

TYPES OF BANK

Commercial banks:- Includes **retail** bank (which serves individual and small business & **wholesale bank** (serves corporate and institutional customer) . Mainly involved in deposits & loans.

Investment Banks:- Assists in **raising capital** and **advising** them on corporate finance matters such as mergers and restructuring.

Based on regulations of the region of business bank can do both business or only one business.

MAJOR RISKS

CREDIT RISK:- Default by borrower or counterparty. Measured as loan losses as % of its assets.

MARKET RISK :- Losses from trading activity such as decline in value of investments.

OPERATIONAL RISK:- Losses arising from **external events** or failures on **internal control**.

CAPITALS

Key measure of capital adequacy is **Equity capital to asset ratio**.

Tire 1 capital:- Equity capital

Tire 2 capital:- Long Term Debt

Regulatory Capital determined by bank regulators. Bank must maintain Amount stated in regulatory capital.

Economic Capital :- capital as per risk models. i.e. to cover banks risk.

MORAL HAZARDS (IMP)

DEPOSITE INSURANCE:- Depositors funds are guaranteed up to some maximum amount if a bank fails. Insurance premium paid by banks. Insurance brings element of **moral hazard**.

Moral Hazard:- insured parties take greater risk than they would take without insurance.

This results in banks pay less attention to there financial health and offers **higher rate on deposits** and **make higher risky loans with those deposits**.

POTENTIAL CONFLICT OF INTEREST

Due to business structure of bank or their holding company faces several conflict of interests. Investment bank division trying to sell newly issued stock might want the securities division to sell these divisions to sell that stock to their clients. Commercial bank might acquire non public information about the company when negotiating a loan or arranging a securities issuance. If trading desk gets this information, may benefit unfairly.

Chinese Wall:- is internal control to prevent information from being shared among these units.

INVESTMENT BANKING (IMP)

FINANCING ARRANGEMENTS

PRIVATE PLACEMENT:- **Securities** are sold directly to qualified investor with substantial wealth and investment knowledge. Investment bank earns fees for arranging private placement.

PUBLIC OFFERING:- when issue is sold to public at large. **Firm Commitment** is when bank first buys entire issue at agreed price from the issuer and bank and then sells to public at higher price. **Best effort** is when bank is buying issue only to the extent of bank is able to sell it to public in this bank is do not have any obligation of buying unsold portion.

Initial public offerings IPOs :- When any firm issues stock for first time, that "first time" issue is IPO. Investment bank assists in determining IPO price, discover path through Dutch auction process.

BANKING BOOK VS TRADING BOOK

BANKING BOOK refers to loans made, which are primary assets of commercial banks. Value of loan includes principal amount to be repaid and accrued interest on loan.

Non Performing Loans (Payment overdue > 90 days) does not include accrued interest. A bank will recognize a loss on a loan if it becomes likely that the borrower will not fully repay the principal. Banks financial statements reflect a reserve for loan losses that is determined by management, against which actual loan losses are charged. Increases or decreases in the loan losses reserve are a potential tool for earning manipulations such as smoothing across business cycles by banks management. **Trading book** refers to assets and liabilities **related to bank's trading activities and Mark to market daily**.

THE ORIGINATE - TO - DISTRIBUTE MODEL

This model involves making loans and selling them to other parties. Eg. GNMA, FNMA, and FHLMC purchase mortgage loans from banks and issue securities backed by the cash flows from these mortgages

- **Increases liquidity in lending market**
- **in addition to residential mortgage market this mode also excels in other areas such as student loan, credit card balances, commercial loans and mortgages**

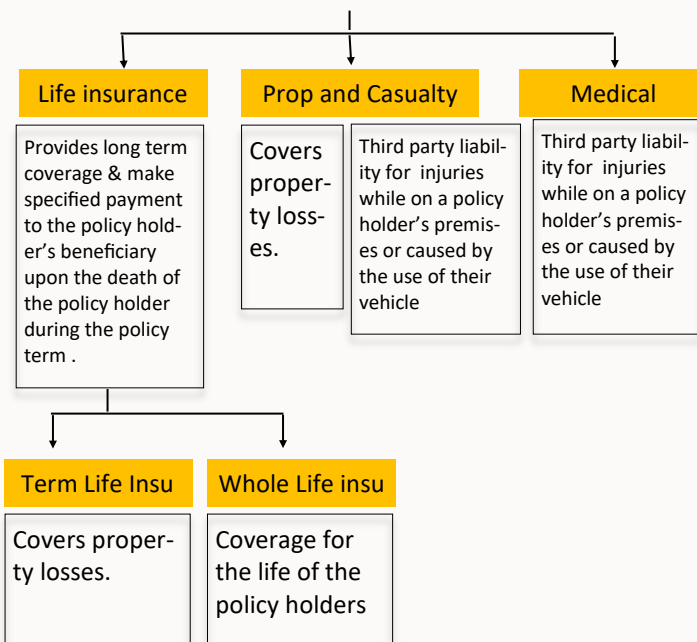
This topic is covered in detail in subject one Foundations of risk management.

Basel Committee Regulations: Started as a regulation for capital requirement of credit risk using standardized models or internal models developed by firm. After crisis of 2007, Basel reduced use of internal models. After credit crisis two new liquidity ratio requirements 1) Liquidity coverage ratio (LCR) is meant to ensure that banks have enough funding sources to remain viable for 30 days in the event of minor financial stress and 2) Net Stable funding ratio.

CATEGORIES OF INSURANCE COMPANY

Insurance company protects policy holders from specific loss events in exchange for the payments of periodic premiums.

Categories of insurance companies



RISKS FACING INSURANCE COMPANIES

1. Insufficient funds to satisfy policyholders claims.
2. Poor return on investment.
3. Liquidity risk of investment.
4. Credit risk
5. Operational risk.

MORTALITY TABLES

Mortality tables can be used to compute life insurance premiums. Mortality tables include information related to the probability of an individual dying within next year, the probability of an individual surviving to a specific age, and the remaining life expectancy of an individual of a specific age.

MORTALITY RISK VS. LONGEVITY RISK

MORTALITY RISK: Risk of policyholders dying earlier than expected due to illness or disease. (earlier than expected life insurance pay out)

LONGEVITY RISK: risk of policyholders living longer than expected. (longer than expected annuity pay out period)

HEDGING MORTALITY & LONGEVITY RISK:

1. Natural hedge (or offset) that deal with both life insurance products & annuity
2. Reinsurance contracts
3. Longevity derivatives.

PROPERTY & CASUALTY INSURANCE RATIOS

1. **Loss ratio = Payouts/ premium generated.**
Usually between 60%-80% & increase over time.
2. **Expense ratio = Expense/ premium generated.**
Usually between 25%-30% & decrease over time.
3. **Combined ratio= Loss ratio + expense ratio**
4. **Combined ratio after dividend = combined ratio + dividend to policy holders**

5. **Operating Ratio = Combined ratio - investment in-**

MORAL HAZARD & ADVERSE SELECTION

Moral hazard is the risk to the insurance company that having insurance will lead the policyholder to act more recklessly than if the policyholder did not have insurance.

Methods to mitigate: deductibles, coinsurance & policy limits.

Adverse selection is a situation where an insurer is unable to differentiate between a good risk & a bad risk & charges the same premium to all policy holders.

Methods to mitigate: Initial due diligence & on going due diligence.

CAPITAL REQUIREMENT FOR INSURANCE CO.

No global requirements exist for insurance companies, however Solvency II is a set of regulations that is applicable in the European Union. Under Solvency II, there is a minimum capital requirements (MCR) and solvency capital requirements (SCR).

- If capital < SCR, capital must increase above the SCR
- If capital < MCR, business operations may become significantly restricted
- MCR is usually 25% to 45% of SCR

GUARANTY SYSTEM FOR INSURANCE COM-

Insurance companies are regulated at the state level in US. Every insurer must be a member of the guaranty associates in the state(s) in which it operates. If an insurance co. becomes insolvent in a state, then each of the other insurance co. must contribute an amount to the state guaranty fund based on the amount of premium income it earns in that state.

PENSION FUNDS

Contribution in the fund is made by both employer & employee. Upon retirement the employee will receive periodic pension payments for the remaining life.

Defined Benefit Plan

Explicitly state the amount of the pension that the employee will receive upon retirement.

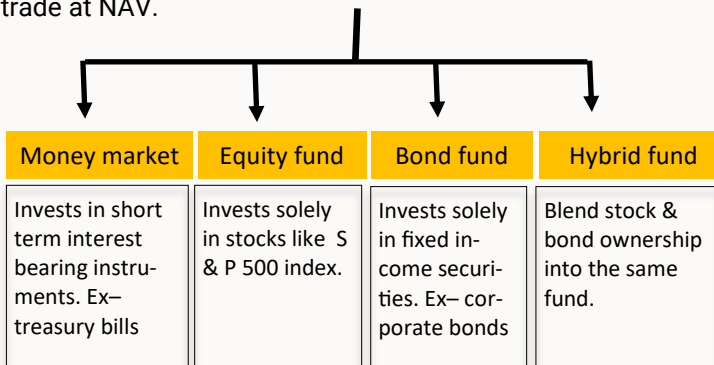
Defined Contribution Plan

Involve both employer & employee contribution being invested in one or more investment options selected by the employee.

TYPES OF MUTUAL FUND

Mutual funds are pooled investment vehicles that offers instant diversification for their investors. There are three types of mutual funds.

1. Open-end Mutual Funds: These are simply called the *mutual funds* and are the most common type of investment pools vehicle. Investors commingle their funds to be better diversified, to save on transaction fees, and to hire a professional management team. The professional management team will conduct research and ultimately invest commingled assets on behalf of their investors. Investors can redeem their funds anytime they want. Open end mutual funds trade at NAV.



2. Close-end Mutual Funds: These are similar to open-end mutual fund except closed-end funds tend to invest in niche areas like specific emerging markets and investors cannot simply redeem their shares from the fund company. They must find another investor to buy their shares. A closed-end fund can transact at a price other than NAV.

3. Exchange traded funds: ETFs enable instant diversification like an open-end fund, but they are exchange-traded, which means they trade throughout the day on the open market just like a closed-end fund does. Exchange-traded funds must disclose their holdings twice each day, which enables investors to have tremendous visibility into their underlying investments.

All these funds are subject to significant regulatory oversight.

These are all regulated by the Securities and Exchange Commission (SEC) and must register with the SEC and provide a very detailed disclosure document, called a prospectus, to all investors prior to investing. The SEC also enforces the prevention of conflicts of interest, fraud, and excessive fees. Regulatory oversight theoretically helps protect investors and causes increased costs for the funds as they hire compliance specialists to ensure that all regulations are being followed.

NET ASSET VALUE (NAV)

The fund needs to know the current value of all investment holdings (including cash positions), any liabilities like management fees payable, and the total number of shares out-

$$NAV = \frac{\text{Fund assets} - \text{Fund liabilities}}{\text{Total shares outstanding}}$$

MUTUAL FUNDS VS. HEDGE FUNDS

MUTUAL FUNDS	HEDGE FUNDS
Marked to any or all investors.	Restricted to wealthy & sophisticated investors.
Regulated	Escape certain regulations.
Need to provide the redemption of shares at any time the investors demand, calculation of daily NAV & full disclosure of policies & strategies.	Need not provide the redemption of shares at any time the investors demand, calculation of daily NAV & full disclosure of policies & strategies
Not permitted to use leverage	Permitted to use leverage.
Long & short term investment are considered as separate classes.	Permitted to use both long & short term investment strategies.

