INTEREST RATE RISK MANAGEMENT

LEARNING OUTCOMES

After going through the chapter student shall be able to understand:

❑ Benchmark Rates

❑ Interest Rate Risk

❑ Hedging Interest Rate Risk

    (a) Traditional Methods

    (b) Modern Methods including Interest Rate Derivatives

1. INTRODUCTION

Companies with low profit margins and high capital expenses may be extremely sensitive to interest rate increases. Interest rate derivatives are valuable tools in managing risks. Derivatives are powerful tools that mitigate risk and build value. They help companies to develop a risk mitigation strategy.

Interest rate is the cost of borrowing money and the compensation for the service and risk of lending money. Interest rates are always changing, and different types of loans offer various interest rates. The lender of money takes a risk because the borrower may not pay back the loan. Thus, interest provides a certain compensation for bearing risk.

Coupled with the risk of default is the risk of inflation. When you lend money now, the prices of goods and services may go up by the time you are paid back, so your money's original purchasing power

would decrease. Thus, interest protects against future rises in inflation. A lender such as a bank uses the interest to process account costs as well.

The factors affecting interest rates are largely macro-economic in nature:

(a)   Demand/supply of money- When economic growth is high, demand for money increases, pushing the interest rates up and vice-versa.

(b)   Inflation - The higher the inflation rate, the more interest rates are likely to rise.

(c)   Government- Government is the biggest borrower. The level of borrowing also determines the interest rates. Central Bank i.e. RBI either by printing more notes or through its Open Market Operations (OMO) changes the key rates (CRR, SLR and bank rates) depending on the state of the economy or to combat inflation.

2.   BENCHMARK RATES

As the name implies the benchmark interest is an interest rate that forms the basis for determination of other interest rates. These rates are also known as 'Reference Rates'. These rates are very important in any economy and banking system and especially in financial transactions as they not only form the basis of financial contracts such as bank overdrafts, loans, mortgages but are also used in other complex financial transactions.

The benchmark rates are widely used in derivative transactions such as Forward, Future, Option Contract and especially Swap Contracts (discussed later in detail). The Benchmark rate also forms the basis for floating rate loans. Generally based on relative credit rating of the concerned entities basis points (BPs) are added over and above the benchmark rate for any financial transaction loan or issuance of Bonds etc.

Now question arises who decides these Benchmark rates, the answer is that the rates are decided by an independent body after considering various factors.

In financial transactions both domestic as well as international benchmark rates are used.

One of the most popular benchmark rates in international financial market was LIBOR (London Interbank Offered Rate). However, after coming of the news of manipulations by some banks in 2012, it was finally decided in 2017 that it would cease to exist. Accordingly, with the beginning of 1st January 2022, to enter into contracts companies are required to use Alternative Reference Rates (ARRs).

ARRs are different from LIBOR because of the following reasons :-

(i) While ARRs are based on actual overnight transactions either secured or unsecured, LIBOR is unsecured without any collateral and mainly relies on the judgment of the panel banks to a great extent.

(ii) ARRs are also considered to be near risk free rates with no term premium.

Now question arises which ARR shall be used for benchmarks rate i.e., what is the alternative to LIBOR. The answer lies in the fact that contrary to single LIBOR for different currencies, the ARRs shall have different names, regulator, and nature. In addition to that, these will be referred on the basis of geographical referred locations of different currencies.

The different ARRs are as follows:

Region	Rate	Regulator	Nature
USA	Secured Overnight Financing Rate (SOFR)	Federal Reserve Bank of New York	Secured
UK	Sterling Overnight Index Average (SONIA)	Bank of England	Unsecured
Europe	Euro-Short-Term Rate (€STER)	European Central Bank	Unsecured
Japan	Tokyo Overnight Average Rate (TONAR)	Bank of Japan	Unsecured
Switzerland	Swiss Average Rate Overnight (SARON)	SIX (Swiss Stock Exchange)	Secured

In India though there are many benchmark interest rates such as Repo Rate, Prime Lending Rate, MCLR (Marginal Cost of Lending Rate) etc. but most of the common benchmark rates are MIBOR (Mumbai Interbank Offered Rate) and MIBID (Mumbai Interbank Bid Rate). While MIBOR is that interest rate at which bank will charge from borrower, the MIBID is that rate at which bank would like to borrow from other bank.

These two rates are used in majority of derivative deals such as Interest Rate Swaps, Forward rate Agreement, Floating Rate Debentures etc.

Further it is also important to note that not only benchmark rates are used in various types of financial transactions as discussed above but they also form the basis for valuation of various financial instruments especially the Bonds and Debentures.

3. INTEREST RATE RISK

Interest risk is the change in prices of bonds that could occur because of change in interest rates. It also considers the impact on interest income due to changes in the rate of interest. In other words, price as well as reinvestment risks require focus. So far as the terms for which interest rates were fixed on deposits banks incurs interest rate risk i.e., they stood to make gains or losses with every change in the level of interest rates.

3.1 Types of Interest Rate Risk

Various types of Interest rate risk faced by companies/ banks are as follows:

3.1.1 Gap Exposure

A gap or mismatch risk arises from holding assets and liabilities and off-balance sheet items with different principal amounts, maturity dates or re-pricing dates, thereby creating exposure to unexpected changes in the level of market interest rates. This exposure is more important in relation to banking business.

The positive Gap indicates that banks have more interest Rate Sensitive Assets (RSAs) than interest Rate Sensitive Liabilities (RSLs). A positive or asset sensitive Gap means that an increase in market interest rates could cause an increase in Net Interest Income (NII). Conversely, a negative or liability sensitive Gap implies that the banks' NII could increase as a result of decrease in market interest rates.

