Precious Metal Volatility Surface Data

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Precious metals are trading commodities. But a precious metal quote is very similar to a Forex quote. The quote is represented in the same way as a quote for a currency pair. For instance, the spot gold traded against the US dollar is XAU/USD.

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 precious metal 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.

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Precious Metal Introduction

- In the past, precious metals were the foremost commodity-based form of payments. The use of precious metals as currency led to the production of coinage that was used as trading devices. The institution of coinage further led to the development of representative currencies in the form of notes.

- Later on, major world currencies were pegged to the value of gold. After the collapse of the Breton Woods agreement, precious metals are no longer used as a primary mode of monetary transactions. But they continuous to share a close relationship with established currencies.

- A precious metal quote is very similar to a Forex quote. The quote is represented in the same way as a quote for a currency pair. For instance, the spot gold traded against the US dollar is XAU/USD.

- Spot precious metal prices are quoted in USD per troy ounce. Thus, a quote of XAU/USD 1000 means 1oz of gold is equal to $1000 USD.

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.

- A precious metal 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.

Implied Volatility Introduction

- 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.

Volatility Surface in Precious Metal Market

- Unlike in other markets that quote volatility versus strike directly, the precious metal 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 precious metal 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.

Volatility Surface in FX Market (cont'd)

- Therefore, precious metal 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 precious metal 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").

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.,

$$25\ RR = 25\ Delta\ Cal\ Vol\ - 25\ Delta\ Put\ Vol$$

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.,

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

PM Volatility Data

- Precious metal 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

PM 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/EqOption.html