

# Overview of financial markets

## Goals:

- Introduce you to the main concepts of financial markets
- Review the main types of derivatives
- Review the types of investors

## Relevant literature:

- Hull, Chapter 1

# Financial markets

- Financial markets move a lot of money in our economy
- This occurs mainly through *trading*
- Banks, hedge funds, governments, private investors, and many other players enter the financial markets to buy and sell *assets*
  - Stocks
  - Bonds
  - Foreign exchange
  - Derivatives
  - Many more
- In order to trade, each asset has to have a *price*
- The study of financial markets focuses on the *pricing* of assets

# Asset pricing

The two main factors driving asset prices are:

1. Future cash flows
2. Risk

Let's analyze why

## Future cash flows

Suppose there are two companies you can invest in:

1. *Company Onetime*. If you buy a stock of this company, it will pay you a one-time dividend of \$100 on December 31.
2. *Company Manytimes*. If you buy a stock of this company, it will pay you dividends of \$1 on 100 days between September 15 and December 31.

Which company would you prefer to invest your money in?

## Future cash flows

Most people will prefer multiple cash flows spread over time than a one-time cash flow.

- The higher demand for Manytimes makes its stock price higher than the stock price of Onetime (assuming that the companies are identical except for their dividend timing)
- What do you think drives the higher demand for Manytimes?

The timing and amount of future cash flows has a significant impact on the pricing of an asset

# Risk

Now, suppose there are two different companies you can invest in:

1. *Company Downhill*. If you buy a stock of this company, it will pay you a one-time dividend of \$100 on December 31. Analysts predict, though, that this company will go bankrupt well before December 31
2. *Company Certain*. If you buy a stock of this company, it will pay you a one-time dividend of \$100 on December 31. Analysts don't forecast bankruptcy for Certain.

Which company would you prefer to invest your money in?

# Risk

Most people will prefer Certain over Downhill

→ Because of the risk of bankruptcy, the demand for Downhill is low, pushing its stock price down

Even if two investments promise the same cash flows, the *uncertainty* involved with these cash flows also has a big impact on asset prices

→ What do you think needs to happen to the price of Downhill in order for you to invest?

# Supply and demand

In the slides above, I asked you which investment you prefer. This is the same as asking if you have any *demand* for the investments.

- Prices in financial markets are set by demand and supply
- If a price is too high, nobody will buy
- If a price is too low, nobody will sell

When market participants interact with each other, they find a price that both sides – supply and demand – are willing to accept. A buyer and a seller then carry out a transaction at this price.

→ This is the *equilibrium price*

We will see later in the course how equilibrium prices can be computed



# Derivatives

This course will mainly focus on the pricing of *derivatives*

- A **derivative** is an instrument whose value depends on, or is derived from, the value of another asset
  - E.g.: You would like to invest in Downhill, but you would like to protect yourself against a drop in Downhill's stock price. You can buy a derivative that will pay you an amount of money if Downhill's stock price falls underneath a certain level. This derivative is known as an *option*
- There are many more derivatives: Futures, forwards, swaps, swaptions, ...

# Trading of derivatives

Derivatives are traded in two ways:

1. *On exchanges such as the Chicago Board Options Exchange*

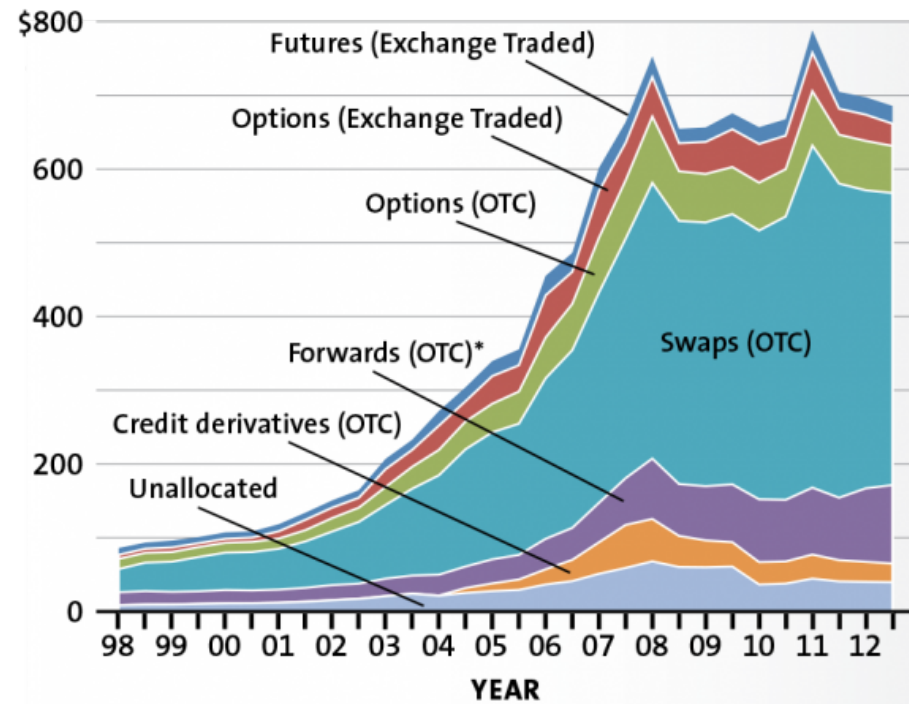
You could go on an exchange and buy a standardized derivative on any exchange traded company (Apple, Google, General Motors, etc), a stock index (S&P 500, Dow Jones, etc), interest rates (LIBOR, Fed funds rate), exchange rates, etc...

2. *In over-the-counter (OTC) markets*

Traders working for banks, fund managers, and corporate treasurers contact each other directly if they want to buy a nonstandard derivative

# Why are derivatives important?

The derivatives market is huge!



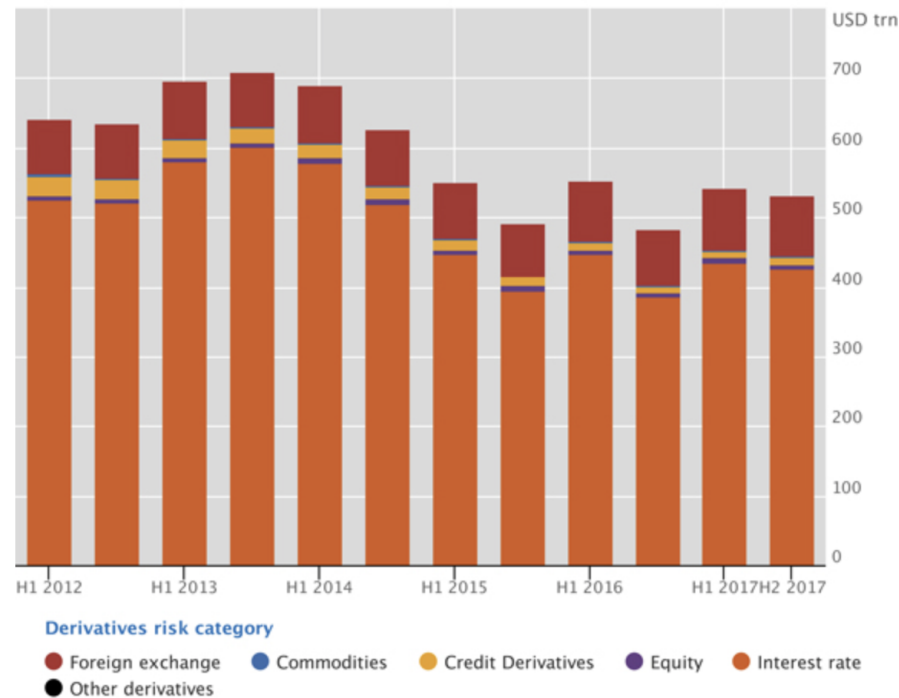
This chart shows total principal amounts for OTC market and value of underlying assets for exchange market. Source: Bank for International Settlements.

## Why are derivatives important?

- Derivatives play a key role in transferring risks in the economy
- By trading derivatives, a party that dislikes certain kinds of risks can transact with another party that enjoys these kinds of risks, leading to an efficient allocation of risks in the economy

# Why are derivatives important?

- Derivatives can be traded on stocks, currencies, interest rates, commodities, debt instruments, electricity, insurance payouts, the weather, etc



This chart shows the notional amounts outstanding for derivatives on different asset classes. Source: Bank for International Settlements.

