

FX PRODUCTS

Mechanics of Volatility Quoted Functionality

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FX PRODUCTS

DESIGNED FOR THE RAPID PACE OF A GLOBAL MARKETPLACE

With \$3.2 trillion traded daily, FX markets represent the largest asset class in the world. CME Group offers the world's largest regulated FX marketplace and one of the top two FX platforms. We offer transparent pricing in a regulated centralized marketplace that provides all participants equal access to 49 futures contracts and 32 options contracts based on 20 major world and emerging market currencies. Trading FX at CME Group gives you effective and efficient investment and risk management opportunities and unprecedented access to a global array of market participants – including banks, hedge funds, proprietary trading firms and individual traders.

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SECTION 1: VOLATILITY-QUOTED FX OPTIONS ON THE CME GLOBEX PLATFORM

This release introduced implied annualized volatility-quoted markets to the CME Globex platform for options on FX futures. Volatility-quoting allows CME Group customers to trade options volatility with an 'auto-hedge' into the corresponding quarterly month of the underlying futures contract. This functionality eliminates the volatility-to-premium conversion and constant price modification previously required to trade options volatility

in premium markets. Additionally, the match and post-match efficiencies for client systems implementing volatility-quoting functionality mitigate underlying hedge price risk and, in most cases, ensure futures hedge quantity allocation.

Volatility-quoting is initially available for European- and American-style options on our FX futures products as follows:

Volatility-Quoted Options

Product	Style	Maturity*	Symbol
Australian dollar	American	Monthly	V6A
		Weekly	VA1 thru VA5
	European	Monthly	VXA
		Weekly	VAA thru VAE
British pound	American	Monthly	V6B
		Weekly	VB1 thru VB5
	European	Monthly	VXB
		Weekly	VBA thru VBE
Canadian dollar	American	Monthly	V6C
		Weekly	VC1 thru VC5
	European	Monthly	VXC
		Weekly	VCA thru VCE
EuroFX	American	Monthly	V6E
		Weekly	VE1 thru VE5
	European	Monthly	VXT
		Weekly	VT A thru VTE
Japanese yen	American	Monthly	V6J
		Weekly	VJA thru VJ5
	European	Monthly	VXJ
		Weekly	VJA thru VJE
Swiss franc	American	Monthly	V6S
		Weekly	VS1 thru VS5
	European	Monthly	VXS
		Weekly	VSA thru VSE

* All existing maturities for premium-quoted options are also available for volatility-quoted: up to five Weeklies, two Serials and four Quarterlies. Listing rules follow premium-quoted listing conventions.

The volatility-quoted options in the preceding table correspond to the following premium-quoted options products.

CME Globex uses the Black options pricing model for European-style options and the Whaley options pricing model for American-style options, as described in Appendix A.

Premium-Quoted Options

Product	Style	Maturity	Symbol
Australian dollar	American	Monthly	6A
		Weekly	6A1 thru 6A
	European	Monthly	XAD
		Weekly	XA1 thru XA5
British pound	American	Monthly	6B
		Weekly	6B1 thru 6B5
	European	Monthly	XB
		Weekly	XB1 thru XB5
Canadian dollar	American	Monthly	6C
		Weekly	6C1 thru 6C5
	European	Monthly	XD
		Weekly	XD1 thru XD5
EuroFX	American	Monthly	6E
		Weekly	6E1 thru 6E5
	European	Monthly	XT
		Weekly	XT1 thru XT5
Japanese yen	American	Monthly	6J
		Weekly	6J1 thru 6J5
	European	Monthly	XJ
		Weekly	XJ1 thru XJ5
Swiss franc	American	Monthly	6S
		Weekly	6S1 thru 6S5
	European	Monthly	XS
		Weekly	XS1 thru XS5

Available Strategy Types

The following strategy types are available for trading in volatility terms using a single volatility bid or ask input, for monthly maturities only:

Strategy	Strategy Type Code
Vertical	VT
Straddle	ST
Strangle	SG

The above strategy types are not listed for Weekly maturities.

