NiSM

National Institute of Securities Markets
www.nism.ac.in

Workbook for

NISM – Series – IV:
Interest Rate Derivatives Certification Examination

Workbook
for
NISM-Series-IV: Interest Rate Derivatives
Certification Examination

National Institute of Securities Markets

www.nism.ac.in

This workbook has been developed to assist candidates in preparing for the National Institute of Securities Markets (NISM) NISM-Series-IV: Interest Rate Derivatives Certification Examination (NISM-Series-IV: IRD Examination).

Workbook Version: April 2010

Published by:
National Institute of Securities Markets

Plot 82, Sector 17, Vashi
Navi Mumbai – 400 705, India

Disclaimer

The contents of this publication do not necessarily constitute or imply its endorsement, recommendation, or favoring by the National Institute of Securities Market (NISM) or the Securities and Exchange Board of India (SEBI). This publication is meant for general reading and educational purpose only. It is not meant to serve as guide for investment. The views and opinions and statements of authors or publishers expressed herein do not constitute a personal recommendation or suggestion for any specific need of an Individual. It shall not be used for advertising or product endorsement purposes.

The statements/explanations/concepts are of general nature and may not have taken into account the particular objective / move / aim / need / circumstances of individual user/reader/organization/institute. Thus NISM and SEBI do not assume any responsibility for any wrong move or action taken based on the information available in this publication.

Therefore before acting on or following the steps suggested on any theme or before following any recommendation given in this publication user/reader should consider/seek professional advice.

The publication contains information, statements, opinions, statistics and materials that have been obtained from sources believed to be reliable and the publishers of this title have made best efforts to avoid any errors. However, publishers of this material offer no guarantees and warranties of any kind to the readers/users of the information contained in this publication.

Since the work and research is still going on in all these knowledge streams, NISM and SEBI do not warrant the totality and absolute accuracy, adequacy or completeness of this information and material and expressly disclaim any liability for errors or omissions in this information and material herein. NISM and SEBI do not accept any legal liability what so ever based on any information contained herein.

While the NISM Certification examination will be largely based on material in this workbook, NISM does not guarantee that all questions in the examination will be from material covered herein.

About NISM

In pursuance of the announcement made by the Finance Minister in his Budget Speech in February 2005, Securities and Exchange Board of India (SEBI) has established the National Institute of Securities Markets (NISM) in Mumbai.

SEBI, by establishing NISM, has articulated the desire expressed by the Indian government to promote securities market education and research.

Towards accomplishing the desire of Government of India and vision of SEBI, NISM has launched an effort to deliver financial and securities education at various levels and across various segments in India and abroad. To implement its objectives, NISM has established six distinct schools to cater the educational needs of various constituencies such as investor, issuers, intermediaries, regulatory staff, policy makers, academia and future professionals of securities markets.

NISM brings out various publications on securities markets with a view to enhance knowledge levels of participants in the securities industry.

NISM is mandated to implement certification examinations for professionals employed in various segments of the Indian securities markets.

Acknowledgement

This workbook has been developed by NISM in close cooperation with the Examination Committee for Interest Rate Derivatives Certification Examination consisting of representatives of Securities and Exchange Board of India (SEBI), Bombay Stock Exchange (BSE), National Stock Exchange (NSE), MCX Stock Exchange (MCX-SX) and Fixed Income Money Market and Derivatives Association of India (FIMMDA). NISM gratefully acknowledges the contribution of all committee members.

About the Authors

This workbook has been developed for NISM by Mr. A. C. Reddi and Mr. R. C. Royappa.

About the Certification Examination on Interest Rate Derivatives

The examination seeks to create a common minimum knowledge benchmark for persons working in the Interest Rate Derivatives market segment, in order to enable a better understanding of fixed income securities markets and exchange traded interest rate derivative products, regulations and risks associated with the products and the exchange mechanisms of clearing and settlement.

Examination Objectives

On successful completion of the examination the candidate should:

- Know the basics of fixed income securities markets and specifically interest rate derivative markets in India and other markets.
- Understand the analytical framework required for Bond Futures market in India along with trading and hedging strategies involved
- Understand the clearing, settlement and risk management as well as the operational mechanism related to exchange traded interest rate derivatives
- Know the regulatory environment in which the interest rate derivatives markets operate in India.

Assessment Structure

The NISM-Series-IV: Interest Rate Derivatives Examination will be of 100 marks, will have 100 questions, and should be completed in 2 hours. There will be negative marking of 25% of the marks assigned to a question. **The passing score for the examination is 60%.**

How to register and take the examination

To find out more and register for the examination please visit www.nism.ac.in

Table of Contents

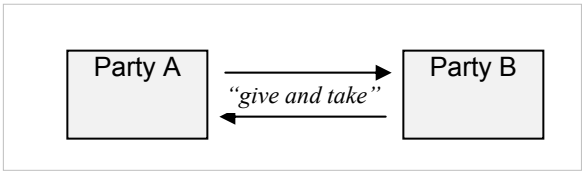
CONTENTS

Unit 1: Introduction to Fixed-income Securities and Interest Rate Market

1.1. Financial Transaction: Structure & Types

The basic legal structure of a contract is "give-and-take" between two parties (Exhibit 1). Each must give as well as take, which is called the "consideration", which is essential for legal enforceability.

EXHIBIT 1: **Legal Structure of Transaction**



Based on the nature of flows between the two parties, we can classify transactions into *buy-sell* and *borrow-lend* transactions. In derivatives, there are two more types,

swap and *option*, which collectively make up the four fundamental types of financial transactions.

Buy-Sell Transaction

- One flow is in a financial asset and the other is in money: it is exchange of an asset for money.
- The exchange occurs simultaneously at a *point* of time called *settlement date*.
- The two sides of the transaction are called *buy-side* and *sell-side*; and the two parties, *buyer* and *seller*.

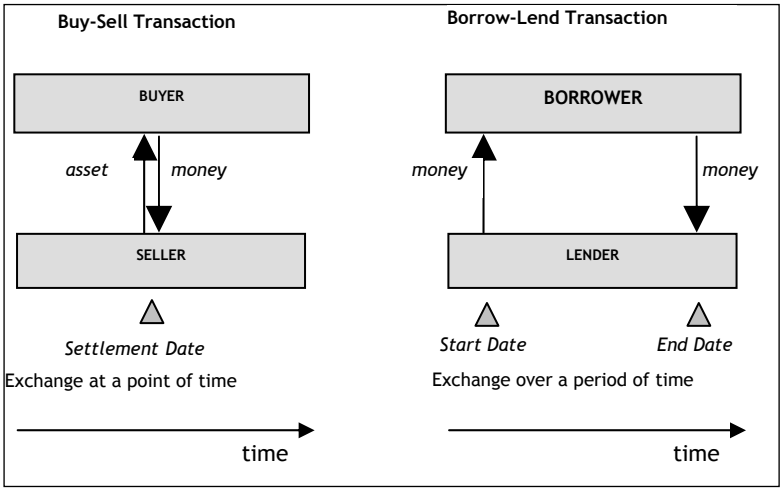
Borrow-Lend Transaction

- Both flows are in money: it is exchange of money for money. Less frequently, both flows are in a security, in which case it is called security borrowing/lending transaction.
- To make the exchange meaningful, the exchange cannot be simultaneous but split over a *period* of time, marked by *start date* and *end date*.
- The two sides of the transaction are called *borrow-side* and *lend-side*; and the two parties, *borrower* and *lender*. The amount of money on end date must include the amount on start date plus an additional amount, representing the "rent" on money for the period. This rent is called *interest*, which represents the "time-value" of money. Exhibit 2 shows the two types of transactions and their flows.

Exhibit 2 shows the differences in the flows of two transaction types. The differences in the timing of exchange will lead to different type of risks in the transaction. We

may note that there are different sources of risk in a transaction: from the counterparty, from the changing market price of flows (which is called market risk or price risk), from sources external to transaction (e.g. market disruption, systemic risk, failure of internal processes, etc. The risk we consider here is the risk from the counterparty and is defined as the possibility that one party performs his obligation while the other fails. The risk from counterparty is distinct in both transactions types: *settlement risk* in buy-sell transactions; and *credit risk* (also known as *default risk*) from borrow-lend transactions.

EXHIBIT 2: **Structure of Buy-Sell and Borrow-Lend Transactions**



Settlement Risk

Settlement risk arises in buy-sell transactions and refers to the possibility of buyer failing to pay money or seller failing to deliver the financial asset. The risk arises to both parties. The traditional tools to eliminate settlement risk are third party guarantee, margining, mark-to-market, and delivery-versus-payment (DvP) practices. Most, if not all, exchanges practice these tools and therefore exchange-traded transactions do not result in settlement risk. In over-the-counter (OTC) market, transactions are based predominantly on good faith in the counterparty and are subject to settlement risk.

Credit Risk (a.k.a. *Default Risk*)

Credit risk arises only in borrow-lend transactions, and refers to the possibility that borrower may not pay the amount due on time. Unlike settlement risk, credit risk is faced only by the lender and not by the borrower, because the give-and-take is split across time such that the borrower receives his dues at the beginning while the lender receiving his after a lapse of time.

The asymmetrical nature of risk in buy-sell and borrow-lend transactions has its effect on transaction pricing. Since the settlement risk is faced by both parties and the same for all parties, it is not priced in the transaction. As a result, at any point of time, it is the same price for all. In borrow-lend transactions, not only credit risk is faced only by lender but also the extent of risk differs from borrower to borrower. As a result, the transaction price (which is the interest rate

on loan) differs from borrower to borrower, and there cannot be unique interest rate for all borrowers.

1.2. Transaction Life Cycle

The transaction life cycle consists of many stages, but the important among them are *trade* and *settlement*.

The trade part precedes settlement part and consists of the parties negotiating and agreeing on the *terms of trade*, which consist of the following.

- *buy-sell transaction*: identification of the asset, quantity, price, and settlement date.
- *borrow-lend transaction*: amount of money, interest rate, and period of borrowing specified by start date and end date.

In the Exchange-traded transactions, the trade part is administered by the Exchange and the traditional mechanism is the open outcry method in trading pits, which is supplanted by the electronic communication networks ("screen-based trading"). The settlement part occurs *after* the trade part, is administered by the Clearing Corporation (which is distinct from the Exchange) and consists of the following.

- *buy-sell transaction*: buyer paying money and seller delivering asset.
- *borrow-lend transaction*: lender paying principal on start date and borrower paying principal plus interest on end date.

Today, in buy-sell transactions, both sides of settlement (namely, money and securities) are through electronic book entry systems with banks (for money) and depositories (for securities). If the settlement date or start date is the same

as trade date, it is called "T+0" settlement, the zero indicating that there is no gap between trade date and settlement date/start date. For most trades, however, there is a delay between them, and settlement date/start is on first business day (T+1) or second business day (T+2) or even third business day (T+3) following the trade date.

Besides the trade and settlement stages, there are many other stages in the trade life cycle: validation/review/repair, documentation, confirmation, pre-settlement confirmation, accounting, reconciliation, margining, market-to-market, etc.

1.3. Financial Markets: Types and Role

Market is the mechanism which brings the two sides of the trade (i.e. buyer/sell, borrower/lender) together and enables business between them in the form of a transaction. At the first level, we can classify financial markets into three types: *underlying markets*, *derivatives markets* and *structured products.*

Underlying markets are the fundamental and most important markets because the other two markets are derived from them. The underlying markets have the following qualifying features.

- They are independent
- The prices in these markets are determined by demand-supply forces
- The *price* and *value* are frequently different: price is set by the demand-supply forces in the market while

the value is subjectively perceived by each market participant.

- To accurately and consistently forecast the price is impossible

Derivatives markets, unlike underlying markets, are not independent but derived (and hence the name "derivative") from underlying market. The underlying market is the object and the derivative market is the shadow, so to speak. To be qualified as a financial derivative, the International Accounting Standard #39 (IAS 39) stipulates the following criteria.

Value of derivative is linked in some way to the value of underlying, rather than determined by demand-supply forces directly

The derivative trade must settle on a future date

- At inception, the derivative requires no cash outlay or a fraction of trade value

Structured products, like derivatives, are not independent but derived from other assets. This can be further classified into two types: structured credit products (which are the results of securitization) and structured investment products. Structured credit products are derived by combining different underlying assets from bond or money markets. The process consists of pooling assets of same class but different character or grading, and blending them to create new assets backed by the underlying. Examples of such synthetic assets are mortgage-backed securities (MBS), asset-backed securities (ABS) and collateralized debt obligations (CDO). Structured investment products are derived by combining a bond and a derivative asset on

equity, forex or commodity. The hybrid assets will now have the features of bond and the other asset class, offering the fixed cash flows of bond and floating cash flows of equity, forex or commodity. Examples of such products are equity-linked note (ELN), commodity-linked note (CLN), etc.

The economic role of underlying market is investment and consumption; that of derivatives, risk management; and that of structured products, investment with risk management. The following summarizes the profile of underlying, derivatives and structured products market.

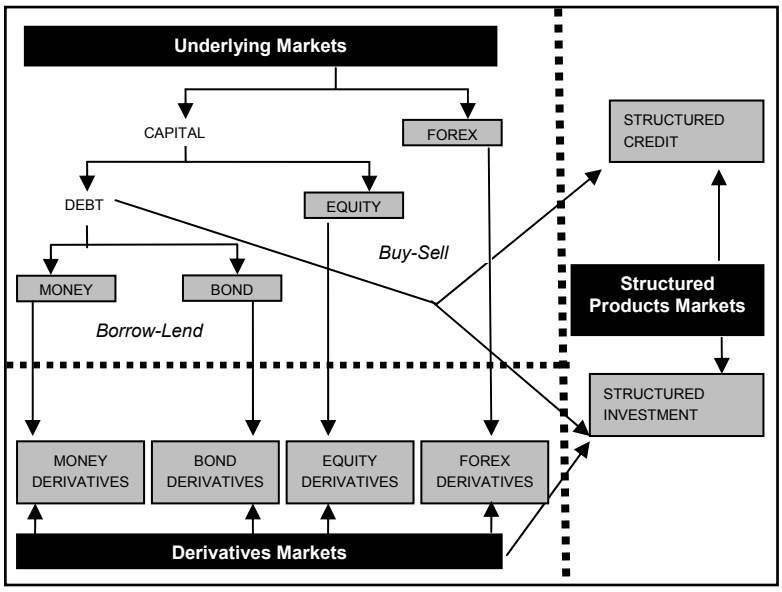
Feature	Underlying	Derivative	Structured Product
Independent ?	Yes	No (derived)	No (derived)
Role	Investment and consumption	Risk management	Investment with risk management
Pricing	Demand-supply	Arbitrage	Arbitrage

The underlying markets can be grouped further into *money, bond, equity* and *forex* markets. The first two, money and bond markets, are borrow-lend transactions; and the last two, equity and forex markets, are buy-sell transactions. The following table summarizes the nature of these four underlying markets.

Market	Transaction Type	Remark
Money	Borrow-lend	Money exchanged for money for a period of less than one year
Bond	Borrow-lend	Money exchanged for money for a period of one year or more
Equity	Buy-sell	Money exchanged for ownership of business
Forex	Buy-sell	One brand of money exchanged for another

Money and bond markets together are called debt or fixed-income securities (FIS) markets, and are the most important among all markets. FIS and equity markets are together called capital market because they provide capital to corporations and businesses. Exhibit 3 summarizes the different markets and relationship between them.

EXHIBIT 3: Financial Markets – Bird's Eye View



1.4. Fixed-income Securities (FIS) Market

Money and bond markets together are called debt or fixed-income securities (FIS) markets. The difference between the two markets is the period of borrowing/lending. In money market, the period is less than one year; and in bond market, it is one year or more. They are called "fixed-income" securities because of the following "fixed" features.

Their life is fixed: they will be redeemed on a specified future date because all borrow-lend transactions are for a fixed period. The only exception to this rule is the "Consolidated Annuity ("consol"), which is a bond issued by the UK Government, and which is a perpetual security with 3% coupon. The coupon is paid for ever and the principal is never redeemed.

In most cases, their cash flows (what you pay and what you get and when) are fixed, too. In other words, the timing and size of cash flows are known in advance. In some securities (e.g. floating-rate bonds), the timing of cash flows is known in advance but not their size because the amount is linked to prevailing interest rate.

It should be noted that fixed-income security does not mean fixed-return security. It merely means that the timing of cash flows (and in certain cases, the size of cash flows, too) is fixed and known in advance. For the purpose of return, fixed-income securities in most cases are risky assets, like equities.

The fixed-income securities (FIS) market is the most important of all markets; and the following are the stylized facts about it.

Tax-deductibility of interest expense makes the debt an essential component of every business for optimal capital structure.

The debt issued by the government ("sovereign debt") constitutes the most important component in FIS market.

The reason is that these securities have no credit (or default) risk (see Section 1.1) and are considered "risk-free" securities, the risk considered here being the credit risk alone and not the price (or market) risk (explained in Sections 2.2 and 3.4). The interest rate prevailing on the risk-free security is the benchmark and reference for determining not only the interest rate for non-sovereign debt securities but also for valuation of non-debt securities (see Section 3.2).

In the developed economies (e.g. US, most members of European Union, Japan, etc), non-sovereign debt market is substantial in size, matching that of the sovereign debt, and directly competes with the banking sector to provide capital to industry and businesses. In the emerging and developing economies, the debt market consists predominantly of sovereign debt; and the industry and businesses rely more on banking sector than on FIS market for their capital.

In the FIS market, the activity is more in primary market segment (where the transaction is directly between issuer/borrower and investor/lender) than in secondary market segment (where the transaction is between two different investors, one of which is prematurely closing his lending). This is in contrast to the equity and forex markets, where the action is more in secondary market segment than in primary market segment. Matter-of-factly, the "market" is the primary segment in FIS and the secondary segment in equities and forex. The daily turnover in secondary segment of FIS market is under one percent of the total outstanding debt even in developed economies.

The reason for the relative non-importance of secondary segment in FIS market is as follows. Debt security is redeemed after a specified maturity and therefore, if the investor is prepared to hold until the maturity, there is no need for an exit by way of secondary market. In contrast, equities and currencies are perpetual securities with no redemption by the issuer and therefore the investors will always require the secondary market to exit the investment.

FIS Market in India

Though India's FIS market is the second or third largest in Asia, it has two major drawbacks. First, the debt market is predominantly the sovereign debt market both in primary and secondary segments. Industry relies more in banking sector rather than FIS market for raising debt. Second, even in the sovereign debt market, there is no free market mechanism for determining the interest rate because of forced lending to the government: the banking regulations require that banks must invest 25% of their time and demand deposits in sovereign debt. As a result, there is almost one percentage point difference in the interest rate prevailing on short-term sovereign debt and the rupee interest rate derived through forex market. The following table shows the profile of primary and secondary segments of FIS market in India.

	2006-07	**2007-08**	**2008-09**
Net increase in bank credit to industry[1]	1,42,569	1,69,536	1,87,515
Resources raised through equity	33,508	87,029	14,720
Resources raised through debt	2,92,553	3,72,250	5,07,200
Of which: share of sovereign debt	68%	69%	70%
share of non-sovereign debt	32%	31%	30%
Secondary market turnover (per day)	7,812	14,148	11,325
Equity	898	1,138	1,412
Whole-sale debt market (WDM)	14	0	0
Retail debt market (RDM)			

[1]Only the credit to industry; credit to trade, agriculture, retail and others excluded

Source: Annual Reports of SEBI, RBI and NSE

1.5. Fixed-income Securities (FIS) Market: Instruments

FIS can be grouped into many categories, based on different parameters: cash flow pattern, tenor, issuer, credit quality, interest rate type, etc. To enable trading in secondary market, a paper or instrument is created to represent the money borrowing/lending, which is issued/invested in primary market and bought/sold in the secondary market. It must be noted, however, that all FIS transactions are borrow-lend transactions and not buy-sell transactions as defined in Section 1.1. The investor/buyer represents the lender; and the issuer/seller, the borrower.

Types of FIS based on Cash Flow Pattern

Based on the pattern of cash flows during the life of the instrument, they are classified into *coupon instrument, annuity* and *zero-coupon instrument.*

Coupon instrument pays periodic fixed amount called coupon (C), representing the interest rate; and a final fixed amount, representing the principal (P), which is also called redemption amount.

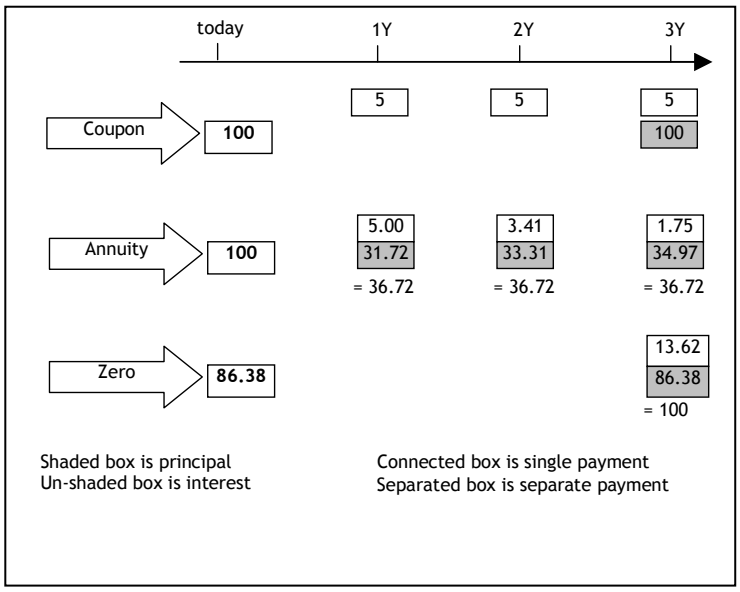
Annuity pays coupon and part of the principal periodically in such a manner that the cash flows are equal in size and equally spaced in time (e.g. equated monthly installments). Most consumer loans and housing loans are structured as annuities. The earlier payments contain more of coupon

and less of principal while the later payments contain more of principal and less of coupon.

Zero-coupon instrument (also called “discount” instrument or simply “zero”) does not pay any amount before maturity date. The interest is accumulated, compounded and paid along with principal at maturity as a single bullet payment.

Exhibit 4 depicts the cash flow pattern for three types of instruments. All of them have an implied interest rate of 5% a year, maturity of three years, redemption value of 100. The amount shown against “today” in the exhibit is the price of bond, which is an outflow for the investor.

EXHIBIT 4: Types of FIS by Cash Flow Pattern



Types of FIS based on Tenor

We have already described that money market instruments are those with an original maturity of less than one year; and bond market instruments are those with original maturity of one year or more. The market instruments are treasury bills (TB), certificate of deposits (CD) and commercial paper (CP).

Treasury bills (TB) are issued by the central government through RBI. They are issued with original maturity of 91-day, 182-day and 364-day and issued as discount instruments: no coupon but issued at discount to the redemption price. The 91-day T Bill is auctioned every week on Wednesdays with settlement on the following Friday. The 182-day T Bill is auctioned every fortnight on Wednesday of non-reporting week with settlement on the following Friday. The 364-day T Bill is auctioned every fortnight on Wednesday of reporting week with settlement on the following Friday. The 182-day T bill is not being issued now. Earlier, 14-day T bill was also issued regularly but is now discontinued. Besides this regular issuance, there is also ad hoc issuance under market stabilization scheme (MSS). The minimum and multiple amounts of issue for T bills is Rs 25,000.

Treasury bills (TB) are issued through *uniform price auction* for 91-day T bill and *multiple price auction* for 364-day T bill. In the uniform price auction method, all bids are sorted on price with descending order, and the price at which cumulative bid quantity equals the offer quantity is the cut-

off price. All the bidders at the cut-off price and above are successful bidders and allotted at the uniform price, which is the cut-off price. This is sometimes called “Dutch auction”. In the multiple price auction method, the bids are sorted and the cut-off price determined as above. However, each successful bidder is awarded at the price bid by him. As a result, there will be multiple prices of allotment. This is sometimes called “French auction” in which there is a “winner’s curse”: the bidder who bids the highest price gets allotment at the highest price; and vice versa.

Certificate of Deposit (CD) is a negotiable and unsecured instrument issued by scheduled commercial banks (excluding regional rural banks and local area banks) and select all-India financial institutions. They are issued in physical form as unsecured usance promissory note or in dematerialized form. The minimum and multiple of issue is Rs 1 lakh. For banks, the maturity of CD should be not less than seven days and not more than one year; and for all-India financial institutions, not less than one year and not more than three years. They are issued as discount instruments or floating-rate instruments.

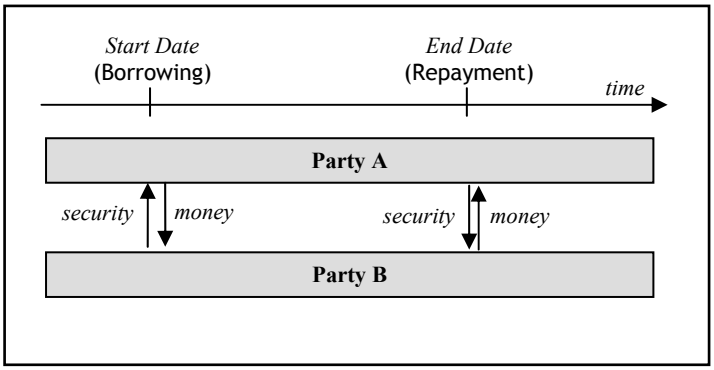
Commercial Paper (CP) is a negotiable, unsecured instrument issued by corporate bodies, primary dealers and all-India financial institutions. The minimum and multiple of issue is Rs 5 lakhs. The maturity of the CP should be a minimum of seven days and a maximum of one year. The maturity should not fall beyond the date for which the credit rating is valid. It should be issued as a discount instrument and should not be underwritten or co-accepted.

However, banks can provide stand-by credit facility or backstop facility; and non-bank entities may provide unconditional and irrevocable guarantee. A scheduled commercial bank will act as Issuing and Paying Agent (IPA).

Besides the TB, CD and CP, there are other money market instruments in OTC market (e.g. repo/reverse repo, bankers acceptance, etc). We will discuss only the repo/reverse repo, which is important in pricing interest rate derivatives.

In repo/reverse repo, at the outset, the lender gives money and takes collateral (which is a publicly-traded prime security); and, at the time of repayment, the lender gets money (principal and interest) and returns the collateral. Exhibit 5 depicts the flows between the two parties.

EXHIBIT 5: Structure of Repo/Reverse Repo



The above flows can be viewed from different perspective: borrowing/lending of money, borrowing/lending of security, buy/sell of security on start date or end date.