HEDGE FUND EXPECTED RETURNS AND FEE STRUCTURE

Hedge funds charges incentive fees that are engineered to give hedge fund managers significant pay-outs based on their performance. The typical hedge fund fee structure is known as "2 plus 20%," which means that they charge a flat 2% of all assets that they manage plus an additional 20% of all profits above a specified benchmark. Hedge funds do soften the incentive fee structure with a few safeguards for investors.

Hurdle rate: It is the benchmark that must be beaten

- **High-water mark clause:** It essentially states that previous losses must first be recouped and hurdle rates surpassed before incentive fees once again apply.
- **Clawback clause:** It enables investors to retain a portion of previously paid incentive fees in an escrow account that is used to offset .

HEDGE FUND PERFORMANCE & MANAGEMENT

1. Participation in hedge fund indices is **voluntary**. If the fund had good performance, then they will report their results to the index vendor. If they did not have good results, then they simply do not report their results to the index. This is known as the **measurement bias** of hedge fund index reporting.
2. When returns are reported by a hedge fund, the database is then backfilled with the fund's **previous returns**. This is known as **backfill bias** and it creates an **issue with reliability** for hedge fund benchmarks.

Undesirable Trading Behaviours

Late trading—when orders are accepted after the 4:00 pm cut off trading time. Significant events can occur after 4:00 and trades might be reversed. **Hence late trading is illegal and subject to prosecution.**

Market Timing—some funds assets are not actively traded, thereby resulting in stale pricing when calculating NAV. If markets are fluctuating before 4:00 pm cut off, it may be profitable to trade at NAV at 4.00pm since the stale pricing means that the value of the shares is likely higher or lower than NAV. Market trades may result in sudden fluctuations in the fund's size that will require fund to maintain greater liquidity. **Although, if trading exceptions are made by regulators, the act of market timing is not illegal.**

Front running involves trading ahead of a likely price movement due to a known upcoming trade to be made by the fund, say by traders own account or favoured clients or employees. **It is illegal and subject to prosecution.**

Directed brokerage involves a quid pro quo whereby a mutual fund will direct trades to a broker in exchange for the broker investing its clients in the mutual fund. **Not illegal, it is a strongly discouraged practice.**

HEDGE FUND STRATEGIES

1. **Long/short equity** : Long/short equity hedge funds endeavour to find **mispriced securities**. **Market neutral funds** are where long and short positions make the fund ambivalent to market direction, and **factor neutral funds** are where positions are isolated from a specific factor like oil or interest rate policy.
2. **Dedicated short** : Dedicated short hedge funds are focused exclusively on **finding a company that they think is overvalued and then short selling the stock**.
3. **Distressed securities** : Bonds with a credit rating of CCC are considered to be "distressed." Distressed bonds usually trade at deep discounts to par value and often offer yields upwards of 10% greater than a comparable Treasury. Distressed securities hedge funds are searching **for distressed bonds with the potential to turn things around**.
4. **Merger Arbitrage**: Merger arbitrage hedge funds try to find **arbitrage opportunities after mergers are announced**. These are primarily positive deals where the managers are planning on the deal going through. There are two different types of mergers:
 - cash deals : Merger deal is settled by paying **cash** to the merger company.
 - Stock deals: Merger deal is settled by paying in **stock** to the seller company.
5. **Convertible arbitrage**: Some hedge funds invest **using convertible bonds**, which are fixed-income instruments that can be converted into shares of stock if the stock price rises above a pre-specified value. If convertible bonds are not converted into shares of stock, then they simply retain their bond status and continue to offer interest payments and a certain principal repayment at maturity.
6. **Fixed income arbitrage** : Fixed income arbitrage hedge funds attempt to **exploit perceived mispricing** in the realm of fixed-income securities.
7. **Emerging market** : Emerging market hedge funds focus on **investments in developing countries**. Some hedge funds choose to invest in developing country securities in their local market while others invest using American depository receipts (ADRs).
8. **Global Macro** : In this strategy, hedge fund managers attempt to profit from a **global macroeconomic trend that they feel is not in equilibrium** (priced correctly and rationally).
9. **Managed Futures**: These hedge funds attempt to **predict future movements** in commodity prices based on either technical analysis or fundamental analysis. Technical analysis attempts to infer patterns from past price movements and use those patterns as a basis for predictions. When technical analysis is used, fund managers will back test their trading rules using

OTC MARKET

OTC Market is **customized** trading market which utilizes telephone & computers to make trade. **Advantage:-** Terms are not specified, hence participants have **more flexibility** to negotiate. **Disadvantage:-** The **credit risk is higher**.

FORWARD CONTRACT

It is a contract between two parties to buy or to sell an asset at a specified future time at a **price agreed today**.
Payoff of long position = $S_t - K$
Payoff of short position = $K - S_t$
Where K = delivery price

OPTION CONTRACT

Option contract gives the option buyer the right to buy (sell) an asset at the exercise price from (to) the option seller.

Call option: Gives the option holder the **right to buy** the underlying asset at a specified price.

Put option: Gives the option holder the **right to sell** the underlying asset at a specified price.

Payoff & profit of call option & put option

Where X = Exercise price/ Strike price of option,

	CALL	PUT
BUYER: Payoff	$\text{MAX}(0, S_T - X)$	$\text{MAX}(0, X - S_T)$
Profit	$\text{MAX}(0, S_T - X) - C$	$\text{MAX}(0, X - S_T) - P$
SELLER: Payoff	$-\text{MAX}(0, S_T - X)$	$-\text{MAX}(0, X - S_T)$
Profit	$C - \text{MAX}(0, S_T - X)$	$P - \text{MAX}(0, X - S_T)$

S_T = Stock price at Maturity,

C = Call premium

P = Put premium

Figure 1: Profit Diagram for a Call at Expiration

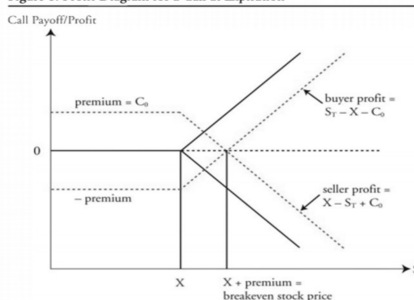
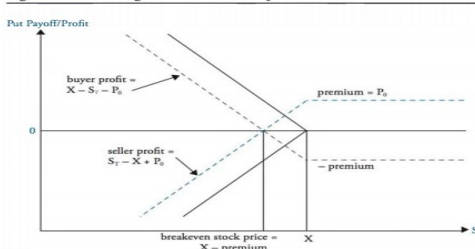


Figure 2: Profit Diagram for a Put at Expiration



FUTURES CONTRACT

It is a more **formalized**, legally binding agreement to buy/sell a commodity/ financial instrument at a **price agreed today** but delivered and paid on a later date.

HEDGING STRATEGIES

Hedgers use forward contracts & options to reduce or eliminate financial exposure by entering into an offsetting position.

SPECULATIVE STRATEGIES

Speculators use derivatives to make **bets on the market**. Risk is higher than average, in return for a higher- than-average profit potential. Speculation requires limited amount of initial investment creating significant leverage.

ARBITRAGE OPPORTUNITIES

Arbitrageurs earn a **risk-free profit** through the discovery and manipulation of **mis-priced securities** by entering into equivalent offsetting positions. Arbitrage opportunities does not last long as supply & demand forces eliminates the pricing differences.

SOME OTHER IMPORTANT DERIVATIVE

MARKET MAKER: A dealer in securities or other assets who undertakes to buy or sell at specified prices at all time.

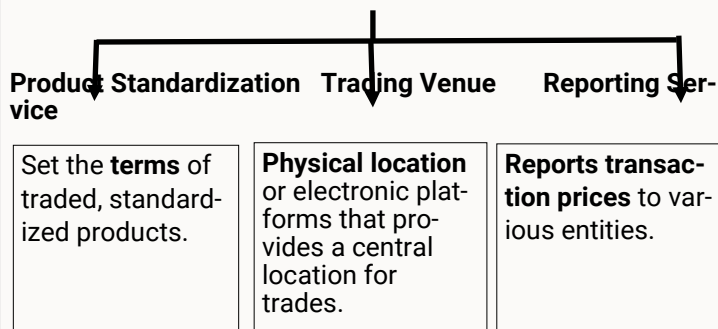
SPOT CONTRACT: An agreement to buy/sell an asset **today**.

AMERICAN OPTIONS: Contract can be exercised **any** time between issue date & expiration date.

EUROPEAN OPTIONS: Contract can be exercised **only** at the time of expiration.

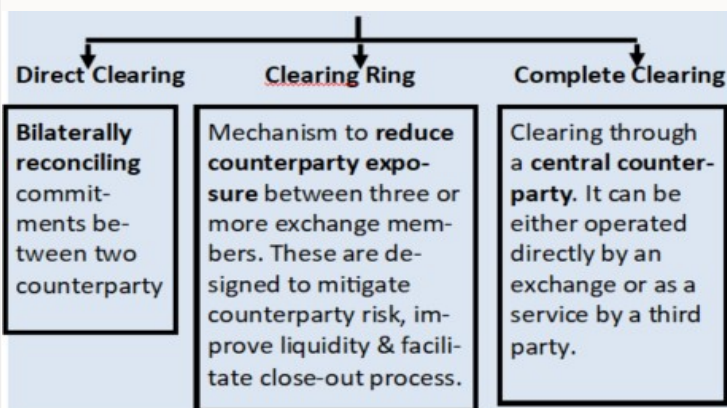
EXCHANGE FUNCTIONS

An exchange is a **central market** where standardized futures, options and other derivatives contracts can be traded. Exchange functions fall into three primary categories:



FORMS OF CLEARING

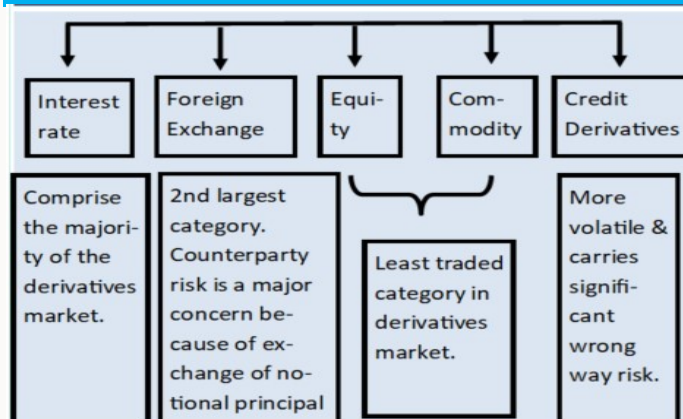
Clearing is the process of **reconciling & matching** contracts between counterparties from the time the commitments are made until settlement.



EXCHANGE TRADED VS. OTC DERIVATIVES

EXCHANGE TRADED	OTC DERIVATIVES
Standardized Contracts.	Privately negotiated bilateral contracts.
Regulated	Little or no regulation
Contracts cannot be customized.	Contracts can be customized.
Little credit risk (CCP Guarantee)	High credit risk (bilateral)
Contracts can easily be closed out.	Contracts cannot be closed out easily.
Derivatives are typically short termed & settled within a few days.	Derivatives are longer term with later settlements making clearing more challenging.
Clearing & settlement are done by CCP.	Clearing & settlement are done bilaterally.

