

Financial Markets

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Lecture 9

Content:

- Derivatives
- Forwards
- Futures
- Swaps
- Options

Derivatives

Derivative: a contractual agreement to execute an exchange at some future date.

Its price “derives” from the value of the underlying asset to be exchanged (a stock, bond, currency, commodity, ...).

There are four main types of derivatives:

- Forwards
- Futures
- Swaps
- Options

Derivatives

Many derivatives (especially the most standardized ones) are traded on **exchange-traded derivatives markets**.

Examples: Chicago Board of Trade (CBOT), Chicago Board Options Exchange (CBOE), and many others.

Other derivatives are traded on **over-the-counter (OTC) markets**. These consist of bilateral transactions between private parties, though they may be mediated by a central counterparty (CCP). A CCP is typically a private company that ensures trades are cleared properly.

New regulations (Dodd-Frank act for US; EMIR for EU) for OTC negotiations made the distinction more blurred.

Forwards

A transaction executed (almost) immediately is a **spot** transaction.

A **forward** contract, on the contrary, is an agreement to an exchange that will happen in the future.

One of the parties takes a long position and agrees to buy a certain quantity of the underlying asset at a future date for a certain price.

The other party takes a short position and agrees to sell the underlying asset.

Forwards are negotiated on OTC markets.

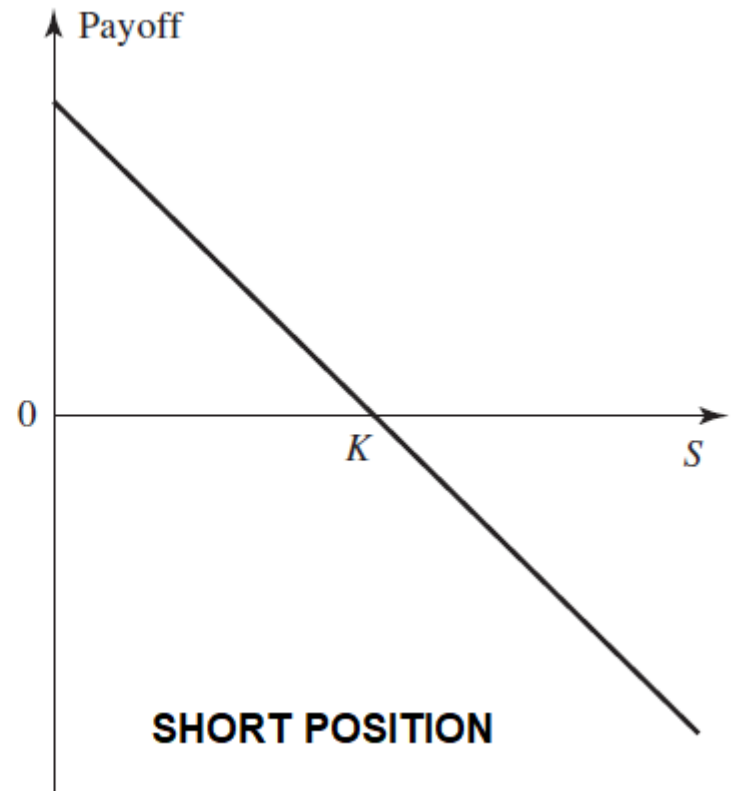
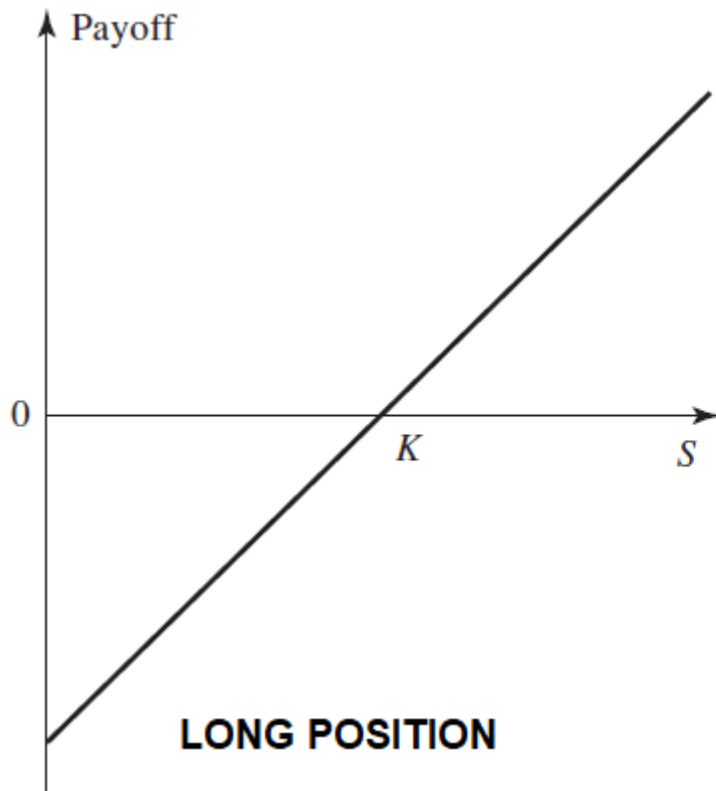
Forwards