Perspective	Party A	Party B
Money borrowing/lending	Lender	Borrower
Security borrowing/lending	Borrower	Lender
Security buy/sell on Start Date	Buyer	Seller
Security buy/sell on End Date	Seller	Buyer
Security buy/sell on both dates	Buyer-Seller	Seller-Buyer
Transaction	Reverse repo	Repo

The borrowing/lending of money/security is structured as sale-cum-repurchase agreement for different settlement dates and contracted as two legs of the same trade. The party borrowing money is said to be doing a “repo” (short for repurchase) and the party lending money is said to be doing “reverse repo”. The leg that is settled first is called first leg or “near leg” and that settled later is called second leg or “far leg.” The period of borrowing/lending is the period between the settlement dates of two legs. The first leg price corresponds to the market price of the security and the second leg price is derived by adding the interest to the repo period to the price of the first leg. The transaction is structured as a sale/purchase rather than borrowing/lending to enable transfer of legal title on the asset to the money lender. The transfer of legal title enables the money lender to directly sell the security and realize the money without any legal process, should the borrower default. This contrasts with other collateral arrangements (e.g. hypothecation, pledge, mortgage, etc,

which do not transfer the legal title on the asset) where the lender is required to follow a lengthy legal procedure to recover the amount due.

Based on the length of repo period, repos is classified into *open repo* (the period is one day with rollover facility and overnight rate reset) and *term repo* (the period is specified in advance and the interest rate is agreed for the whole of the term). The open repo is more liquid that term repo. Based on the collateral, repo is also classified into *general repo* and *specific repo*. In the general repo, any of the specified securities can be used as collateral with facility for substitution of the securities during the repo period. In specific repo, the collateral is restricted to a specific security with no facility of substitution.

Bonds and loans are instruments that enable borrowing or lending of money for a period of a year or more. We use the word "loan" when the borrowing/lending is an OTC contract (i.e. bilateral and private contract; and the word "bond" when the instrument is publicly traded and has secondary market. In some markets, the term "note" is used if the original maturity of the instrument at the time of issue is between one and 10 years; and the term "bond" is used if it is more than 10 years. In India, we also use the term "debenture" for bond. Bonds can be further classified based on issuer, interest rate type, credit quality, etc.

Based on the issuer, bonds are classified into sovereign bonds and corporate bonds. Sovereign bonds are those issued by the governments and hence "risk-free" securities, the risk being referred to here is the credit risk. They are

called by different names in different countries: Treasuries in the US, Gilts in the UK, Bunds in Germany and GSecs in India. Sovereign bonds have a regular issue calendar. Together with Treasury Bills, they constitute the most important securities because the interest rate on them is the benchmark for determining the interest rate on other debt securities.

Corporate bonds are those issued by corporations. Unlike money market, there is no distinction for the instruments issued by banks/financial institutions and corporations. All of them are called corporate bonds in bond market.

Another way to classify bonds is by the interest type, based on which we can classify them into fixed-rate, floater, and inverse floaters. If the bond's periodic coupon is known in advance, it is called fixed-rate bond, and most bonds are issued as fixed-rate bonds. The fixed cash flow does not necessarily mean a *constant* amount. For example, the coupon may be 5% for first year, 5.25% for second year, 4.75% in third year, and so on. The qualifying feature is that the timing and amount are known in advance, but the coupon may not be constant and may have "step-up" or "step-down" features.

If the coupon is linked to a specified market interest rate, then only its timing but not its amount is known in advance. Such bonds are said to be *floaters.* Its interest rate varies periodically and is proportional to the market interest rate: if the market rates goes up, it pays higher rate and vice versa. Inverse floater pays coupon linked to the market interest rate, but links it inversely proportional to the

market rate. That is, if the market rate goes up, it pays lower amount, and vice versa. This is operationalized by setting the periodic amount as the difference between a fixed rate (FXD) minus the market rate (FLT). To avoid the negative interest amount, the difference between the FXD and FLT rates is floored at zero. Thus,

Coupon = Max (0, FXD − FLT)

The following table shows the interest rate payable by floater and inverse floater, assuming that the FXD rate for inverse floater is 12%.

Market Rate	Floater	Inverse Floater Max (0, FXD – FLT)
1%	1%	11%
5%	5%	7%
9%	9%	3%
14%	14%	0%

FIS are “rated” by independent credit rating agencies for their credit quality. Higher the rating, the better is the credit quality and vice versa. The three major international credit rating agencies are Standard & Poor’s (operated through CRISIL in India), Moody’s and Fitch. Ratings are separately given for money market instruments and bonds/notes. The rating is determined by currently available information on the capacity of the issuer to repay the loan, guarantee available, seniority of the instrument, bankruptcy laws, etc. Each rating agency has its own notation for assigning the rating, and the following is the ratings spectrum for bonds/notes by Standard & Poor’s.

Rating	Implication (for issuer's capacity to repay)
AAA	Extremely strong
AA	Extremely strong
A	Strong but is susceptible to adverse changes in economic conditions
BBB	Adequate but adverse economic conditions will weaken the capacity
BB	Vulnerable to nonpayment and faces uncertainties to adverse business, financial and economic conditions
B	More vulnerable than BB but currently has the capacity to meet its obligations
CCC	Currently vulnerable to nonpayment
CC	Currently highly vulnerable to nonpayment
C	Payments are being continued but bankruptcy petition is filed or similar action initiated. This rating is assigned for preferred stock in arrears on dividend or sinking fund payments that is currently paying
D	Payment default has already occurred

The ratings of BBB and higher are considered as "investment grade" and those with BB and lower until C are considered "speculative grades." Further, there may be modifiers to ratings, with the modifier indicating as follows.

Modifier	Implication
+ or –	The modifier shows the relative standing within rating category
N.R.	No rating has been requested and there is insufficient information to base rating; or that the agency does not rate the instrument as a matter of policy
I	The modifier "i" indicates that it applies only to the interest rate portion of obligation; and is always used with the modifier "p". For example, "AAAp N.R. I" means that the principal portion is rated "AAA" and the interest portion is not rated.
P	The modifier "p" indicates that it applies only to the principal portion of obligation; and is always used with the modifier "i".
pi	The rating is based on publicly available information and therefore is based on less comprehensive information. Such ratings are reviewed annually based on new year's financial statements.
pr	Indicates that rating is provisional, and relies on the assumption that the project will be successfully completed.

Standard & Poor's also defines "rating outlook" and "credit watch." The rating outlook is to indicate the potential direction a long-term rating may take in the next six months to two years. The outlook is stated as:

Positive	Rating may be raised
Negative	Rating may be lowered
Stable	Rating is unlikely to change
Developing	Rating may be raised or lowered

The credit watch also relates to potential direction of both short-term and long-term rating. It focuses on identifiable events and short-term trends that cause ratings to be placed under special surveillance. It includes mergers, re-capitalization, regulatory action, voter referendums, etc. It is stated has Positive, Negative or Stable, and these have the same meaning as those under rating outlook.

Some bonds have embedded options, which make them redeemed before the contractual maturity or convert the bond into issuer's equity at a specified price. Based on the nature of option contract, three types of bonds are distinguished, as shown below.

Bond Type	**Nature of Option**	**Implication**
Callable	Call option is on bond; it is sold by investor to issuer	Issuer has the right, but not obligation, to redeem the bond before maturity
Puttable	Put option is on bond; it is sold by issuer to investor	Investor has the right, but not obligation, to demand redemption of bond before maturity
Convertible	Call option issuer's equity; it is sold by issuer to investor	Investor has the right, but not obligation, to convert bond into issuer's equity

Key Concepts

Two types of financial transactions: buy-sell and borrow-lend

Two types of counterparty risk: settlement risk (in buy-sell transactions) and credit risk (in borrow-lend transactions)

Two major stages in trade life cycle: Trade and Settlement

Three groups of financial markets: Underlying, Derivatives and Structured Products

Four types of Underlying Markets: money, bond, equity and forex

Fixed-income securities (FIS): money and bond markets together are called FIS; the distinctive features is that cash flow timing (and in most cases, size) is fixed. The "fixed" does not mean that they are fixed-return securities

Risk-free securities: FIS that do not have credit risk, and are those issued by sovereign government

Exercise

1. Which of the following markets are borrow-lend type of transactions?
    a. Money market
    b. Bond market
    c. Both (a) and (b) above
    d. None of the above
    (Answer: see Section 1.4)
2. Which of the following is a "risk-free" security?
    a. Commercial paper
    b. Certificate of deposit
    c. Bank deposit
    d. None of the above
    (Answer: see Section 1.5)
3. The "risk-free" security means a security that does not possess
    a. Settlement risk
    b. Credit risk
    c. Both (a) and (b) above
    d. None of the above
    (Answer: see Section 1.5)
4. Which of the following constitute the "capital" market?
    a. Money and bond markets
    b. Equity and forex markets
    c. Bond and equity markets
    d. Debt and equity markets
    (Answer: see Section 1.3)
5. If you do a repo transaction, then you have
    a. Borrowed money and lent security

b. Borrowed security and lent money
c. Both (a) and (b) above
d. None of the above

(Answer: see Section 1.5)

CONTENTS

Unit 2: Introduction to Interest Rate Derivatives Market

General Introduction: OTC versus Exchange Market

Based on the style in which a transaction is negotiated and settled, the market can be classified into two segments: over-the-counter (OTC) and Exchange. Traditionally, the following are the differences between OTC and Exchange segments.

Price Discovery and Price Transparency

Price discovery is letting the market discover the price at which demand equals supply, which is called equilibrium price. Price transparency means that the price and volume at which the business is transacted is disseminated to everyone as the business happens.

OTC is a privately negotiated contract between two parties that are known to each other. To find the best price, there has to be search for it by negotiating with many parties privately. In contrast, Exchange is publicly negotiated contract between many parties that are not known to each

other. All potential buyers and sellers pool their orders and do business multilaterally under the supervision of an entity called the Exchange so that everyone knows at what price and volume the business is transacted.

Because of this arrangement, Exchange market scores over the OTC market in price discovery and price transparency.

Standardization

In OTC market, the contract can be customized for amount and settlement date to suit the requirements of both parties. For example, one can buy or sell an odd amount for delivery on an odd date. In Exchange market, the contract is standardized for amount ("market lot") and settlement date ("expiry date").

Because of this arrangement, the Exchange contract may not be always effective in buying and selling for the desired amount and for the desired delivery date.

Liquidity

Because Exchange brings all buy and sell orders at one place, the liquidity is better in it compared to the OTC market, which is a bilateral negotiation. This is true only in normal market conditions. When the market experiences shocks, the Exchange market becomes one-sided (with only buyers or only sellers) with no possibility of trade while the OTC market may still conclude business, though at wider bid-offer quotes.

Counterparty credit risk

Counterparty credit risk (see Section 7.5) is the possible loss arising from the default of the counterparty to perform his obligation. It arises before the settlement date (and hence is also called pre-settlement risk) and on settlement date it becomes the settlement risk. Counterparty credit risk is more pronounced in derivatives because there is a considerable delay between trade date and settlement date.

All OTC contracts have counterparty credit risk. To mitigate this risk, the trade can happen only between two parties that are known to each other and have assessed each other's credit standing. Exchange contract can take place between two strangers and yet has no counterparty credit risk because a third entity, called the Clearing Corporation, gives a trade guarantee. The trade guarantee is operationalized as follows. After the trade is agreed between the two parties in the Exchange, the Clearing Corporation takes over the trade and becomes the seller to the buyer; and buyer to the seller. In other words, the Clearing Corporation is always one of the two parties in every Exchange-traded contract. The Clearing Corporation protects itself from the possible default of the other party by implementing margining and mark-to-market practices (explained in Unit 7).

Because of the increased competition between OTC and Exchange markets, the traditional differences as above are fast disappearing. For example, many Exchanges today provide for a facility to negotiate for customized amount and customized settlement date on their trading platforms through the "request for quote" (RFQ) facility. Similarly,

many OTC dealers have developed the concepts of market lot and standard tenors for what are called “vanilla products” (e.g. for interest rate swap, the amount is 5 million and tenor is 10Y). Many OTC contracts are increasingly secured against counterparty credit risk through the arrangement of what is called “collateral management” (which is similar to the margining and mark-to-market practices of Exchange) and settlement through a central counterparty (CCP), who would provide trade guarantee. One such example in India is Clearing Corporation of India Ltd (CCIL).

Today, the one difference between OTC and Exchange contract is that the OTC contract is bilaterally negotiated for the trade part of transactions while the Exchange contract is multilaterally contracted for both trade part and settlement part of the transaction. Further, Exchange market has become the favorite market, particularly for the retail players, for “vanilla products” (i.e. those that are widely used and easier to understand) while the OTC market is the market for relatively complex products in which high-level of customization is required.

2.1. Derivatives Introduction

The name “derivative” says what it is: something that is derived from another called the underlying. The underlying is independent and the derivative is dependent on and derived from the underlying. The derivative cannot exist without the underlying.

Accounting standards like FAS 133 (in the US), IAS 39 (in the EU) and AS 30 (in India) impose more qualifications for a financial derivative. For example, IAS 39 requires the following three criteria for financial derivatives.

1. Value of derivative is linked to the value of underlying
2. Trade settled on a future date (beyond second business day from trade date)
3. On trade date, there should be no cash outlay or (no outlay for full value)

FAS 133 requires an addition qualification: trade must settle (or capable being settled) on *net* basis and not on gross basis.

Because of the above additional criteria, many financial instruments such as cross rates in forex and repo in FIS market, though derived from others, do not qualify to be derivatives. Each qualifying requirement imparts a characteristic feature to the derivatives. The first requirement implies that the price of the underlying, not the demand-supply forces, determines the price of the derivative. If the underlying price changes, the derivative price must automatically change, regardless of the demand-supply situation for the derivative. The second requirement makes the derivative an off-balance-sheet item between trade date and settlement date, and gap between them could range between three months and ten years (or more). The third requirement is somewhat redundant because it follows from the second: if the trade settles on a future date, no cash outlay is required on trade date.

The second (and third) requirement provides *leverage* in the derivative. In the specific context of derivatives, leverage means profit/loss from owning the underlying without buying it or possessing it; or profit/loss from selling the underlying without delivering it. In other words, the derivative confers the profit/loss from *economic* long or short position in the underlying without legal ownership or physical possession of the underlying. Leverage is essential for risk management, which is the economic role of derivatives, as discussed later.

Each of the four underlying assets (see Section 1.3 in Unit 1) gives rise to four derivatives asset classes. However, derivatives are classified in another way, based on the cash flow pattern, into four "generic" types: *forward, futures, swap* and *option*.

Forward and Futures are functionally similar and involve buying or selling of a specified underlying asset at specified price for specified quantity for delivery on a specified *later* date. The difference between them is that the forward is an OTC market instrument (i.e. privately negotiated bilateral contract) and the futures is publicly-traded Exchange instrument. Accordingly, they differ in the institutional arrangement for conducting the Trade and Settlement parts of the transaction (see Section 1.2 in Unit 1).

Swap differs from all other derivatives in the sense it does not involve exchange of cash for an underlying asset: it involves exchange of *returns* from the underlying against return from money. In other words, the cash-for-asset

exchange is replaced with return-for-return exchange. The return from money is interest rate and that from the underlying asset is another interest rate (if the underlying is money or bond) or dividend and capital gains/loss (if the underlying is equity) or foreign currency interest rate and capital gain/loss (if the underlying is currency). Swap is traded only in OTC market.

Option is unique not only among derivatives but among all financial contracts. Its primary focus is on the rights and obligations of the parties rather than on the underlying asset. It deals with buying or selling of a specified right (without any obligation) on a specified UA. It is traded both in OTC and Exchange markets.

The four asset classes and four generic types give us sixteen types of derivatives as follows, of which "bond swap" does not exist.

Underlying	**Derivatives**			
	Forward	**Futures**	**Swap**	**Option**
Money	FRA[1]	Interest rate futures	Interest rate swap[2]	Interest rate option
Bond	Bond forward	Bond futures		Bond option
Equity	Equity forward	Equity futures	Equity swap	Equity option
Forex	FX forward	FX futures	Currency swap[3]	FX option

[1]Forward rate agreement (FRA)

[2]The underlying for swap is money (and not bond) and the tenor of swap is between one year and 25 years. Thus, the swap is typically a long-tenor (or bond market) instrument. Though there is an instrument called “bond swap”, it is not a derivative but a cash market instrument; and involves exchange of one bond for another, which is more like a barter trade.

[3]Currency swap is different from similar-sounding “forex swap”. The former is a derivative and the later is a cash market product and the forex counterpart of repo/reverse repo in FIS market.

2.2. Economic Role of Derivatives

The economic role of underlying markets is investment and consumption. In contrast, the economic role of derivatives is risk management.

The market price of underlying assets is subject to change by demand-supply forces. All market participants know what the current market price is, but every market participant is not certain about what would be the price on a future date. This uncertainty is called price risk or market risk. Derivatives are tools to manage this price risk.

We must note here that risk is related to the return. Return is the change between the current price (which is known) and the future price (which is unknown). The return could be favorable, resulting is profit; or unfavorable, resulting in loss. Profit and loss are thus two faces of return: profit is positive return and loss is negative return. Whether there will be profit or loss is uncertain, and this uncertainty is

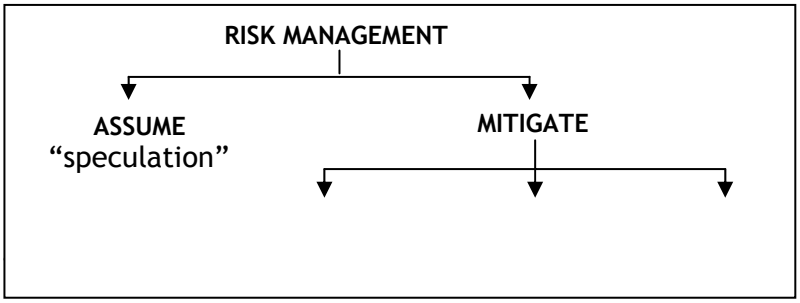
called risk. Thus, risk is defined as the uncertainty about future return

Derivatives are risk management tools for price risk. They are not financing, liquidity or cash management tools. Examples of financing tools are bonds and equity instruments; and examples of liquidity or cash management tools are money market instruments (e.g. repo/reverse repo in FIS market, FX swap in forex market, etc). Derivatives cannot be financing or liquidity or cash management tools because they do not involve cash outlay at the outset.

2.3. Risk Management with Derivatives

Managing risk depends on our appetite for and attitude to it. If we like risk and have appetite for it, we assume risk, which is called *speculation*. On the other hand, if we do not like risk or have no appetite for it, we mitigate it in three ways: *eliminate*, *minimize* or *insure*. Eliminating risk is called hedging; minimizing it is called diversification; and insuring it is called financial risk insurance (which is different from actuarial insurance). Exhibit 1 summarizes the different approaches to risk management.

EXHIBIT 1: **Risk Management**



Assuming risk is called speculation (or "trading"). To begin with there is no risk but we assume it deliberately (by buying or short-selling an underlying) and expose ourselves to uncertain future return, which could be profit (or positive return) or loss (or negative return).

Hedging is the opposite of speculation. To begin with there is a risk (because we bought or short-sold an underlying) and eliminate it assuming the opposite market side in the underlying. As a result, the future return is locked up at a known level, with neither profit nor loss resulting from price changes in the underlying. Diversification involves minimizing risk per unit of return or maximizing return per unit of risk. Insurance eliminates the negative side while retaining the positive side of return. Unlike other ways of managing risk, insurance has an explicit cost. The "insurance" here is for financial risk, not pure risk or *actuarial risk*. The cost of actuarial risk is based on statistical laws of the probability while that of financial risk is based predominantly on replication of the payoff. The following shows the implications of different ways of managing risk.

Approach	**Before**	**After**
Speculation	No uncertainty	Positive or negative return
Hedging	Positive or negative return	No uncertainty
Financial risk insurance	Positive or negative return	Positive return

Diversification	Positive or negative return	Minimized uncertainty

Diversification does not require derivatives but the other three (i.e. speculation, hedging and insurance) require derivatives. Derivatives enable risk management by providing leverage: ability to provide economic ownership of an underlying asset without paying for it immediately; or economic sale without delivering the underlying immediately. In forward, futures and option, leverage is provided by postponing the settlement to a future date; and in swap, leverage is provided innovatively by replacing the underlying asset with the return from underlying asset.

As stated earlier, the risk that the derivatives manage is the *price or market risk*, which differs for each underlying asset. For money and bond market transactions (which are borrow-lend) transactions, it is interest rate risk. For equity market, it is equity risk; and for forex market, it is currency risk. It should be noted that interest rate risk is more complex than equity risk and currency risk because it has different forms, which will be discussed on Unit 3. Further, borrow-lend transactions have additional source of risk, which is the counterparty-borrower and which is called credit risk. Interest rate derivatives manage only the interest rate risk. To manage credit risk, one needs to use separate class of derivatives called credit derivatives.

One area where derivatives can be misused is clearly the speculation. Because derivatives provide leverage, they are liable for misuse. For example, one can buy an asset with Rs 100 in the cash market. An alternative to purchase in the cash market is buy in the futures with Rs 10 as the margin

money and investing the balance Rs 90 in the money market account. Both alternatives will have more or less the same risk profile. However, w can use the entire Rs 100 as margin money and buy for amount that is 10 times more than that in the cash market. The result is risk and return that is tem times higher than that in the cash market. This is clearly abusing the leverage facility in derivatives. Another problem with derivatives is the market concentration. If you exposure is half the outstanding exposures in the market (called “open interest” in Exchanges), then it implies that you are one side of the market while all others are on the opposite side. This is a dangerous situation for exiting the trade, and liable for squeeze and loss of market liquidity.

Speculation is not the only are where derivatives can be misused. We have seen cases where the genuine hedging resulted in losses, too. One such case is the German metals trading company of Metallgesellschaft. The company sold long-term crude oil products to its customers at fixed rate and hedged it by buying them in the futures market. The crude oil prices dropped so that the company has profit on the long-term OTC contracts with its customers and the offsetting losses in the futures market. Because of mark-to-market feature in futures market, the losses had to be funded immediately while the profit from OTC contracts remained in the books. The company could not arrange for sufficient funding and suffered funding liquidity in managing the hedge.

2.4. Interest Rate Derivatives Market

Interest rate derivatives are the most important among all derivatives, as shown in the following table of notional outstanding amount as at June 2009.

Notional Amount (US$ billion) Outstanding as at June 2009

Under-lying	Derivatives					Total
	OTC				Exchange	
	Forward	Option	Swap	Sub-Total	Fut. & Opt.	
Interest[1]	46,798	48,513	341,886	437,198	57,732	494,930
Equity	…	4,910	1,709	6,619	5,477	12,096
Forex	23,107	10,596	15,072	48,775	240	49,015
Others[2]				112,030		112,030
Total	**69,905**	**64,019**	**358,667**	**604,622**	**63,449**	**668,071**

[1]Both money and bond markets are included under interest rate market
[2]Include commodities, credit and others
Source: Bank for International Settlement (www.bis.org)

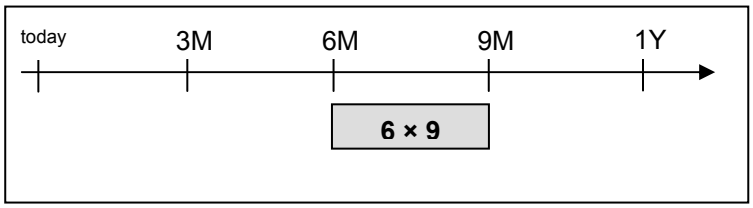
We can see that in every generic type of derivatives (i.e. forward, futures, option and swap), interest rate derivative outnumber their counterparts in other underlying markets. The reason is quite obvious: every business or corporation faces interest rate risk (and therefore need to use interest rate derivatives) while they need not necessarily face other risks like equity risk, currency risk, etc. We have explained earlier (see Section 1.4 in Unit 1) that capital of almost every company includes debt and there every business faces interest rate risk. In contrast, only investment companies with exposure to equity market will face equity

risk; only those with exports and imports will face currency risk; and only those with exposures to commodities will face commodity price risk. The total outstanding notional amount of about US$ 500 trillion is almost 10 times the total world GDP!

Though the term “interest rate derivatives” is loosely used as an omnibus term for derivatives in money and bond market, there are important differences between money and bond derivatives. The term “interest rate derivatives” in a narrow sense is used only for money derivatives, and the tenor of these derivatives can be short-term (i.e. less than one year) or long term (i.e. more than one year). The underlying for these derivatives is the future interest rate of a benchmark index (e.g. MIBOR, etc.), which is from the interbank money market. There is no specific issuer and therefore issuer-related credit risk is not factored in these derivatives. In contrast, bond derivatives are derivatives on a specific bond issued by a specific issuer. If the issuer is not a sovereign government, then these derivatives factor both the interest rate risk and the credit risk of the issuer. The second difference between money and bond derivatives is that no bond is as liquid as the interest rate benchmark index and therefore the pricing of bond derivatives is subject to liquidity risk and not as transparent as pricing money derivatives. The third difference is that *all* money derivatives are compulsorily cash-settled while bond derivatives are physically settled by exchange of underlying asset for cash. Let us examine all the combinations of two underlying (i.e. money and bond) and four generic types of derivatives (i.e. forward, futures, swap and option) and the standard terminology.

Money – Forward

The derivative is called *forward rate agreement* (FRA) and pronounced "fra" and never spelt by letters ("f-r-a"). It is a contract on short-tenor (usually 3-month) future interest rate in the short-term (i.e. within one year) future. The start and end months are indicated by numbers (e.g. 3 × 6, pronounced "three by six"). The following shows the timeline for 6×9 FRA.



The contract entered into today will commence at 6M ("start date") from today and cover the period from there until 9M ("end date") from today so that the actual period covered is 3 months between 6M and 9M. The usual convention is that the start leg must comment within one year from today. In other words, FRA is a derivative to manage short-tenor interest rate risk in the short-term. FRA is traded only in OTC market.

Money – Futures

The derivative is called *interest rate futures* (IRF). It is a contract on short-tenor (usually 3-month) future interest rate that will commence anytime in future between 1M and 10Y. Every contract is for a period of 3-month and its start date can be up to 10Y in futures. For example, an IRF that settles on March 20, 2013 will fix today the future 3-

month interest rate for the period starting from March 20, 2013 and ending with June 20, 2013. In other words, IRF is a short-tenor interest rate risk management tool for the short-term or long-term. Note that though the tenor is short-term (i.e. 3M), it can be positioned far beyond 1Y in future. IRF is traded only in Exchange market.

