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The Intermediate and Advanced Greeks: An Examination of Vega, Rho, and the Second Order Greeks

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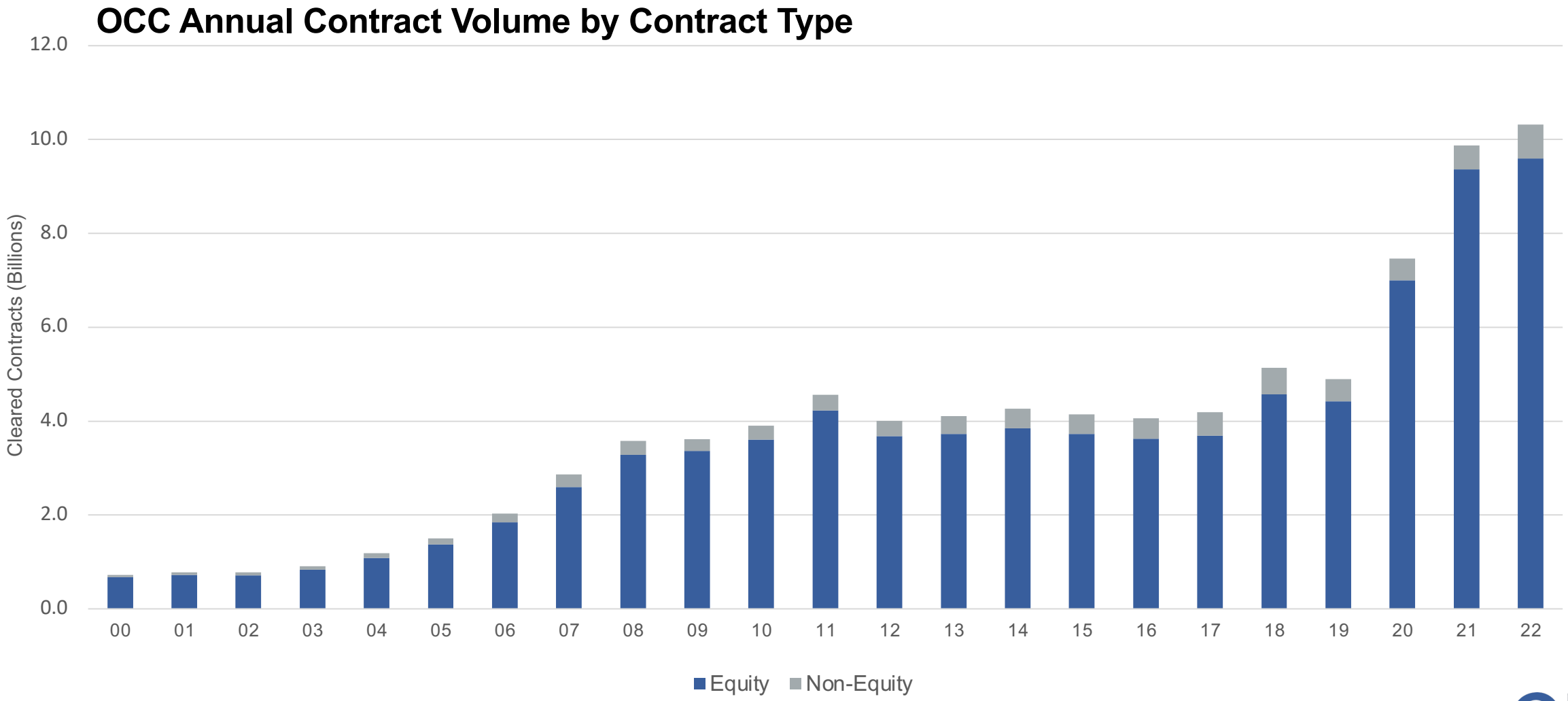
Annual Options Volume 2000-2022



Presentation Outline

- Greeks Overview
- Vega
- Rho
- Second Order Greeks
- Q & A

Introduction to selected First Order Greeks

K	**Vega**	Expected change in option value with respect to changing implied volatility
Γ	**Rho**	Expected change in option value with respect to changing risk-free interest rate

Up next, the Second Order Greeks…

Introduction to selected Second Order Greeks

Second Order Greeks are additional Greeks derived from the First Order Greeks – ways to measure change of the First Order Greeks relative to movement in other Greeks or exogenous factors, like time.

