Introduction to Derivative Instruments

Paris Dauphine University - Master I.E.F. (272)
Autumn 2025

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Slides on book: John C. Hull, “Options, Futures, and Other Derivatives”, Pearson ed.

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Chapter 8

Chapter 8: Mechanics of Options Markets
Outline

Introduction
Motivation

- This chapter explains how options markets are organized, what terminology is used, how the contracts are traded, how margin requirements are set, and so on.
- Later chapters will examine such topics as trading strategies involving options, the determination of option prices, and the ways in which portfolios of options can be hedged.

Introduction
Option vs Forward and Futures Contracts

- Options are fundamentally different from forward and futures contracts.
  - An option gives the holder of the option the right to do something, but the holder does not have to exercise this right.
  - By contrast, in a forward or futures contract, the two parties have committed themselves to some action.
  - It costs a trader nothing (except for the margin requirements) to enter into a forward or futures contract, whereas the purchase of an option requires an up-front payment.
- When charts showing the gain or loss from options trading are produced, the usual practice is to ignore discounting, so that the profit is the final payoff minus the initial cost.

Definition

A **call** (resp. **put) option** gives the holder of the option the right to buy (resp. sell) an asset by a certain date for a certain price.

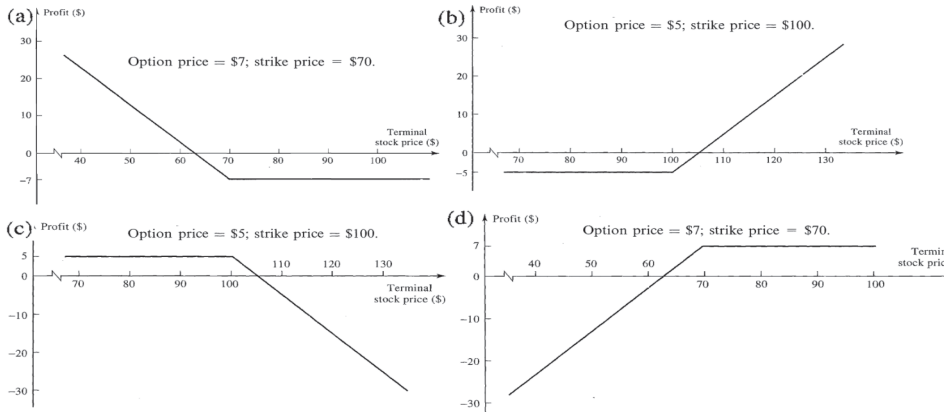
The date specified in the contract is known as the **expiration date** or the **maturity date**.

The price specified in the contract is known as the **exercise price** or the **strike price**.

American options can be exercised at any time up to the expiration date.

European options can be exercised only on the expiration date itself.

- Most, of the options that are traded on exchanges are American.
  - However, European options are generally easier to analyze than American options, and some of the properties of an American option are frequently deduced from those of its European counterpart.



- Which type of European option is (a), (b), (c), and (d)?
  - (a) Long Put; (b) Long Call; (c) Short Call; and (d) Short Put.

- If K is the strike price and S_T is the final price of the underlying asset, the payoff from a long position in a European call option is

$$\max(S_T - K, 0)$$

  - This reflects the fact that the option will be exercised if $S_T > K$ and will not be exercised if $S_T \leq K$.
  - The payoff to the holder of a short position in the European call option is

$$-\max(S_T - K, 0) = \min(K - S_T, 0)$$

- The payoff to the holder of a long position in a European put option is

$$\max(K - S_T, 0)$$

and the payoff from a short position in a European put option is

$$-\max(K - S_T, 0) = \min(S_T - K, 0).$$

- Stocks
- Foreign Currency
- Stock Indices
- Futures
  - When an exchange trades a particular futures contract, it often also trades options on that contract.
  - A futures option normally matures just before the delivery period in the futures contract.
  - When a call (resp. put) option is exercised, the holder's gain equals the excess of the futures price (resp. strike price) over the strike price (resp. futures price).
- In the rest of this chapter, we will focus on stock options.

Exercise (6)

A trader buys a call option with a strike price of \$45 and a put option with a strike price of \$40.
Both options have the same maturity.
The call costs \$3 and the put costs \$4.

Draw a diagram showing the variation of the trader's profit with the asset price at maturity.

Solution (6)

Solution (6)

Chapter 8: Mechanics of Options Markets
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Stock Options
Terminology

Definition

All options of the same type (calls or puts) are referred to as an **option class**.

- For example, IBM calls are one class, whereas IBM puts are another class.