Money – Swap

The derivatives is called *interest rate swap* (IRS). It is the most widely used instrument not only among interest rate derivatives but also among all derivatives. Unlike FRA and IRF, IRS is not a focused on the level of future interest rate but the spread between two interest rates of different tenors (e.g. difference between 3M and 5Y rates, between 3M and 10Y rates, etc). Depending on the two interest rates involved, IRS is of the following types. In the following, the "short-term" should be understood as less than 1Y and "long-term", as more than 1Y.

IRS type	**Tenor of two interest rates**	**Example**
Vanilla swap	Unknown future short-term rate versus current known long-term rate	Future 3M rate (unknown) versus current 5Y rate (which is 7%)
Basis swap	Two future short-term rates of different tenors, both currently unknown	Future 3M rate versus future 6M rate (both currently unknown)
Constant maturity swap	Two future long-term rates of different tenors, both currently	Future 2Y rate versus future 10Y rate (both currently unknown)

	unknown	

IRS is traded only in OTC market. Some Exchanges have introduced an innovative contract called "swap futures" which is not a swap but a future on swap. In other words, the underlying for swap futures is the swap.

Money – Option

The derivative is called *interest rate option* (IRO). It is a contract on short-tenor future interest rate (usually 3-month) either in short-term or long-term future. In the OTC market, it can be also structured as a contract on long-tenor future interest rate in short-term or long-term future. IRO is traded in both OTC and Exchange markets.

Bond – Forward

The derivative is called *bond forward*. It is a contract, not on future interest rate, but the yield (or price) of a *specific bond* issued by a *specific issuer*. The bond's maturity is usually of longer term (10Y to 30Y) and the maturity of the derivative is usually short term (i.e. less than 1Y). Thus, bond forward is a short-term contract on the yield of a long-term bond of specific issuer. Bond forward is a product in the OTC market (i.e. privately and bilaterally negotiated and settled contract).

Bond – Futures

The derivative is called *bond futures*. It is similar to the bond forward except that it is an Exchange-traded instrument. Another difference between bond forward and bond futures is that the tenor of the derivative can exceed one year on some Exchanges. Yet another, and perhaps the most important, difference is that the underlying for bond

futures is not a specific bond, but a group of bonds from the same issuer that satisfy the specified criteria. Multiple bonds (satisfying the specified criteria) are allowed to be underlying in order to improve the liquidity of the derivative contract.

Bond – Swap

There is no such derivative, unlike interest rate swap. However, there is a product called "bond swap", which is not a derivative but a cash market product in the bond market; and consists of exchanging one bond for another, like in barter system of exchange.

Bond – Option

The derivative is called *bond option* and is traded both in OTC and Exchange markets. It is an option contract to buy or sell a specific bond issued by a specific issuer at a specified yield or price. The bond's maturity is usually of longer term (10Y to 30Y) and the maturity of the derivative is usually short term (i.e. less than 1Y) in OTC market and can be long term on Exchanges.

The following summarizes the money and bond derivatives.
(ST = short term; LT = long term)

Underlying	Generic Derivative	Product Name	Remark
Money	Forward	Forward rate agreement (FRA)	ST (≤1Y) derivative on ST (usually 3M) interest rate
	Futures	Interest rate futures (IRF)	ST or LT (1M to 10Y) derivative on ST (usually 3M) interest rate
	Swap	Interest rate swap (IRS)	LT (1Y to 25Y) derivative on the spread between: (a) ST (<1Y) & LT (>1Y) interest rates; (b) two ST (<1Y) interest rates; or (c) two LT (>1Y) interest rates
	Option	Interest rate option	ST or LT (1M to 10Y) derivative on ST (usually 3M) interest rate
Bond	Forward	Bond forward	ST (≤1Y) derivative on the yield of LT (10Y to 30Y) bond of a specific issuer
	Futures	Bond futures	ST to LT (1M to 5Y) derivative on the yield of LT (10Y to 30Y) bond of a

			specific issuer
	Swap	No such derivative exists	
	Option	Bond option	ST to LT (1M to 5Y) derivative on the yield of LT (10Y to 30Y) bond of a specific issuer

2.5. Derivatives Market in India

Though OTC derivatives have had a long history in India, particularly in forex market, Exchange-traded derivatives are introduced only in the last decade. The following table shows the important milestones in the development of Exchange-traded financial derivatives in India with respect to National Stock Exchange of India, which is the premier bourse for derivatives trading in India.

Year	Derivative
June 2000	Index futures
June 2001	Index options
July 2001	Single stock options
November 2001	Single stock futures
June 2003	Interest rate and bond futures (abandoned later)
August 2008	Currency futures
August 2009	Bond futures (re-launch)

The following table shows the daily turnover in various segments of cash and derivatives market on National Stock Exchange of India.

Daily turnover (Rs. Cr.)

Period	Equity		Debt	Currency
	Cash	Derivatives	Cash	Derivatives
January 2010	17,813	78,437	2,851	13,837
2008-09	11,325	45,310	1,411	
2007-08	14,148	52,153	1,138	
2006-07	7,812	29,543	897	
2005-06	6,253	19,220	1,754	
2004-05	4,506	10,107	3,028	

Source: NSE Newsletter, February 2010.

We can see that equity derivatives have become so popular and successful that their turnover greatly exceeds that in the cash segment. Currency futures also have become quite successfully in a short period after their launch. In contrast, interest rate derivatives have not been successful.

Derivatives are essential for risk management, especially hedging. Though, technically, non-derivatives can be used for hedging, such a process is cumbersome, costly and non-optimal. In the Indian market, the OTC forex market has had a long-history of using the forward contract for hedging currency risk by exporters and importers; and, in recent years, currency swaps and currency options have been introduced to provide for diverse and flexible hedging strategies. Exchanges have started in 2008 the currency futures to compete with the OTC market, and they are received very well. In the equity market (which is predominantly Exchange market), derivatives were

introduced a decade ago and have overtaken the cash market in daily turnover shortly after they were introduced. For banks, financial institutions and businesses, the exposure to interest rate risk is much more severe than that to currency risk and equity risk. Accordingly, one would expect that the interest rate derivatives market would be larger than that for currency and equity derivatives. However, interest rate derivatives were the last to be introduced in India and have not taken off well. Though the OTC interest rate derivatives market has been successful with good volumes for interest rate swaps, the Exchange-traded interest rate derivatives have not been so successful. The first attempt in June 2003 launched three futures contracts on 91-bill Treasury Bill, 6% 10Y bond and zero-coupon 10Y bond of Government of India. The launch was a miserable failure and the contracts were withdrawn soon thereafter. The major reason was the valuation procedure adopted by the Exchange, which was different from that in the cash market. The second attempt was made in August 2009 with launch of bond futures on 7% 10Y bond of Government of India with practices more in tune with those in the cash bond market.

Convergence of practices in cash and futures markets is the necessary and but not sufficient condition by itself. For any market to be successful, the market liquidity is essential, which is provided by the speculators. Speculating with bond futures is different from and more complex than that with equity and currency futures (explained in Unit 5). Until the retail speculators develop the requisite skills for speculating with bond futures, the liquidity in futures market will be thin. Another requirement for arbitrageurs and hedgers is

the relatively large trading lot in cash market, which is at Rs 5 Cr. To hedge or arbitrage a single trade in cash market, we require a minimum volume of 250 futures contracts (explained in Unit 4).

Key Concepts

Definition of derivatives and four generic types of derivatives

Four underlying markets combined with four generic types of derivatives

Derivatives are risk management tools, not financing or cash or liquidity management tools

Risk management with derivatives: speculation, hedging, and financial risk insurance

Interest rate derivatives: their role and market size

Interest rate derivatives: money derivatives versus bond derivatives

Development of derivatives market in India

Exercise

1. Which of the following is the role of derivatives?
    a. Financing
    b. Cash or liquidity management
    c. Risk management
    d. All of the above

    (**Answer: see Section 2.2**)
2. Which of the following derivatives have the largest market size globally as at 2009?
    a. Equity derivatives
    b. Interest rate derivatives
    c. Currency derivatives
    d. Commodity derivatives

    (**Answer: see Section 2.4**)
3. Which of the following derivatives have the largest market size in India as at 2009?
    a. Equity derivatives
    b. Interest rate derivatives
    c. Currency derivatives
    d. Commodity derivatives

    (**Answer: see Section 2.5**)
4. Bond futures usually are settled as follows
    a. Cash settlement
    b. Physical settlement
    c. Both (a) and (b)
    d. None of the above

    (**Answer: see Section 2.4**)
5. Which of the following correctly describes “hedging”?
    a. Risk reduction

b. Risk minimization
c. Risk insurance
d. Risk elimination

(**Answer: see Section 2.3**)

Unit 3: Bond Arithmetic and Analytics

3.1. Interest Rate Arithmetic and Conventions

It is a market convention that interest is always quoted per unit time (hence the name *rate*), which is year, regardless of the period of borrowing and lending. Therefore, we need to translate the *rate* into *amount* in settlements. The translation is complicated by

- Day count basis
- Payment and compounding frequency
- Payment Timing

3.1.1. Day Count Basis

Interest rate is always quoted as a rate for year, but the period of borrowing/lending is usually other than a year. Therefore, we need to convert the period into year fraction, which is called *day count basis* in money and bond markets, and *day count fraction* in OTC derivatives market.

Day count basis is expressed as a fraction. The numerator indicates the method of counting the number of days between the start date and the end date of the period; and the denominator indicates the total number of days in a year or 'full coupon period'. There are different conventions, which can be classified into the following four categories.

Actual / constant

For the numerator, count the *actual* number of days in the given period; and for the denominator, assume *constant* number of days in a year. The conventions in this category are: *Actual/365 Fixed* and *Actual/360.*

Actual / Actual

For the numerator, count the *actual* number of days in the given period; and for the denominator, count the *actual* number of calendar days in a year or full coupon period. The conventions in this category are: *Actual/Actual-ISDA, Actual/Actual-AFB* and

Actual/Actual-ISMA.
30 / 360 (or *360 / 360*)
This category assumes that the year consists of 12 months, each of which has exactly 30 days. In other words, for the numerator, count the number of days in the given period by assuming that every completed month has 30 days; and for the denominator, assume a constant of 360. The conventions in this category are: *30E/360, 30/360, 30/360 German, 30/360 SIA, 30A/360, 30E+/360* and *30/360 Italian.*

Others
All other conventions that do not fit into any of the three categories above are grouped in this category. The conventions in this category are: *Actual/365 Japan* and *Actual/365 Sterling*.

Note on Accrual Days
It is the convention in all markets (except the 30/360 Italian method) to include the first day of the period and exclude the last day of the period for interest accrual. For example, in the period from 30-April-2006 to 05-May-2006, there is one day in April and four days in May. In the 30/360 Italian method, both the start date and end date of the period are counted.

In contrast to the above practice, most software utilities exclude the first day and include the last day. As long as one of them is included and the other is excluded, they will result in the same result except in Actual/Actual-ISDA

convention. In India, we use only Actual / 365 Fixed, Actual/360 and 30E/360, and hence only these three are discussed here.

Actual/365 Fixed (earlier called Actual/365)

Count the actual number of days in the given period and divide it by the constant of 365 regardless of leap or non-leap year.

In the earlier days, it was called simply 'Actual/365'. However, the 2000 Definitions of ISDA documentation defined "Actual/365" in a different way. To avoid confusion, what used to be simply
'Actual/365' in the earlier days is now renamed as 'Actual/365 Fixed', particularly in ISDA documentation. In India, all financial transactions (except accrued interest calculations in the secondary market transactions in government securities) follow this method.

Example: Accrual period is from 25-Jan-2005 to 03-Feb-2005. There are seven days in January 2005 (including Jan 25) and two days in February 2005 (excluding Feb 03), and the basis is (7+2)/365 = 0.024657534.

30E/360 (**Eurobond basis**, **AIBD basis**, **30/360 ISMA**, **30/360 Special German**, **30S/360**)

In India, it is simply referred to as "30/360", which is confusing because in OTC derivatives the "30/360" is used for a different method. Readers should note that what is called "30/360" in the literature of Indian bond market is

described as “30E/360” in this handout because that is how it is officially called in ISDA documentation and SWIFT messaging.

The method assumes that every month has uniformly 30 days so that full year has 360 days. If the day of either start date or end date is 31, it is arbitrarily set to 30. After the day of start date and end date are shortened when required, the period as year fraction is computed as:

$$[360 \times (Y2 - Y1) + 30 \times (M2 - M1) + (D2 - D1)] / 360$$

where Y, M and D are the year, month and day, respectively; and 1 and 2 refer to the start date and end date, respectively.

Example: Accrual period is from 31-Dec-2004 to 25-Jan-2005. The day of the start date, being 31, needs to be shortened to 30, while the day of the end date requires no adjustment. After the adjustment, the Y2, Y1, M2, M1, D2 and D1 are 2005, 2004, 1, 12, 25 and 30, respectively.

$[360 \times (2005 - 2004) + 30 \times (1 - 12) + (25 - 30)] / 360 =$ 25/360 (or 0.069444)

It is followed in Eurobond market, many domestic European bond markets and the secondary market of Indian bond market. Association of International Bond Dealers (AIBD) is a body that formulates rules on issuance, trading and settlement of Eurobonds. It was renamed as International Securities Market Association (ISMA) in 1991. In July 2005, there was a merger between ISMA and

International Primary Market Association (IPMA), and the merged entity is now named as International Capital Market Association (ICMA).

3.1.2. Payment and Compounding Frequency

Interest payment frequency is not always once in a year. It may be yearly, semi-annual (e.g. government bonds, corporate bond), quarterly, monthly (e.g. bank loans) or at maturity (e.g. all money market transactions).

Two securities that have the same annual rate but with different payment frequency are not comparable for their yield: we need to bring the both the rates into the same payment frequency or to a common payment frequency.

The following formula transforms an interest rate (R1) with a given payment frequency (M1) into equivalent interest rate (R2) in the other desired payment frequency (M2).

$$R2 = [(1 + R1 / M1)^{(M1 / M2)} - 1] \times M2$$

where M1 and M2 will take the following values for different payment frequencies

Period	Number
Annual	1
Semi-annual	2
Quarterly	4
Monthly	12
Weekly	52
Daily	365

For example, the equivalent of 10% (paid monthly) with quarterly, half-yearly and annually paid interest rate is:

Equivalent rate with quarterly payment:
$[(1 + 0.10 / 12)^{(12 / 4)} - 1] \times 4 = 10.083565\%$
Equivalent rate with half-yearly payment:
$[(1 + 0.10 / 12)^{(12 / 2)} - 1] \times 2 = 10.210663\%$
Equivalent rate with annual payment:
$[(1 + 0.10 / 12)^{(12 / 1)} - 1] \times 1 = 10.471307\%$

The current market practice is to convert all other payment frequency into either annual frequency (called *effective annual rate*) or continuously compounded rate (CCR).

Effective Annual Rate (EAR)

It is the most widely used rate to compare interest rates with different payment frequency. EAR restates the other discretely compounded rate (called *nominal rate*) into its equivalent annually compounded rate. The relation between EAR and nominal rate (R) will simply to.

$$EAR = (1 + R / M1)^{M1} - 1$$

Continuously Compounded Rate (CCR)

The conversion from and into CCR is as follows:

From discretely compounded rate (R) into CCR:

$$CCR = [LN (1 + R / M1)] \times M1$$

From CCR to discretely compounded rate (R)

$$R = [EXP (R / M2) - 1] \times M2$$

For example, 10% half-yearly compounded rate (i.e. M1 = 2) is equivalent to a continuously compounded rate of

$$CCR = [LN (1 + 0.10 / 2)] \times 2 \quad = 9.758033\%$$

Similarly, 10% continuously compounded rate is equivalent to a quarterly compounded rate (i.e. M2 = 4) of

$$R = [EXP (0.10 / 4) - 1] \times 4 \quad = 10.126048\%$$

CCR has two features. First, it is mathematically efficient. Second, it is logically consistent. We know that compounded rate results in higher interest amount than the simple rate. However, this is true only when there is *more* than one compounding period. For *less* than one period, it results in a lower interest amount. For example, 10% (semi-annual) rate on a principal of one unit for a period of 1 year (i.e. two periods), half year (i.e. 1 period) and quarter (i.e. 0.5 period) results in the following interest amounts with and without compounding.

Period	Number of compounding periods	Compounded Interest Amount	Simple Interest Amount
1Y	2	$(1 + 0.10 / 2)^2 - 1 = 0.1025$	$0.10 \times 1 = 0.10$
6M (0.5Y)	1	$(1 + 0.10 / 2)^1 - 1 = 0.0500$	$0.10 \times 0.5 = 0.05$
3M (0.25Y)	0.5	$(1 + 0.10 / 2)^{0.5} - 1 = 0.02470$	$0.10 \times 0.25 = 0.025$

Compounding always requires more than one period. Compounding for less than period is logically inconsistent: it amounts to paying before accrual. Continuous compounding removes this logical inconsistency by making the length of compounding period infinitesimally small.

3.1.3. Payment Timing: in Arrears and in Advance

T-Bill, Certificate of Deposit (CD) and Commercial Paper (CP) are called *discount or zero-coupon instruments* (see section 1.5 in Unit 1): they are redeemed at a round face value (F) of 100 and issued at discount, which is the price (P) of the instrument. The interest earned is the difference between F and P, also called the discount amount (D), which when expressed as a percentage of face value (F) and annualized is called *discount yield.* For example, a T-Bill with a face value (F) will be redeemed after 91 days (N) and issued at a price (P) of 98.25. What is the discount yield?

Face Value (F) per Rs 100	100
Issue/Market Price (P) per Rs 100	98.2500
Days to maturity (N)	91

Discount (D): is the difference between face value and price, and is interest earned on investment. For example,

D = 100 − 98.25 = 1.75

Discount yield (DY) is the discount (D) expressed as a percentage of face value (F) and annualized. For our example,

DY = (D × 365) / (F × 91) = 0.070192 (or 7.0192%)

True yield (Y) is more than the discount yield (DY). The true yield (Y) is computed on the amount invested at the beginning, not on the amount received at the end. In other words, to compute the true yield, we must express the discount (or interest earned) as a percentage of the price (which is investment made at the beginning) and not as percentage of face value (investment received at the end). For our example,

Y = (D × 365) / (P × 91) = 0.071443 (or 7.1443%)

We can generalize the above into the following formulas with assumptions: (1) face value (F) is 100; (2) price (P) is quoted per face value of 100; (3) N is the days to maturity/redemption; and (4) DY or Y must be expressed in decimal notation (that is, 7.15% must be expressed as 0.0715).

Price (P) from Discount Yield (DY)

$$P = 100\left(1 - \frac{DY \times N}{365}\right)$$

Discount Yield (DY) from Price (P)

$$DY = 100\left(1 - \frac{P}{100}\right)\frac{365}{N}$$

Price (P) from True Yield (Y)

$$P = \frac{100}{\left(1 + Y\frac{N}{365}\right)}$$

True Yield (Y) from Price (P)

$$Y = \left(\frac{100}{P} - 1\right)\frac{365}{N}$$

In order to accommodate other types of day count fraction (DCF), we can write DCF for N/365, and re-write the above equations as:

$$P = 100(1 - DY \times DCF)$$

$$DY = \frac{100\left(1 - \frac{P}{100}\right)}{DCF}$$

$$P = \frac{100}{(1 + Y \times DCF)}$$

$$Y = \frac{\left(\frac{100}{P} - 1\right)}{DCF}$$

We can also convert from DY to Y and vice versa from the following relationship.

Discount Yield (DY) from True Yield (Y)

$$DY = \frac{Y}{(1 + Y \times DCF)}$$

True Yield (Y) from Discount Yield (DY)

$$Y = \frac{DY}{(1 - D * DCF)}$$

Special Names for Interest Rate Types

Interest rates quoted with a particular combination of day count basis, compounding frequency and payment timing are given special names. Three such measures are *discount yield* (DY), *money market yield* (MMY) and *bond-equivalent yield* (BEY). The following table shows their properties of three yield measures and gives the conversion formula from one to the other.

Rate	Day Count Basis	Compounding	Payment Timing
DY	Act/360	Simple	In advance
MMY	Act/360	Simple	In arrears
BEY	Act/Act-ICMA	Semi annual	In arrears

We can convert from one rate type to another through the following formula.

DY from MMY: $DY = MMY / [1 + MMY \times (N / 360)]$

MMY from DY: $MMY = DY / [1 - DY \times (N / 360)]$

BEY from DY: $BEY = (365 \times DY) / [360 - (DY \times N)]$

The above works only when the maturity is 6M or less (because of semiannual compounding in BEY). If February 29 occurs in the next one year, use 366 instead of 365 in the denominator (because of A/A-ICMA day count basis in BEY)

EAR from BEY: $EAR = (1 + BEY / 2)^2 - 1$

Annual Percentage Rate (APR)

In the US, UK and EU, there is a legal requirement of quoting interest as APR for consumer credit. The purpose of APR is to enable consumers to compare different interest rates quoted by banks. In each country, however, it is defined differently and hence not comparable across the countries.

In the US, it is introduced by the Truth in Lending Act (TILA) and operationalized by the Regulation Z of the Federal Reserve. It requires that the period interest rate must be multiplied by the number of periods in a year; and certain (but not all) non-interest charges like fee, etc must be incorporated into the rate. For example, if the credit card interest is stated as 1.25% month, its APR is

$$1.25\% \times 12 = 15\%$$

Notice that it does not incorporate the effect of compounding but merely converts the period rate into annual rate without compounding effect. And it incorporates certain (but not all) non-interest charges. If non-interest charges are excluded, then APR is the *nominal rate*. In the above example, the nominal interest rate is 15% because it does not include the non-interest charges.

3.2. Term Structure of Interest Rates

What is the interest rate today? This question cannot be answered because it is incomplete in two respects. First,

there is a separate interest rate for each term (or tenor) of borrowing/lending. The standard terms quoted in the market are:

Money market: overnight (ON), 1-week (1W), 2-week (2W), 1-month (1M) to 1-year (1Y) at the interval of a month. Of these, only ON and 1M and 3M are more liquid than other tenors.

Bond Market: 2Y, 5Y, 7Y, 10Y, 15Y, 20Y, 25Y and 30Y. Of these, 2Y and 10Y are more liquid.

Second, the interest rate for the same term may be different for different borrowers because the rates in borrow-lend transaction are not uniform for all market participants but linked the counterparty's credit risk (see Section 1.1 in Unit 1), which is measured by credit rating of the borrower (see Section 1.5 in Unit 1). At the base, we have the interest rate for sovereign borrower, who will not default by definition. The rate applicable to the default-free borrower is called the "risk-free rate". Every other borrower has to pay a premium for compensating the credit risk. The premium is called "credit spread", which is an add-on to the risk-free rate for the same term. The following tables shows the interest rates for various terms and for various borrowers rated by their credit rating (AAA, AA, A, BBB, etc.)

Term	Risk-free rate	Credit Spread		
		AAA	A	BBB
1M	5.00%	0.15%	0.25%	0.35%
3M	5.25%	0.25%	0.50%	0.75%
1Y	5.75%	0.40%	0.75%	1.10%
5Y	6.50%	0.85%	1.50%	2.25%

When the interest rate (on vertical axis) is plotted against the term (on horizontal axis), it is called the *term structure* of interest rates. The term structure of risk-free rate is the most important tool in *any* valuation because it represents the ultimate opportunity cost. It is the rate an investor can earn without any risk of default or loss for a given term. Any other competing alternative has a risk, which has to be priced and added to the risk-free rate for the same term as the "risk premium." It is important to note that the risk considered here is the credit (or default) risk and not the price (or market) risk. For fixed-income securities, if the investor holds the security until its maturity, the price (or market) risk does not arise; and if the issuer does not default on interest and principal payments, the credit (or default) risk does not arise, too.

But what determines the interest rate? The answer is demand-supply for money of different terms. For example, the demand-supply for money borrowing/lending for 1Y term determines the 1Y interest rate, and so on. It is convenient to assess the demand-supply separately for short-term and long-term. The short-term rate is determined by liquidity, which in turn is caused by seasonal demand-supply for credit, foreign portfolio investment

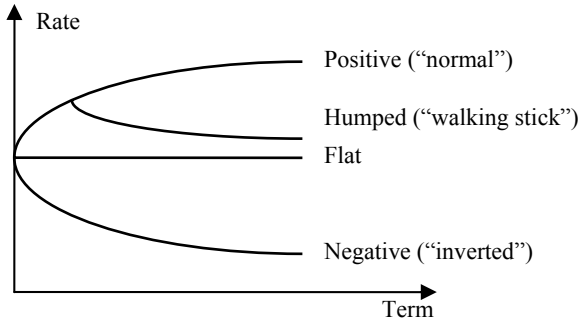
inflows and outflows, bunching of tax and government payments, etc. The long-term rate is predominantly determined by inflation outlook and the capital expenditure by industry and business. Both the short-term and long-term rates are controlled by central bank's monetary policy through various policy tools.

The central bank uses the repo and reverse repo with commercial banks to control the short-term rate. It uses repo (for commercial bank) to inject liquidity into money market and reverse repo (for commercial bank) to drain excess liquidity. To control long-term interest rate, the central bank uses bank rate (i.e. the rate at which the central bank lends to commercial banks), cash reserve ratio, statutory liquidity ratio) and open market operations. In the Indian market, there is distortion of free play of demand-supply forces for determining the interest rate. The reason for this is that the statutory liquidity ratio (SLR) requires banks to compulsorily invest 25% of the time and demand deposits into sovereign debt, and the government decides what interest rate is acceptable to it. This is somewhat forced lending to the government at artificial interest rate. It also creates what is called "uncovered parity" between the interest rates in India and other countries.

3.2.1. Shape of Term Structure

Term structure comes in many shapes but four shapes account for the most. If the rate is the same for all terms, the relationship is a flat, straight line: term structure is said to be *flat*. If the rate rises with term, the relationship has upward slope: term structure is said to be *positive* or

normal; and if the rate falls with term, it has downward slope and the term structure is said to be *negative* or *inverted*. If the rate rises between short and medium terms, but falls between medium and long terms, the term structure is said to be *humped* or *walking stick*.



What is the reason for different shapes of the yield curves? There are different theories but they are not important for our purposes except the empirical fact that the inverted term structure implies economic recession in the future.

3.2.2. Shifts in Term Structure

Term structure is a snapshot of interest rates at a point of time. It does not remain static over time but changes. The change can be either in shape or in the slope while retaining the shape. They are called shifts in the term structure. Most shifts can be categorized into three: *steepening, flattening* and *parallel.*

Steepening

The difference between the long-term rate (LR) minus the short-term rate (SR) rises, which makes the term structure

shift in anti-clockwise direction. This could happen in many ways, as follows.

