



# Dynamic Hedging

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# Option Valuation and Delta Hedging

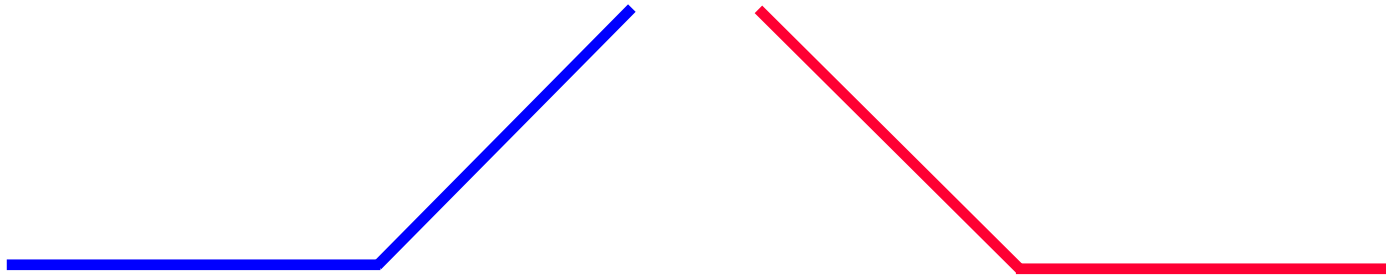
The Black-Scholes insight:

by taking an opposing (offsetting) position in the underlying asset, one can dynamically create a portfolio that is (locally) independent of changes in the underlying price – which, given their other assumptions, created a risk-free portfolio – which should receive a risk-free rate of return.

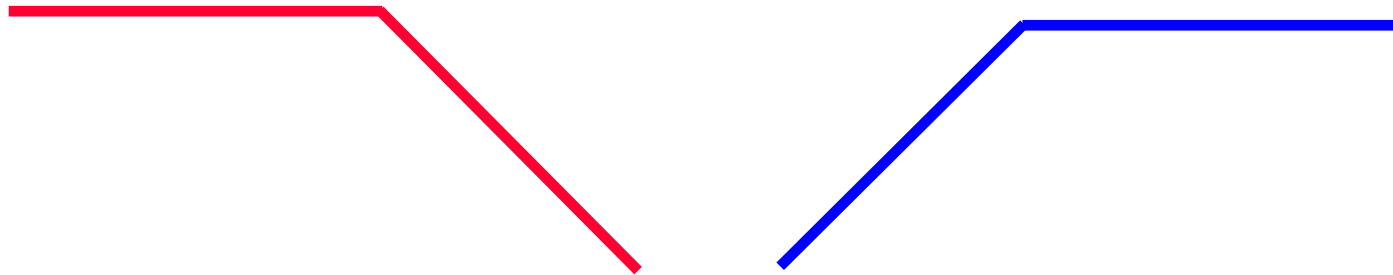
That presumption (taking an offsetting position in the underlying) is central to option valuation.

# Graphical Exposition

**LONG CALL (LONG)**      **LONG PUT (SHORT)**



**SHORT CALL (SHORT)**      **SHORT PUT (LONG)**



# To be Delta Neutral, . . .

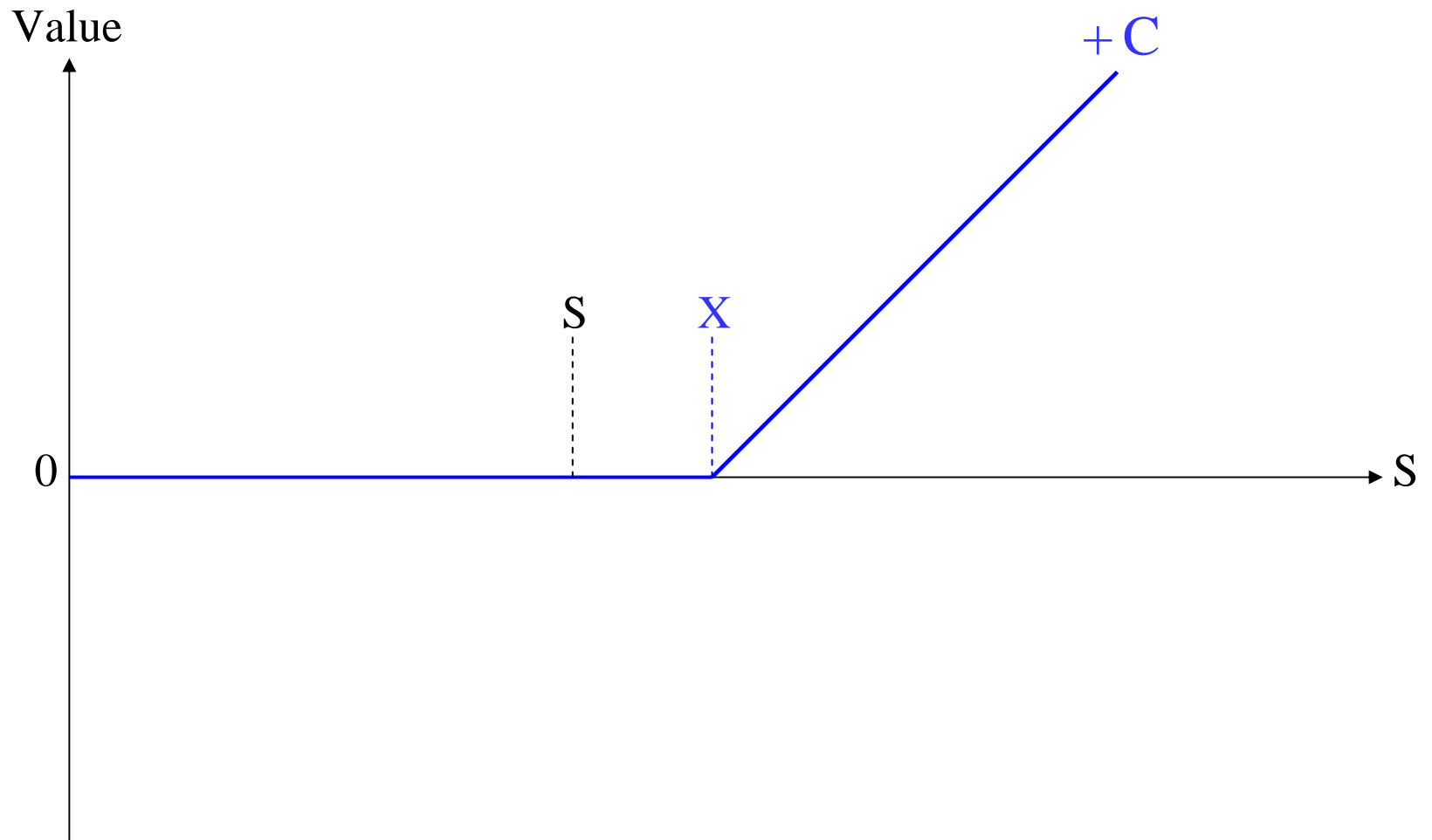
If you buy a Call, sell  $\Delta$  of the Underlying.

If you sell a Call, buy  $\Delta$  of the Underlying

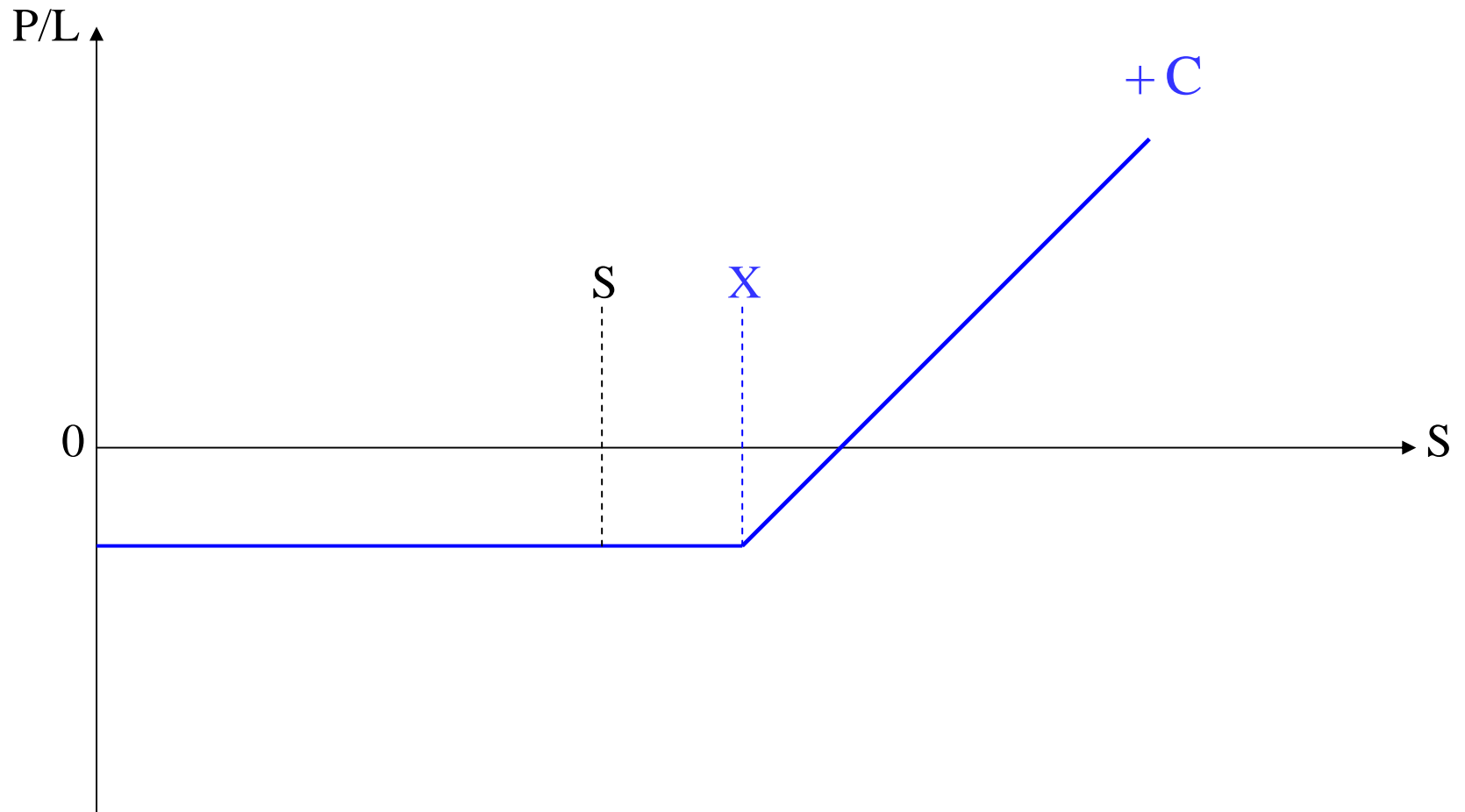
If you buy a Put, buy  $\Delta$  of the Underlying.

