Altus Group

ALTUS GROUP – *Finance Active – Market Data Note*

V4.2. November 2024

Regulatory Expertise of Finance Active

For over 20 years, Finance Active, a leader in debt and financial risk management, has advised Corporate & Equity Investors' finance departments on IFRS, AIFM & Regulatory issues related to financial liabilities accounting, by combining two fields of expertise:

- Technology Expertise: Our currency exchange and interest rate solutions facilitate the valuation of your financial instruments for accounting purposes.

- Consulting Expertise & Advisory Services: Our consultants assist you during each step of the process to establish and produce your Regulatory Reports and in your discussions with Statutory Auditors.

Finance Active (an Altus Group company) provides assistance across the entire value chain.

Finance Active Valuation Methods

Finance Active provides valuation for a large panel of debt products and Interest rates derivatives. Throw this document, we will present valuation methods implemented by Finance Active, started with the basics, namely Discounting and forward curves building. After we will give an overview on basics instruments such as Interest Rate Swap, Caps/Floors and Swaptions.

In general, Finance Active will choose models to use, based on Market Practices and recommendations of our market data providers. The model will depend on the product to value, and the calibration of the model will take on consideration market practices and instrument liquidity.

Finance Active uses market data provided by well-known market data brokers around the world: Tullett-Icap, Ice, Reuters… please refer to our market data notice for more information about our market data providers and brokers.

Applications supplyment: Provision for applications

Once all these steps have been validated, the market data is made available to the pricers of the Finance active applications. They allow the valuation of our clients' financial products. If necessary (e.g. during a closing valuation), Finance Active can provide a booklet of the market data used for the calculations.

Finance Active Zero-Coupon curves and Forward curves

Since the 2007 crisis, the equivalence between quoted interest rates is no longer observed on financial markets due to liquidity and counterparty risks.

This phenomenon results from the non-respect of the no-arbitrage condition and the fact that interbank rates that were considered until then as no risk rates have become riskier as their maturity increases (for example EUR 12M is riskier than EUR 3M).

Computing all IBOR forward curves from one sole curve is no longer in accordance with the market and the new notion of risk. In this context, the approach used on trading floors – which is now used by Finance Active – consists in building a zero-coupon for each tenor (1M, 3M, 6M, 12M). We only use instruments which have as underlying the same tenor.

Each zero-coupon curve is well defined by using simultaneously the techniques of bootstrapping and interpolation.

In a first part we provide all the steps for the construction of zero coupon and forward curves and in a second part we give details for each step.

Zero Coupon Curves and Forward curves building steps

For each currency we build 4 zero coupon curves for the 4 tenors : 1M, 3M, 6M, 1Y. There is a reference tenor for each currency (for example 3M for USD, 6M for EUR). We always begin with the construction of the reference tenor zero coupon curve. The steps are as follow:

1- Select a panel of market instruments with the same underlying tenor as the reference tenor between Depo, FRA, Futures and Interest Rate Swaps provided by our brokers
2- Using the bootstrapping method calculate the zero-coupon values at discrete times using the selected instruments
3- Using the Tikhonov Regularization method obtain a zero-coupon curve smooth, defined at each time and with the good mathematical properties needful for the pricing of financial products
4- Calculate the forward curve of the reference tenor from the zero-coupon curve with the simple relation between forward and zero coupon

Once we have built the zero-coupon curve of the reference tenor we then build the curves for the other tenors. In all the paper x will now represent the tenor of the curve that we are building. The steps are as follow:

1- Select a panel of market instruments with x as the underlying tenor between Depo, FRA, Futures but Interest Rate Swaps with the reference tenor as underlying tenor and Basis Swaps between x and the reference tenor
2- From the Interest Rate Swaps and the Basis Swaps build synthetic Interest Rate Swaps with x for underlying tenor
3- Since we now have only instruments with x as underlying tenor we build the zero-coupon curve with the bootstrapping and Tikhonov regularization methods as for the reference tenor curve
4- Calculate the forward curve from the zero-coupon curve

Market instruments

The first thing is to select a set of maturities, called pillars, and a market instrument for each of these maturities that we will use to calculate the zero-coupon value at this maturity. The rule is to choose a market instrument which is liquid in the currency and for the maturity considered. For example, for the short maturities (between 0Y and 2Y) Forward Rate Agreements (FRA) are very liquids in the EUR market. For USD Futures are also very liquids between 0Y and 2Y. For longer maturities Interest Rate Swaps (IRS) are the most liquids instruments. We present briefly the most used market instruments: Deposit, FRA, Future, IRS and Basis Swap. $Px(t,T)$ is the value of the zero coupon with tenor x at date t and with maturity T, $PD(t,T)$ is the discounting zero coupon, in our case it is the reference tenor zero coupon.

