

# Math 174E

## Lecture 1

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# Chapter 1: Introduction



Hull

Chapters 1.1, 1.2, 1.3

# Financial Derivatives

## Definition 1.1

A **financial derivative** is a financial instrument (**contract**) whose value (price) depends on, or is derived from, the value (price) of other (more basic) financial assets or variables (**underlyings**).

Examples of underlyings:

Stocks, market indices (S&P 500 stock market index), bonds, interest rates, currencies, cryptocurrencies, commodities, electricity, credit, other financial derivatives, . . .

underlyings are *tradable* financial **risky assets** (**financial securities**)

# Examples of Financial Derivatives

Most basic examples:

- ▶ Forward contracts
- ▶ Futures contracts
- ▶ Options
- ▶ Swaps

## (Very) Generic Description of Financial Derivatives

- ▶ financial derivatives constitute the **exchange of cashflows** (or **financial securities**) between **two parties**
  - ▶ at time  $t = 0$  when the contract is initiated (today)
  - ▶ at a **future point** in time  $t = T > 0$  when contract expires (**maturity date**)
  - ▶ and, more generally, possibly also during the **lifetime**  $[0, T]$  of the contract
- ▶ the exchanged cashflows depend on the market value of the **underlying asset** and are determined by the **contract** of the financial derivative
- ▶ cashflows = **payoffs** (reflecting current market values)
- ▶ today at time  $t = 0$  when the contract is initiated between the two parties
  - ▶ initial cashflow exchanged between the two parties is known
  - ▶ but all cashflows exchanged in the future (or the market value of the exchanged financial securities) are typically **unknown**

# Our Main Concerns and Goals

1. What are the most basic financial derivatives and how do they work?
  - ▶ How are they traded? Why are they traded? What is their purpose? What are their financial risks?
2. How are these financial derivatives **valued**?
  - ▶ Is there a notion of a fair (or meaningful) evaluation?
  - ▶ How to manage the financial risks of derivatives?

# Derivatives Markets 1/2

## 1. Exchange traded

- ▶ many derivatives exchanges all over the world:  
Chicago Board Options Exchange (CBOE), CME Group Inc.,  
Eurex Exchange, Shanghai Futures Exchange, ...
- ▶ standardized contracts
- ▶ trades are handled by the exchange **clearing house** which manages the risk (**credit risk**)
- ▶ electronic trading platforms

## 2. Over-the-counter (OTC)

- ▶ financial derivatives are traded directly between two parties  
(investment banks, financial institutions, fund managers,  
corporations)
- ▶ no standardization
- ▶ bilateral agreements, cleared bilaterally
- ▶ some **credit risk, systemic risk**
- ▶ after the credit crisis in 2007, new regulations were implemented which require a **central counterparty (CCP)** to clear trades between two counterparties

## Derivatives Markets 2/2

- ▶ large investment banks typically act as **market makers** for financial derivatives, as for many other financial securities (stocks etc.)
  - ▶ a market maker stands ready to trade (buy and sell) financial securities on a regular and continuous basis, to quote prices, and to take both sides of a trade in a derivatives contract
- ▶ in the U.S. all securities trading is overseen by the **U.S. Securities and Exchange Commission (SEC)**
  - ▶ the SEC is an independent agency of the United States federal government, created in the aftermath of the Wall Street Crash of 1929
  - ▶ primary purpose of the SEC is to enforce the law against market manipulation (to protect investors; maintain fair, orderly, and efficient markets; and facilitate capital formation)

Source: Wikipedia.



# Purpose of Financial Derivatives

**Three types of traders:** speculators, hedgers, arbitrageurs.

- ▶ **Speculation** (investment purposes): to bet on the future direction of a market variable
- ▶ **Hedging** of (financial) risks: to reduce the risk from potential future movements in a market variable (transfer risks) or to avoid exposure to adverse movements in the price of an asset
- ▶ **Arbitrage:** to take offsetting positions in two or more instruments to lock in a *riskless* profit

Financial derivatives are used by corporations, investment banks, investment funds, pension funds, hedge funds (see Business Snapshot 1.3 in Hull).

# Example 1: Forward Contracts

## Definition 1.2

A **forward contract** is an agreement between two parties to buy or sell an asset for a predetermined delivery price (**forward price**) at a predetermined future time (**maturity date**).

Some terminology:

- ▶ party who agrees to buy the asset: **long position**
- ▶ party who agrees to sell the asset: **short position**
- ▶ **spot price** of an asset: immediate market price, i.e., for buying/selling the asset “on the spot” (**spot market**)  
(in contrast to the asset’s **forward price** in the **forward market**)

## Characteristics of a Forward Contract 1/2

- ▶ traded over-the-counter (e.g., between two financial institutions, or between a financial institution and one of its clients)
- ▶ no money changes hands until delivery, i.e., *it does not cost anything to enter into a forward contract*
- ▶ asset has to be delivered by the short position and paid for by the long position (**binding commitment**)
- ▶ at maturity date either **physical delivery** of the asset or the contract is *settled in cash* (**cash settlement**)

## Characteristics of a Forward Contract 2/2

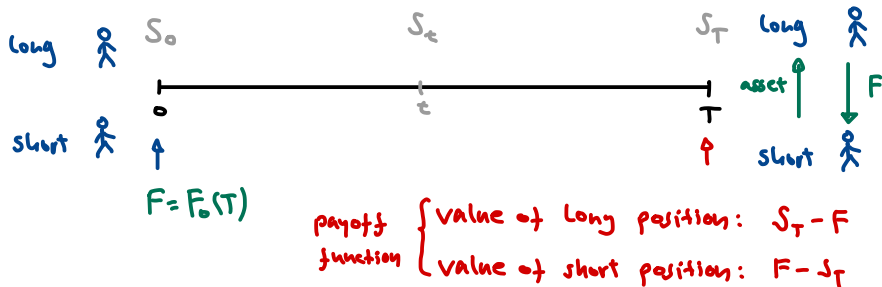
- ▶ at the time when the contract is set up, the **forward price** is fixed so that the **forward contract has no value**
- ▶ however, as the value of the underlying changes over time, the value of the forward contract becomes positive or negative, depending on the position held
- ▶ determination of forward prices and valuing forward contracts are discussed in **Chapter 5**

# Some Notation

Notation:

- ▶  $(S_t)_{0 \leq t \leq T}$  = underlying asset's spot price process
- ▶  $S_t$  = spot price of the asset at time  $t \in [0, T]$
- ▶  $F$  = forward price at time 0 with maturity  $T$  (alternatively, more precisely  $F_0(T)$ )

Timeline:



# Purpose of Trading a Forward Contract

## Long position:

- ▶ agrees today at time  $t = 0$  to **buy** the underlying asset at the future time  $t = T$  for a price  $F$  (per unit)
- ▶ locks in today a predetermined purchase price  $F$  for time  $T$  (instead of buying the asset at the then prevailing market spot price  $S_T$  at time  $T$  which is not known today)

## Short position:

- ▶ agrees today at time  $t = 0$  to **sell** the underlying asset at the future time  $t = T$  for a price  $F$  (per unit)
- ▶ locks in today a predetermined sell price  $F$  for time  $T$  (instead of selling the asset at the then prevailing market spot price  $S_T$  at time  $T$  which is not known today)

That is: Purpose can be *hedging* and *speculation*