A negative gap indicates that banks have more RSLs than RSAs. The Gap is used as a measure of interest rate sensitivity.

Positive or Negative Gap is multiplied by the assumed interest rate changes to derive the Earnings at Risk (EaR). The EaR method facilitates to estimate how much the earnings might be impacted by an adverse movement in interest rates. The changes in interest rate could be estimated on the basis of past trends, forecasting of interest rates, etc. The banks should fix EaR which could be based on last/current year's income and a trigger point at which the line management should adopt on-or off-balance sheet hedging strategies may be clearly defined.

Gap calculations can be augmented by information on the average coupon on assets and liabilities in each time band and the same could be used to calculate estimates of the level of NII from positions maturing or due for repricing within a given time-band, which would then provide a scale to assess the changes in income implied by the gap analysis.

The periodic gap analysis indicates the interest rate risk exposure of banks over distinct maturities and suggests magnitude of portfolio changes necessary to alter the risk profile.

Although the Gap Report is very useful for analysis of Risk but it also suffers from following limitations:

❖ The Gap report quantifies only the time difference between re-pricing dates of assets and liabilities but fails to measure the impact of basis and embedded option risks.

❖ The Gap report also fails to measure the entire impact of a change in interest rate (Gap report assumes that all assets and liabilities are matured or re-priced simultaneously) within a given time-band and effect of changes in interest rates on the economic or market value of assets, liabilities and off-balance sheet position.

❖ It also does not take into account any differences in the timing of payments that might occur as a result of changes in interest rate environment.

❖ Further, the assumption of parallel shift in yield curves seldom happen in the financial market.

❖ The Gap report also fails to capture variability in non-interest revenue and expenses, a potentially important source of risk to current income.

3.1.2 Basis Risk

Market interest rates of various instruments seldom change by the same degree during a given period of time. The risk that the interest rate of different assets, liabilities and off-balance sheet items may change in different magnitude is termed as basis risk. For example, while assets may be benchmarked to Fixed Rate of Interest, liabilities may be benchmarked to floating rate of interest. The degree of basis risk is fairly high in respect of banks that create composite assets out of composite liabilities. The Loan book in India is funded out of a composite liability portfolio and is exposed to a considerable degree of basis risk. The basis risk is quite visible in volatile interest rate scenarios.

When the variation in market interest rate causes the NII to expand, the banks have experienced favourable basis shifts and if the interest rate movement causes the NII to contract, the basis has moved against the banks.

3.1.3 Embedded Option Risk

Significant changes in market interest rates create another source of risk to banks' profitability by encouraging prepayment of cash credit/demand loans/term loans and exercise of call/put options on bonds/debentures and/or premature withdrawal of term deposits before their stated maturities. The

embedded option risk is becoming a reality in India and is experienced in volatile situations. The faster and higher the magnitude of changes in interest rate, the greater will be the embedded option risk to the banks' NII. Thus, banks should evolve scientific techniques to estimate the probable embedded options and adjust the Gap statements (Liquidity and Interest Rate Sensitivity) to realistically estimate the risk profiles in their balance sheet. Banks should also endeavour to stipulate appropriate penalties based on opportunity costs to stem the exercise of options, which is always to the disadvantage of banks.

3.1.4 Yield Curve Risk

The movements in yield curve are rather frequent when the economy moves through business cycles. Thus, banks should evaluate the movement in yield curves and its impact on the portfolio values and income.

3.1.5 Price Risk

Price risk occurs when assets are sold before their stated maturities. In the financial market, bond prices and yields are inversely related. The price risk is closely associated with the trading book, which is created for making profit out of short-term movements in interest rates.

Banks which have an active trading book should, therefore, formulate policies to limit the portfolio size, holding period, duration, defeasance period, stop loss limits, marking to market, etc.

3.1.6 Reinvestment Risk

Uncertainty with regard to interest rate at which the future cash flows could be reinvested is called reinvestment risk. Any mismatches in cash flows would expose the banks to variations in NII as the market interest rates move in different directions.

3.2　Measuring Interest Rate Risk

Before interest rate risk could be managed, they should be identified and quantified. Unless the quantum of IRR inherent in the balance sheet is identified, it is impossible to measure the degree of risks to which banks are exposed. It is also equally impossible to develop effective risk management strategies/hedging techniques without being able to understand the correct risk position of banks.

The IRR measurement system should address all material sources of interest rate risk including gap or mismatch, basis, embedded option, yield curve, price, reinvestment and net interest position risks exposures. The IRR measurement system should also take into account the specific characteristics of each individual interest rate sensitive position and should capture in detail the full range of potential movements in interest rates.

There are different techniques for measurement of interest rate risk, ranging from the traditional Maturity Gap Analysis (to measure the interest rate sensitivity of earnings), Duration (to measure interest rate sensitivity of capital), Simulation and Value at Risk.

While these methods highlight different facets of interest rate risk, many banks use them in combination, or use hybrid methods that combine features of all the techniques.

4. HEDGING INTEREST RATE RISK

Methods of Hedging of Interest Rate Risk can be broadly divided into following two categories:

(A)   Traditional Methods: These methods can further be classified in following categories:

      i.   Asset and Liability Management (ALM)

      ii.   Forward Rate Agreement (FRA)

(B)   Modern Methods: These methods can further be classified in following categories:

      i.   Interest Rate Futures (IRF)

      ii.   Interest Rate Options (IRO)

      iii.   Interest Rate Swaps

4.1 Traditional Methods

Now let us discuss some of the traditional methods of hedging interest rate risk.