# Why are derivatives important?

- Many financial transactions have embedded derivatives
  - For example, your future compensation package when you get a job will likely contain employee stock options

We will thoroughly study how to price derivatives. But first, let's understand who trades derivatives, why they are traded, and what kind of derivatives there are

# What kind of derivatives are there?

There are three main types of derivatives

- Forwards
- Futures
- Options

There exist many more derivatives that are constructed by combining forwards, futures, and options

# Forwards

A **forward** is an agreement to buy or sell an asset at a future point of time to a pre-determined **forward price**

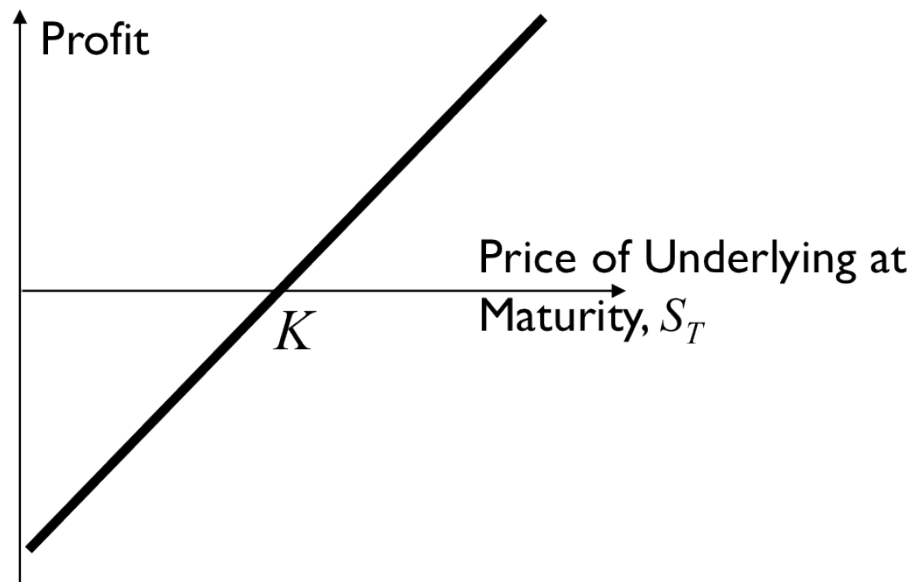
- E.g.: Ford needs aluminum for its production on January 10. Instead of facing the risk of an uncertain aluminum price in January, it can enter a forward contract with an investment bank today. In this case, Ford will pay the investment bank a fee today and then buy aluminum on January 10 for a predetermined price

Forwards are traded over-the-counter



# Forwards

Suppose Ford decides to fix the forward price at  $K$ . The profit it will make from entering the forward looks like in the figure below. If the aluminum price on January 10 is higher than  $K$ , Ford will make a profit. Otherwise, Ford will lose money.



# Futures

- Futures are very similar to forwards
- In a futures, you can also fix a futures price at which to buy or sell an asset at a later point of time
- In contrast to a forward, your broker will require that you deposit money into a *margin account*. As time evolves, on any day that the futures price rises, the broker deposits money into the account. When the futures price falls, you deposit money into the account
- In the end, you win or lose as much as with a forward, only dispersed throughout the lifetime of the future
- Futures are only traded on exchanges

## **Futures vs forwards**

Futures and forwards have the same payoff. Why would an investor prefer one over the other?

## Futures vs forwards

Futures and forwards have the same payoff. Why would an investor prefer one over the other?

- This has to do with the investor's attitude towards risks
- A forward will only pay out once at the end of the lifetime, while a futures pays off throughout its lifetime
- A futures minimizes the risk that you will not get paid off in the end (if your counterparty goes bankrupt, for example)
- However, a future requires that you are *liquid*. In other words, you need to have the money to be able to deposit into your margin account on any given day
- When is a futures more desirable than a forward?