If you sell a Put, sell  $\Delta$  of the Underlying.

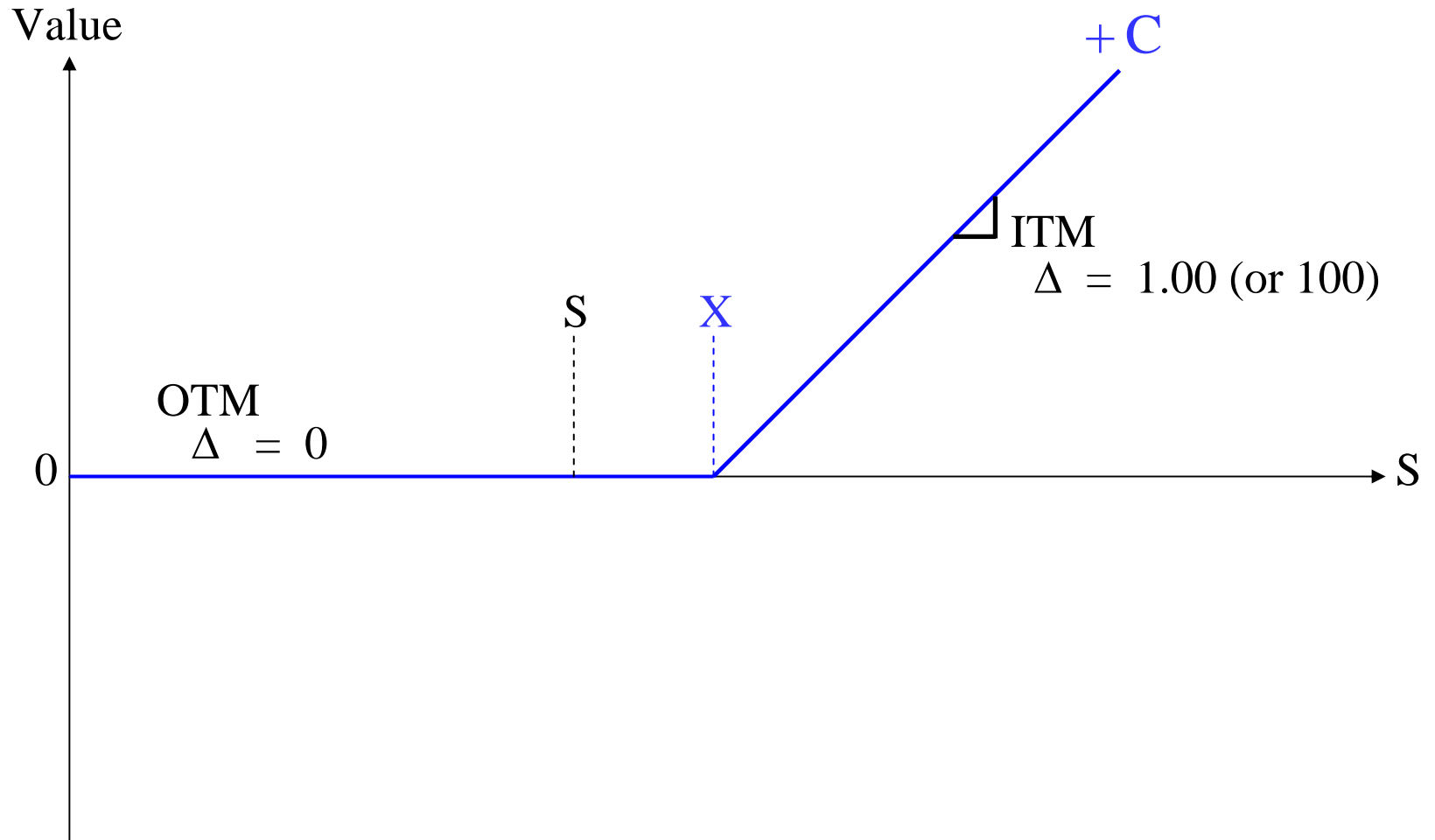
# Long a Call At Expiration



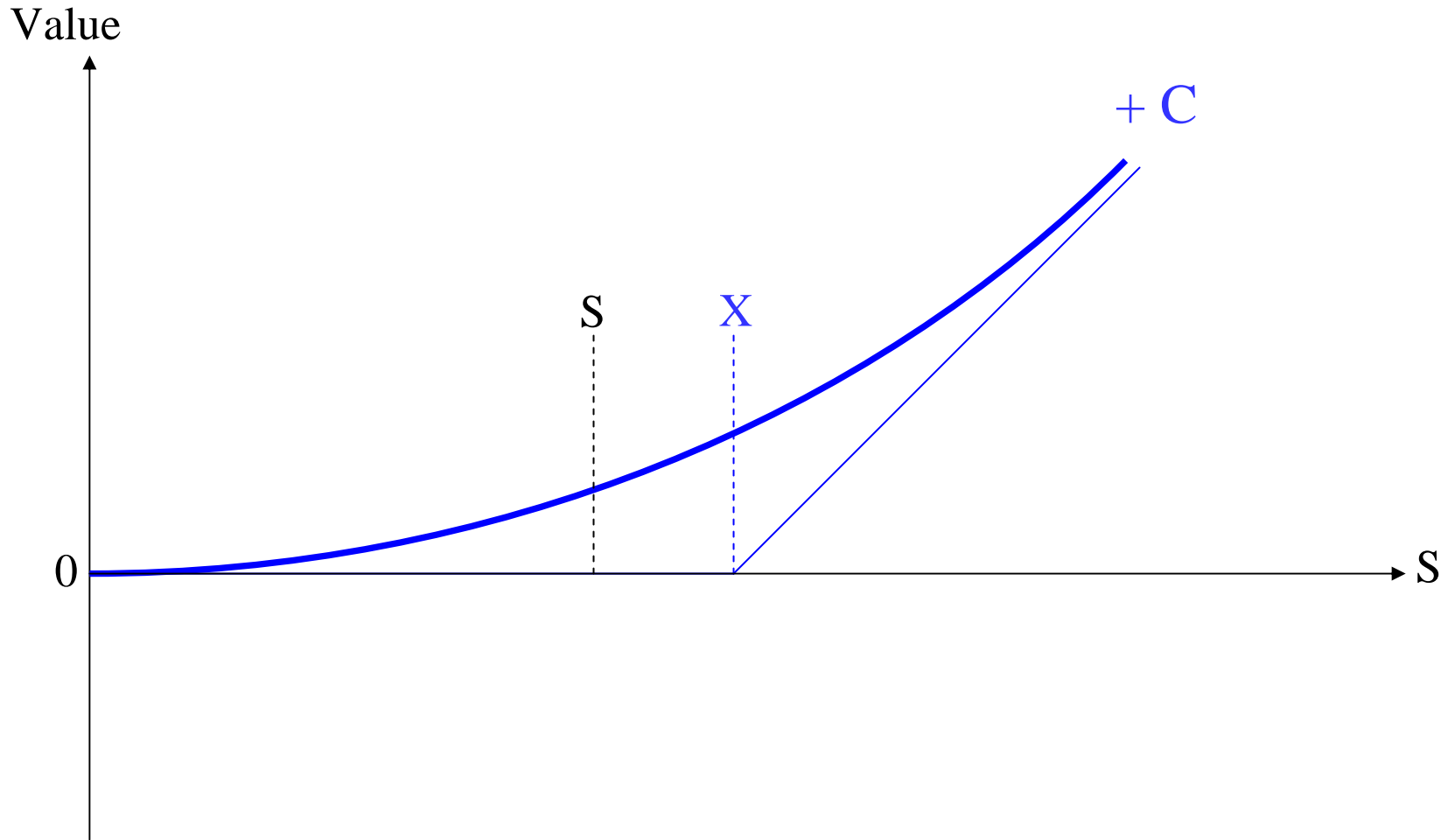
# Long a Call



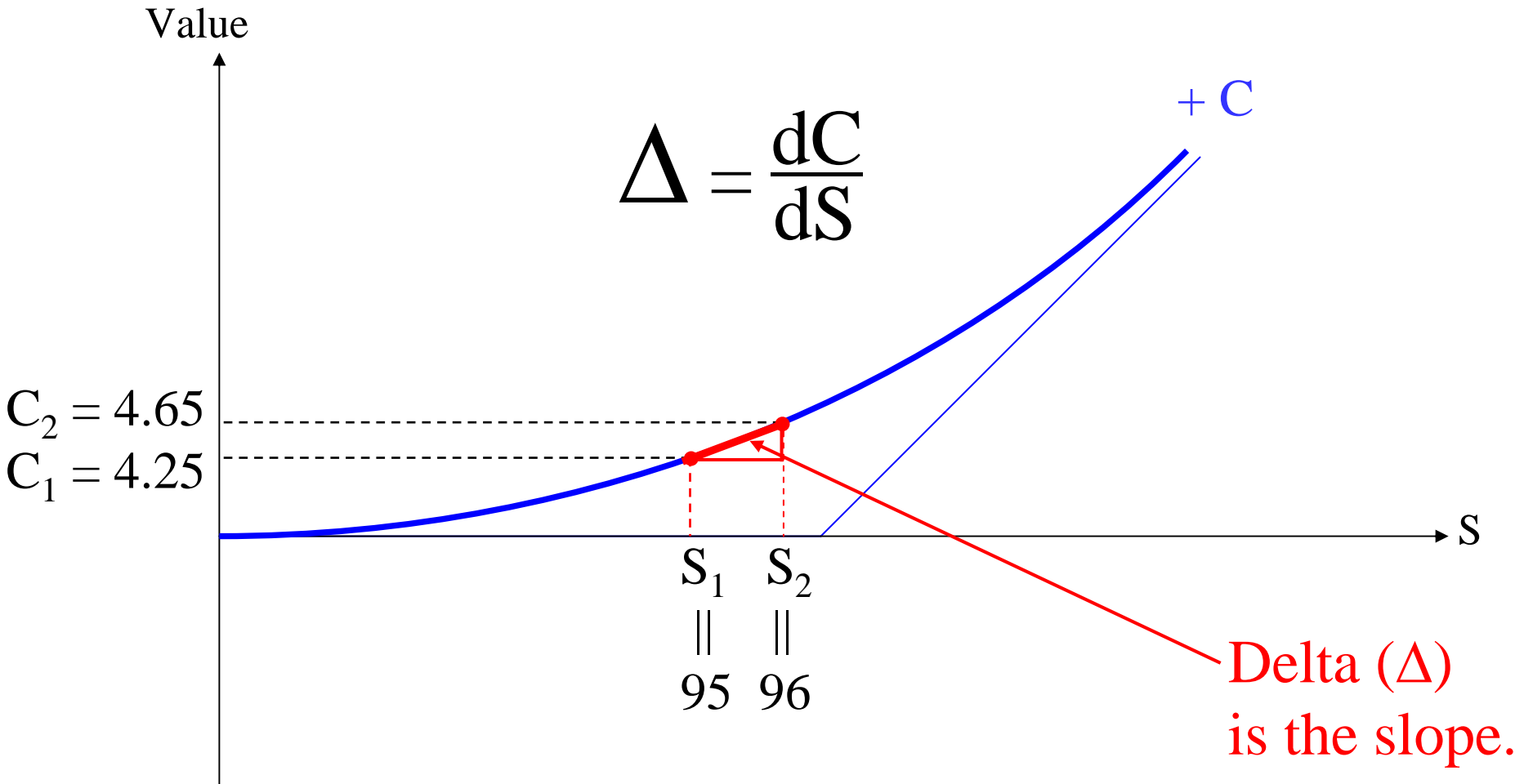
