

International Securities Exchange



INTERNATIONAL SECURITIES EXCHANGE®

January 2008

Steve Meizinger

Smeizinger@ise.com

www.ise.com



INTERNATIONAL SECURITIES EXCHANGE®

Implied Volatility for FX Options Pairs - What Does It Mean for You?



INTERNATIONAL SECURITIES EXCHANGE®

For the sake of simplicity, the examples that follow do not take into consideration commissions and other transaction fees, tax considerations, or margin requirements, which are factors that may significantly affect the economic consequences of a given strategy. An investor should review transaction costs, margin requirements and tax considerations with a broker and tax advisor before entering into any options strategy.

Options involve risk and are not suitable for everyone. Prior to buying or selling an option, a person must receive a copy of **CHARACTERISTICS AND RISKS OF STANDARDIZED OPTIONS**. Copies have been provided for you today and may be obtained from your broker, one of the exchanges or The Options Clearing Corporation. A prospectus, which discusses the role of The Options Clearing Corporation, is also available, without charge, upon request at 1-888-OPTIONS or www.888options.com.

Any strategies discussed, including examples using actual securities price data, are strictly for illustrative and educational purposes and are not to be construed as an endorsement, recommendation or solicitation to buy or sell securities.

Likelihood of events

- Options pricing is based on the likelihood of an event occurring
- Terms such as most likely, most unlikely, probable, improbable, likely, unlikely and possible describe the likelihood an event occurring, but not from a specific or quantifiable perspective
- Options traders wanted a more quantifiable solution, the answer: Black-Scholes Options Pricing Model

Sequence of foreign exchange market events

1. Some news event occurs
2. Uncertainty- What does it mean for the market?
3. Volatility moves up or down based on the dissemination of the news
4. Simultaneously, exchange rates will move up or down based on the news
5. At some point the market will “find” a new equilibrium point of the exchange rate and volatility after digesting the news event



Where do the option prices come from?

- Fisher Black and Myron Scholes developed the most popular pricing model
- Based on the concept that dynamic behavior of asset prices is expected
- Assumption of model is risk-neutrality
- Many other models are now used, Cox-Ross-Rubenstein is another famous option model along with Garman and Kohlhagen for FX options
- Most are extensions of Black-Scholes

Pricing models, who cares?

- Laws of probability enable practitioners to predict the likelihood of events to occur
- Option pricing models are based on the premise that stock prices are random and cannot be predicted with any accuracy
- Option values are based on bell-shaped, lognormal distribution with a slight upward bias

Efficient or not?

- Efficient Market Hypothesis (EMH) assumes the market fully reflects all available information
- What about periods of excess volatility, pricing “bubbles” and the occasional chaos of the market?

