Lecture 5

Introduction to Options, Futures and Other Derivatives

Why Derivatives Are Important

- Derivatives play key roles in trading and managing risks in the economy.
- Derivatives markets are much larger than stock markets in terms of underlying asset values.
- Underlying assets include stocks, currencies, interest rates, commodities, debt instruments, electricity, insurance payouts, the weather, etc.

Why Derivatives Are Important

- Financial instruments commonly contain *embedded options*; e.g., bonds can be callable, putable, and convertible, mortgagees can pre-pay their mortgages, term life insurance policyholders can convert to cash value policies, etc.
- Companies hold "real" options to expand, defer, or abandon projects, etc.

How Derivatives are Traded

- On exchanges such as the Chicago Board Options Exchange (CBOE) and various options and futures exchanges operating under the auspices of CME Group, such as CME (agriculture, equities, foreign exchange, interest rates), CBOT (agriculture, equities, interest rates), COMEX (metals), NYMEX (energy, metals, agricultural).
- In the over-the-counter (OTC) market where contracts are traded (and privately negotiated) directly between counterparties, *sans* exchanges or other intermediaries.

Global Stocks vs. OTC Derivatives

- Global Stocks: As of 12/31/2020, the total market market value of all stocks worldwide was **approximately** $93.7 trillion (see https://en.wikipedia.org/wiki/Stock_market).
- Global OTC Derivatives *Notional* Value: As of 12/31/2020, the total *notional* value of all OTC foreign exchange, interest rate, and equity-linked derivatives contracts came to **$582,055 trillion.**
- Global OTC Derivatives *Market* Value: As of 12/31/2020, the total *market* value of all OTC foreign exchange, interest rate, and equity-linked derivatives contracts came to $**15.8 trillion** (see Bank of International Settlements (BIS), Table D5.1).

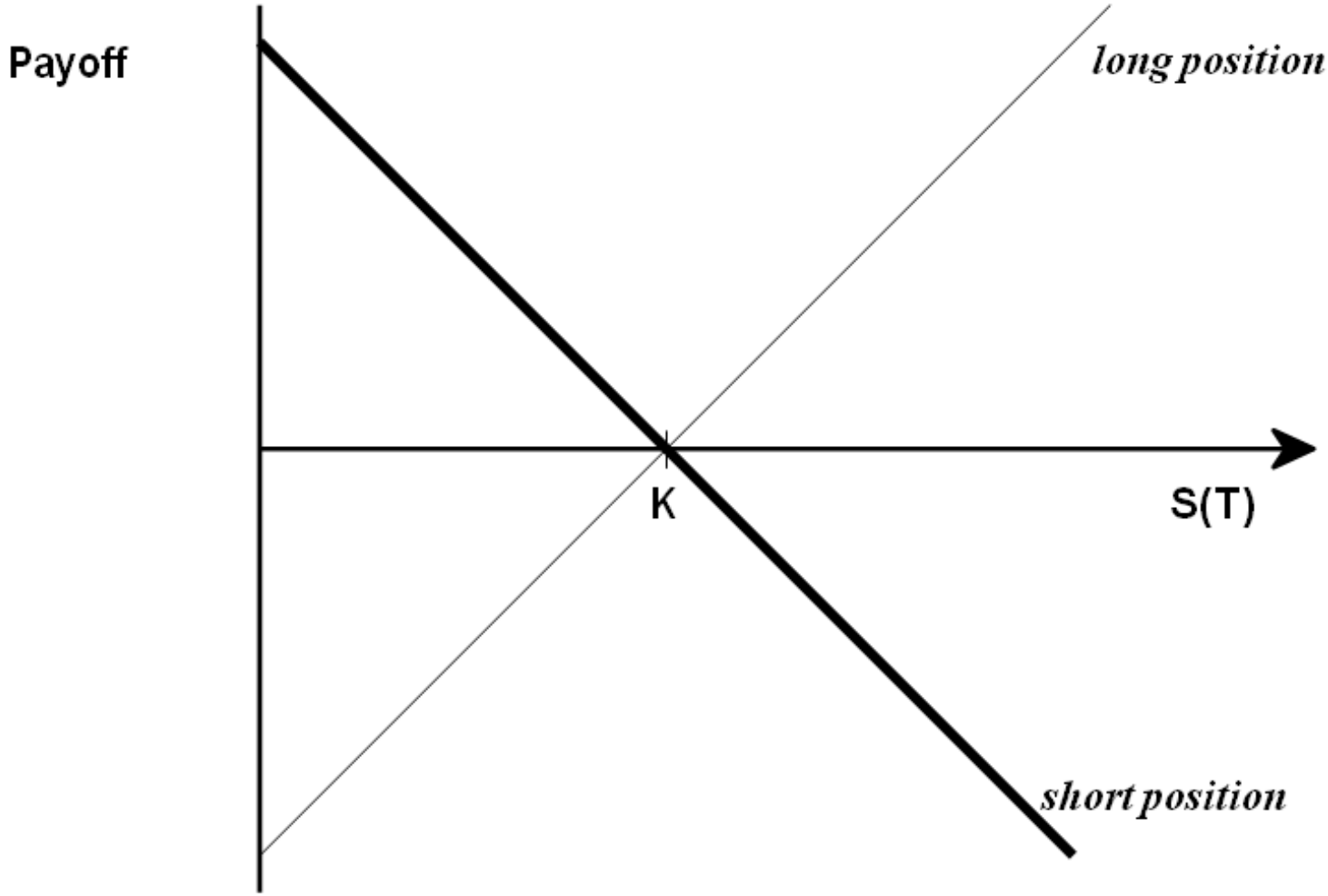
Forward Contracts

- A forward contract is an agreement between two parties to buy/sell an underlying asset at a specified price on a specified date.
- The specified price is the forward price.
- The party agreeing to buy the underlying asset in the future "buys forward" and holds a "long" position in that contract.
- The party agreeing to sell the underlying asset in the future "sells forward" and holds a "short" position in that contract.

Forward Contract Specification

- Amount and quality of the underlying.
- Delivery or forward price, denoted as K.
- Time of delivery, denoted as T.
- Location of Delivery.

Forward Payoff Diagram



Swaps

- Whereas a forward contract involves the exchange of cash flows on one future date, a swap is essentially a *portfolio* of forwards involving a series of cash-flow exchanges occurring on several future dates.
- The most common types of swaps include interest rate and currency swaps.
  - An interest rate swap transforms a floating-rate loan or investment into a fixed-rate loan or investment, or vice versa.
  - A currency swap transforms a loan or investment denominated in one currency into a loan or investment denominated in another currency.

Futures Contracts

- Agreement to buy or sell the underlying at a specified price on a specified date.
- Economics of futures contracting is essentially equivalent to forward contracting!
- However, whereas forward contracts are traded "over-the-counter" (OTC), futures contracts are traded on exchanges.
- The main difference between exchange-traded futures and OTC traded forwards is marking to market, or realizing gains and losses each day rather than all at once at expiration.

Forwards vs. Futures Contracts

FORWARDS	FUTURES
Private contract between 2 parties	Exchange traded
Non-standard contract	Standard contract
Usually 1 specified delivery date	Range of delivery dates
Settled at end of contract	Settled daily
Delivery or final cash settlement usually occurs	prior to maturity
Some credit risk	Virtually no credit risk

Options vs. Forwards/Futures

- Futures and forwards convey the *obligation* to purchase/sell the underlying at a given price and at a given point of time in the future.
- Options are *choices*.
  - A call (put) option conveys the *right* (not obligation) to purchase (sell) a security at a given price within a given period of time.