4.1.1 Asset and Liability Management (ALM)

Asset-Liability Management (ALM) is one of the important tools of risk management in commercial banks of India. Indian banking industry is exposed to a number of risks prevailing in the market such as market risk, financial risk, interest rate risk etc. The net income of the banks is very sensitive to these factors or risks. For this purpose, Reserve bank of India (RBI), regulator of Indian banking industry evolved the tool known as ALM.

ALM is a comprehensive and dynamic framework for measuring, monitoring and managing the market risk of a bank. It is the management of structure of Balance Sheet (liabilities and assets) in such a way that the net earnings from interest are maximized within the overall risk preference (present and future) of the institutions. The ALM functions extend to liquidity risk management, management of market risk, trading risk management, funding & capital planning, profit planning and growth projection.

The concept of ALM is of recent origin in India. It has been introduced in Indian Banking industry w.e.f. 1st April, 1999. ALM is concerned with risk management and provides a comprehensive and dynamic framework for measuring, monitoring and managing liquidity, interest rate, foreign exchange and equity and commodity price risks of a bank that needs to be closely integrated with the bank's business strategy. Asset-liability management basically refers to the process by which an institution manages its balance sheet in order to allow for alternative interest rate and liquidity scenarios.

Banks and other financial institutions provide services which expose them to various kinds of risks like credit risk, interest risk, and liquidity risk. Asset liability management is an approach that provides institutions with protection that makes such risk acceptable. Asset-liability management models enable institutions to measure and monitor risk, and provide suitable strategies for their management.

It is therefore appropriate for institutions (banks, finance companies, leasing companies, insurance companies, and others) to focus on asset-liability management when they face financial risks of different types. Asset-liability management includes not only a formalization of this understanding, but also a way to quantify and manage these risks. Further, even in the absence of a formal asset-liability management program, the understanding of these concepts is of value to an institution as it provides a true picture of the risk/reward trade-off in which the institution is engaged.

Asset-liability management is a first step in the long-term strategic planning process.

Therefore, it can be considered as a planning function for an intermediate term. In a sense, the various aspects of balance sheet management deal with planning as well as direction and control of the levels, changes and mixes of assets, liabilities, and capital.

4.1.2 Forward Rate Agreements (FRAs)

A Forward Rate Agreement (FRA) is an agreement between two parties through which a borrower/ lender protects itself from the unfavourable changes to the interest rate. Unlike futures FRAs are not traded on an exchange thus are called OTC product. Following are main features of FRA.

• Normally it is used by banks to fix interest costs on anticipated future deposits or interest revenues on variable-rate loans indexed to Benchmark Interest Rate e.g. SOFR, ESTER, MIBOR etc.

• It is an off-Balance Sheet instrument.

• It does not involve any transfer of principal. The principal amount of the agreement is termed "notional" because, while it determines the amount of the payment, actual exchange of the

principal never takes place.

- It is settled at maturity in cash representing the profit or loss. A bank that sells an FRA agrees to pay the buyer the increased interest cost on some "notional" principal amount if Reference Rate of some specified maturity is above a stipulated "Forward Interest Rate" on the contract maturity or settlement date. Conversely, the buyer agrees to pay the seller any decrease in interest cost if Reference Rate fall below the forward rate.

- Final settlement of the amounts owed by the parties to an FRA is determined by the formula

$$= \frac{(N)(RR - FR)(dtm/DY)}{[1 + RR(dtm/DY)]} \times 100$$

Where,

N = the notional principal amount of the agreement;

RR = Reference Rate for the maturity specified by the contract prevailing on the contract settlement date; typically SOFR, ESTER or MIBOR

FR = Agreed-upon Forward Rate; and

dtm = maturity of the forward rate, specified in days (FRA Days)

DY = Day count basis applicable to money market transactions which could be 360 or 365 days.

If Reference Rate > FR then the seller owes the payment to the buyer, and if Reference Rate < FR then the buyer owes the seller the absolute value of the payment amount determined by the above formula.

- The differential amount is discounted at post change (actual) interest rate as it is settled in the beginning of the period not at the end.

Example

Suppose two banks enter into an agreement specifying:

- a forward rate of 5 percent on a Eurodollar deposit with a three-month maturity;

- a $1 million notional principal; and settlement in one month.

Such an agreement is termed a 1x4 FRA because it fixes the interest rate for a deposit to be placed after one month and maturing four months after the date the contract is negotiated.

If the three-month SOFR is 6 percent on the contract settlement date, the seller would owe the buyer the difference between 6 and 5 percent interest on $1 million for a period of 90 days.

Every 1 basis point change in the interest rate payable on a principal of $1 million for a 90-day maturity changes interest cost by $25, so that the increase in the interest cost on a three-month Eurodollar deposit over the specified forward rate in this case is $25 x 100 basis points = $2,500.

The $2,500 difference in interest costs calculated above is discounted back three months using the actual three-month SOFR prevailing on the settlement date.

Thus, if 90-day SOFR turns out to be 6 percent on the contract maturity date the buyer would receive $2,463.05 = $2,500/[1 + 0.06(90/360)].

4.2 Modern Methods

Now let us discuss some of the modern methods of hedging interest rate risk.

4.2.1 Interest Rate Futures

As per Investopedia, an interest rate future is a futures contract with an underlying instrument that pays interest. An interest rate future is a contract between the buyer and seller agreeing to the future delivery of any interest-bearing asset. The interest rate future allows the buyer and seller to lock in the price of the interest-bearing asset for a future date.

Interest rate futures are used to hedge against the risk that interest rates will move in an adverse direction, causing a cost to the company.