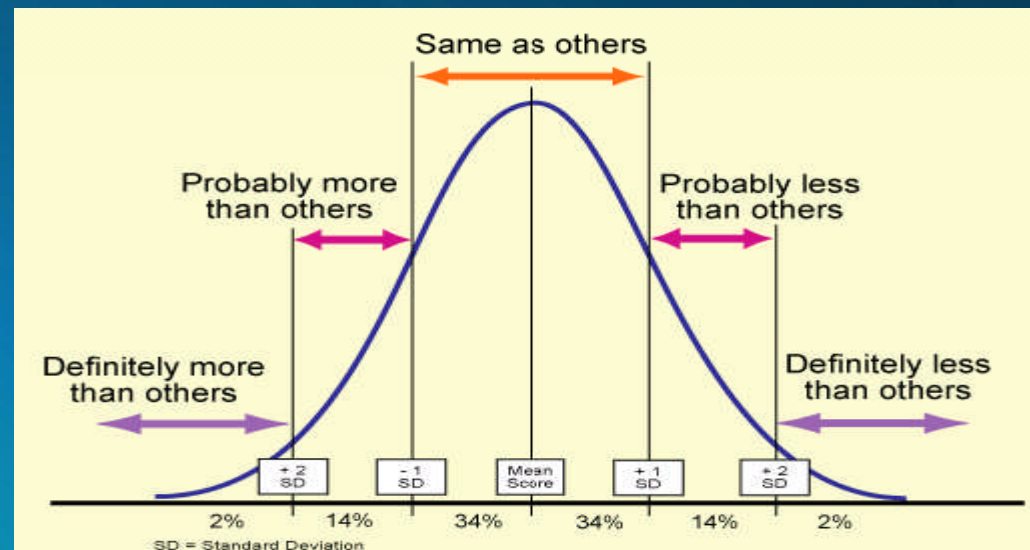


Practical use of normal distributions

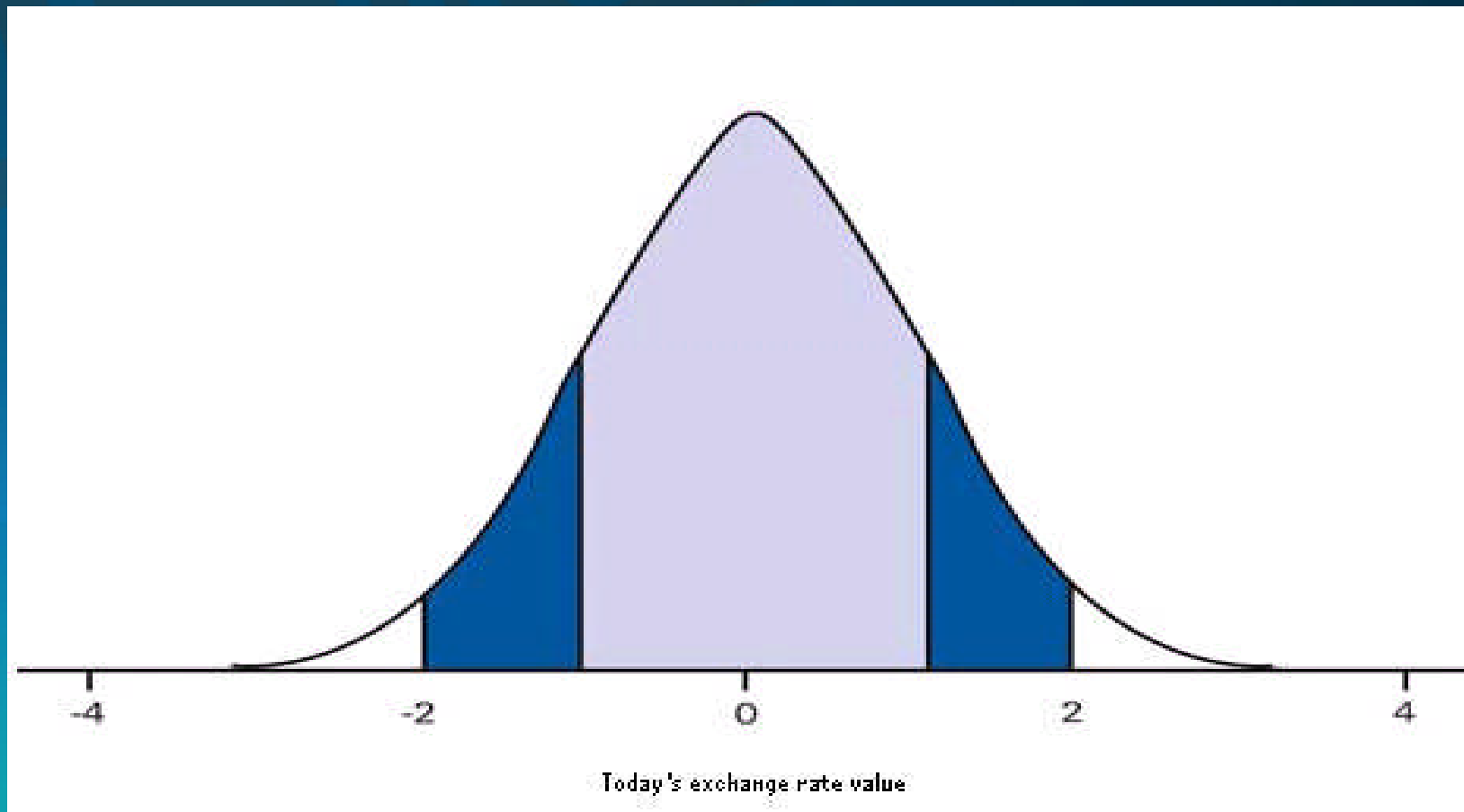
- The distribution of heights of American women aged 18 to 24 is approximately normally distributed with mean 65.5 inches and standard deviation 2.5 inches. From the above rule, it follows that
- 68%
 - of these American women have heights between $65.5 - 2.5$ and $65.5 + 2.5$ inches, or between 63 and 68 inches,
- 95%
 - of these American women have heights between $65.5 - 2(2.5)$ and $65.5 + 2(2.5)$ inches, or between 60.5 and 70.5 inches

Statistics play a vital role in options pricing

- Practically speaking, one example could be the general male (or female) adult heights



Probabilities matter for FX options



The essence of options

- Options investments are about forecasts
- Each individual investor can make their own forecasts and find complementary options strategies either for hedging or implementing a certain view of the market

ISE FX options are based on per US\$

- Using the ISE FX options trading convention, the U.S. dollar is listed first, the valuation is expressed as the number of the units of the other currency per U.S. dollar.
- At ISE we describe it as, “What is the dollar worth?”