# Delta At Expiration



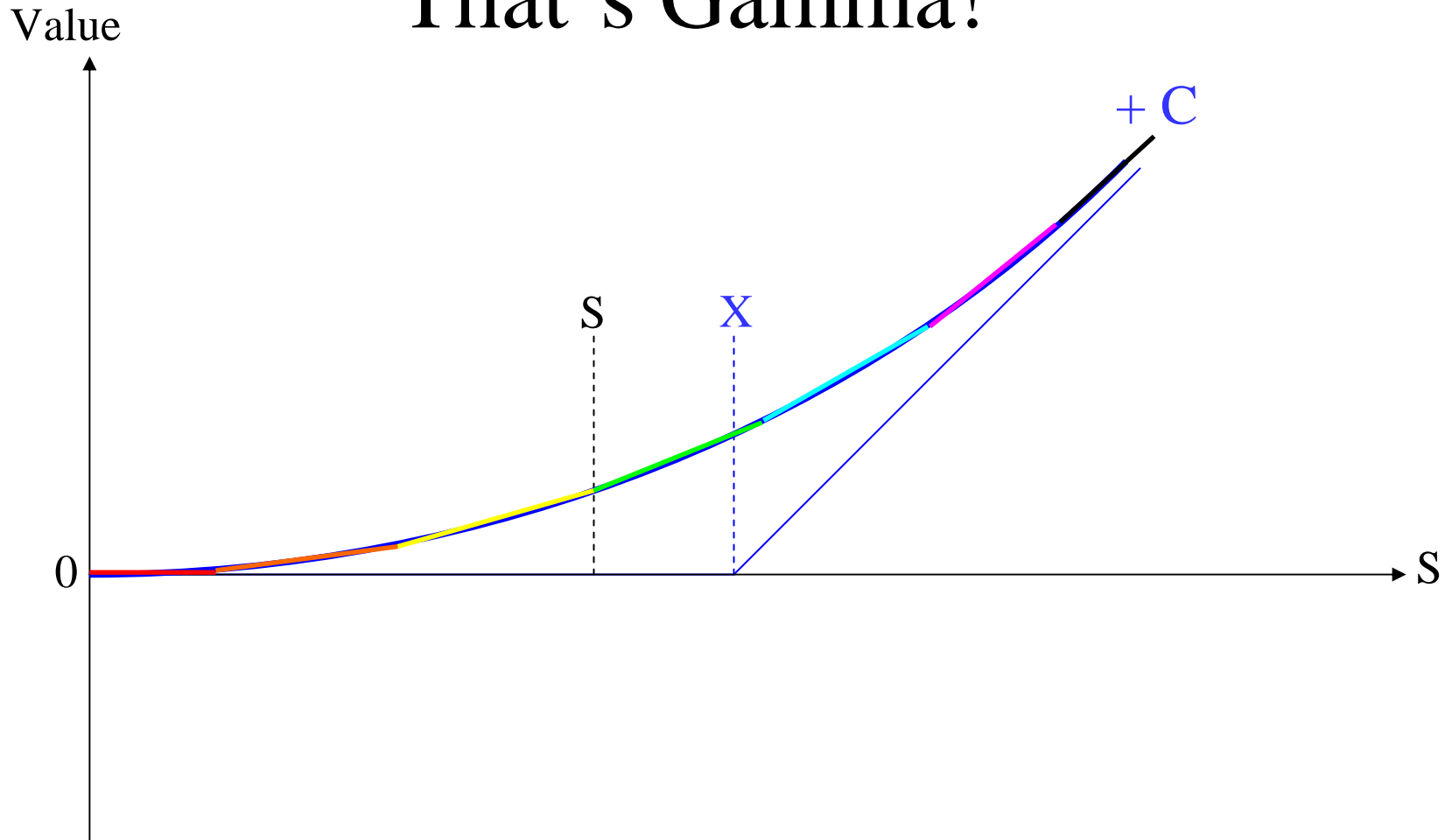
# Value Graph Before Expiration



$$\text{Delta} = \frac{\text{Change in Option Value}}{\text{Change in Underlying Price}}$$