# Options

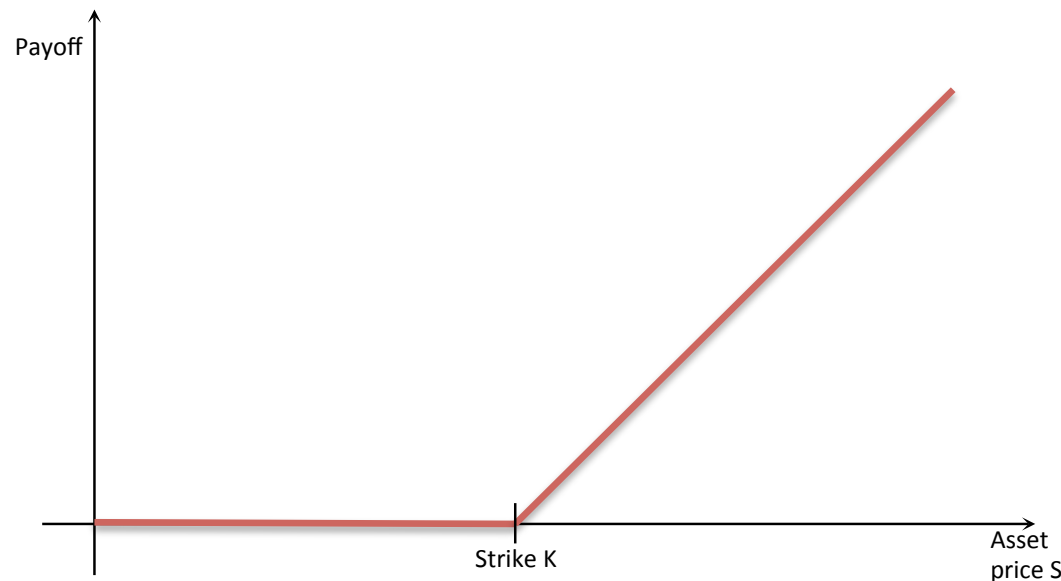
An **option** gives you the *right* to buy or sell an asset at a later time

- A **call option** gives you the right to buy a certain asset by a certain date for a certain price
- A **put option** gives you the right to sell a certain asset by a certain date for a certain price
- Unlike futures and forwards, an option grants you a right but no obligation to buy or sell

The future point of time at which to exercise the option is known as **maturity**. The price at which the option is exercised is known as **strike**

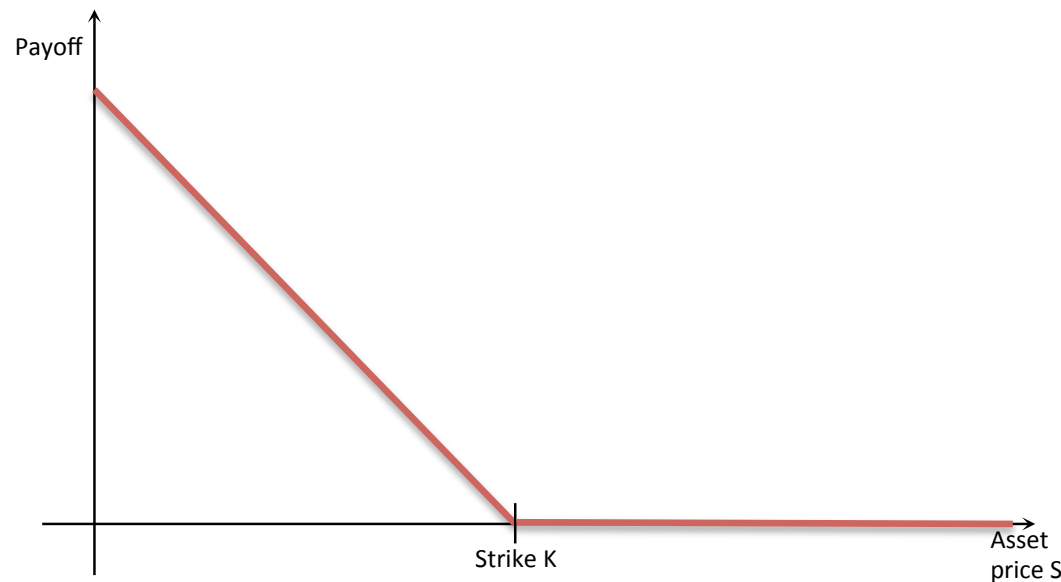
# Payoff of a call option

If the asset price is higher than the strike, then you **exercise** the option: It's cheaper to buy the asset at the strike price than in the market. If the asset price is lower than the strike price, then you don't exercise the option and let it **expire**: You prefer to buy on the market. The payoff below indicates the cash flow that a call option will provide for any given future asset price  $S$