ISE FX symbols prices as of January 11

Convention	ISE symbol	FX value	Implied volatility
• USD/Yen	YUK	108.93	12%
• USD/CAD	CDD	102.01	13%
• USD/Euro	EUI	67.64	10%
• USD/GBP	BPX	51.09	10%

Of course, the FX values and the implied volatilities change each and every trading day

Features Of ISE FX Options

- Options on exchange rates
- U.S. dollar based
- .50 strike prices
- Premium quoted in U.S. dollars
- European Exercise
- Cash-settled
- Noon Settlement/Option Friday
- Noon Buying Rate FRB of NY
- Available in Conventional Brokerage Account
- Continuous Two-Sided Quotes
- Trading Hours 9:30 – 4:15 EST



Options give you options...

- Options allow investors to control assets with a limited amount of capital; this is also known as leverage
- Long options are sometimes deployed when an investor is expecting a large move in an equity, bond or (in this case) a foreign exchange rate, or if the investor prefers the limited risk of purchased options
- If an investor is “expecting” a big move up or down an option may be the best choice

Why a big move?

- Due to the options' limited cost, an investor holds all the upside (calls) or substantial downside (puts) with a limited amount of risk
- When the market expects large moves (up or down) the market will increase (or decrease) option premiums
- When the market does not expect large moves, the option premiums most likely will contract and should change less than during more volatile periods

Option premiums

- Option premiums can be used to gauge investor expectations
- High premiums for FX options mean investors expect something “really good, or really bad,” a large move in the exchange rate either up or down



Volatility

- Volatility is a conditionally biased predictor of the future (also called realized volatility) across many different asset classes
- Foreign exchange options also exhibits this behavior
- Option prices depend on the volatility of the underlying asset
- Implied volatility can help investors assess the market's view of the future

Foreign exchange uncertainty

- 3 sources of FX option uncertainty
 - Exchange rate itself (spot)
 - Interest rate differential
 - Volatility of the foreign exchange rate pair



Pricing Inputs

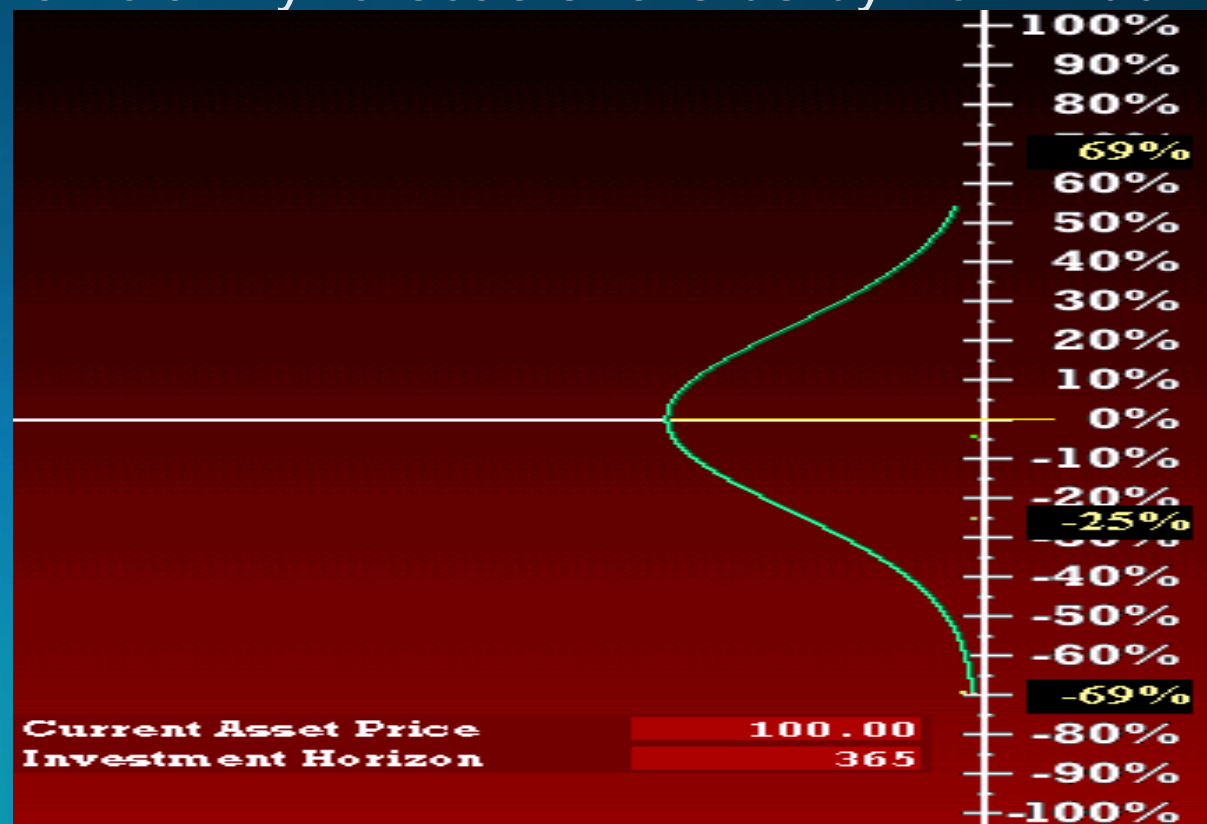
- » Underlying price
- » Strike price
- » Time until expiration
- » Interest rate differential
- » Volatility