If S is the price of the asset at maturity and K is the delivery price, the payoff from the long position is:

$$S - K$$

The payoff from the short position is:

$$K - S$$



Futures

A **futures** contract is virtually identical to a forward contract, with the difference that they are normally standardized and traded on an exchange.

Gains and losses on a futures position are posted and cleared at the end of each day (“marking-to-market”).

At any given time, the total number of contracts outstanding as long positions must equal the total number of contracts outstanding as short positions.

The total number of contracts outstanding (long or short) is called **open interest**.

Futures

Even in an efficient market with no arbitrage opportunities, the spot price for a certain asset will not be equal to the futures (or forward) price. This is because holding an assets can have both costs and benefits.

Costs include:

- **cost of funds:** money spent to buy the asset cannot be invested in other ways
- **cost of carry:** the cost to store, insure, etc., if the underlying asset is a physical good

Futures

Benefits include:

- **income**: if the asset is a financial instrument, it might generate cash flows (e.g., a bond that pays coupons)
- **convenience yield**: if the asset is a physical good, having it ready to use might be an advantage

Therefore, the futures/forward price can be both superior (“contango”) or inferior (“backwardation”) to the spot price.

As the maturity date approaches, the two prices tend however to become equal or very close.

Swaps

A **swap** is an over-the-counter agreement between two companies to exchange cash flows in the future.

The most common is the **interest rate swap**, where interest at a predetermined fixed rate, applied to a certain principal (i.e., the notional amount on which interests are computed), is exchanged for interest at a floating reference rate, applied to the same principal.

Conceptually, a swap can be thought of as a portfolio of forward contracts with different maturity dates, whose underlying asset is the reference interest rate.

Options

Financial option: a contract that gives its owner the right (but not the obligation) to purchase or sell an asset at a fixed price at some future date.

- **Call option:** gives the owner the right to buy the asset;
- **Put option:** gives the owner the right to sell the asset.

Option writer: the person who takes the other side of the contract, who sells the option for a **premium** (the price of the option). This person has the obligation to sell the asset at the stipulated price if the owner of the call option exercises it, and to buy it if the owner of a put price exercises it.

Options

The **buyer** (or “holder”) of an option has a **long** position.

The **seller** (or “writer”) of an option has a **short** position.

When the holder of an option enforces the agreement and buys or sells a share of stock at the agreed-upon price, he is **exercising** the option.

Strike price (or exercise price): the price at which the holder buys or sells the share of stock when the option is exercised.

Open interest: the total number of outstanding contracts of an option.

Options

American options: allow their holders to exercise the option on any date up to and including a final date (**expiration date**).

European options: allow their holders to exercise the option only on the expiration date, not before.

Asian options: the payoff depends on the average price of the underlying asset over a certain period of time.