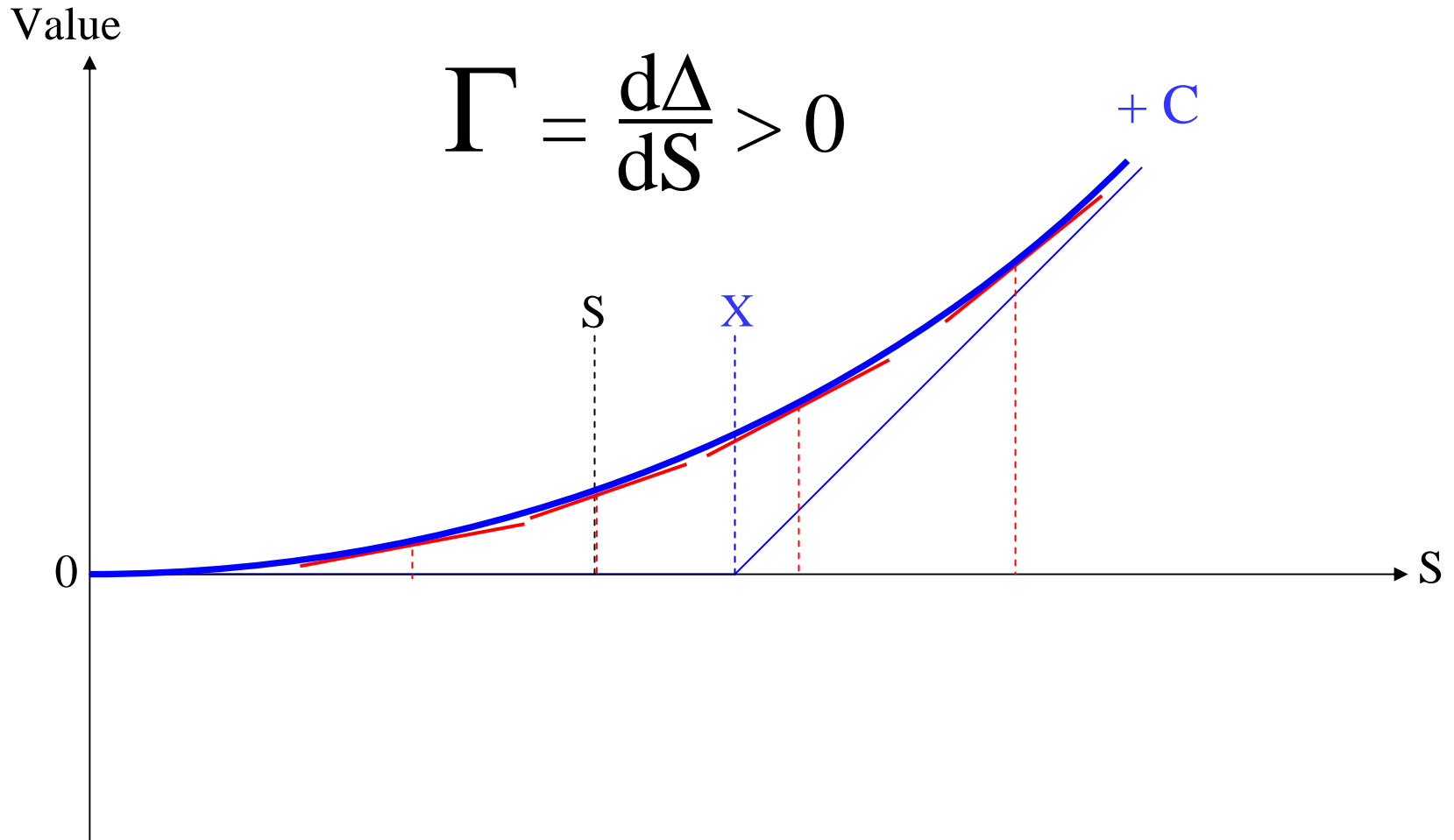


# Delta (The Slope) Changes as the Underlying Price Changes. That's Gamma!



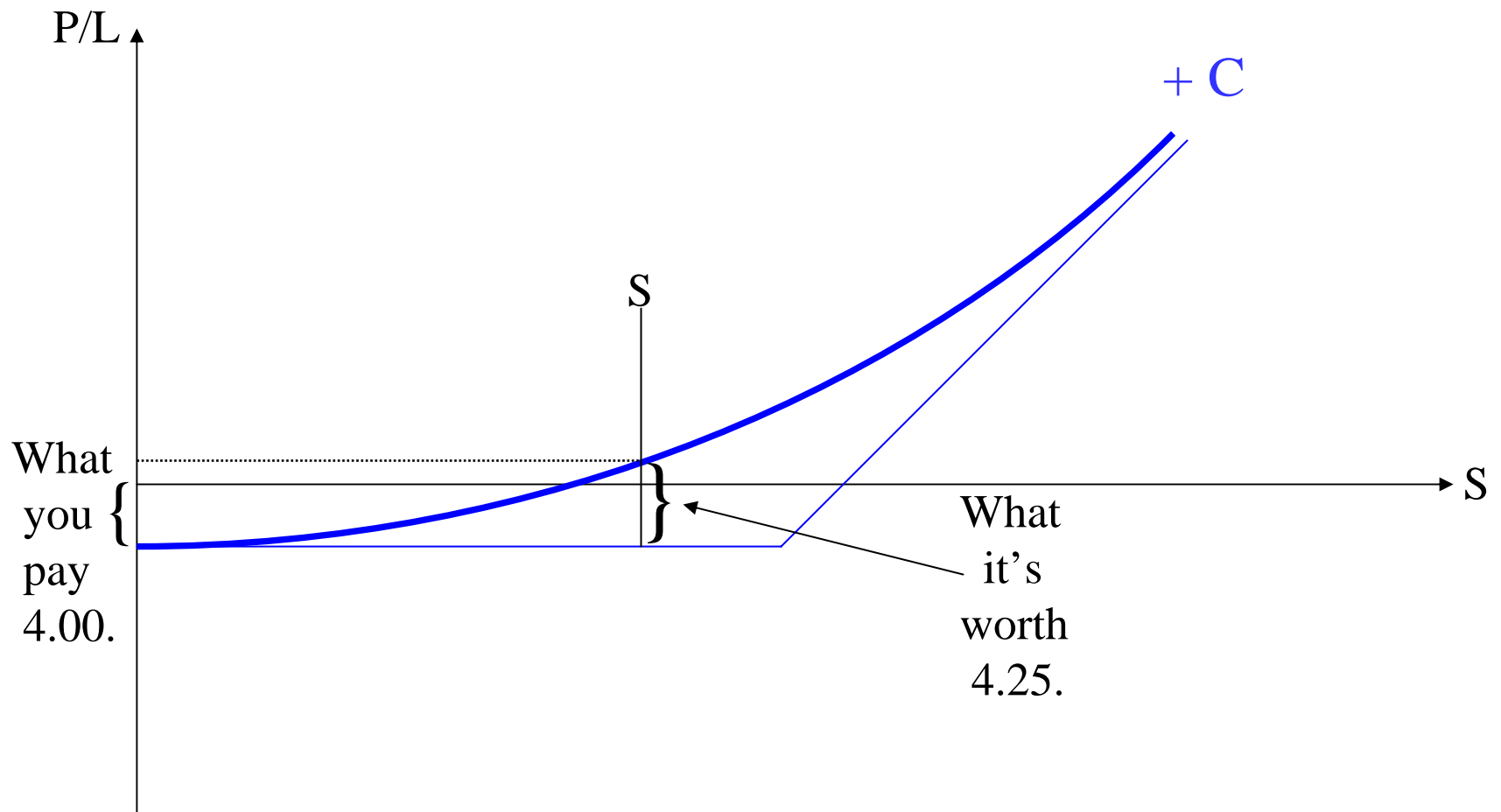
# Long Gamma

As  $S$  goes up, Delta goes up.