INTERNATIONAL SECURITIES EXCHANGE®

Probability of change

- The theory says the asset is just as likely to move up as down, the volatility forecasts tells us by how much



More about models...

- Option pricing models “try” to calculate the probability of an event occurring
- Most times the models are accurate; occasionally they are inaccurate
- Just remember, the models “claim” 99% accuracy, they will never guarantee that the probabilities are 100% accurate



Underlying exchange rate value

- Relationship between the strike price and the underlying price creates the value of the option at expiration
- At expiration all options are worth the intrinsic value or they are worthless
- Option pricing expectations are measured by delta, the amount an option moves based on a one unit change in the underlying price
- The greater the likelihood of the option expiring in the money the greater the delta



Strike Price

- Each option has a strike price at which the underlying can be bought or sold
- Option strike prices are similar to insurance policies deductibles
- Various strikes prices offer differing risk/reward propositions
- Call strikes can be viewed as protecting against US dollar appreciation
- Put strikes can be viewed protecting US dollar declines



Time

- In most cases the greater amount of time, the greater the option's value
- Time decay is not linear, shorter term options decay faster than longer term (theta)
- Generally the greater the time decay, the greater the potential for a rapidly changing delta (gamma)
- Gamma manufactures delta creating option price change

Options have value for 2 reasons

- Cost of carrying underlying position (risk-free interest rates), this is also called the interest rate differential
- Potential underlying variance (volatility)

If both currency rates were 0% and the underlying currency pair had no potential for movement, all options would trade at intrinsic value or 0



Risk-free Rates

- ISE FX options are dollar based, all of the pairs use the US dollar as the base currency
- Due to the ISE FX options being dollar based, as US rates rise, puts increase in value; as rates drop, calls increase in value
- Of course, not only are the US rates important but the foreign rate is important too; the difference in the rates is called the interest rate differential

Dividends for stocks are like the contra currencies' risk free interest rate

- Theoretically, exchange rates should decline by the amount of the interest rate differential
- If another currency has much lower risk-free interest rates than the US, the puts will reflect the potential for US dollar devaluation by increasing the put values
- If another currency has much higher risk-free interest rates than the US, the calls will reflect the potential for US dollar revaluation by increasing the call values

Volatility

- How much change is expected?
- Variance as measured by volatility, expected error factor from the mean
- Risk = Standard deviation (this can be debated as sometimes the standard deviations may be grossly incorrect)
- Price movements within one standard deviation movements should occur 68% of the time, within two standard deviations 95%
- Risk/Reward remain in balance, the more growth the market expects for a currency the more risk the currency infers



The Greeks

- *Delta*- The change in the option's value for every one unit change in the currency pair (0.00-1.00)
- *Gamma*- The change in the option's delta for every one unit change in the underlying (gamma "manufactures delta") (i.e. .07). For example, the currency pair moves up 1 unit and call delta was .52, new call delta will be .59
- *Theta*- The change in the option's value for every one day decrease in the time remaining until expiration. The dollar amount of time decay expressed in decimals. If an option closes at \$3.5 with -.20 theta and the pair opens the next day unchanged, the new theoretical value is \$3.3



The Greeks

- *Vega*- The change in the option's value for a one percentage point increase in implied volatility; expressed in decimals. For example if an option had a vega of .25 and a theoretical value is \$2.5, if the volatility were increase by 1% the option would have a new theoretical value of \$2.75
- *Rho*- The change in the option's value for a one percentage point increase in risk-free interest rates. Expressed in decimals, calls and puts have differing values. For example a Rho of .06 indicates the option's theoretical value will increase by .06 given a 1% increase in interest rates Long calls and short puts have positive rho