For example, borrowers face the risk of interest rates rising. Futures use the inverse relationship between interest rates and bond prices to hedge against the risk of rising interest rates.

A borrower will enter to sell a future today. Then if interest rates rise in the future, the value of the future will fall (as it is linked to the underlying asset, bond prices), and hence a profit can be made when closing out the future (i.e. buying the future).

Currently, Interest Rate Futures segment of NSE offers two instruments i.e. Futures on 6 year, 10 year and 13 year Government of India Security and 91-day Government of India Treasury Bill (91DTB).

Bonds form the underlying instruments, not the interest rate. Further, IRF, settlement is done at two levels:

•   Mark-to-Market settlement done on a daily basis and

•   physical delivery which happens on any day in the expiry month.

Final settlement can happen only on the expiry date. Prices of IRF determined by demand and supply Interest rates are inversely related to prices of underlying bonds. In IRF following are two important terms:

(a) **Conversion factor:** All the deliverable bonds have different maturities and coupon rates. To make them comparable to each other, and also with the notional bond, RBI introduced Conversion Factor. Conversion factor for each deliverable bond and for each expiry at the time of introduction of the contract is being published by NSE.

(Conversion Factor) x (futures price) = actual delivery price for a given deliverable bond.

(b) **Cheapest to Deliver (CTD):** The CTD is the bond that minimizes difference between the quoted Spot Price of bond and the Futures Settlement Price (adjusted by the conversion factor). It is called CTD bond because it is the least expensive bond in the basket of deliverable bonds.

CTD bond is determined by the difference between cost of acquiring the bonds for delivery and the price received by delivering the acquired bond. This difference gives the profit / loss of the seller of the futures.

Profit of seller of futures = (Futures Settlement Price x Conversion factor) – Quoted Spot Price of Deliverable Bond

Loss of Seller of futures = Quoted Spot Price of deliverable bond – (Futures Settlement Price x

Conversion factor)

That bond is chosen as CTD bond which either maximizes the profit or minimizes the loss.

4.2.2 Interest Rate Options

Also known as Interest Rate Guarantee (IRG) as option is a right not an obligation and acts as insurance by allowing businesses to protect themselves against adverse interest rate movements while allowing them to benefit from favourable movements.

It should be noted that the IRO is basically a series of FRAs which are exercisable at predetermined benchmarked interest rates on each period say 3 months, 6 months etc. Some of the important types of Interest Rate Options are as follows:

4.2.2.1 Cap Option

Also called Call Option, the buyer of an interest rate cap pays the seller a premium in return for the right to receive the difference in the interest cost on some notional principal amount any time a specified index or market interest rates rises above a stipulated "Cap Rate." The buyer bears no

obligation or liability if interest rates fall below the cap rate. Thus, a cap resembles an option as it represents a right rather than an obligation to the buyer.

Caps evolved from interest rate guarantees that fixed a maximum level of interest payable on floating-rate loans. The advent of trading in over-the-counter interest rate caps dates back to 1985, when banks began to strip such guarantees from floating-rate notes to sell to the market. The leveraged buyout boom of the 1980s spurred the evolution of the market for interest rate caps. Firms engaged in leveraged buyouts typically took on large quantities of short-term debt, which made them vulnerable to financial distress in the event of a rise in interest rates. As a result, lenders began requiring such borrowers to buy interest-rate caps to reduce the risk of financial distress. More recently, trading activity in interest rate caps has declined as the number of new leveraged buyouts has fallen. An interest rate cap is characterized by:

❖ a notional principal amount upon which interest payments are based;

❖ an interest rate benchmark say SOFR, MIBOR, PLR etc. for typically some specified maturity period;

❖ a cap rate, which is equivalent to a strike or exercise price of an option; and

❖ the period of the agreement, including payment dates and interest rate reset dates.

Payment schedules for interest rate caps follow conventions in the interest rate swap market. Payment amounts are determined by the value of the benchmark rate on a series of interest rate reset dates. Intervals between interest rate reset dates and scheduled payment dates typically coincide with the term of the benchmark interest rate.

If the specified index or interest rate is above the cap rate, the seller pays the buyer the difference in interest cost on the next payment date. The amount of the payment is determined by the formula

(N) max $(0, r - r_c)(d_t/$No. of days a year),

where

N is the notional principal amount of the agreement,

r is the actual spot rate on the reset date

r_c is the cap rate (expressed as a decimal), and

d_t is the number of days from the interest rate reset date to the payment date.

Example

Consider a one-year interest rate cap that specifies a notional principal amount of $1 million and a six-month SOFR cap rate of 5 percent. Assume the agreement covers a period starting January 15 through the following January 15 with the interest rate to be reset on July 15. The first period of a cap agreement typically is excluded from the agreement as it is known on the date of agreement. Hence, the cap buyer will be entitled to a payment only if the six-month SOFR exceeds 5 percent on the July 15 interest rate reset date. Suppose that six-month SOFR is 5.5 percent on July 15. Then, on the following January 15 (184 days after the July 15 reset date) the seller will owe the buyer.

$2,555.56 = ($1,000,000)(0.055 - 0.050)(184/360).

4.2.2.2 Floor Option

It is an OTC instrument that protects the buyer of the floor from losses arising from a decrease in interest rates. The seller of the floor compensates the buyer with a pay off when the interest rate falls below the strike rate of the floor.