## Payoff of a put option

If the asset price is higher than the strike, then you let the option expire: You prefer to sell in the market. If the asset price is lower than the strike, then you exercise the option: You make more money by selling the asset at the strike price than in the market. The payoff below indicates the cash flow that a put option will provide for any given future asset price  $S$



# Call option prices

Strike Price	Jul 2010 Bid	Jul 2010 Offer	Sep 2010 Bid	Sep 2010 Offer	Dec 2010 Bid	Dec 2010 Offer
460	43.30	44.00	51.90	53.90	63.40	64.80
480	28.60	29.00	39.70	40.40	50.80	52.30
500	17.00	17.40	28.30	29.30	40.60	41.30
520	9.00	9.30	19.10	19.90	31.40	32.00
540	4.20	4.40	12.70	13.00	23.10	24.00
560	1.75	2.10	7.40	8.40	16.80	17.70

Google call option prices (June 15, 2010; stock price is bid 497.07, offer 497.25);

Source: CBOE

- Prices fall with strike
- Prices increase with maturity → Why?
- Offer prices (prices to sell) are always higher than bid prices (prices to buy) → Why?



# Put option prices

Strike Price	Jul 2010 Bid	Jul 2010 Offer	Sep 2010 Bid	Sep 2010 Offer	Dec 2010 Bid	Dec 2010 Offer
460	6.30	6.60	15.70	16.20	26.00	27.30
480	11.30	11.70	22.20	22.70	33.30	35.00
500	19.50	20.00	30.90	32.60	42.20	43.00
520	31.60	33.90	41.80	43.60	52.80	54.50
540	46.30	47.20	54.90	56.10	64.90	66.20
560	64.30	66.70	70.00	71.30	78.60	80.00

Google put option prices (June 15, 2010; stock price is bid 497.07, offer 497.25);

Source: CBOE

- Prices increase with strike
- Prices increase with maturity

# American and European options

- The options discussed above are **European**. They can only be exercised at maturity
- An **American** option can be exercised at any time during its life

→ Which kind of option is more expensive: European or American?

# Terminology

The derivatives just introduced can be bought or sold. There is specific terminology for buy and sell positions:

- The party that has agreed to buy has the **long** position
- The party that has agreed to sell has the **short** position

# How are derivatives used?

- To hedge risks
  - Think of the option that you can buy to protect yourself against the downfall of Downhill's stock price. That option *hedges* (eliminates) the risk of losing money when the stock price drops
- To speculate (take a view on the future direction of the market)
  - If you believe the Google's stock price is going to rise, you could buy a derivative that pays you off if the price rises
- To lock in an arbitrage profit
  - If you think that the Australian dollar is valued higher in the US than in Europe, you can buy a derivative that will exploit this discrepancy in the exchange rates and pay you some amount of money

## How are derivative used?

- To change the nature of a liability
  - If you have a mortgage and are paying floating interest rates, you can buy a derivative that transforms your payments to a fixed interest rate
- To change the nature of an investment without incurring the costs of selling one portfolio and buying another
  - Suppose you have a few stocks of Ford. You think the stock price of Ford will fall, so you want to sell your stocks. Nevertheless, your broker is asking you to pay high transaction fees to do so. You could buy a derivative that would buy the Ford stocks from you if Ford's stock price actually goes down. Buying a derivative may be cheaper than paying the fees