Volatility

- The volatility associated with an asset is stated in annual percentage, it is a one standard deviation up or down estimation of future price
- Very concise and powerful way of conveying the amount of uncertainty in underlying forecasts
- The option's sensitivity to volatility is measured by vega, the amount the option will increase by a 1 unit change in volatility

Types of Volatility

- Historical
- Implied
- Your forecast- your strategy may favor an increase or decrease in volatility



INTERNATIONAL SECURITIES EXCHANGE®

Historical Volatility

- Calculate the past history of the mean price of the currency pair over a certain period of time (10 day, 30, 60, or 252)
- Calculate the standard deviations for the periods
- Standard deviation is a mathematical term for probability, or the variance from the average
- The distribution curve graphically describes how much the stock fluctuated in the past

Implied Volatility

- Reverse engineering of the Black-Scholes option pricing model or similar models
- Instead of solving for an option's value, use the current market price and solve for implied volatility
- Assumption is that market participants are more knowledgeable than past data
- Many experts believe implied volatility is the best predictor for future volatility

Actual Volatility

What actually occurs in the marketplace

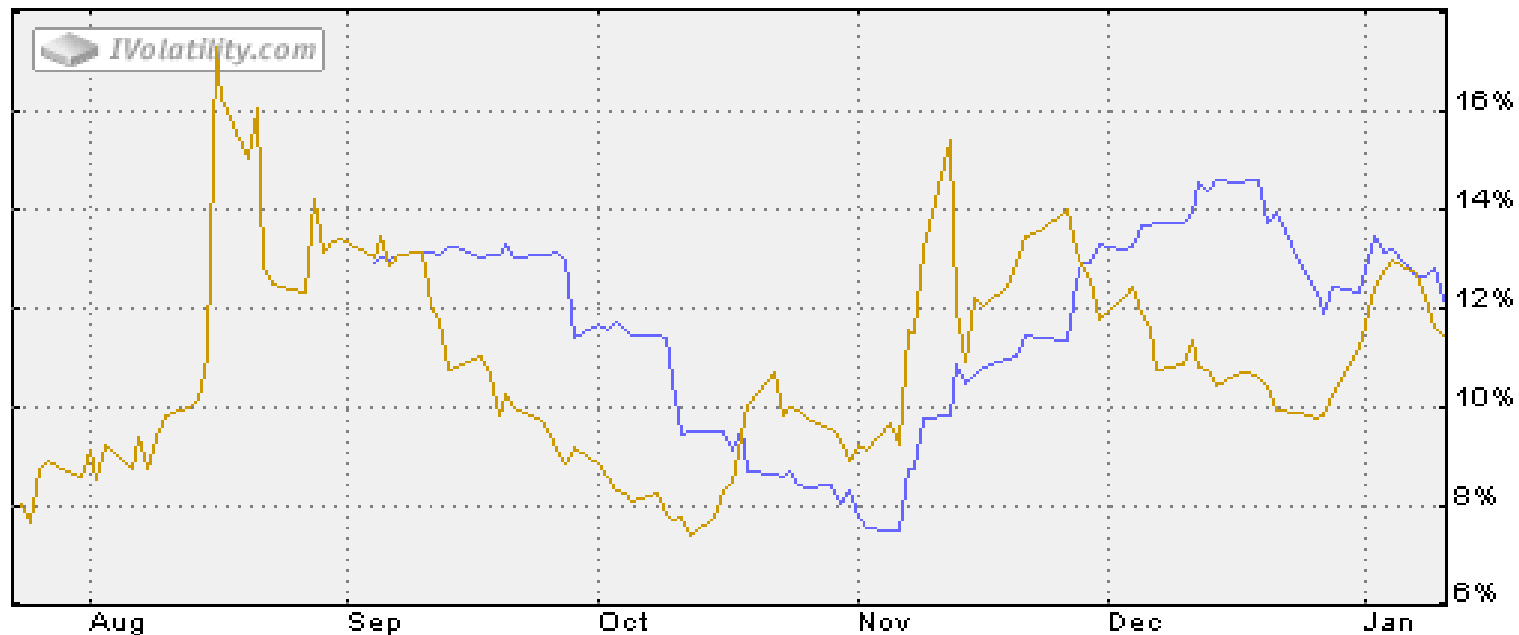
YUK: DAILY 1 YEAR VOLATILITY CHART ([3 months](#) [6 months](#) 1 year)

[IV Index Call](#)

[IV Index Put](#)

[IV Index Call & Put](#)

[IV Index Mean](#)



Case study CDD (USD/CAD)

- The implied volatility is the market's best guess of what the future volatility of the market may be



Forecasting Volatility

- Each option trade includes embedded forecasts, not only for the underlying, the time period, but also for volatility
- Differing strike prices are affected differently by changes in perceived volatility (Vega)
- The longer the time period the greater the impact of volatility (Vega)

