived volatility surface generator called *CommodityVolatilityProxy* should be used.

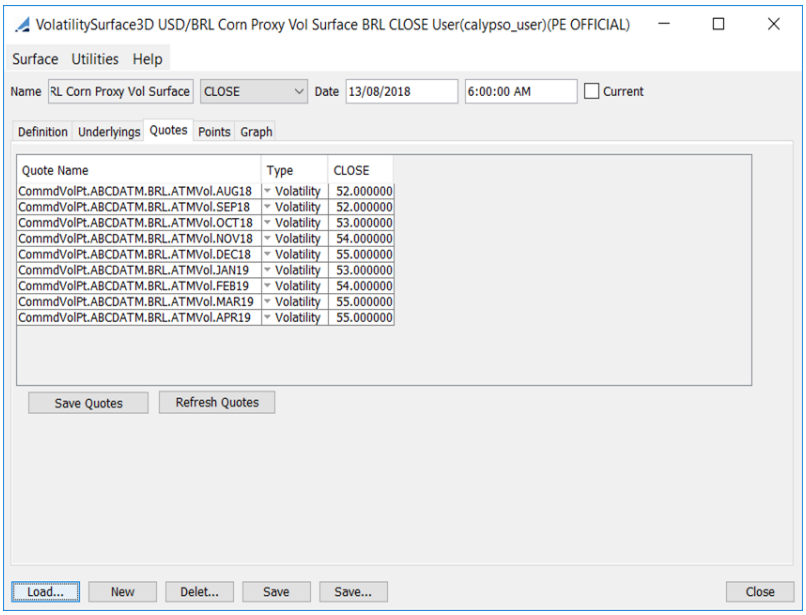
An example of proxy commodity vol surface with underlying commodity and domestic currency BRL as currency is shown below.

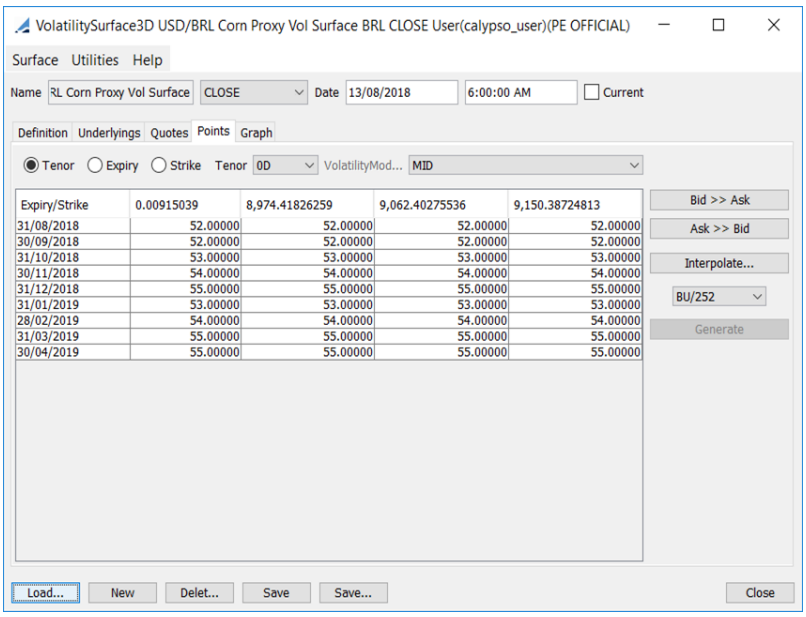
Additional dependent Market data Items (MDI): Base (Foreign) Vol Surface, FX Vol Surface, Correlation Matrix need to be added to the commodity vol surface screen when the generator is selected as *CommodityVolatilityProxy*.

In the Underlyings tab, it relies on two OTC domestic futures options underlyings corresponding to Call and Put At the money (ATM) per expiry.









On clicking **Generate**, the volatility points following the expiries and FX-adjusted strikes of the base(foreign) volatility surface are computed. USD is used in the example.