CLASSES OF OTC DERIVATIVES



CLASSES OF OTC DERIVATIVES

1. SPECIAL PURPOSE VEHICLE (SPV) : SPVs are bankruptcy remote legal entities set up by a parent firm to shield the SPV from any financial distress of the firm. The firm transfers assets to the SPV, which in turn issues structured products to investors to finance a particular project. Benefits of using SPV:

- Strong credit rating
- They alter bankruptcy rule & transform counterparty risk into legal risk.

2. DERIVATIVES PRODUCT COMPANIES (DPCs) : DPCs are set up by firms as bankruptcy remote subsidiaries to **originate derivatives products and sell** them to investors. DPCs calculate their internal quantitative risk assessment to quantify credit risk & to make sure they are benchmarked similarly relative to the desired AAA ratings criteria. Criteria are:

- Market risk minimization through participating on both sides of the market.
- Parent support, with the bankruptcy remote status, shielding against the parent's potential distress.
- Credit risk & operational risk management through restrictions.

3. MONOLINES & CREDIT DERIVATIVE PRODUCT COMPANIES (CDPCs) : Monolines are **highly-rated insurance companies** that provide financial guarantees called "**credit wraps**" to investors. CDPCs are similar to DPCs but have a business model more similar to that of monolines.

CLASSES OF OTC DERIVATIVES

1. CCPs give priority to OTC derivatives counter parties increasing the risk in other markets.
2. Relying on a solid legal framework exposes CCPs and exchange market to legal risk.
3. CCPs do not take residual risk in the market given that they maintain a **matched book of trades**. This is in contrast to monolines & CDPCs, which typically have one-way market exposure.
4. In contrast to monolines & CDPCs which posts no initial or variation margin, CCPs requires members to post both initial & variation margin.

THE ROLE OF A CENTRAL COUNTERPARTY

1. **CLEARING & SETTLEMENT** : Clearing refers to the process (including margining & netting) between the **period from trade execution until settlement**. Settlement of a trade occurs when the **trade is completed** and all payments have been made and legal obligations satisfied. A CCPs primary function is to **simplify the operational process and reduce counterparty risk** that exists in the bilateral market.
2. **AUCTIONS & LOSS MUTUALIZATION**: Key functions of a CCP related to the clearing process include: margining, novation, netting, managing the auction process and loss mutualisation. When a Central clearing member defaults, rather than closing out the trades at market value, the CCP typically auctions off the trades to the surviving members through an auctioning process. Loss mutualisation is a form of insurance & refers to **member's contributions to a default fund** to cover future losses from member defaults. So when a member does default, any amount that cannot be covered from the member's own resources are covered from the fund.

OTHER MECHANICS OF A CCP

PRODUCTS:

Currently there are four categories in OTC derivatives according to their stages of central clearing history:

1. Products with long history of central clearing (int. rate swaps)
2. Products with short history of central clearing (index CDS)
3. Products that may soon be centrally cleared (CDS).
4. Products that are not suitable for central clearing (exotic derivatives).

For a product to be centrally cleared, the contract should be standardized, need to be easily valued & should be liquid.

PARTICIPANTS:

Only clearing members can transact with CCP. Requirements for becoming a member includes:

1. **Admission criteria**: CCPs set different admission criteria like credit quality & size.
2. **Financial commitments**: Members should contribute to the CCP's default fund.
3. **Operational Criteria**: It includes posting margin, participating in "fire drills" to simulate member default & in auctions if default does occur.

NUMBER OF CCPs:

Although a single large CCP can benefit from economies of scale, it is not feasible to have a single CCP because:

1. **Regional difference** : beneficial to centrally clear trades in the region's currency & under the laws & regulations of the region.
2. **Product types**: Often specialize in clearing certain derivatives products.

3. **Regulatory reasons**: Regulations may dictate that products be cleared by local CCPs.

TYPES OF CCPs

Utility Driven

Focused on long term stability rather than short-term profits.

Profit Driven

Focused on the bottom line in order to attract personal & build the best systems.

FAILURE OF A CCP

CCPs have systemic risk & its failure can lead to catastrophic events. Therefore, it must maintain sufficient loss absorption methods to withhold large member de-

DIFFERENCE BETWEEN OTC DERIVATIVES & CCP/

	OTC DERIVATIVES	CCP/EXCHANGE
Trading	Bilateral	Bilateral/Centralized
Counterparty	Original trade CP	CCP
Participants	All	Clearing Members
Products	All	Standard, Vanilla
Margining	Bilateral, custom	Full margining set by CCP
Loss buffers	Margin, regulatory capital	Initial margin, default fund, CCP capital

ADVANTAGES OF CENTRAL CLEARING

1. **TRANSPARENCY**: CCPs have a consolidated view of trading positions and can therefore better react to extreme events.
2. **OFFSETTING**: Duplicate bilateral contracts can be offset improving flexibility & reducing cost.
3. **LOSS MUTUALIZATION**: A member losses are distributed among all surviving members minimizing market impact & systemic risk.
4. **LEGAL & OPERATIONAL EFFICIENCY**: The centralized role in clearing & settlement improves operational efficiency.
5. **LIQUIDITY**: Daily margining of products ensures transparency in product valuation which increases product liquidity.
6. **DEFAULT MANAGEMENT**: It acts counterparty to each trade reducing counterparty risk.

DISADVANTAGES OF CENTRAL CLEARING

1. **MORAL HAZARD:** One party can take on higher risk knowing that other parties bears the costs of this risk.
2. **ADVERSE SELECTION :** Risk that participants with a better understanding of product risk & pricing will trade more products whose risks the CCP underprices.
3. **BIFURCATION:** The separation of trading into cleared and non-cleared products can increase cash flow volatility even for hedged products.
4. **PROCYCLICALITY:** It reflects a scenario where a CCP increases margin requirements (initial margin) in volatile market or during a crises, which may aggravate systemic risk.

MARGINING

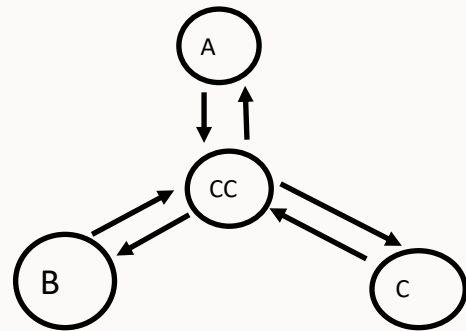
Margining involves posting cash or marketable security collateral by the member.

1. **Initial Margin :** Cash or liquid assets transferred by a member at trade inception.
2. **Variation Margin :** Cash posted by a member to cover the daily net change of the member's position.

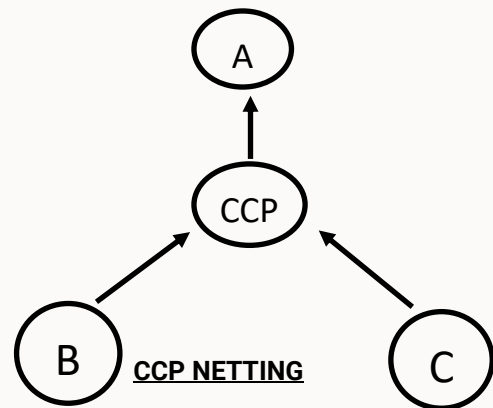
NOVATION & NETTING

The legal process of interposing the CCP between seller & the buyer is called **Novation**. Through novation, one contract is replaced with another contract with the CCP.

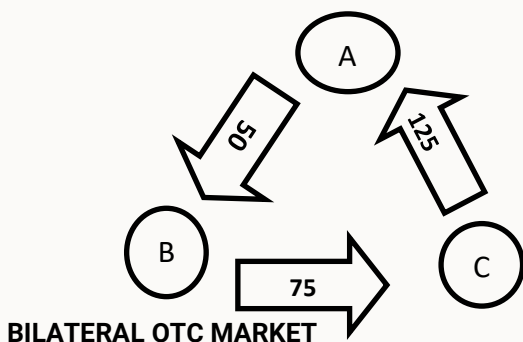
When trades are novated to a CCP, these redundant trades become a single net obligation between each participant & the CCP. This process is called **multilateral offsetting or netting**. Netting reduces total risk & minimizes the potential of a domino effect stemming from the default of a participant.



NOVATION TO CCP



CCP NETTING



BASICS OF FUTURES MARKET

A contract for assets bought at an **agreed price** but delivered & paid at a **later date**.

- **LONG POSITION:** The **purchaser** of a futures contract is said to have gone long or taken a long position.
- **SHORT POSITION:** The **seller** of a futures contract is said to have gone short or taken a short position.

CHARACTERISTICS OF FUTURES CONTRACT

1. **Quality of the underlying asset:** Specifies the quality of the goods that will be acceptable.
2. **Contract size:** Specifies the quantity of the asset that must be delivered.
3. **Delivery location:** place where the delivery will take place.
4. **Delivery time:** Month in which delivery will take place.
5. **Price quotations & tick size:** How the price of a contract will be quoted as well as the **minimum price fluctuation** for the contract, known as tick size.
6. **Daily price limits:** Max price movement for a contract during a day.
7. **Position limits:** Max number of contracts that a speculator may hold.

CONVERGENCE FOR FUTURES & SPOT PRICES

The spot price is the **price for immediate delivery**.

The futures price is the price today for delivery at some future point in time.

At expiration, the **spot price must equal the futures price**.

OPERATION OF MARGINS

1. **Margin:** Cash/high liquid collateral placed in an a/c to meet trading losses.
2. **Mark-to-market:** Determination of asset value according to market prices at the end of **each day**.
3. **Initial margin:** Amount required to open a futures position.
4. **Maintenance margin:** Minimum margin account balance required to retain the futures position.
5. **Variation margin:** Variation margin is the daily payment of profits & losses.

MARGIN REQUIREMENTS

Margin is cash or highly liquid collateral placed in an account to ensure that any trading losses will be met. MTM is daily procedure of adjusting the margin account balance for daily moments in the future price. **Look for margin requirements illustrations in main book**

CLEARING HOUSES IN FUTURES & OTC MAR-

Clearing house guarantees that traders in the futures market will honour their obligations by acting as the **counter party to the traders**. It acts as a buyer to every seller & seller to every buyer.

OTC Market is subject to great deal of credit risk and hence requires **collateralization**. Some OTC transaction uses clearing houses. Arguments for the use of clearing houses in OTC market includes:

1. Automatic posting of collateral.
2. Reduction of financial system credit risk.
3. Increased transparency of OTC trade.

NORMAL AND INVERTED FUTURES MARKET

Settlement price is the average of the price of the trade during the last period of trading.

- Increasing settlement prices over time indicates **normal market**.
- Decreasing settlement prices over time indicates an **inverted market**.

DELIVERY PROCESS

1. **Actual delivery:** Actual delivery of goods is accepted by the long by paying the contract price to the short.
2. **Cash settlement:** Futures contract is marked to market based on the settlement price on the last day of trading.
3. **Reverse or offsetting** the trade by entering the exact opposite option.
4. **Exchange for physicals:** Here the futures contract on a commodity is exchanged for the actual physical good.