- LR rises and SR falls
- Both rise but LR rises more
- Both fall but SR falls more
- LR remains the same but SR falls
- LR rises and the SR remains the same

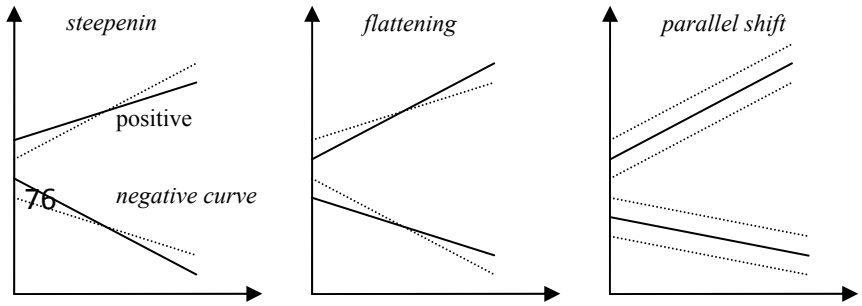
Flattening

It is the opposite of steepening: the difference between the LR minus the SR falls, which makes the term structure shift in clockwise direction. This could happen in many ways, as follows.

- LR falls and SR rises
- Both rise but SR rises more
- Both fall but LR falls more
- LR remains the same but SR rises
- LR falls and the SR remains the same

Parallel

Rates for all terms rise in the same direction and by the same extent so that the difference between rates of any two terms remains the same. The following exhibit shows various shifts in term structure under different shapes. The solid line is the shape before and the dotted line is the shape after the shift.



When the shape of the term structure is negative (or inverted), the names "steepening" and flattening are confusing. For example, the steepening of inverted term structure visually looks flattening; and its flattening looks visually steepening. The correct definition for steepening is LT rate minus ST rate is rising; and that for flattening is LT rate minus ST rate is falling. Let us illustrate this with the following example of inverted term structure.

Term	Before	Steepening	Flattening
ST rate	6.00%	5.75%	6.25%
LT rate	5.00%	5.25	4.75%
LT rate minus ST rate	−1.00%	−0.50%	−1.50%

In the scenario of steepening, the LT rate minus ST, though remained negative, actually rate *rose* from −1% to −0.5%. Imagine that the ground water table *rose* from 1 feet below the ground to half-feet below the ground. However, visually, the dotted "looks" flatter. Similarly, in the scenario of flattening above, the difference between the two rates actually fell (ground water fell from 1 feet below the ground to 1.5 feet below the ground), though the curve has become visually steeper. Bond traders the quickly assess the shift with the following thumb rule: anti-clockwise shift is steepening; and clockwise shift is flattening.

3.3. Measures of Return

Return on investment is the most important measure of performance. It has the following properties.

- Expressed as a rate per annum
- Considers reinvestment of any interim income
- Considers compounding over smaller intervals than year

If there is no interim income, then it is simple to compute the return as follows.

$$\left\{\left[\frac{F}{P}\right]^{\frac{1}{N\times C}} - 1\right\} \times C$$

where

F = final amount received (i.e. face value)
P = initial amount invested (market price)
N = number years
C = compounding frequency

The first term, (F/P), is the growth factor: it indicates how much unit amount has grown into over the entire investment period. For example, if Rs 100 grows into Rs 150 over three years, the growth factor is 1.5: one unit has grown into 1.5. The exponent term, the reciprocal of ($N \times C$), converts the growth factor from "per investment period" to "per compounding period". The third term, deducting unity from the "per compounding period" growth factor, converts it from growth factor to growth rate. The fourth term, C, converts the "per compounding period" growth rate into annualized growth rate, which is how the return is expressed. Using the same example of Rs

100 resulting Rs 150 after three years, the return measure with different compounding frequency is:
With annual compounding:

$$\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times1}}-1\right\}\times 1 \qquad = 14.4714\%.$$

With semiannual compounding:

$$\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times2}}-1\right\}\times 2 \qquad = 13.9826\%.$$

With quarterly compounding:

$$\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times4}}-1\right\}\times 4 \qquad = 13.7464\%.$$

With monthly compounding:

$$\left\{\left[\frac{150}{100}\right]^{\frac{1}{3\times12}}-1\right\}\times 12 \qquad = 13.5919\%.$$

The above is the true and realized return. In the above example, we can say that we have earned 13.5919% pa for every month for the next three years, and the interest earned every month is automatically reinvested at the same rate of 13.5919% pa until the end of three years. This return, which is the realized return, is also called *zero rate* or *spot rate* in the interest rate market. A 5Y zero rate of 7.5% means that the return on initial investment is 7.5% for first year, which is reinvested automatically for four more years at the same rate of 7.5%; the return for the second year is 7.5%, which is reinvested automatically for three more years at the same rate of 7.5%; and so on.

For zero-coupon securities (i.e. discount instruments), it is possible to readily compute the true return or zero rate because there are no interim cash flows. The redemption value corresponds to the *F* and the initial purchase price corresponds to the *P*. For coupon bonds and annuities, it is not possible to compute true return because of interim cash flows, which need reinvestment until maturity. The reinvestment rates are not known until the reinvestment time (except when the future cash flows are locked through interest rate derivatives), and therefore true return is not known at the beginning ("ex ante") but known only at the end of investment period ("ex post"). At the end of investment period, all the reinvestment rates are known, and we can compute the true return, which is called *holding period return* (HPR). Since HPR is can be computed only ex post and not ex ante, some other approximate measures of return are developed for coupon bonds and annuities. They are *coupon*, *current yield* and *yield-to-maturity*.

3.3.1. Coupon

Coupon cannot be considered as return because it does not consider the premium/discount in bond price and the capital gain/loss at redemption. For example, a 3Y 8% coupon bond purchased at a price of 103. We cannot consider coupon of 8% as the return, because the bond pays the following amounts during its life.

Year	Amount	Return
1	8	8 / 103 = 7.7670%
2	8	8 / 103 = 7.7670%
3	8 + 100	(108 /103) − 1 = 4.8544%

In the third year, there is redemption and therefore we must convert the growth factor into growth rate. We find that the return is 7.7670% p.a. for the first two years and 4.8544% for the third year. We cannot consider these as true return because the first year coupon must be reinvested for two more years; and the second year coupon must be reinvested for one more year. Unless these reinvestment rates are known, we cannot compute the true return even for a single year except for the last. And then we need to blend all three true returns into a single return measure. Thus, coupon is not a return measure because it ignores: (1) the premium/discount in bond price; (2) capital gain or loss at redemption; and (3) reinvestment rate of periodic cash flows.

3.3.2. Current Yield

Current yield is defined as: coupon divided by bond price. For the example given earlier, the current yield is:

$$8 / 103 = 7.7670\%$$

Current yield is better than coupon but is still unsatisfactory. It considers the premium/discount in bond price but ignores the capital gain/loss and reinvestment rate. Current yield does not result in a single return measure but considers the return for each period separately. What we really need is a single annual measure for the entire period.

3.3.3. Yield-to-maturity (YTM)

Yield-to-maturity (YTM) is the most widely encountered measure and is simply called “yield”. However, it is still not

a true return measure. YTM considers the premium/discount in bond price and capital gain/loss at redemption and even handles the reinvestment in a rough way. What it does is: (a) amortizes the capital gain/loss at redemption over the bond's life and adds it to the current yield; (b) averages the returns for all periods in a complex way; and (c) assumes that interim cash flows are reinvested at the same average return. A crude method to compute YTM using the same example is as follows. The capital loss is Rs 3, which, when amortized over three years is: 3 /3 = 1. The loss of 1% is added to the current yield of 7.7670, resulting in the YTM of 6.7670%. And it assumes that the periodic coupons are reinvested at the same 6.7670%.

The more precise way of computing YTM is to discount the bond's cash flows at such interest rate that it results in the current market price. In other words, YTM in bond market corresponds to *internal rate of return* (IRR) in corporate finance and *effective yield* (EY) in accounting/tax jargon. The actual factors that determine the bond price are relevant here to examine the true meaning of YTM.

Any fixed-income security is priced by discounting its cash flows at the appropriate interest rate, which is the zero rate applicable to the maturity of that cash flow. The reason for using only zero rate is that it represents the true measure of return and hence the opportunity cost. At any point of time, there are multiple zero rates, corresponding to the multiple maturity points. For example, the rate is Z_1 for 1Y, Z_2 for 2Y, and so on, which is called the *term structure* of zero rates. Any cash flow falling at 1Y must be discounted at Z_1; any cash flows at 2Y at Z_2; and so on. For the previous

example of 3Y 8% coupon bond, the market price would be derived by discounting its various cash flows at the appropriate zero rates, as follows.

$$\text{Price} = \frac{8}{(1+Z_1)^1} + \frac{8}{(1+Z_2)^2} + \frac{108}{(1+Z_3)^3}$$

In the above, each cash flow is discounted at the corresponding zero rate from the term structure, and the sum of discounted cash flows is the current price of the bond. For the above example, what is the true return? The answer is that there is no single answer but there are three answers. For the first year, the return is Z_1 on a final amount of 8; for the second year, Z_2 on a final amount of 8; and for the third year, Z_3 on a final amount of 108.

Instead of using different rates of Z_1, Z_2 and Z_3 for discounting, we find the same rate at which the resulting amount equals the price. This uniform rate is the YTM or IRR or EY. Notice that YTM is computed from the price. In other words, it is another way of quoting price, rather than a true return measure. Alternatively, given YTM, one can compute the price. Using the above formula, and given that the price is 103, the YTM works out to be 6.8598%. To sum up, the following are the drawbacks in using YTM as a true return measure.

- By using the same rate for all cash flows, it assumes that the term structure of zero rates is flat and at artificial level
- Bond with different coupons but with same maturity will have different YTMs (which is called “coupon effect”). In other words, YTM is

inconsistent because it simultaneously assumes different levels of term structure of zero rates at the same time

- YTM is inconsistent in another way: it assumes that reinvestment of periodic cash flows will be at the YTM itself. Further, for bonds with different prices (and hence at different YTM because YTM is merely another way of quoting bond price), different reinvestment rates are assumed at the same time.
- For zero-coupon bond, YTM is also the true measure of return because there are no interim cash flows to be reinvested and there is a single zero rate used.

3.3.4. Holding Period Return (HPR)

HPR is the true return measure. As stated earlier, it can be computed only ex post, not ex ante. For our earlier example, of 8% 3Y coupon bond, we will know the final reinvestment rate at the end of 2Y, when the second coupon of Rs 8 is reinvested for one year. Assuming the following are the reinvestment rates, the true return or HPR is:

Value of 1Y coupon reinvested at, say, 6.5% for 2Y:

8×1.065^2 = 9.0738

Value of 2Y coupon reinvested at, say, 6.25% for 1Y:

8×1.0625^1 = 8.5

Redemption amount in 3Y:

= 108

TOTAL cash flow at 3Y

= 125.5738

Using the formula given at the beginning, the true return or HPR is:

$$\left\{\left[\frac{125.5738}{103}\right]^{\frac{1}{3\times 1}} - 1\right\} \times 1 = 6.8285\%$$

The HPR of 6.8285% is in contrast with the YTM of 6.8598%. As the reinvestment rate varies, so does the HPR, but the YTM continues to be the same as 6.8598%.

Price/YTM is not a Judgment Tool

We cannot use the bond price to determine the mispricing of bond. For example, there are two 3Y bonds issued by the same issuer. One bond has a coupon of 8% and the other 9%. The market prices of these bonds, given the following term structure of zero rates, and the translation of price into YTM will be as follows.

		Bond A		Bond B	
Year	Zero Rate	Coupon	Disc Amnt	Coupon	Disc Amnt
1	7.7500%	8	7.4246	9	8.3527
2	8.0000%	8	6.8587	9	7.7160
3	8.2500%	108	85.1413	109	85.9296
Total			99.4246		101.9983
YTM			8.2941%		8.2215%

Both bonds have the same maturity and issued by the same issuer. Therefore, maturity-related price risk and issuer-related credit risk do not influence the bond return. Which

bond is better? Bond A would seem under-priced at 99.4246 and Bond B would seem overpriced at 101.9983. However, this is incorrect because we are comparing apples with oranges. Both bonds are priced correctly at the same term structure of zero rates. Therefore, price cannot be used as a judgment tool for determining the mis-pricing. Since YTM is another way of quoting price, it cannot be used as judgment tool, too. Only if the actual market price of the bonds is different from 99.4246 (for Bond A) and 101.9983 (for Bond B), we can say that there is a mispricing or cheapness/richness of bonds.

Investor may still have preference to the bonds, which is decided by factors other than price/YTM. These factors are tax considerations and expectations about future interest rates for reinvestment. If you expect interest rate would rise in future, then you may prefer Bond B because higher amount of Rs 9 will be reinvested at higher rate. Similarly, if capital gains are taxed at lower rate than income, then investor will prefer Bond A because it has lower income of Rs 8 a year and a capital gain at redemption.

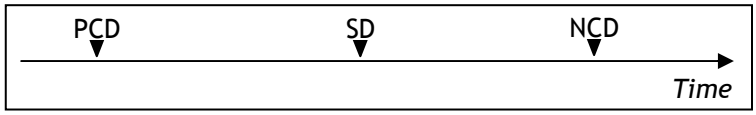
3.3.5. Accrued Interest

In the secondary market for bonds, what is quoted in the market is called the *clean price* (CP), and the trade is settled at a different price called *dirty price* (DP) or *invoice price* (IP), which is higher than the CP. The extent by which DP is higher than CP is called the *accrued interest* (AI).

$$DP = CP + AI$$

Why should be the settlement price higher than market price? And what exactly is this AI? The accrued interest

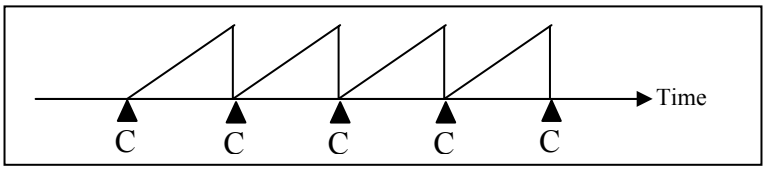
arises because the security pays a coupon and coupon is paid on specified coupon payments dates, which are usually semi-annual. Consider a transaction in secondary market executed on some date, called Settlement Date (SD), which falls between two coupon payment dates, which we will designate the payment date prior to SD as the previous coupon date (PCD) and that after SD as the next coupon date (NCD), as shown below.



The issuer computes the accrued interest between PCD and NCD, and pays it to whosoever holds the bond on NCD. The person holding the bond as at NCD is the buyer and therefore he gets the entire accrued interest from PCD to NCD, though he holds the bond only for the period between SD and NCD. The seller holds the bond between PCD and SD and therefore he should get accrued interest between PCD and SD.

To make the interest accrual fair according to the holding period, buyer computes the interest from PCD and SD, and adds this amount to the negotiated CP and makes the payment. This add-on amount is called the accrued interest (AI). The buyer gets AI from the issuer on NCD. Two questions arise: why this AI is not factored in the market price? Why there is no such convention in equity market for dividend, which is the equivalent of coupon?

If the accrued interest is factored in the market price, its effect will be to raise the bond price every day (by the interest accrual for one day) steadily from one coupon date to the next, and then make the bond price drop suddenly on the next coupon date (by coupon amount for the whole period). This leads to saw-tooth like pattern in the bond price changes, as shown below.



The changes in the price as above (which are known in advance) are in addition to the changes in bond price caused by changes in interest rate (i.e. demand-supply for money) and changes in credit quality of issuer (i.e. demand-supply for credit quality). Bond traders would like to see only those price changes caused by demand-supply, and therefore would like the changes driven by accrued interest to be removed from bond price, and take it into account as an add-on item at the time of settlement by way of AI.

Why there is no similar convention for dividend accrual in equities? The reason is that the dividend yield for most equities is negligible, and the returns predominantly consist of capital gain/loss. In contrast, coupon constitutes the major component in total return from bond, if not the total return, and therefore the AI cannot be ignored.

Market Practices in India - FIMMDA

Fixed-income and Money Market Derivatives Association (FIMMDA) is the self-regulatory organization in India for money, bond and derivatives markets. According to FIMMDA rules, the following are the market conventions.

Round-off of Interest Amounts

All interest amounts must be rounded off to the nearest whole rupee.

Round-off of Price and Yield

Price (per face value of 100) and yield (in percentage format) quotes must be rounded to the nearest fourth decimal place when used in interest amount calculations. The exception is the second leg of repo/reverse repo transaction for which price can be quoted up to the nearest eighth decimal point.

Day Count Basis

Day count basis for all transactions is Actual/365 Fixed except for the accrued interest calculation in the secondary market for sovereign bonds, for which is it is 30E/360.

Yield Quote on Money Market Discount Instrument

Yield on money market discount instruments (T-Bill, CD, CP) must be quoted on true yield (Y) basis and not on discount yield basis; and for bill rediscounting, it should be in discount yield (DY) basis.

3.4. Risk Measures

Risk is the uncertainty about the future price of bond. The bond prices change over time for two reasons. First, changes in the term structure of zero rates (i.e. shift in term structure) will change price of bonds. The changes in the term structure are due to changes in demand-supply for money. This is called interest rate risk and affects all bonds. Second, changes in the credit quality of the borrower will change the credit spread, which in turn will change the bond price. This is called credit risk. We will ignore the credit risk and consider only the interest rate risk because interest rate derivatives will manage only the interest rate risk.

Interest rate risk can be decomposed into two further components: price risk and reinvestment risk. Price risk is the change in market price of bond because of shifts in term structure. Price risk affects all bonds and its impact is sudden and immediate because of discounting. Reinvestment risk is the change in the terminal value of periodic cash flows reinvested during the life of the bond. Reinvestment risk affects only those bonds with interim cash flows (i.e. coupon bonds and annuities) and its effect is slow over a period of time because interest accrual occurs slowly over time.

Price risk and reinvestment risk always work in the opposite way. For example, if the rates in the term structure rise, the bond price will fall immediately (because of discounting), resulting in loss to its holder. On the other hand, the holder will benefit from reinvestment risk because the cash flows

are now reinvested at higher than the original rates, but the benefit will not be immediate but will occur over time until the end of reinvestment period. Similarly, if the term structure of rates falls, the price will rise immediately but there would be fall in reinvestment income which occurs slowly.

3.4.1. Duration (D) and Modified Duration (MD)

Macaulay was the first to measure the price risk. He proposed that bond maturity is a rough measure of price risk. Consider a change of 1% rise in the interest rate. The price of 1Y zero-coupon bond will fall by roughly 1%; that of 2Y zero-coupon bond will fall by roughly 2%; that of 3Y zero-coupon bond will fall by roughly 3%; and so on. Thus, the change in the bond price is roughly proportional to the maturity. The periodic coupon will make the effective maturity less than the legal maturity because of coupon payments before the legal maturity. The reduction in effective maturity will correspondingly bring down the riskiness of the bond. The measure of risk is the weighted average of years in bond's life, the weights being the cash-flows discounted at YTM. Macaulay explained this with an intuitive example such as the one below. Consider a 10% 2Y coupon bond currently priced at 101.7125, corresponding to YTM of 11%. Let us derive the discounted cash flows and the time-weighted discounted cash flows.

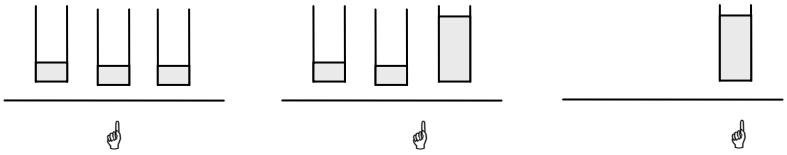
Time	YTM	Discount Factor	Cash Flow	Discount Cash Flow (DCF)	Time-Weighted DCF (TDCF)
(a)	(b)	(c) = $1 / (1+b)^a$	(d)	(e) = (c) × (d)	(a) × (e)

1	11%	0.900901	12	10.8108	10.8108
2	11%	0.811622	112	90.9017	181.8034
				101.7125	192.6142

The sum of (DCF) is the current price of the bond, of course. If we divide the sum of TDCF with the sum of DCF, what we get is T or time, which Macaulay called it as "Duration" (D), which he considered the effective maturity of bond and a measure of price risk. For the above example, Macaulay's Duration (D) is:

192.6142 / 101.7125 = 1.89

Notice that the units for Duration are the time units (in this example, years). Thus the effective maturity is brought down from 2Y to 1.89Y. For zero-coupon bonds, since there are no interim cash flows, D will be exactly the same as bond's maturity. An intuitive interpretation of duration is that it points to the centre of gravity. Imagine a plate on which are placed a series of glasses filled with water. The glass corresponds to the year of cash-flow; and the amount of water in it, to the amount to cash-flow. The pointer, which corresponds to Duration, indicates the place where you hold the plate to maintain balance.



The first is annuity (equally-sized and equally-spaced cash flows) whose D is half-way in its legal maturity. The second is a coupon bond whose D will be slightly less than its

maturity. The third is a zero-coupon bond whose D is the same as its maturity.

Subsequently, more rigorous measure of price risk is developed as the first-order derivative of price to YTM. This measure is called Modified Duration (MD), which is related to D as follows.

$$MD = \frac{D}{\left(1 + YTM/n\right)}$$

where *n* is the frequency of compounding in a year. For the above example, MD will be, assuming annual compounding,

1.89 / (1.11) = 1.71.

Both D and MD give the *proportional* change in bond price caused by a small change in YTM. For example, if MD is 1.71 and YTM changes by a small amount, then the bond price changes by 1.71 times the change in YTM. Designating the changes as Δ,

$$\frac{\Delta P}{P} = \mathrm{MD} \times \Delta YTM$$

where *P* is the bond price. We can solve the above equation for absolute change in bond price, ΔP, which is also called *sensitivity*, as follows.

$$\Delta P = P \times \mathrm{MD} \times \Delta YTM$$

Applying these measures to our example and assuming that YTM changes by 1% from 11% to 10%, the D and MD will indicate the following changes in bond price.

D: 101.7125 × 1.89 × 1% = 1.92

MD: 101.7125 × 1.71 × 1% = 1.74

The actual bond price at YTM of 10% will be 103.4711, which is a change of 1.7586, which is closer to that indicated by MD than that by D. Modified Duration (MD) differs from Macaulay Duration (D) in three ways. First, it is a better measure than D as a measure of price risk. Second, it is a pure number and has no units. Third, it is always less than D.

MD enables us to calculate the hedge ratio. If P_1 and P_2 are the prices of two bonds in the hedge portfolio; and MD_1 and MD_2, their respective Modified Durations, then the hedge ratio (H) is:

$$H = \frac{\Delta P_1}{\Delta P_2} = \frac{P_1 \times \mathrm{MD}_1}{P_2 \times \mathrm{MD}_2}.$$

MD is additive, meaning that the MD for a portfolio of bonds is simply the algebraic sum of the weighted average of each bond's MD, the weights being the amount invested in bonds. For example, a portfolio consists of the following two bonds.

Bond	Price	Qty	Value	MD	Weighted MD
$Bond_1$	81.1622	100	8,116.22	1.82	14,771.52
$Bond_2$	101.7125	200	20,342.50	1.72	34,989.10
		TOTAL	28,458.72		49,760.62

Portfolio MD = 49,760.62 / 28,458.72 = 1.75.

Thus, if the YTM changes by 0.1%, the portfolio's value would change by 0.175%. MD is a better measure of price risk than D but is not a perfect measure for three reasons. First, being the first derivative, it holds good only for small changes (say, changes in YTM of 0.01% to 0.10%). Second, the relationship between bond price and YTM is not linear but convex while MD assumes a linear relationship. To capture the effect of convexity, we require a second derivative of price to yield, which is called *convexity*. Third, by using YTM rather than the term structure of zero rates, MD assumes flat term structure at the level of YTM and assumes parallel shifts in term structure. If the shift is steepening or flattening, MD does not hold good even for small changes in rates. Further, MD is not constant but changes during bond's life.

MD is affected by YTM, coupon, and maturity. It is inversely proportional to coupon and YTM: higher the coupon or higher the YTM, the lower is the MD. It is proportional to maturity: the longer the maturity, the higher the MD, but it flattens (or even decreases) as maturity extends beyond 30 years. The following table summarizes the effect of these factors on MD.

Factor	**Level**	**Effect on MD**
Maturity	Higher	Higher
Yield	Higher	Lower
Coupon	Higher	Lower
Coupon frequency	Higher	Lower
Callable		Lower

3.4.2. Price Value of a Basis Point (PVBP) and Rupee Duration

Senior management and risk managers are interested in change in the *total* market value of the bond portfolio for a given change in the YTM. For that, they need to replace bond price with the market value of the bond portfolio in the equation, as follows.

Change in portfolio market value = Portfolio market value × Portfolio MD × Change in YTM

This is called rupee duration (RD). For example, if the portfolio's current market value of Rs 987.89 Cr and the portfolio MD is 5.68, then change in market portfolio for a change of 10 basis points (i.e. 0.10%) will be:

$$987.89 \times 5.68 \times 0.10\% = \text{Rs } 5.61 \text{ Cr.}$$

Unlike in equity and forex markets, daily changes in YTM are very small and are about 0.01% to 0.10%. The change in YTM of 0.01% (or 0.0001) is called a *basis point* (BP) or "bip". Bond traders would like to know what would be the change in bond price for a change in YTM of one BP, which is called PVBP (or PV01). Since one BP is 0.0001 in YTM, PVBP can be derived from MD as follows.

$$PVBP = P \times MD \times 0.0001$$

For example, if the current price of bond (P) is 101.7125 and its MD is 1.71, then PVBP will be

$$101.7125 \times 1.71 \times 0.0001 = 0.0174.$$

3.4.3. Convexity (CX)

Convexity (CX) is the second-order derivative of bond price to changes in its YTM. Unfortunately, there is no intuitive interpretation for CX like the one we gave for D and MD. For small changes in YTM, the effect of CX can be ignored. For large changes in YTM, however, it must be incorporated alongside MD.