CDD prices



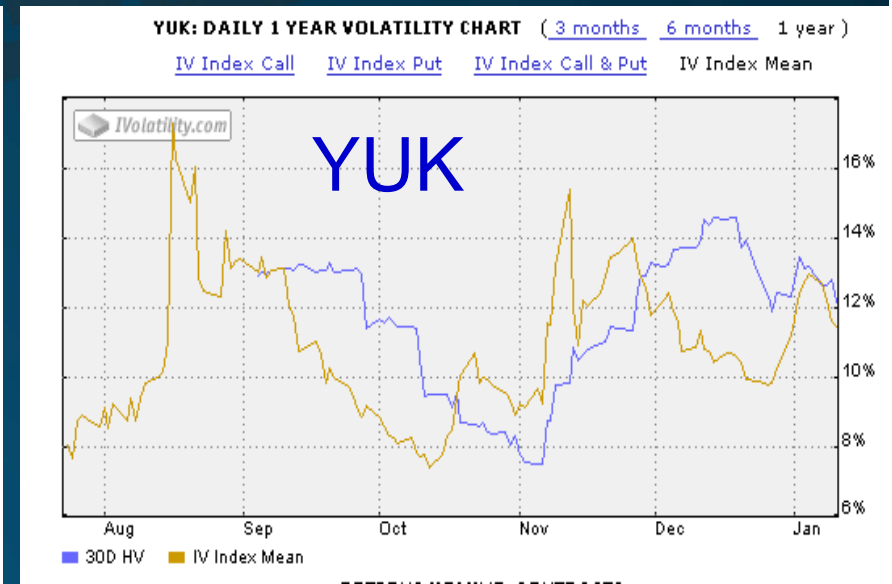
INTERNATIONAL SECURITIES EXCHANGE®

YUK prices



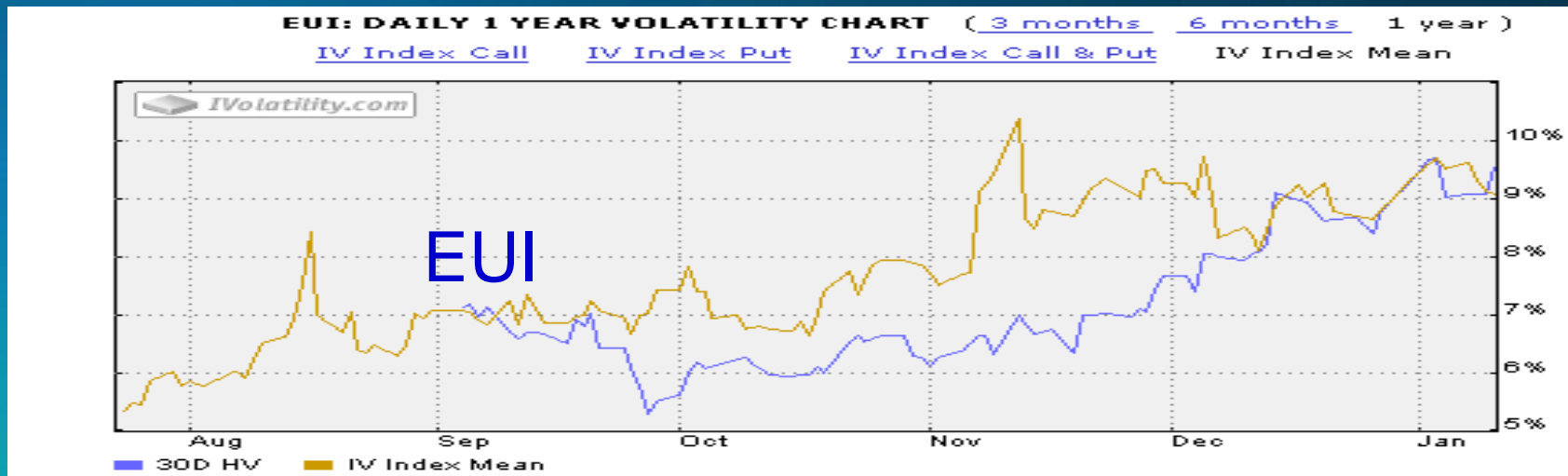
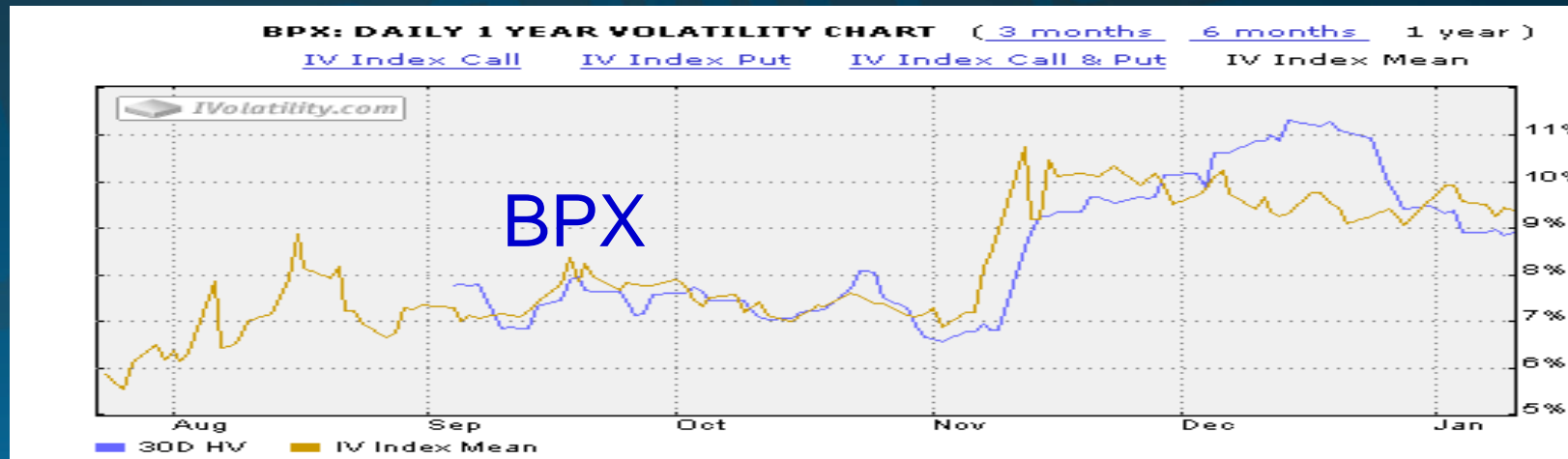
INTERNATIONAL SECURITIES EXCHANGE.