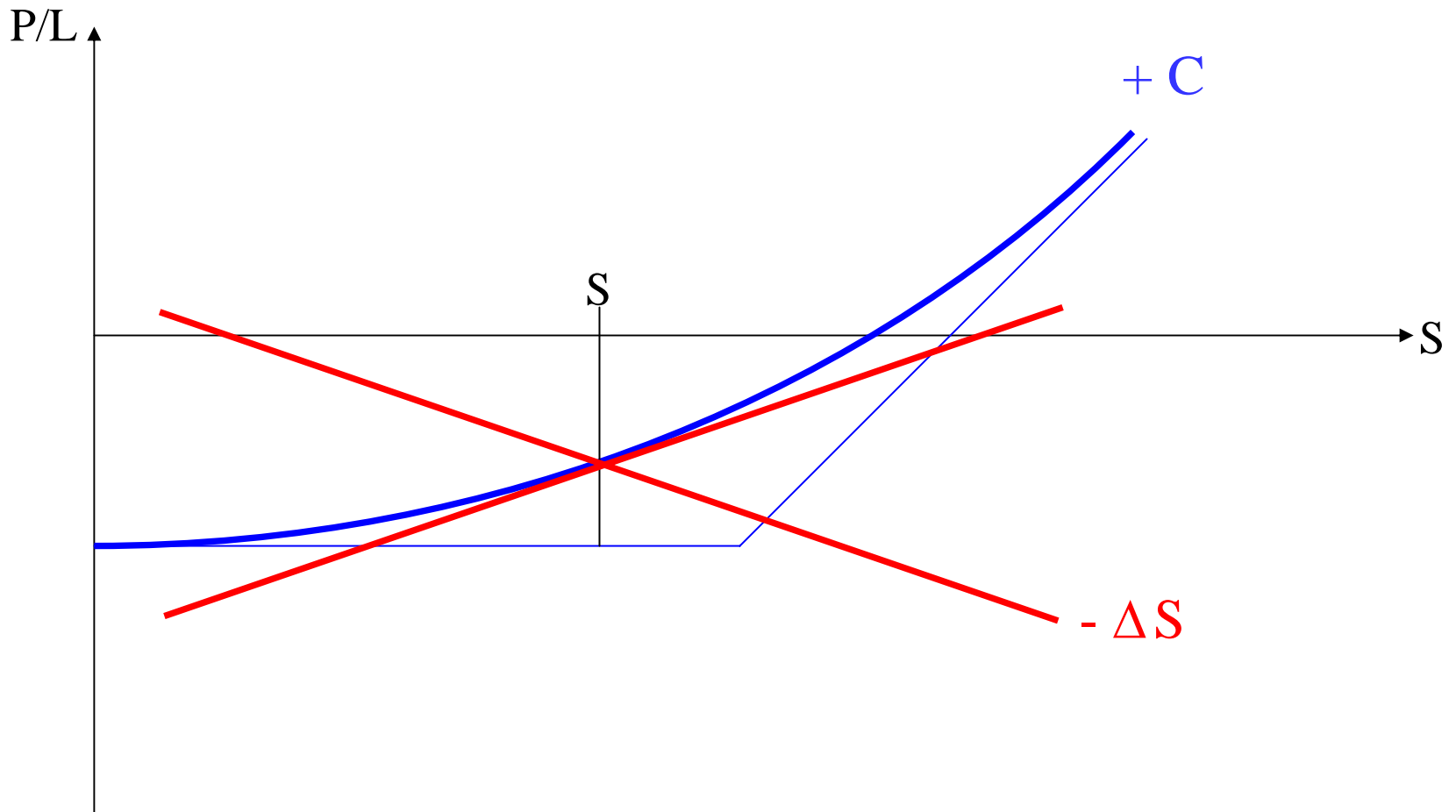
# Long Gamma

Buy a Call. Why? It's "cheap"!

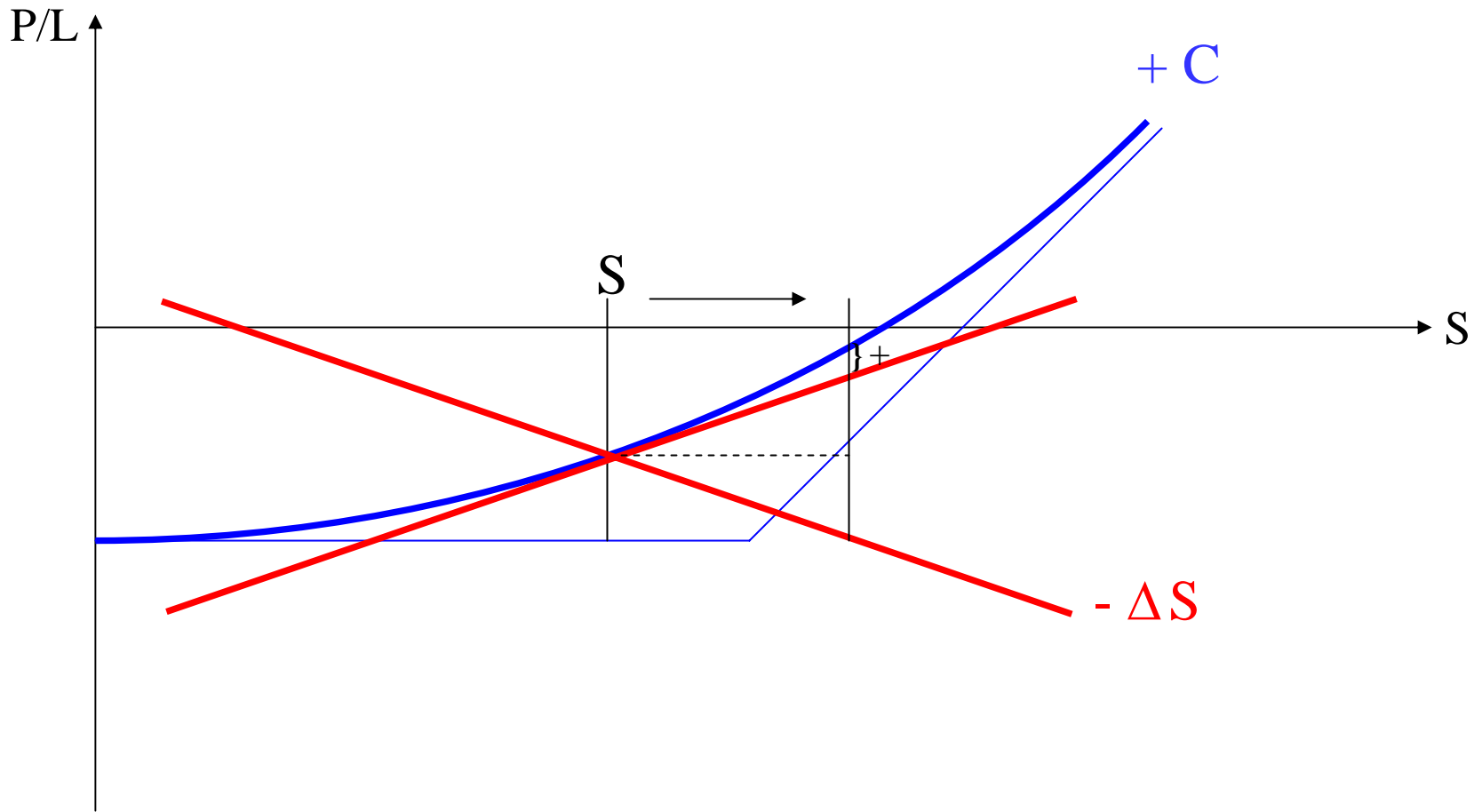


# Delta

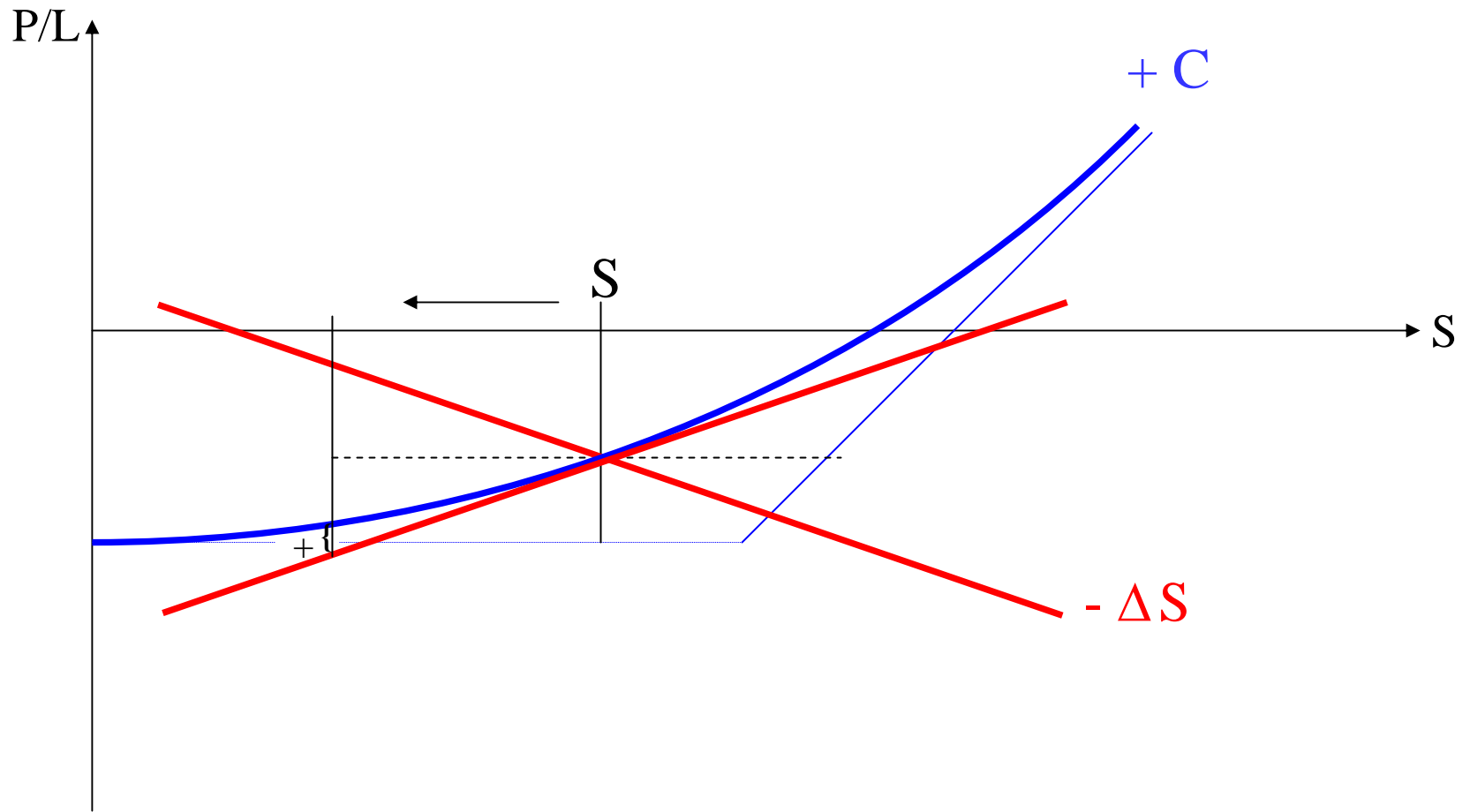
Buy a Call. Because it's "cheap"!



