Equity Option Introduction and Valuation

FinPricing

Summary

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Equity Option Introduction

- Equity options, which are the most common type of equity derivatives, give an investor the right but not the obligation to buy a call or sell a put at a set strike price prior to the contract's expiry date.
- Equity options are derivatives that means their value is derived from the value of an underlying equity.
- Investors and traders can use equity options to take a long or short position in a stock without actually buying or shorting the stock.
- This is advantageous because taking a position with options allows the investor/trader more leverage in that the amount of capital needed is much less than a similar outright long or short position on margin.
- Investors/traders can therefore profit more from a price movement in the underlying stock.

The Use of Equity Options

- Equity options or stock options provide investors a way to hedge risk or speculate.
- Option investors have a number of strategies they can utilize, depending on risk tolerance and expected return.
- Buying call options allows you to benefit from an upward price movement. The right to buy stock at a fixed price becomes more valuable as the price of the underlying stock increases.
- Put options may provide a more attractive method than shorting stock for profiting on stock price declines.
- If you have an established profitable long stock position, you can buy puts to protect this position against short-term stock price declines.
- An option seller earns the premium if the underlying stock price would not change much.

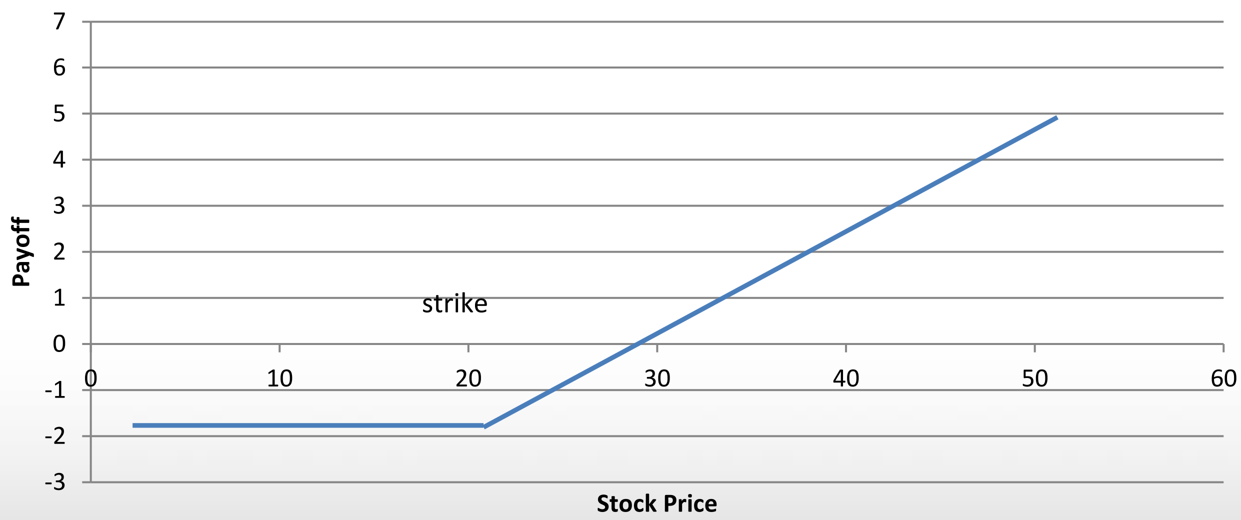
Equity Option Payoffs

- The payoff of a call option

$$Payoff = N * max(S - K, 0)$$

where N – the notional; S – the stock price; K – the strike.