TYPES OF ORDERS

1. **Market orders:** orders to buy or sell at the best price available.
2. **Discretionary orders:** market orders where the broker has the option to **delay transaction** in search of a better price.
3. **Limit orders:** orders to buy below the current price (limit buy order) or sell above the current price (limit sell order).
4. **Stop loss order:** orders used to **prevent losses** or to protect profit.
5. **Stop limit order:** combination of stop & limit orders.
6. **MIT order:** orders that would become market orders once a **specific price is reached** in the market place.
7. **GTC/Open order:** orders that remain open until they are either transact or cancelled.
8. **Fill or kill:** Should be **executed immediately** or the trade will not take place.

HEDGING WITH FUTURES

SHORT HEDGE : Short a futures contract to hedge against a price decrease in the existing long position.

LONG HEDGE : Long a futures contract to hedge against an increase in the value of the shorted asset.

ADVANTAGES & DISADVANTAGES OF HEDGING

ADVANTAGE : Leads to less uncertainty regarding future profitability.

DISADVANTAGE :

1. Can lead to less profitability if the asset being hedged ends up increasing in value.
2. Questionable benefit that accrues to shareholders. Shareholders can hedge risk on their own.
3. If price in an industry frequently adjust for changes in input prices & exchange rates, not hedging will give more stable return than hedging frequent changes.

BASIS RISK

The basis in a hedge is defined as the difference between the spot price on a hedged asset and the futures price of the hedging instrument.

Basis = Spot price of asset being hedged – futures price of contracts used in hedge.

- When spot increases faster than futures
Basis increase \longrightarrow Strengthening of basis.
When futures increases faster than spot
Basis decrease \longrightarrow Weakening of basis.

The change in basis over the hedge horizon is termed as **Basis Risk**.

Three sources of basis risk are:

- **Interruption in the convergence of the futures & spot price** : If the position is unwound prior to maturity, the return to the futures position could be different from the return to the cash position.
- **Changes in the cost of carry** : Changes in the component of the cost of carry (storage, interest, insurance etc.) can lead to basis risk.
- **Imperfect matching between the cash asset & the hedge asset** : Sometimes it may be more efficient to cross hedge or hedge a cash position with a hedge asset that is closely related but different from the cash asset. However, if there is a structural shock that changes the close relationship of these two assets, the position may not be hedged as effectively as originally believed. This is the most common form of basis risk. Other forms of mismatch include maturity or duration mismatches, liquidity mismatches, and credit risk mismatches.

OPTIMAL HEDGE RATIO

The hedge ratio is the ratio of the size of the future position relative to the spot position.

Hedge ratio, HR = $\rho_{s,f} \times \sigma_s / \sigma_f$ [This is also beta (β)]
Where, ρ = correlation between the spot & the future prices.

σ_s = Standard Deviation of spot price

σ_f = Standard deviation of futures price

The **effectiveness of the hedge** measures the variance that is reduced by implementing the optimal hedge. This effectiveness can be **evaluated with a coefficient of determination (R^2)** term where the independent variable is the change in futures prices and the dependent variable is the change in spot prices.

The beta of spot prices with respect to futures prices is equal to the hedge ratio (HR), which is also **the slope of this regression**. The R^2 measure for this simple linear regression is the square of the correlation coefficient (ρ^2) between spot and futures prices.

Hedging with Stock index

No. of contracts = $\beta \times \text{Portfolio value} / \text{Value of futures contract}$

TAILING THE HEDGE

To correct the possibility of over-hedging if daily settlement is not accounted for, a hedger can implement a tailing the hedge strategy in which the hedge ratio is multiplied by the daily spot price to future price ratio.

TYPES OF ORDERS

Hedging an existing portfolio with index futures is an attempt to reduce the systemic risk of the portfolio. If the beta of the CAPM is used as the systematic risk measure, then hedging boils down to a reduction of the portfolio beta. To calculate the appropriate number of futures

No. of contracts = $(\beta^* - \beta) \times \text{Portfolio value} / \text{underlying asset}$

Where β^* = Target Beta

β = Portfolio beta

"-" indicates selling futures

"+" indicates buying futures

ADJUSTING THE PORTFOLIO BETA

When the hedging horizon is long relative to the maturity of the futures used in the hedging strategy, hedges have to be rolled forward as the futures contract in the hedge come to maturity or expiration. This is called **rolling the hedge forward**.

Hedgers are exposed to the basis risk of the original hedge as well as new position known as **rollover basis risk**.

BASICS OF FOREIGN EXCHANGE

DIRECT QUOTE:- Home currency denoted as one unit of foreign currency Eg. \$1 = ₹
INDIRECT QUOTE:- Foreign currency as one unit of home currency Eg. ₹1 = \$

BID ASK RATES

BID RATE	\$ 1 = ₹ 65/66	ASK RATE
Meaning = Buy rate - lower rate	will quote the rate - to consumer.	Meaning = selling rate - higher rate

Exam note:- If transaction is in between **interbank market** to **BANK** then **interbank market will quote**. (Similar to question in question bank)

Net exposure (IMP) (FRM PART I May 17 EXAM)

Net position exposure (Say USD) = (USD Asset - USD Liability) + (USD Bought - USD Sold)
 IF ANSWER IS + THEN BANK IS NET LONG AND (-) THEN NET SHORT

(Note: Refer question bank and its alternate possible variation to be asked in exam in Q No 13 in Question bank Pro)

FOREIGN EXCHANGE TRADING ACTIVITY

4 KEY TRADING ACTIVITY

- INTERNATIONAL **COMMERCIAL BUSINESS TRANSACTION** SALE/ BUY OF GOODS ETC
- TAKE POSITION IN REAL FOREX **INVESTMENT**
- OFSETTING EXPOSURE - **HEDGING**
- SPECULATING** OF FOREIGN CURRENCIES.

PARITIES (PURCHASING POWER PARITY) VIMP

States exchange price should be reflective of purchasing power in both the countries.

Forward rate calculation using purchasing power parity.

$$F = S \frac{(1 + I_H)^n}{(1 + I_F)^n}$$

F = FWD rate I_H = inflation in home currency

S = SPOT rate I_F = Inflation of foreign currency

PARITIES (Interest Rate) VIMP

Forward rate calculation using interest rate parity.

$$\text{forward} = \text{spot} \left[\frac{(1 + r_{DC})}{(1 + r_{FC})} \right]^T$$

where:

r_{DC} = domestic currency rate

r_{FC} = foreign currency rate

Note:- Solve all the questions from the question bank given on these two concepts

If interest rate is in continuously compounded

$$\text{forward} = \text{spot} \times e^{(r_{DC} - r_{FC})T}$$

RELATION BETWEEN (Int. Rate and inflation)

$$(1 + \text{Nominal rate}) = (1 + \text{Real Rate})(1 + \text{inflation rate})$$

INVESTMENT & CONSUMPTION ASSET

- **INVESTMENT ASSET:** Held for the purpose of investment.
- **CONSUMPTION ASSET:** Held for the purpose of con-

SHORT SELLING & SHORT SQUEEZE

Short selling is the sale of a security that is not owned by the seller. Short seller-

1. Simultaneously borrows & sells securities through a broker.
2. Must return the securities at the request of the lender or when the short sales is closed out.
3. Must keep the proceeds of the short sale on deposit with the broker.

Short squeeze is the situation where short seller is forced to close his position when the borrower runs out of securities to borrow.

DIFF & SIMILARITIES BETWEEN FORWARD & FU-

SIMILARITIES: Forward & futures contracts:

- Can be either deliverable or cash settlement contract.
- Priced to have zero value when investor enters the contract.

FUTURES	FORWARDS
Trades on exchanges	Private contracts
Highly standardized	Customized
Clearinghouse is the counterparty.	Trader is the counterparty
Govt. regulated	Not regulated
Daily MTM	No daily requirement of MTM

FORWARD PRICING

Assumptions in forward prices:

1. No transaction cost or short sale restrictions.
2. Same tax rates.
3. Borrowing & lending at risk free rate.
4. Arbitrage opportunities are exploited.

Forward price $F_0 = S_0 e^{rT}$

$$F_0 = (S_0 - I)e^{rT}$$

$$F_0 = S_0 e^{(r-q)T}$$

with carrying cost
with dividend

Where S_0 = Spot price
 T = Time to maturity
 r = risk-free rate
 I = carrying cost
 q = dividend

CURRENCY FUTURES

INTEREST RATE PARITY: Forward exchange rate, F_0 must be related to the spot exchange rate S_0 & to the interest rate between the domestic & the foreign currency.

$$F_0 = S_0 e^{(r-r_f)T}$$

Where, r = risk free rate in domestic country
 r_f = risk free rate in foreign country

COMMODITY FUTURES

1. **Income & storage cost:** underlying is a consumption asset having actual storage cost.

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

2. **Convenience yield:** A convenience yield is an implied return on holding inventories.

$$F_0 = S_0 e^{(r+u-y)T}$$

DELIVERY OPTIONS IN THE FUTURE MARKET

Delivery options on what, where, when to deliver, choice of bonds that are acceptable to deliver are given to the "short".

If cost of carrying asset is greater than convenience

FUTURES & EXPECTED FUTURE SPOT PRICES

Expectations model: Current futures price for delivery at time T is **equal** to the expected spot price at time T . If the futures price is less than the expected price, aggressive buying of the futures would push up the futures price. If the futures price is greater than the expected spot rate, aggressive selling of the futures would lead to lower the futures price.

CONTANGO & BACKWARDATION

- **CONTANGO:** Situation where the future price is **above** the spot price. Benefit in holding the asset.
- **BACKWARDATION:** Future price is **below** the spot price. No benefit in holding the asset.

PRICING COMMODITY FORWARDS & FUTURES

For a given commodity on any trading day, several futures contracts will exist with varying maturity dates. The prices of the commodity futures contracts will differ with the different contract expiration dates. The set of futures prices for a given commodity is known as a **forward curve** or a **forward strip** on that particular day.

Commodity forward price :

$$F_{0,T} = E(S_T)e^{(r-\alpha)T}$$

Where $E(S_T)$ = expected spot price of the commodity at time T

α = discount rate for the S_T cashflow at time T.

Forward price today is the bilateral estimate of the expected commodity spot price at time T.

LEASE RATE

The forward price must be greater than the spot price to compensate physical storage costs & financial storage cost.

- If the commodity is sold at forward price— Cash & Carry
- Market in which commodity is stored— Carry market.

The commodity will only be stored if the forward price is greater than or equal to the expected spot price plus storage cost.

$$F_{0,T} = S_0 e^{(r+\lambda)T}$$

λ = Continuous annual storage cost proportional to the value of the commodity.

COMMODITY ARBITRAGE

Cash- and- carry arbitrage:

At the initiation:

1. Borrow money to market interest rate.
2. Buy underlying commodity at the spot price.
3. Sell a futures contract at the current futures price.

At contract expiration:

1. Deliver the commodity & receive futures contract price.
2. Repay the loan plus interest

If the futures contract is overpriced, above steps will generate a riskless profit

If futures price is too low-

Reverse cash- and- carry arbitrage: (opposite of above mentioned steps should be exercised).

COMMODITY ARBITRAGE

Holding an excess amount of a commodity for a non-monetary return is referred to as convenience yield.

$$F_{0,T} \geq S_0 e^{(r+\lambda-c)T}$$

c = continuously compounded convenience yield, proportional to the value of the commodity.

COMMODITY CHARACTERSTICS

1. GOLD FORWARD PRICE FACTORS : Strategies for holding synthetic gold offer a higher return than holding just the physical gold without lending it out. The present value of gold received in the future is the present value of the forward price computed at the risk free rate of return.

2. CORN FORWARD PRICE FACTOR: Commodity with a seasonal production & constant demand. Interest & storage cost need to be considered in determination of forward price. Forward curve is increasing until harvest time & it drops sharply and slopes upward again after harvest time is over.

3. ELECTRICITYPRICE FACTORS : Electricity is not storable & demand is not constant. Due to non-stability, price is set by demand & supply.

4. NATURAL GAS FORWARD PRICE FACTORS: Constant production but seasonal demand. Forward curve rises steadily when the demand is low due to storage cost.

5. OIL FORWARD PRICE FACTORS: Long run forward price is more stable due to constant demand. In the short run, supply & demand shocks cause more volatile prices because supply is fixed.

LEASE RATE

Amount of return the investor requires to buy and then lend a commodity. From the borrower's perspective, the lease rate represents the cost of borrowing the commodity.

Commodity forward price with time T with an active lease market is expressed as :

$$F_{0,T} = S_0 e^{(r-\delta)T}$$

Where, S_0 = Commodity current spot price

$r - \delta$ = Risk free rate less the lease rate

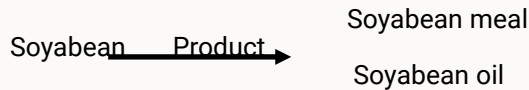
CONTANGO & BACKWARDATION:

Contango— Upward sloping forward curve. Lease rate is less than the risk free rate. Forward price must be greater than the spot price.

Backwardation - Downward sloping forward curve. Lease rate is greater than the risk free rate. Forward price must be less than the spot price.

COMMODITY SPREAD

Commodity spread results from a commodity that is an input in the production process of other commodities. Example:



Long position in soyabean & short in soyabean meal & oil is **crush spread**.

Difference between the price of crude oil & petroleum products extracted from it is **crack spread**.

BASIS RISK

Basis = Futures price used to hedge - Spot price.

Basis Risk: Risk that the value of a future contract will not move in lines with that of the underlying exposure.

STRIP HEDGE VS. STACK HEDGE

Suppose a firm faces a series of dates during which it faces price risk. That is, it has a year (or longer) of production. It can:

- Use a **strip hedge** futures contracts, each with a different delivery date.
- Use a **Stack hedge**, in which the most nearby and liquid contract is used, and is **rolled over** to the next-to-nearest contract as time passes.

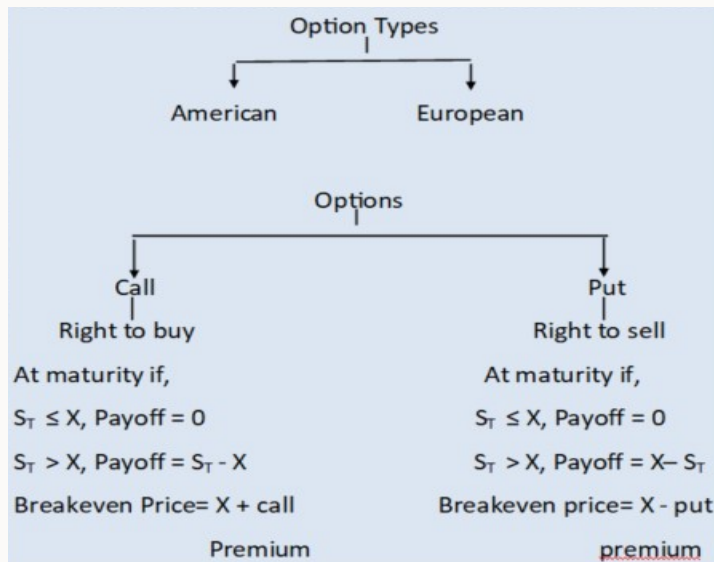
CROSS HEDGE

A cross hedge happens when there is risk due to market factors that need to be mitigated but there are no futures on the underlying commodities that are available for trading in the market.

Three factors are relevant when trading a cross hedge decision :

1. Liquidity of the futures contracts (Since delivery may not be an option).
2. The correlation between the underlying for the futures contract and the asset(s) being hedged.
3. The maturity of the futures contract.

BASICS



FOUR PRIMARY UNDERLYING ASSETS

- Stock options:** Typically exchange traded, **American-style** options.
- Currency options:** Majority of currency options are traded on the OTC market, while the remainder are exchange traded. Investors holding currency options receive the **right to buy or sell** an amount of foreign currency based on a domestic currency amount.
- Index options:** index options can be found on both the OTC markets and exchange traded markets. These are typically **European style** options and are cash settled.
- Futures options:** **American style**, exchange traded options most often utilized for futures contract.

STOCK OPTIONS SPECIFICATIONS

1. Expiration		
American	Can be exercised through- Out the life	European can be exercised only at expiration.
2. Strike prices: The price at which a put or call option can be exercised.		
3. Moneyness:		
	CALL	PUT
In-the-money	Spot price > strike	Spot price < strike
At-the-money	Spot price = exercise price	Spot price = exercise price
Out-of-the-money	Spot price < strike	Spot price > strike
4. Intrinsic Value: Difference between the underlying asset & the strike price. [Max (0, S - X)].		
5. Time value: Difference between option premium & the intrinsic value.		

NON STANDARD PRODUCTS

- FLEX options:** Exchange traded options that allow some alteration of the options contract specifications.
- ETF options:** American style option, actual delivery of shares rather than cash settlement.
- Weekly options:** Short term options created on Thursday & have expiration on Friday of next week.
- Binary options:** The payoff is either some fixed monetary amount or nothing at all.
- CEBO:** Payoff is triggered on the occurrence of a qualifying credit-event (ex- bankruptcy) prior to the options expiration date.
- DOOM options:** **Put options** are structured to only be in the money in the event of a large downward price movement in the underlying asset.

STOCK SPLITS & DIVIDENDS

- Stock splits:** Options are adjusted for stock splits. If a stock experiences b-for-a stock split, the strike price becomes (a/b) of its previous value and the number of shares underlying the option is increased by multiples of (b/a).
- Stock dividends:** Deals in the same manner as stock splits.
- Option dividends:** Options are not adjusted for cash dividends. Option pricing consequences are incorporated into the valuation model.

POSITION & EXERCISE LIMITS

Position limit: Max number of options a trader can have on one stock.

Exercise limit: A restriction on the amount of option contract of a single class that any one trader can exercise within a fixed time period (5 consecutive business days).

FACTORS EFFECTING OPTION PRICES

Effect of increasing a factor on the price of an option:

Factor	European call	European put	American call	American put
S	+	-	+	-
X	-	+	-	+
T	NA	NA	+	+
σ	+	+	+	+
r	+	-	+	-
D	-	+	-	+

RELATIONSHIP BETWEEN AMERICAN CALL & PUT OP-

Put call parity only holds for European option. For American options, we have an inequality.

$$S_0 - X \leq C - P \leq S_0 - Xe^{-rT}$$

IMPACT OF DIVIDENDS ON OPTION PRICING

To prevent arbitrage, when a stock pays a dividend, its value must decrease by the amount of the dividend. This increases the value put & decreases the value of call.

European option:

$$c \geq S_0 - D - Xe^{-rT}$$

$$p \geq S_0 - D - Xe^{-rT}$$

Early exercise of American option:

$$P + S_0 = C + D + Xe^{-rT}$$

$$S_0 - X - D \leq C - P \leq S_0 - Xe^{-rT}$$

LOWER & UPPER BOUNDS FOR OPTIONS

OPTION	MINIMUM VALUE	MAXIMUM VALUE
European call	$c \geq \text{Max}(0, S_0 - Xe^{-rT})$	S_0
American call	$C \geq \text{Max}(0, S_0 - Xe^{-rT})$	S_0
European put	$p \geq \text{Max}(0, Xe^{-rT} - S_0)$	Xe^{-rT}
American put	$P \geq \text{Max}(0, X - S_0)$	X

Where, c = value of European call option

C = value of American call option

p = value of European put option

P = value of American put option

PUT CALL PARITY

Put call parity is the relationship that must exist between the prices of **European** put & call option, having same underlying, strike price and expiration date.

$$\text{Call} + Xe^{-rT} = S_0 + \text{Put}$$

Fiduciary call Protective put

COVERED CALLS & PROTECTIVE PUTS

- **COVERED CALLS:** Sell a call option on a stock owned by the option writer.

Use: To generate cash on a stock that is not expected to increase above the exercise price.

- **PROTECTIVE PUTS:** Constructed by holding a long position in the underlying security and buying a put option.

Use: limit the downside risk at the cost of the put premium.

SPREAD STRATEGIES

- **BULL & BEAR SPREADS:**

	Bull Call Spread	Bear Call Spread
Lower Priced Call	Buy	Sell
Higher Price Call	Sell	Buy
Profits if stock goes	Up	Flat or Down

	Bull Put Spread	Bear Put Spread
Lower Priced Put	Buy	Sell
Higher Price Put	Sell	Buy
Profits if stock goes	Up	Flat or Down

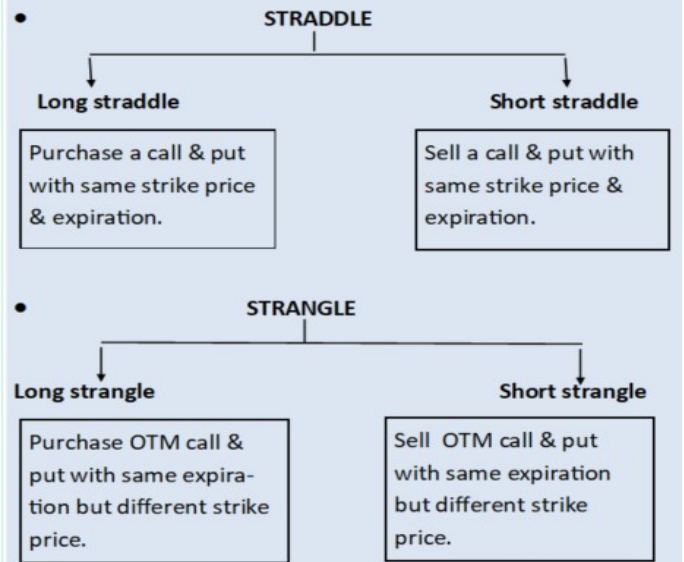
- **BUTTERFLY SPREAD:**

Long butterfly spread	Short butterfly spread
1 x ITM long put/call	1 x ITM short put/call
2 x ATM short put/call	2 x ATM long put/call
1 x OTM long put/call	1 x OTM short put/call

- **CALENDER SPREAD:** Sell short dated option & buy long dated option with same strike price.

Neutral	Bullish	Bearish	Reverse
Strike price is close to the current stock price.	Strike price is above the current stock price.	Strike price is below the current stock price.	Buy a short dated option & sell a long dated option.

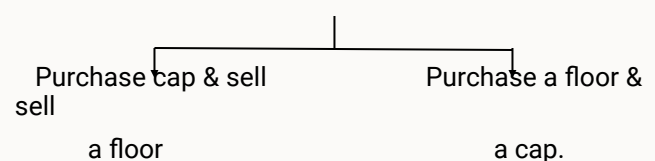
COMBINATION STRATEGIES



- **STRIPS & STRAPS**
 - 2 puts + 1 call with same strike & expiration
 - 2 calls + 1 put with same strike & expiration
- **COLLAR:** Combination of protective put & covered call.

INTEREST RATE CAPS & FLOORS

- **INTEREST RATE CAP:** One party agrees to pay the other at regular interval, when the benchmark interest rate (ex- LIBOR) exceeds the **cap rate** (strike rate) specified in the contract.
- **INTEREST RATE FLOOR:** One party agrees to pay the other at regular interval, when the benchmark interest rate (ex- LIBOR) falls below the **floor rate** (strike rate) specified in the contract.
- **INTEREST RATE COLLAR:** Simultaneous position in a floor and a cap on the same benchmark rate over the same period with the same settlement date.



Zero cost collar: Premium paid for buying the cap is equal to premium received from selling the floor.

Exotic Option

BASIC

Exotic derivatives are customized to fit a specific firm need for hedging that cannot be met by plain vanilla derivatives.

Reasons for developing exotic derivatives:

1. Provide a unique hedge for a firm's underlying assets.
2. Addressing tax and regulatory concerns.
3. Speculating on the expected future direction of market prices.

PACKAGES TO FORMULATE A ZERO-COST

A package is defined as some combination of standard European options, forwards, cash & the underlying asset., example - straddle, bull, bear etc. Because packages often consist of a long position and at short position, they can be constructed so that the initial cost of the investor is zero.

TRANSFORMING STANDARD AMERICAN OPTIONS INTO NON STANDARD AMERICAN OPTIONS

When some changes are made to standard feature of options, standard options become non standard options. Three common features that transform standard options into non-standard are:

1. Restrict early exercise to certain dates. → Bermudan options.
2. Early exercise can be limited to a certain portion of the life of the option.

EXOTIC OPTION PAYOFF STRUCTURES

1. GAP OPTIONS : A gap option has two strike prices, X_1 & X_2 (trigger price).

• **GAP CALL OPTION :- If $X_2 > X_1$**

If $S_T > X_2$, Payoff = $S_T - X_1$

$S_T \leq X_2$, Payoff = 0

If $X_2 \leq X_1$ Payoff = $X_2 - X_1$

• **GAP PUT OPTION :- If $X_2 < X_1$**

If $S_T < X_2$, Payoff = $X_1 - S_T$

$S_T \geq X_2$, Payoff = 0

If $X_2 \geq X_1$ Payoff = $X_2 - X_1$

2. FORWARD START OPTIONS: Options that begin their existence at sometime in the future. Example: Employee incentive plan.

3. COMPOUND OPTIONS: Compound options are options on options. Compound options have two levels of the underlying that determines their value - the value of the underlying option which in turn is determined by the value of the underlying asset. It consists of two strike price & two exercise dates.

- A call on a call gives the investor the right to buy a call option at a set price for a set period of time.
- A call on a put gives the investor the right to buy a put option at a set price for a set period of time.
- A put on a call gives the investor the right to sell a call option at a set price for a set period of time.
- A put on a put gives the investor the right to sell a put option.

4. CHOOSER OPTIONS : Allows the owner to choose whether the options is a call or a put after a certain period of time.

5. BARRIER OPTIONS : Options whose payoff depends on whether the underlying's asset price reaches a certain barrier level over the life of the option. Specific types of barrier options are:

- **Down-and-out call (put).** A standard call (put) option that ceases to exist if the underlying asset price hits the barrier level, which is set below the current stock value.
- **Down-and-in call (put).** A standard call (put) option that only comes into existence if the underlying asset price hits the barrier level, which is set below the current stock value.
- **Up-and-out call (put).** A standard call (put) option that ceases to exist if the underlying asset price hits a barrier level, which is set above the current stock value.
- **Up-and-in call (put).** A standard call (put) option that only comes into existence if the underlying asset price hits the above-current stock-price barrier level.

6. BINARY OPTIONS : Options payoff has one of two states: The option pays a set dollar amount at expiration if the option is above the strike price, or the option pays nothing if the price is below the strike price.

- **Cash - or - nothing call :** Fixed amount is paid if the asset ends up above the strike price.
- **Asset - or - nothing call :** Pays the value of the stock when the contract is initiated if the stock price ends up above the strike price at expiration.

7. LOOKBACK OPTIONS: Options whose payoff depends on the maximum or minimum price of the underlying asset during the life of the option

- **Floating look back call:** Pays minimum price - Expiration price
- **Floating look back put :** Maximum price - Expiration Price
- **Fixed lookback call :** It is identical to a European call option except the expiration price is the maximum price during the option's life.
- **Fixed lookback Put :** Payoff is like European Put option but replaces the final stock price with the minimum price during the option's life.

8. SHOUT OPTIONS : It allows the holder to receive either the intrinsic value of the option at the *shout date* or at expiration, whichever is greater.

9. ASIAN OPTIONS : Asian options have payoff profiles based on the average price of the security over the life of the option. Average price calls & puts payoff the difference between the average stock price & the strike price.

10. EXCHANGE OPTIONS : It is used to exchange one currency with another.

11. BASKET OPTIONS : Options to purchase or sell baskets of securities. Basket may consist of specific stocks, indices or currencies.

VOLATILITY & VARIANCE SWAP

- **VOLATILITY SWAP :** Exchange of volatility based on a notional principal.
- **VARIANCE SWAP :** It involves exchange a pre specified fixed variance rate for a realized variance rate.

ISSUES IN HEDGING EXOTIC OPTIONS

Hedging exotic options requires replication of portfolio. It may require further futures adjustment called **Dynamic options replication**. Dynamic options replication requires frequent trading which makes it costly to implement.

As an alternative, a static options replication is used in which a short portfolio of actively traded options is created which drastically reduces the transaction costs associated with dynamic rebalancing.

TYPES OF RATES

1. **Treasury Rates:** Treasury rates are the rates that correspond to government borrowing in its own currency. They are considered risk-free rates.
2. **LIBOR:** The London Interbank Offered Rate (LIBOR) is the rate at which large international banks fund their activities. Some credit risk exists with LIBOR.
3. **Repo Rates:** The "repo" or repurchase agreement rate is the implied rate on a repurchase agreement.

COMPOUNDING

If we have an initial investment of A that earns an annual rate R, compounded m times a year for n years, then it has a future value of:

$$FV_1 = A \left(1 + \frac{R}{m}\right)^{m \times n}$$

If our same investment is continuously compounded over that period, it has a future value of:

$$FV_2 = Ae^{R \times n}$$

SPOT (ZERO) RATES AND BOND PRICING

SPOT RATES

Spot rates are the rates that correspond to zero-coupon bond yields. They are the appropriate discount rates for a single cash flow at a particular future time or maturity.

BOND PRICING

A coupon bond is a series of zero-coupon bonds, and its value, assuming continuous compounding & semi-annual coupons, is:

BOND YIELD

$$B = \left[\frac{c}{2} \times \sum_{j=1}^N e^{-\frac{z_j}{2} \times j} \right] + \left[FV \times e^{-\frac{z_N}{2} \times N} \right]$$

where:

- c = the annual coupon
- N = the number of semiannual payment periods
- z_j = the bond equivalent spot rate that corresponds to j periods (j/2 years) on a continuously compounded basis
- FV = the face value of the bond

The yield of a bond is the single discount rate that equates the present value of a bond to its market price.

The bond's par yield is the rate which makes the price of a bond equal to its par value. When the bond is trading at par, the coupon will be equal to the bond's yield.

BOOTSTRAPPING SPOT RATES The theoretical spot curve is derived by interpreting each Treasury bond (T-bond) as a package of zero-coupon bonds. Using the prices for each bond, the spot curve is computed using the bootstrapping methodology.

FORWARD RATES

Forward rates are interest rates implied by the spot curve for a specified future period. Forward rates are computed from spot rates. When the spot curve is upward-sloping, the corresponding forward rate curve is upward-sloping and above the spot curve. When the spot curve is downward-sloping, the corresponding forward rate curve is downward-sloping and below the spot curve.

FORWARD RATE AGREEMENTS

A forward rate agreement (FRA) is a forward contract obligating two parties to agree that a certain interest rate will apply to a principal amount during a specified future time. The T_2 cash flow of an FRA that promises the receipt or payment of R_K is:

cash flow (if receiving R_K) = $L \times (R_K - R) \times (T_2 - T_1)$
 cash flow (if paying R_K) = $L \times (R - R_K) \times (T_2 - T_1)$

where: L = principal

R_K = annualized rate on L expressed with compounding period $T_1 - T_2$

R = annualized actual rate, expressed with compounding period $T_1 - T_2$

T_i = time i, expressed in years

The value of an FRA if we were receiving or paying is:

value (if receiving R_K) = $L \times (R_K - R_{\text{forward}}) \times (T_2 - T_1) \times e^{-R_2 \times T_2}$
 value (if paying R_K) = $L \times (R_{\text{forward}} - R_K) \times (T_2 - T_1) \times e^{-R_2 \times T_2}$

where: R_{forward} = forward rate between T_1 and T_2

Note that R_2 is expressed as a continuously compounded rate.

DURATION

The duration of a bond is the average time until the cash flows on the bond are received. The formula for duration using continuously compounded discounting of the cash flows is:

$$\text{duration} = \sum_{i=1}^n t_i \left[\frac{c_i e^{-y t_i}}{B} \right]$$

Where: t_i = the time to the cash flow c_i is to be received
 y = the continuously compounded yield (discount rate) based on a bond price of B.

MODIFIED DURATION

Modified duration is used when the yield given is something other than a continuously compounded rate.

Modified duration = duration / (1 + y/m)

Where m is the number of compounding periods per year.

CONVEXITY

Convexity shows that the difference between actual and estimated prices widens as the yield swings grow. That is, the widening error in the estimated price is due to the curvature of the actual price path. This is known as the degree of convexity.

In order to obtain an estimate of the percentage change in price due to convexity, the following calculation will need to be made:

Convexity effect = $1/2 \times \text{convexity} \times \Delta y^2$

Combining duration and convexity creates a more accurate estimate of the percentage change in the price of a bond:

percentage bond price change = duration effect + convexity effect

The **expectations theory** suggests that forward rates correspond to expected future spot rates. The **market segmentation theory** states that bonds are segmented into different maturity sectors and that supply and demand dictate rates in the segmented maturity sectors. The **liquidity preference theory** suggests that longer-term rates incorporate a liquidity premium.

Corporate Bonds

BASIC

The term **"bond"** refers to a variety of assets which offer a wide range of interest rate payments from fixed cash payments, to accruals without cash, to payments in the form of additional securities.

BOND INDENTURE & ROLE OF CORPORATE

The **bond indenture** is a document that sets forth the obligation of the issuer & the rights of the bond holders.

Corporate trustee act in a fiduciary capacity on behalf of the bondholders. They authenticate the issue & monitor the corporate activities to make sure the issuer abides by the indenture's covenants.

All corporate bonds offering over \$5 million & sold in interstate commerce must have a corporate trustee as set forth in the **Trust Indenture Act**.

MATURITY DATE

The maturity date of a bond is when the bond issuer's obligations are fulfilled. At maturity, the issuer pays the principal & any accrued interest or premium. The contract may terminate prior to the maturity date if the corporation chooses to retire the bonds early.

INTEREST PAYMENT CLASSIFICATIONS

1. Straight- coupon bond/ fixed rate bonds : They have a fixed interest rate set for the entire life of the issue.

- * **Participating bonds** : Pays atleast the specified interest rate but may pay more if companies profit increase.
- * **Income bonds** : Pays almost the specified interest but they may pay less if the companies income is not sufficient.