# If the market goes up,...

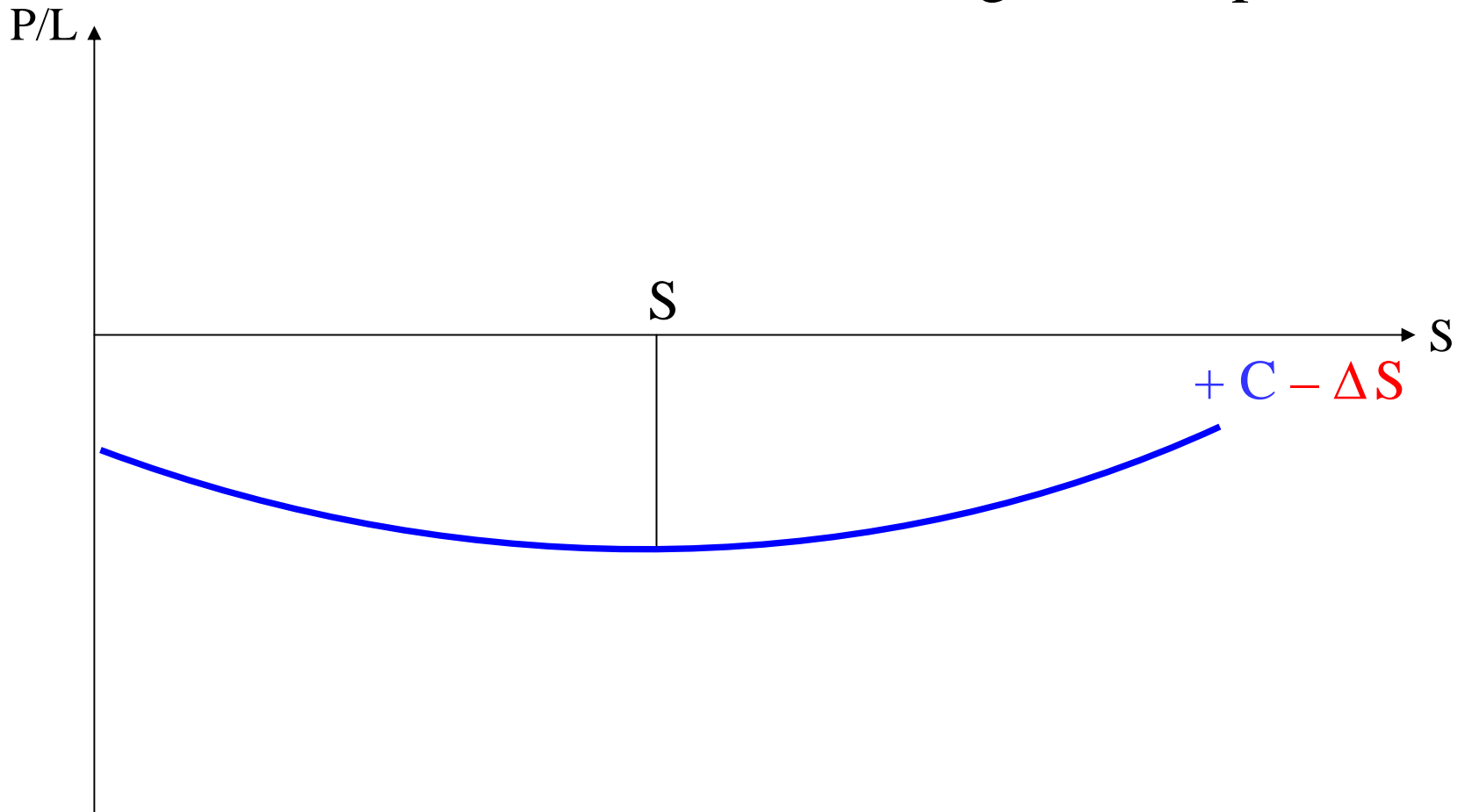


# If the market goes down,...



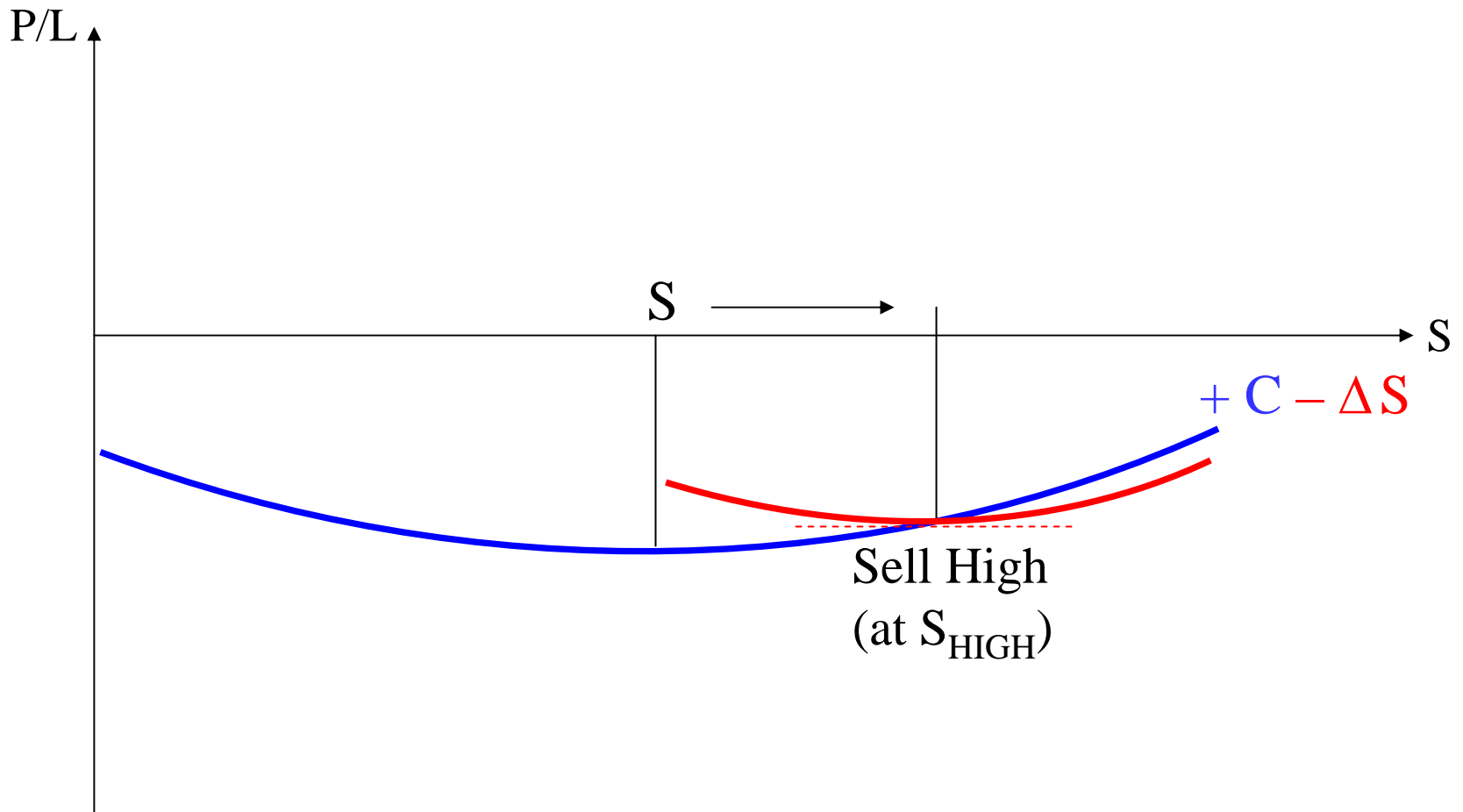
# Hedged Option Position

Delta Neutral = Flat (neither long = positive slope  
nor short = negative slope)



