

OPTION VALUATION PART 1

What is an option worth?

Option valuation

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- Readings: Chapter 21
- Problems
 - ▣ All concept checks
 - ▣ Problem sets 2, 5, 6, 8, 9, 21, 24, 26

Outline

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- ▣ What are the components of call option value?
- ▣ The determinants of call option value (intuition)
- ▣ Restrictions on call option values

The components of option value

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- ▣ C is the *premium*, the market price of the call with exercise price X, and time to expiration T.
- ▣ The *intrinsic value* is the payoff to immediate exercise (or zero, whichever is larger)
 - ▣ Intrinsic value = $\text{Max}(0, S - X)$
 - S is the price of the underlying (stock).
- ▣ The *time value* of the call is C – Intrinsic value
 - ▣ The time value of the call depends on the time value of money (the interest), but it also depends on other things.

With AAPL at 95 ... what are the premium, intrinsic value and time value of the 08 Nov 90 call?

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Calls	Last Sale
08 Nov 85.00 (QAA KQ-E)	11.15
08 Nov 90.00 (QAA KR-E)	7.15
08 Nov 95.00 (QAA KS-E)	4.40
08 Nov 100.00 (QAA KT-E)	2.25
08 Dec 85.00 (QAALQ-E)	14.40
08 Dec 90.00 (QAALR-E)	11.50
08 Dec 95.00 (QAALS-E)	8.90
08 Dec 100.00 (QAALT-E)	6.30

$$\text{Int val} = 95 - 90 = 5$$

$$S - X$$

$$* \quad 7.15 - 5 = 2.15$$

time
value

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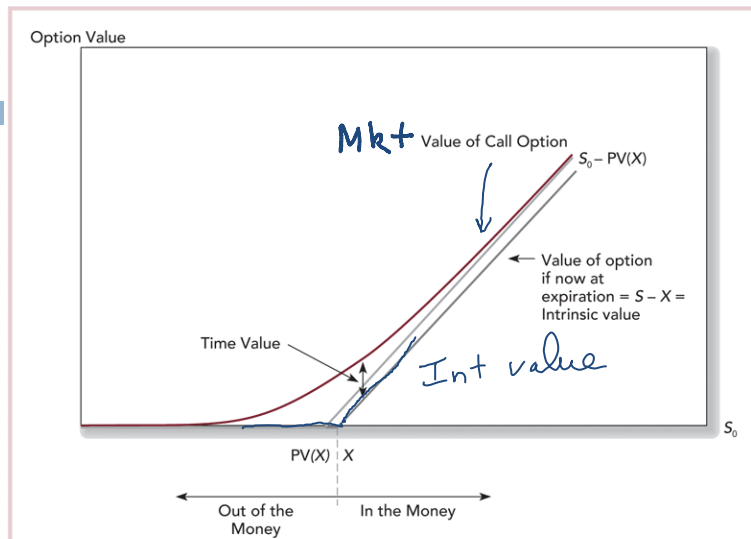


FIGURE 21.1 Call option value before expiration

The determinants of option value, C , (intuition)

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- The stock price S
 - S_0 is the current price; S_T is the price at expiration
 - As $S_0 \uparrow$, the call either goes deeper in the money or comes closer to being in the money: if $S_0 \uparrow$ then $C \uparrow$
- Exercise price, X
 - If the call is in the money and we make X larger, the intrinsic value of the call, $S-X$, drops: if $X \uparrow$ then $C \downarrow$
- Time to maturity, T
 - As T increases, there is a larger likelihood that the stock price will at some point be higher than it is now: if $T \uparrow$ then $C \uparrow$

If stock volatility $\sigma \uparrow$ then $C \uparrow$.

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- Volatility is usually defined as the standard deviation of the stock's annual return, σ .
 - Volatility is "total risk". The concepts of systematic and unsystematic risk aren't relevant in this context.
 - For a stock that doesn't pay dividends, its entire return comes from price changes (gains or losses).
 - Return volatility is (approximately) the same thing as price volatility.
- High volatility increases the likelihood of a large price swing that would push the option into the money.

If interest rate $r \uparrow$ then $C \uparrow$

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- Call options give us leverage
 - ▣ A small % increase in the stock price can cause a large % increase in the intrinsic value and market price of a call.
- You can get leverage by buying stock on margin, borrowing \$ at a cost r .
- When $r \uparrow$,
 - ▣ margin borrowing becomes more expensive
 - ▣ a call option becomes more attractive as an alternative
 - ▣ The call price rises

Restrictions on option values

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- Example: $C \geq \max(S-X, 0)$
 - ▣ If $C < \max(S-X, 0)$ we could make an immediate profit by buying the call and exercising it.
- Why study restrictions on option values?
 - ▣ Why not skip right to precise valuation formulas?
 - ▣ Valuation formulas are based on models that are only approximately correct.
- Restrictions don't depend on model.

- $C \geq 0$ (C cannot be negative)
- $C \leq S$ (C cannot exceed the stock value)
 - ▣ How large can $S - X$ be?
- For a stock that doesn't pay dividends
 - ▣ $C \geq S - PV(X)$