Steve Meizinger

Understanding the FX Option Greeks

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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

Initial ISE FX Offerings

- USD/EUR (ticker symbol, EUI): 67.97 (0.6797 x 100)
- USD/GBP (ticker symbol, BPX): 48.85 (0.4885 x 100)
- USD/JPY (ticker symbol, YUK) 111.68

  (111.68 x 1) the rate modifier is 1 for JPY
- USD/CAD (ticker symbol, CDD) 110.61 (1.0061 x 100)

The dollar has dropped recently

	7-31	12-10	Change
CDD	106.61	100.61	6.0%
YUK	118.53	111.68	5.7%
EUI	73.07	67.97	6.9%
BPX	49.34	48.85	0.1%

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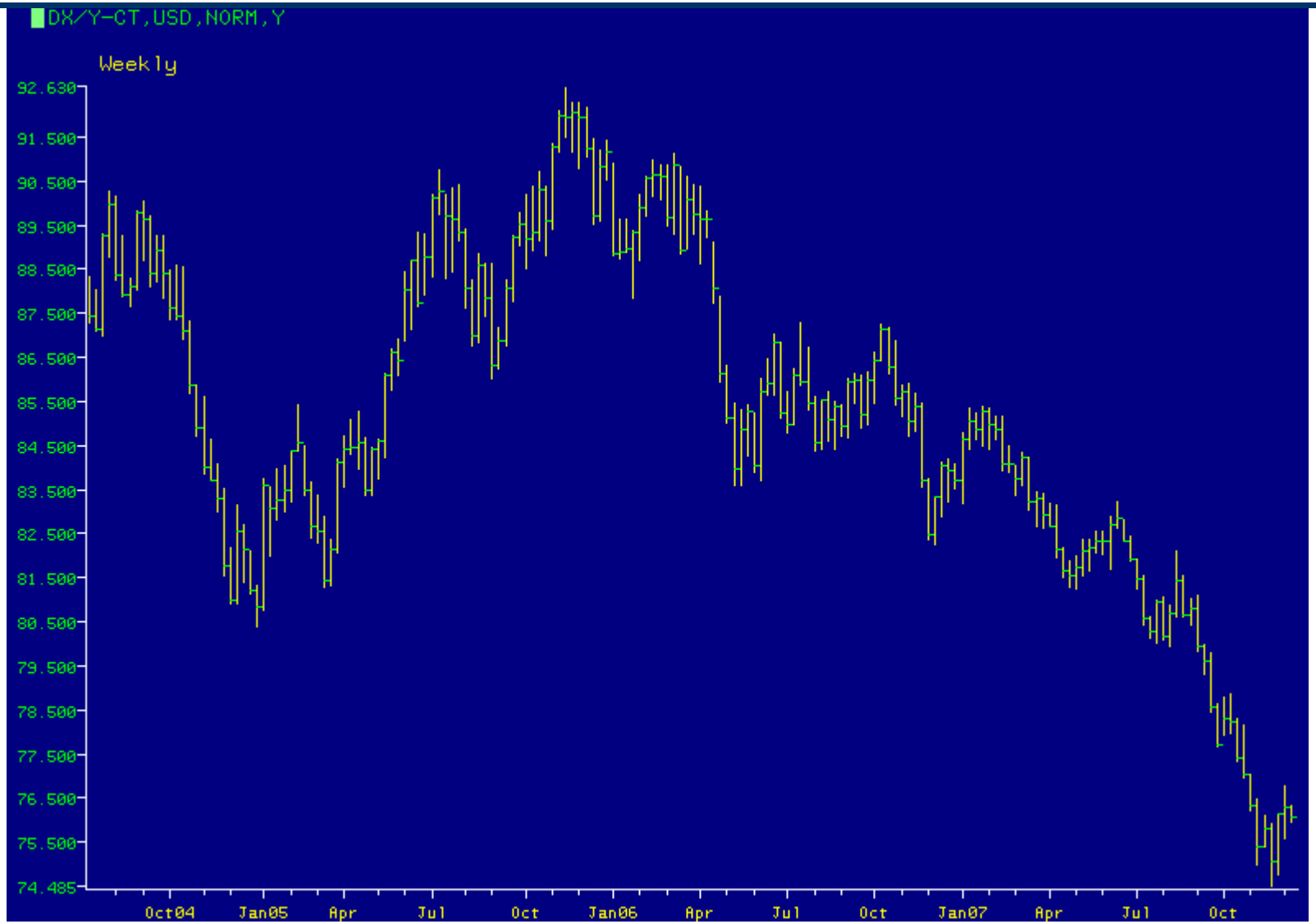
The US dollar index DXY



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CDD has been moving a bit

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A Further Understanding of Option Premiums

- The relationships between the underlying price, the strike price, the amount of days remaining in the option's life and the volatility and the interest rate differential of the currency pair are very important in FX options pricing

Option Greeks, what are they?

- The measure of the sensitivity of an option's price to different factors
  - Delta
  - Gamma
  - Theta
  - Vega
  - Rho

Delta, Gamma, Theta

- *Delta*- The change in the option's value for every one unit change in the underlying (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 exchange rate moves up 1 unit and call delta was .52, new call delta will be .59

Delta, Gamma, Theta

- *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 stock opens the next day unchanged, the new theoretical value is $3.3

Review of Vega and Rho

- *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

Risk-free rates are important

- *Standard definition for 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

- The interest rate differential is very important when trading FX options. The appropriate risk-free rates must used when calculating options values

Let’s first focus on delta and gamma and theta

- Why Delta, Gamma and Theta?
- These three Greek “Risk Gauges” are very closely interrelated
- Due to the potential for price gaps options have what’s called convexity
- The greater the convexity, the greater the Gamma for options allowing for the Delta to change more rapidly
- The delta of the option changes if the underlying changes enough during the time period selected

Delta, Gamma and Theta

- What is enough underlying price movement that would move the option?
- It depends on the strike price, the time remaining and the volatility
- The greater the convexity the greater the Gamma
- Why not purchase maximum Gamma?

Delta, Gamma and Theta

- When you purchase Gamma you are purchasing leverage (also called potential delta)
- If the underlying asset does not move the purchase of leverage depreciates (Theta)
- Gamma manufactures Delta, Gamma gives the option “acceleration,” but with a cost
- Think of the metaphor of the four cylinder car and eight cylinder car, which one has better acceleration which one has better gas mileage?
- Gamma gives leverage, but with an additional cost

Delta, Gamma and Theta are dynamic

- Differing options have different Gammas
- Options have the most Gamma at the strike price on expiration day
- Far-out-of-the-money options and in-the-money options have much less Gamma
- Theta and Delta are also dynamic

Practical use of Delta, Gamma and Theta

- Delta is the approximate value that the option should move given a unit move in the underlying
- Gamma is the approximate change in Delta of an option given a one unit change in the underlying
- Theta is the approximate time erosion per day for an option

Gamma

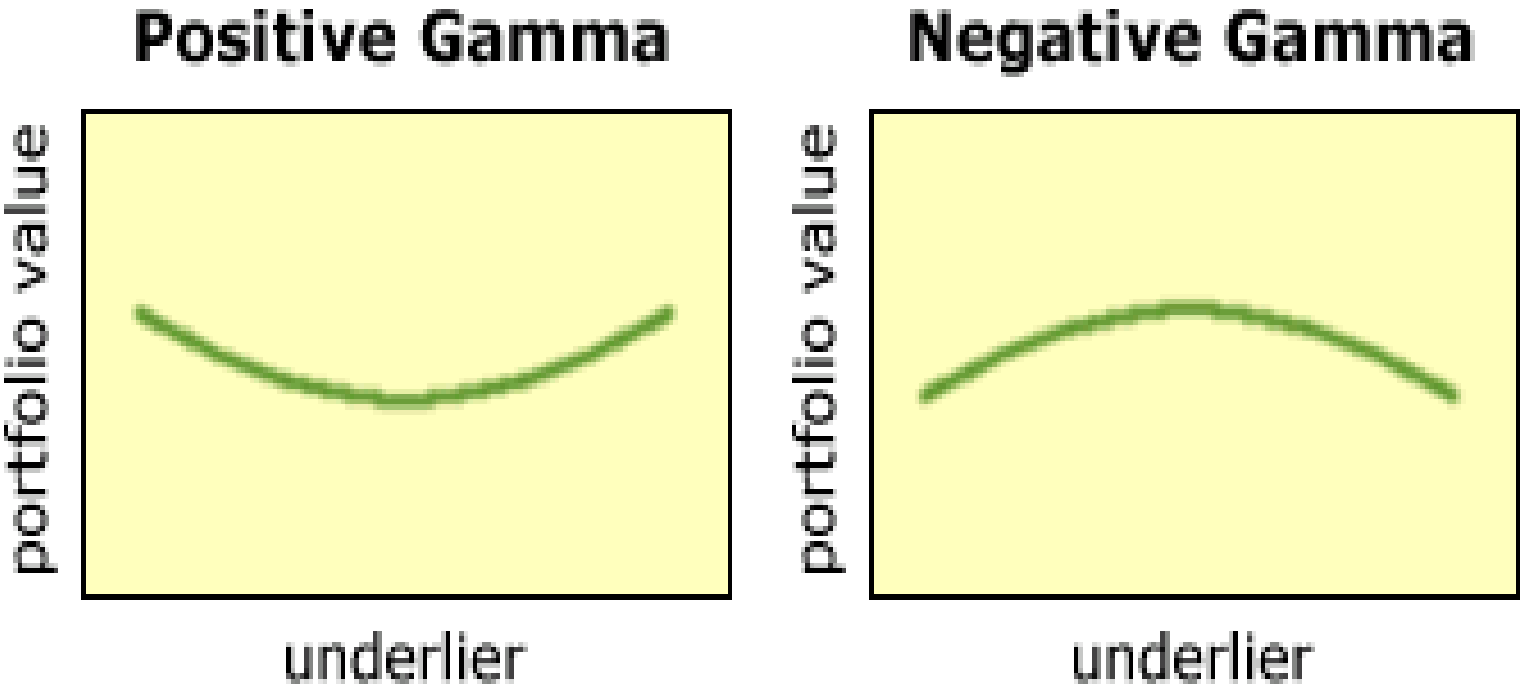
- From a practical sense, you add or subtract the gamma for each point that the underlying moves
- Long calls and puts have long gamma and short calls and puts have short gamma
- Calls and puts with the same strike have identical Gamma
- Gamma is also increased for ATM option if volatility decreases in the marketplace