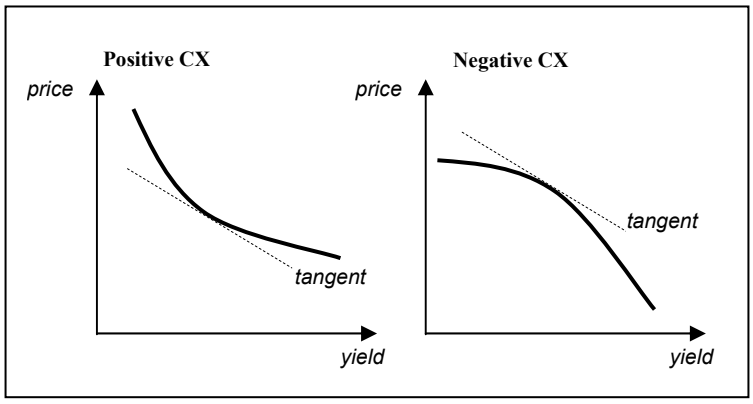
Mathematically, convexity is the second derivative of the price (*P*) with respect to yield (*y*), expressed as a proportion of price.

$$\frac{1}{P}\frac{d^2P}{dy^2}$$

The second derivative is the change in first derivative or slope for unit change in yield. Like Modified Duration, there is no analytical formula for computing CX: it has to be calculated numerically. However, the following formula can be used as an approximation of CX.

$$CX = 10^8 \times \frac{1}{P} \times \left[\left(P^+ + P^-\right) - \left(2 \times P\right)\right]$$

where P is the bond price; P^+ is the bond price at yield of one basis point higher; and P^- is the bond price at yield of one basis point lower. The sign of convexity can be seen from the shape of price-yield relation. If the curve is above the tangent (i.e. it looks like a “smile”), it is positive convexity. If it is below the tangent (i.e. it looks like a “frown”), it is negative convexity.



Combining Modified Duration and CX gives a better measure of bond price sensitivity to change in yield, as follows:

$$\text{Percentage change in price} = -(\text{MD} \times \text{change in yield}) + 0.5 \times \text{CX} \times (\text{change in yield})^2$$

Whether yield rises or falls, the square of change in yield will be always positive. It follows then that positive CX will result in profit as long as yield changes regardless of their direction, with larger change resulting in large profit. Negative convexity works in the opposite way: if yield changes in either direction, it results in loss. We can say that MD is a bet on the *direction* of yield changes while CX is a bet on the *volatility* of yield changes. Like MD, CX is inversely proportional to coupon and YTM but directly proportional to maturity.

It should be noted that by additionally incorporating CX, the hedge or risk management may not be precise because CX, like, MD, assumes that the term structure is flat and at the level of YTM. For precise risk management, bond traders would consider the changes in term structure with respect to key tenors (e.g. 3M, 1Y, 5Y, etc) and develop a series of risk measures like Key rate Duration (KRD), etc. Besides, bond that have embedded options (convertible bonds, callable bonds, puttable bonds) must additionally consider the effect of changes in term structure on these options and their impact on bond price.

The modern approach of risk management is to use tools like value-at-risk (VaR), which considers the volatility of the entire term structure and then assess the change in bond price for a given shift in the term structure.

Key Concepts

Interest rate arithmetic: effect of day count fraction, compounding frequency and payment timing

Term structure of interest rates: the most important concept in any valuation

Term structure shapes: normal, inverted, flat and humped

Term structure shifts: steepening, flattening and parallel

Return measures: current yield, YTM and zero rate

YTM is another way of quoting bond price and not a judgment tool

Risks: price risk and reinvestment risk

Traditional risk measures: Duration, MD, PVBP, RD and Convexity

Inadequacy of traditional risk measures because of using YTM

Exercise

1. Which of the following is a correct measure of the realized return for a coupon bond?
    a. Current yield
    b. Yield-to-maturity (YTM)
    c. Coupon
    d. None of the above

    (**Answer:** see section 3.3.3)
2. Which of the following is a correct measure of the realized return for a zero-coupon bond?
    a. Current yield
    b. Yield-to-maturity (YTM)
    c. Coupon
    d. None of the above

    (**Answer:** see section 3.3.3)
3. If the term structure of interest rate is inverted or negative, which of the following statement is true?
    a. Rate rises with term
    b. Rate falls with term
    c. Rates are the same for all terms
    d. None of the above

    (**Answer:** see section 3.2.1)
4. If the shift in the term structure is flattening, which of the following statement is true?
    a. Different between long-term rate and short-term rate is rising
    b. Different between long-term rate and short-term rate is falling

c. Different between long-term rate and short-term rate is the same
d. None of the above

(**Answer:** see section 3.2.2)

5. Bond A and Bond B are issued by the same issuer and have the same maturity. Bond is priced at 99 and Bond B at 101. Which of the two bonds is a better investment?
    a. Bond A
    b. Bond B
    c. The one with the higher coupon
    d. Bonds cannot be judged based on their prices

CONTENTS

Unit 4: Bond Futures in India – Contract Features

4.1. Underlying

The underlying for the bond futures is the 7% 10Y bond issued by Government of India. The coupon is paid half-yearly on 30E/360 day count basis (see Section 3.1.1), and the maturity of 10Y is from the first calendar day of Delivery Month (which is explained in Section 4.7).

In practice, such a bond does not exist at all. It is a notional or an imaginary bond. In settlement, such imaginary bond is replaced with any of the qualifying real bonds. As an

analogy, imagine that the imaginary bond is 21 carat gold, and there are real bonds that are 14 carats, 18 carats and 22 carats. You sell the imaginary 21 carat bond but deliver it in 18 carat real bond. How do we make the settlement fair to both seller and buyer? Since the seller sold a superior quality (i.e. 21 carat) but delivering an inferior quality, he must increase the quantity of delivery by 21/18 = 1.16667. This factor is called Conversion Factor.

The criteria for qualifying real bonds (i.e. 14 carats, 18 carats and 22 carats) and Conversion Factor for each is described in Section 4.7.

4.2. Contract Amount (or "Market Lot")

Each bond futures contract is for a face value (also called nominal value or par value) of Rs 200,000. In other words, we can buy or sell the underlying in lots of 200,000 (or 2 lakhs) of face value. Because the face value will always be an integral multiple of Rs 2 lakhs, we can buy for face value of 2 lakhs, 4 lakhs, 6 lakhs, 8 lakhs and so on, not for 3 lakhs, 5 lakhs, 7 lakhs and so on. In contrast, the market lot in the cash bond market is Rs 5 Cr. This could lead to a problem in hedging or arbitrage between futures and the cash market. For example, we cannot hedge 300 bond futures contracts (for a total face value of Rs 6 Cr) in the cash market without paying off-market-price premium for the odd amount.

The face value and market value are linked by the market price. In both cash and futures markets, the prices are

quoted for Rs 100 face value so that the relation between face value and market value is:

Market Value = Face Value × (Market Price / 100)

Thus, if the price is 106.10, the face value of 200,000 will have a market value of: 200,000 × (106.10/100) = 212,200.

4.3. Delivery Month (or "Expiry Month")

At any point of time, there will be a maximum of four different Delivery Months available for trading, each an independent contract (but the Exchanges may list less than four contracts, depending on the market conditions). The four delivery months are the nearest consecutive months from Mar-Jun-Sep-Dec cycle. The last trading day (also known as "Expiry Date") for the contract will be the second business day prior the last business day of the Delivery Month. The following illustrates the last trading (LTD) and the last business day (LBD) using a hypothetical calendar. The shaded boxes indicate that the day is not a business day.

21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	LBD = 31; LTD = 29
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	LBD = 29; LTD = 27
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	LBD = 28; LTD = 25
21	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	LBD = 30; LTD = 26

[**Note**: when the contract was launched in August 2009, the LTD was set at seven business days prior to the LBD of the Delivery Month. It was subsequently changed in December

2009 to two business days prior to LBD of the Delivery Month.]

As the trading ceases on this last trading day of the contract, a new contract is introduced on the next day so that there will be four contracts available for trading. Given this arrangement, the shortest futures expiry date will vary between 1M and 3M; and the longest, between 10M and 12M, as shown in the following table.

Trading Date	Contract Months	Shortest Maturity	Longest Maturity
Mar 01, 2010	Mar-10, Jun-10, Sep-10, Dec-10	1M (Mar-10)	10M (Dec-10)
Apr 01, 2010	Jun-10, Sep-10, Dec-10, Mar-11	3M (Jun-10)	12M (Mar-11)
May 01, 2010	Jun-10, Sep-10, Dec-10, Mar-11	2M (Jun-10)	11M (Mar-11)

The shorter of the range will be on the first day of the Delivery Month; and longer of the range, on the first day of the month immediately following the Delivery Month.

The trading hours of the futures contract are between 09:00 and 17:00 hrs IST, which coincide with the trading hours of the cash bond market.

4.4. Price Quotation and Tick Size

Price is quoted per 100 of face value with a minimum price change ("tick size") of 0.0025 (that is, one quarter paisa per 100 of face value). In contrast, the price in the cash bond market is quoted in yield basis up to second decimal place

(that is 0.01% or 0.0001) and translated into equivalent price, rounded to the nearest fourth decimal place.

The minimum price change ("tick size") of 0.0025 per 100 of face value will imply a minimum change in market value of Rs 5 per one futures contract as follows.

Contract Amount × (Tick Size / 100)
= Rs. 2,00,000 × (0.0025 / 100)
= Rs. 5

4.5. Daily and Final Settlement Price

The Exchange will fix the daily settlement price on every trading day for mark-to-market; and the final settlement day on the last trading day for settlement. They are computed as the volume-weighted average price (VWAP) of the trades in the last 30 minutes of the trading. In the absence of trading in the last 30 minutes, the Exchange will disclose the method of determining the Settlement Price. They are discussed further in Section 6.2.4 (in Unit 6).

4.6. Settlement

Settlement of bond futures has peculiar features that are different from that in cash market as well as money market futures on interest rate. Money market futures on interest rate are compulsorily cash-settled and therefore require a benchmark index (e.g. MIBOR) to be specified. There is no cash settlement for bond futures (other than squaring it up by entering into an offsetting futures contract), but are physically settled. Physical settlement brings a problem: the underlying is an imaginary bond and does not exist.

To enable physical settlement for an imaginary bond, certain bonds of the same issuer are made eligible for delivery and are designated as Deliverable Bonds (explained in Section 4.7). Since the deliverable bonds are different from the underlying imaginary bond in coupon and maturity, a "conversion factor" (explained in Section 4.7) is employed to equate them in value, in much the same as 18-carat gold is delivered for 21-carat gold sold, as explained in Section 4.1.

The final settlement is on the last business day of the Delivery Month (which is two business days after the last trading day of the contract). The delivery must be through Subsidiary General Ledger Account (SGL A/c) or Constituent SGL Account (CSGL A/c) (explained in Section 6.1 of Unit 6), and the intention to deliver must be notified on the last trading day. The settlement amount is computed after taking into account the Deliverable Security, Conversion Factor and accrued interest relevant to that security; and the final settlement price fixed by the Exchange, which are explained in Section 4.7.

[**Note:** Originally, when the contract was introduced in August 2009, the seller was allowed to deliver the deliverable securities on any business day during the Delivery Month with a prior notice of two business days. In December 2009, SEBI has allowed the Exchange to determine their own procedure for settlement delivery, and the Exchanges have restricted the delivery to the last business day of the Delivery Month.]

4.7. Deliverable Securities: Eligibility Criteria and Conversion Factor

Because the underlying is an imaginary bond that does not exist and because the settlement is by physical settlement, the seller must be allowed to deliver any of real bonds that are closer to the imaginary bond. The criteria for the eligible bonds are:

- Maturity of at least 8Y and not more than 10.5Y from the first calendar day of the Delivery Month
- Minimum total outstanding stock of Rs 10,000 Cr for the bond, and this amount is computed not later than 10 business days prior to the first business day of the Delivery Month.

[**Note:** Originally, when the contract was introduced in August 2009, the maturity criterion was at least 7.5Y but not more than 15Y from the first calendar day of the Delivery Month. The regulator has allowed the Exchanges in December 2009 to narrow the maturity]

It is desirable to allow multiple securities for delivery because of two reasons. First, institutional investors generally adopt buy-and-hold strategy. Since the outstanding stock of a bond is much less compared to floating stock of equities, the bond will quickly lose liquidity in cash market, which in turn will affect the liquidity of futures. Second, given the low outstanding stock of bonds, market manipulators can easily create squeeze by simultaneously buying the bond in cash market and buying

futures. It must be noted, however, that the facility to allow multiple securities for delivery will be effective only they are not much different in their cost of delivery.

The seller would naturally deliver that bond which is of most advantage to him and which is detrimental to the interest of the buyer. To make the delivery of eligible securities equally fair to both the buyer and seller, the quantity/price of deliverable bond is increased or decreased by introducing a "conversion factor" that is unique to each bond. The principle is similar to the delivery of 18-carat bond in the sale of 21-carat bond illustrated in Section 4.1

Conversion Factor (also called *Price Factor*)

Conversion Factor (CF) is used to bring equivalence between the imaginary underlying bond and the real bond delivered. It is the clean price (i.e. without accrued interest) of one unit face value of Deliverable Bond computed at the yield-to-maturity of 7% (semi-annual payment, 30E/360 day count) on the first calendar day of Delivery Month, after rounding down its remaining maturity to the nearest quarter-year. If there is a single quarter in the remaining maturity (i.e. broken period or stub), it is placed at the beginning (i.e. front stub). It can be computed through the following formula.

[**Note:** the following formula and the accompanying example in Microsoft Excel® are for reference only.]

$$CF = A\left(\frac{coupon}{2} + C + D\right) - B$$

$$A = \frac{1}{(1+0.035)^{\frac{V}{6}}}$$

$$B = \frac{coupon}{2} \times \frac{6-V}{6}$$

$$C = \frac{1}{(1+0.035)^{2N}} \; if \; Z < 7 \; or \; \frac{1}{(1+0.035)^{2N+1}} \; if \; Z \geq 7$$

$$D = \frac{coupon}{0.07} \times (1-C)$$

N = integer number of completed *years* in the remaining maturity of Deliverable Bond

Z = integer number of completed *months* in the remaining maturity of Deliverable Bond

V = *Z* (if Z < 7) or 3 (if Z ≥ 7)

The first term in the formula for CF is the sum of discounted cash flows from the Deliverable Bond (using the bond pricing equation) and the second term, *B*, is the accrued interest. Both of them are computed for one unit of face value. The numerals 0.035 and 0.07 represent the coupon from the imaginary underlying bond in decimal form for half-year and full year. The numeral 6 represents the six

months (which is the full coupon period).

The CF is more easily computed in Microsoft Excel®, using its built-in function of (where the words in SMALL CAPS are Excel function names):

Step #1: Finding Adjusted Maturity (in years)

Compute the adjusted maturity (in years) rounded down to the quarter-year, as follows. Let this be *a*.

a =INT(((*Date1* − *Date2*)/365)/0.25)*0.25

where *Date1* = Maturity Date of Deliverable Bond; and *Date2* = first calendar date of the Delivery Month). Note that, though the coupon payments are computed on 360-day year basis, the maturity is adjusted on 365-day basis.

Step #2: Converting Adjusted Maturity (in years) to Adjusted Maturity (date)

Compute the adjusted maturity as a date, as follows, using the EDATE function in Excel, which returns the calendar date that is specified number months (the second argument) from a given date (the first argument).

=EDATE (*Date2*, *a* * 12)

Both Steps #1 and #2 can be combined into a single formula, as follows.

=EDATE (*Date2*, INT(((*Date1* − *Date2*)/360)/0.25)*0.25*12)

Step #3: Compute the price per one unit of face value with adjusted maturity date at yield-to-maturity of 7% which is

the coupon on the imaginary underlying bond.

=PRICE (*SettlementDate, AdjustedMaturityDate, Coupon, Yield, Redemption, Frequency, Basis*)/100

where,

SettlementDate	First calendar day of the Delivery Month
AdjustedMaturityDate	Adjusted maturity date at computed in Step #2
Coupon	Annual coupon (in decimal form) on Deliverable Bond
Yield	Coupon on the notional underlying (which is 7% or 0.07)
Redemption	100
Frequency	2 (to account for semiannual payment on notional underlying)
Basis	4 (which is the Excel® code for 30E/360 day count)

Example: The following example illustrates the calculation of adjusted maturity and conversion factor for GOI loan 8.20% 2023 (SPL-Oil) due on 10-Nov-2023, with the calculations for the Delivery Month of July 2009.

Adjusted Maturity Date

=EDATE (01-Jul-2009, INT(((10-Nov-2023 – 01-Jul-2009)/365)/0.25)*0.25*12)

The output will be 01-Oct-2023, which is before the contractual maturity date of 10-Nov-2023. Note that if we use 360 instead of 365, the output will be 01-Jan-2024, which is *after* the contractual maturity date. For the same bond, the adjusted maturity date for the Delivery Months of September 2009 and December 2009 will be 01-Sep-2023.

Conversion Factor

=PRICE (01-Jul-2009, 01-Oct-2023, 0.0820, 0.07, 100, 2, 4)/100

The output is 1.1069416. For the same bond, the conversion factor for the delivery months of September 2009 and December 2009 will be, respectively, 1.1060021 and 1.1046907.

[**Note:** the for-reference-only part ends here, and what follows now forms part of the syllabus for questions in NISM Certification Examination]

The CF will be announced by the Exchange when the contract is introduced for trading or few days before the trading for Delivery Month commences, using the above procedure. We may notice the following features of CF.

- For the same bond, the CF will be different for different Delivery Months because of change in remaining maturity of the Deliverable Bond from the first calendar day of different Delivery Months
- CF will remain constant for a Delivery Month regardless of changes in yields over time. Changes in yield will drive changes in the price of Deliverable Bond (and futures price), but do not change the CF
- For Deliverable Bonds whose coupon is less than the notional coupon (NC), which is currently 7%, the CF will be less than unity; for those with coupon of more than NC, the CF will be more than unity; for those whose coupon is NC, the CF will be unity.
- CF works perfectly only when the term structure is flat and at the level NC. If the term structure is flat and at this level, then the ratio of price-to-CF will

be 100 for all deliverable bonds. Term structure is rarely flat and its shape will affect which of the Deliverable Bond will be delivered by the futures seller.

- As the term structure moves away from the NC, then the CF no longer adjusts the prices perfectly. As the yields rise above the NC, the prices of all bonds fall, but the price of the bond with the highest Modified Duration (MD) falls more, making it the candidate for delivery. As the yields fall below the NC, the prices of all bonds rise, but the price of the bond with the lowest MD rises the least, making it the candidate for delivery. In general, higher-MD bond will likely to be the candidate for delivery when the term structure steepens; and lower-MD bond, when the term structure flattens.
- As stated above, the MD of futures increases with the rising yields and falls with falling yields. This is called negative convexity, which is more pronounced when the deliverable basket contains bonds with wide range of MD and when the futures expiry is farther. This is the reason for curtailing the maturity of deliverable bonds into a narrow band. If the notional coupon is away from the current yields in the market, the switch in CTD bond unlikely and the futures contracts becomes virtually a contract on single underlying, and shows positive convexity.

4.8. Invoice Amount

The invoice amount (IA) payable by the futures buyer to futures seller is derived as follows.

$$IA = \left[\left(\frac{SP}{100} \times CF \right) + \frac{AI}{100} \right] \times CA$$

or

$$IA = \left[(SP \times CF) + AI \right] \times \frac{CA}{100}$$

where

SP: Settlement price (per 100 of face value)
CF: Conversion factor unique to the Deliverable Bond
AI: Accrued interest (per 100 of face value) on the Deliverable Bond
CA: Contract amount (or market lot), which is 200,000

The term in parentheses represents the settlement price (which is the market price) per unit of face value adjusted for the quality of Deliverable Bond with multiplicative CF. The second term in the square brackets is the interest accrual on the Deliverable Bond from the previous coupon date to the futures settlement date. The term outside the square brackets converts the settlement amount per one unit of face value (in the first equation) or per 100 units of face value (in the second equation) to the contract amount of one futures contract.

4.9. Cheapest-to-Deliver (CTD) Bond

In the delivery of bond futures, the futures seller can deliver any of the Deliverable Bonds. In theory, the introduction of Conversion Factor for each Deliverable Bond should make the seller indifferent to any preference for particular bond. In practice, however, there is a particular bond (called the "cheapest-to-deliver" or CTD bond) that every futures seller will prefer to deliver. The reason for this preference is that the Conversion Factor does not change during the Delivery Month while the prices/yields of Deliverable Bonds do change during trading hours. Accordingly, the futures price will be tracking the cash market price of the CTD bond.

Which of the Deliverable Bonds is the CTD bond? Before we examine this issue, we must note that "cheapest-to-deliver" is a misnomer because the word 'cheap" is associated with the cost price. What is the cheapest in price is not necessarily the best. For example, investors do not prefer low-priced stocks but prefer under-valued stocks. In other words, they are interested in the return on investment rather than the cost of investment.

Similarly, the cheapest of the Deliverable Bonds will have the lowest of Conversion Factors, which results in lowest revenue. Accordingly, the CTD bond is not the Deliverable Bond that costs the least but the Deliverable Bond that maximizes the profit, which is the revenue minus cost. Even this approach is wrong. Consider the following two investments.

Investment	Cost	Revenue	Profit	Return
A	100	105	5	5.00%
B	200	215	15	7.50%
C	150	163	13	8.67%

Profit = Revenue – Cost
Return = Profit / Cost

Going by the cost, we prefer investment A; by the profit, we prefer investment B; and by return, which is true performance measure, we prefer investment C. We can compute this return by the following simplified formula.

$$\mathrm{Re}\,turn = \frac{\mathrm{Re}\,venue}{Cost} - 1$$

The denominator is what we invest and the numerator is what we get out of it, and their ratio is the relative return for the investment period. The relative return indicates how much of one unit of investment has grown into. For example, the relative return of 1.05 implies that one unit of investment has grown to be 1.05 during the period. Deducting unity from the relative return converts the latter into proportional return.

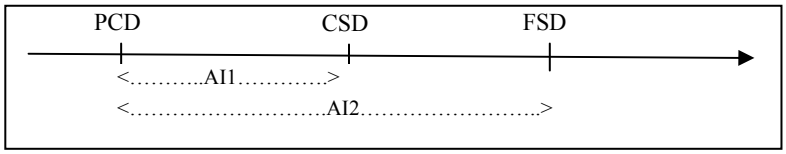
Let us apply this performance return to identify the CTD bond out of Deliverable Bonds. The revenue from delivery is

$$\text{Revenue} = \left(F \times CF\right) + AI\,2$$

where,

F:	Market price of futures (per 100 of face value)
CF:	Conversion factor unique to the Deliverable Bond
AI2:	Accrued interest (per 100 of face value) on the Deliverable Bond from the previous coupon date (PCD) to the futures settlement date (FSD)

The cost of Deliverable Bond in the cash market is the clean price (CP) plus the accrued interest (AI1) computed from previous coupon date (PCD) to the cash settlement date (CSD). The period covered by AI1 and AI2 are shown the diagram below.



The return therefore is

$$\text{Return} = \frac{(F \times CF) + AI2}{CP + AI1} - 1$$

The result is called the *implied repo rate*. For each of the Deliverable Bond, we must evaluate the above formula for implied repo rate. The bond that has the highest implied repo rate has the highest return and therefore is the CTD bond.

We have explained in Section 4.7 that Conversion Factor remains constant during the Delivery Month. However,

there is no guarantee that a bond that is the CTD bond at a point of time continues to be the CTD bond during the life of the contract. It can change over time as the yield changes. This poses a problem when bond futures are used for hedging interest rate risk in a fixed-income portfolio. When the yield curve is not flat, the conversion factor bias can change dramatically. In general, which of the Deliverable Bond will be the CTD will depend on the relations between notional coupon (NC) of the imaginary underlying bond, coupon (C) on Deliverable Bond and the yield (Y) from the Deliverable Bond. The table below indicates the coupon and maturity features of the CTD in a given combination of NC, C and Y.

Relation between NC, C and Y	**CTD coupon**	**CTD maturity**	**Applicability**
$NC > Y > C_H$	Highest	Shortest (usually)	In most cases
$NC > Y, C_H > Y$	Highest	Shortest	Always
$NC < Y, C_L > NC$	Lowest	Longest	Not always
$Y > NC > C_L$	Lowest	$M_H \geq M_{CTD} \geq M_L$	Not always

where

C_L : Lowest coupon in the Deliverable Bonds basket

C_H : Highest coupon in the Deliverable Bonds basket

M_L : Shortest maturity in the Deliverable Bonds basket

M_H : Longest coupon in the Deliverable Bonds basket

M_{CTD} : Maturity of the CTD

4.10. Pricing of Bond Futures

The pricing of futures, like that of any derivatives, is based on no-arbitrage principle, which, for the futures is called "cost-of-carry" or "cash-and-carry" model. It consists of taking a position on one side of the market (i.e. buy or sell) in one market (i.e. cash or futures) and taking the opposite market side in the other market.

Case 1: Futures Bid Price – buy in cash market and sell in futures market

We sell in the futures market at the futures bid price and hedge it by buying in the cash market at the cash offer price. Of course, the bond we buy in the cash market will be the Cheapest-to-Deliver (CTD) bond determined through implied repo rate, as explained in Section 4.9. The cost price (or "dirty price") in the cash will be the clean price (CP) plus accrued interest (AI1), the accrued interest being as explained in the previous section.

$$\text{Cost Price (or Dirty Price)} = CP + AI1 \qquad \text{(Eq. 1)}$$

and AI1 is computed on 30E/360 day count basis. The amount as above required for buying CTD bond in cash market is borrowed by a repo on the CTD bond (sell the bond today and simultaneously buy for delivery corresponding to futures settlement date). The repo has to be (see Section 1.5 in Unit 1) *special* repo (i.e. specific to the security) and not *general* repo (i.e. against any

security). Further it has to be *term* repo (i.e. for a specific term ending on futures delivery date) and not *open* repo (i.e. term extendible with overnight rollovers). The repo period (T) is the period between cash settlement date (CSD) and futures delivery date (FDD), and the repo interest is computed on "Actual/365 Fixed" day count basis in the Indian market. Assuming that the repo rate is R, the financing cost (also known as "carry cost") is:

$$\text{Carry Cost} = (\text{CP} + \text{AI1}) \times \text{R} \times \text{T} \qquad \text{(Eq. 2)}$$

During the holding period between CSD and FDD, there is an income by way of coupon accrual (paid by the futures buyer to the futures seller in the delivery settlement of the futures sale). It is called "carry income" and equals the accrued interest (AI2) from CSD to FDD, computed on 30E/360 day count basis. The net cost of purchase in cash market is thus:

$$\text{Dirty Price} + \text{Carry Cost} - \text{Carry Income} \qquad \text{(Eq. 3)}$$

The above corresponds to the price of bond forward. Let us examine the two "carry" items. The difference between the two items (i.e. carry cost and carry income) is called "carry basis" (also called "net carry") and defined as follows.

$$\text{Carry Basis (or Net Carry)} = \text{Carry Income} - \text{Carry Cost} \qquad \text{(Eq. 4)}$$

Substituting the Eq. 4 in Eq. 3, the final cost price of purchase in cash market, which is also the price of forward, is

$$\text{Dirty Price} - \text{Carry Basis} \qquad \text{(Eq. 5)}$$

Let us now turn the revenue from the arbitrage operations. We will be delivering the CTD bond in the physical settlement of futures sale, and the invoice price (per 100 par value) received will be

$$(F \times CF) + AI2 \qquad \text{(Eq. 6)}$$

where F is the futures price and CF is the conversion factor for the CTD bond and AI2 is accrued interest for the period between cash settlement date (CSD) to the futures delivery date (FDD) computed on 30E/360 day count basis. To preclude arbitrage, the cost and revenues must be the same, which implies that

$$\text{Dirty Price} - \text{Carry Basis} = (F \times CF) + AI2$$

or rearranging it

$$F = (\text{Dirty Price} - \text{Carry Basis} - AI2) / CF \qquad \text{(Eq. 7)}$$

If the actual futures bid price is higher than F, it presents an arbitrage opportunity: sell in futures and buy in cash. Accordingly, the futures bid cannot be higher than F. In other words, F is the *upper* bound on futures bid price.

