Introduction - Derivatives

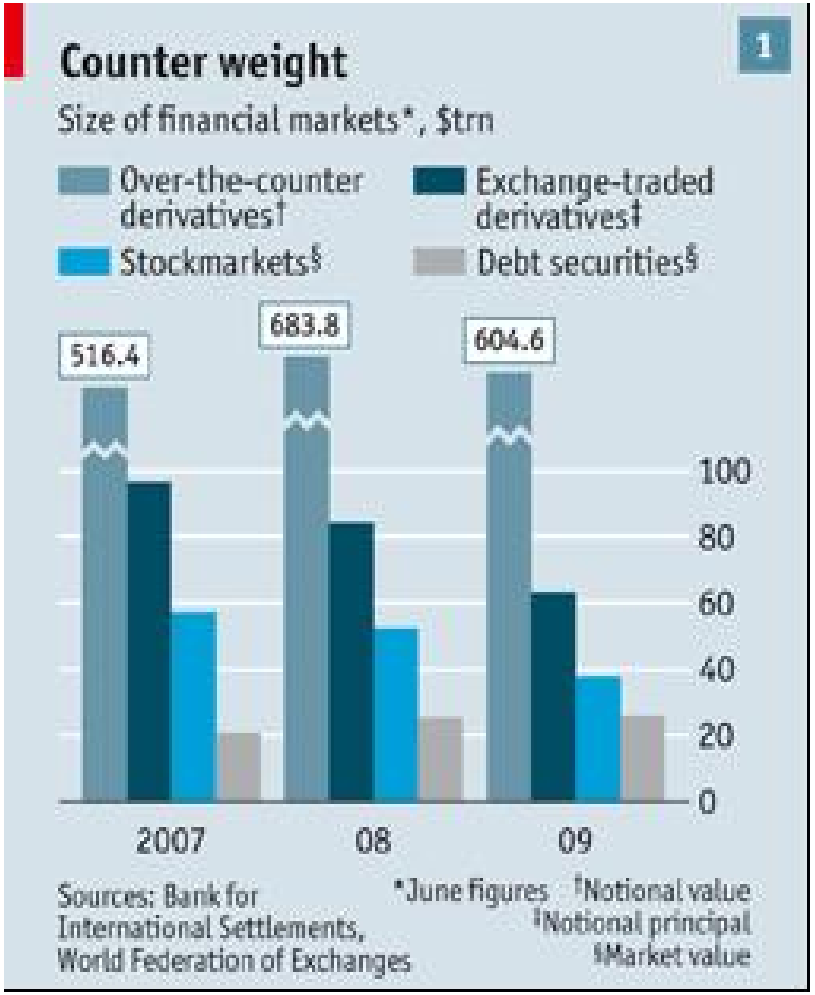
- Derivatives are financial instruments which can be traded in the market
- Derivatives derive their value from an **underlying asset** and some other variables such as interest rates, volatilities etc.
- Futures, forwards, options and swaps are some of the most common examples of derivatives.
- The **underlying asset**: It is a more basic financial instrument. Example: stocks.

- Example of a derivative: Option:

  An investor owns a call option (which is a derivative) whose underlying asset is the common stock of a company A. This option gives the investor, the right to buy the stock at a certain predefined price on or before a future date.

Introduction - Markets

- Exchange traded Markets
  - Market where individuals trade standardized contracts that have been defined by the exchange themselves.
  - An Exchange acts as an intermediary which facilitates a regulatory oversight and hence makes the markets a safer place for trading
  - Chicago Board of Trade and Chicago Mercantile Exchange are two examples
  - Open outcry system and Electronic trading
- Over the counter markets
  - There is no intermediary and no standardized contracts, parties can be created their own T&C with each other.
  - Much larger than the exchange traded market in terms of value of underlying assets (more than 4 times larger)
  - Trades done between financial institutions or between financial institutions and clients. Financial institutions act as a market maker (quote both bid and offer)