Gamma for either long calls or long puts

- Positive (or long) Gamma manufactures positive Deltas when the stock goes up and negative Deltas when stock goes down

- Negative (or short) Gamma manufactures negative Deltas when the stock goes up and positive Deltas when the stock moves down

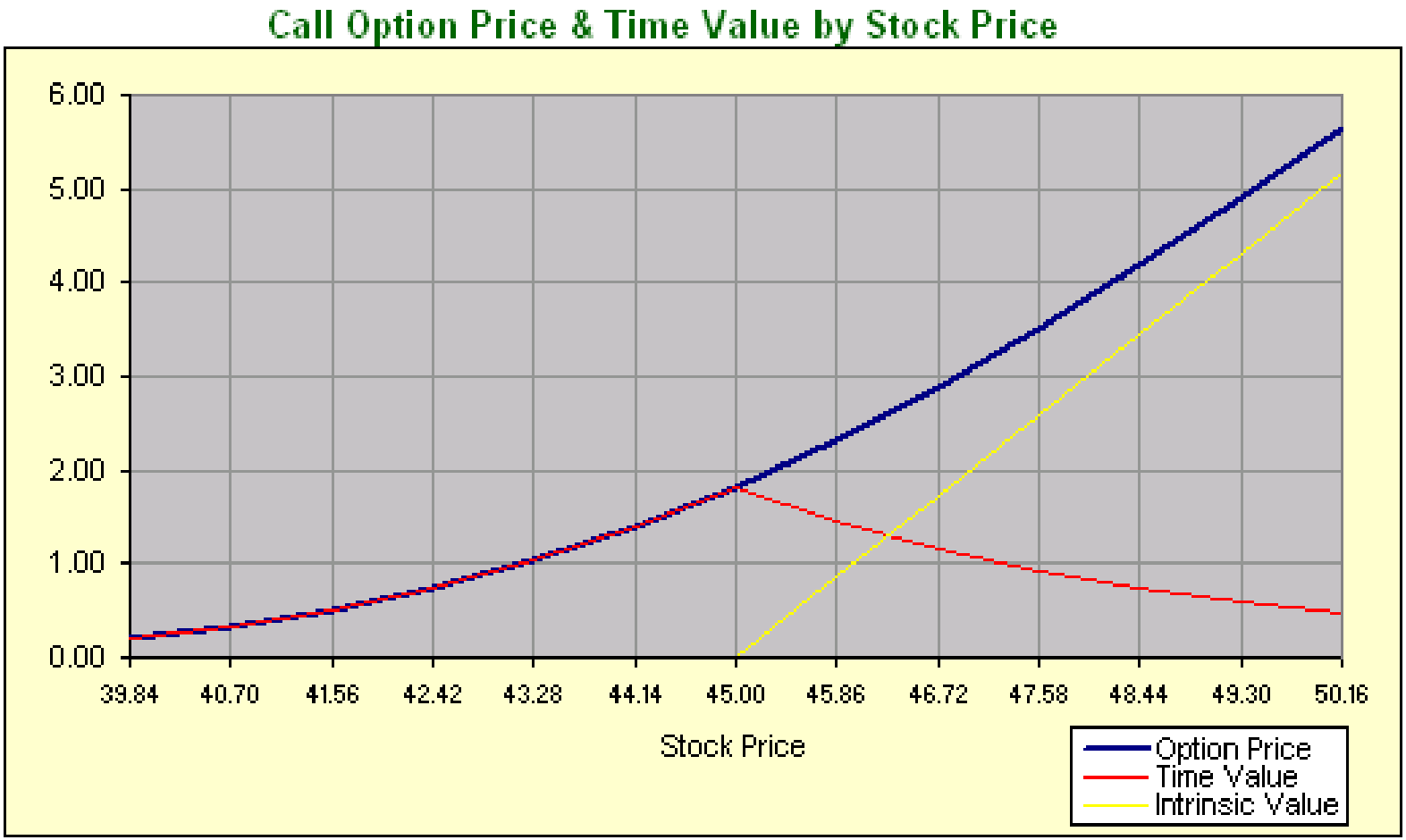
Graphing positive and negative Gamma



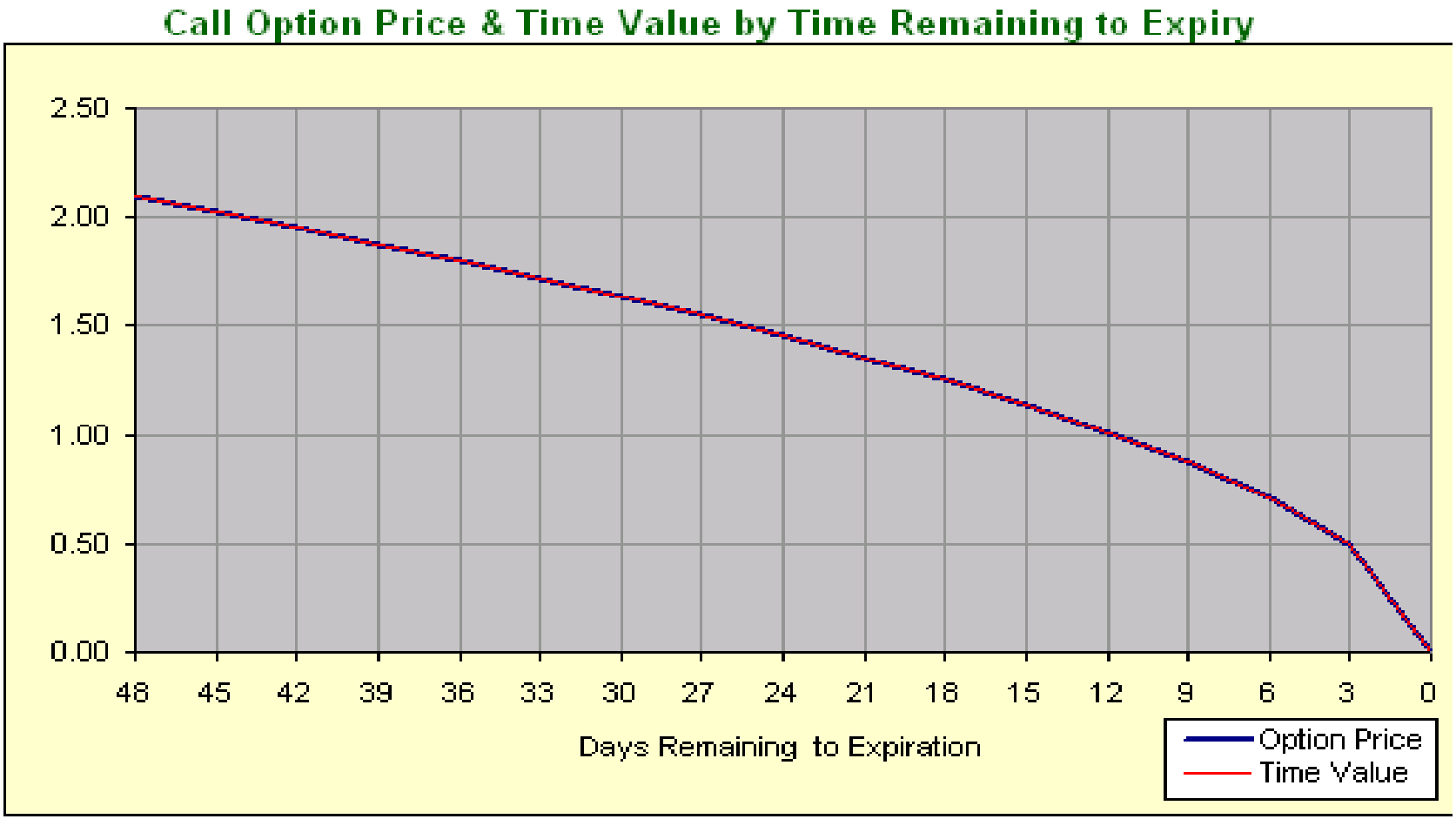
Delta, Gamma and Theta

- Positive Gamma has negative Theta
- Theta measures how much an option loses per day
- Theta is also called “time decay”
- Long options have positive Gamma but negative Theta (the cost per day of holding the option)