Options

The option is said to be **at-the-money** when its exercise price is equal to the current price of the stock

The option is **in-the-money** if the payoff from exercising it immediately is positive. This happens when the strike price is:

- is below the current stock price for call options
- is above the current stock price for put options

The option is **out-of-the-money** if the payoff from exercising it immediately is negative. This happens when the strike price:

- is above the current stock price for call options
- is below the current stock price for put options

Options

Options are only exercised when they are in-the-money. Otherwise, they are useless, and their value is zero.

Thus, for the holder (long position), if S is the stock price at expiration, K is the exercise price, C is the value of the call option and P is the value of the put option:

- the value of the call at expiration is

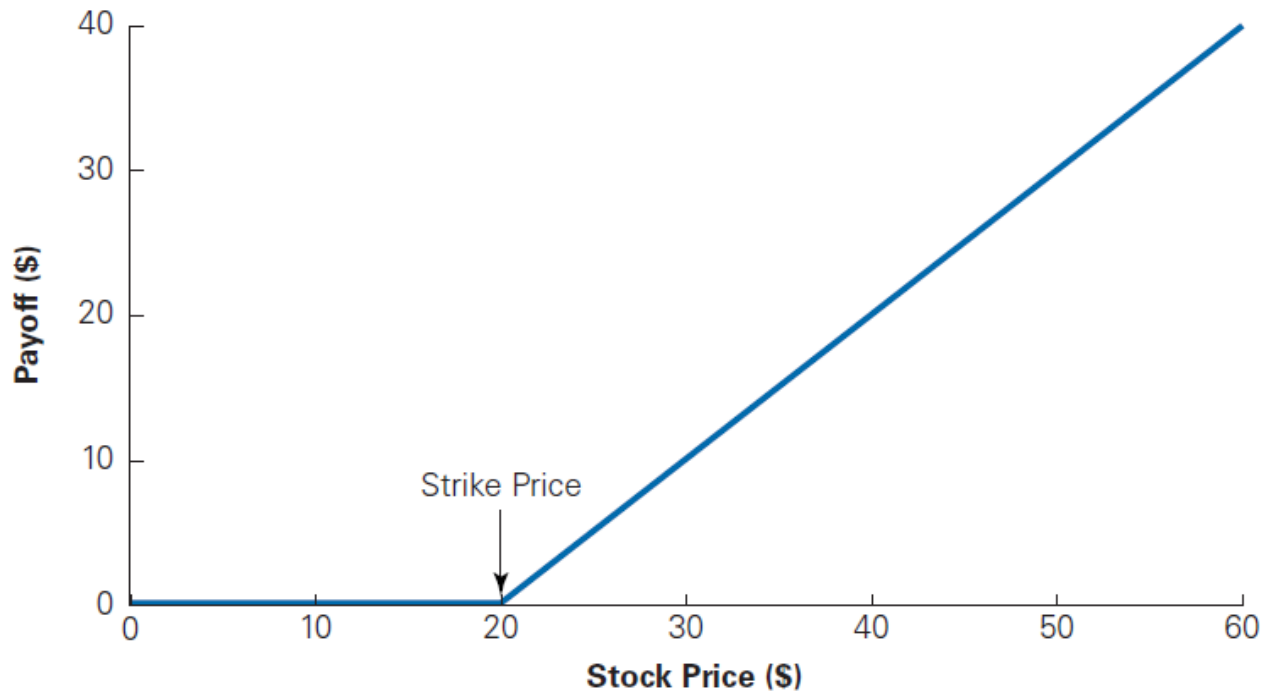