Please note: effective November 1, 2009, these exchange-defined spreads will no longer be available. Traders can use the User-Defined Spreads functionality to create and trade any strategy desired.

1.1 User-Defined Spread (UDS) Functionality

UDS: Combos functionality is available on volatility-quoted options with the following exceptions:

- the UDS instrument cannot combine volatility-quoted and premium options
- the volatility-quoted instruments must deliver into the same futures product

UDS: Covered functionality is not allowed for volatility-quoted options

SECTION 2: VOLATILITY-QUOTED MARKETS

Volatility-quoted markets are separate from premium markets and designated as such in the appropriate market data messages. Products in volatility-quoted markets are bid or offered in terms of annualized implied volatility to three decimal places and trade in increments of 0.025 of a vol (i.e., one percentage point of annualized implied volatility). The order book for any given strike price will be represented by quantity and volatility as shown below.

900 Call/Currency Option			
Bid		Ask	
Quantity	Volatility	Volatility	Quantity
90	8.150	8.175	100
50	8.125	8.200	50
20	8.100	8.225	20

2.1 Hedge Assignment

Following the volatility-quoted options match, CME Globex performs pricing and hedge quantity assignment as follows:

1. Determine the hedge quantity for the volatility match.
2. Determine the option premium price using the following variables applied in the appropriate options pricing model:
 - matched implied volatility
 - underlying futures price*
 - time to expiration
 - option strike
 - interest rate**
 - call/put
 - option style (European or American)

Note: When performing the volatility to premium conversion, CME Globex uses an additional decimal place to allow for greater rounding precision. Please see Appendix B for detailed examples.

3. Determine the future hedge quantity by multiplying the matched volatility option quantity by the associated delta value for the option.

Note: Only one futures product is supported for the futures hedge.

4. Determine futures price. Price is based on the midpoint of the most recent Bid and Ask spread of the future.

- If the midpoint is not on-tick, CME Globex will round to the side with the smallest quantity.
- If no resting Bid/Ask spread is available, CME Globex will use the last traded price.
- If no traded price is available, the previous day's settle will be used.

Note: It is possible for a volatility match to occur without a futures hedge if the total calculated futures hedge ratio per buy/sell match is between + 0.50 and - 0.50. In either instance, the futures hedge rounds to zero.

Example

The matched quantity is a 10-lot and its corresponding delta is 0.04. The product of these two multiplied factors equates to a futures hedge ratio of 0.40 (10-lot * 0.04 delta). The hedge ratio equals zero futures since the hedge ratio is rounded to zero.

* The most liquid front month future will be used to calculate all underlying futures prices used for hedging. This calculation will be direct for options delivering into this front month futures contract. For all options delivering into back month futures, CME Globex will use the mid-market price of the front month contract and add or subtract the appropriate spread to produce a synthetic value for the back month underlying futures contract. The spread used in this computation will be the closing value for this particular spread as of the prior trading day. Also, during expiration week of the front month future, CME Globex will compare the Bid/Ask spread of the front month future against the next quarterly and use the instrument with the tightest Bid/Ask spread as the basis for calculating the underlying futures price.

** This value is 100 minus the previous day's settlement price of the front month Eurodollar future until LTD. It then rolls to the next front month contract.

2.1.1 Hedge Assignment with Multiple Counterparties

If a single volatility match has multiple counterparties, then the incoming futures hedge ratio will be determined for the entire incoming order. The futures hedge ratio for each counterparty will be determined individually for each resting order.

The following example is for a European-style option:

1. Assume the Ask side order enters the market and sweeps the Bid side quantity.

1.7000 Call / Currency Option			
Bid		Ask	
Quantity	Volatility	Volatility	Quantity
40	1220	1220	100 (incoming order.)
30	1220	1220	100 (incoming order.)
20	1220	1220	100 (incoming order.)
10	1220	1220	100 (incoming order.)