A Further Look at Implied Volatilities



- » FX implied volatilities can vary widely, volatilities normally rise when market participants are more uncertain on foreign exchange for various reasons
- » Implied volatilities may trend just like asset prices, investors should consider the implied volatility prior to entering any options strategy

Volatility changes



INTERNATIONAL SECURITIES EXCHANGE.

Volatilities “should” revert back to their past average price; the mean

- Volatility is normally changing
- What time frame do you use to calculate historical volatilities?
- Question is, when will it revert?

Option market prices (YUK) 4.12% interest rate

differential

YUK	Calls	Puts
106	3.15	1.70
108	1.95	2.55
110	1.15	3.65
112	0.65	5.05
114	0.35	6.80
YUK	108.17	55 days left

What if we change volatility?

- If volatility moves up and you are long options you benefit
- If volatility moves down and you are long options you suffer



What if we change volatility?

	10.4c	13.4c	16.4c	10.4p	13.4p	16.4p
106	2.56	3.03	3.51	1.07	1.54	2.02
108	1.49	1.98	2.48	1.99	2.49	2.99
110	0.77	1.21	1.68	3.27	3.72	4.18
112	0.35	0.69	1.09	4.85	5.19	5.59
114	0.14	0.37	0.67	6.64	6.86	7.17



Call prices change as volatility changes

Percentage changes	10.4 vol call	13.4 vol call	16.4 vol call
106	15.5%		15.8%
108	24.7%		25.3%
110	36.3%		38.9%
112	49.2%		57.9%
114	62.1%		81.0%

Put prices change as volatility change

Percentage changes	10.4 vol put	13.4 vol put	16.4 vol put
106	30.5%		31.1%
108	20%		20.0%
110	12.0%		12.3%
112	6.5%		7.7%
114	3.2%		4.5%

How can you reduce your volatility risk?

- Trade spreads
- The simultaneous purchase and sale of options allows for a mitigation of volatility risk
- The risk is reduced in most cases, **it is not eliminated**



Call spreads mitigate volatility changes

	10.4 vol	13.4 vol	16.4 vol
106/110 call spread	1.79	1.82	1.83
108/112 call spread	1.14	1.29	1.39
106/112 call spread	2.21	2.34	2.42

Put spreads mitigate volatility too

	10.4 vol	13.4 vol	16.4 vol
114/108 put spread	4.65	4.37	4.08
112/106 put spread	3.78	3.65	3.57
114/106 put spread	5.57	5.32	5.15

How about strangles?