If the benchmark rate is below the floor rate on the interest rate reset date the buyer receives a payment of, which is equivalent to the payoff from selling an FRA at a forward rate. On the other hand, if the index rate is above the floor rate the buyer receives no payment and loses the premium paid to the seller. Thus, a floor effectively gives the buyer the right, but not the obligation, to sell an FRA, which makes it equivalent to a European put option on an FRA. More generally, a multi-period floor can be viewed as a bundle of European-style put options on a sequence of FRAs maturing on a succession of future maturity dates.

The payment received by the buyer of an interest rate floor is determined by the formula

$(N) \max(0, r_f - r)(d_t/\text{No. of days a year})$,

Where,

N is the notional principal amount of the agreement,

r is the actual spot rate on the reset date

r_f is the floor rate or strike price, and

d_t is the number of days from the last interest rate reset date to the payment date.

4.2.2.3 Interest Rate Collars

It is a combination of a Cap and Floor. The purchaser of a Collar buys a Cap and simultaneously sells a Floor. A Collar has the effect of locking its purchases into a floating rate of interest that is bounded on both high side and the low side.

Although buying a collar limits a borrower's ability to benefit from a significant decline in market interest rates, it has the advantage of being less expensive than buying a cap alone because the borrower earns premium income from the sale of the floor that offsets the cost of the cap. A zero-cost collar results when the premium earned by selling a floor exactly offsets the cap premium.

The amount of the payment due to or owed by a buyer of an interest rate collar is determined by the expression

$$(N) [\max(0, r - r_c) - \max(0, r_f - r)](d_t / \text{No. of days a year}),$$

Where,

N is the notional principal amount of the agreement,

r is the actual spot rate on the reset date

r_c is the cap rate,

r_f is the floor rate, and

d_t is the term of the index in days.

4.2.3 Interest Rate Swaps

In an interest rate swap, the parties to the agreement, termed the swap counterparties, agree to exchange payments indexed to two different interest rates. Total payments are determined by the specified notional principal amount of the swap, which is never actually exchanged.

4.2.3.1 Swap Dealers

The intermediary collected a brokerage fee as compensation, but did not maintain a continuing role once the transaction was completed. The contract was between the two ultimate swap users, who exchanged payments directly.

4.2.3.2 A fixed/floating swap is characterized by

❖   a fixed interest rate;

❖   a variable or floating interest rate which is periodically reset;

❖   a notional principal amount upon which total interest payments are based; and

❖ the term of the agreement, including a schedule of interest rate reset dates (that is, dates when the value of the interest rate used to determine floating-rate payments is determined) and payment dates.

4.2.3.3 Timing of Payments

A swap is negotiated on its "trade date" and settlement takes effect two days later called "settlement date."

4.2.3.4 Price Quotation

The convention in the swap market is to quote the fixed interest rate as an All-In-Cost (AIC), which means that the fixed interest rate is quoted relative to a flat floating-rate index.

4.2.3.5 Types of Swap

(a) Plain Vanilla Swap: Also called Generic Swap or Coupon Swap and it involves the exchange of a fixed rate loan to a floating rate loan over a period of time and that too on notional principal. Floating rate basis can be SOFR, ESTER, SONIA, MIBOR, Prime Lending Rate etc.

For example, Fixed interest payments on a generic swap are calculated assuming each month has 30 days and the quoted interest rate is based on a 360-day year. Given an All-In-Cost of the swap, the semi-annual fixed-rate payment would be:

(N)(AIC)(180/360),

Where,

N denotes the notional principal amount of the agreement.

AIC denotes the fixed rate

Then, the floating-rate receipt is determined by the formula:

$(N)(R)(d_t/360)$

Where,

d_t denotes the number of days since the last settlement date

R denotes the reference rate such as SOFR, ESTER, SONIA, MIBOR etc.

(b) Basis Rate Swap: Also, called Non-Generic Swap. Similar to plain vanilla swap with the difference that payments are based on the difference between two different variable rates. For example one rate may be 1 month SOFR and other may be 3-month SOFR. In other words two legs of swap are floating but measured against different benchmarks.

(c)   **Asset Swap:** Like plain vanilla swaps with the difference that it is the exchange fixed rate investments such as bonds which pay a guaranteed coupon rate with floating rate investments such as an index.

(d)   **Amortising Swap:** An interest rate swap in which the notional principal for the interest payments declines during the life of the swap. They are particularly useful for borrowers who have issued redeemable bonds or debentures. It enables them to do interest rate risk hedging attached with redemption profile of bonds or debentures.

4.2.4 Swaptions

An interest rate swaption is simply an option on an interest rate swap. It gives the holder the right but not the obligation to enter into an interest rate swap at a specific date in the future, at a particular fixed rate and for a specified term.

There are two types of swaption contracts: -

* A **fixed rate payer swaption** (also called Call Swaption) gives the owner of the swaption the right but not the obligation to enter into a swap where they pay the fixed leg and receive the floating leg.

* A **fixed rate receiver swaption** (also called Put Swaption) gives the owner of the swaption the right but not the obligation to enter into a swap in which they will receive the fixed leg, and pay the floating leg.

4.2.4.1 Principal features of Swaptions

A.   A swaption is effectively an option on a forward-start IRS, where exact terms such as the fixed rate of interest, the floating reference interest rate and the tenure of the IRS are established upon conclusion of the swaption contract.

B.   A 3-month into 5-year swaption would therefore be seen as an option to enter into a 5-year IRS, 3 months from now.

C.   The 'option period' refers to the time which elapses between the transaction date and the expiry date.

D.   The swaption premium is expressed as basis points.

E.   Swaptions can be cash-settled; therefore, at expiry they are marked to market off the applicable forward curve at that time and the difference is settled in cash.

4.2.4.2 Pricing of Swaptions

The pricing methodology depends upon setting up a model of probability distribution of the forward zero-coupon curve which undoes a Market process.