The volatility formula is as follows :

$$V_d^2 = V_f^2 + V_{fx}^2 - 2\ rho * V_f * V_{fx}$$

where,

Vd: The volatility of the commodity in domestic currency. The strike will be converted using FX rate.

Vf: The volatility of the commodity asset in foreign currency.

Vfx: The ATM volatility of FX with same maturity as the future option.

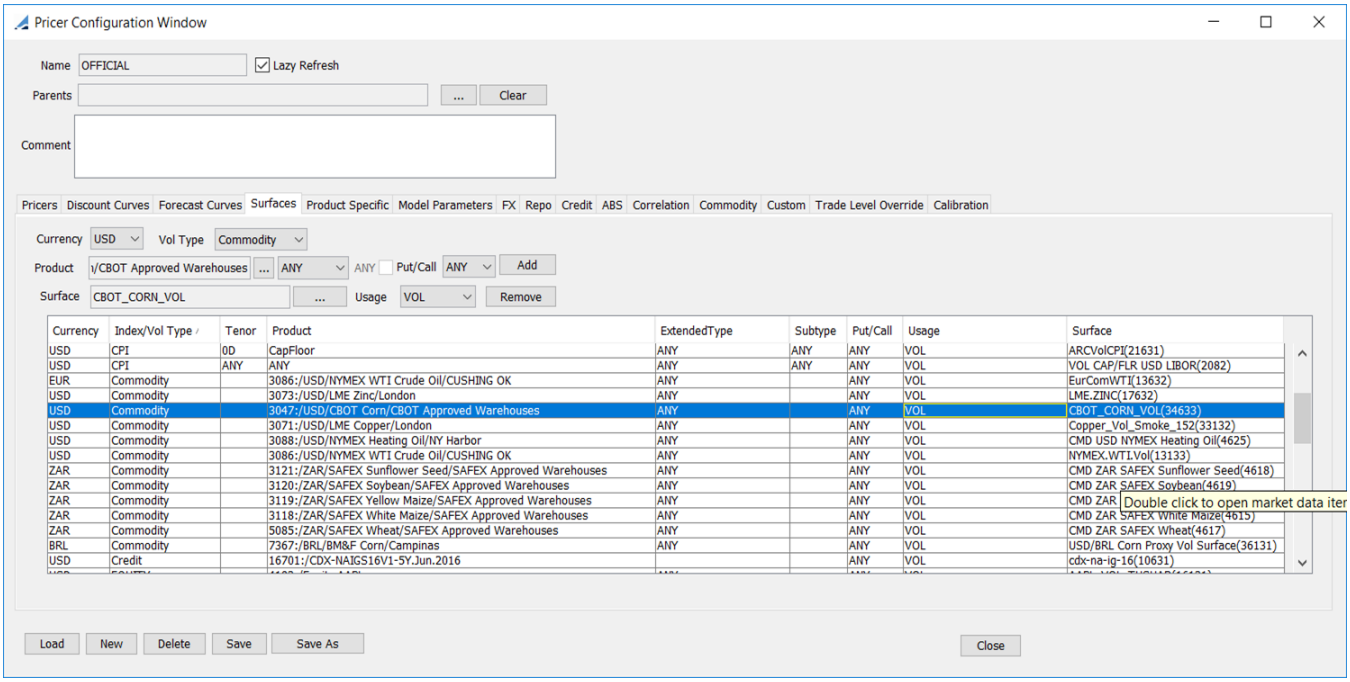
Rho: Correlation between foreign commodity and FX.