Types of Investments and Purposes

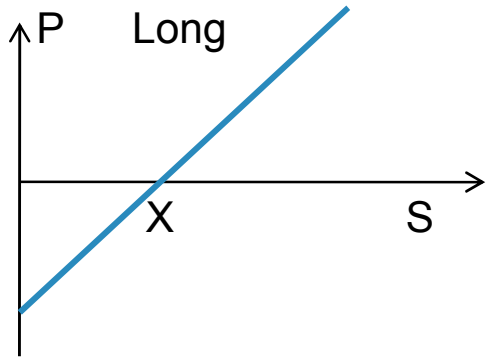
- Asset Types
  - Financial Assets: Equity, Debt securities
  - Commodities: Gold, Copper, Crude Oil
  - Real Estate
- Let's take an example of a financial asset (stock).
  - We can buy the stock through the broker by paying the stock price.
  - We can either hold the bought asset or sell it at the current market price.
  - During the holding period of the stock, the dividends received goes to your pocket as the income from the asset.
  - After selling the asset, we earn a profit or loss on the asset, depending on the selling price of the asset (stock).
- Purpose of Assets
  - Investment Asset
  - Consumption Asset
- Market Maker
  - An individual or an institution which keeps an inventory of financial instruments or commodities who could be asked for the trade of those assets. The individual or the institution then quotes a bid and an offer price on the option.

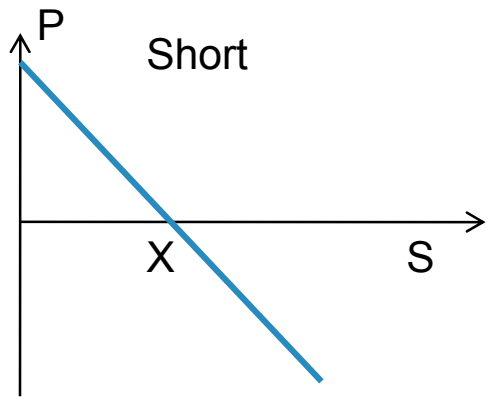
Consumption vs Investment Assets

- Investment assets
  - Assets held for investment purposes by significant numbers of investors. (examples: stocks, bonds, gold, silver)
- Consumption assets:
  - Assets held primarily for consumption (examples: copper, oil and pork bellies)
- Gambling – Short Selling an example
  - Short selling involves selling securities that are not owned.
    - Suppose an investor short sells 500 IBM shares, the broker will borrow the securities from another client and sells them in the market in the usual way.
    - At some stage the investor will close the position by purchasing 500 IBM shares. The investor takes the profit if the stock prices have declined , else vice versa.
    - Short Squeezed: If anytime the broker runs out of shares to borrow, the investor is short squeezed and forced to close his position immediately

Forward and Futures Contracts

- Futures Contracts: Agreement to buy or sell an asset for a certain price at a certain time . A futures contract is traded on an exchange.
- Forward Contracts : Forward contracts are similar to futures except that they trade in the over-the-counter market
- Notation for Valuing Futures and Forward Contracts
  - S0: Spot price of the asset underlying today
  - F0: Futures or forward price today
  - T: Time until delivery date (in years)
  - R: Risk-free interest rate per annum, expressed in continuous compounding, for maturity T
  - Payoff of forwards and futures:





In both Forward and Futures contracts there is an obligation to buy or sell an asset

Notation for Valuing Futures and Forward Contracts

- Consider a stock price at $100 today and the borrowing rate is 8% for 1 year. What should the 1 year forward price of the stock be? When will you make a profit in this case?

$$F_0 = S_0 e^{rT}$$
$$F_0 = S_0 (1+r)^T$$

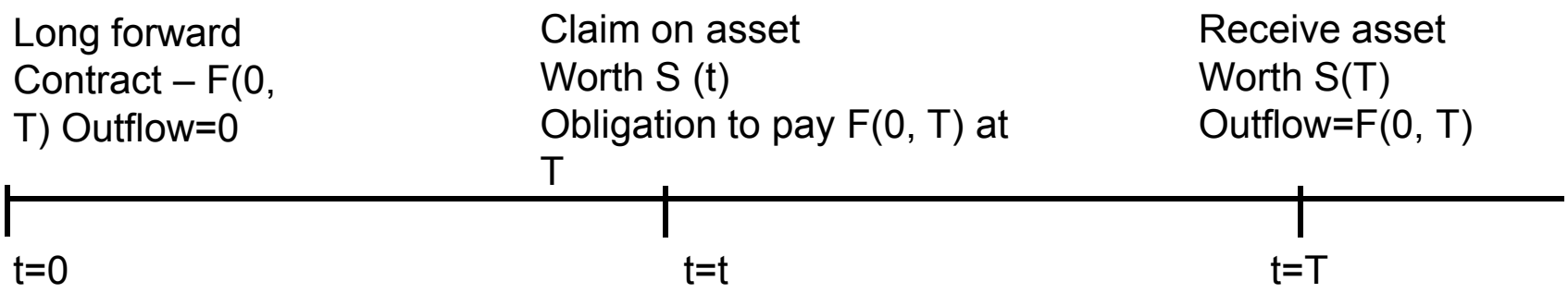
- Where:
  - S_0: Spot price today
  - F_0: Futures or forward price today
  - T: Time until delivery date
  - r: Risk-free interest rate for maturity T