$$C = \max(S - K, 0)$$

- the value of the put at expiration is

$$P = \max(K - S, 0)$$

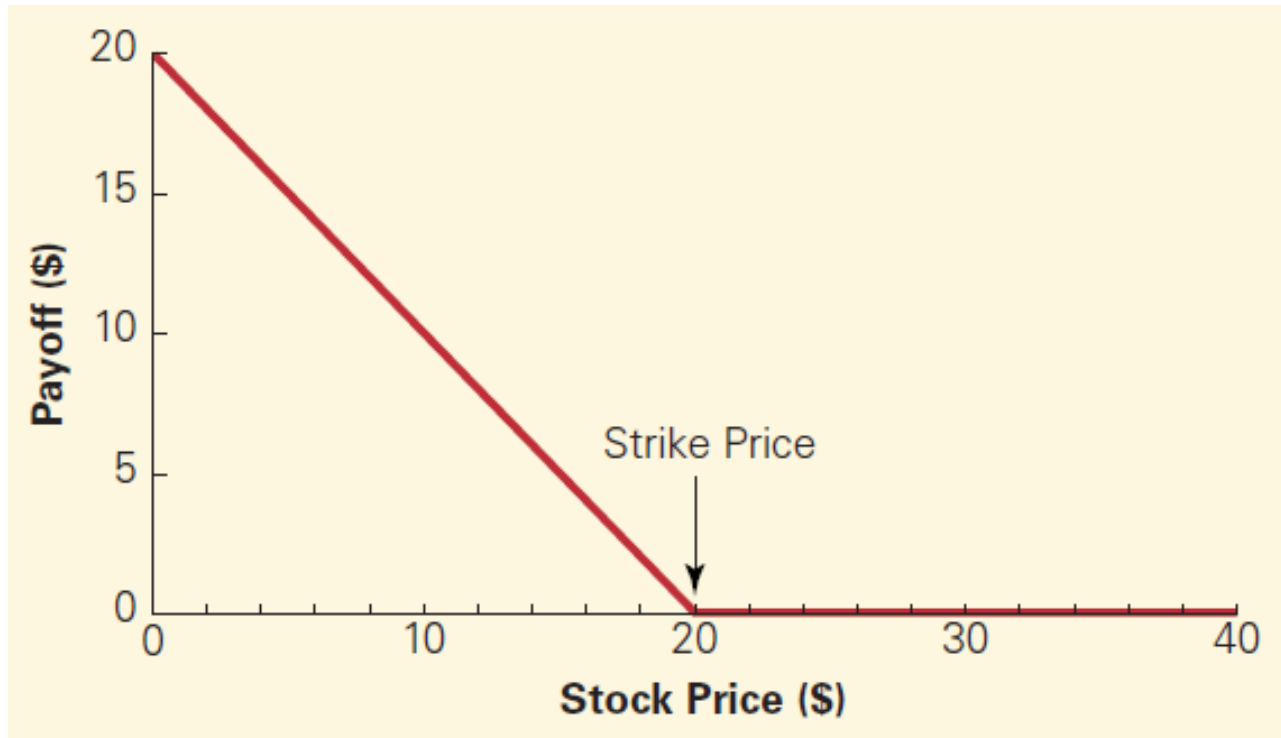
Options

Example: holder's payoff of a call option with a strike price of 20\$ (i.e., it gives the owner the right to buy the stock at a price of 20\$)



Options

Example: holder's payoff of a put option with a strike price of 20\$ (i.e., it gives the owner the right to sell the stock at a price of 20\$)



Options

The seller (short position) only profits from the premium (i.e., the price paid by the holder to buy the option contract). The payoff at expiration for the seller can thus only be zero or negative: the short position's cash flows are the negative of the long position's cash flows.

If S is the stock price at expiration and K is the exercise price:

- the seller's cash flow of the call at expiration is
$$-\max(S - K, 0)$$
- the seller's cash flow of the put at expiration is
$$-\max(K - S, 0)$$