Call Option Price & Time Value

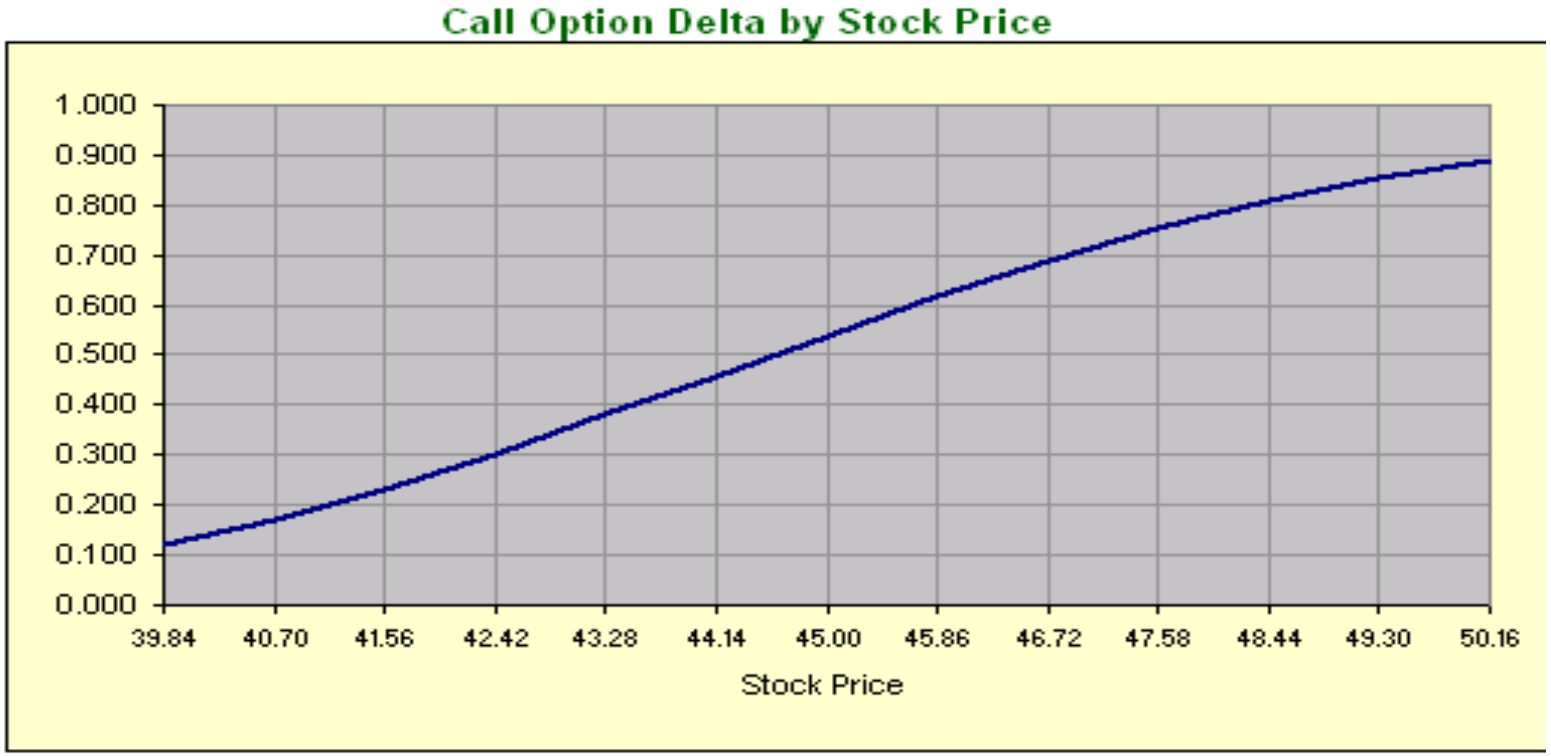


Option prices depreciate as time goes by (assuming an unchanged underlying price)

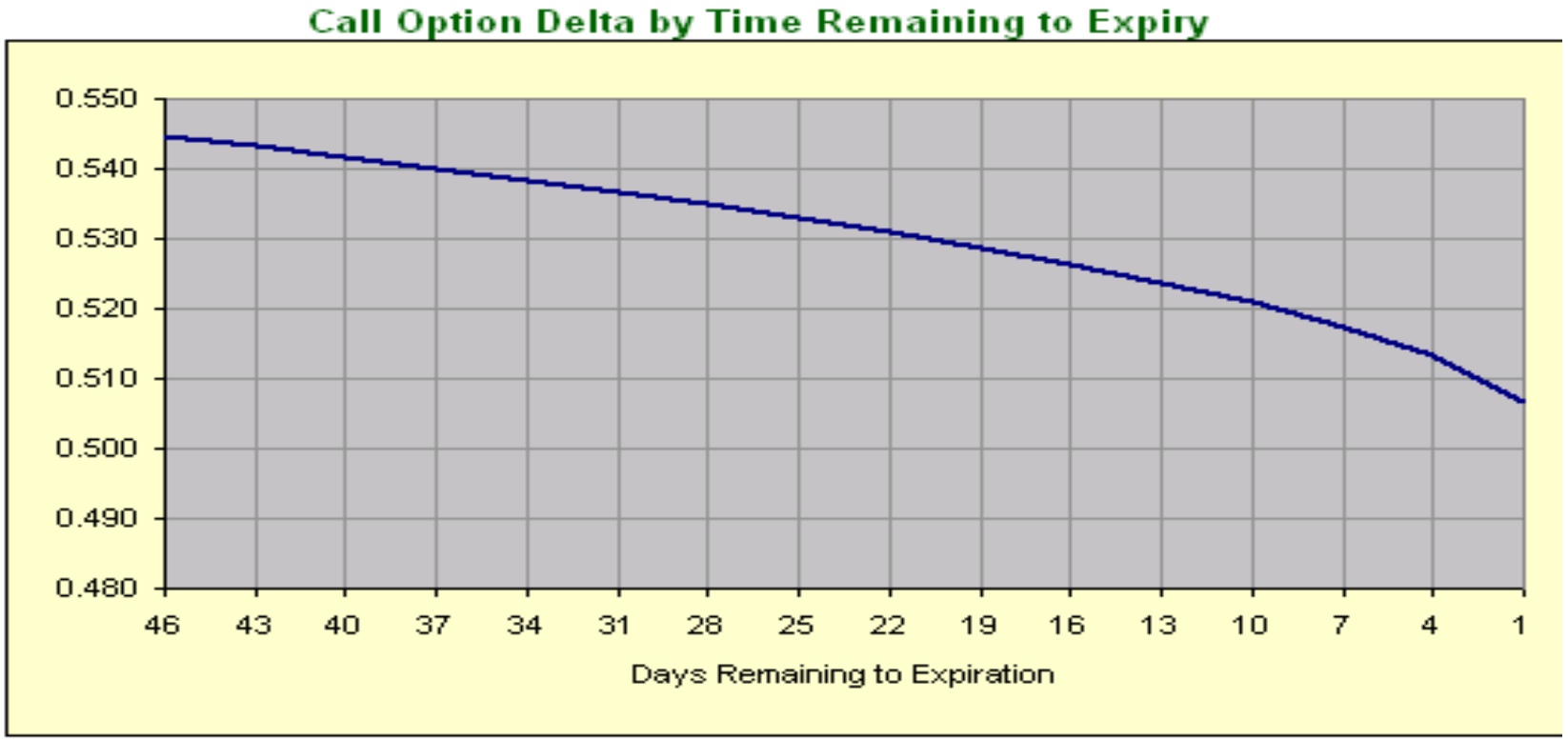


Call option Delta

Assuming all other factors remained constant

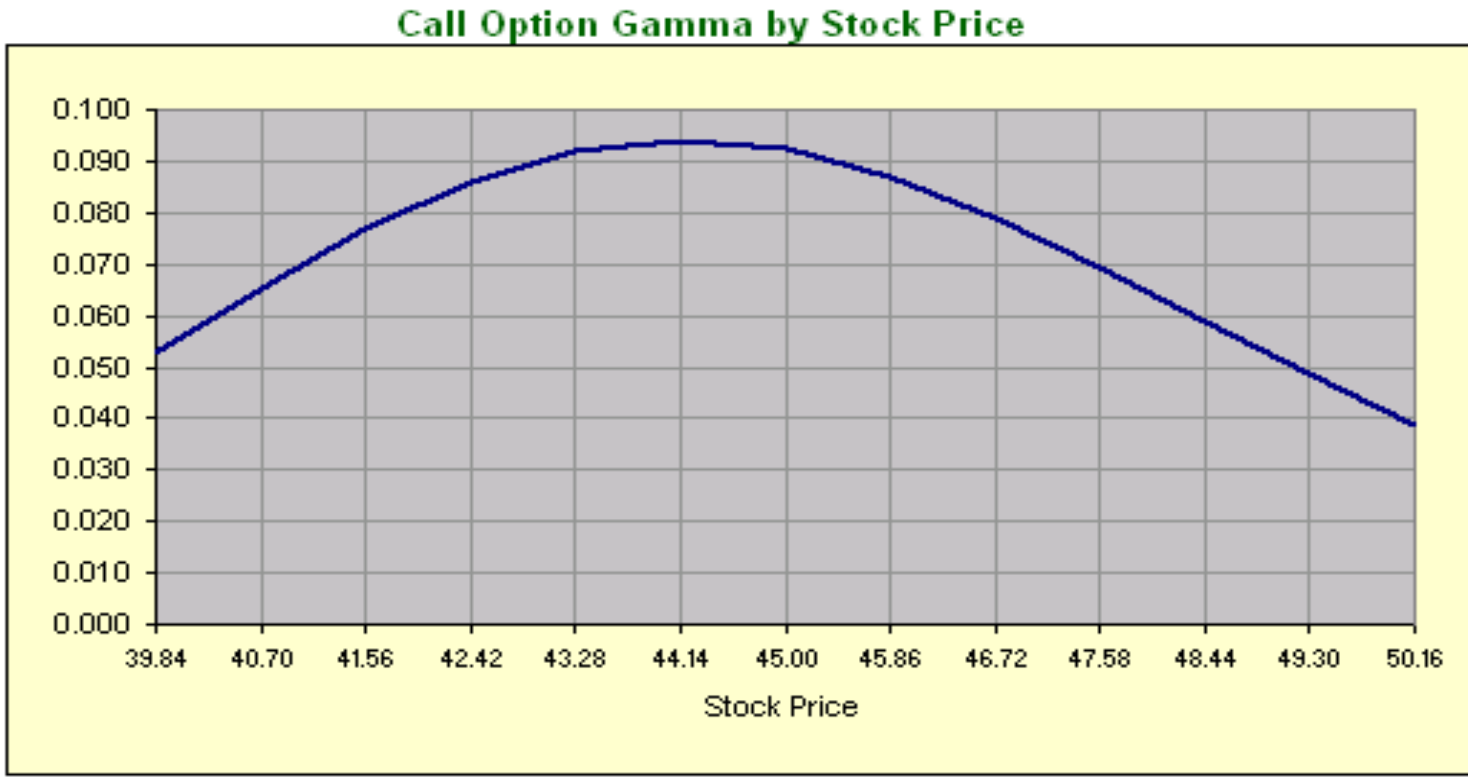


Call Delta stays relatively constant (ATM), until expiration

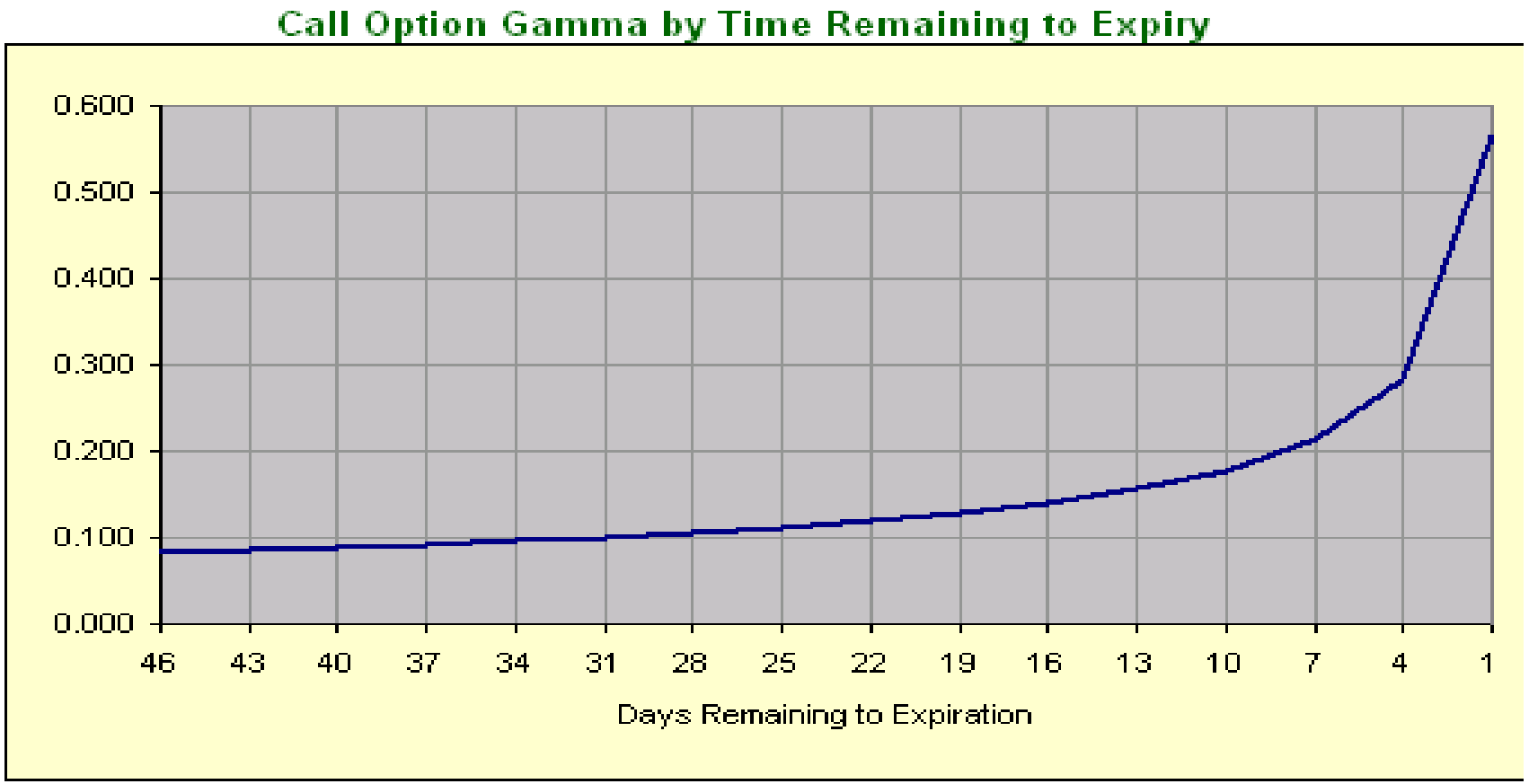


Call option Gamma

Assuming no change in any other pricing input

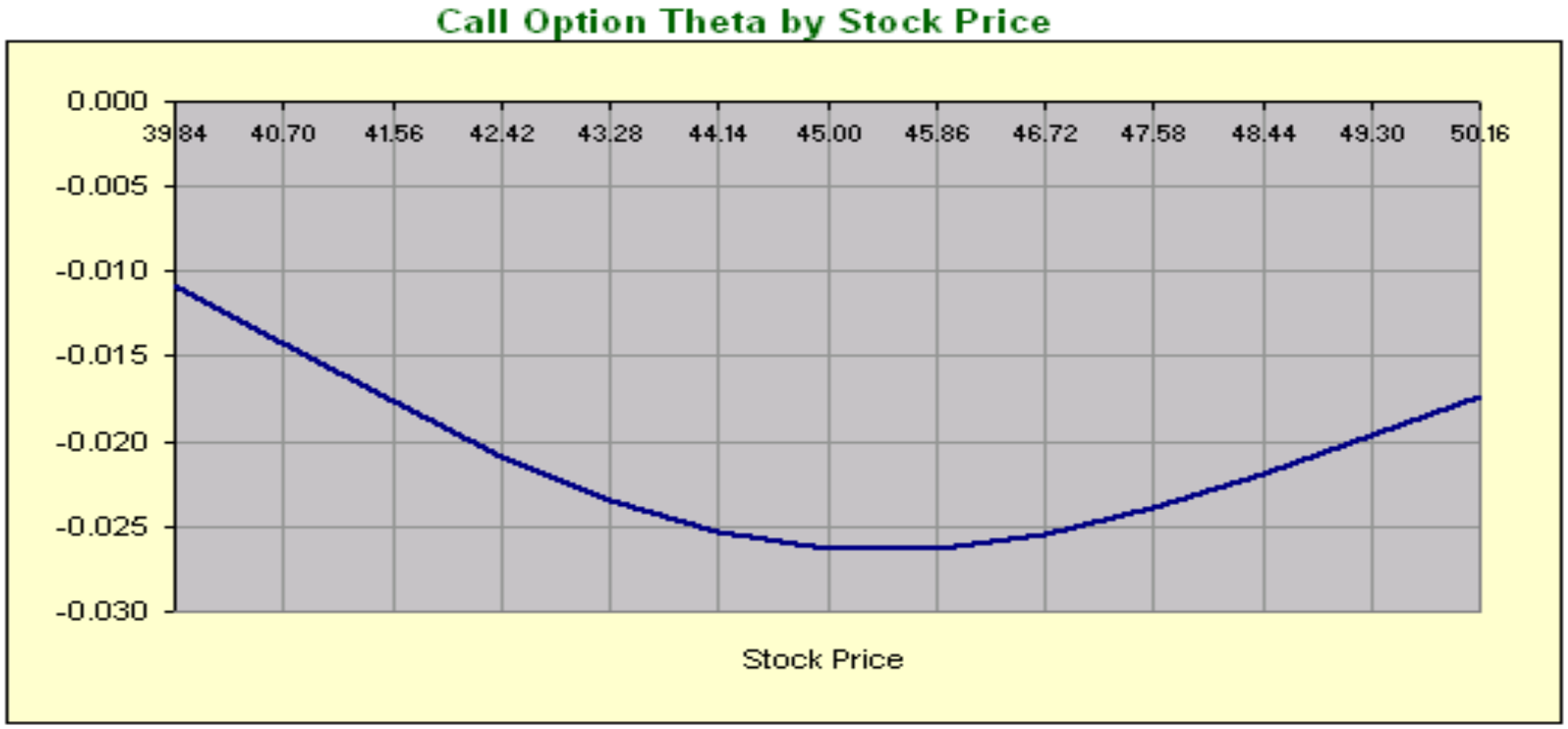


Gamma increases as time goes by (ATM)

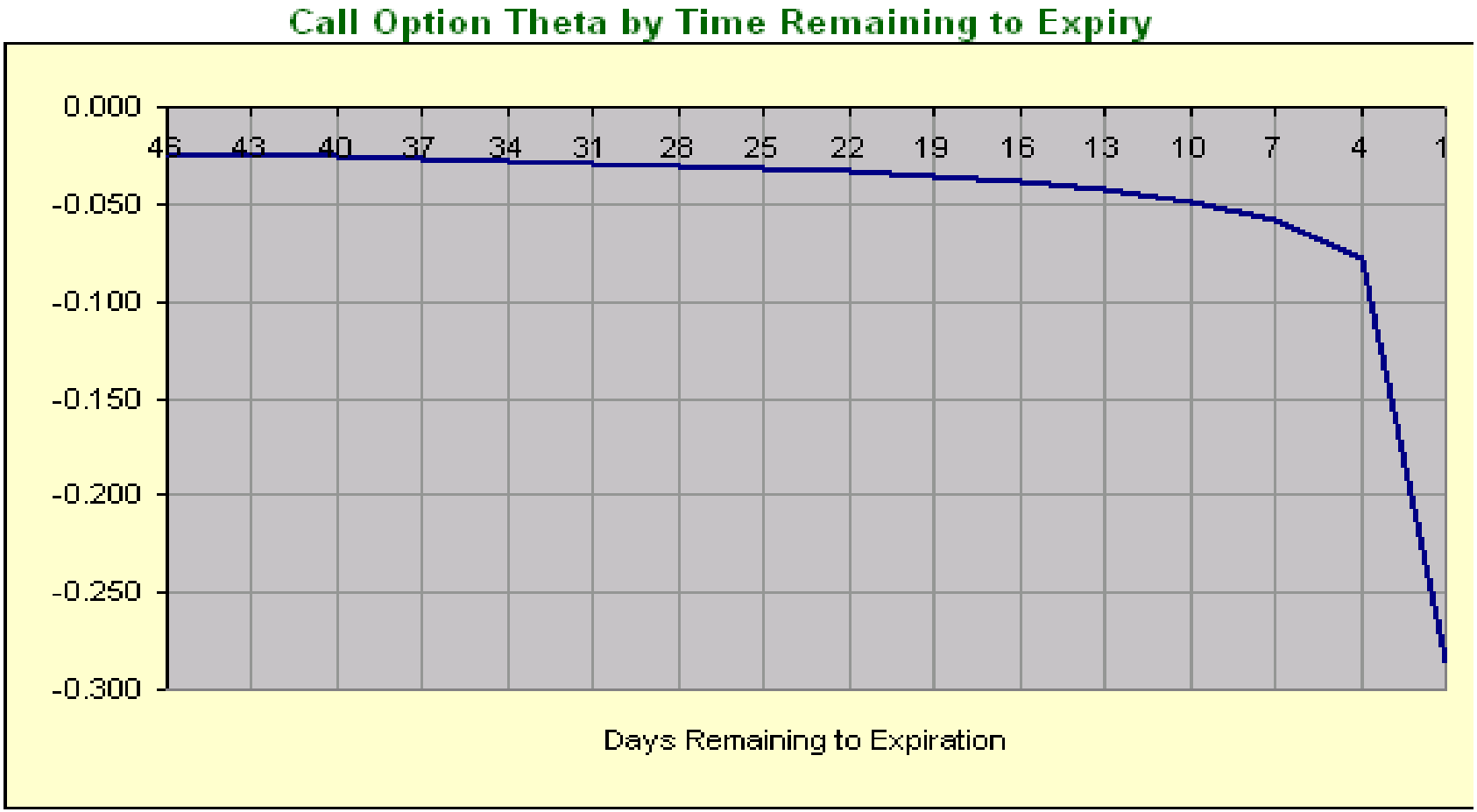


Call option theta

Assuming no change in any other pricing input



Theta increases as time goes by (ATM)