Deposit

Depo are standard money market contracts where, at start date T_0 (today or spot), counterparty A, called the *Lender*, pays a nominal amount N to counterparty B, called the *Borrower*, and at maturity date T_i, the Borrower pays back to the Lender the nominal amount N plus the interest accrued over the period $[T_0; T_i]$ at the Deposit Rate $R_x^{Depo}(T_0^F, T_i)$ fixed at time $T_0^F \leq T_0$.
For example the EUR market quotes at time t_0 = today a standard strip of Deposits based on Euribor rates, with fixing dates $T_0^F = t_0$, start date T_0 = spot date = t_0 + 2 business days, and maturity dates $T_1, \dots, T_n$ from 1 day up to 1 year.
The discount curve of maturity T_i is obtained using the following relation:

$$P^x(T_0, T_i) = \frac{1}{1 + \tau(T_0, T_i) R_x^{Depo}(t_0, T_i)}$$

Where $\tau(T_0, T_i)$ is the year fraction between T_0 and T_i.

Forward Rate Agreement (FRA)

FRA contracts are forward starting Deposits. For instance, a 3x9 FRA is a six months Deposit starting three months forward. FRA contracts are quoted on the interbank OTC market for various currencies. For example the EUR market quotes at $t_0 =$ today three standard strips of Euribor FRA, starting at spot date $T_0 = t_0 + 2$ business days with different forward start and end dates, T_{i-1} and T_i, and tenors $x = 1M, 3M, 6M, 12M$.

Let's consider a T_{i-1}xT_i FRA. The underlying Euribor FRA rate fixes at time T_{i-1}^F, two business days before the forward start date T_{i-1}, and shares the same tenor of the FRA. We have the following relation:

$$P^x(T_0, T_i) = \frac{P^x(T_0, T_{i-1})}{1 + \tau(T_{i-1}, T_i) R_x^{FRA}(t_0, T_i)}$$

Where $\tau(T_0, T_i)$ is the year fraction between T_0 and T_i.

Futures

Futures are exchanged-traded contracts similar to FRAs. Any profit and loss is regulated through daily marking to market (margining process). Future contracts are rolled on the IMM dates which are the third Wednesday of March, June, September and December. The relation between Futures rates and discount curve is the same as the one for the FRA.

Interest Rate Swaps (IRS)

Interest Rate Swaps are contracts in which two counterparties agree to exchange two streams of cash-flows in the same currency, typically tied to a floating Libor rate $L^x(T_{i-1}, T_i)$ versus a fixed rate K. These payments streams are called fixed and floating leg of the swap, respectively.

We consider a vanilla swap with a maturity T_n $(= T_m)$, starting in T_0 and with payment dates $T_{i=1,..,n}$ for the floating leg and $T_{j=1,..,m}$ for the fixed leg. We have:

$$FixedLeg = \sum_{j=1}^{m} \tau_j K P^D(t, T_j)$$

$$FloatLeg = \sum_{i=1}^{n} \delta_i L_t^x(T_{i-1}, T_i) P^D(t, T_i)$$

with $L_t^x(T_{i-1}, T_i)$ the forward IBOR beginning in T_{i-1} and maturing in T_i and $\delta_i = T_i - T_{i-1}$. We have the relation:

$$\delta_i L_t^x(T_{i-1}, T_i) = \frac{P^x(t, T_{i-1})}{P^x(t, T_i)} - 1$$

The swap rate R_x^{IRS} is the rate that makes the two legs of the swap equal:

$$R_x^{IRS}(t, T_0, T_n) = \frac{\sum_{i=1}^{n} \delta_i L_t^x(T_{i-1}, T_i) P^D(t, T_i)}{\sum_{j=1}^{m} \tau_j P^D(t, T_i)}$$

Interest Rate Swaps are quoted on the market with their swap rates.