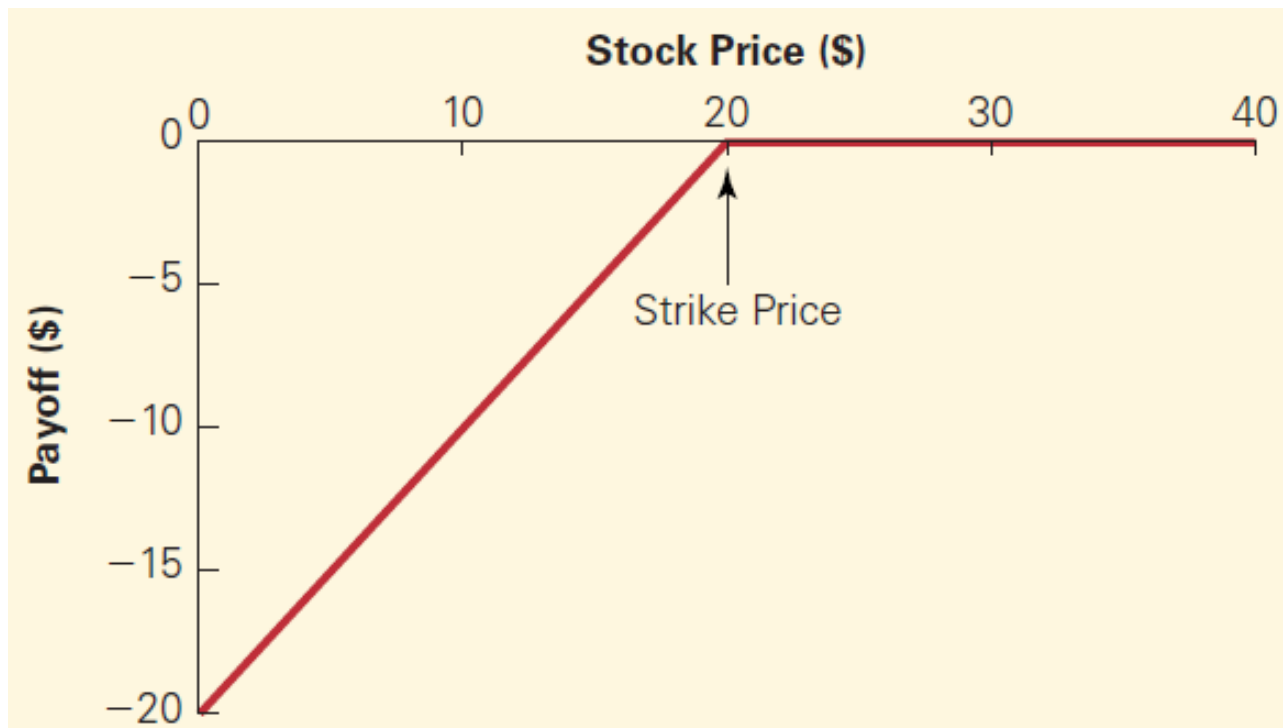
Options

Example: writer's payoff of a call option with a strike price of 20\$ (i.e., it gives the owner the right to buy the stock at a price of 20\$)



Options

Example: writer's payoff of a put option with a strike price of 20\$ (i.e., it gives the owner the right to sell the stock at a price of 20\$)



Options

As the stock price cannot fall below 0, but can always rise:

- the upside (downside) of a call option for the holder (writer) is unlimited
- the upside (downside) of a put option for the holder (writer) is limited to the strike price

To compute the overall profit or loss of a position in an option, we should also account for the option price p .

Options

Thus, for the holder, if S is the stock price at expiration, K is the exercise price, and p is the price paid to buy the option, the overall cash flow of the contract is:

- for a call: $\max(S - K, 0) - p$
- for a put: $\max(K - S, 0) - p$

While for the writer the overall cash flow of the contract is:

- for a call: $-\max(S - K, 0) + p$
- for a put: $-\max(K - S, 0) + p$

Options

Option positions can be combined to achieve various goals.

One of the simplest combinations is the **straddle**: buying both a call and a put option on a certain stock.

The payoff of this portfolio of options at expiration is zero if the stock price is exactly equal to the strike price, and positive in all other cases.

However, we need to account for the cost of implementing the strategy (i.e. the money paid to buy the options).

The profits are therefore negative if the stock price at expiration is equal or close to the strike price.

Options

Payoff and profit at expiration for the investor who buys a portfolios of options to implement a straddle:

