

# Derivatives

## mthree Alumni Training





# Derivatives

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## Objective

- This lesson provides a foundation in the derivatives trading business, covering the main products and their use.



# Introduction

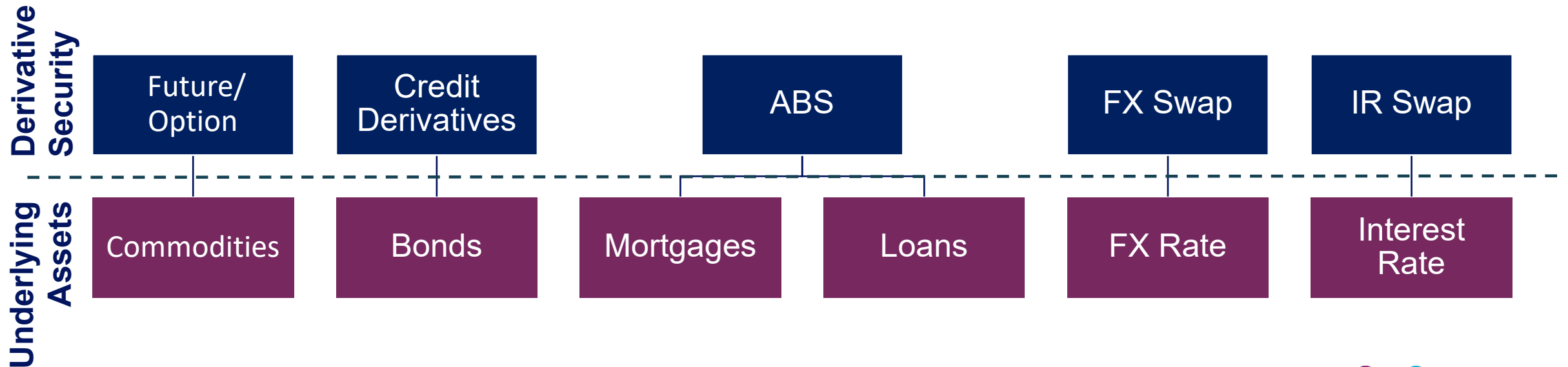
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- Investing has become more complicated with the creation of derivatives
- The idea of derivatives has been around for generations, particularly in the farming industry – e.g., a contract to sell goods/livestock on a particular date at a particular price
- Derivatives have numerous uses, mostly on the hedging and risk management, while incurring various levels of risk.



# Derivatives Securities

- **Derivative securities** are a contract whose value is based on the assets underlying the contract. These are traditionally the most complex of financial instruments. Generally used for hedging or speculation.





# Some Key Derivatives Terms

- Here are some of the terms you will likely hear when dealing with derivatives:

## Counterparty

The party taking the other side of the trade

## Strike Price

The price at which the derivative (option) can be exercised

## Expiry

The date at which the derivative contract expires

## Hedging

Insuring yourself against a negative event: it does not stop the event from happening, but it does reduce its impact



# Derivative Structure

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- Here are some of the types of derivatives you will hear about:

## Forward

Agree to buy or sell something at a specific point of time in the future for a specific price

## Future

A forward that is traded on an exchange

## Swap

An exchange of two things

## Options

The right to buy or sell a security on an agreed future date at a pre-agreed price

## Warrant

An option issued by the company itself and traded over the counter

# Forwards



- Forwards are privately negotiated, sold over the counter, and the terms are negotiable.
- The price is established at the inception of the contract.
- Higher risk than futures as they do not use a central clearing house and so both sides are exposed to credit risk.
- Mainly used for hedging, i.e., reducing the risk of a negative event



# Futures

**Future:** a contract that commits to selling or purchasing a specific amount of assets, at a specific price, at a particular point in the future.