24.7 Pricer Configuration

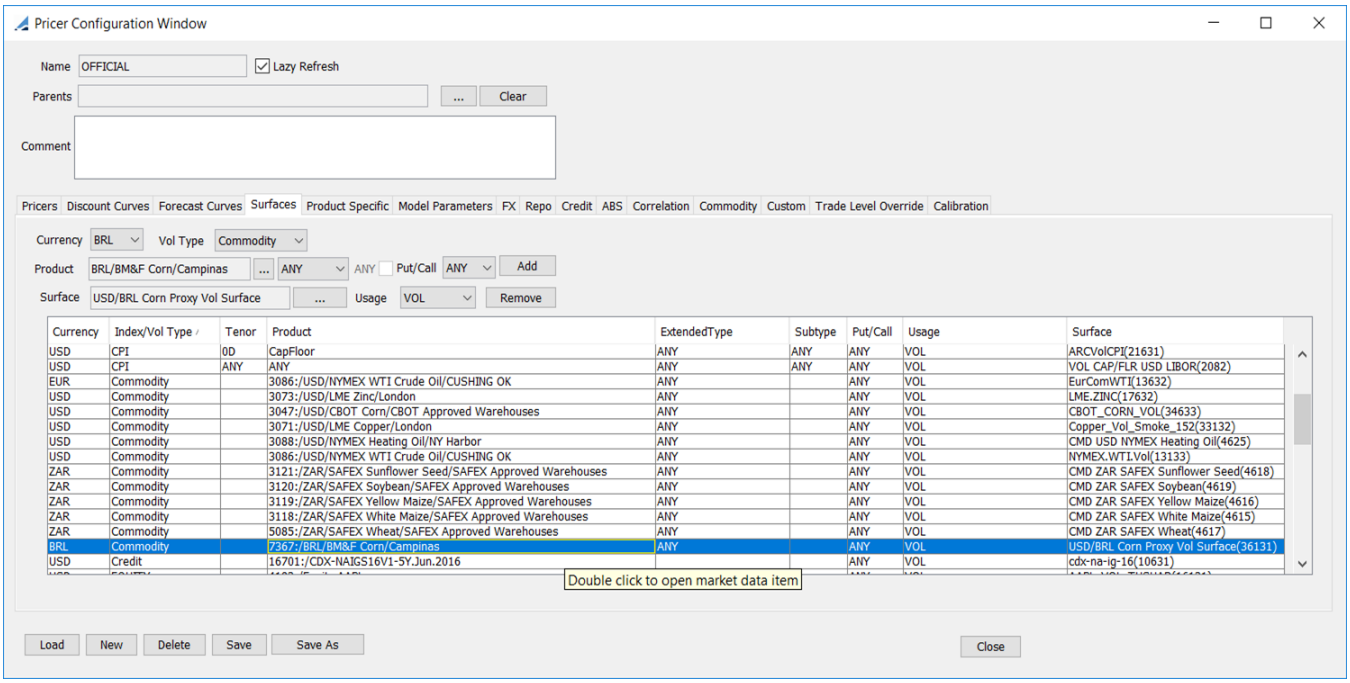
Make sure all the vol surfaces and correlation matrix is defined correctly in the pricer configuration. You can bring up the Pricer Configuration window from the Pricing Environment window, or navigate to **Market Data > Pricing Environment > Pricer Configuration** from the Calypso Navigator.

▶ Refer to *Calypso Pricer Configuration Documentation* for more details.