Basis Swaps

Interest Rate Basis Swaps are contracts in which two counterparties agree to exchange two streams of cash-flows in the same currency, tied to two floating IBOR rates with different tenors x and y. Basis swaps are quoted on the market with their basis spread ($\Delta_{n,m}^{x,y}$) which makes the two legs of the swap equal :

$$\sum_{i=1}^{n} \delta_i L_t^x(T_{i-1}, T_i) P^D(t, T_i) = \sum_{j=1}^{m} \tau_j \left(L_t^y(T_{j-1}, T_j) + \Delta_{n,m}^{x,y} \right) P^D(t, T_j)$$

Examples of maturities and market instruments

IRS xMyM is an interest rate swap with floating leg frequency x months and fixed leg frequency y months.

EUR 6M

FRA : 0x6, 1x7, 2x8, 3x9, 4x10, 5x11, 6x12, 7x13, 8x14, 9x15, 10x16, 11x17, 12x18

IRS 6M12M : 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 12Y, 15Y, 20Y, 25Y, 30Y, 40Y, 50Y

USD 3M

Depo : 3M

Futures : 1, 2, 3, 4

IRS 3M12M : 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 12Y, 15Y, 20Y, 25Y, 30Y, 40Y, 50Y

SEK 1M

Depo : 1M

IRS 3M12M : 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 12Y, 15Y, 20Y, 25Y, 30Y

Basis Swap 1M3M : 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 12Y, 15Y, 20Y, 25Y, 30Y

Bootstrapping method

The bootstrapping method consists in calculating the value of the zero coupon at each maturity pillar using the associated market instrument in a recursive way starting from t (today) to the last maturity pillar. We always have :

$$P^x(t, t) = 1$$

Bootstrapping from Deposit, FRA, Futures

There is no difficulty to deduce the zero-coupon value from the Depo, FRA and Futures rates. For the Deposit the zero-coupon value depends only on the Depo rate. For FRA and Futures, the zero coupon value of maturity T_i depends on the FRA (or Future) rate and the value of the zero coupon of maturity T_{i-1}.

Bootstrapping from swap rates

We recall the formula of the swap rate :

$$R_x^{IRS}(t,T_0,T_n) = \frac{1}{\sum_{j=1}^{m} \tau_j P^D(t,T_i)} \sum_{i=1}^{n} \left(\frac{P^x(t,T_{i-1})}{P^x(t,T_i)} - 1\right) P^D(t,T_i)$$

There is two zero coupon in the formula, the zero coupon of tenor x that we are building and the discounting zero coupon curve. As said previously we always build the reference tenor curve first. In this case $P^x(t,T) = P^D(t,T)$ and:

$$\left(\frac{P^x(t,T_{i-1})}{P^x(t,T_i)} - 1\right) P^D(t,T_i) = P^x(t,T_{i-1}) - P^x(t,T_i)$$

There is a geometric sum in the swap rate which is now simply :

$$R_x^{IRS}(t,T_0,T_n) = \frac{P^x(t,T_0) - P^x(t,T_n)}{\sum_{j=1}^{m} \tau_j P^x(t,T_i)}$$

By inversing this formula and knowing that quoted swaps are starting at t ($T_0 = t$) we have :

$$P^x(t,T_n) = \frac{1 - \sum_{j=1}^{m-1} \tau_j R_x^{IRS}(t,T_n) P^x\left(t,T_j\right)}{1 + \tau_m R_x^{IRS}(t,T_n)}$$

This formula shows that the the zero coupon of maturity T_n depends only on the swap rate $R_x^{IRS}(t,T_n)$ and the zero coupon values of maturities $T_i, i = 1,..,m-1$ that we know thanks to the bootstrapping method.
Once the reference tenor curve, that we use as the discounting curve, is build the method is the same for the other tenors.

We don't give details on how we calculate swap rates for other tenors from reference tenor swap rates and basis swaps, these can be found in the reference article from Ametrano and Bianchetti.
Before the bootstrapping we build synthetic swap rates between the pillars maturities by simple linear interpolation.
The zero-coupon values needed in the bootstrapping formula are in fact not always known, due to the difference between the fixed leg frequency and the floating leg frequency for example. In this case we deduce it by polynomial spline between the zero-coupon values previously calculated.

Tikhonov Regularization method

The Tikhonov method is a method of regularization of ill-posed problems. In our case we only have, from the bootstrapping method, zero coupon values at discrete pillar maturities. The goal of the method is to find the values of the zero coupon at every time between today and the longest maturity but with good mathematical properties like smoothness and twice differentiability.
This is a regression problem of the type solving $Ax = b$ with A being a matrix and b a vector. The classical method is to minimize $\|Ax - b\|^2$ (least square method). With Tikhonov we will minimize $\|Ax - b\|^2 + \|\Gamma x\|^2$ where Γ is the "Tikhonov matrix".