2. Black's model outputs a computed delta of 0.51.

3. The breakdown for hedge ratios is as follows:

Bid			Ask		
Quantity	Delta	Assigned Hedge Ratio	Quantity	Delta	Assigned Hedge Ratio
40	0.51	21	100	0.51	51
30	0.51	15	100	0.51	51
20	0.51	10	100	0.51	51
10	0.51	5	100	0.51	51
		51	100	0.51	51

Explanation:

The resting 40 lot had a total delta of 20.4

The resting 30 lot had a total delta of 15.3

The resting 20 lot had a total delta of 10.2

The resting 10 lot had a total delta of 5.1

INOF/RNOF methodology dictates that INOF must = RNOF

To have INOF=RNOF, CME Globex distributes the leftover futures from INOF to the least allocated RNOF, 1 lot at a time. Therefore, the resting 40 lot will receive the leftover 1 lot since it was the least allocated RNOF.

This rule ensures that an incoming order is never uncovered by more than 0.50 futures. Also, the resting orders are never uncovered/over covered by more than 0.99 futures.

2.1.2 Position Management

Volatility trades will not create separate volatility positions in CME Clearing but will be added to the position aggregate for the premium instrument.

APPENDIX A: PRICING MODELS

Black Option Pricing Model for European-Style Options

Waiting for copyright approval to display Black Option model as defined in: *Natenberg, S. (1994). *Option Volatility and Pricing*. New York: McGraw-Hill.

Whaley Option Pricing Model for American-Style Options For a comprehensive description of the Whaley pricing model, please see:

<http://www.cmegroup.com/globex/files/whaleymodel.pdf>

Also, please see the developer notes below, which include modifications made to the model described in the above article about improving calculation within CME Globex:

- On page 309, there is mention of an “acceptable tolerance level”. In their example, their tolerance equation is: $|LHS(S_i) - RHS(S_i)| / X < 0.00001$. CME Globex actually goes slightly further in the precision, to 0.000001 (one more decimal place).
- If after 10,000 iterations, CME Globex is not within a tolerance of 0.000001, it falls back to the European model.
- There is no notion of a carrying-cost or foreign interest rate. The b variable is always equal to zero in the equations.
- There is an edge case scenario not documented in the model, but implemented by SPAN and also included in the CME Globex model. This scenario is extremely rare but prevents a delta from falling outside of -1.0 through 1.0.
 - For a call, if the underlying price is greater than or equal to S^{**} , the delta is set to 1.0 and the premium equal to the underlying price minus the strike price (or 0, if this value is < 0).
 - For a put, if the underlying price is less than S^{**} , the delta is set to -1.0 and the premium equal to the strike price minus the underlying price (or 0, if this value is < 0).

* American and European style options

** Only American style

APPENDIX B: OPTION PREMIUM PRICE ADJUSTMENT

The following table provides an example of the Option Premium Price Adjustment CME Globex performs for each volatility-quoted options product.

Option Premium Rounding Tick			
Product	Minimum Tick	Half Tick	Option Premium Rounding Tick
EuroFX	0.0001 = \$12.50	0.00005 = \$6.25	0.00001 = \$1.25
British pound	0.0001 = \$6.25	N/A	0.00002 = \$1.25
Japanese yen	0.000001 = \$12.50	0.0000005 = \$6.25	0.0000001 = \$1.25
Canadian dollar	0.0001 = \$10.00	0.00005 = \$5.00	0.00001 = \$1.00
Swiss franc	0.0001 = \$12.50	0.00005 = \$6.25	0.00001 = \$1.25
Australian dollar	0.0001 = \$10.00	0.00005 = \$5.00	0.00001 = \$1.00

As with premium-quoted options, a bid of zero is not valid. A Volatility Price of 0.025 percent or greater will be rounded up to the minimum Option Premium Rounding Tick described above should the conversion premium price fall between 0 and the minimum Option Premium Rounding Tick.

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