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## OCC / OIC

# The Beginning Greeks – A Deep Dive Into Delta, Gamma, and Theta

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# The Beginning Greeks – A Deep Dive Into Delta, Gamma, and Theta

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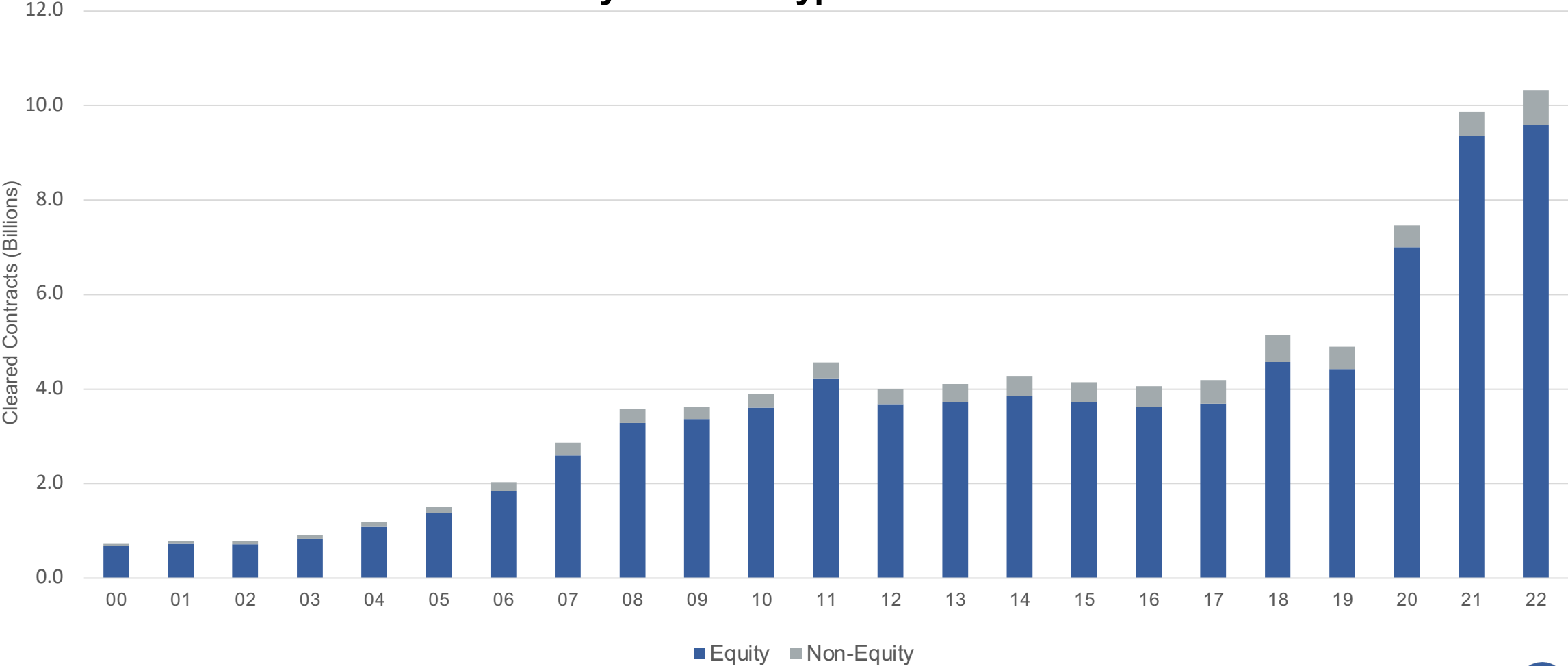
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# Annual Options Volume 2000-2022

## OCC Annual Contract Volume by Contract Type








# Presentation Outline

- Greeks Overview
- Delta
- Gamma
- Theta
- Q & A





# Introduction to the Greeks

	<b>Delta</b>	Expected change in option value with respect to changing underlying stock price
	<b>Gamma</b>	Expected change in option <u>delta</u> with respect to changing underlying stock price
	<b>Theta</b>	Expected change in option value through the passage of time ( <b>time decay</b> )

# 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



# Delta and Direction



# Option Delta – A definition



## **Delta: Option Value's sensitivity to stock price**

The *expected* change in an option's price (up or down) for each \$1.00 move in underlying stock price

### **Deep in-the-money options**

- High deltas approaching 100% (or 1.00)

### **At-the-money options**

- Deltas around 50% (or .50)

### **Far out-of-the-money options**





- Low deltas approaching 0% (or 0)









# Delta Characteristics

## Calls have positive (long) deltas

- Positive correlation to underlying stock price change
- Stock price  → call price 
- Stock price  → call price 
- Call deltas range from 0 to +1.00

## Puts have negative (short) deltas

- Negative correlation to underlying stock price change
- Stock price  → put price 
- Stock price  → put price 
- Put deltas range from 0 to -1.00

# Delta as ITM Probability

Another way investors might use delta is to determine **probability of an option finishing ITM**