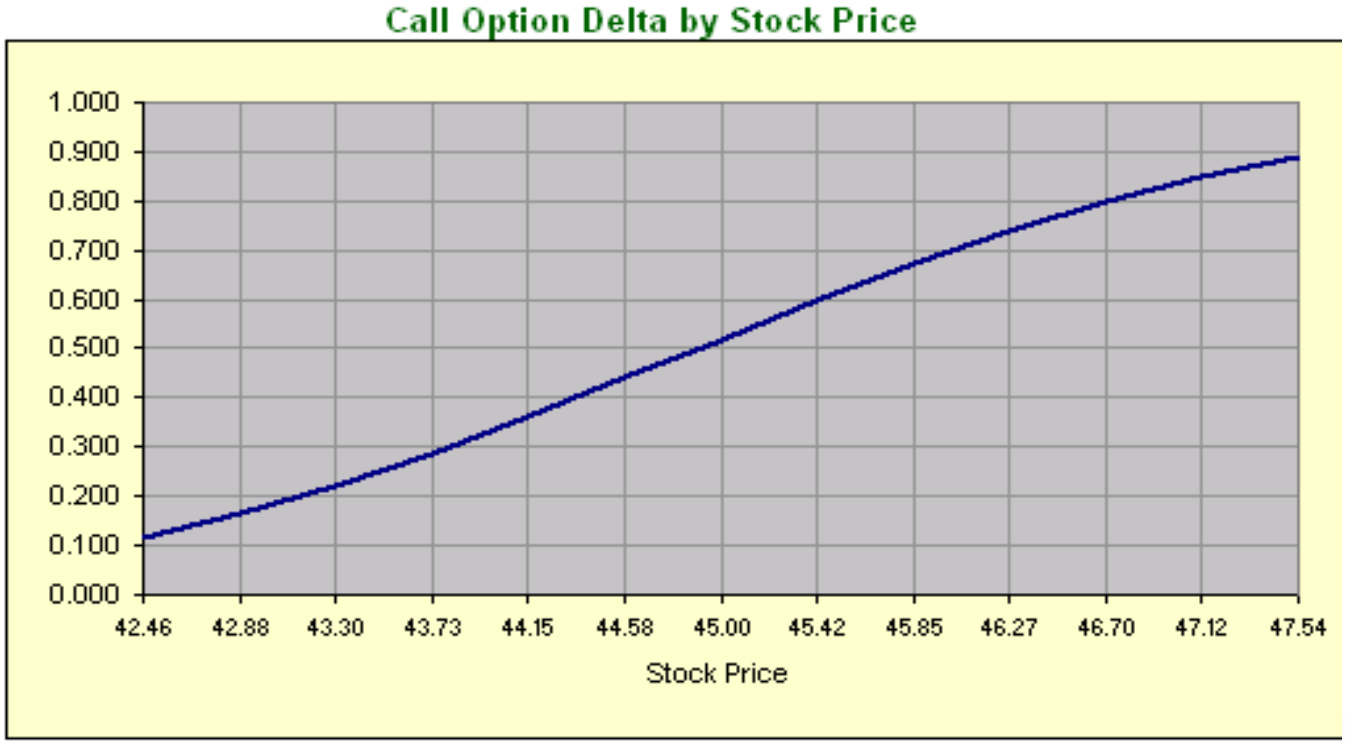


Call Option Price & Time Value

Assuming only 9 days left until expiration and no other pricing input changes

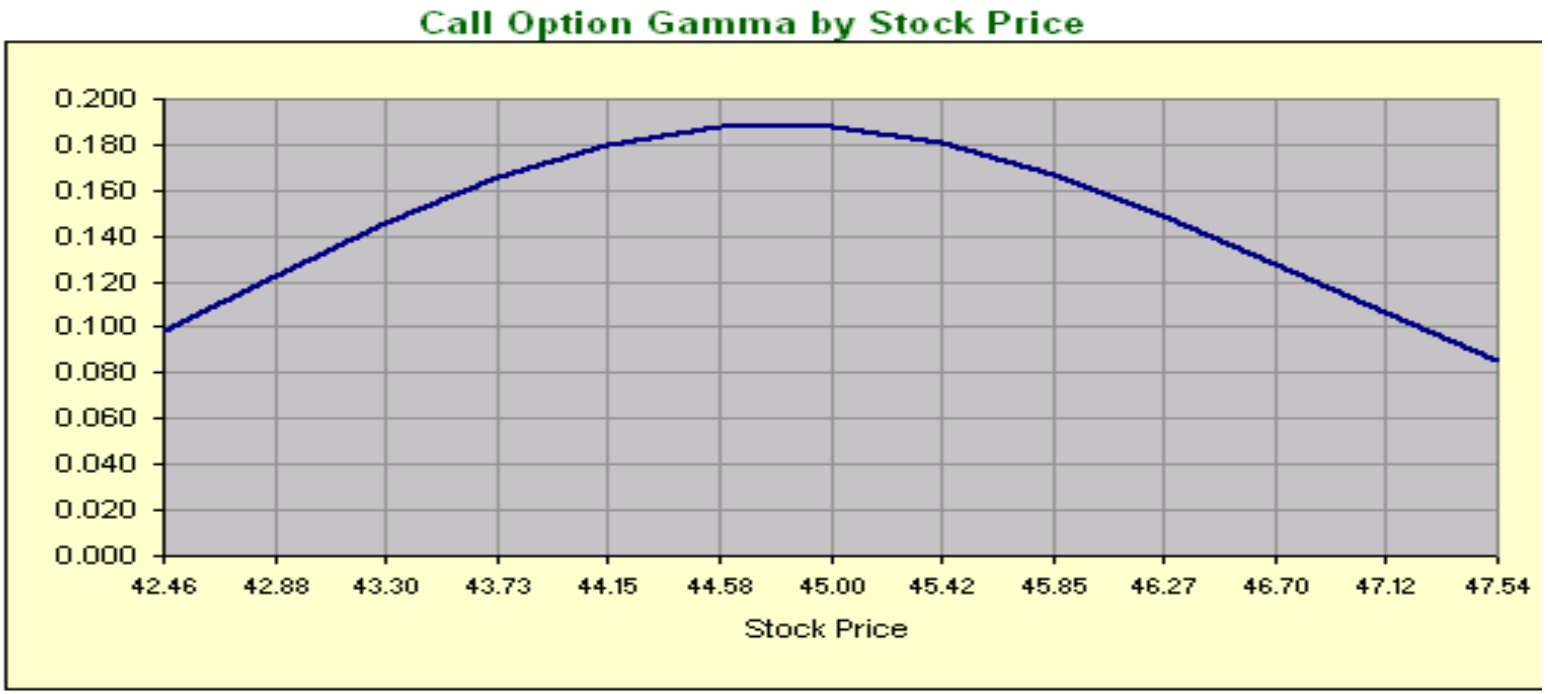
Call option Delta

Assuming only 9 days left until expiration and no other pricing input changes



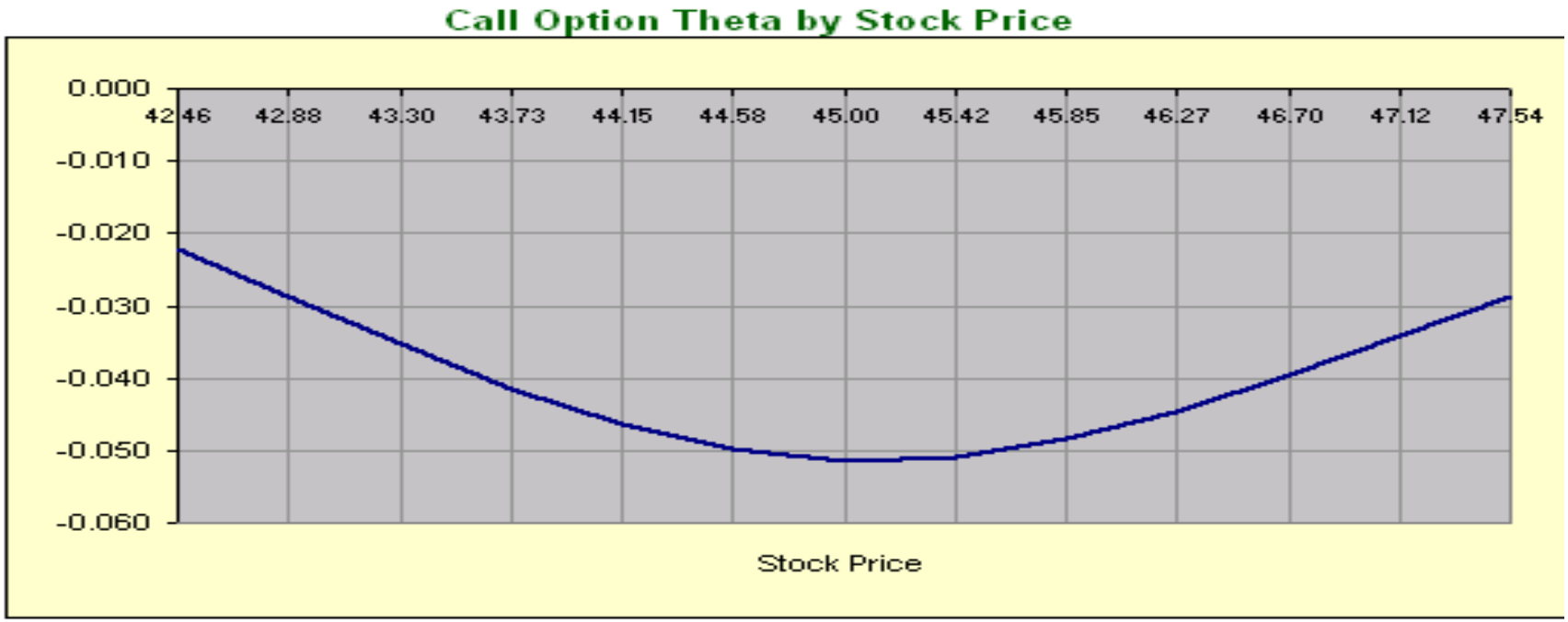
Call option Gamma

Assuming only 9 days left until expiration and no other pricing input changes



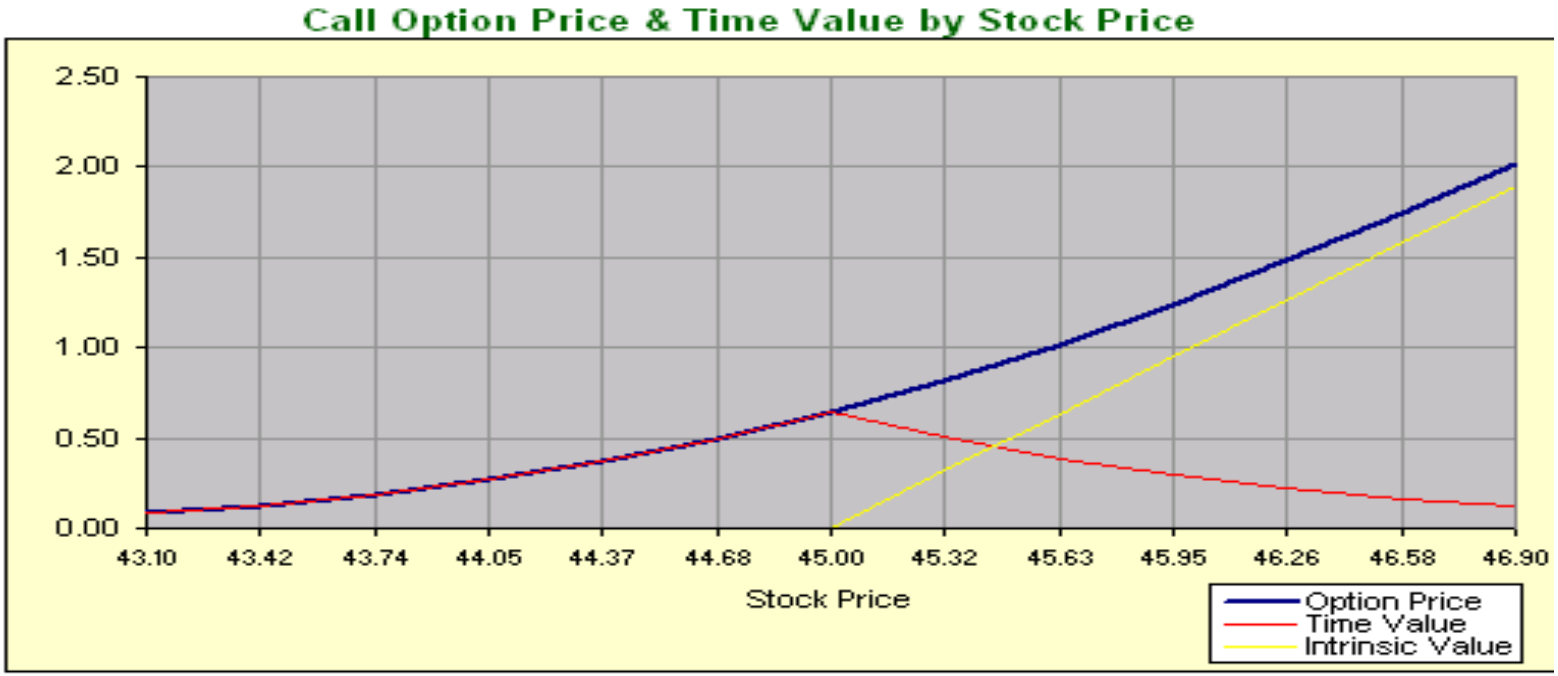
Call option Theta

Assuming only 9 days left until expiration and no other pricing input changes