Forward curve from zero coupon curve

We have the following relation between forward IBOR and zero coupon:

$$L_t^x(T, T+\delta) = \frac{1}{\delta}\left(\frac{P^x(t,T)}{P^x(t,T+\delta)} - 1\right)$$

This shows that knowing the function $T \mapsto P^x(t,T)$ you can directly deduce the function $T \mapsto L_t^x(T, T+\delta)$.

Case of RFR rates

The method to build the RFR zero coupon curves and the RFR forward curves is the same as for IBOR. We simply build one zero coupon per RFR rate (we can say that the tenor is overnight or 1D to compare with IBOR). We only use one type of market instrument in this case which is Overnight Index Swap (OIS). Overnight Index Swaps are like Interest Rate Swaps except that the floating leg underlying rate is in this case the forward RFR compounded rate:

$$L_t^x(T_{i-1}, T_i) = \frac{1}{\delta_i}\left(\prod_{j=1}^{n}(1 + \tau_j r_{j-1}) - 1\right)$$

Where $r_j, j = 1, .., n$ are the daily RFR rates on the considered period (corresponding to the frequency of the floating leg of the swap) and $T_{i-1} \sim (j = 1)$ and $T_i \sim (j = n)$. We deduce the zero coupon with the same bootstrapping method as for IBOR.
We also use the same formula to deduce forward curves form the zero-coupon curve with the only difference that we use the same zero coupon curve for each forward curve (we have one zero coupon 1D and four forward curves 1M, 3M, 6M, 12M).

Reference

Ametrano F., Bianchetti M. – Everything you always wanted to know about multiple interest rate curve bootstrapping

Pricing of Caps / Floors

Before the 2007 crisis Caps and Floors were priced in a Black frame where we supposed that the forward Ibors follow a Black log-normal diffusion :

$$dF_t = \sigma\, F_t\, dW_t$$

Since the crisis the forward Ibors that could take negative values are supposed following a shifted Black log-normal diffusion :

$$dF_t = \sigma\, (F_t + s)\, dW_t$$

In both cases the only unknown data needed to price a caplet is the volatility σ .
As the price of a Cap is the sum of each of its caplets, if you know the volatility of each caplet's Ibor forward that compose the Cap you have its price.
In fact the market provides vol for caps, linked with a maturity and a strike, where it is supposed that the cap is priced with this vol for each of its caplets. So to build a good surface of volatility for caplets, the first step is to do a 'stripping' to find the volatilities of the caplets which match the market prices of the caps. The second step is to 'smooth' our volatiliy curve by supposing that the forward rates follow a SABR model.
We give details for these two steps in the case of non-negative interest rates and then in the case of negative interest rates.

1. Case of non-negative interest rates

As we said in the introduction the market provides the volatility for caps of different maturities and strikes. The stripping consists in finding the vol of each caplet that compose these caps from this volatility.
Let's consider that we want to price a Cap indexed on the 3M USD LIBOR at the date of 22/02/2016. The market provides us vol for 1Y, 2Y, 3Y, 4Y, 5Y, 7Y, 10Y, 20Y maturities and 0.5, 1, 1.5, …, 6.5, 7 strikes in percentage. Every Cap is considered starting in 3 months.
For the first maturity 1Y and the strike 0.5% we have $\sigma_{1Y}^{Mkt} = 64.03\%$ so :

$$Cap(1Y) = Caplet(3M, \sigma_{1Y}^{Mkt}) + Caplet(6M, \sigma_{1Y}^{Mkt}) + Caplet(9M, \sigma_{1Y}^{Mkt})$$

where $Caplet(T, \sigma)$ is the well known Black formula for the price of a caplet.
We suppose here that the vol of each caplet is the market vol so :

$$\sigma_{1Y}^{Cpl} = \sigma_{iM}^{Cpl} = \sigma_{1Y}^{Mkt}\ , i = 3, 6, 9$$

Where σ_{iM}^{Cpl} is the volatility of the forward USD LIBOR $F_t(iM, iM + \delta)$ with $\delta = 3M$ in our example.
For the second maturity 2Y we have $\sigma_{2Y}^{Mkt} = 85.68\%$. The strike is still 0.5%. We have :

$$Cap(2Y) = \sum_i Caplet(iM, \sigma_{2Y}^{Mkt})\ \ , i = 3, 6, 9, 12, 15, 18$$

The idea is then to find the vol σ_{2Y}^{Cpl} where :

$$Cap(2Y) - \sum_i Caplet(iM, \sigma_{1Y}^{Cpl}) = \sum_i Caplet(iM, \sigma_{2Y}^{Cpl})$$