- Traded on exchanges
- Standard sizes
- Standard maturity dates
- Profits/losses settled each day

Chicago SRW Wheat Futures Contract	
Contract Unit	5000 bushels (~136 metric tons)
Price Quotation	Cents per bushel
Settlement Method	Cash
Termination	Bus. Day preceding 15 <sup>th</sup> of month
Currency	USD
Quotes	July 2017: 429 cents

- Futures are highly standardized and are traded on exchanges such as CME, Euronext, London Metal Exchange (LME), ICE Futures Europe, Eurex.
- Most exchanges clear their own trades and act as central counterparty.
- Often bought by speculators betting on the price of the commodity or underlying asset rising or falling.



# Options



- **Option:** a contract for the option to purchase or sell a specific amount of assets, at a specific price, at a particular point in the future.
- The option price is influenced by the underlying asset's market price, the length of the contract, the current volatility of the underlying asset, supply and demand, dividend rate of the underlying asset.



# Option – Risks and Benefits

Let's look at the underlying risks and profits around the options:

## Buying Call Options

Holder has no obligation to buy the asset (i.e., if the price of the asset on the market is cheaper than the contract price); the risk to the holder is then the loss of the premium.

## Selling Call Options

Otherwise known as **writing the contract**: maximum profit is the premium value. The loss for the seller can be a lot higher if the buyer exercises the option as they will need to sell the underlying asset at a price worse than market.

## Buying Put options

The buyer believes the underlying stock market price will fall. They will sell the shares at the options higher price; if they want to replace the shares, they can then buy them back at the lower market price. The risk here is limited to the loss of the premium if the option is not exercised.

## Selling Put options

Again writing a contract, the seller believes the underlying asset will increase over time. Maximum profit again is the premium. The loss will be having to buy shares at a strike price above the current market value.



# Option Underliers

**Options** give you the right but not the obligation to buy or sell the underlying asset at a specified price in the future – the buyer pays a premium for the rights granted by the contract

- **Put option:** Allows the holder to sell the asset at a stated price within a specific timeframe.
- **Call option:** Allows the holder to buy the asset at a stated price within a specific timeframe.

## Example:

- Suppose Google shares are trading at \$300 a share. You believe they are going to increase in value, so you purchase a call option.
  - The call option has a strike price of \$315 for one month in the future for 37 cents per contract (usually sold in 100 lots). Your cash outlay is \$37 for the premium ( $37c * 100$ ).
  - If the stock rises to \$320 in that time, you can purchase at \$315 and then immediately sell the stock on the open market with a profit of \$5 (and you have purchased 100 shares).
  - In this example you paid 37c per share and gained \$5 for each share, with a profit of \$463 ( $\$5 - 0.37 * 100$ ).

# Black-Scholes Formula for Option Pricing

$$C = N(d_1)S_t - N(d_2)Ke^{-rt}$$

$$\text{where } d_1 = \frac{\ln \frac{S_1}{K} + \left(r + \frac{\sigma^2}{2}\right)t}{\sigma\sqrt{t}}$$

$$\text{and } d_2 = d_1 - \sigma\sqrt{t}$$

$C$  = call option price

$N$  = CDF of the normal distribution

$S_t$  = spot price of an asset

$K$  = strike price

$r$  = risk-free interest rate

$t$  = time to maturity

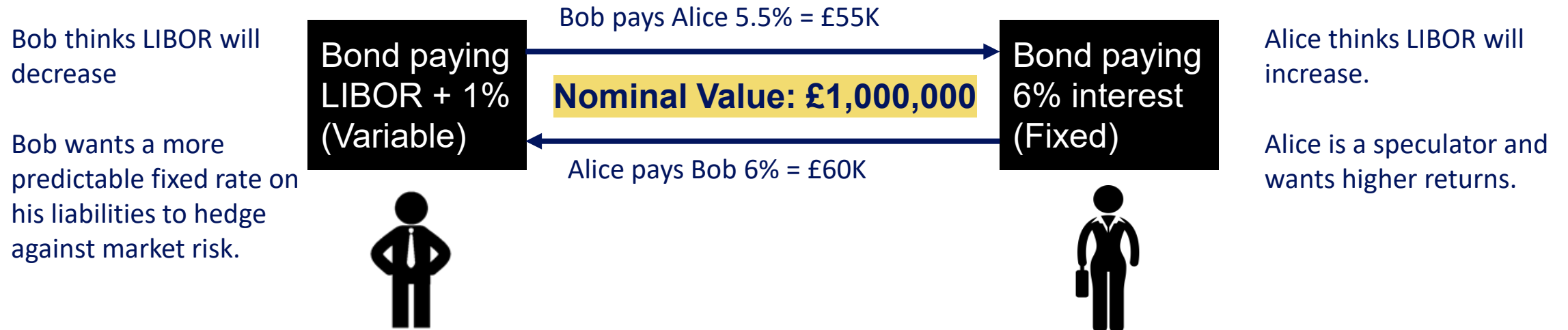
$\sigma$  = volatility of the asset

- The Black-Scholes model and its many variants assume that stock prices follow a lognormal distribution
- The formulas allow stock prices to be substituted for any other asset, e.g., FX, interest rates etc.
- Option values also depend on an asset's volatility, which is essentially the dispersion of its returns
- As such, any product with optionality does not react to market prices in a linear manner in terms of either value or calculated risk position



# Interest Rate Swaps (IRS)

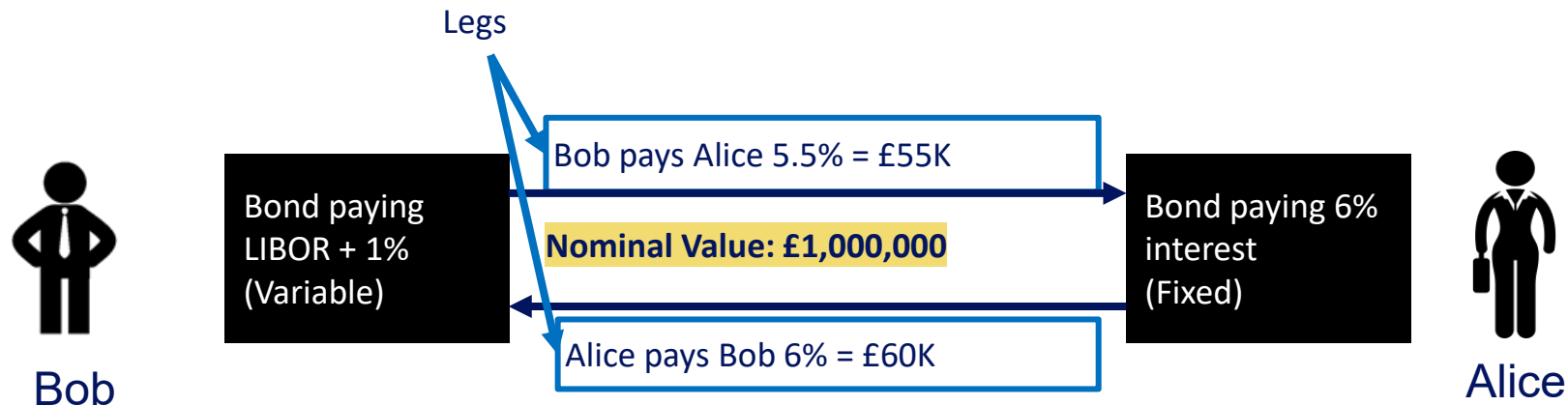
- Swap: a contract to exchange a series of cash flows at a specific point in the future based on a specific principal amount
- Assume that LIBOR is 5% and the contract is 1 million GBP.



- Rate goes down to 4.5%. Bob pays less and receives more.
- Zero-sum game. There is always a winner and a loser.

# Interest Rate Swap Legs

**Legs:** The cash flows exchanged in an interest rate swap are referred to as legs.



- The two legs may be fixed or floating.
- Fixed: Pays a series of payments agreed at the outset of the contract
- Floating: Linked to the future level of interest rates
- Vanilla swap: where a floating interest rate is exchanged for a fixed rate or vice versa
- Mostly traded OTC although some must be traded on a SEF (swap execution facility trading venue)



# Comparative Advantage Argument for Interest Rate Swap

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- Company A: Can borrow fixed at 10% or floating at  $\text{Libor} + 0.35\%$
- Company B: Can borrow fixed at 11.25% or floating at  $\text{Libor} + 1.0\%$
- They both want to borrow \$10M from the markets for 5 years. Company A borrows fixed at 10%. Company B borrows floating at  $\text{Libor} + 1\%$ . Coupons are semi-annual.
- Company A and Company B enter into an interest rate swap for 5 years at semi-annual intervals:
  - Company A pays LIBOR flat to Company B throughout the swap.
  - Company B pays fixed rate of 9.9% to Company A throughout the swap.
- **Exercise:** Draw the net cash flows and demonstrate that this is more beneficial to both parties than borrowing floating/fixed on their own.
- Company A has a comparative advantage on fixed rate borrowing; Company B has a comparative advantage in floating rate borrowing. They use these advantages and then they swap via IRS.



# Comparative Advantage Argument for Interest Rate Swap

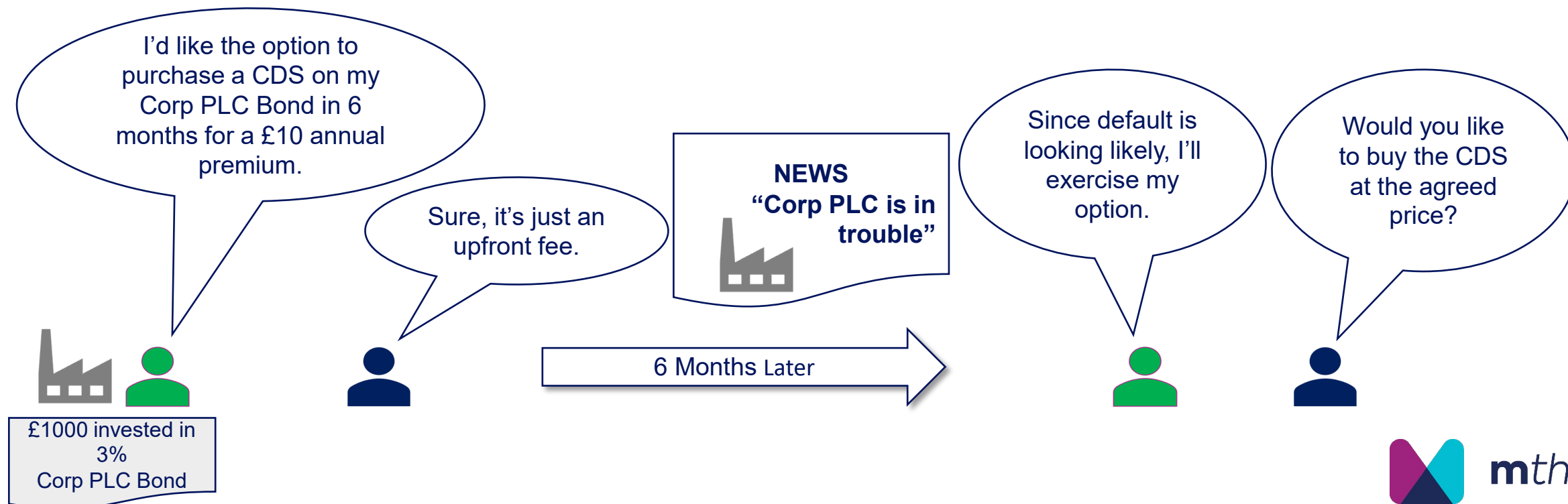
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Company A borrows fixed at 10%. Company B borrows floating at Libor + 1%. Coupons are semi-annual.



# Swaptions

- **Swaption:** a contract for the option to enter into a swap agreement at a specific price, at a particular point in the future. In exchange for an options premium, the buyer gains the right but not an obligation to enter into a specified swap agreement with the issuer on a specified future date.