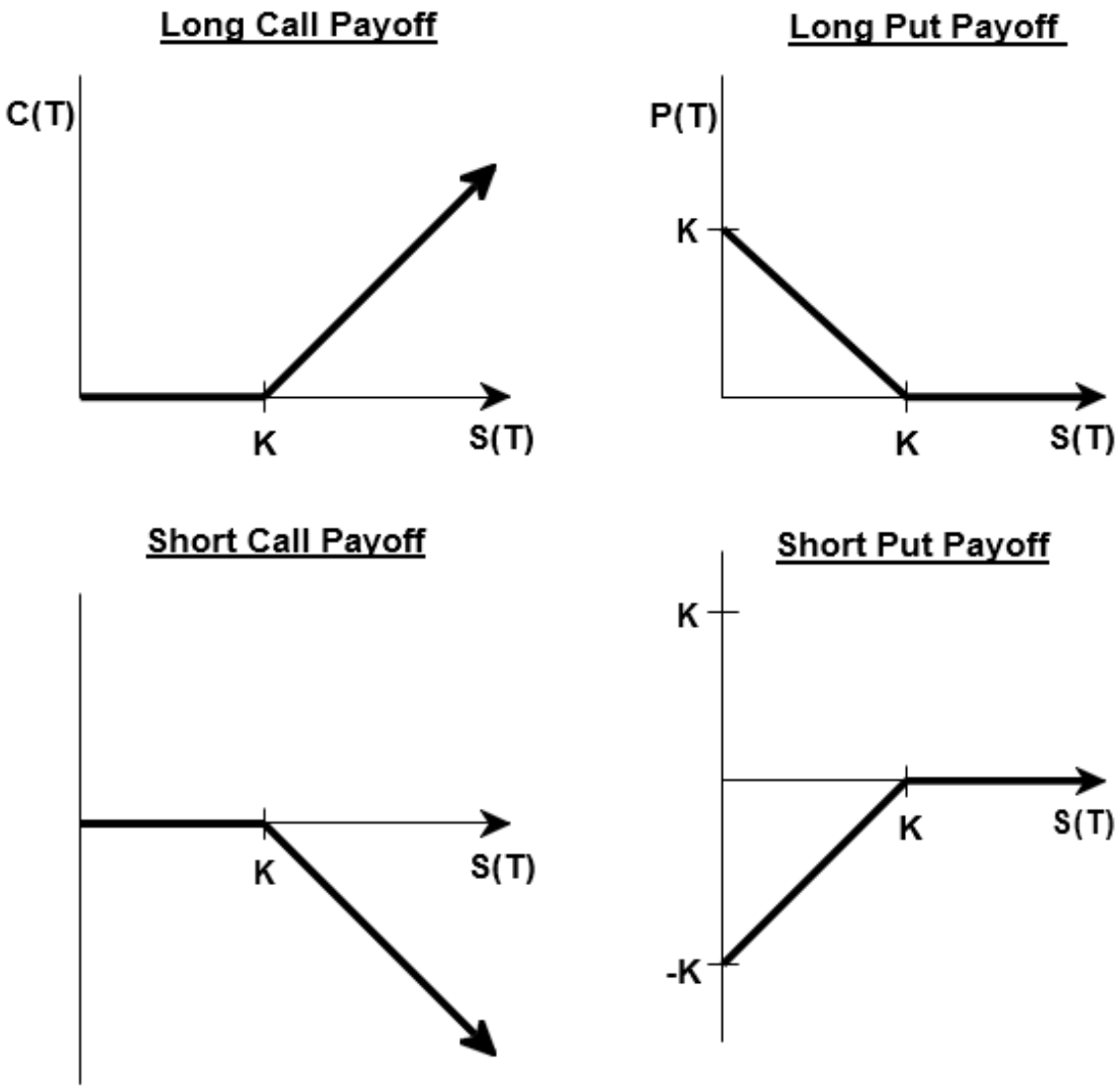
Option Contract Specification

- Number of units of the underlying.
- Strike or exercise price, denoted as K.
- Maturity or expiration date, denoted as T.
- Options styles: European or American
  - The owner of an European-style option can exercise *only on* the expiration date.
  - The owner of an American-style option can exercise at any time *up to and including* the expiration date.

Option Properties

- An option is *in-the-money* (*ITM*) if it is worth something if exercised today.
- An option is *out-of-the-money* (*OTM*) if it would cost something to exercise today.
- An option is *at-the-money* (*ATM*) if the current price of the underlying is equal to the strike price
- At expiration, the payoff on a call option is Max[0, $S(T)$-K], whereas the payoff on a put option is Max[0, K - $S(T)$].

Payoffs from Options



Examples of Exchange-Traded Options

- Options on individual stocks
- Option on indices (e.g., S&P 100 and S&P 500)
- Foreign Currency Options
- Options on Futures

Warrants

- Warrants are generally issued by the company itself, not a third party, and they are traded over-the-counter more often than on an exchange.
- Warrants tend to have much longer periods between issue and expiration than options, of years rather than months.
- Warrants are no longer common in the United States but are actively traded in Hong Kong, Germany, and other countries.

Employee Stock Options

- Employee stock options are a form of remuneration issued by a company to its employees.
- They are usually issued as at-the-money (call) options.
- When options are exercised the company issues more stock and sells it to the option holder for the strike price.

Convertible Bonds

- Convertible bonds are regular bonds that can be exchanged for equity at certain times in the future according to a predetermined exchange ratio.
- Usually a convertible is callable; i.e., it can be redeemed by the issuer prior to its maturity.
- The call provision is a way in which the issuer can force conversion at a time earlier than the holder might otherwise choose.

Over-the-Counter (OTC) Options

- OTC options are not exchange-traded.
- They are privately negotiated arrangements between financial institutions and/or corporations.
- OTC options tend to be highly personalized and therefore not easily traded.
- Because of personalization, OTC options can be designed to accommodate any unique hedging need.