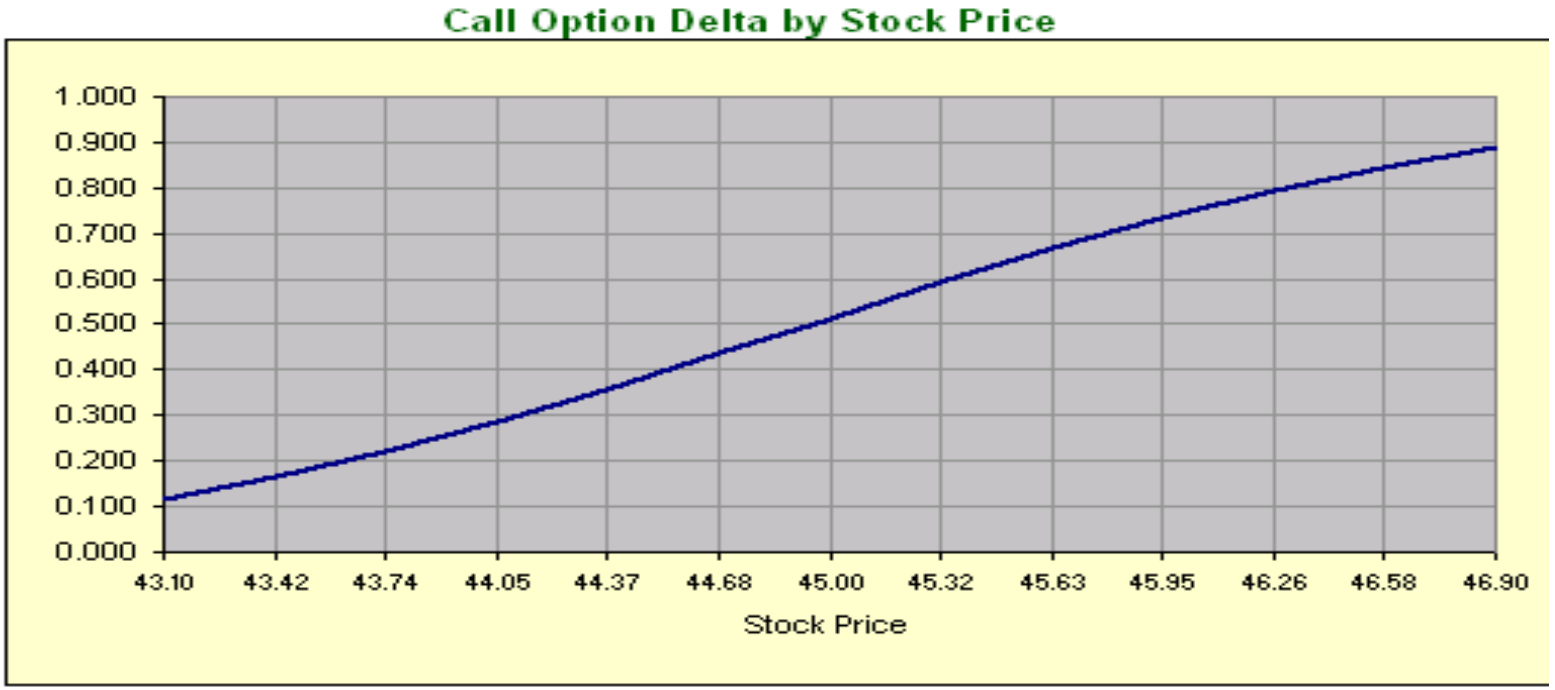
Call Option Price & Time Value

Assuming only 1 day left until expiration and no other pricing input changes



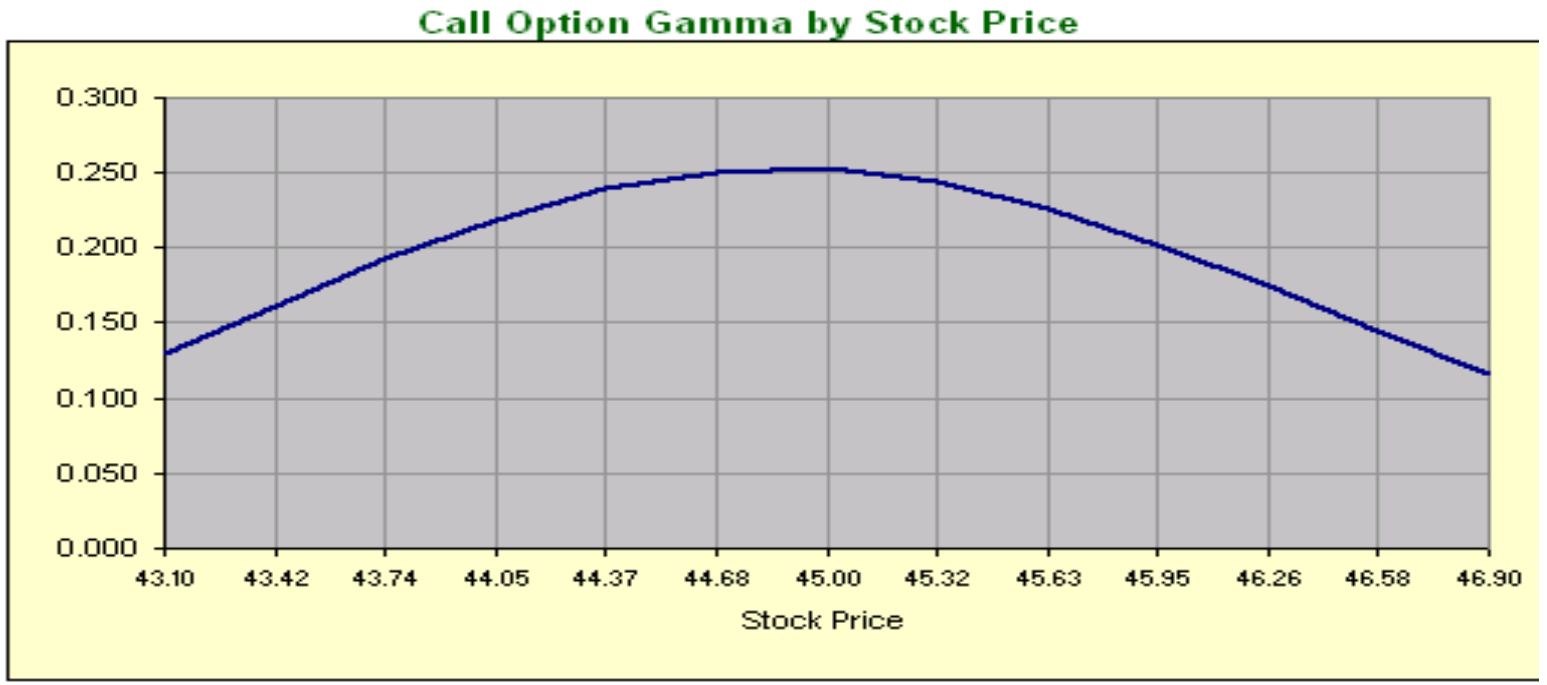
Call option Delta

Assuming only 1 day left until expiration and no other pricing input changes



Call option Gamma

Assuming only 1 day left until expiration and no other pricing input changes



Call option Theta

Assuming only 1 day left until expiration and no other pricing input changes. Theta increases much more dramatically as expiration nears