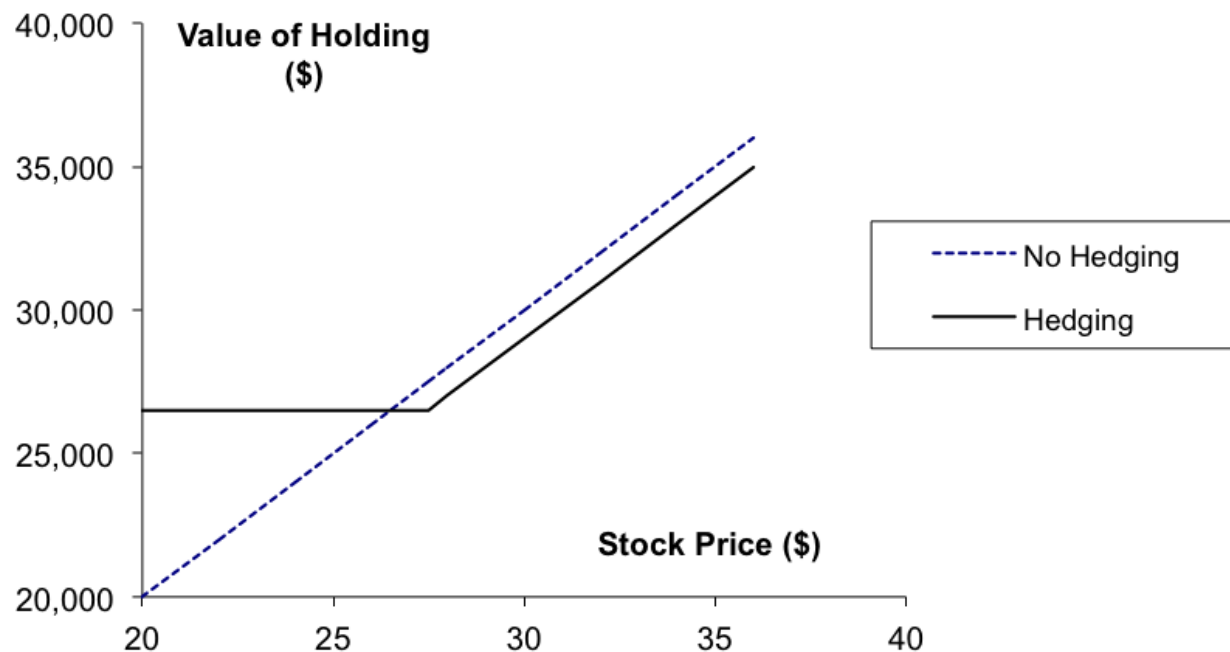
# Who trades derivatives?

There are three main types of participants in the derivatives market

- Hedgers
- Speculators
- Arbitrageurs

# Hedging example

An investor owns 1,000 Microsoft shares currently worth \$28 per share. A two-month put with a strike price of \$27.50 costs \$1. The investor decides to hedge by buying 10 puts to sell 100 shares each



Value of Microsoft Shares with and without Hedging

## Speculation example

An investor has \$2,000 and feels that the stock price of ABC will increase over the next 2 months. The current stock price is \$20 and the price of a 2-month call option with a strike of 22.50 is \$1.

Can the investor make a profit somehow?



## Speculation example

An investor has \$2,000 and feels that the stock price of ABC will increase over the next 2 months. The current stock price is \$20 and the price of a 2-month call option with a strike of \$22.50 is \$1.

Can the investor make a profit somehow?

- If the investor believes the stock price will rise much higher than \$22.50, then she can buy call options today and lock in the stock price of \$22.50
  - If she is right and the stock price actually rises that high, then she will make a profit of  $S_2 - 22.50 - 1$  on every option she bought. Here,  $S_2$  is the stock price in 2 months
- Suppose that  $S_2$  can take on a maximum value of \$25. What is the maximum profit that can be made by buying the stock versus buying the option?

## Arbitrage example

A stock price is quoted as 100 GBP in London and 140 USD in New York. The current exchange rate is 1.4300

What is the arbitrage opportunity?

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A stock price is quoted as 100 GBP in London and 140 USD in New York. The current exchange rate is 1.4300

What is the arbitrage opportunity?

- Buy in New York
- Sell in London
- Wire the back to your US account

This argument ignores the transaction costs involved, which may eat up the profits from trading