2.2.4.3 Uses of Swaptions

(a) Swaptions can be applied in a variety of ways for both active traders as well as for corporate treasurers.

(b) Swap traders can use them for speculation purposes or to hedge a portion of their swap books.

(c) Swaptions have become useful tools for hedging embedded optionality which is common to the natural course of many businesses.

(d) Swaptions are useful to borrowers targeting an acceptable borrowing rate.

(e) Swaptions are also useful to those businesses tendering for contracts.

(f) Swaptions also provide protection on callable/puttable bond issues.

TEST YOUR KNOWLEDGE

Theoretical Questions

1. Write a short note on Forward Rate Agreements.

2. What do you know about swaptions and their uses?

Practical Questions

1. M/s. Parker & Co. is contemplating to borrow an amount of ₹60 crores for a Period of 3 months in the coming 6 month's time from now. The current rate of interest is 9% p.a., but it may go up in 6 month's time. The company wants to hedge itself against the likely increase in interest rate.

   The Company's Bankers quoted an FRA (Forward Rate Agreement) at 9.30% p.a.

   What will be the Final settlement amount, if the actual rate of interest after 6 months happens to be (i) 9.60% p.a. and (ii) 8.80% p.a.?

2. TM Fincorp has bought a 6 x 9 ₹ 100 crore Forward Rate Agreement (FRA) at 5.25%. On fixing date reference rate i.e. MIBOR turns out be as follows:

Period	Rate (%)
3 months	5.50
6 months	5.70
9 months	5.85

You are required to determine:

(a)   Profit/Loss to TM Fincorp. in terms of basis points.

(b)   The settlement amount.

(Assume 360 days in a year)

3.   XYZ Limited borrows £ 15 Million of six months SONIA + 10.00% for a period of 24 months. The company anticipates a rise in SONIA, hence it proposes to buy a Cap Option from its Bankers at the strike rate of 8.00%. The lump sum premium is 1.00% for the entire reset periods and the fixed rate of interest is 7.00% per annum. The actual position of SONIA during the forthcoming reset period is as under:

Reset Period	SONIA
1	9.00%
2	9.50%
3	10.00%

You are required to show how far interest rate risk is hedged through Cap Option.

For calculation, work out figures at each stage up to three decimal points and amount nearest to £. It should be part of working notes.

4.   Suppose a dealer quotes 'All-in-cost' for a generic swap at 8% against six month SOFR flat. If the notional principal amount of swap is US$ 5,00,000.

(i)   Calculate semi-annual fixed payment.

(ii)   Find the first floating rate payment for (i) above if the six month period from the effective date of swap to the settlement date comprises 181 days and that the corresponding SOFR was 6% on the effective date of swap.

In (ii) above, if the settlement is on 'Net' basis, how much the fixed rate payer would pay to the floating rate payer?

Generic swap is based on 30/360 days basis.

5.　Derivative Bank entered into a plain vanilla swap through on OIS (Overnight Index Swap) on a principal of ₹ 10 crores and agreed to receive MIBOR overnight floating rate for a fixed payment on the principal. The swap was entered into on Monday, 2nd August, 2010 and was to commence on 3rd August, 2010 and run for a period of 7 days.

Respective MIBOR rates for Tuesday to Monday were:

7.75%,8.15%,8.12%,7.95%,7.98%,8.15%.

If Derivative Bank received ₹ 317 net on settlement, calculate Fixed rate and interest under both legs.

Notes:

(i)　Sunday is Holiday.

(ii)　Work in rounded rupees and avoid decimal working.

6.　A Inc. and B Inc. intend to borrow $200,000 and $200,000 in ¥ respectively for a time horizon of one year. The prevalent interest rates are as follows:

Company	¥ Loan	$ Loan
A Inc	5%	9%
B Inc	8%	10%

The prevalent exchange rate is $1 = ¥120.

They entered in a currency swap under which it is agreed that B Inc will pay A Inc @ 1% over the ¥ Loan interest rate which the later will have to pay as a result of the agreed currency swap whereas A Inc will reimburse interest to B Inc only to the extent of 9%. Keeping the exchange rate invariant, quantify the opportunity gain or loss component of the ultimate outcome, resulting from the designed currency swap.

7.　A textile manufacturer has taken floating interest rate loan of ₹ 40,00,000 on 1st April, 2012. The rate of interest at the inception of loan is 8.5% p.a. interest is to be paid every year on 31st March. In the month of October 2012, the Central bank of the country releases following projections about the interest rates likely to prevail in future.

(i)　On 31st March, 2013, at 8.75%; on 31st March, 2014 at 10% on 31st March, 2015 at 10.5% and on 31st March, 2016 at 7.75%. Show how the borrower can hedge the risk using Option Cap arising out of expected rise in the rate of interest when he wants to peg his interest cost at 8.50% p.a.

(ii) Assume that the premium negotiated by both the parties is 0.75% to be paid at once on 1st October, 2012 and the actual rate of interest on the respective due dates happens to be as: on 31st March, 2013 at 10.2%; on 31st March, 2014 at 11.5%; on 31st March, 2015 at 9.25%; on 31st March, 2016 at 8.25%. Show how the settlement will be executed on the perspective interest due dates.