- Buying a 70-delta call could indicate a 70% chance of the option finishing **ITM**, and
- Selling a 30-delta call could indicate a 70% chance of the option finishing **OTM**

ITM/OTM does not equal **PROFITABILITY!**

# Knowledge Check

*Shares trading \$100 45-days  
until expiration*

- If an investor buys the 110 calls for \$1, what is the expected option value if shares increase to \$105 ? **\$2.00\***
- If an investor sells two of the 90 strike puts, what is the estimated probability that the contracts will finish OTM? **85% chance**
- If an investor buys the 100/110 call spread for \$3.20, what is the expected value of the spread if shares increase to \$105 ? **\$4.70\***

Strike	Call Delta	Put Delta
80	1.00	.00
90	.85	.15
100	.50	.50
110	.20	.80
120	.05	.95

**\*Estimated value assumes all other factors constant**



# Gamma



# Option Gamma – A definition

**Gamma: Delta's sensitivity to stock price**

The anticipated change in the delta value for a \$1.00 move in the underlying stock









- All other pricing factors constant
- In decimal form (e.g., .002)
- **Adjustment to Delta**

Only options have gamma

**Gamma**

# Gamma Characteristics

Gamma amount is the same for calls and puts on the same strike

- Gamma for calls
  - Stock price  → delta  by gamma amount
  - Stock price  → delta  by gamma amount
- Gamma for puts
  - Stock price  → delta  by gamma amount
  - Stock price  → delta  by gamma amount

Gamma is what option buyers are paying for

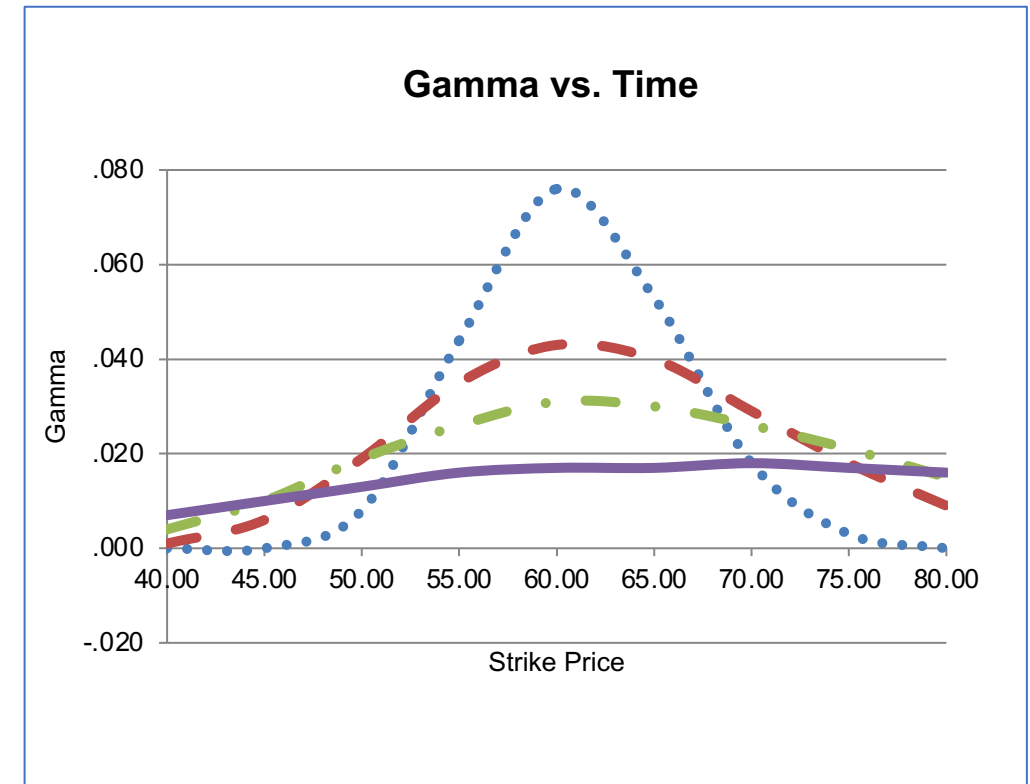
- Acceleration of delta
- “Delta of the delta”

# Gamma over Time

As expiration nears:

- Gamma of ATM calls and puts **increases**
- Gamma of both ITM and OTM calls and puts **decreases**

XYZ \$60.00 30% vol. 4% int.