We do it with a classic root-finding algorithm like the Newton Raphson's one for example.
We continue until the maturity 20Y and reproduce the stripping for each strike. We then have the volatility of the Ibor Forward every 3 months until 20Y and for the strikes provided by the market.
The next step is to have a complete volatility surface to be able to price our caplets at every maturity and every strike, not only the ones that we can deduce from the market.
For this we suppose that the forward Ibor, in our example the 3 months forward USD LIBOR, follows a SABR diffusion at each market's maturity :

$$dF_t^T = \sigma_t^T (F_t^T)^\beta dW_t$$
$$d\sigma_t = \alpha \sigma_t dB_t$$
$$d < W, B >_t = \rho dt$$

The reason why we use the SABR model, and why it is world famous, is that it gives a (nearly) closed formula for the implied volatility. Let's note $\sigma^{impl}(\alpha, \beta, \rho, T, K)$ the SABR-implied volatility. The idea is then to calibrate the parameters of our model (α, β, ρ) on the caplets volatility that we deduced from the stripping. We do this for each maturity. A classic way to do this calibration is to minimize the following function :

$$\sum_K (\sigma^{impl}(\alpha, \beta, \rho, T_i, K) - \sigma_{T_i}^{Cpl}(K))^2$$

for each $T_i = 3M, 6M, 9M, \dots, 20Y$.

After this calibration we have a smooth volatility curve, function of the strike, for each maturity. To finish we interpolate linearly these curves between the maturities to get our Cap volatility surface. We can now price every caplet by using the Black formula and so every Cap.

2. Case of negative interest rates

In the case of negative interest rates, the market doesn't provide the 'log-normal' vol as in 1. but the 'normal' vol. This vol is the implied volatility deduced from the price of Caps where it is supposed that the forward Ibor follows a normal diffusion :

$$dF_t = \sigma F_t dW_t$$

Contrary to the Black model the normal model allows the Ibor to take negative values.

As in the case of non-negative rates we do a stripping but it needs one more step.

For the maturity 1Y we deduce the price of the 1Y Cap with :

$$Cap(1Y) = Caplet_N\left(3M, \sigma_{1Y}^{Mkt,N}\right) + Caplet_N\left(6M, \sigma_{1Y}^{Mkt,N}\right) + Caplet_N(9M, \sigma_{1Y}^{Mkt,N})$$

where $Caplet_N(T, \sigma)$ is the price of a caplet in the normal model.

We then find the volatility $\sigma_{1Y}^{Cpl,S}$ who solves :

$$Cap(1Y) = Caplet_S\left(3M, \sigma_{1Y}^{Cpl,S}\right) + Caplet_S\left(6M, \sigma_{1Y}^{Cpl,S}\right) + Caplet_S(9M, \sigma_{1Y}^{Cpl,S})$$

where we suppose that the forward Ibor follows a shifted log-normal diffusion and $Caplet_S(T, \sigma)$ is the price of a caplet in this model.

We finally choose : $\sigma_{iM}^{Cpl} = \sigma_{1Y}^{Cpl,S}, i = 3, 6, 9.$

For the maturity 2Y we first calculate the price of the 2Y Cap with the 'normal' vol from the market then do the stripping as before and as in the first paragraph but where the Ibor forward is supposed following a shifted log-normal diffusion.

We continue until the maturity 20Y and reproduce the stripping for each strike.

To have a smooth a surface we suppose now that for each maturity the forward Ibor follows a shifted SABR diffusion :

$$dF_t^T = \sigma_t^T (F_t^T + s)^\beta dW_t$$
$$d\sigma_t = \alpha \sigma_t dB_t$$
$$d < W, B >_t = \rho dt$$

We then calibrate as in the first paragraph and interpolate to find our volatility surface.

3. Case of Risk Free Rates (RFR)

In the case of RFR there are two possibilities. The first one is when our broker provides us directly with the volatility of Caps with the RFR as the underlying. The second one is when our broker doesn't provide us with RFR volatility (that could be the case when the RFR cap market in the considered currency is not enough liquid for example) and in this case we use the Ibor volatility to calculate the RFR one (proxy method).