Let’s focus on Vega

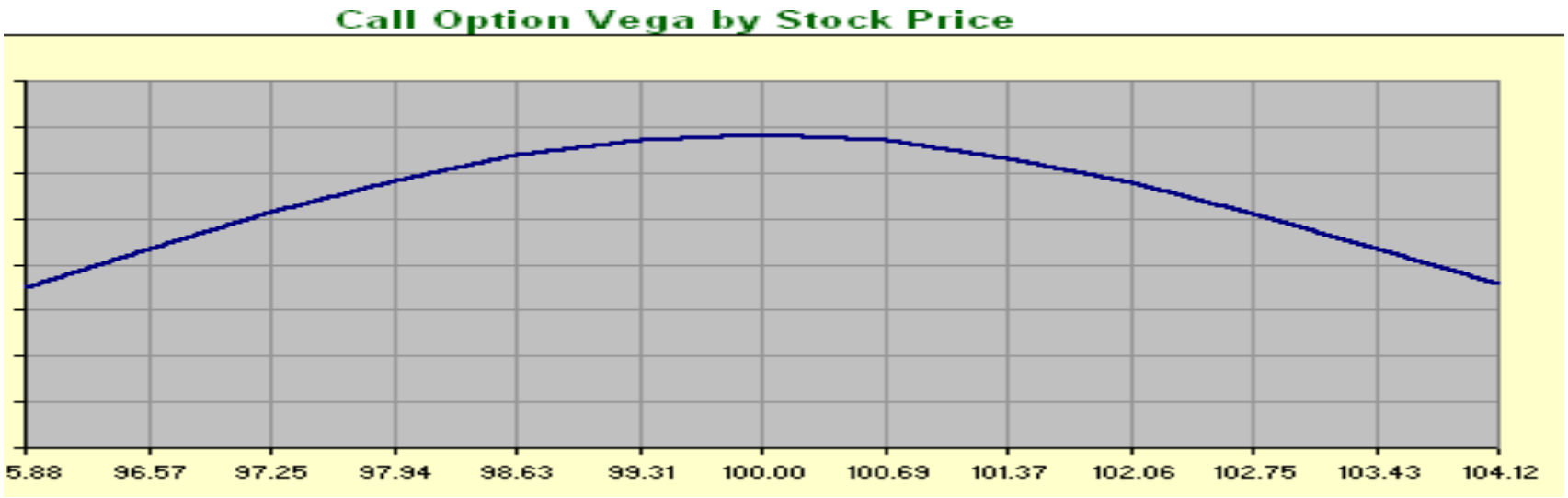
- Have you ever seen an option’s price change unexpectedly even though the underlying did not move dramatically?

Option Vega

- Why is this important to understand?
- Does volatility change during the life of an option?
- Which strike prices are most impacted by changing volatilities?
- Are call and put Vegas at the same strike price equal?

Vega

Vega is greatest at the strike, with the most time left until expiration



Volatility is assumed to be constant

- In the “real world” volatility changes as risk perceptions change
- Options theory was based on static volatility, options market prices “risk in” to options changing the prices
- Volatility is one methodology of inferring risk from the currency markets
- The higher the volatility the greater the perceived risk of the currency pair

Market Risk

- Markets price risk each day, the greater the perceived risk, the greater the potential reward
- If the market is pricing in large volatility the market expects large moves in one direction or another
- Changing volatilities will affect the option premiums

Implied Volatility

- Implied volatility is the estimate of the future volatility of the security's price
- Professionals often reverse-engineer from the options marketplace to see what the implied volatility of an option is
- Given the price of an option and all other pricing inputs (security price, strike price, time, interest rates) except volatility, you can solve for the implied volatility of that option

Implied Volatility

- Implied volatility can give investors the marketplace's best approximation of future underlying volatility
- Implied volatility often changes prior to government financial releases. Also during market turmoil volatility is normally elevated
- Vega measures how much an option can change based on changing volatilities

Understanding Vega risk

- Prior to implementing your market forecast using an option strategy you may want to ascertain the Vega risk of the trade
- Where is the implied volatility currently in the marketplace?
- What has the range been in the last year?
- How much risk does my strategy have if my volatility forecast is wrong?
- How much profit potential does my strategy have if I am right?

Balancing Risk and Reward

- Investors must balance their own financial goals and their own risk tolerances
- Implementing a strategy usually involves a price forecast for the security during a certain period of time and the magnitude of the price move must also be considered
- The likelihood of volatility change should also be considered

Effect of Interest Rates (Rho)

- Strike price * risk free interest rate * days until expiration = “cost of carry”
- The interest rate differential will dictate if the calls or the puts are more “expensive”
- The higher the value of the exchange rate the more the “carry cost”
- The more time remaining until expiration the more the “carry cost”

Rho measures the interest rate risk

- The interest rate differential is of vital importance for FX markets and specifically for ISE FX Options
- Rho measures the interest rate risk based on a 1% move in the risk-free interest rates

Cost of money

- Since ISE FX options are dollar relative an investor must use the proper interest rate and dividend yield
  - **The "dividend yield" is the US risk-free**
  - **The "interest rate" is the contra currency risk-free interest rate**
  - The options Rho measures the interest rate risk for each specific option

Forward pricing

- *An interest rate is nothing more than a mathematical relationship that maps a present value to a future value or vice versa*

- This interest rate differential for foreign currency pairs may create a different forward price relative to the “spot” or cash price

Forward pricing

- In forward pricing the difference between the risk-free interest rates will create the forward price
- **If** the US interest rate is higher than the contra-currency the puts will reflect this relationship by increasing in value relative to the calls
- The current best example of this is YUK, US dollar/Japanese yen, the difference in short-term interest rates is currently approximately 4.25%

Effect of Volatility

- According to option pricing theory, the greater the potential for volatility the greater the theoretical value of options
- “Potential” is measured by probabilities
- Volatility is normally measured by annualized volatility numbers

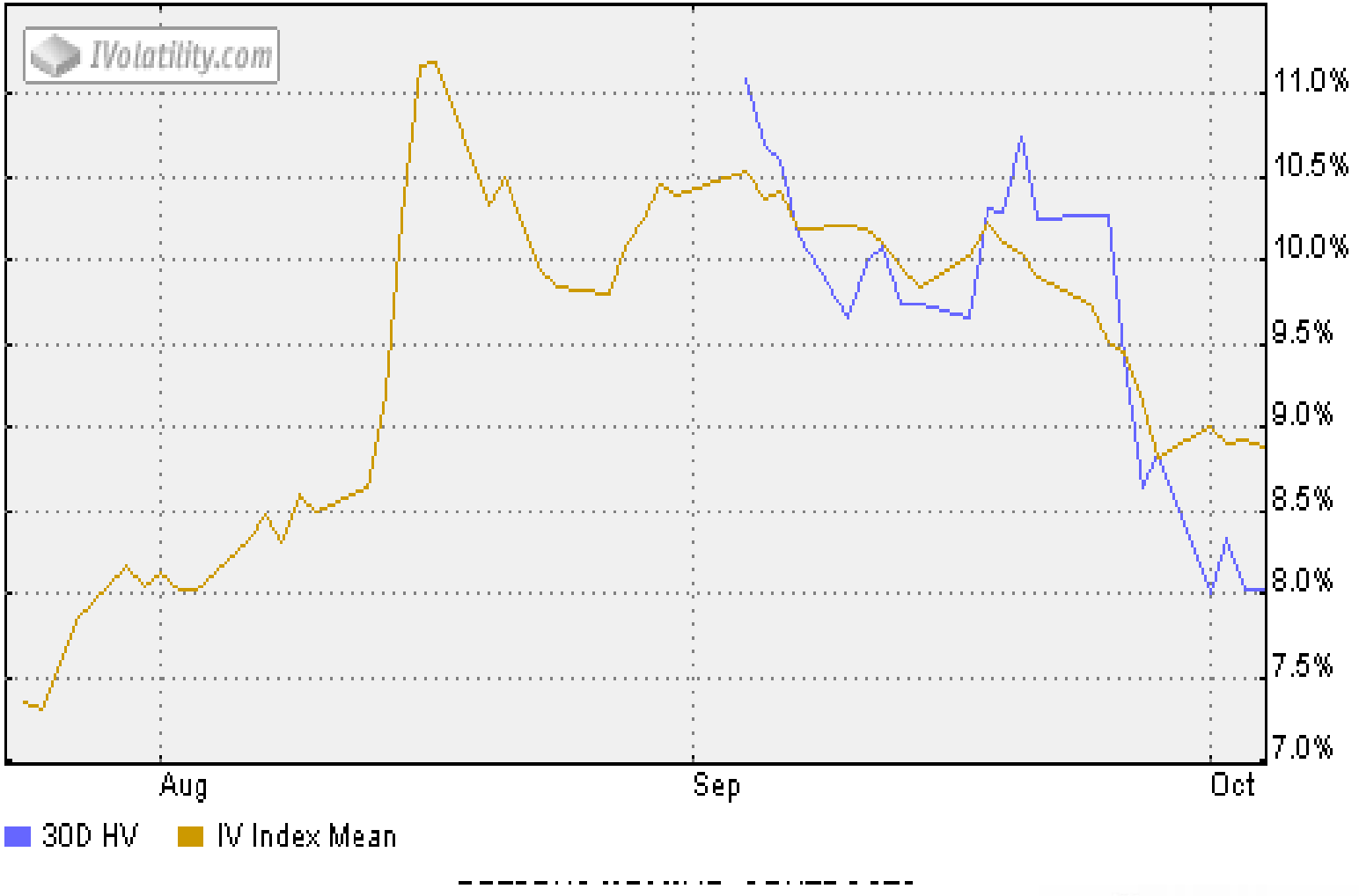
Annual Volatility, what is it?