- 1 month
- - - - - 3 month
- . - . 6 month
- 18 month

# Knowledge Check

*Shares trading \$50 10-days 'til expiration*

- If an investor were to buy the 50 calls and shares increased \$2, what is the new expected delta? **.75**
- If an investor was short the 50 calls with stock trading \$50, would a share price increase to \$52 result in an increase or decrease in gamma? **Decrease**
- If a trader was long 10 of the 52 calls (delta neutral) and shares increased from \$50 to \$51, how many shares would they need to buy/sell in order remain delta neutral? **Short an additional 100 shares (390 total short shares)**

Strike	Call Delta	Call Gamma
48	.74	.09
49	.63	.11
50	.51	.12
51	.39	.11
52	.29	.10



# Theta (Time Decay)

# Option Theta (Time Decay) – A definition



**Theta: Option value's sensitivity to time**

## Expected time decay in option value

- With the passage of 1 day
- Expressed in decimal form (-.080)
- Decay is per **calendar day**, not per trading day
- Represents cash amount per option
- All other pricing factors constant

**Calls and puts both have negative theta amounts**



Theta



# An Example of Theta (Time Decay)

## An option is trading today at \$3.50

- Theta of  $-\$.030$  ( $-\$.03$ )
- Contract is worth  $\$3.50 \times 100$  shares =  $\$350.00$

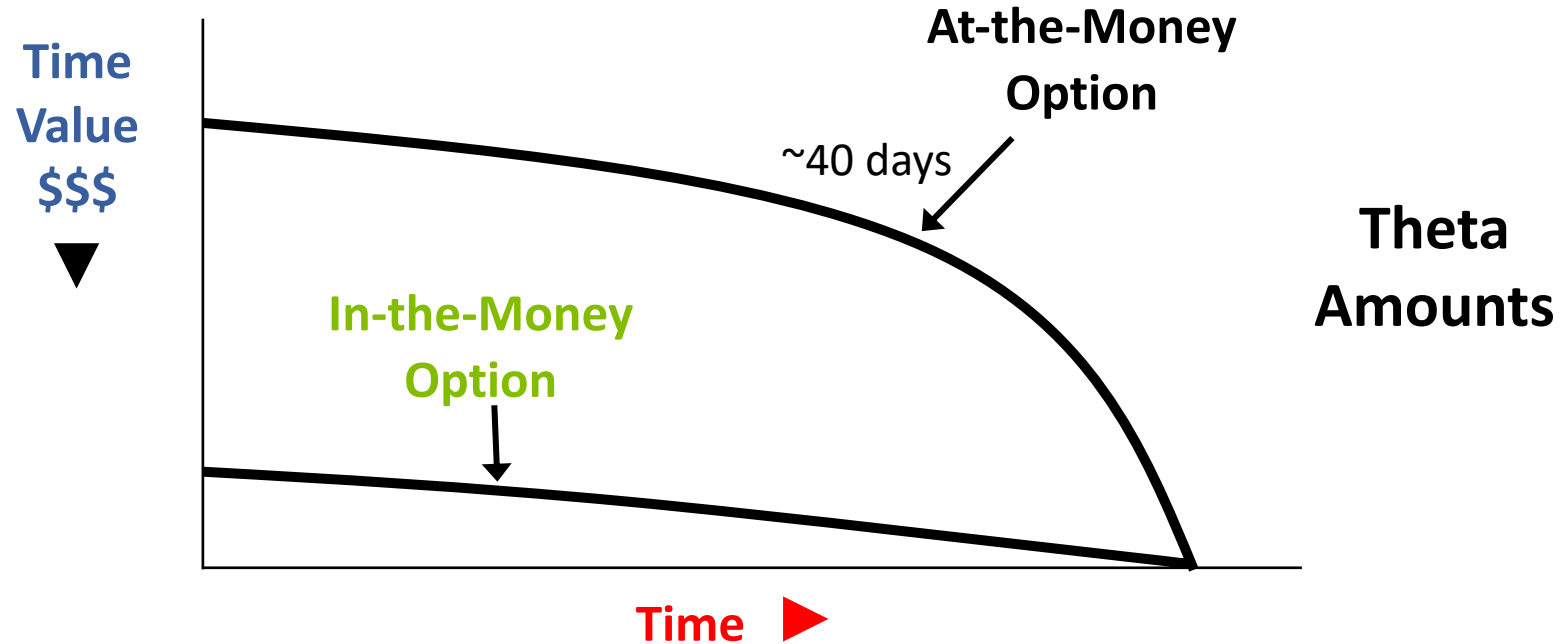
## Expected value tomorrow = $\$3.50 - \$.03 = \$3.47$

- Contract is worth  $\$3.47 \times 100$  shares =  $\$347.00$
- Theta  $-\$.03 \rightarrow$   $\$3.00$  loss per contract

## Expected value 10 days from now = $\$3.20$

## Assuming other pricing factors constant

# Time Decay is Not Always Linear



Overall rate of time decay is exponential (**accelerates** towards expiry)

# Knowledge Check

## *Shares trading \$100*

Long the 95/90 put spread for \$0.50. Does Theta help or hurt this position?     **Hurt**

Long 80-strike calls for \$20.25 or long 85-strike puts for \$.40. Which is more affected by time decay?     **85-strike puts**

Stock is trading \$50 and you are long the April \$50/March \$50 calendar spread. Does theta help or hurt you?     **Help**



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