ANSWERS/ SOLUTIONS

Answers to Theoretical Questions

1. Please refer paragraph 4.1.2.

2. Please refer paragraph 4.2.4.

Answers to the Practical Questions

1. **Final settlement amount shall be computed by using formula:**

$$= \frac{(N)(RR - FR)(dtm/DY)}{[1 + RR(dtm/DY)]}$$

Where,

   N = the notional principal amount of the agreement;

   RR = Reference Rate for the maturity specified by the contract prevailing on the contract settlement date;

   FR = Agreed-upon Forward Rate; and

   dtm = maturity of the forward rate, specified in days (FRA Days)

   DY = Day count basis applicable to money market transactions which could be 360 or 365 days.

Accordingly,

If actual rate of interest after 6 months happens to be 9.60%

$$= \frac{(₹60\,crore)(0.096 - 0.093)(3/12)}{[1 + 0.096(3/12)]}$$

$$= \frac{(₹60\,crore)(0.00075)}{1.024} = ₹\ 4,39,453.13$$

Thus banker will pay Parker & Co. a sum of ₹ 4,39,453.13 or ₹ 4,39,453.

If actual rate of interest after 6 months happens to be 8.80%

$$= \frac{(₹\,60\,crore)(0.088 - 0.093)(3/12)}{[1 + 0.088(3/12)]}$$

$$= \frac{(₹\,60\,crore)(-0.00125)}{1.022} = -₹\,7,33,855.19$$

Thus Parker & Co. will pay banker a sum of ₹ 7,33,855.19 or ₹ 7,33,855.

Note: Alternatively, students may solve the question on basis of different days count conventions instead of months (as considered in above calculations) i.e. 90 days/360 days, 90 days/ 365 days, 91 days/360 days or 91 days/365 days.

2. **(a)** TM will make a profit of 25 basis points since a 6X9 FRA is a contract on 3-month interest rate in 6 months, which turns out to be 5.50% (higher than FRA price).

    (b) The settlement amount shall be calculated by using the following formula:

    $$\frac{N(RR - FR)(dtm / 360)}{1 + RR(dtm / 360)}$$

    Where

    > N   = Notional Principal Amount
    >
    > RR = Reference Rate
    >
    > FR = Agreed upon Forward Rate
    >
    > Dtm = FRA period specified in days.

    Accordingly:

    $$\frac{100\,crore(5.50\% - 5.25\%)(90 / 360)}{1 + 0.055(90 / 360)} = ₹\,6,16,523$$

    Hence there is profit of ₹ 6,16,523 to TM Fincorp.

3. First of all we shall calculate premium payable to bank as follows:

    $$P = \frac{rp}{\left[(1 \div i) - \frac{1}{i \times (1+i)^t}\right]} \times A \text{ or } \frac{rp}{PVAF(3.5\%, 4)} \times A$$

Where

  P = Premium

  A = Principal Amount

  rp = Rate of Premium

  i = Fixed Rate of Interest

  t = Time

$$= \frac{0.01}{\left[(1/0.035) - \dfrac{1}{0.035 \times 1.035^4}\right]} \times £15,000,000 \text{ or } \frac{0.01}{(0.966 + 0.933 + 0.901 + 0.871)}$$

$\times £15,000,000$

$$= \frac{0.01}{\left[(28.571) - \dfrac{1}{0.0402}\right]} \times £15,000,000 = £\,40,595 \text{ or } \frac{£150,000}{3.671} = £\,40,861$$

Now we see the net payment received from bank

Reset Period	Additional interest due to rise in interest rate	Amount received from bank	Premium paid to bank*	Net Amt. received from bank
1	£ 75,000	£ 75,000	£ 40,861	£34,139
2	£ 112,500	£ 112,500	£ 40,861	£71,639
3	£ 150,000	£ 150,000	£ 40,861	£109,139
TOTAL	£ 337,500	£ 337,500	£122,583	£ 214,917

Thus, from above it can be seen that interest rate risk amount of £ 337,500 reduced by £ 214,917 by using of Cap option.

* Alternatively, if premium paid is considered as £ 40,595, then above figure of £ 214,917 shall be changed to £ 215,715.

4.   (i)   Semi-annual fixed payment

  = (N) (AIC) (Period)

  Where N = Notional Principal amount = US$ 5,00,000

    AIC   = All-in-cost = 8% = 0.08

$$= 5,00,000 \times 0.08 \left(\frac{180}{360}\right)$$

$$= 5,00,000 \times 0.08 \,(0.5)$$

$$= 5,00,000 \times 0.04 \,= ₹20,000/\text{-}$$

(ii) Floating Rate Payment

$$= N\,(SOFR) \left(\frac{dt}{360}\right)$$

$$= 5,00,000 \times 0.06 \times \frac{181}{360}$$

$$= 5,00,000 \times 0.06 \,(0.503) \text{ or } 5,00,000 \times 0.06 \,(0.502777)$$

$$= 5,00,000 \times 0.03018 \text{ or } 5,00,000 \times 0.030166 = \text{ US\$ 15,090 or 15,083}$$

(iii) Net Amount

$$= (i) - (ii)$$

$$= \text{US\$ } 20,000 \,- \text{US\$ } 15,090 = \text{US\$ } 4,910$$

$$\textbf{or } = \text{US\$ } 20,000 - \text{US\$ } 15,083 = \text{US\$ } 4,917$$

5.

Day	Principal (₹)	MIBOR (%)	Interest (₹)
Tuesday	10,00,00,000	7.75	21,233
Wednesday	10,00,21,233	8.15	22,334
Thursday	10,00,43,567	8.12	22,256
Friday	10,00,65,823	7.95	21,795
Saturday & Sunday (*)	10,00,87,618	7.98	43,764
Monday	10,01,31,382	8.15	22,358
Total Interest @ Floating			1,53,740
Less: Net Received			317
Expected Interest @ fixed			1,53,423
Thus Fixed Rate of Interest			0.07999914
Approx.			8%

(*) i.e. interest for two days.