# Swaptions

- Swaptions come in two main types:

## Payer Swaption

The purchaser has the right to enter into a swap contract where they become the fixed rate payer and the floating rate receiver

## Receiver Swaption

The purchaser has the right to enter into a swap contract where they become the floating rate payer and receive the fixed rate

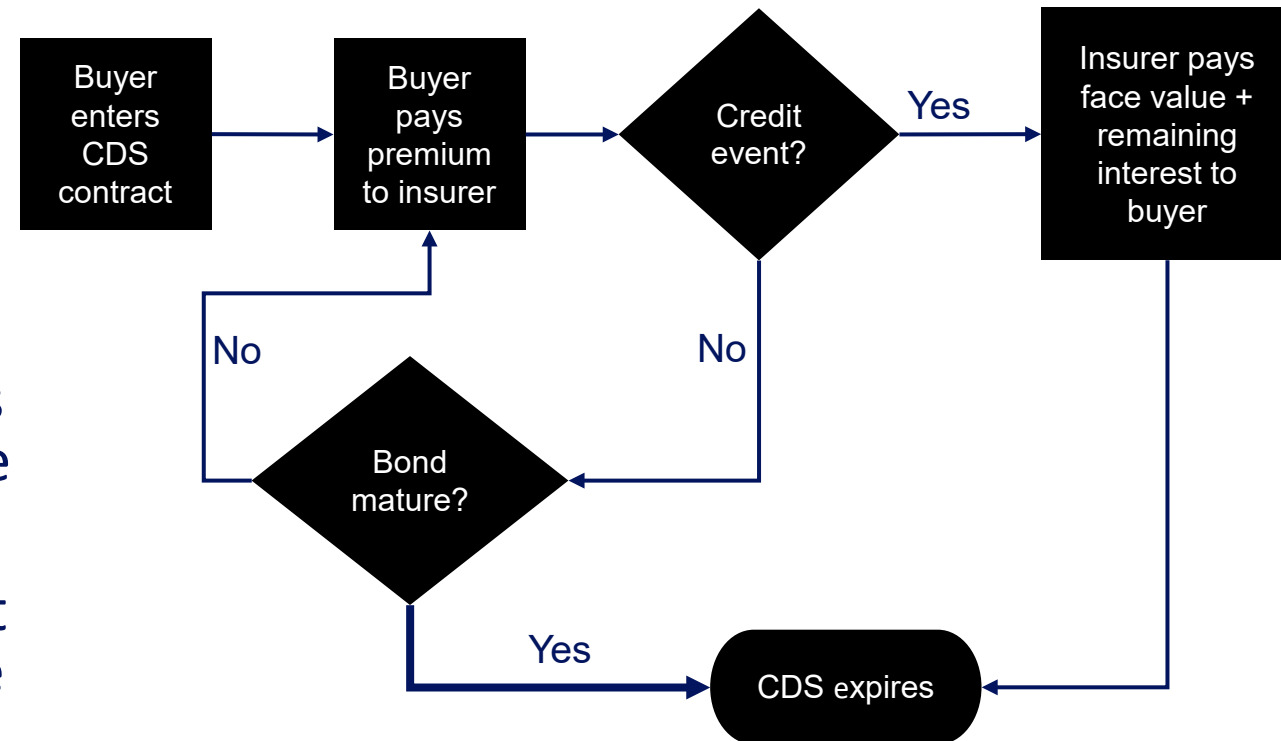
- These are OTC (Over the Counter) and are not standardized. Everything about these contracts need to be agreed by the buyer and seller.
- Commercial banks are the main market makers in swaptions due to the unstandardized nature; they are the only one who can monitor a portfolio of swaptions.



# Credit Derivatives

**Credit Default Swap (CDS):** a contract to insure the credit risk of an underlying bond for an agreed fee over an agreed amount of time.