Pricing and Valuation of Forward Contracts

- Arbitrage free Forward prices are given as:

$$F(0,T)= S_0 * e^{rT}$$

- If we long the forward contract at time t=0, at forward's price F(0,T), the initial cash outlay would be zero
- At time t=t, we have claim on the asset which is worth St and an obligation to pay F(0,T) at time t=T
- At time t= T, we pay F(0,T) and receive the asset worth ST



- Forward rates are rates of interest implied by the current zero rates for a period of time in the future

Question: Forward Prices

We have the zero rates for year 4 and year 5 then the forward rate for the period of time between year 4 and year 5 would be known as the forward rate for that time period of 1 year.

Consider that you invest $100 for 4 years and then roll it forward for one year in the 5 year. Calculate the Forward rate $F_{4,5}$

Solution:

The total amount at the end of 5 years would be given as:

$$100*e^{0.04*4}e^{F4,5*1}$$

If the same $100 was invested for 5 years instead then it would grow to

$$100*e^{.05*5}$$

Equating the two with natural log we get forward rate F4,5 = 8.99%

Generalized formula for forward rate:

- In above scenario, assume year 4 and 5 to be T1, T2 and zero rates as R1, R2, then
- $e^{R1*T1}*e^{F4,5\,*(T2-T1)} = e^{R2*T2}$, simplifying this we get a generalized formula for forward rate

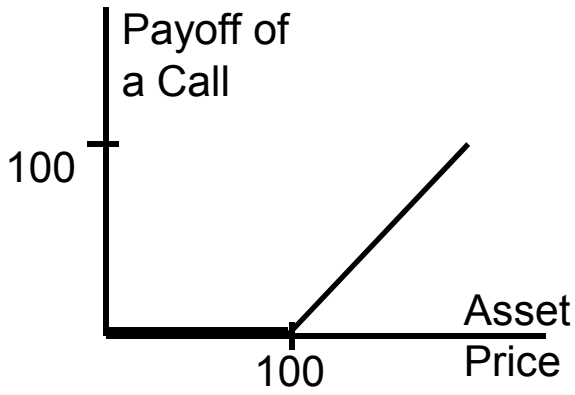
$$F_{4,5}(\text{forward rate}) = (R_2T_2 - R_1T_1)/(T_2 - T_1)$$

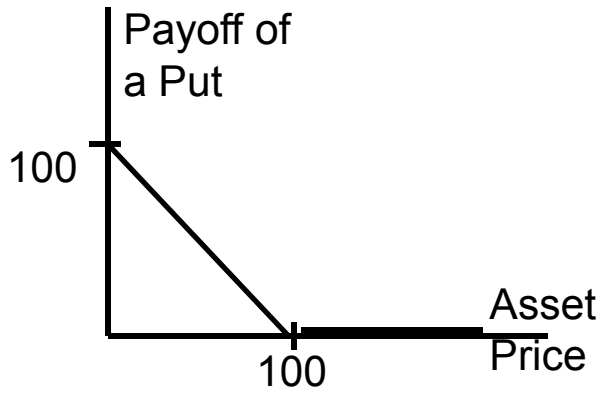
- Use this formula to solve the above question.

Options *(to be covered in detail in later slides)*

- Traded both on exchanges and over the counter markets
- Call option gives the holder the right to buy the underlying asset by a specified time at a certain price.
- Put option gives the holder a right to sell the underlying asset by a specified time at a certain price
- European options can be exercised on the specified date only, unlike American options which can be exercised anytime up to the expiration date.
- One option contract is to buy/sell 100 shares in the US

No obligation to exercise the right





To be covered in detail in next session