2. Floating rate bonds/ variable rate bonds : The interest paid is generally linked to some widely used reference rate such as LIBOR or the Federal Fund Rates.

3. Zero coupon Bonds: There is not a cash interest payment. Instead the bondholder earns a return by purchasing the bond at a discount to Face value & receiving the full face value at maturity. Variations of the zero-coupon bonds include:

- * **Deferred interest bonds (DIB)** : DIB will not pay cash interest for some number of years early in the life of the bond. That period is the deferred-interest period.
- * **Payment in kind bonds (PIK)** : PIK bonds pay interest with additional bonds for the initial period, and then cash interest after that period ends.
- * A zero-coupon bond's interest rate is determined by the original-issue discount (OID):

original-issue discount (OID) = face value – offering price
There is a zero reinvestment risk in zero-coupon bonds.

BOND TYPES

1. **Mortgage Bonds** : Those who own mortgage bonds have a first-mortgage lien on the properties of the issuer. This security allows the issuer to pay a lower rate of return than it would have to pay on unsecured bonds.
2. **Collateral trust Bonds** : Collateral trust bonds are backed by stocks, notes, bonds, or other similar obligations that the company owns. The underlying assets are called the collateral.
3. **Equipment trust certificates (ETCs)** : ETCs are a variation of a mortgage bond where a particular piece of equipment underlies the bond. The usual arrangement is that the trustee purchases the equipment and leases it to the user of the equipment who pays rent on the equipment, and that rent is passed through to the holders of the ETCs. The payments to the creditors are called dividends.
4. **Debentures** : debentures are unsecured bonds. Most corporate bonds are debentures and usually pay a higher interest rate for that reason.
5. **Subordinated debenture bonds** : They have a claim that is at the bottom of the list of creditors if the issuer goes into default. They are bonds that are unsecured and have another unsecured bond with a higher claim above them.
7. **Convertible debentures**: They give the bondholder the right to convert the bond into common stock. This feature will lower the interest rate paid.
8. **Exchangeable debentures** : These are convertible into the common stock of a corporation other than that of the issuer.
9. **Guaranteed bonds** : Bonds issued by one company may also be guaranteed by other companies. These bonds are known as guaranteed bonds.

INTEREST PAYMENT CLASSIFICATIONS

1. Call & refunding provisions : Call and refunding provisions are essentially call options on the bonds that the issuer owns and give the issuer the right to purchase at a fixed price either in whole or in part prior to maturity. A call provision can either be a fixed-price call or a make-whole call.

* **Fixed-price call** : The firm can call back the bonds at specific prices that can vary over the life of the bonds as specified in the indenture.

* **Make-whole call** : In this case, market rates determine the call price, which is the present value of the bond's remaining cash flows subject to a floor price equal to par value

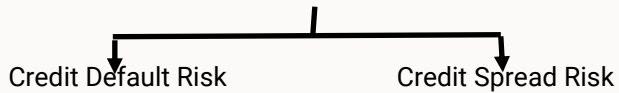
2. Sinking Fund Provision : A sinking fund provision generally means the issuing firm retires a specified portion of the debt each year as outlined in the indenture. The bonds can either be retired by use of a lottery where the owners of the selected bonds must redeem them, or the bonds are purchased in the open market. Unlike the call provision, there may be advantages to the bondholders. First, the retirement of bonds improves the financial health of the firm. Second, the redemption price may exceed the market price.

3. Maintenance & Replacement Fund (M&R) : M&R has the same goal as a sinking fund provision, which is to maintain the credibility of the property backing the bonds. M&R provision is more complex since it requires valuation formulas for the underlying assets.

4. Tender offers : Tender offers are usually a means for retiring debt for most firms. The firm openly indicates an interest in buying back a certain dollar amount of bonds or, more often, all of the bonds at a set price. The goal is to eliminate restrictive covenants or to use excess cash.

Corporate Bonds

CREDIT RISK



Credit default risk is the **uncertainty concerning the issuer making timely payments** of interest and principal as prescribed by the bond's indenture.

Credit spread risk focuses on the **difference between a corporate bond's yield and the yield on a comparable-maturity benchmark Treasury security**. This difference is known as the credit spread.

A method commonly used to evaluate credit spread risk is **spread duration**. The duration of the spread is the approximate percentage change in a bond's price for a 100 basis point change in the credit spread assuming that the Treasury rate is constant.

EVENT RISK

Event risk addresses the **adverse consequences from possible events** such as mergers, recapitalizations etc. Such events can drastically change the firm's capital structure and reduce the creditworthiness of the bonds and their value. Investors can lobby for clauses in the indenture to activate a put option for a variety of reasons including a change in the bond's rating.

HIGH YIELD BONDS

High-yield bonds are those bonds rated below investment grade by ratings agencies. There are many types of high-yield bonds.

1. **Companies issuing bonds with a non-investment grade rating**: Such issuers include young and growing companies that do not have strong financial statements but who have promising prospects.
2. **Fallen angels**: They are bonds that were issued with an investment-grade rating, but then events led to the ratings agencies lowering the rating to below investment grade.
3. **Restructuring & Leveraged Buyouts**: Restructurings and leveraged buyouts may increase the credit risk of a company to the point where the bonds become non-investment grade.

High-yield bonds can have several types of coupon structures. There are reset bonds, where designated investment banks periodically reset the coupon to reflect market rates and the creditworthiness of the issuer. There are also deferred-coupon structures, which include three types:

1. **Deferred-interest bonds**: sell at a deep discount and do not pay interest in the early years of the issue, say, for three to seven years.
2. **Step-up bonds**: pay a low coupon in the early years and then a higher coupon in later years.
3. **Payment-in-kind bonds**: allow the issuer to pay interest in the form of additional bonds over the initial

DEFAULT RATE

A default occurs if there are any missed or delayed disbursements of interest and/or principal.

1. **Issuer's default rate**: The issuer default rate is the number of issuers that defaulted over a year divided by the total number of issuers at the beginning of the year.
2. **Dollar default rate**: The dollar default rate is the par value of all bonds that defaulted in a given calendar year divided by the total par value of all bonds outstanding during the year.

RECOVERY RATE

The recovery rate is the amount received as a proportion of the total obligation after a bond defaults. The value of the total obligation requires computing the present value of the remaining cash flows at the time of the default.

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Mortgages & Mortgage-Backed Securities

RESEDENTIAL MORTGAGE PRODUCTS

LIEN STATUS

Whether the mortgage is a first lien, a second lien, or a subsequent lien will greatly impact the lender's ability to recover the balance owed in the event of default.

ORIGINAL LOAN TERM

Mortgage terms of 10 to 30 years are common, with the most popular being 30 years (long term).

CREDIT CLASSIFICATION

Classifying loans between prime and subprime is determined mainly by credit score

- **Prime (A-grade) loans** have low rates of delinquency and default as a result of low loan-to-value (LTV) ratios, borrowers with stable and sufficient income, and a strong history of repayments.
- **Subprime (B-grade) loans** have higher rates of delinquency and default compared to prime loans.
- **Alternative-A loans** are the loans in between prime and subprime.

INTEREST RATE TYPES

Fixed-rate mortgages have a set rate of interest for the term of the mortgage. Payments are constant for the term and consist of blended amounts of interest and principal.

Adjustable-rate mortgages (ARMs) have rate changes throughout the term of the mortgage. The rate is usually based on a base rate (e.g., prime rate, LIBOR) plus a spread.

PREPAYMENTS & PREPAYMENTS PENALTIES

Prepayments reduce the mortgage balance and amortization period.

To counteract the negative effects of prepayments, many loans contain prepayment penalties. They are amounts payable to the servicer for prepayments within a certain time and/or over a certain amount. Soft penalties are those that may be waived on the sale of the home; hard penalties may not be waived.

CREDIT GUARANTEES

The ability to create mortgage-backed securities requires loans that have credit guarantees.

Government loans are those that are backed by federal government agencies.

Conventional loans could be securitized by either government-sponsored enterprises (GSEs): Federal Home Loan Mortgage Corporation (FHLMC) or Federal National Mortgage Association.

PREPAYMENTS

Mortgage prepayments come in two forms: (1) increasing the frequency or amount of payments and (2) repaying/refinancing the entire outstanding balance. Prepayments are much more likely to occur when market interest rates fall and borrowers wish to refinance their existing mortgages at a new and lower rate.

Other factors that influence prepayments include seasonality, age of mortgage pool, personal, housing prices, and refinancing

FIXED RATE, LEVEL-PAYMENT MORTGAGES

A mortgage is a loan that is collateralized with a specific piece of real property, either residential or commercial. A level-payment, fixed-rate conventional mortgage has a fixed term, a fixed interest rate, and a fixed monthly payment. Even though the term, rate, and payment are fixed, the cash flows are not known with certainty because the borrower has the right to repay all or any part of the mortgage balance at any time.

Allocation Between Principal and Interest

Fully amortizing fixed-rate mortgage:

- The mortgage payment consists primarily of interest in the early years.
- Interest is calculated on a declining principal balance so the interest payable will gradually decrease over time. As a result, more of the fixed mortgage payment will be applied toward reducing the principal amount.
- The crossover point is the point in the mortgage where principal and interest allocation amounts are the same. After that point, relatively more amounts will be allocated to principal.
- Mortgages with shorter amortization periods result in less interest paid and more of the payment applied toward reducing the principal balance sooner. In other words, equity buildup occurs at a quicker rate when the amortization period is shorter.

SECURITIZATION

To reduce the risk from holding a potentially undiversified portfolio of mortgage loans, a number of financial institutions (originators) will work together to pool residential mortgage loans with similar characteristics into a more diversified portfolio. They will then sell the loans to a separate entity, called a special purpose vehicle (SPV), in exchange for cash. An issuer will purchase those mortgage assets in the SPV and then use the SPV to issue mortgage-backed securities (MBSs) to investors; the securities are backed by the mortgage loans as collateral.

PASS THROUGH SECURITIES

Fixed-rate pass-through securities trade in one of the following ways:

- The specified pools market.
- The To Be Announced (TBA) market.

MEASURING PREPAYMENTS SPEED

The value of an MBS is a function of:

- Weighted average maturity (WAM).
- Weighted average coupon (WAC).
- Speed of prepayments.

Regarding prepayment speeds, the single monthly mortality (SMM) rate is derived from the conditional prepayment rate and is used to estimate monthly prepayments for a mortgage pool:

$$SMM = 1 - (1 - CPR)^{1/12}$$

DOLLAR ROLL TRANSACTION

A dollar roll transaction occurs when an MBS market maker buys positions for one settlement month and, at the same time, sells those same positions for another month.

HOW TO VALUE A DOLLAR ROLL

The process involves assessing the income and the expenses related over the holding period. Income is determined by coupon payments, reinvested interest, and principal payments. Expenses are determined by financing costs [i.e., repurchase (repo) market].

Factors that impact dollar roll valuations:

- The security's coupon, age, and WAC.
- Holding period (period between the two settlement dates).
- Assumed prepayment speed.
- Funding cost in the repo market.

FACTOR CAUSING A DOLLAR ROLL TO TRADE SPECIAL

implied cost of funds, then the dollar roll is **trading special**. It could be caused by:

- A decrease in the back month price (due to an increased number of sale/settlement transactions on the back month date by originators).
- An increase in the front month price (due to an increased demand in the front month for deal collateral).
- Shortages of certain securities in the market that require the dealer to suddenly purchase the security for delivery in the front month, thereby increasing the front month price.