Arbitrage traders closely watch the difference between cash price and the futures price, which called the “basis”. In bond futures, there is peculiarity of Conversion Factor (CF) for each deliverable bond, and the difference between the cash price and the futures price along with its CF is called “Gross Basis”)

$$\text{Gross Basis} = \text{Cash Price} - (\text{Futures Price} \times \text{CF}) \quad \text{(Eq. 8)}$$

On the face of it, the Gross Basis should be equal to the two carry items incorporated in Carry Basis. However, because of certain long option-like features for bond seller (e.g. right to deliver any deliverable bond and the fact and CTD can change during the bond futures life), Gross Basis may not be equal to Carry Basis, and their difference is called Net Basis.

$$\text{Net Basis} = \text{Gross Basis} - \text{Carry Basis}$$

Case 2: Futures Offer price – sell in cash market and buy in futures market

We buy in futures market at futures offer price and simultaneously sell in the cash market at cash bid price. Because we need to deliver in the cash market sale immediately, we do reverse repo on the bond. The reverse repo has to be *special* repo and *term* repo

The cost is the invoice price in the physical settlement of the futures purchase, which is given by the Eq. 6; and the revenue is the proceeds of cash sale, which is given by the Eq. 5. Besides the reversal of sign, the R will be the reverse repo rate. If the actual futures offer price is less than F, it presents an arbitrage opportunity. Therefore, the F derived here is the *lower* bound on the futures offer price.

It should be noted that the above arbitrage-free pricing applies when all the three markets (cash market, futures market and special & term repo/reverse repo markets) are

liquid. Illiquidity in any of them will make the prices deviate from the arbitrage-free price and yet provide no arbitrage opportunities. Transaction costs will widen the futures bid-offer spread by raising the upper bound for futures bid price and lowering the lower bound for the futures offer price.

Key Concepts

Physical settlement and multiple Deliverable Bonds and Conversion Factors

Conversion factor is not perfect

Cheapest-to-deliver (CTD) bond is not necessarily the Deliverable Bond that costs the least. It is the bond that has highest implied repo rate

Conversion factor is constant during the Delivery Month but the CTD bond may change during the contract life, if the term structure of yield changes

Cash price and futures price are linked through repo/reverse repo rate

Repo/reverse repo establishes the upper bound for the futures bid price and lower bound for the futures offer price

Exercise

1. The underlying for bond futures is
    a. An imaginary notional bond
    b. Always a real, existing bond
    c. Both (a) and (b) above
    d. None of the above
2. Which of the following is the last trading date for a bond futures contract?
    a. Two business days after the first business day of the Expiry Month
    b. Two business days before the last business day of the Expiry Month
    c. Seven business days before the last business day of the Expiry Month
    d. None of the above
3. Which of the following is the settlement day of the bond futures contract?
    a. Last business day of the Expiry Month
    b. Two business days after the last trading day
    c. Both (a) and (b) above
    d. None of the above
4. Which of the following is correct about the Conversion Factor?
    a. It adjusts the quantity of Deliverable Bond
    b. It adjusts the price of Deliverable Bond
    c. Both (a) and (b) above
    d. None of the above
5. Which of the following is correct about the Conversion Factor?

a. It makes the adjustment always perfect
b. It makes the adjustment always imperfect
c. It is a good and practical approximation for adjustment
d. None of the above

CONTENTS

Unit 5: Hedging and Speculation

5.1. Introduction

As stated in Sections 2.2 and 2.3 (in Unit 2), the economic role of derivatives is risk management, not cash management; and the three ways of using derivatives are speculation, hedging and insurance. We may add “investment” as another use for derivatives, though there is no clear distinction between investment and speculation. For the purpose of this handout, we may consider investment as a subset of speculation with the following features.

- *Unlevered*: to buy an asset with owned funds and without borrowed funds or on margin; or to sell an asset that is owned, but not short-sell.
- *Lesser return volatility*: capital protection and periodic income are fairly certain or guaranteed. Government bonds and bonds issued by credit-worthy non-government entities fall under this category

Risk insurance can be provided by options. Futures can be used for three functions: investment, speculation and hedging. We will examine the use of bond futures for each of them.

In fixed income securities, investment as above is often called "passive management" to distinguish it from speculation, which is called "active management". The risks in fixed income securities are credit risk, price risk and reinvestment risk (see Section 3.4 in Unit 3).

Credit risk: it is the possibility of default by the issuer for coupon or principal either in part or full. If the issuer is sovereign government, credit risk does not arise. In the rest of this Unit, we consider only sovereign bonds so as to eliminate credit risk.

Price risk: it is the change in bond price during the life of bond, the changes being caused by changes in the market yields (or, more precisely, in the term structure of zero rates). Whatever be the change during its life, the market price of bond will reach its redemption value at maturity, which is called "pull to par" effect. Therefore, if the bond is held until maturity, price risk does not arise.

Reinvestment risk: it is the uncertainty of reinvesting the periodic coupons until maturity at unknown future interest rates. If the bond is zero-coupon or discount instrument, there will be no periodic coupon and therefore no reinvestment risk. In any case, the size of reinvestment risk is small if the maturity is not very long for two reasons: first, coupon is a small fraction (e.g. 6–7%)of bond's current market price ; and second, changes in interest rates are not more than 2–3% during the bond life (of, say, 10 years). Therefore, in present-value terms, the reinvestment risk is not more than, roughly, 8–15% over 10 years or 0.8–1.5% a year.

5.2. Passive Management

Passive management takes no view on the interest rate changes in futures. It is a buy-and-hold strategy, matching the holding period ("investment horizon") with the bond's maturity or Modified Duration. Unlike equities (which are perpetual securities), bonds have limited life and therefore the investment horizon can be clearly specified in advance. However, there may not be any bond whose maturity matches the required investment horizon. In such cases, the holder can choose a bond or portfolio of bonds such that the portfolio Modified Duration (MD) equals the MD of required investment horizon. The following example illustrates the point.

Example 1: We will assume that the term structure is flat at 10% and we need Rs 1000 after 10Y. To generate the cash flow, we need to invest today in 10Y zero-coupon bond, currently priced at

$$1{,}000 / 1.10^{10} = 385.54.$$

The MD of the above zero-coupon bond will be 9.09. However, there is no such 10Y zero-coupon bond available, but there is 7% 20Y coupon bond priced at 74.46 (corresponding to YTM of 10%) whose MD is 9.09. Since the MD exactly matches, we can buy the 7% 20Y bond, reinvest the periodic coupon at 10% (assuming there is no change in the yields) and liquidate the bond at the end of 10Y. The face value of bond we will be buying for total amount of 385.54 will be

$$385.54 \times 100 / 74.46 = 517.79.$$

The price of the bond after 10Y (with a remaining maturity of 10Y) with no change in the yield of 10% will be 81.5663, and the coupon reinvestment will be as follows.

Year	Coupon[1]	Reinvestment Rate	Reinvestment Period	Cumulative Amount[2]
1	36.25	10%	9	85.48
2	36.25	10%	8	77.71
3	36.25	10%	7	70.64
4	36.25	10%	6	64.22
5	36.25	10%	5	58.38
6	36.25	10%	4	53.07
7	36.25	10%	3	48.25
8	36.25	10%	2	43.86
9	36.25	10%	1	39.88
10	36.25	10%	0	36.25
Proceeds of selling 517.79 face value @ 81.56				422.31
Total				1000.05

[1]Computed at 7% of the face value of 517.79
[2]Computed as: Coupon × $1.10^{\text{reinvestment period}}$

The terminal value is exactly the same as the expected value of 1,000. The residual amount of 0.05 is due to round off and truncation errors.

Example 2: The required investment horizon is 3Y and the term structure is flat at 10%. With 10%, the price of 3Y zero-coupon bond will be

$$100 / 1.10^3 = 75.13$$

and its MD will be: 3 / 1.10 = 2.73. There is no zero-coupon bond in the market but there are the following two coupon bonds.

	Bond A	**Bond B**
Coupon	6%	6.5%
Maturity (years)	1	4
Price / YTM	96.36 / 10%	88.91 / 10%
Modified Duration	0.91	3.30

We will have to buy both the bonds in such proportion of total investment that the portfolio MD is equal to the 2.73 which is the MD of the 3Y zero-coupon bond). Let the proportion of investment in Bond A be w so that the proportion in Bond B will be $(1 - w)$. Thus,

$$0.91w + 3.30(1-w) = 2.73$$

so that $w = 24\%$

In other words, we must invest 24% of the initial investment in Bond A and the balance 76% in Bond B. We can construct the portfolio with more than two bonds, in which case the weight for each bond is determined through linear programming techniques (or Solver tool in

Microsoft® Excel). Given that the investment amount is 75.13, the amount invested in these bonds and their face value are as follows.

	Weight	Market Value	Face Value[1]
Bond A	24%	18.03	18.71
Bond B	76%	57.10	64.23
Total		75.13	

[1]Computed as: Market Value × 100 / Price

Assuming that the term structure continues to be flat at 10%, the coupons from both bonds will be reinvested at 10%, Bond A is redeemed and Bond B (with remaining maturity of 1Y) is sold at a price of 96.82 (corresponding to yield of 10%) at the end of 3Y, resulting in the following cash flows.

Year	Coupon from Bond A	Coupon from Bond B	Total Coupon	Reinvested Coupon
1	1.12	4.17	5.29	6.40
2	-	4.17	4.17	4.59
3	-	4.17	4.17	4.17
Bond A redemption of 18.71 invested at 10% for 2Y				22.64
Sale of Bond B @ 96.82 for face value of 64.23				62.19
			Total	99.99

The terminal value again results in 100 (ignoring the rounding error of 0.01). What the two examples above illustrated is called *portfolio immunization* or *duration balancing*. There are three limitations on portfolio immunization.

First, it is valid only for one change in the term structure. After the term structure changes, the MD of bonds will be different and we need to immunize the portfolio again with the new values for MD. This is called *rebalancing*, which

may be required even if the term structure does not change because MD of different bonds changes at different rates with the passage of time.

Second, it works only when the change in term structure is parallel shift and does not work for steepening or flattening. Third, portfolio is protected for yield only for small changes in the yield level. For larger changes, we need to additionally match the convexity.

Using Bond Futures

Buying bond futures is an alternative to buying the bond in the cash market. We buy bond in the futures market with margin money and invest the balance in short-term money market accounts. Theoretically, the long bond futures should exactly replicate the payoff from long bond in the cash market. In practice, however, the long bond futures is not an attractive alternative to long bond in cash market for the following reasons. First, the choice of maturity in futures is restricted to the maturity of underlying (which is about 10Y) plus the expiry of futures (which is between 1M and 1Y). Second, the daily mark-to-market in futures market results in uncertain inflows and outflows, and the money market account has to be reinvested repeatedly over the life of the bond, involving daily monitoring, which does not fit the passive management strategy. Third, the difference in the money market account rate and repo rate factored in futures price will affect the return on investment. Fourth, since the longest futures expiry date is only one year, the long bond futures contract has to be rolled over many times during the investment horizon of 10 years, involving transaction costs and administrative work.

Further, changing market liquidity at rollover will affect the futures prices and through them the return on investment. In contrast, the return on long bond in the cash market is not affected by changing market liquidity for the bond in the cash market.

However, to adjust the Modified Duration of a bond portfolio, futures contract offers more flexibility, which is explained in Section 5.4.1 and 5.4.2 in this unit.

5.3. Active Management ("Speculation")

Speculation is assuming risk, which means there will be either profit (i.e. positive return) or loss (i.e. negative return). Speculation differs from investment in the following features.

- *Levered:* speculation requires cash outlay only for a fraction of transaction value. It deals with the economic ownership rather than legal or physical ownership. Effectively, it is buying the asset without fully paying for it; or selling it without possessing it or delivering it immediately. Such levered transactions are exposed to "path dependence": it is not the final price but the path taken by the final price that determines the return.
- *Short Horizon:* the long or short positions are held for short horizon, ranging from few hours to few days.

Speculation in bond market is more complex and involved than that in equity or currency markets. The reason is that the bond price is determined, not by demand-supply for

the bond, but by the demand-supply for money of different terms, which is expressed as term structure of interest rates (see Section 3.2 in Unit 3). For coupon bonds, it is not the interest rate of one term but multiple interest rates of different terms that determine its price. For example, a 10Y bond with half-yearly coupon payments is influenced by 20 different interests equally spaced at intervals of six months (6M, 1Y, 1.5Y and so on), each corresponding to the timing of cash flows. However, the predominant influence is by the rate corresponding to the maturity of the bond because the redemption cash flow is the largest among all cash flows. In other words, the 10Y interest rate will have the largest influence on the price of 10Y bond. Because there are multiple rates in the term structure, there are multiple strategies, which can be grouped as follows.

Outlook	Strategies
No change in term structure	Riding the yield curve
Parallel shift in term structure (change in the direction but no change in the slope)	Rate anticipation (with maturity mismatch)
Non-parallel shift in term structure (change in the slope but no view on direction)	Yield spread anticipation
Volatility of term structure (but no view on direction or slope)	Barbell, ladder and butterfly

5.3.1. No Change in Yield Curve: Riding the Yield Curve

The strategy consists of buying a bond with maturity longer than the investment horizon (for investor) or buying a long-maturity bond with short-term funding through repo (for speculator). There are two requirements for the success of this strategy. First, the yield curve should be normal or

upward sloping (i.e. long-term rate is higher than short-term rate). Second, the yield level should not change or, at least, should not rise in any case. The following example illustrates the strategy. For simplicity, we will assume that all the bonds are zero-coupon bonds so that reinvestment calculations need not be considered.

Example 3: the investment horizon is 1Y and the following are the prices and yields of zero-coupon bonds of different maturity.

Term	Yield	Price
1	5.00%	95.24
2	5.30%	90.19
3	5.40%	85.40
4	5.50%	80.72
5	5.55%	76.33

Investor has five ways to invest, as follows. He can buy 1Y bond @ 95.24, hold it until maturity, redeem it for 100, and realize a guaranteed return of 5%; buy 2Y bond @ 90.19, hold it for 1Y and sell it at the expected price of 95.24 (the 2Y bond will have a remaining maturity of 1Y after 1Y and, since the yields do not change, its price after 1Y will be the same as the current 1Y bond price); and so on. The expected return will be as follows, depending on the bond bought.

Bond	Investment	Realization	Return	Remark
1	95.24	100	5.00%	Guaranteed return
2	90.19	95.24	5.60%	Expected return
3	85.40	90.19	5.61%	Expected return
4	80.72	85.40	5.80%	Expected return
5	76.33	80.72	5.00%	Expected return

Thus, buying the 4Y bond at 80.72 and selling it after 1Y at the expected price of 85.40 would result in the highest yield of 5.80%. However, this is only an expectation, on the condition that yield levels do not change and that the 3Y yield after 1Y will continue to be 5.40%. The case of falling yields is not a problem because it results in higher bond price, boosting the return above the expected 5.80%. The case of rising yields, however, is dangerous because it results in falling bond prices, lowering the expected yield.

Using Bond Futures

For the strategy of riding the yield curve, the bond futures has nothing to offer because the difference in the spread between long-term rate and short-term rate is already factored in the price of futures contract.

5.3.2. Parallel Shift: Rate Anticipation with Maturity Mismatch

The assumption underlying the strategy is that there would be parallel shift in yield curve: yields would either rise or fall across all maturities so that the slope of the curve remains the same. The strategy is implemented with maturity mismatch: buying a bond whose maturity is other than the investment horizon.

When yields are expected to fall (i.e. bond prices are expected to rise), we buy a bond whose maturity is longer than the investment horizon. For example, the investment horizon is 5Y but we buy a bond whose maturity is 10Y or more. When the yields fall, we liquidate the bond before maturity and realize price gains, which is in addition to the

coupon income. If there are multiple bonds with the same maturity, we prefer the one with lower coupon because it will have the higher Modified Duration (MD). In general, the principle is to buy a bond with higher MD because its price would rise the highest.

When yields are expected to rise (i.e. bond prices are expected to fall), we buy a bond whose maturity is shorter than the investment horizon. For example, if the investment horizon is 5Y, we buy a 1Y bond and reinvest the proceeds after one year at the expected higher yield.

Using Bond Futures

Rate anticipation with maturity mismatch requires that there are different futures contracts on short-maturity and long-maturity underlying bonds (e.g. futures on 2Y bond, on 10Y bond, etc). Currently in the Indian market, we have only a single underlying with a maturity of 10Y. Nevertheless, bond futures can be used for rate anticipation strategy because short-sale is easier and unrestricted in futures market. If you expect the yield to fall, we buy the bond futures now and liquidate it when the yield falls (which must occur before the expiry of futures). Similarly, If you expect the yield to rise, we sell the bond futures now and cover it when the yield rises (which must occur before the expiry of futures). In other words, in the second case, we replace the strategy of buying short-term bond and reinvesting the amount later in the cash market with the strategy of short-selling the long-term bond in the futures.

5.3.3. Non-parallel Shifts: Yield Spread Anticipation

Two significant non-parallel shifts are flattening and steepening. In flattening, short-term rate rises relative to long-term rate (or the difference of long-term rate minus short-term rate falls). In steepening, short-term rate falls relative to long-term rate (or the difference of long-term rate minus short-term rate rises). Typically, flattening occurs in rising interest rate environment and steepening, in falling interest rate environment. This is because the short rates respond more to the central bank's monetary policy changes than long rates. This might change in some circumstances. For example, if the central bank raises rate, we should expect the curve to flatten. However, if the market perceives that central bank's action is not enough to contain inflation, long-term rates (which are more sensitive to inflation than short rates) will rise more than the short-term rates, leading to curve steepening. Supply-demand imbalance in a particular term may lead to idiosyncratic curve dynamics, too.

The yield spread strategies consists simultaneous purchase and sale of short-maturity and long-maturity bonds. We will use the following two bonds with the following price, YTM, modified duration (MD) and price value of basis point (PVBP) to illustrate the yield spread strategies.

	Bond A	**Bond B**
Coupon	Zero-coupon	Zero-coupon
Maturity	1Y	10Y
Price	94.34	52.04
YTM	6.00%	6.75%

MD	0.94	9.37
PVBP	0.008868	0.048761

It is important to note that in yield spread strategies, the focus is on changes in yield spread between two terms, not on changes in yield levels or direction. Therefore, any effect from the changes in the direction of yields must be neutralized by matching the PVBP, as we will explain in the following sections.

Example 4: Flattening

Flattening is the short-term rate rising relative to long-term rate. To match this expectation, our action should be short-sell short-term (1Y) bond at 94.34 and buy long-term (10Y) bond at 52.04. The quantity of bonds should be such that the portfolio is PVBP-neutral. The ratio of PVBP for the two bonds is:

0.048761 / 0.008868 = 5.50

Thus, the quantity of short-term bond should be 5.5 times more than that of long-term bond to make the PVBP-neutral so that the change in the direction of interest rates will not affect the portfolio performance. Assuming that we buy 100 units of long-term bond, the quantity of short-term bond to be short-sold is 550, and the following are their market values.

Bond A: 550 × 94.34 = 51,887
Bond B: 100 × 52.04 = 5,204

The portfolio as a whole generates initial cash surplus of 46,683 which we will invest in reverse repo on the bond at,

say, 5%. Let us analyze the performance of our portfolio after, say, 0.25Y so that the remaining maturity of Bond A and B are 0.75Y and 9.75Y, respectively. Flattening can occur in many ways, as shown below.

Scenario	Short Rate	Long Rate	Diff.
1. Both rates rise but short rate rises more	6.00 → 6.75	6.75 → 7.00	0.25
2. Both rates fall but short rate falls less	6.00 → 5.75	6.75 → 6.00	0.25
3. Short rate rises and long rate remains the same	6.00 → 6.50	6.75 → 6.75	0.25
4. Short rate remains the same and long rate falls	6.00 → 6.00	6.75 → 6.25	0.25
5. Short rate rises and long rate falls	6.00 → 6.25	6.75 → 6.50	0.25

In all the scenarios above, the spread between the long-term rate and short-term rate fell from 0.75% to 0.25%, which qualifies to be flattening. The following table shows the profit/loss in various scenarios.

Scenario	Yield		Price[a]		P/L[b]		Net P/L[c]
	Bond A	Bond B	Bond A	Bond B	Bond A	Bond B	
1	6.75%	7.00%	95.22	51.70	–484	–34	66
2	5.75%	6.00%	95.89	56.66	–852	462	194
3	6.50%	6.75%	95.39	52.89	–577	85	92
4	6.00%	6.25%	95.72	55.37	–759	333	158
5	6.25%	6.50%	95.55	54.12	–665	208	127

[a]Computed as: $100 / (1+\text{Yield})^{0.75}$ for Bond A; $100 / (1+\text{Yield})^{9.75}$ for Bond B

[b]Computed as: (difference in old price and new price) × quantity

[c]To the P/L from both bonds is added the interest of Rs. 584 earned in reverse repo on an amount of 46,683 at 5% for 0.25Y.

We can see that whatever is the direction of change in interest rate, the strategy results in profit as long as it is flattening. Notice that there is a loss in short-term bond in all scenarios. This is because of the "pull-to-par" effect of bond price as the maturity approaches, regardless of yield changes. The passage of time works in two conflicting ways. First, larger the passage, the higher the loss on short-term bond but greater the interest earned in reverse repo. Overall, if the flattening occurs immediately after the trade, there would be higher profit; and the longer the time elapses, the profit turns into loss. One way to prevent the loss from short-term bond because of passage of time is to rebalance the portfolio to maintain PVBP-neutrality.

Example 5: Steepening

Steepening is the opposite of flattening: long-term rate rising relative to short-term rate (or the difference of long-term rate and short-term rate rises). To implement this strategy, we buy the short-term bond and sell the long-term bond with PVBP-neutrality, as in flattening. As long as the spread between long-term and short-term rates rises, there would be profit. All other conditions and limitations explained in flattening would apply to steepening, too.

Using Bond Futures

Trading the flattening and steepening involves short-selling a bond, which is difficult in cash market but easy in the futures market. Therefore, yield spread strategies are easier to implement in futures market than in cash market.

For flattening outlook, we sell the futures on short-maturity underlying (say, 2Y) and buy the futures on long-maturity underlying (say, 10Y). This is called *selling the spread*. For steepening, we buy the futures on short-maturity underlying and sell the futures on long-maturity underlying, which is called *buying the spread*. The term "buying" and "selling" with respect to spread is derived from the market side of the futures on short-maturity underlying. Thus, if you expect steepening, we "buy" the spread; and if you expect flattening, we "sell" the spread. Both futures contracts have the same expiry but must be for different number of contracts to achieve PVBP-neutrality. If the PVBP of futures contract on long-maturity underlying is $PVBP_L$ and that on short-maturity underlying is $PVBP_S$, then the number of futures contract on short-maturity underlying for every futures contract on long-maturity underlying should be:

$$PVBP_L / PVBP_S$$

Another additional factor to consider with futures is the possibility of change in the cheapest-to-deliver (CTD) bond (see Section 4.9) because of changes in the yields. The futures contract derives its PVBP from the CTD bond it tracks and the conversion factor (see Section 4.7) that applies to the CTD bond. Any change in CTD bond will naturally change the PVBP, which needs rebalancing. The rebalancing is also required for the passage of time, which affects the PVBP. In general, we should construct the following six scenarios at different points of time after the spread is bought or sold to assess the relative outcomes and their payoffs.

	Rates Up	Rates Down
Parallel	1	4
Steepening	2	5
Flattening	3	6

The yield spread trades in futures supposes that there are at least two different futures contracts, one on short-maturity underlying and the other on long-maturity underlying. If there is only one bond futures with an underling of single maturity, then yield spread trades are not possible in the futures market.

5.3.4. Volatility Trades: Barbell, Ladder and Butterfly

Volatility is the opposite of stability: we expect the rates to move by a large extent in either direction. If we expect higher volatility in future, we buy a bond of higher convexity (CX). If we expect stable rates in future, we buy bond with lower convexity CX). Let us illustrate with three zero-coupon bonds with the following price, YTM, modified duration (MD), PVBP (per 100 market value) and convexity (CX).

	Bond A	Bond B	Bond C
Maturity	2Y	5Y	10Y
Yield	6.00%	6.30%	6.50%
Price	89.00	73.68	53.27
MD	1.89	4.70	9.39
PVBP	0.016792	0.034655	0.050021
CX	5.34	26.55	96.98

Example 6: Bullet versus Barbell

If the investment horizon is 5Y, the straight play is to buy the 5Y bond at a price of 73.68 and MD of 4.70. This is

called *bullet* strategy because the principal redemption is at a single ("bullet") maturity of 5Y. An alternative to bullet strategy is the *barbell* portfolio, which consists of buying shorter and longer maturities (in this case, 2Y and 10Y) in such proportion that the portfolio is PVBP-neutral. Letting w be the proportional quantity Bond A, it is solved as

$$0.016792w + 0.050021(1-w) = 0.034655$$

or

$$w = 0.4624$$

Thus, if the quantity of Bond B is 100 units, then the quantity of Bond A should be 46.24 units and that of Bond C should be 53.76 units. The following shows the bullet and barbell portfolio's market value.