- If an exchange rate of 100 has a 10 volatility what does that mean?
- Based on statistics this means that within one standard deviation the exchange rate's expected range for the next year is down $10.00 to up $10.00
- Two and three standard deviation measurements could also be calculated

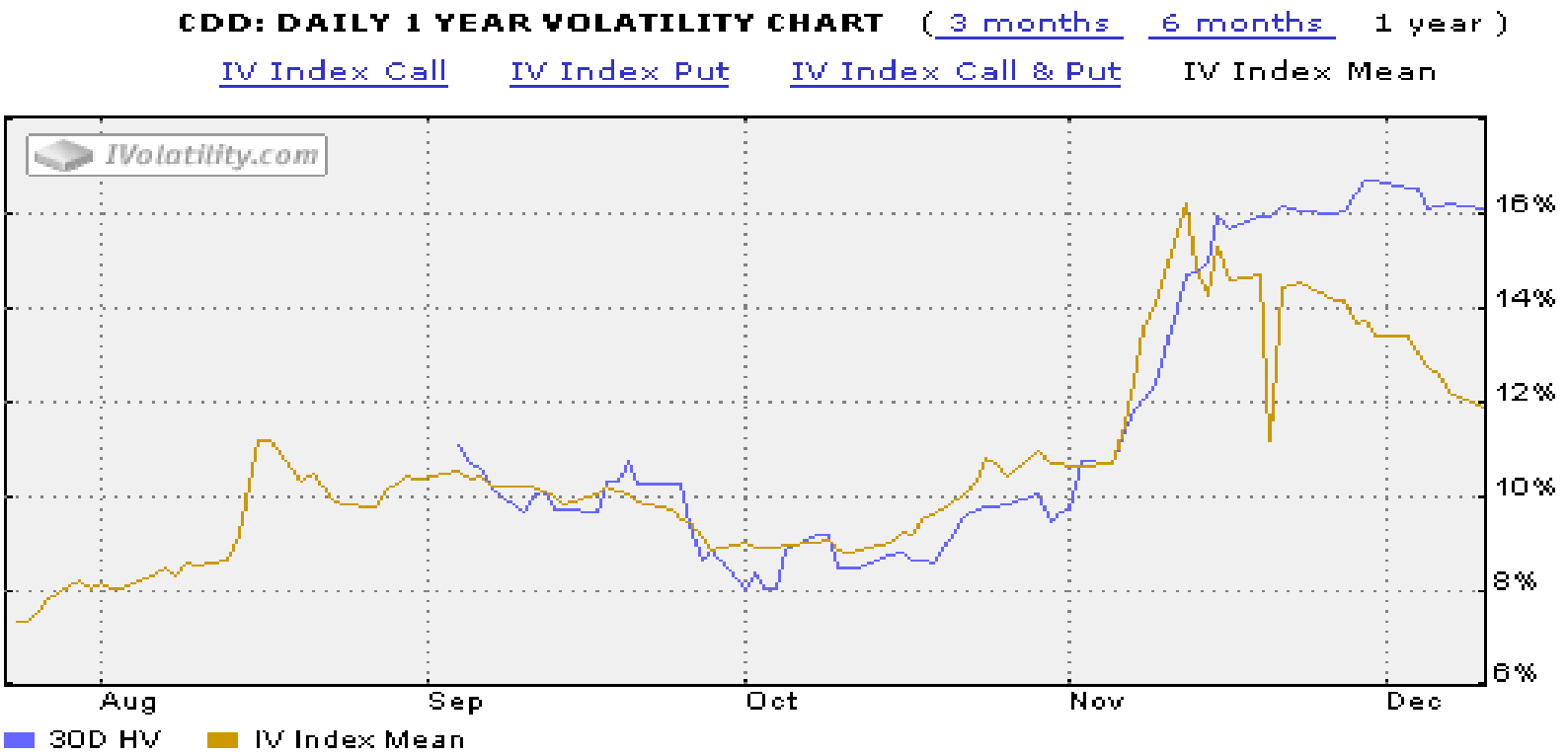
Vega risk

- Call and put Vegas are equal at the same strike prices
- There is no inherent advantage to trading calls or puts based on Vega risk

CDD implied volatility



More recent data for CDD



Comparing call and put Greeks

- Put and call gamma and vegas are identical
- As a rough rule, call delta aggregated with put deltas should equal approximately 100 or 1.00
- Due to the differing cost of carrying a designated position the theta and rho greeks will be different
- One other thought, normally each strike price will display a slightly different implied volatility due to supply/demand considerations

CDD 43 Day Call Greeks CDD 99.70

	Mkt value	Theo value	Delta	Gamma	Theta	Vega	Rho
96	3.90	3.87	.89	.06	.0046	.0607	.1004
98	2.25	2.26	.72	.11	.0105	.1140	.0819
100	1.10	1.08	.49	.13	.0132	.1356	.0539
102	0.45	0.41	.24	.10	.0105	.1049	.0271
104	0.15	0.12	.09	.05	.0055	.0541	.0101

CDD 43 Day Put Greeks CDD 99.70

	Mkt value	Theo value	Delta	Gamma	Theta	Vega	Rho
96	0.20	0.15	.11	.06	.0064	.0607	.1021
98	0.55	0.52	.28	.11	.0105	.1140	.0330
100	1.35	1.34	.52	.13	.0132	.1356	.0633
102	2.70	2.66	.76	.10	.0105	.1049	.0925
104	4.40	4.35	.91	.05	.0055	.0541	.1119

CDD recent example

- CDD value is 100.68
- 39 days until expiry
- Canadian rate is 4.9915
- US rate is 5.15

Call Greeks

Strike	Theo value	delta	gamma	theta	vega	rho
98	3.24	.75	.0776	.0154	.1029	.0773
100	1.88	.57	.1008	.0188	.1282	.0596
102	1.08	.38	.0913	.0199	.1249	.0398
104	0.49	.21	.0716	.0150	.0957	.0225

Put Greeks

Strike	Theo value	delta	gamma	theta	vega	rho
98	0.60	.24	.0776	.0162	.1029	-.0269
100	1.22	.42	.1008	.0193	.1282	-.0467
102	2.41	.61	.0913	.0202	.1249	-.0686
104	3.81	.78	.0716	.0150	.0957	-.0880

Importance of Volatility cannot be understated

- Differing implied volatilities relative to historic volatilities show the market's view on future exchange rate volatility
- These views are estimates of what the options market "expects" future exchange rate volatility to be
- The differences in historic and implied volatilities are not "right" or "wrong" but approximations of future volatility

Historical Volatility or Implied Volatility

- The implied volatility will determine the Vega not the historic volatility, since the implied volatility is the price where supply meets demand

- Of course each trading day the implied volatility is subject to change affecting the Vega of the option

Options Market is fairly efficient

- What are the trading opportunities?
- What are the challenges?
- The goal may be to try to make a forecast, then decide if the options market place will allow you a favorable risk reward transaction when implementing your view
- The option Greeks will help investors to further understand the risks and rewards of the strategies selected

High volatility (selling Vega) gives traders opportunities (assuming volatility decreases)

- Some strategies that would benefit from a decrease in volatility (Vega) are:

➢ Buying ATM or ITM vertical spreads
➢ Selling straddles, strangles
➢ Selling iron condors

High volatility can also create challenges

- If the underlying moves outside of its expected range losses can be incurred:

- Selling ATM or ITM vertical spreads
- Selling straddles or strangles
- Selling iron condors
- Buying calendars

High volatility can also create challenges for the more basic strategies

- Buying stand-alone call and puts can be problematic
- Due to the higher implied volatility and the corresponding higher Vega the underlying exchange rate must move further in your desired direction to earn a profit

Using vertical spreads can help reduce the risk of basic call and put strategies

- Depending on your forecast (bullish or bearish) call spreads might be the appropriate alternative strategy for reducing your Greek risks
- Buying debit call spreads or debit put spreads allow investors to hedge a lot of their Vega exposure
- Given a situation in which the implied volatilities are much different than under normal conditions, spreads are a viable solution, although with a capped profit potential due to the selling of the upside/downside option

Vega helps define the risk **of volatility change**

- Traders must consider their own financial goals while considering their own risk tolerances
- As implied volatility changes from the normal range, the risk of the trades increases along with the potential rewards
- Investors should always remember the term “unlikely” does not mean impossible
- Also investors should remember the term “most likely” is not a 100% guarantee

Summary

- The option risk gauges Delta, Gamma and Theta are dynamic, they change as the underlying, time left until expiration and the volatility change
- Delta is the most straightforward, the sensitivity to the underlying exchange rate change
- ITM, ATM and OTM options have differing numeric values of Delta, Gamma and Theta
- Comparing and contrasting the differing strike prices can help investors select the appropriate strike prices based on each individual investor's risk reward tradeoffs

Summary

- Gamma measures the sensitivity to change in Delta
- Long options have positive Gamma, short options have negative Gamma
- The Gamma is added or subtracted to the original Delta to calculate the new Delta
- Theta measures the daily cost of an option
- Long options have negative Theta
- The cost of Gamma can be considered its Theta

Summary

- Vega measures the amount an option change if the (implied) volatility changes
- Rho measures the amount an option will change if the interest rate differential for the FX pair changes

Summary

- Learning more about the option “Greeks” can help option investors set their expectations in a more precise manner

- Investors that have a better understanding of their expectations can select the best options strategy for them based on their own risk reward tradeoffs

Commonly asked questions regarding ISE FX Options

- Can I get price charts? Yes, Bigcharts.com has all of the ISE traded pairs available as well as the option chains
- Do the “greeks” work for FX options pricing? 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
- How much do these options cost? Same as equity options, $1.50 options costs $150
- 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

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