- The payoff diagram of a call option



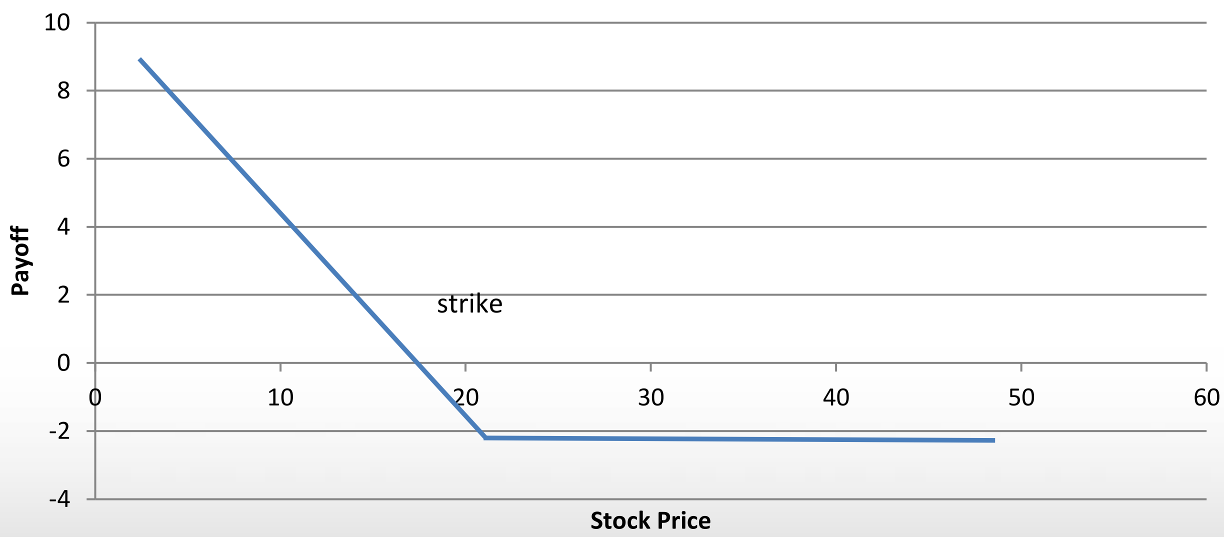
Equity Option Payoffs (Cont)

- The payoff of a put option

$$Payoff = N * max(K - S, 0)$$

where N – the notional; S – the stock price; K – the strike.

- The payoff diagram of a put option



Valuation

- The present value of call option is given by

$$PV(t) = N[S_T\Phi(d_1) - K\Phi(d_2)]D_T$$

$$d_{1,2} = {[ln(S_T/K) \pm \sigma^2 T/2]}/{\sigma\sqrt{T}}$$

where

Φ - the cumulative standard normal distribution function

t – the valuation date

T – the maturity date

K – the strike

$S_T = [S - PV(D)]e^{r_T(T-t)}$ – the equity forward price at T

Valuation (Cont)

$S_T = [S - PV(D)]e^{r_T(T-t)}$ – the equity forward price at *T*

$PV(D) = \sum_{t<\tau<T} d_\tau e^{-r_\tau(\tau-t)}$ - the present value of all dividends between *t* and *T*

d_τ – the discrete dividend paid at τ where t ≤ τ ≤ T

S - the equity spot price at t

N – the notational principal amount

$D_T = D(t,T)$ – the discount factor from *T* to *t*

Valuation (Cont)

- The present value of a put option is given by

$$PV(t) = N[K\Phi(-d_2) - S_T\Phi(-d_1)]D_T$$

where all notations are the same as above

- The put-call parity

The put-call parity defines a relationship between the price of a European call option and European put option with the identical strike and expiry

C – P = S – D*K

where C – the present value of a call option; P – the present value of a put option; S –the spot stock price; K – the strike; D – the discount factor.

Practical Guide

- Equity options are valued via the Black model in the market.
- First, you need to construct an interest zero rate curve by bootstring some most liquity interest rate instruments.
- Second, you need to construct an arbitrage-free volatility surface. FinPricing is using SVI model to construct equity volatility surface.
- Then you need to calculate equity forward price correctly by taking all dividends into account.
- Finally, you can get the price via the Black formula.

A Real World Example

Underlying equity	**.CSEARC5E**
Currency	USD
Strike	150.4292
Maturity Date	2/24/2022
Call or Put	Call
Exercise Type	European
Settlement Type	Physical
Position	598.2881

Thank You

Reference:

https://finpricing.com/lib/EqBarrier.html