	Bond A	**Bond B**	**Bond C**
Quantity	46.24	100	53.76
Price	89.00	73.68	53.27
Market Value	4,115	7,368	2,864

Note that the cash outlay for bullet and barbell will not be the same. The total investment in barbell is 6,979 (of which 59% is in Bond A and 41% in Bond C) while that in bullet is Rs 7,368. Let us consider the value of three bonds after lapse of 0.5Y (so that the remaining maturity will be 0Y, 4Y and 9Y for Bonds A, B and C, respectively) for different level of yield changes.

		Bullet	**Barbell**		
Scenario		**Bond B**	**Bond A**	**Bond C**	**Total**
parallel shift – 200bp up	P/L	-99	166	-184	-18
	Return	-1.34%	4.04%	-6.43%	-0.26%
parallel shift –	P/L	1082	331	754	1085

200bp down	Return	14.69%	8.04%	26.31%	15.54%
parallel shift – 20bp up	P/L	406	239	135	374
	Return	5.50%	5.80%	4.72%	5.36%
parallel shift – 20bp down	P/L	523	255	238	493
	Return	7.10%	6.20%	8.32%	7.07%

We can see from the table above that barbell outperforms the bullet whenever changes in yield are large on either side; and underperforms the bullet whenever changes in yield are small. When the changes in yield are large, there may be loss in both bullet and barbell, but the loss in the barbell can be avoided by periodic re-balancing for PVBP-neutrality. We must note that, in the above example, we are considering the payoff after a lapse of one year without any re-balancing, which would have removed the effect of the direction of change. In any case, we can always say that, when yield changes are large on either side, the barbell outperforms the bullet: it will always have larger profit and small losses than with the bullet portfolio.

A strategy similar to barbell is the *ladder* portfolio, which consists of buying bonds in more than two maturities. For example, instead of buying 2Y and 10Y bond, we may choose to buy 2Y, 5Y, 8Y and 10Y bonds. The initial amount invested in each will be such that it is Duration-neutral overall. The ladder portfolio's risk/return profile will be intermediary between that of bullet and barbell portfolios.

Butterfly is a more complex strategy because it consists of both long and short positions at three different maturities. For example, buy 2Y bond and 10Y bond and simultaneously sell 5Y bond. You may notice that the first

two constitutes the barbell and the third is a bullet. Thus, the butterfly strategy is a combination of barbell and bullet on the opposite market sides (i.e. buy one and sell the other). The outer barbell is called the "wings" and the inner bullet is called the "body" of the butterfly. The proportion invested in each bond is so chosen that the butterfly is overall cash-neutral and PVBP-neutral.

Example 7: Butterfly

We will use the same three bonds (A, B and C) as in Example 6 to illustrate the butterfly strategy. We short-sell Bond B for 100 units at the price of 73.68 and buy Bonds A and C in such quantity that the overall portfolio is cash-neutral and PVBP-neutral. The two conditions allow us to solve for the quantity for Bonds A and C. Assuming that the quantity of Bond B is 100 units and letting the quantity of Bond A be Q_A and that for Bond C be Q_C.

Cash-neutrality condition: $Q_A \times 89.00 + Q_C \times 53.27 = 100 \times 73.68$

PVBP-neutrality condition: $Q_A \times 0.016792 + Q_C \times 0.050021 = 100 \times 0.034655$

They are two equations with two unknowns, which can be solved through linear algebra as follows.

$$\begin{pmatrix} Q_A \\ Q_C \end{pmatrix} = \begin{pmatrix} 89.00 & 53.27 \\ 0.016792 & 0.050021 \end{pmatrix}^{-1} \times \begin{pmatrix} 7368 \\ 3.4655 \end{pmatrix}$$

The solution is 51.71 units for Q_A and 51.92 units for Q_C. We can check the portfolio is both cash-neutral and PVBP-neutral, as follows.

Cash: $(51.71 \times 89.00 + 51.92 \times 53.27) - 100 \times 73.68 = 0$

PVBP: $(51.71 \times 0.016792 + 51.92 \times 0.050021) - 100 \times 0.034655 = 0$

Butterfly strategies are held for a smaller holding periods. We will consider the payoff after 0.1Y (i.e. 36.5 days or slightly more than a month) in the following scenarios of yield curve changes.

Scenario	Bond A (1.9Y)	Bond B (4.9Y)	Bond C (9.9Y)
1. No change	6.00%	6.30%	6.50%
2. Parallel shift of 25bp up	6.25%	6.55%	6.75%
3. Parallel shift of 25bp down	5.75%	6.05%	6.25%
4. Steepening: −25/0/+25	5.75%	6.30%	6.75%
5. Flattening: +25/0/−25	6.25%	6.30%	6.25%

The following shows the bond price and P/L for each of the scenarios.

Scenario	Bond A	Bond B	Bond C	Total
1	27	-45	18	0
2	6	40	-46	0
3	48	-131	83	0
4	48	-45	-46	-43
5	6	-45	83	44

The particular composition of the butterfly (i.e. selling the body and buying the wings) benefits from flattening of yield curve and is an alternative to the strategy in Example 4. If

the outlook is steepening, we can use the same butter fly with switch in the market sides of the bonds (i.e. buy the body and sell the wings).

Using Bond Futures

As explained in the section on non-parallel shifts, futures market is better than cash market whenever there is a short-sale. To execute the butterfly, we need futures contracts on three different underlying bonds that have short, middle and long maturity. All the three futures contracts will have same expiry and their quantity is so chosen that the butterfly is cash-neutral and PVBP-neutral.

For flattening outlook: buy futures on short-maturity underlying, buy futures on long-maturity underlying and sell futures on middle-maturity underlying.

For steepening outlook: sell futures on short-maturity underlying, sell futures on long-maturity underlying and buy futures on middle-maturity underlying.

5.3.5. Basis Trading

Basis is the difference between cash price of the cheapest-to-deliver (CTD) bond and the futures price (see Section 4.10 in Unit 4). Let us recall from Section 4.10 the relation between various items.

Gross Basis = Cash Price – (Futures Price × Conversion Factor)

Net Basis = Gross Basis – Carry Basis

Carry Basis = Carry Income – Carry Cost

Trading the basis consists of simultaneously buying in cash market and selling in the futures market. The following are the two strategies.

Buying / Long the Basis: buy cash and sell futures
Selling / Short the Basis: sell cash and buy futures

The quantity of futures contracts bought or sold is linked to the conversion factor for the bond as follows.

Number of futures contracts = Face Value of bond × CF for bond / Contract Amount

You buy the basis when you expect that the fall in basis is less than the carry basis. Similarly, you sell the basis when basis is expected to narrow more than the negative carry. In long basis trade, we buy in cash at P1 and sell in futures at F1. We close out the trade by selling in cash at P2 and buying the futures at F2. The combined payoff is called change in Gross Basis, which is

$(P2 – P1) + (F1 – F2)$.

During the period the position is held, there is a carry income (CI), which is the coupon accrual in the bond; and carry cost (CC), which is the repo cost of funding the bond purchase in cash market. The difference between them is called Carry Basis

$\text{Carry Basis} = CI – CC$

The total payoff is thus $(P2 – P1) + (F1 – F2) + (CI – CC)$. Long basis will earn profit even when the basis falls as long as carry basis is more than the fall in basis.

When we sell the basis, the CI is the reverse repo interest and CC is the coupon. Short basis makes money despite negative carry as long as decrease in basis is more than the negative carry. In these trades, we have not considered CF because we closeout the position before expiry and without settlement.

In general basis is a complex trade for experienced traders. If there are strategic options in bond futures (e.g. quality option, timing option, etc), basis is strongly affected by them.

Another trade related to basis trading is the calendar spread, which consists of buying futures of one expiry and selling futures of different expiry, both contracts being on the same underlying bond. For example, we may buy March-2010 bond futures and sell June-2010 bond futures, both on the same underlying of 7% 10Y notional bond. Such a strategy is not a bet on the direction of future interest rate of a particular term. Nor is it a bet on the changes in the spread between two interest rates of different term. It is a bet on the changes in the Carry Basis. If there is no switch in the CTD bond, the carry income will remain the same but the carry cost will change as the repo rate changes over time. If the repo rate rises, the futures price will rise; and vice versa.

If we expect the repo rate will rise in the near future, we should sell the near month futures and buy the far month futures. As the repo rate rise, the future price will rise for both expiry months but it will rise more for far month expiry. We liquidate both contracts and book a small loss

on near month contract and higher profit on far month contract with an overall net profit. Similarly, if we expect the repo rate to fall in the near future, we should buy the near month expiry and sell the far month expiry, and liquidate them both when repo rate falls as expected.

5.4. Hedging

Hedging is the elimination of existing risk. Though there are non-derivative products that can act as hedge, derivatives are the most important hedging tools and the easiest to execute.

It is important to note that risk is defined as the uncertainty about the future cash flows. If the futures cash flows are fixed and known (in terms of their size and timing) at the outset, there is no risk. If you have taken a fixed-rate loan, there is no risk because you know in advance how much you will have to pay in future. On the other hand, if you have taken a floating-rate loan, there is risk because you do not know in advance how much you will have to pay in future for the interest. Thus, converting a floating-rate loan into a fixed-rate loan is hedging; and converting fixed-rate loan into floating-rate loan (in the expectation that the rate in future will be lower) is speculation.

To understand the application of hedging with bond futures, we must recall the concept of Modified Duration and other risk measures explained in Section 3.4 in Unit 3. Let us recall the following definitions.

Modified Duration (MD)*:* it is a dimensionless number that tells us the percentage change in bond's price caused by a given change in the yield. For example, if MD is 5.5 for a bond, then it implies that if the yield changes by *Z%*, the percentage change in bond price is

$$5.5 \times Z\%.$$

Rupee Duration (RD): it is the absolute change in the total market value of bond for a given change in the yield. For example, if MD is 5.5 for a bond, change in the yield is *Z%*, market price is *P* and the face value quantity is *Q*, then RD is:

$$Q \times (P / 100) \times 5.5 \times Z\%$$

Price Value of a Basis Point (PVBP): it is the same as RD except that the change in yield is considered at one basis point (or 0.01%).

$$Q \times (P / 100) \times 5.5 \times 0.01\%$$

To hedge a bond or bond portfolio in future market, we must match the PVBP of both bond position and the futures position in an offsetting manner: gain on one will be offset by the loss on the other. Bond futures derives its Modified Duration or Price Value of Basis Point (PVBP) from the underlying CTD bond it tracks and the link between the PVBP of bonds futures and that of CTD bond is the Conversion Factor (CF). Let us recap the relation between equivalent prices in cash and futures market.

Adjusted futures price (or equivalent cash price) =
Futures Price $\times$ CF

or

Adjusted cash price (or equivalent futures) price = Cash Price / CF

Accordingly, the PVBP (or other sensitivity measures) of futures contract is

Futures PVBP (per contract) = Cash PVBP of CTD bond per futures Contract Amount / CF

Buying futures will add to the portfolio MD and selling it will reduce it. The number of futures contracts to be bought or sold for adjustment of portfolio MD will be computed as follows. Let

$PVBP_C$ = Current price value of basis point (PVBP) of the cash portfolio

$PVBP_F$ = price value of basis point (PVBP) per futures contract

MD_C = Current portfolio MD

MD_T = Target portfolio MD

To match the sensitivity of the portfolio, the number of futures contract on the opposite market side must therefore be

$$PVBP_C / PVBP_F$$

Since the portfolio sensitivity is to be changed from MD_C to MD_T, their ratio would be the scaling factor and the number of futures contract required would be

$$(PVBP_C / PVBP_F) \times (MD_T / MD_C - 1)$$

If the sign is positive, we need to buy the required number of futures contracts; and if it is negative, we need to sell

them. In adjusting the portfolio MD, if we expect parallel shift (i.e. change in the rate level without change in the slope) in the term structure, we may use a single futures contract on the underlying of any maturity. For example, we can use futures on 2Y-maturity underlying, 10Y-maturity underlying, etc. However, if we expect steepening or flattening (i.e. change in the slope or shape) in term structure, we should use multiple futures on underlying bonds with different maturity, corresponding to the key points in the curve. For example, if the key maturity points are 2Y, 5Y and 10Y, then we must use three different futures contracts whose underlying has maturity of 2Y, 5Y and 10Y. For each of the 'maturity bucket', the number of futures contracts to be bought or sold is given by the formula above. The strategy of multiple-maturity futures overlay corresponds to the gap analysis for duration-balancing in the cash market.

Bond futures are indispensable for risk management of fixed-income portfolios. Senior management would periodically desire the portfolio Modified Duration (MD) be increased or decreased, based on their perception risk. Portfolio MD can be adjusted without interest rate derivatives by simply reshuffling the proportion of long-dated and short-dated bonds. However, such reshuffling might create conflict between risk management and portfolio allocation. Portfolio managers identify and decide the composition of the portfolio after cheap/richness analysis of bonds and carefully selecting those that are undervalued. If risk management requires that the weights for some should be reduced while that for others increased, it will create a conflict between risk

management and portfolio allocation. Interest rate derivatives will help avoid such conflicts: they allow the portfolio manager to retain the portfolio composition and yet alter its duration by buying and selling bond futures.

5.4.1. Hedging Bond Portfolio

We have a bond portfolio whose current market value is Rs 5.74 Cr and its Modified Duration is 6.28. How will you hedge this portfolio against interest rate risk?

Step #1: Determine the PVBP of cash position ($PVBP_C$)

$PVBP_C = 5,74,00,000 \times 6.28 \times 0.01\% = 36,047.20$

Thus, if the yield changes by one basis point, the market value will change by Rs 36,047.20.

Step #2: Determine the PVBP of one futures contract ($PVBP_F$)

The futures price is currently 95.2375 and the CTD bond that is currently tracked by futures contract has a MD of 7.62 and current market price of 104.6523. The Conversion Factor for this CTD bond is 1.0949. Since the contract amount is Rs 200,000 for futures, the futures PVBP per contract is

$PVBP_F = 200,000 \times (104.6523/100) \times 7.62 \times 0.01\% / 1.0949 = 145.67$

Step #3: Determine the number of futures contracts required for hedge

Number of futures contracts = 36,047.20 / 145.67 = 247.46

Rounding of the nearest integer, the number of futures contracts to be sold in order to hedge the long position in the bonds is 247.

5.4.2. Duration Adjustment with Bond Futures

We will use the same example as in the previous section. The aim now is to reduce the risk of bond portfolio from MD of 6.28 to MD of 3.5. How many futures contracts should we sell to reduce the MD of bond to 3.5.

We have already computed the $PVBP_C$ and $PVBP_F$ to be 36,047.20 and 145.67, respectively. Given that the current MD is 6.28 and the desired MD is 3.5, the scaling factor for this adjustment is 3.5/6.28. Therefore, the number of futures contracts required for this adjustment is

$$(36{,}047.20 / 145.67) \times (3.5 / 6.28 - 1) = -109.54 \approx -110.$$

Thus, if we sell 110 futures contracts at the current price of 95.2375 (see the previous section), then the PVBP of the portfolio will be such that it corresponds to the target MD of 3.5. Note that this would work only when there is a parallel shift in the yield curve.

5.5. Risks associated with futures: Basis, Correlation and Liquidity

When using futures for hedging, the hedger would expect complete elimination of price (or market) risk. In practice, the hedging in futures can never eliminate the price risk *completely*. There is always a residual risk called *basis risk*, which is much less in size than price risk.

Basis risk arises because of standardization of the futures contract (for Contract Amount and Delivery Date), which makes perfect hedge impossible. Let us illustrate the basis risk with the following example. As explained in Section 5.4.1, the number of futures contracts to be sold for completely hedging the bond portfolio will be 247.46 contracts. However, since we can only sell integral multiples, we will sell 247 (or 248) contracts, which results in under-hedging (or over-hedging) of the bond portfolio. Thus, the standardization of contract amount is the one source of basis risk. The next source of basis risk is the standardization of delivery date for futures, which is the last business day of the delivery month. If, for example, we need hedge until February 15, 2010, we need to sell the futures for the same date for delivery. However, the nearest futures contract to this required date is March 31, 2010.

Accordingly, we will be doing the following actions in cash and futures market on February 15, 2010.

Cash market: sell bond portfolio
Futures market: buy the March-2010 futures sold earlier and close-out the position

The price in cash market and futures will not be the same because the futures contract has more time to expiry date, and carry cost and carry income will be factored in it. In theory, the difference in futures and cash price should not matter if the Gross Basis (see the equation 8 in Section 4.10) does not change during the life of the futures contract. However, Gross Basis does change over time (because of repo/reverse rates), and its change between

the contract initiation date and liquidation date will affect the quality of hedge, though on a minor scale. For futures on bonds, there is a third source of basis risk, which is the possible switch in the CTD bond that the futures contract tracks. Changes in the yield can switch the CTD bond and the new CTD bond will have different PVBP/MD, which can significantly affect the hedge effectiveness. Since this basis risk from this source is significant, we need to calculate the new hedge ratio and adjust the size of futures position to re-establish the proper hedge relation. Of course, the basis risk due to switch in CTD bond does not arise with futures on other underlying assets (e.g. equities, currencies) but is peculiar to bond futures. Overall, we can say that the hedging through futures will transform the price risk into basis risk.

Besides the basis risk (which is not very significant expect for the switch in CTD bond), two other risks associated with futures for hedging are correlation and liquidity. Correlation risk arises only when the underlying in futures and cash market is different. For example, we may bond futures on sovereign bond to hedge the interest rate risk on corporate bond. In other words, we are using sovereign bond as a proxy for corporate bond to hedge interest rate risk, and this is called *cross hedge*. In such cases, if the yields on corporate and sovereign bonds do not move in tandem, the hedge effectiveness will be lost. Such a situation may arise in crisis periods. For example, when there is flight to quality, investors would be shifting their investments from corporate bonds to sovereign bonds, resulting in rising yields on the former and falling yields on the latter. In such cases, the hedge breaks down totally,

because we are losing on long position in the corporate bonds *and* losing on the short position on sovereign bonds. Even if the rates on bond class of bonds move in the same direction but to different extent, the risk arises though on a smaller scale. This is *correlation risk* in cross hedges.

Liquidity risk is not specific to futures and applies to any market. We may distinguish two forms of liquidity risk: *market liquidity risk* and *funding liquidity risk*.

Market liquidity risk is related to buying or selling the required quantity in futures market without causing price pressure. It is often measured *liquidity impact cost*: how much different the actual price would be from the current market price to execute a given quantity. In general, the futures market is more liquid than cash market. However, for newly introduced contracts, the market liquidity of futures will be much less than that for cash market. In such cases, it will magnify the basis risk in futures to a significant extent. This is what happened to interest rate futures when they were first introduced in 2003 (and subsequently withdrawn).

Funding liquidity risk in futures arises because of mark-to-market process. Any loss on futures must be settled daily because of mark-to-market. For hedgers, the loss in futures is offset by the profit on the hedged exposure. However, there is a problem: the losses in futures are immediate and in cash while the profit on the hedger exposure is in future and not crystallized in cash. The mismatch in cash flow results in funding problem. This is problem faced by the German company, Metallgesellschaft, in hedging its exposure to oil prices (see Section 2.3).

It must be noted that the risks associated with futures (i.e. basis risk, correlation risk and liquidity risk) will affect both hedging and speculation.

Key Concepts

Features of investment and speculation: leverage, horizon length, return volatility and path dependence

Investment as passive management; speculation as active management

Risks in fixed income securities: credit risk, price risk and reinvestment risk

Passive management: buy-and-hold until maturity; immunization for maturity mismatch

Active management: outlook on yield curve shifts and volatility

Active management strategies: riding the yield curve, maturity mismatch, yield spreads, barbell, ladder, butterfly, and basis trading

Hedging: portfolio duration adjustment with futures and calculation of hedge ratios

Risks in futures for hedging: basis risk, correlation risk in cross hedged and liquidity risk

Exercise

1. Which of the following is a feature of what is usually called “investment”?
    a. Leverage
    b. Higher return volatility
    c. Path dependence
    d. None of the above
    (See Sections 5.1 and 5.3)
2. Which of the following is a feature of what is usually called “investment”?
    a. Leverage
    b. Higher return volatility
    c. Speculation
    d. All of the above
    (See Sections 5.1 and 5.3)
3. Which of the following risks are relevant in bond market?
    a. Credit risk
    b. Price risk
    c. Reinvestment risk
    d. None of the above
    (See Sections 5.1)
4. Which of the following is an “active management” strategy?
    a. Buy-and-hold until maturity
    b. Hedging risk
    c. Riding the yield curve
    d. None of the above
    (See Sections 5.3)

5. Bond futures can be used for
    a. To increase the portfolio MD
    b. To lower the portfolio MD
    c. Both (a) and (b) above
    d. None of the above

    (See Sections 5.4)

CONTENTS

Unit 6: Operational Mechanism

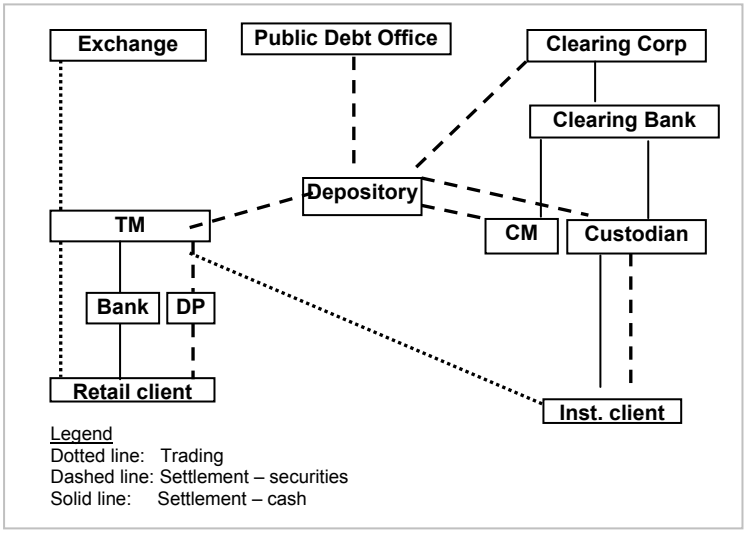
6.1. Players and their Role

Every trade requires a minimum of two parties: buyer and seller. To bring efficiency and effectiveness, there are other entities that assist the buyer-seller pair, all of which collectively constitute the "market." The various players associated with Trade and Settlement parts of the transaction (see Section 1.2) are as follows.

Trade: negotiation and conclusion of trade and the parties involved are clients, Trading Members and the Exchange.

Settlement: exchange for cash for security and the parties involved are Clearing Members (CM), custodian, banks, depository, depository participants (DP), public debt office and the Clearing Corporation.

The following exhibit summarizes various parties and flows between them, and the role of each party is described below.



Clients

They are the buyer-seller pair for the trade. They are further classified as follows.

Retail: individuals and firms that are relatively unsophisticated with smaller business volumes

Institutional: specialized and organized entities registered with the market regulator (which in India is Securities and Exchange Board of India) and possessing specialized investment skills and conducting relatively large business volumes.

Exchange (EX)

It is the entity that conducts and controls the “Trade” part of the transaction (see Section 1.2): that is, bringing the buyer and seller together and providing mechanism for efficient and effective price discovery, price transparency, and liquidity. Traditionally, business is conducted at a physical place (called “trading pits”) by “open outcry” method in which the orders are vocally announced. Today, the open outcry method is replaced with electronic communication network called Trading Platform or “screen-based trading”.

Clearing Corporation (CC)
It is the entity that conducts the “Settlement” part of the transaction (see Section 1.2: that is, exchange of cash for security: buyer pays cash and seller delivers security. After the Trade part of the transaction is completed, the control of trade processing moves from the Exchange to the Clearing Corporation.

Trading Member (TM)
It is the interface between clients and the Exchange because the latter does not deal with the former directly but through Trading Member. In other words, Trading Members are the entities that bring orders from buyers and sellers and execute them in the Trading Platform of the Exchange. They are popularly called “brokers”. Trading member can either deal for himself (called “proprietary trades”) and for clients (called “client trades”).

Clearing Member (CM)
It is the entity that does two functions: *clearing* and *settlement* (which are discussed in Unit 7). It clears and

settles the trades on behalf of the Trading Member. There are the following types of clearing members.

- **Trading Member – Clearing Member (TM-CM):** the same entity acts as Trading Member and Clearing Member. They clear & settle their own proprietary trades, their clients' trades and trades of other Trading Members.
- **Professional Clearing Member (PCM):** the entity that acts as Clearing Member but not as Trading Member. Such entities are typically banks, and clear & settle trades on behalf of Trading Members.
- **Self-clearing Members (SCM):** it is similar to TM-CM but can clear & settle only proprietary trades and its clients' trades but not the trades of other Trading Members.

Custodian

It is a subset of Professional Clearing Member that clear & settle trades of institutional investors, who have executed the trades through a Trading Member. In other words, Trading Member will be involved only with order execution on the Exchange, but the settlement will be successively between Custodian and the institutional client; and then between the Custodian and Clearing Corporation. In the case of retail clients, the settlement will be successively between Trading Member and retail client; Trading Member and Clearing Member; and then between Clearing Member and Clearing Corporation.

Custodian must confirm the trade with the Clearing Corporation on behalf of the institutional client immediately after trade execution. This is called "Give Up"

and the obligation to settle the trade is transferred from Trading Member to the Custodian. If the custodian does not confirm the trade, the obligation to settle the trade will revert to the Trading Member.

Depository

It is the entity that maintains the securities in electronic book entries. The depository system for government securities is different from that for equities and non-government debt instruments in two respects.

First, for government securities, the electronic book entries for securities are exclusively maintained by the Public Debt Office (PDO) of the Reserve Bank of India (RBI), and not by the two depository institutions in India, namely, National Securities Depository Ltd (NSDL) and Central Depository Services (India) Ltd (CDSL). The security account maintained with PDO is called Subsidiary General Ledger (SGL) Account, which is the equivalent of demat account with NSDL and CSDL for equity and non-government debt instruments. PDO maintains SGL Accounts only for Schedule Commercial Banks (SCB), Primary Dealers (PD) and few select financial institutions that maintain current account (for cash) with RBI. All other entities must have their securities account with a SCB or PD, who are allowed to maintain a second account with PDO exclusively for their constituents, and this second account is called Constituent SGL (CSGL) Account or SGL II A/c. The account maintained by these constituents with SCB/PDs is called Gilt Account. Thus, all proprietary deals of SCB/PD must be through SGL Account and those of their constituents, through CSGL A/c. To enable retail investors to invest in government securities,

PDO of RBI has allowed NSDL and CDSL to maintain CSGL Account with it so that NSDL and CDSL can include the government securities of retail investors in their demat accounts. Of course, the retail investors do not deal with NSDL/CDSL directly but through another category of intermediaries called Depository Participants (DP).