- Types: Single name CDS; Basket CDS and Index CDS
- In a CDS, the buyer of the swap makes payments to the swap's seller until the maturity date of the contract.
- In return the seller agrees in the event of a credit event the seller will pay the value of the security as well as any interest.



# In a Credit Default Swap:

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- **Protection seller**

- earns investment income with no funding cost
- gains a customized, synthetic access/exposure to the risky bond

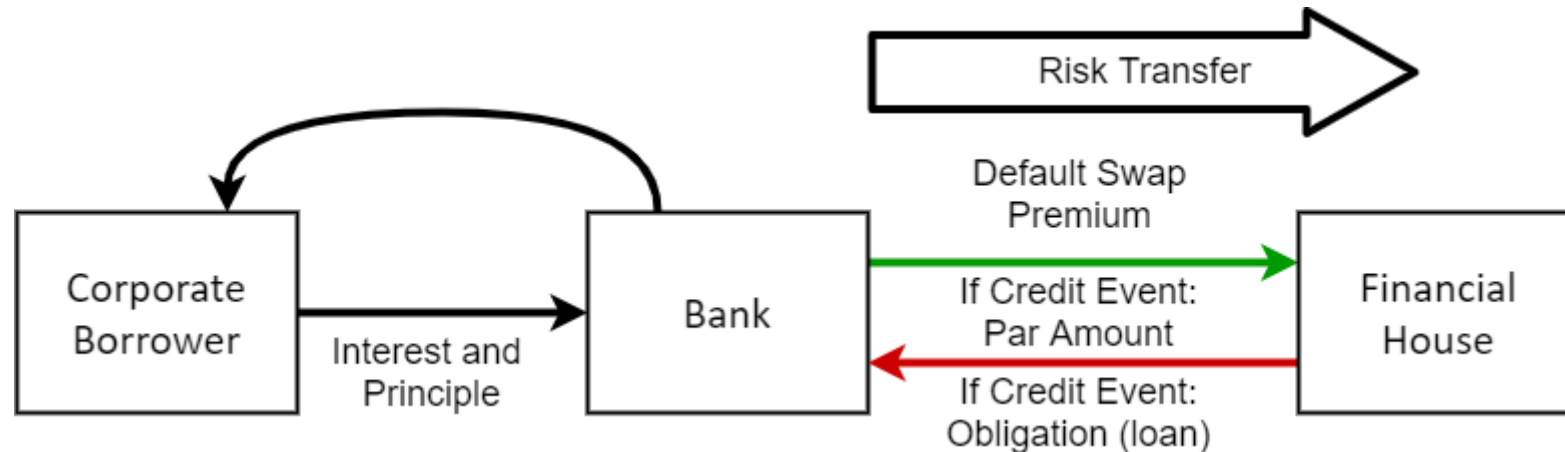
- **Protection buyer**

- hedges the default risk on the reference asset (bond etc)

Very often, the bond tenor is longer than the swap tenor. In this way, the protection seller does not have exposure to the full market risk of the bond throughout its existence.

# CDS Use by a Bank

- A bank lends 10mm to a corporate client at  $L + 65\text{bps}$ . The bank also buys 10mm default protection on the corporate client for 50bps.



## Objective achieved

- maintain relationship
- reduce credit risk on a new loan



# Credit Events

The CDS is triggered when the following events occur:

## Bankruptcy

The issuer becomes insolvent or unable to pay debts

## Failure to pay

The issuer becomes insolvent or unable to pay debts

## Debt restructuring

The configuration of the debt obligations is changed in a way that negatively affects the credit holder

## Obligation acceleration

Also known as obligation default: the debt payment is scheduled before their maturity date

## Repudiation / moratorium

The issuer refuses to pay the principle and interest amounts



# Mortgage-Backed Securities



**MBS:** Investment similar to a bond made up of a bundle of home loans bought from the banks that issued them. Investors receive periodic payments similar to bond coupon payments. Investors are purchasing the cash flow from the underlying mortgages – the monthly mortgage payments.