Definition

An **option series** consists of all the options of a given class with the same expiration date and strike price.

- For example,IBM 70 October calls would constitute an option series.

Stock Options
Terminology

Definition

If S is the stock price and K is the strike price, a call (resp. put) option is **in the money** when $S > K$ (resp. $S < K$),**at the money** when $S = K$, and **out of the money** when $S < K$ (resp. $S > K$).

- Clearly, an option will be exercised only when it is in the money.

Stock Options
Terminology

Definition

The **intrinsic value** of an option is defined as the maximum of zero and the value the option would have if it were exercised immediately.

- For a call option, the intrinsic value is therefore $\max(S - K, 0)$. For a put option, it is $\max(K - S, 0)$.
- An in-the-money American option must be worth at least as much as its intrinsic value because the holder can realize the intrinsic value by exercising immediately.
  - Often it is optimal for the holder of an in-the-money American option to wait rather than exercise immediately.
  - The option is then said to have **time value**.
  - The total value of an option can be thought of as the sum of its intrinsic value and its time value.

Stock Options
Dividends & Stock Splits

- Exchange-traded options are not usually adjusted for cash dividends.
  - In other words, when a cash dividend occurs, there are no adjustments to the terms of the option contract.
- Exchange-traded options are adjusted for stock splits.
  - A stock split occurs when the existing shares are “split” into more shares.
  - For example, in a 3-for-1 stock split, three new shares are issued to replace each existing share.
  - Because a stock split does not change the fundamentals of a company, we should not expect it to have any effect on the wealth of the company’s shareholders.
  - All else being equal, the 3-for-1 stock split should cause the stock price to go down to one-third of its previous value.

Stock Options
Dividends & Stock Splits

- In general, an n-for-m stock split should cause the stock price to go down to $\frac{m}{n}$ of its previous value.
  - The terms of option contracts are adjusted to reflect expected changes in a stock price arising from a stock split.
  - After an n-for-m stock split, the strike price is reduced to $\frac{m}{n}$ of its previous value, and the number of shares covered by one contract is increased to $\frac{n}{m}$ of its previous value.
  - If the stock price declines in the way expected, the positions of both the writer and the purchaser of a contract remain unchanged.

Example

Consider a call option to buy 100 shares of a company for $30 per share.
Suppose the company makes a 2-for-1 stock split.
The terms of the option contract are then changed so that it gives the holder the right to purchase 200 shares for $15 per share.

Stock Options
Dividends & Stock Splits

Example

Consider a put option to sell 100 shares of a company for $15 per share.
Suppose the company declares a 25% stock dividend.
This is equivalent to a 5-for-4 stock split.
The terms of the option contract are changed so that it gives the holder the right to sell 125 shares for $12.

Exercise (3)

A company declares a 2-for-1 stock split.

Explain how the terms change for a call option with a strike price of $60.

Solution (3)

Stock Options
Market Makers

Definition

A **market maker** for a certain option is an individual who, when asked to do so, will quote both a bid and an offer price on the option.
The **bid** is the price at which the market maker is prepared to buy, and the **offer** or **asked** is the price at which the market maker is prepared to sell.
The offer is always higher than the bid, and the amount by which the offer exceeds the bid is referred to as the **bid-offer spread**.

- Most exchanges use market makers to facilitate options trading.
  - At the time the bid and offer prices are quoted, the market maker does not know whether the trader who asked for the quotes wants to buy or sell the option.
  - Market makers add liquidity to the market.

Stock Options
Market Makers

- Not all options are traded on exchanges. Many options are traded in the OTC market.
  - An advantage of OTC options is that they can be tailored by a financial institution to meet the particular needs of a corporate treasurer or fund manager.
  - A disadvantage is that the option writer may default. This means that the purchaser is subject to some credit risk.

Stock Options
Margins

- When shares are purchased in the U.S., an investor can borrow up to 50% of the price from the broker.
  - This is known as **buying on margin**.
  - If the share price declines so that the loan is substantially more than 50% of the stock's current value, there is a *margin call*, where the broker requests that cash be deposited by the investor.
  - If the margin call is not met, the broker sells the stock.
- When call and put options with maturities less than 9 months are purchased, the option price must be paid in full.
  - Investors are not allowed to buy these options on margin because options already contain substantial leverage and buying on margin would raise this leverage to an unacceptable level.
  - For options with maturities greater than 9 months investors can buy on margin, borrowing up to 25% of the option value.

Stock Options
Warrants, Employee stock options, and Convertible bonds

Definition

Stock Warrants are options issued directly by the company concerned.