Note: Alternatively, answer can also be calculated on the basis of 360 days in a year.

6.

Opportunity gain of A Inc under currency swap	Receipt	Payment	Net
Interest to be remitted to B. Inc in $ 2,00,000 x 9% = $18,000 Converted into ($18,000 x ¥120)		¥21,60,000	
Interest to be received from B. Inc in $ converted into ¥ (6%x $2,00,000 x ¥120)	¥14,40,000	-	
Interest payable on ¥ loan	-	¥12,00,000	
	¥14,40,000	¥33,60,000	
Net Payment	¥19,20,000	-	
	¥33,60,000	¥33,60,000	
$ equivalent paid ¥19,20,000 x (1/¥120)			$16,000
Interest payable without swap in $			$18,000
Opportunity gain in $			$ 2,000

Opportunity gain of B inc under currency swap	Receipt	Payment	Net
Interest to be remitted to A. Inc in ($ 2,00,000 x 6%)		$12,000	
Interest to be received from A. Inc in ¥ converted into $ = ¥21,60,000/¥120	$18,000		
Interest payable on $ loan@10%	-	$20,000	
	$18,000	$32,000	
Net Payment	$14,000$32,000	-	
		$32,000	
¥ equivalent paid $14,000 X ¥120			¥16,80,000
Interest payable without swap in ¥ ($2,00,000 X ¥ 120 X 8%)			¥19,20,000
Opportunity gain in ¥			¥ 2,40,000

Alternative Solution

Cash Flows of A Inc

(i) **At the time of exchange of principal amount**

Transactions		Cash Flows
Borrowings	$2,00,000 x ¥120	+ ¥240,00,000
Swap		- ¥240,00,000
Swap		+$2,00,000
Net Amount		+$2,00,000

(ii) **At the time of exchange of interest amount**

Transactions		Cash Flows
Interest to the lender	¥240,00,000X5%	¥12,00,000
Interest Receipt from B Inc.	¥2,00,000X120X6%	¥14,40,000
Net Saving (in $)	¥2,40,000/¥120	$2,000
Interest to B Inc.	$2,00,000X9%	-$18,000
Net Interest Cost		-$16,000

A Inc. used $2,00,000 at the net cost of borrowing of $16,000 i.e. 8%. If it had not opted for swap agreement the borrowing cost would have been 9%. Thus there is saving of 1%.

Cash Flows of B Inc

(i) **At the time of exchange of principal amount**

Transactions		Cash Flows
Borrowings		+ $2,00,000
Swap		- $2,00,000
Swap	$2,00,000X¥120	+¥240,00,000
Net Amount		+¥240,00,000

(ii) **At the time of exchange of interest amount**

Transactions		Cash Flows
Interest to the lender	$2,00,000X10%	- $20,000
Interest Receipt from A Inc.		+$18,000
Net Saving (in ¥)	-$2,000X¥120	- ¥2,40,000

| Interest to A Inc. | $2,00,000X6%X¥120 | - ¥14,40,000 |
| Net Interest Cost | | - ¥16,80,000 |

B Inc. used ¥240,00,000 at the net cost of borrowing of ¥16,80,000 i.e. 7%. If it had not opted for swap agreement the borrowing cost would have been 8%. Thus there is saving of 1%.

7.   As borrower does not want to pay more than 8.5% p.a., on this loan where the rate of interest is likely to rise beyond this, hence, he has hedge the risk by entering into an agreement to buy interest rate caps with the following parameters:

- Notional Principal: ₹ 40,00,000/-

- Strike rate: 8.5% p.a.

- Reference rate: the rate of interest applicable to this loan

- Calculation and settlement date: 31st March every year

- Duration of the caps: till 31st March 2016

- Premium for caps: negotiable between both the parties

To purchase the caps this borrower is required to pay the premium upfront at the time of buying caps. The payment of such premium will entitle him with right to receive the compensation from the seller of the caps as soon as the rate of interest on this loan rises above 8.5%. The compensation will be at the rate of the difference between the rate of none of the cases the cost of this loan will rise above 8.5% calculated on ₹ 40,00,000/-. This implies that in none of the cases the cost of this loan will rise above 8.5%. This hedging benefit is received at the respective interest due dates at the cost of premium to be paid only once.

The premium to be paid on 1st October 2012 is **30,000/-** (₹ 40,00,000 x 0.75/100). The payment of this premium will entitle the buyer of the caps to receive the compensation from the seller of the caps whereas the buyer will not have obligation. The compensation received by the buyer of caps will be as follows:

On 31st March 2013

The buyer of the caps will receive the compensation at the rate of 1.70% (10.20 - 8.50) to be calculated on ₹ 40,00,000, the amount of compensation will be ₹ 68000/- (40,00,000 x 1.70/100).

On 31st March 2014

The buyer of the caps will receive the compensation at the rate of 3.00% (11.50 – 8.50) to be calculated on ₹ 40,00,000/-, the amount of compensation will be ₹ 120000/- (40,00,000 x 3.00/100).

On 31st March 2015

The buyer of the caps will receive the compensation at the rate of 0.75% (9.25 – 8.50) to be calculated on ₹ 40,00,000/-, the amount of compensation will be ₹ 30,000 (40,00,000 x 0.75/100).

On 31st March 2016

The buyer of the caps will not receive the compensation as the actual rate of interest is 8.25% whereas strike rate of caps is 8.5%. Hence, his interest liability shall not exceed 8.50%.

Thus, by paying once the premium upfront buyer of the caps gets the compensation on the respective interest due dates without any obligations.