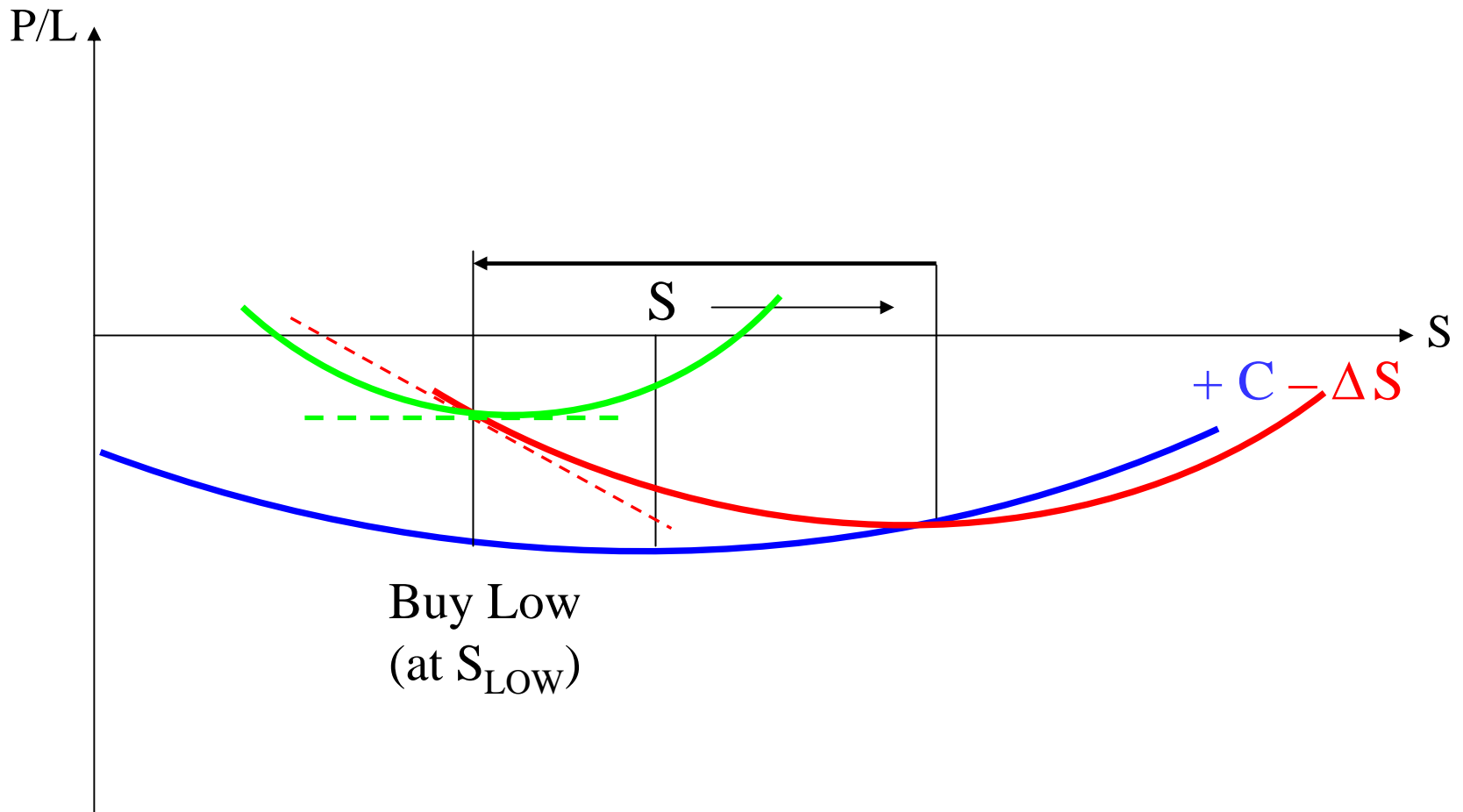
# What if the Spot price rises?

You will become unhedged. Is that a good thing?

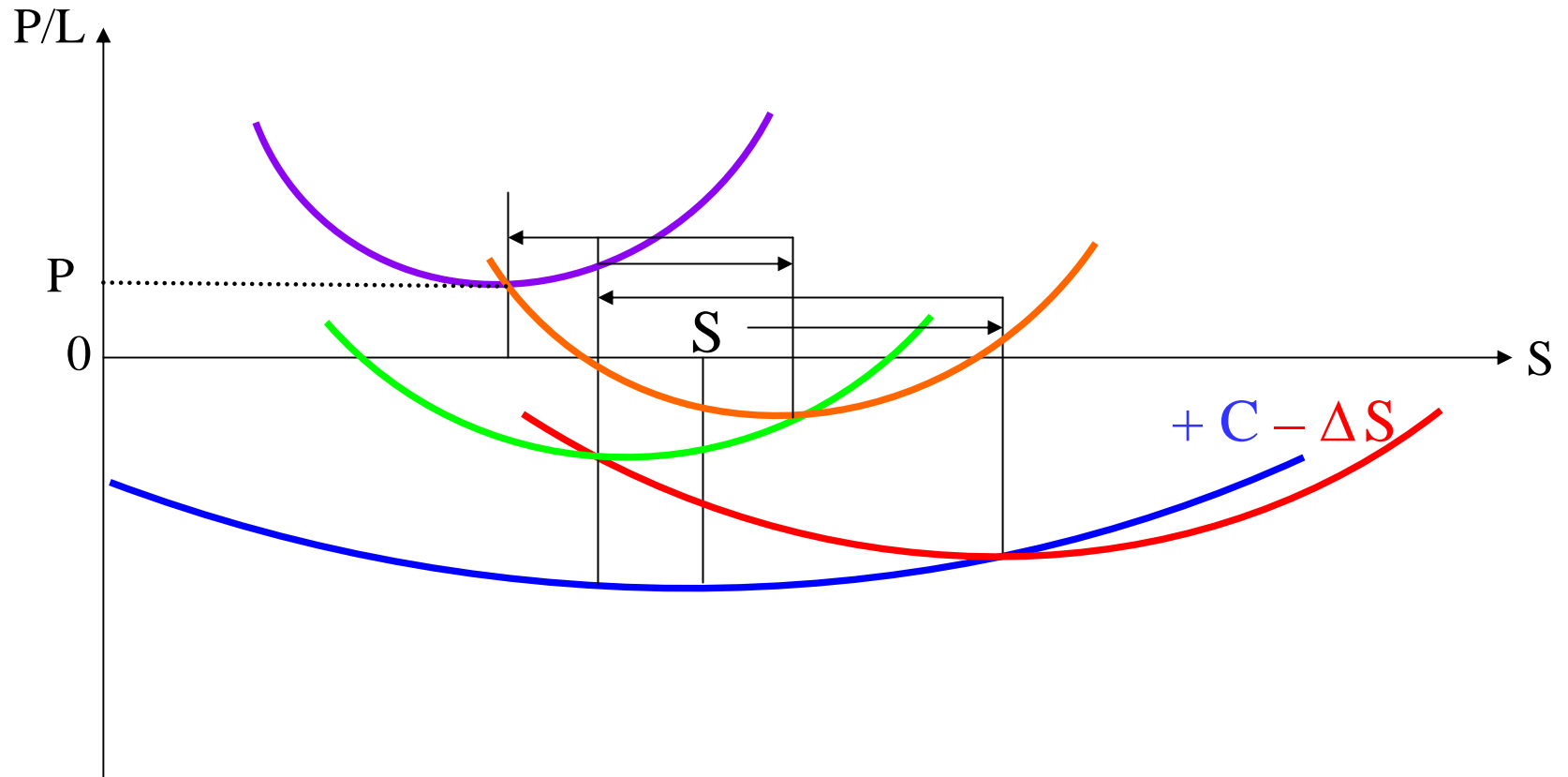


# Rehedging

Selling high and buying low.

