



# FX Volatility Surface Data



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## FX Volatility

An implied volatility is the volatility implied by the market price of an option based on the Black-Scholes option pricing model. A volatility surface is derived from quoted volatilities that provides a way to interpolate an implied volatility at any strike and maturity.

Unlike in other markets that quote volatility versus strike directly, the FX smile is given implicitly as a set of restrictions implied by market instruments and as such a calibration procedure to construct a volatility- delta or volatility-strike smile is used.



# Summary

- Implied Volatility Introduction
- Volatility Surface in FX Market
- Risk Reversal and Butterfly
- FX Volatility Surface Data



## FX Volatility

### Implied Volatility Introduction

- An implied volatility is the volatility implied by the market price of an option based on the Black-Scholes option pricing model.
- An FX volatility surface is a three-dimensional plot of the implied volatility as a function of term and Delta and smile.
- The term structures of implied volatilities provide indications of the market's near- and long-term uncertainty about future short- and long-term swap rates.
- Vol skew or smile pattern is directly related to the conditional non-normality of the underlying return risk-neutral distribution.
- In particular, a smile reflects fat tails in the return distribution whereas a skew indicates return distribution asymmetry.
- A crucial property of the implied volatility surface is the absence of arbitrage.





## FX Volatility

### Volatility Surface in FX Market

- Unlike in other markets that quote volatility versus strike directly, the FX smile is given implicitly as a set of restrictions implied by market instruments and as such a calibration procedure to construct a volatility- delta or volatility-strike smile is used
- The volatility surface in FX market is constructed based on the sticky delta rule. The underlying assumption is that options are valued depending on their delta, so that when the FX spot rate moves and the delta of an option changes accordingly, a different implied volatility has to be used into the pricing formula.



## FX Volatility

### Volatility Surface in FX Market (cont'd)

- Therefore, FX volatility smile is represented by three entities: at-the-money (ATM) volatility, risk reversal, and butterfly. The standard market quotes are ATM level, 10 delta risk reversal, 10 delta butterfly, 25 delta risk reversal, and 25 delta butterfly.
- The ATM volatilities quoted by brokers can have various interpretations depending on currency pairs. Here we introduced the most popular one used by the FX brokers. The ATM volatility is the value from the smile curve where the strike is such that the delta of the call equals, in absolute value, that of the put (this strike is called ATM “straddle” or ATM “delta neutral”).



## FX Volatility

### Risk Reversal

- A risk reversal (RR) is a combination of a long call option and a short put option with the same maturity. This is a zero-cost product as one can finance a call option by selling a put option. Risk reversal volatility is the difference between the volatility of the call option and the put option at the same moneyness level, i.e.,

$$25 \text{ RR} = 25 \text{ Delta Cal Vol} - 25 \text{ Delta Put Vol}$$



## FX Volatility

### Butterfly

- A butterfly (BF) is a combination of a long call option, a long put option, a short ATM call option, and a short ATM put option. Butterfly volatility is the average of the difference between the volatility of the call option and put option minus the ATM volatility, i.e.,

$$25 BF = \frac{25 \text{ Delta Cal Vol} + 25 \text{ Delta Put Vol}}{2} - ATM$$





## FX Volatility

### FX Volatility Data

- FX volatility is quoted 10 and 25 delta call and put, such as

Term	Delta	Type	Vol
2Y	10	Call	0.0723
2Y	10	Put	0.0635
2Y	25	Call	0.0646
2Y	25	Put	0.0596
2Y	ATM		0.0596
3Y	10	Call	0.0812
3Y	10	Put	0.0678
3Y	25	Call	0.0717
3Y	25	Put	0.0642
3Y	ATM		0.065
4Y	10	Call	0.0887
4Y	10	Put	0.073
4Y	25	Call	0.0782
4Y	25	Put	0.0694
4Y	ATM		0.0706



# FX Volatility

- The original volatility cannot be used for valuation directly. The processed ready-to-use FX implied volatility surface looks like

erm	Delta	Smile	Vol
2Y	10	Butterfly	0.0083
2Y	10	Risk_Reversal	0.0088
2Y	25	Butterfly	0.0025
2Y	25	Risk_Reversal	0.005
2Y	50	Volatility	0.0596
3Y	10	Butterfly	0.0095
3Y	10	Risk_Reversal	0.0134
3Y	25	Butterfly	0.00295
3Y	25	Risk_Reversal	0.0075
3Y	50	Volatility	0.065
4Y	10	Butterfly	0.01025
4Y	10	Risk_Reversal	0.0157
4Y	25	Butterfly	0.0032
4Y	25	Risk_Reversal	0.0088
4Y	50	Volatility	0.0706



# Thank You

You can find more details at

<https://finpricing.com/lib/FxVolIntroduction.html>