FOREX Volatility Surface

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 FOREX 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.

An FOREX 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-nomality 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.

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The volatility surface in FOREX 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 FOREX spot rate moves and the delta of an option changes accordingly, a different implied volatility has to be used into the pricing formula.

Therefore, FOREX 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 FOREX 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").

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.

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.,

Reference:

https://finpricing.com/lib/EqConvertible.html