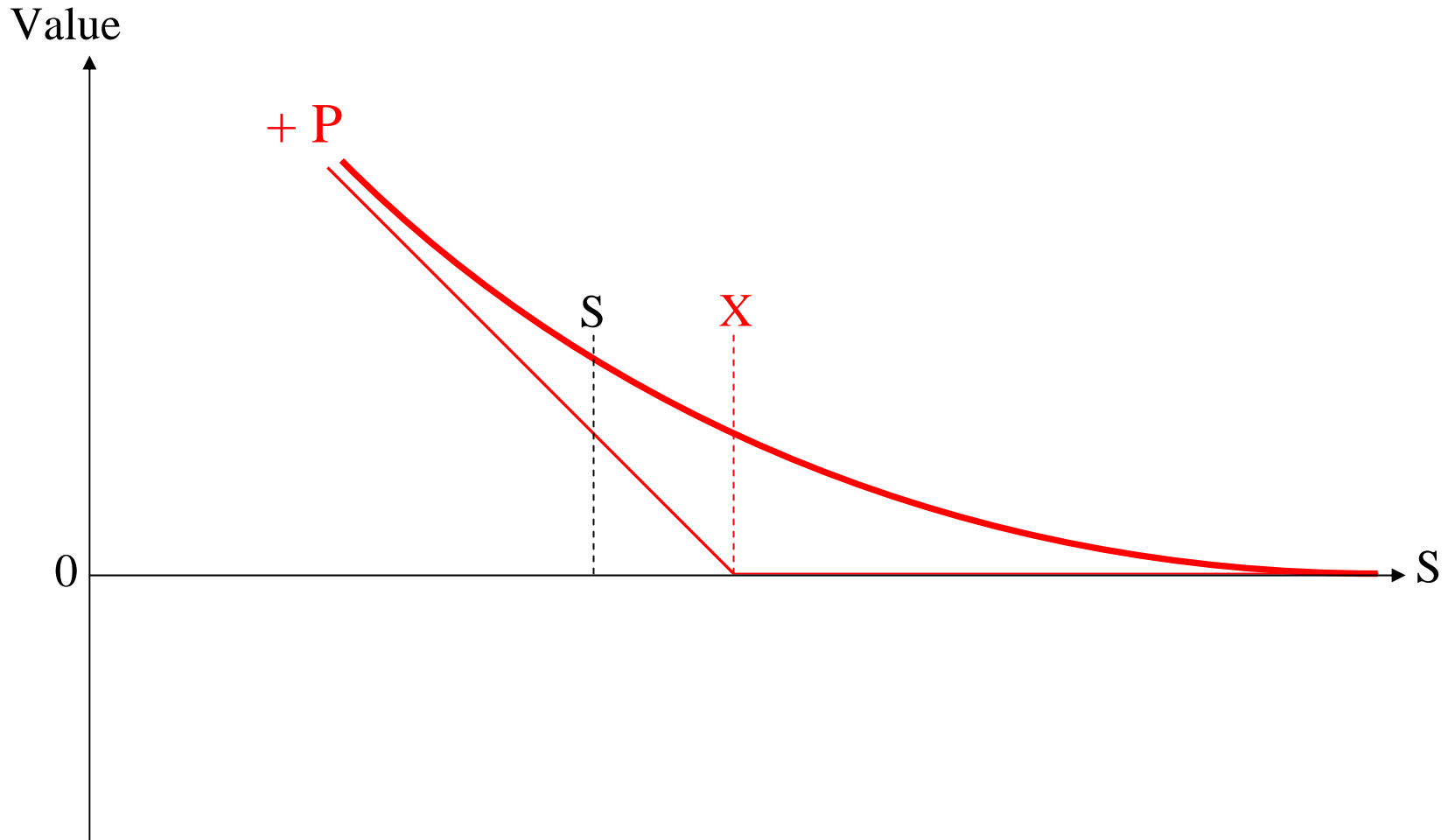


# Goal: By Expiration,...

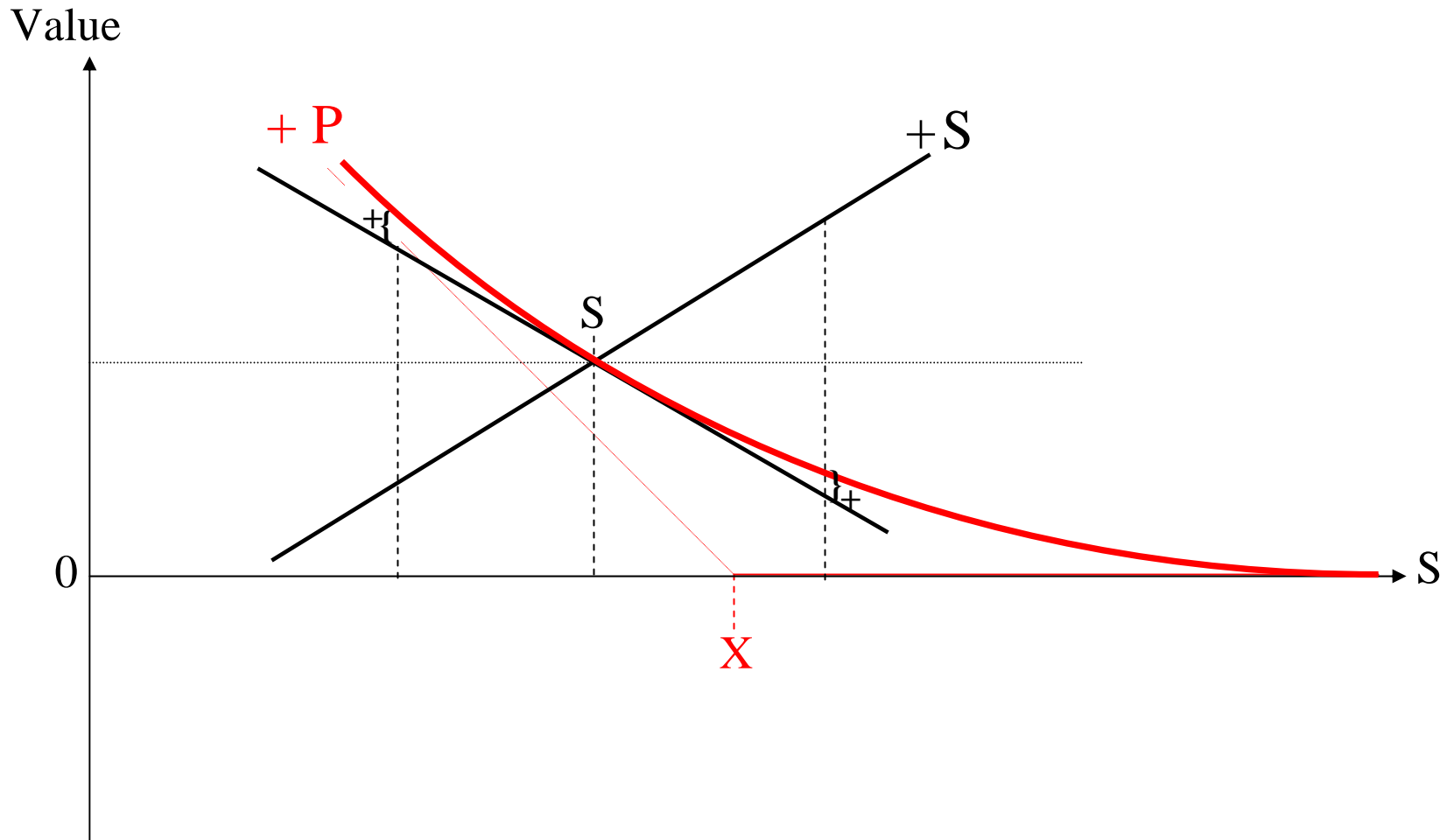


How would this differ if this was a Put?

# Value Graph Before Expiration

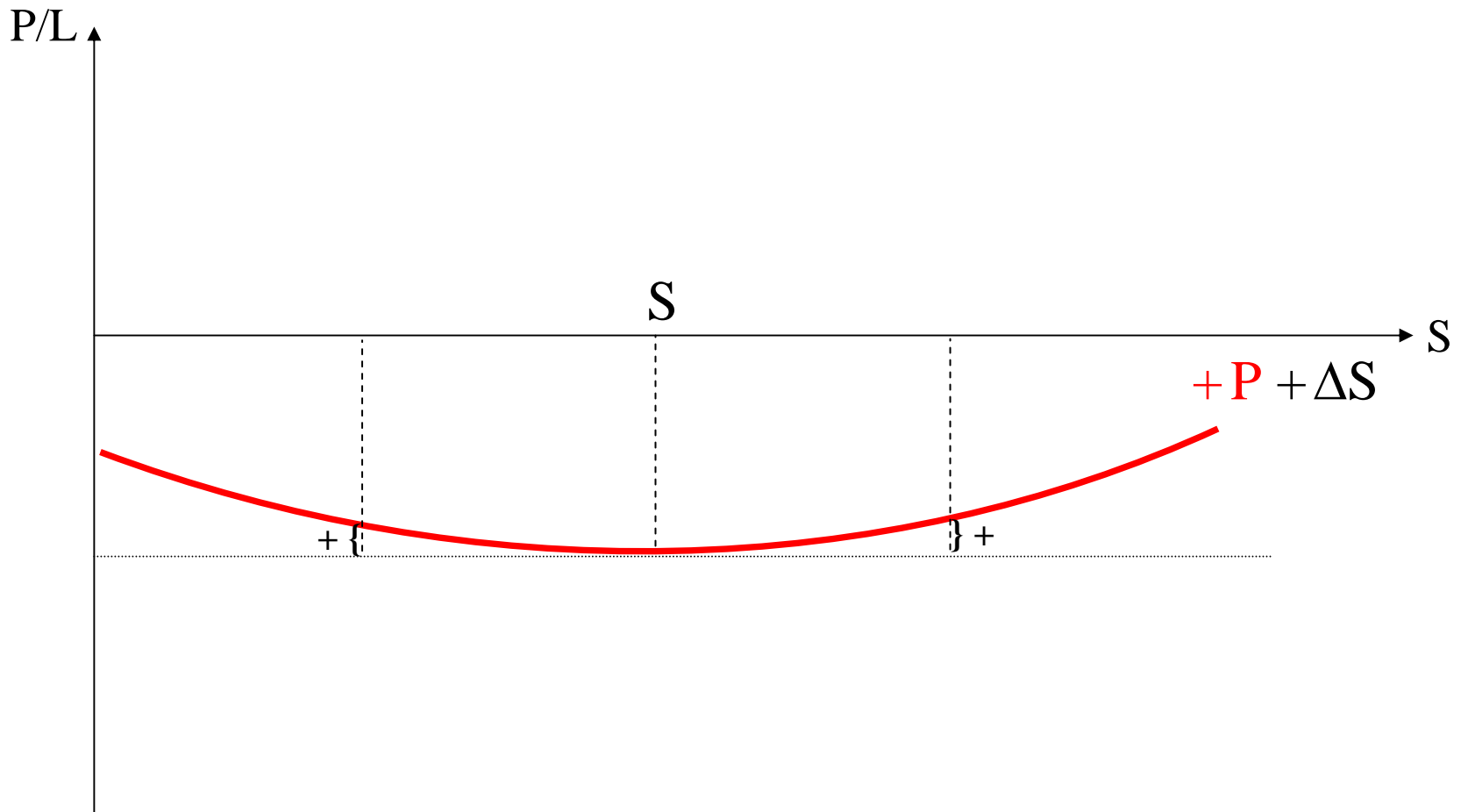


# Value Graph Before Expiration



# Long Gamma

Delta Neutral = Flat



# Long Gamma

Long Gamma = Long Options

(You want the market to move.)

There's more than one type of volatility:

Short-dated, at-the-money options: Gamma Options

(position in actual volatility)

Longer-dated options: Vega Options

(position in implied volatility)

Questions ?