Second Order Greeks

Charm	Expected change in an option delta with respect to the passage of time. (Delta Decay)
Vomma	Expected change in option Vega with respect to changing Implied Volatility Levels (Vega Convexity)

Nature of the Greeks

- Meaningful only during an option's lifetime
  - At expiration they disappear / become irrelevant
- Greeks may affect each other
  - e.g., change in an options Theta (time decay) may affect its delta
- Impact of changes in Greeks differ for each option contract
  - ITM vs. ATM vs. OTM
  - Near-term vs. Long-term

Vega and Implied Volatility

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Vega: The Volatility Greek – A definition

Vega: Option value's sensitivity to volatility

- Expected change in option value
  - With a 1%-point change in implied volatility (IV)
  - Expressed in decimal form (.080)
  - Represents cash amount per option
  - All other pricing factors constant

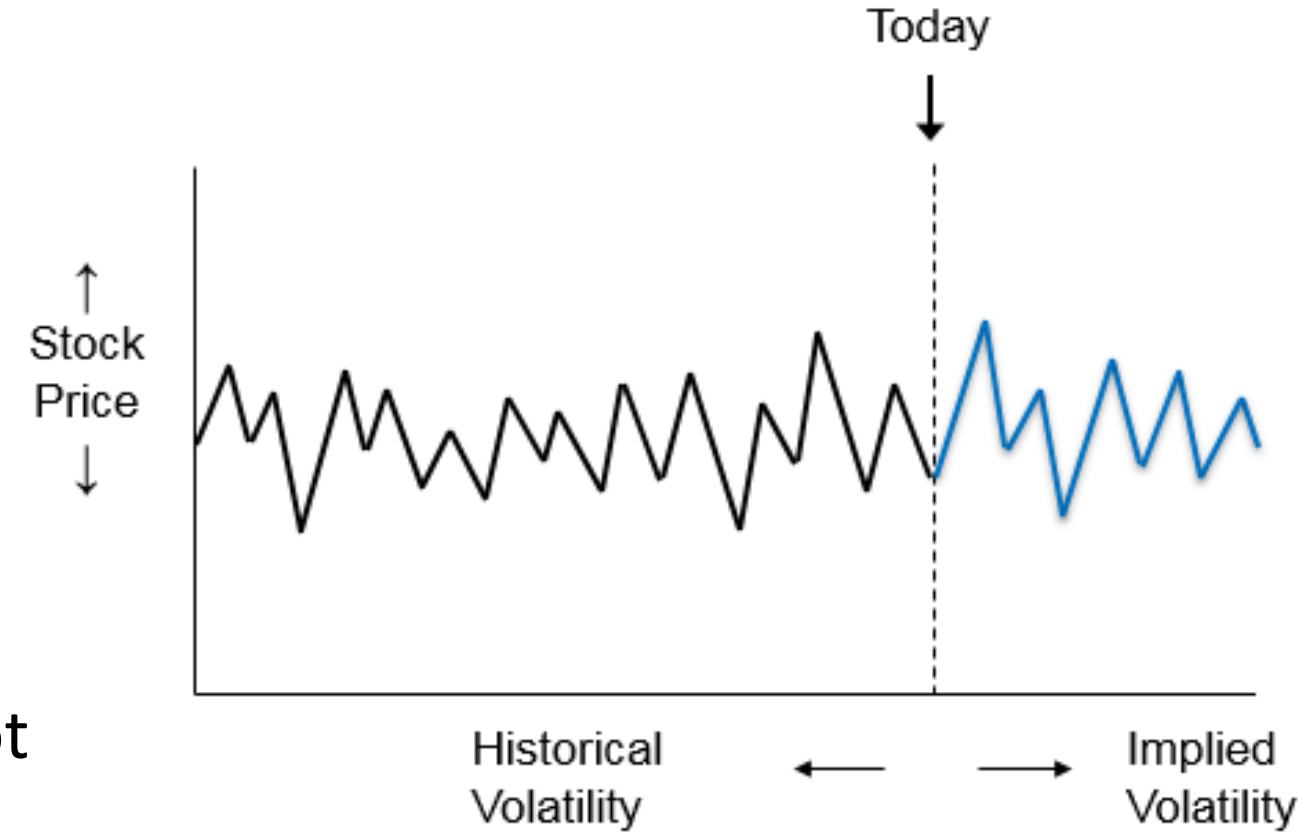
- Calls and puts both have positive Vega amounts
  - IV ⬆ option value ⬆ by Vega amount
  - IV ⬇ option value ⬇ by Vega amount

Vega

Historical Volatility (HV)

A stock's volatility in the past:

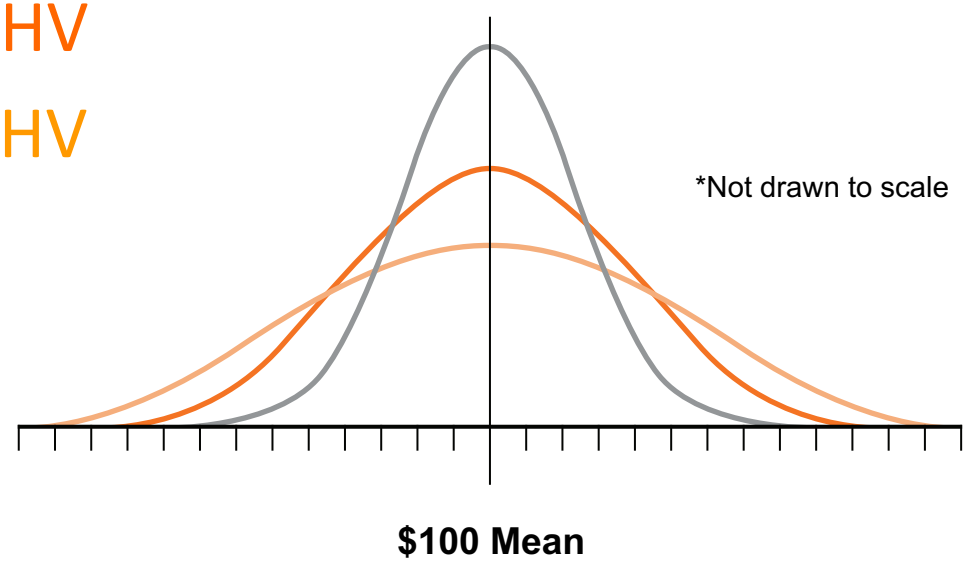
- Can be observed and quantified
- This is "historical" or "delivered" volatility
- A statistic, or a fact (backward looking) --not a prediction



Comparing Distributions

Compare distributions of three stocks – each with different delivered volatility:

- Stock A = 15% HV
- Stock B = 25% HV
- Stock C = 35% HV



Implied Volatility (IV)

- Option implied volatility:
  - Volatility level that influences an options price
  - Can be determined via option pricing models (calculator)
- Reflects underlying stock volatility expected by marketplace:
  - Forward Looking
  - Consensus of all market participants
- Who ultimately determines option market prices?
  - Everybody who makes a bid/ask price and trades an option
  - Professionals and individual investors alike

Implied Volatility: Effect on Option Prices

- A change in an underlying stock's historical volatility may or may not affect an option's market price. However…
- **Other pricing factors remaining constant, a change in IMPLIED volatility WILL affect option prices:**
- As implied volatility increases ↑
  - both call and put prices will increase ↑
- As implied volatility decreases ↓
  - both call and put prices will decrease ↓

Implied Volatility and Vega in Action

Pre-Earnings

- Stock: $100
- DTE: 13
- IV: 50%

	105 Call
Value	**$1.85**
Delta	**.30**
Gamma	**.05**
Theta	**.15**
Vega	**.10**
Rho	**.01**

Post-Earnings

- Stock: $105
- DTE: 6
- IV: 30%

	105 Call
Value	**$1.20**
Delta	**.50**
Gamma	**.15**
Theta	**.20**
Vega	**.05**
Rho	**.01**

Even with a $5 increase in share price, these calls lost value due to time decay and decreasing IV

Knowledge Check

With a 100-strike call, is Vega greater on a contract expiring in 5 days, 30 days, or 90 days? **90 days**

An investor puts on a Covered Call strategy. Do they have a long or short Vega position and will an increase in Vega likely help or hurt the position? **Short/hurt**

If stock drops 15% as a result of unexpected company news, are long or short Vega positions likely to be positively impacted? **Long**

Rho & Interest Rates

Rho – A definition

P Rho: Option value's sensitivity to interest rates

Expected change in option value

- With a 1%-point change in the risk-free interest rate
- Expressed in decimal form (.080)
- Represents cash amount per option
- All other pricing factors constant

Considered the least significant of all pricing factors

- Component of "cost of carry"—time/LEAPS
- Small portion of any option's total premium

Rho Characteristics

- Rho amounts generated by pricing model
  - Calls have + rho/Puts -
- Rho is largest for in-the-money calls and puts
  - Decreases as options move out-of-the-money
  - Rho increases with higher priced underlying stocks
- Rho increases with more time until expiration
  - For shorter-term options → little impact
  - For longer-term options (**LEAPS**) → more significant

- Rates increase, calls increase/puts decrease
- Rates decrease, calls decrease/puts increase

Second Order Greeks

Charm – A definition

Charm: Option Delta's sensitivity to the passage of time (Delta decay)

Expected change in option Delta

- With the passage of 1 day
- Expressed in decimal form (.10)
- Charm values range from -1.00 to +1.00

$$CHARM = \frac{\partial \Delta}{\partial t}$$

An option's Charm is dependent on ITM vs OTM

- In-the-money **Calls** and out-of-the-money **Puts** have positive Charm values
- In-the-money **Puts** and out-of-the-money **Calls** have negative Charm values

Vomma – A definition

Vomma: Option Vega sensitivity with respect to implied volatility level

Expected change in option Vega

- With a 1%-point change in the implied volatility
- Expressed in decimal form (.10)
- Vomma, like Vega is expressed as a positive number

$$VOMMA = \frac{\partial V}{\partial \sigma}$$

Many refer to Vomma as Vega convexity

- Adds curvature to the linear relationship between implied volatility level and Option price
- Because of its natural convexity, Vomma can be helpful in estimating values over large implied vol moves

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