- This leaves the MBS investor open to the risks of repayment defaults, such as falling house prices, job loss, bankruptcy etc.

MBS-specific risks include:

- Prepayment Risk: As interest rates decrease, mortgage-owners are more likely to refinance or prepay their fixed-rate mortgages, similar to a callable bond.
- Correlation Risk: If mortgage default risks are highly correlated due to a geographic area, housing market collapse, etc., then diversification benefit is significantly reduced.
- Illiquidity: Because many MBS investors are institutional, smaller lots are very difficult to sell in the secondary market. Institutional positions may be too large to easily liquidate, too.



# Principal-Agent Problem in Lending

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- Historically, commercial banks underwrote loans and were responsible for collecting payments until their maturity. This incentivized the banks to minimize credit risk as all defaults would impact them.
- Because of the strong demand for mortgages from investment banks which securitize them and sell them, the commercial banks (originators) were able to re-sell their mortgage loans very quickly, and therefore did not hold the credit risk.
- Investment banks purchased mortgage pools based on limited metrics such as credit scores and Loan-To-Value (LTV) ratio, which were not adequate.
- This was a principal-agent problem in the sense that originators acted as the agents of the investment banks, and eventually of investors, to originate the loans that they did not care too much about credit quality of.
- This principal-agent problem encouraged subprime lending.
- Additionally, the rating agencies underestimated the risks associated with the MBS lending.





# MBS in the Financial Crisis

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How did MBS contribute to the financial crisis in 2008?

- Rapid increase in home prices caused banks to lower their lending standards
- Quality of all MBS backed securities declined and ratings became meaningless
- 2006 housing prices peaked
- Subprime borrowers started to default as housing market started to collapse
- More people walked away from their mortgages as they were more expensive than the value of their homes
- The large amount of non payments meant many MBSs and collateralized debt obligations (CDOs) based off pools of mortgages were greatly overvalued
- Losses piled up as institutional investors and banks tried and failed to unload bad MBS investments
- Credit tightened and banks were at risk of insolvency



# Asset-Backed Securities

**Asset-Backed Security (ABS)** – A security that is collateralized by a pool of assets.

- Examples include loans, leases, credit card debt, royalties or receivables.
- An ABS is attractive as an alternative to investing in corporate debt.
- Similar to an MBS but the underlying asset is not mortgages.
- Usually the underlying assets are illiquid; as such, the ABS are created with lots of different types of underlying assets to make them tradable. This process is called Securitization.
- The creator of ABS can include just about anything that produces cash flow, such as movie revenues.



# Asset-Backed Securities

## Securitization

### Originate Loan

- Credit card debt
- Home equity loans
- Student loans (USA)
- Automotive loans

### Loan Originators

- Loan originators sell to an SPV (special purpose vehicle)
- SPV: orphan company created to spread risks in underlying assets by reallocating across investors.

### SPV

- The SPV provides "remoteness" for the loan originator. The SPV will not issue the securities.
- The SPV sells to a trust.

### Trust

- The trust repackages the loans as interest-bearing securities.

### Ready for Sale

- Investors receive cashflows from the underlying pool of loans
- Usually in tranches
- Fees are paid to the security providers



# CDOs: Collateralized Debt Obligations

**CDOs:** complex types of asset-backed securities with either mortgage-backed assets, non-mortgage-backed assets or a combination of both. The assets become the collateral if the loan defaults.