- Strangle defined:
 - The purchase or sale of an out of the money call and an out of the money put
 - The implicit forecast is that the asset will make a large move in one direction or another
 - Also implicit in this forecast is the purchase of volatility

A strangle example using YUK

- Buy the 2 month 106p and the 110c for \$2.75, assuming a 13.4 volatility for YUK

	10.4 vol	13.4 vol	16.4 vol
106p/110c	1.84	2.75	3.70



Strangles and volatility

- At expiration the YUK strangle will start to earn money at \$103.25 and 112.75
- Prior to expiry, the implied volatility will affect the profitability of the trade
- An investor would normally buy strangles when they felt the market might make a big move however they must balance that view with the debit of the trade



Differing prices?

- Market professionals use slightly different pricing models, creating opportunities to trade
- When prices are too high (relative to your expectations) this simply means that there are more buyers than sellers.
- When prices are too low (relative to your expectations) this simply means there are more sellers than buyers
- Pricing differences are based on the aggregation of all market participants future expectations for volatility



Your Forecast: Volatility is “high”, and future volatility will be lower than today’s

- Buy call vertical or put vertical spread depending on your market forecast to mitigate volatility risk
- Sell out of the money call spread and out of the money put spread (iron condor) with balanced risk
- Sell straddles or strangles albeit with **substantially** more downside risk
- Buy butterfly spread, buy in the money spread and sell at the money spread (buy 106c, sell 108c, sell 108c buy 110c. The 2 month butterfly was quoted at approximately \$0.30 in the previous example)

Your Forecast: Volatility is “low”, and future volatility will be higher than today’s

- Purchase calls or puts, purchase out of the money call spreads or put spreads
- Buy ratio spread, buy two out of the money options, sell one at the money
- Buy straddles or strangles hoping to realize increased stock volatility (breakouts) or increased implied volatility

Changing FX parameters

Increase input	CALL PRICE	PUT PRICE
Strike Price	Down	Up
Exchange rate	Up	Down
Time Until Expiration	Up	Up
US rate - foreign rate	Down	Up
Volatility	Up	Up



Assumptions for Option Models

- Exchange rates are efficient creating a lognormal distribution
- The interest rate differentials are constant though the term structure (They actually deviate slightly throughout the term normally)
- Early exercise is not possible (American style options allow early exercise) This assumption is true for ISE FX options
- Volatility is constant (Not always true, especially during stressful market periods)
- Markets do not gap (Markets do gap creating difficulty for delta neutral hedging). Gaps are much less likely in foreign exchange markets, but the ISE FX options only trade from 9:30 until 4:15 EST

Who cares about all this?

- Due to variances in interest rates and volatility, options have extrinsic values as well as the more apparent intrinsic value
- Gaining a better understanding of options pricing allows investors to understand the risk/reward tradeoffs
- Pricing is based on the theory that markets are random and efficient
- The Black Scholes model and similar models help give investors guidance on option pricing; it does not **guarantee** a certain options price



Summary

- The Black-Scholes option pricing model and similar models calculate theoretical prices based on exchange rate, strike price, time left until expiration, interest rate differential and volatility
- The interest rate differential and the volatility of the pair are vitally important when trading ISE FX options

Summary

- Implied volatility impacts options pricing in a meaningful way
- Learning spread trading can help mitigate implied volatility changes
- A better understanding of the pricing model inputs can help you incorporate your own market expectations with your own risk/return tradeoffs

Commonly asked questions regarding ISE FX Options

- Do the “greeks” work? Yes, if an investor inputs the correct interest rate and dividend yield (US risk-free rate) option calculators will work and of course the volatility will affect the price computed
- Can I get volatilities for the ISE FX pairs? Yes, ivolatility.com has the data on their site
- How much do these options cost? Same as equity options, \$1.50 options costs \$150
- How does cash settlement work? If the exchange rate is above the strike price (calls) or below (puts) at expiry, the options have intrinsic value. (i.e. If an investor holds a 100 put and CDD closes at \$97, the option is worth \$3 and \$300 is deposited into your account at expiry)
- How does the term “pips” relate to ISE FX Options. Roughly speaking 100 pips equals 1 ISE point
- What does “dollar relative” mean? The base currency is the US dollar, if the US dollar increases relative to the foreign currency, the value of the pair increases; if the dollar decreases, the value of the pair decreases



Future ISE Webinars 4:30 EST at www.ise.com

- **January 15** Steve Misic - FX Trading based on supply and demand
- **January 16** Tom Busby - Demystifying the Trading Environment for FX Options
- **January 23** Kathy Lien - The Most Effective Strategies for Trading the Currency Market

International Securities Exchange



INTERNATIONAL SECURITIES EXCHANGE®