3.1. Direct RFR volatility

This method is the same as for Ibors. The forward rate considered is simply the compounded RFR rate on the tenor considered:

$$F_t = \frac{1}{\delta_i}\left(\prod_{j=1}^{n}(1+\tau_j r_{j-1}) - 1\right)$$

Where r_j are the daily RFR rates on the tenor considered.

3.2. Ibor proxy volatility

When we don't have direct quotations from RFR Caps we use our Ibor volatility surface to build the RFR one. This method is caller Proxy as proposed by Mercurio in his paper "A Note on Building Proxy Volatility Cubes".
To illustrate it lets first suppose a more naïve hypothesis where there is a constant spread (deterministic) between the compounded RFR (F_t) and the associated Ibor (L_t) on the same tenor:

$$F_t = L_t + c$$

In this case we have for a caplet price:

$$\Pi_t((F_T - K)^+, T) = \Pi_t\left(\left(L_T - (K-c)\right)^+, T\right)$$

So the price of a caplet on F with strike K is equal to the price of a caplet on L with strike $K - c$ and you can directly price a Cap on RFR from the Ibor volatility.

The Mercurio model is:

$$dF_t = \sigma_t^F dW_t^F$$
$$dL_t = \sigma_t^L dW_t^L$$
$$d < W^F, W^L >_t = \rho dt$$

With ρ the correlation between the RFR compounded rate (F) and the Ibor rate (L) (the correlation is equal to 1 in the preceding naïve hypothesis).
In this case Mercurio shows that we have:

$$\sigma_t^F = \rho \sigma_t^L$$

If we then suppose that L follows a shifted log normal process ($dL_t = \sigma(L_t + s)dW_t^L$) then we have that F follows a gaussian SABR process :

$$dF_t = V_t dW_t^F$$
$$dV_t = \sigma V_t dW_t^L$$
$$V_t = \rho\sigma(L_t + s)$$

Knowing the correlation (we estimate it historically) we can deduce prices for every RFR Caps and then continue with the direct method to build the volatility surface.

$$dF_t = \sigma dW_t$$

Market Data sources

Market data

The Market Data section contains historical and forward prices of indices or financial instruments.

It incorporates a powerful market data and pricing engine called Top Ten, which provides the necessary information for all financial calculations performed on the platform.

The system retrieves market data from various data providers. This data is then calibrated and calibrated for use in the platform.

TopTen provides the following services:

- Fixing history for all major indices and swap rates
- History of fixings for exchange rates
- Historical price rate and exchange, charts, averages, forward curves
- Derivatives pricers (Spot Sensitivity, Term, Foreign Exchange Swap, Vanilla Option, Barrier Option, Tunnel, Cap, Floor, Tunnel, Swap, Swaption)
- Real-time Mark-to-Market valuation
- Zero coupon curve for major currencies

Market data is available as of today, and retroactively, to allow users to situate themselves in a historical market context.

This data is directly connected to the portfolio of operations, allowing the user to have a vision of his portfolio, valued automatically, without manual updating of rates.

Data Providers

Finance Active mainly uses data from the following providers:

Tullett Prebon: A World Leading Provider Of Unbiased Global, Pricing Data.

www.tullettprebon.com

Refinitiv/Reuters: The world's leading source of intelligent information for businesses and professionals.

https://www.refinitiv.com/

Super Derivatives: Widely recognized as the leading market data provider for derivatives

https://www.superderivatives.com/

ICE owns exchanges for financial and commodity markets, and operates 12 regulated exchanges and marketplaces. This includes ICE futures exchanges in the United States, Canada and Europe, the Life futures exchanges in Europe, the New York Stock Exchange equity options exchanges and OTC energy, credit and equity markets

https://www.theice.com/index

All essential data, such as the Interest Rate Swap (IRS) curve, is compared between these different providers.

- IR Curves : ICE, Tullett Prebon
- Rates Fixing : EMMI, ICE, Reuters
- IR Structured : ICE, Tullett
- IR Vol : ICE, Tullett
- FX : ICE, Reuters, Tullett

The corrections relating to interest rates and exchange rates come from official publications: the ECB for exchange rates and European inflation, EBF for Euribor, BBA for Libor, ISDA for CMS and INSEE for French inflation and Livret A savings account rates.

- European Central Bank: www.ecb.int
- European Banking Federation: www.ebf-fbe.eu
- British Bankers Association: www.bba.org.uk
- ISDA: www.isda.org
- INSEE: www.insee.fr

In case of requests for data not available in Top Ten, the provision may be the subject of a special estimate.