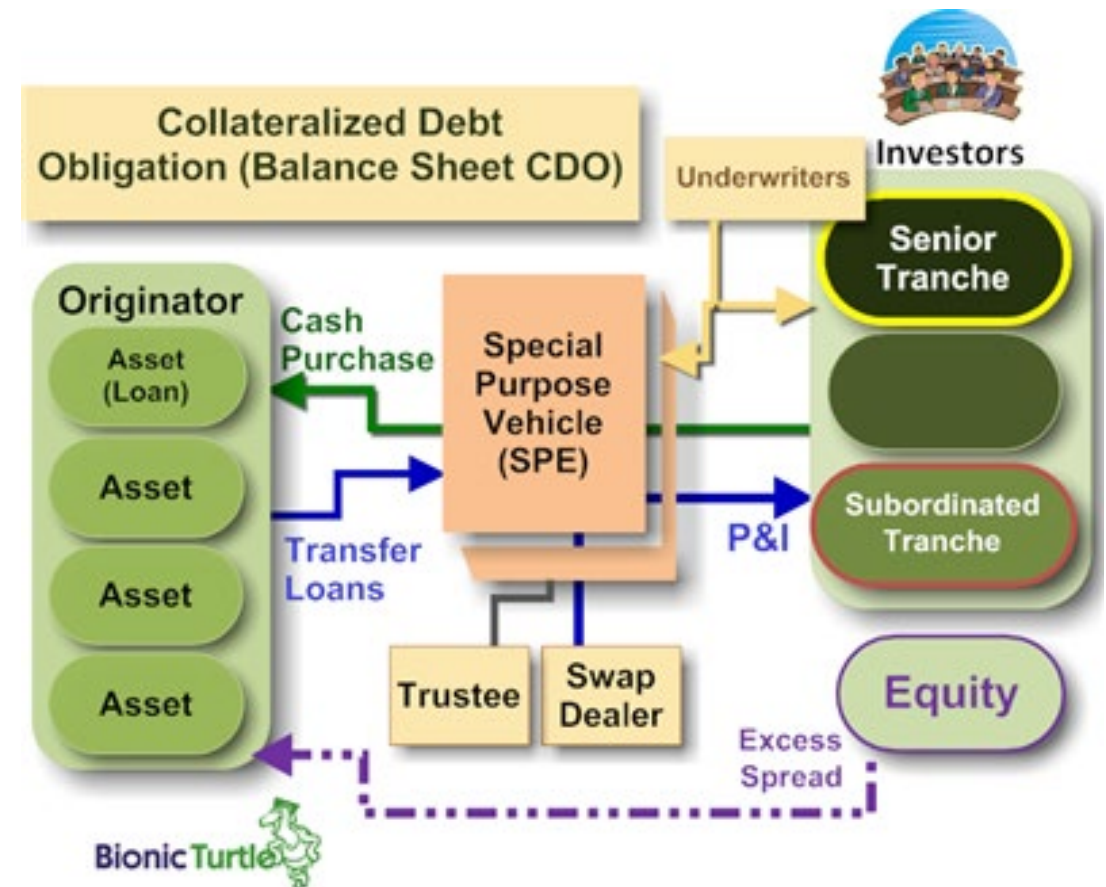
- They come in two flavors:
  - CLO: Collateralized Loan Obligation – often corporate loans that have a low credit rating
  - CBO: Collateralized Bond Obligation – bond backed by a pool of junk bonds

**Tranches:** pieces of a pooled collection of securities, usually debt instruments

- Split up by the risk of other characteristics to make them marketable
- The best quality tranches will yield the lowest reward; the low-quality tranches are more risky and therefore potentially more rewarding

# Collateralised Debt Obligations (CDOs)

- Although ABS—and thus CDOs—grew out of MBS, they are more varied and more complex in structure.
- CDOs consist of a variety of loans and debt instruments. To create a CDO, investment banks gather cash flow-generating assets—such as mortgages, bonds, and other types of debt—and repackage them into discrete classes, or tranches, based on their level of credit risk.





# How do Tranches Work?

The tranches making up a security have different credit ratings.

## Senior Tranches

- Contain assets with higher credit ratings than junior tranches
- In line to be repaid first in case of default

## Junior Tranches

- Contain assets with a lower credit rating than the senior tranches
- May not get repaid in case of default

- Tranches exist in MBS also - an MBS is made up of multiple mortgage pools with a wide variety of loan types attached
- Tranches in MBS are made to divide up the different mortgage profiles into slices that have financial terms suitable for investors.