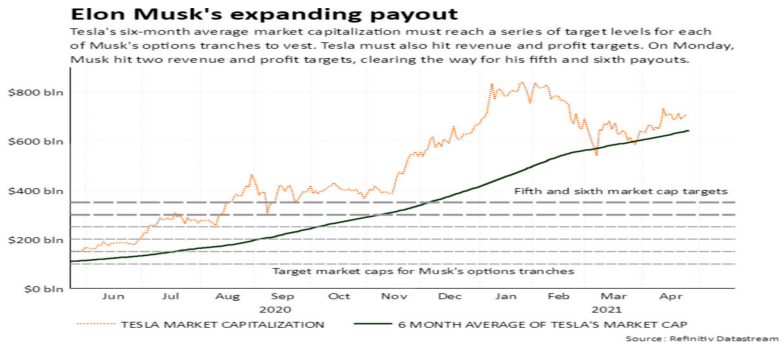
- Warrants are *dilutive*.
  - When the warrant issued by the company is exercised, the company issues new shares of stock, so the number of outstanding shares increases.
- The corporation issues call warrants on its own stock and then attaches them to the bond issue to make it more attractive to investors.

Definition

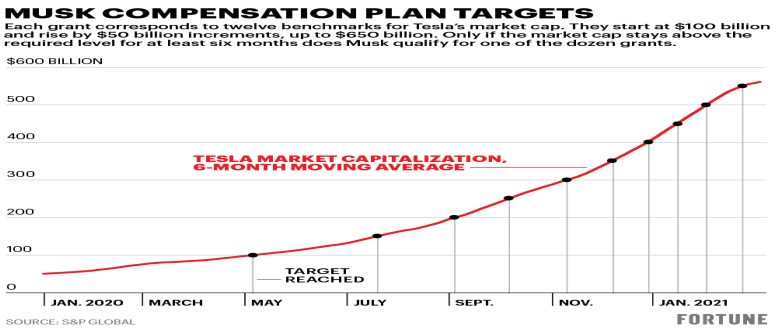
Employee stock options are call options issued to employees by their company to motivate them to act in the best interests of the company's shareholders.

- They are usually at the money at the time of issue.
- They are now a cost on the income statement of the company in most countries, making them a less attractive form of compensation than they used to be.
- In 2022, still around half of the companies traded on the S&P 500 offer some form of Employee Stock Purchase Plan to their staff.

- Elon Musk doesn't receive any cash salary or bonus from Tesla, but is instead paid entirely with stock options.
  - In 2012, he get options on 22.8 million shares with $K = \$6.24$.
  - He received other options at higher strike later on...
  - In 2018, the Tesla board fashioned a new 10-year pay plan.



- In his 2018 pay package, Elon Musk was granted 12 tranches of options.
  - Each tranche gave him the option to buy 8.4 million Tesla shares at \$70 each.
  - Each tranche is associated with a target on the Tesla 6-month average market capitalization.



- In 2021, Tesla shares exceeded \$1,200 (adjusted from stock-split) and its market cap. exceeded \$550 billion.
- Musk's stock options allowed him to pay \$1.8 billion to buy 25.32 million shares, worth \$23 billion.
- He then faced a \$15 billion tax bill.

Definition

Convertible bonds are bonds issued by a company that can be converted into equity at certain times using a predetermined exchange ratio.

- They are therefore bonds with an embedded call option on the company's stock.

- Warrants issued by a company on its own stock, employee stock options, and convertibles are different from exchange-traded options:
  - First, a predetermined number of options are issued with these instruments.
  - Second, when these instruments are exercised, the company issues more shares of its own stock and sells them to the option holder for the strike price.
    - By contrast, when an exchange-traded call option is exercised, the party with the short position buys in the market shares that have already been issued and sells them to the party with the long position for the strike price.
    - The company whose stock underlies the option is not involved in any way.

- A call (resp. put) option gives the holder the right to buy (resp. sell) the underlying asset for a certain price by a certain date.
- There are four possible positions in options markets: a long position in a call, a short position in a call, a long position in a put, and a short position in a put.
- The terms-of a stock option are not normally adjusted for cash dividends.
  - However, they are adjusted for stock dividends, and stock splits.
  - The aim of the adjustment is to keep the positions of both the writer and the buyer of a contract unchanged.
- Most option exchanges use market makers.
  - Market makers improve the liquidity of the market and ensure that there is never any delay in executing market orders.
- Writers of options have potential liabilities and are required to maintain margins with their brokers.