3.Defaults: When a borrower defaults, mortgage guarantors pay the interest and principal outstanding. These payments act as a source of prepayment. Modeling prepayments from default requires an analysis of loan-to-value (LTV) ratios and FICO scores, as well as an overall analysis of the housing market.

4. Curtailments : Partial payments by the borrower are referred to as curtailments. These partial payments tend to occur when a mortgage is older or has a relatively low balance. Thus, prepayment modelling due to curtailment typically takes into account the age of the mortgage.

DYNAMIC VALUATION

The Monte Carlo methodology is a simulation approach for valuing MBSs. The binomial model is not appropriate for valuing MBSs because MBSs have embedded prepayment options and the historical evolution of interest rates over time impacts prepayments.

A mortgage security is valued using the Monte Carlo methodology by simulating the interest rate path and refinancing path, projecting cash flows for each interest rate path, calculating the present value of cash flows for each interest rate path, and calculating the theoretical value of the mortgage security.

PREPAYMENT MODELLING

Borrowers may prepay a mortgage due to the sale of the property or a desire to refinance at lower prevailing rates. In addition, prepayments may occur when the borrower has defaulted on the mortgage or when the borrower has cash available to make partial prepayments (curtailment). It's four components are:

1. **Refinancing:** Refinancing a mortgage involves using the proceeds of a new mortgage to pay off the principal from an existing mortgage.
2. **Turnover:** It is typically the case that the mortgage is due once the property is sold. This is referred to as due on sale. Because most borrowers sell their homes without regard for the path of mortgage rates, MBS investors will be subjected to a degree of housing turnover that does not correlate with the behavior of rates. One factor that slows the degree of housing turnover is known as the lock-in effect. This essentially means that borrowers may wish to avoid the costs of a new mortgage, which likely consists of a higher mortgage rate.

SECURITIZATION

The option-adjusted spread (OAS) is the spread that, when added to all the spot rates of all the interest rate paths, will make the average present value of the paths equal to the actual observed market price plus accrued interest. The zero-volatility spread (\wedge -spread) is the spread that an investor realizes over the entire Treasury spot rate curve, assuming the mortgage security is held to maturity. The option cost is the implied cost of the embedded prepayment option and is calculated as the difference between the z-spread and OAS.

Four major limitations of OASs are related to:

- (1) modeling risk associated with Monte Carlo simulations,
- (2) required adjustments to interest rate paths,
- (3) model assumption of a constant OAS over time, and
- (4) dependency on the underlying prepayment model.

Interest Rate Futures

DAY COUNT CONVENTIONS

Day count conventions play a role when computing the interest that accrues on a fixed income security. When a bond is purchased, the buyer must pay any accrued interest earned through the settlement date.

accrued interest = coupon X (# of days from last coupon to the settlement date/# of days in coupon period)

There are three commonly used day count conventions.

1. Treasury bonds use **actual/actual**.
2. corporate and municipal bonds use **30/360**.
3. money market instruments (T bills) use **actual/360**.

QUOTATIONS FOR T-BONDS

T-bond prices are quoted relative to a \$100 par amount in dollars and 32nds. So a 95–05 is 95 5/32, or 95.15625.

CLEAN & DIRTY PRICES

The cash price (a.k.a. invoice price or dirty price) is the price that the seller of the bond must be paid to give up ownership. It includes the present value of the bond (a.k.a. quoted price or clean price) plus the accrued interest.

Dirty price = quoted price + accrued interest

Clean price = dirty price – accrued interest

QUOTATIONS FOR T-BILLS

T-bills and other money-market instruments use a discount rate basis and an actual/360 day count. A T-bill with a \$100 face value with n days to maturity and a cash price of T is quoted as:

TREASURY BOND FUTURES

In a T-bond futures contract, any government bond with more than 13 years to maturity on the first of the delivery month (and not callable within 15 years) is deliverable on the contract. Since the deliverable bonds have very different market values, the Chicago Board of Trade (CBOT) has created **conversion factors**. The conversion factor defines the price received by the short position of the contract.

Specifically, the cash received by the short position is computed as follows:

cash received = (QFP x CF) + AI

where: QFP = quoted futures price (most recent settlement price) CF = conversion factor for the bond delivered AI = accrued interest since the last coupon date on the bond delivered.

CHEAPEST - TO-DELIVER BOND

The procedure to determine which bond is the cheapest-to-deliver (CTD) is as follows:

cash received by the short = (QFP x CF) + AI

cost to purchase bond = (quoted bond price + AI)

The CTD bond minimizes the following: quoted bond price - (QFP x CF). This expression calculates the cost of delivering the bond.

TREASURY BOND FUTURE PRICE

The futures price is calculated in the following fashion:

$$F_0 = (S_0 - I)e^{rt}$$

where: I = present value of cash flow

We can use this equation to calculate the theoretical futures price when accounting for the CTD bond's accrued interest and its conversion factor.

EURODOLLAR FUTURES

The 3-month eurodollar futures contract trades on the Chicago Mercantile Exchange (CME) and is the most popular interest rate futures in the United States. This contract settles in cash and the minimum price change is one "tick," which is a price change of one basis point, or \$23 per \$1 million contract.

CONVEXITY ADJUSTMENT

The daily marking to market aspect of the futures contract can result in differences between actual forward rates and those implied by futures contracts. This difference is reduced by using the convexity adjustment. In general, long-dated eurodollar futures contracts result in implied forward rates larger than actual forward rates.

Forward rates implied by convexity-adjusted eurodollar futures can be used to produce a LIBOR spot curve (also called a LIBOR zero curve).

$$R_{\text{Forward}} = \frac{R_2 T_2 - R_1 T_1}{T_2 - T_1}$$

where:

R_i = spot rate corresponding with T_i periods

R_{Forward} = the forward rate between T_1 and T_2

DURATION BASED HEDGING

The objective of a duration-based hedge is to create a combined position that does not change in value when yields change by a small amount. In other words, a position that has a duration of zero needs to be produced. The duration-based hedge ratio can be expressed as follows:

$$N = -(P \times D_P) / (F \times D_F)$$

Where: N = number of contracts to hedge

D_P = Duration of the portfolio at the hedging horizon

D_F = Duration of the futures contract

P = Portfolio Value

F = Futures Value

LIMITATIONS OF DURATION

The price/yield relationship of a bond is convex, meaning it is nonlinear in shape. Duration measures are linear approximations of this relationship. Therefore, as the change in yield increases, the duration measures become progressively less accurate. Moreover, duration implies that all yields are perfectly correlated. Both of these assumptions place limitations on the use of duration as a single risk measurement tool. When changes in interest rates are both large and nonparallel (i.e., not perfectly correlated), duration-based hedge strategies will perform poorly.

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Swaps

MECHANICS OF INTEREST RATE SWAPS

The most common interest rate swap is the plain vanilla interest rate swap. In this swap arrangement, Company X agrees to pay Company Y a periodic fixed rate on a notional principal over the tenor of the swap. In return, Company Y agrees to pay Company X a periodic floating rate on the same notional principal. Both payments are in the same currency.

FINANCIAL INTERMEDIARIES

There are swap intermediaries who bring together parties with needs for the opposite side of a swap. Financial intermediaries, such as banks, will typically earn a spread of about 3 to 4 basis points for bringing two nonfinancial companies together in a swap agreement. This fee is charged to compensate the intermediary for the risk involved. If one of the parties defaults on its swap payments, the intermediary is responsible for making the other party whole. Confirmations, outline the details of each swap agreement. A representative of each party signs the confirmation, ensuring that they agree with all swap details (such as tenor and fixed/floating rates) and the steps taken in the event of default.

QUOTATIONS FOR T-BILLS

T-bills and other money-market instruments use a discount rate basis and an actual/360 day count. A T-bill with a \$100 face value with n days to maturity and a cash price of T is quoted as:

VALUING INTEREST RATE SWAPS

THE DISCOUNT RATE

The forward rates implied by either forward rate agreements (FRAs) or the convexity-adjusted Eurodollar futures are used to produce a LIBOR spot curve. The swap cash flows are then discounted using the corresponding spot rate from this curve. The following connection between forward rates and spot rates exists when continuous compounding is used:

$$R_{\text{forward}} = R_2 + (R_2 - R_1) T_1/T_2 - T_1$$

VALUING AN INTEREST RATE SWAP WITH BONDS

Valuing an interest rate swap in terms of bond positions involves understanding that the value of a floating rate bond will be equal to the notional amount at any of its periodic settlement dates when the next payment is set to the market (floating) rate. Since $V_{\text{swap}} = \text{Bond}_{\text{fixed}} - \text{Bond}_{\text{floating}}$, we can value the fixed-rate bond using the spot rate curve and then discount the next (known) floating-rate payment plus the notional amount at the current discount rate.

VALUING AN INTEREST RATE SWAP WITH FRAs

An interest rate swap is equivalent to a series of FRAs. One way to value a swap would be to use expected forward rates to forecast the expected net cash flows and then discount these expected cash flows at the corresponding spot rates, consistent with forward rate expectations.

CURRENCY SWAPS

A currency swap exchanges both principal and interest rate payments with payments in different currencies. The exchange rate used in currency swaps is the spot exchange rate. The valuation and application of currency swaps is similar to the interest rate swap.

USING CURRENCY SWAP TO TRANSFORM EXISTING POSITIONS

Currency swaps can be combined with existing positions to completely alter the risk of a liability or an asset.

COMPARITIVE ADVANTAGE

Comparative advantage is also used to explain the success of currency swaps. Typically, a domestic borrower will have an easier time borrowing in his own currency. This often results in comparative advantages that can be exploited by using a currency swap. The argument is directly analogous to that used for interest rate swaps.

SWAP CREDIT RISK

Because $V_{\text{swap}}(A) + V_{\text{swap}}(B) = 0$, whenever one side of a swap has a positive value, the other side must be negative. For example, if $V_{\text{swap}}(A) > 0$, $V_{\text{swap}}(B) < 0$. As $V_{\text{swap}}(A)$ increases in value, $V_{\text{swap}}(B)$ must become more negative. This results in increased credit risk to A since the likelihood of default increases as B has larger and larger payments to make to A. However, the potential losses in swaps are generally much smaller than the potential losses from defaults on debt with the same principal. This is because the value of swaps is generally much smaller than the value of the debt.

LIMITATIONS OF DURATION

- **Equity swap:** In an equity swap, the return on a stock, a portfolio, or a stock index is paid each period by one party in return for a fixed-rate or floating-rate payment. The return can be the capital appreciation or the total return including dividends on the stock, portfolio, or index.
- **Swaption:** A swaption is an option which gives the holder the right to enter into an interest rate swap. Swaptions can be American- or European-style options. Like any option, a swaption is purchased for a premium that depends on the strike rate (the fixed rate) specified in the swaption.
- **Commodity Swap:** Firms may enter into commodity swap agreements where they agree to pay a fixed rate for the multi-period delivery of a commodity and receive a corresponding floating rate based on the average commodity spot rates at the time of delivery.
- **Volatility Swap:** A volatility swap involves the exchanging of volatility based on a notional principal. One side of the swap pays based on a pre-specified volatility while the other side pays based on historical volatility.