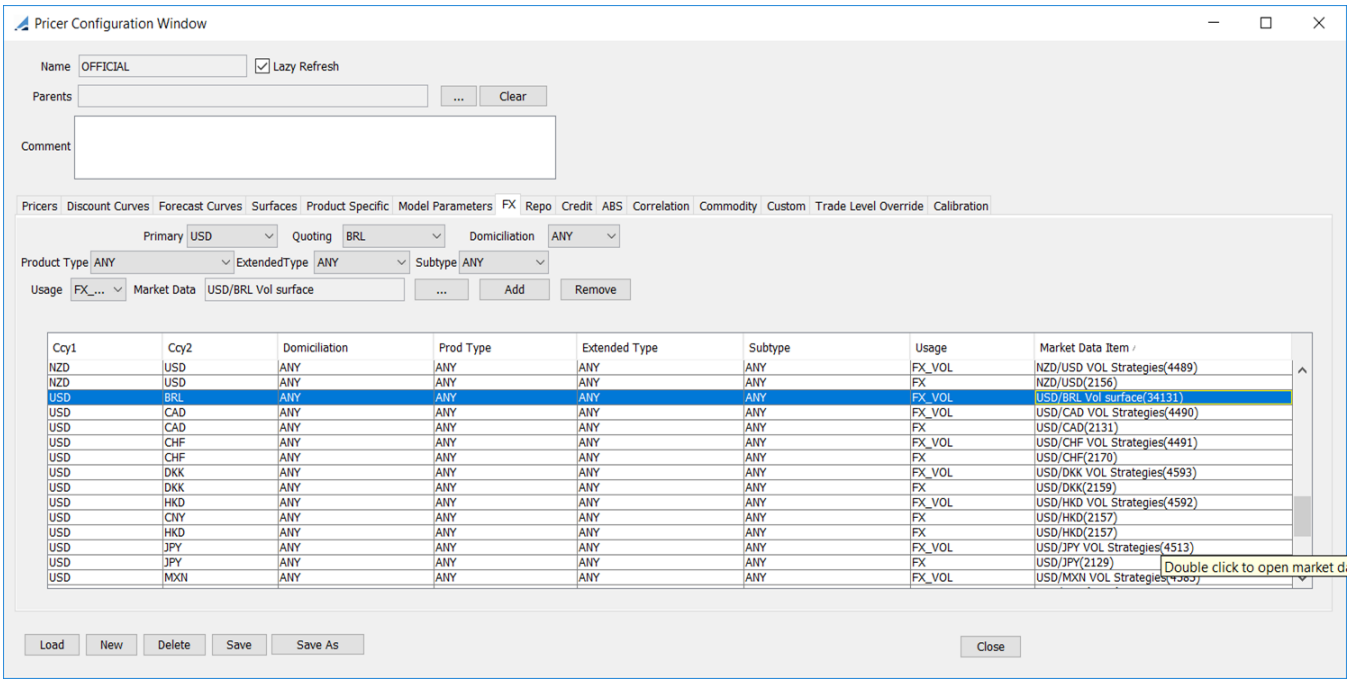
Examples of configuring base vol, proxy vol, FX vol and correlation is shown below.



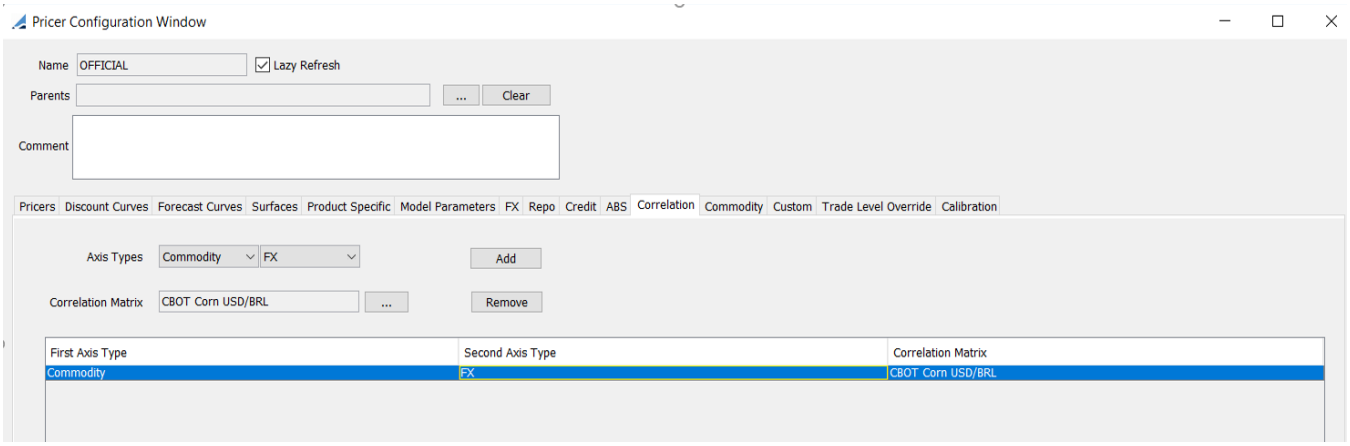
Base USD Vol in Pricer Config



Proxy Vol in Pricer Config



FX USD/BRL Vol in Pricer Config



Correlation Matrix in Pricer Config