Second, PDO would require that both cash and securities accounts must be maintained with the same entity. That is, SCB/PDs must have current account for cash and SGL account for securities with RBI. This is required to ensure that both securities and cash are settled simultaneously, which is called delivery-versus-payment (DvP) method of settlement, which is fool-proof and not subjected to settlement risk (see Section 1.1 in Unit 1). Similar restriction would apply to Gilt Accounts maintained with SCBs: both Gilt Account (for government securities) and current account (for cash) must be maintained with the same SCB. For Gilts Accounts with PDs, NSDL or CDSL, such restriction does not apply because they maintain only securities accounts and not cash accounts. In such cases, the PD/NSDL/CDSL must record the particulars of bank accounts of the client.

Government securities are held in both electronic book entry form (as described above) and in physical certificates. However, all entities regulated by RBI must hold their securities compulsorily in electronic book entry form in SGL Account (with RBI) or Gilt Account (with SCB or PD). When held in physical form, the ownership cannot be transferred by endorsement and delivery alone but every transfer must be additionally registered in the books of PDO.

Clearing Corporation will settle government securities either directly in its SGL Account maintained with PDO or with demat accounts system of NSDL and CDSL.

Banks

Banks are required for moving cash between various parties in settlement. While the movement of cash between retail clients and Trading Members is mostly through physical instruments such as checks, the movement between others is through electronic fund transfer. For the movement of cash between Clearing Corporation and Clearing Members, the following are the special features.

- Cash movement must be only through designated banks called Clearing Banks, who provide specialized services required to deal with the Clearing Corporation.
- Clearing Member must maintain a special account called Primary Clearing Account with a Clearing Bank, which shall be used exclusively for payments to and receipts from Clearing Corporation, and not for any other purposes. Clearing Member may maintain another separate account with the Clearing Bank for enhancement of collateral
- Clearing Member must authorize the Clearing Bank to allow Clearing Corporation to directly debit or credit its Primary Clearing Account and seek information on balances
- Clearing Member can deposit funds into the Primary Clearing Account in any form but can withdraw funds only in its name. In other words, it

cannot pay to anyone other than Clearing Corporation or itself.

- Clearing Member cannot close or de-activate the Primary Clearing Account without the prior consent of the Clearing Corporation

6.2. Operational Guidelines

Bond futures are traded in the Currency Derivatives segment of the Exchange. Accordingly, a Trading Member with access to currency derivatives is allowed to trade in bond futures.

The contract specifications (contract amount, expiry months, last trading date, settlement date, settlement method, price quotation & tick size, and trading hours) are fully explained in Unit 4. We will cover only the operational procedures in this module.

6.2.1. Order Entry: Minimum Inputs

Any order entry in the trading platform must contain the following minimum inputs:

- Contract ID: it consists of the following three pieces of information
    - The derivatives type (i.e. futures or option) and asset class (i.e. bond futures, which is called Interest Rate Derivative or IRD in India)
    - Underlying, which is the notional or imaginary bond issued by the Government of India with a maturity of 10Y and coupon of 7% (see Section 4.1 in Unit 4)

- Expiry Date of the contract: specify from the pre-defined list

  For example, on the National Stock Exchange of India, the Contract ID could be:
  "FUTIRD 10YGS7 29MAR2010"
- Client ID: specify the Client ID on whose behalf the order is introduced
- Quantity: specify the number of market lots, which is an integer (1, 2, etc)
- Market side: specify whether to buy or sell

6.2.2. Trade Work Station

The terminal of the trading platform operated by the Exchange and installed in the office of the Trading Member will differ from Exchange to Exchange. You should consult the User Manual provided by the Exchange for understanding the features of trade entry, trade modification, order types, and other trade information. What follows in the subsequent sections is the generic description.

6.2.3. Order Types

There are different order types that enable the trader to control the price, time and circumstances in which order should be executed. The order types allowed in India for bond futures are as follows.

To control price: Market Order, Limit Order

To control timing of execution: Immediate or Cancel Order, Good Till Day Order

To control circumstances: Stop-loss Order

Market Order

It is an order to buy or sell at the *prevailing market* price. It must be specified as a combination of two inputs: market side + quantity. For example, "**buy** [market side] **2 contracts** [quantity]"

The advantage of market order is liquidity: it will be executed immediately. The disadvantage is price: you have no control over the price at which it is executed.

Limit Order

It is an order to buy or sell only at the *specified* price or better. It must be specified as a combination of three inputs: market side + quantity + price limit. For example, "**buy** [market side] **2 contracts** [quantity] at **101.10** [limit]". For buy orders, the limit must be less than the current market price and the order must be executed at the limit specified or lower. For sell orders, the limit must be higher than the current market price and the order must be executed at the limit specified or higher. For example, if the current market price is 101.50, then

> For buy order: the limit must be lower than 101.50 (say, 101.40) and the order must be executed at or lower than the limit (in this case, at or lower than 101.40)
>
> For sell order: the limit must be higher than 101.50 (say, 101.60) and the order must be executed at or higher than the limit (in this case, at or higher than 101.60)

The advantage of limit order is that you can control the price at which it is executed. The disadvantage is the lack of liquidity: the order may not be executed at all, if the limit specified is not tested.

Immediate or Cancel (IOC)
It is an order to execute the order immediately on introduction and, if it cannot be executed, it should be cancelled. IOC order can be executed for partial quantity. For example, if the order is "Sell 10 contracts at 101.50 IOC" and there are buyers at this price but only for 6 contracts, then the order will be executed at 101.50 for 6 contracts, and the balance of 4 contracts will be automatically treated as cancelled.
Good Till Day
It is a limit order that is kept in the market until the close of trading hours, at which any unexecuted portion will be automatically cancelled.

Stop-Loss Order
It is an order to exit from (or "square up") an existing trade if the market moves against the trade at a pre-defined loss. Stop-loss order is essential for speculators to control their losses if the market turns unfavourable. The stop-loss order specifies a price at which the order will be executed, and the limit has to be lower than the current market price for buy trades; and higher than the current market price for sell trades. Without specifying "stop", the limit specified may create confusion.

For example, consider the buy trade already executed at the current market price of 101.50. To ensure that you

should not lose more than 0.10 on the trade, you will place a stop at, say, 101.40 by placing the order as: "**Sell 2 contracts at 101.40 Buyer's Stop**". If you do not specify the stop (say, "Sell 2 contracts at 101.40"), it will be construed at a regular Limit Order, which will be executed immediately because the current market price (i.e. 101.50) is better than the limit (i.e. 101.40) for the sell order.

Take-Profit Order
It is the counterpart of stop-loss order to exit from an existing trade at a pre-defined level, which will be higher than the current market price for long/buy positions and lower than it for short/sell positions. For the example, if the current market price is 110 and you already have a long position at 105, then you place a take-profit order at higher than 110.

Once Cancels the Other (OCO)
It is an order to exit from existing trade either at profit or loss, both at pre-defined levels. In other words, it combines the stop-loss and take-profit orders into a single order. Whichever level is traded first, it will be executed and such execution will automatically cancel the other.

For example, you have a long/buy position at 100. You want to book profit at 110 and loss at 90. You place an order: "Sell 110, Sell 95 OCO". If 110 is traded first in the market, the "Sell 110" order is executed and the "Sell 95" order is automatically cancelled, and the trade is exited with a profit of 10. On the other hand, if 95 is traded first, the "Sell 95" order is executed and the "Sell 110" is automatically cancelled, and the trade is exited with a loss

of 5. The OCO orders are popular with intra-day traders or "scalpers" (speculators with a holding period of few hours). Not all Exchanges have the facility of OCO order in their trading platform software.

6.2.4. Controls by the Exchange

In order to control the efficient and effective execution of the Trade part of transaction, the Exchange imposes the following controls.

Base Price and the Pricing Range

Base price is the price that us used to compute the price range for the opening trade on any trading day. The base price is calculated by Exchange differently for the first day of contract's life (i.e. when it is introduced newly) and for subsequent days in its life, as follows.

For the first day of contract's life: theoretical futures price computed according to the model specified by the Exchange.

For subsequent days during contract's life: the daily settlement price of the previous trading day.

The price range is plus or minus a specified percentage (which is revised periodically by the Exchange) of the base price, rounded to the nearest tick size (which is currently 0.0025). For example, if the base price for the trading day is 101.50 and the price range is 2% of the base price, then the opening price range (after rounding to the nearest 0.0025) will be:

Lower bound: 101.2525 / 1.02 = 99.2672= 99.2675

Upper bound: 101.2525 × 1.02 = 103.2776= 103.2775

Daily Price Range (or Price Freeze)
After the market is opened within the Price Range described above, there is no limit for the price range for the rest of the trading day. However, to ensure that there is no erroneous order entry by Trading Member, the Exchange will specify “Daily Price Range” or “Price Freeze” for the limit price. If the limit price input by the Trading Member falls outside this Daily Price Range, the order will not be automatically executed unless the Trading Member confirms separately that the order entry is genuine and without mistakes.

Quantity Freeze
Quantity freeze is not a limit on the trade size (or limit on the outstanding trades, which is called Position Limit and explained below). Like Price Freeze, it is a check to ensure that the order entry is not erroneous. The Exchange will specify the Quantity Freeze, and any order input with quantity higher than the Quantity Freeze will not be executed automatically unless the Trading Member separately confirms to the Exchange that the order is genuine and without errors.

The Quantity Freeze limit is periodically revised by the Exchange, depending on the liquidity in the contract.

Daily Settlement Price (DSP)

Daily settlement price is announced by the Exchange for the purpose of mark-to-market margining with the Clearing Corporation. DSP computed in the following manner.

Step #1: If there are at least 5 trades in the last 30 minutes of trading for an aggregate notional volume of Rs 10 Cr, DSP is the volume-weighted average price (VWAP) of the last 5 trades. The following table illustrates the computation of VWSP.

Trade #	Price	Quantity	Notional (Rs Cr)[A]	Volume-weighted Price (VWP)[B]
1	101.2525	100	2	202.5050
2	101.2575	125	2.5	253.1438
3	101.2675	95	1.9	192.4083
4	101.2525	105	2.1	212.6303
5	101.2550	85	1.7	172.1335
			10.2	1032.8209

[A]Notional: is computed as the quantity multiplied by Rs 0.02 Cr (which is the Contract Amount or market lot of the notional)
[B]VWP is the notional multiplied by the Price.

VWAP (or DSP) = 1032.8209 / 10.2 = 101.2570, which is rounded to 101.2575

Step #2: If the criterion (minimum 5 trades for an aggregate notional of Rs 10 Cr) is not satisfied in the last 30 minutes of trading, apply the same procedure for the last one hour of trading day.

Step #3: If the criterion (minimum 5 trades for an aggregate notional of Rs 10 Cr) is not satisfied in the last one hour of

trading, apply the same procedure for the last two hours of trading day.

Step #4: If DSP cannot be computed by Steps #1 through #3, then compute the theoretical futures price as follows.

Step #4A: Compute the theoretical futures price for each security separately as follows.

Futures price = Forward Price of the Security / Conversion for that Security

Where

Forward price = Cash price + Carry cost – Carry Income

With

Cash price obtained as the weighted average cash price of outright trades in that security on the Negotiated Dealing System-Order Matching (NDS-OM) platform of the RBI, subject to at least there being a minimum of 5 trades for an aggregate face value of Rs 10 Cr. If there are not enough trades, then the revaluation price for that security fixed by Fixed-income Securities and Money Market Derivatives Association (FIMMDA) and announced through Bloomberg will be taken as the cash price.

Carry cost is computed at the interest rate prevailing on 91-day Treasury bill

Carry Income is computed as the coupon accrual on that security with 30E/360 day count basis.

Step #4B: Select the lowest of the theoretical prices among the Deliverable Bonds.

Position Limit

Position limit is the limit on the outstanding trades, and is defined separately at the level of client and at the level of Trading Member, as follows.

For client: 6% of total open interest or Rs 300 Cr of notional value, whichever is higher

For Trading Member: 15% of total open interest or Rs 1,000 Cr of notional value, whichever is higher

The purpose of position limit is to avoid market concentration in the hands of few players so that price manipulation is curtailed.

Key Concepts

Players: Exchange, Clearing Corporation, Trading Members, Clearing Members, Custodian, PDO, NSDL/CDSL, Clearing Banks

Order types: Market Order and Limit Order; Immediate or Cancel and Good Till Day; Stop Order; Spread Order

Controls on trading: base price and opening price range, price freeze, quantity freeze, daily settlement price, and position limit (separately at client level and Trading Member level)

Exercise

1. Custodian's role is to settle
    a. Cash leg of the trade
    b. Securities leg of the trade
    c. Both (a) and (b) above
    d. None of the above
    (**Answer: see Section 6.1**)
2. Government Securities are maintained in
    a. Only in electronic book entry form
    b. Only in physical form
    c. Both in electronic and physical form
    d. None of the above
    (**Answer: see Section 6.1**)
3. Which of the following entities is the registry for government securities?
    a. Public Debt Office (PDO), RBI
    b. National Securities Depository Ltd (NSDL)
    c. Central Depository Services (India) Ltd (CDSL)
    d. Both (b) and (c) above
    (**Answer: see Section 6.1**)
4. Retail investors can open demat account for government securities only with
    a. Public Debt Office, RBI
    b. National Securities Depository Ltd (NSDL)
    c. Central Depository Services (India) Ltd (CDSL)
    d. Either (b) or (c) above
    (**Answer: see Section 6.1**)
5. Which of the following statement is true about Limit Order?

a. Guaranteed execution at the desired price
b. Uncertain execution at the desired price
c. Guaranteed execution at an uncertain price
d. None of the above

(**Answer: see Section 6.2.3**)

CONTENTS

Unit 7: Clearing, Settlement and Risk Management

7.1. Basic Definitions

Clearing is the process of collecting information on obligations to pay from all parties and then netting the payable and receivable amounts into a single amount after offsetting them. Netting is done multilaterally to determine the net payment position for each party. It is conducted by a central counterparty, which is the Clearing Corporation.

Settlement is the process of payment of net obligation (determined from Clearing, which precedes settlement) by each party to the Clearing Corporation, which in turn will pass on the amounts to the parties with net receivable position. Both clearing and settlement are conducted for both sides of the transaction: namely, cash and securities.

Risk management is the process to ensure that all trades contracted in the Exchange are settled. The settlement is

ensured by collection of margins and implementing mark-to-market process. Risk management is essential for derivatives trades because there is a delay between Trade and Settlement parts of the transaction (see Section 1.2). For bond futures, the delay could be two business days to 12 calendar months (see Section 4.3).

7.2. Clearing

Clearing Corporations conducts the multilateral netting of obligations (in cash and securities) at the level of Clearing Members (CM). The net position for each Clearing Member is called the Open Position (separately for cash and securities), which is settled with the Clearing Corporation. The following are the rules for deriving the Open Position for a Clearing Member.

a) For each Trading Member attached to the CM, separate the proprietary and client trades
b) For the proprietary trades of the Trading Member, offset the long and short positions into a single net position. The net position will be either long or short, but not both.
c) For client trades of the Trading Member, offset the long and short positions into a single net position for each client separately, but not across the clients. In other words, the buy trades of one client cannot be offset with the sell trades of another client. If one client has net buy position and another client has net sell position, they must be shown separately. Accordingly, every client will have either net long or net short position.

d) Sum the net position at (b) and (c) above separately for net long and net short positions
e) Repeat the above steps from (a) to (d) for all other Trading Members of the CM
f) Sum the Trading Member-wise net long and net short positions across at (d) above. This is the net long and net short positions for the CM

The following example illustrates the Open Position for Clearing Member A (CM-A), who clears & settles for Trading Member A (TM-A) and Trading Member B (TM-B). TM-A has Client #1 and #2 and TM-B has Client #3 and Client #4.

		TM-A			TM-B		
		Proprietary	**Client #1**	**Client #2**	**Proprietary**	**Client #3**	**Client #4**
Buy	Securities	12	26	35	115	58	13
	Cash	115	258	345	1,135	564	128
Sell	Securities	8	19	38	114	55	16
	Cash	83	160	381	1,131	551	160
Net	Securities	4	7	−3	1	3	−3
	Cash	−32	−98	36	−4	−13	32

Given the above trades, the Open Position for the CM-A is computed as follows.

	Buy / Long		Sell / Short	
	Securities	**Cash**	**Securities**	**Cash**
TM-A	4+7 = 11	−32−98 = −130	−3	36
TM-B	1+3 = 4	−4−13 = −17	−3	32
Total	15	−147	−6	68

The above is repeated for all Clearing Members, and the Open Position for each is derived as above. Consider the following example.

	Buy / Long		Sell / Short	
	Securities	**Cash**	**Securities**	**Cash**
CM-A	15	−147	−6	68
CM-B	25	−252	−15	148
CM-C	13	−134	−24	245
CM-D	6	−61	−12	119
CM-E	9	−91	−7	58
CM-F	14	−129	−18	176
Total	82	−814	−82	814

The total long position (for securities as well as cash) must be exactly equal to the total short position (for securities as well as cash). If not, there is an arithmetic mistake in netting calculations. The total long position must be exactly equal to the total short position because every trade requires a buyer and a seller so that the market as a whole has neither net long nor net short position.

7.3. Settlement

Bond futures are settled physically: that is, exchange of cash for the security. It does not mean that every sell trade during contract's life results in physical delivery. The seller can always close ("square up") his position with an offsetting buy trade, but it must be done before the close of business on the Last Trading Day (see Section 4.3). The Open Position at the close on Last Trading Day must be settled with physical delivery of any of the Deliverable Securities (see Section 4.7).

Every Clearing Member must discharge his obligation (i.e. deliver securities for sell trades and pay cash for buy trades) first before he is entitled to receive securities and cash due to him. This is called “pay-in” first and “pay-out” later, both occurring on the same day with few minutes or hours between them. Thus, the settlement is not the delivery-versus-payment (DvP) type practiced for the settlement of government securities which are settled in the SGL A/c at PDO (see Section 6.1).

Intent to Deliver by Seller

For the Open Position on the Last Trading Day, the seller must notify the Clearing Corporation his intention to deliver by 06:00PM on the Last Trading Day, which is also called, for the purpose of settlement, the “Day of Intention”. The deadline of 06:00 PM is for the Clearing Member, who may advance this deadline to its Trading Members, who in turn may further advance it to its Clients.

The Notice of Intent to Deliver must include the details of the Deliverable Bond. Seller may deliver different Deliverable Bonds, provided each of them is in multiples of Contract Amount (or market lot), which is Rs 2 lakhs in face value. For example, if the seller has to deliver two contracts (i.e. total face value of Rs 4 lakhs), he can deliver Rs 2 lakhs of Deliverable Bond A for one contract and another Rs 2 lakhs of Deliverable Bond B for the other. He cannot deliver Rs 3 lakhs of Deliverable Bond A and Rs 1 lakh of Deliverable Bond B. In practice, of course, all sellers will be delivering the same Deliverable Bond, which is the Cheapest-to-Deliver (CTD), as explained in Section 4.9.

If the seller fails to serve the Notice of Intent to Deliver by the stipulated time either for full Open Position or part of it, the failed quantity will be taken into Auction Settlement (see Section 7.4 in this Unit).

Allocation to Buyer

Clearing Corporation will assign the intentions from the sellers to the buyers, at the client-level, starting from longest maturity/age. If for a maturity/age, the total deliveries are less than the total buy quantity, then the allocation is done randomly.

Clearing Corporation will finalize and announce the security delivery Open Position at the Clearing Member level by 08:00PM on the Day of Intention (which is also the Last Trading Day for the contract).

Security Settlement

Clearing Corporation will receive and deliver Deliverable Bonds either in SGL Accounts with PDO or through the demat accounts system of NDSL/CDSL.

Procedure for pay-in of securities through SGL:

On the settlement day, Clearing Member (or its Bank holding CSGL Account) must transfer the security through the Negotiated Dealing System (NDS) operated by PDO.

Clearing Corporation will confirm each such transfer in the NDS; and the pay-in for securities must be completed before 11:00 AM on the settlement day.

For the pay-out, Clearing Corporation will transfer the securities through the NDS, and the Clearing Member (or its Bank holding CSGL Account) must accept the transfer in the NDS.

Procedure for pay-in of securities through NSDL/CDSL:

On the settlement day, Clearing Member must transfer the security in its Settlement Pool Account maintained with a Depository Participant (DP) before the cut-off time specified by NDSL/CDSL. Clearing Member can use the same Settlement Pool Account of Capital Market segment for bond futures, too.

For the pay-out, Clearing Corporation will transfer the securities in its Settlement Pool Account of the Clearing Member.

The timing for pay-in and pay-out are the same as those applicable for Capital Market segment.

Seller can early pay-in (EPI) the securities before the scheduled pay-in time, which will help reduce the "delivery margin" (see Section 7.5.1 of this Unit).

Settlement of Cash Leg

Cash is settled through the Clearing Banks in the same account applicable for the currency derivatives. The timings of pay-in and pay-out are the same as that applicable for the Capital Market segment.

7.4. Auction Settlement

Auction settlement is a special settlement and distinguished from "normal" settlement. It applies on two occasions. First, seller fails to notify the Intent to Deliver. Second, there is a short-delivery of securities on the settlement day (that is, seller notifies the delivery but fails to deliver the full quantity).

When there is a failure to notify the Intent to Deliver, the auction is conducted on the first business day after the Day of Intention, and the result of auction is added to the settlement obligation due on the settlement day (which is one business day after the auction day).

When there is a short-delivery on the settlement day, the shortage is auctioned on the same day. This is called "buy-in" in which the Clearing Corporation initiates (hence called the "Initiator" in the buy-in) the auction; and any Trading Member can participate in the auction as "Solicitor".

Trading Member can place only sell order and only Limit Order (see Section 5.2.3) in the auction. The price range applicable for the auction market is plus or minus 5% of the Base Price; and the Base Price is the latest price for that security published by Fixed-income and Money Market Derivatives Association (FIMMDA) and broadcast by the Clearing Corporation. The result of the buy-in is settled on the first business day after the auction date. The following shows the time line for settlement of securities.

Day	Description
Day of Intent (T)	This is also the Last Trading Day, which is two business days prior to the Settlement Day. Clearing Member must submit the Intent to Deliver by 06:00 PM; and Clearing Corporation will publish the Security Delivery Settlement Report by 08:00 PM
T + 1	Auction for failure to notify the Intent to Deliver. Obligations from the auction are added to the Security Delivery Settlement Report published on the Day T
T + 2	This is the Settlement Day, which is the last business day of the month and two days after the Day of Intention (T). Pay-in and pay-out of securities and cash occurs on this day, and buy-in auction is held for short-deliveries.
T + 3	This is the first business day following Settlement Day (or third business day after the Day of Intent) on which the buy-in auction (held on T + 2) is settled.

In case of auction, the invoice amount for the short-delivery, which is called “Valuation Debit”, is debited to the defaulting member’s account from the Security Delivery Settlement Report. Further, the defaulting member will pay the sum of following amounts in cash.

1. Amount at the auction price with accrued interest computed up to auction settlement day (T+3);
2. The difference between the original invoice amount and the auction amount, if the latter is less than the former. This ensures that the defaulter will not benefit from any favourable price change to him between T and T+2 days.
3. A penalty of 2% of the face value of the short-delivery amount, which shall be passed on to the buyer-client

Close-out

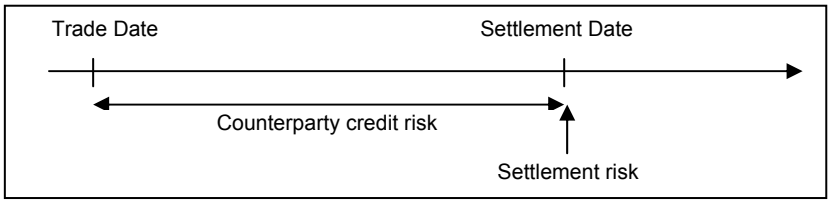
It is possible that the auction is unsuccessful: that is, there is no seller in the auction for the short-delivery amount or auction is successful but the seller in auction failed to deliver the security. In such case, the transaction is "financially closed-out" by the Clearing Corporation, as follows:

(1) Unsuccessful auction
The defaulting member's account is debited for cash at the original invoice amount plus a penalty of 5% of the face value of short-delivery amount, which will be passed on to the original buyer-client.

(2) Auction successful but the seller in auction fails to deliver
The defaulting member's account is debited for cash at the invoice amount in auction plus a penalty of 3% of the face value of short-delivery amount, which will be passed on to the buyer-client.

7.5. Risk Management

Derivative trades have enhanced settlement risk because there is a delay between Trade and Settlement parts of the transaction (see Section 1.2), which could be as long as 12 months in bond futures. A party may contract on trade date but fail to honour the obligation on the settlement date. The risk of failure of one party between trade date and settlement date is called “counterparty credit risk” or “pre-settlement risk”. On the settlement date, after one party has fulfilled his obligation while the other does not, the same risk is called “settlement risk.”



Notice that the counterparty credit risk less than the contract amount because no party has fulfilled his obligation as yet. If one party fails, the other party will withhold to pay his obligation. The loss to the non-defaulting party in such cases is equal to the replacement cost of the transaction, which in turn is equal to the price risk between the trade date and the date of default. Settlement risk, on the other hand, is equal to the full amount of the contract because one party has paid his obligation while the other has failed. In any Exchange-traded derivative, both the counterparty credit risk and

settlement risk are eliminated by Clearing Corporation by providing trade guarantee to each party to the trade. Clearing Corporation protects itself by administering two safety features: margining and mark-to-market.

7.5.1. Margining

Margining is the mechanism through the Clearing Corporation protects itself from the counterparty credit risk. Margining system requires that both parties to the trade, buyer and seller, must post with the Clearing Corporation an upfront margin ("initial margin") before the trade is initiated. The initial margin is a fraction of trade value and does not represent the part payment but a performance (or "good faith") deposit. This is the reason why both buyer and seller pay the initial margin. To sum up, initial margin is a performance margin and paid upfront at Client level.

SPAN Margining System for Initial Margin

The amount of initial margin is computed using the Standard Portfolio Analysis of Risk (SPAN), a method originally developed by the Chicago Mercantile Exchange (CME) in 1988, and is used by most derivative exchanges throughout the world. The SPAN method includes all futures and options on the same underlying, and considers them a single portfolio.

The SPAN method generates 16 scenarios of different market conditions for the next trading day. For each scenario, each position in futures and options is valued, and the positive and negative changes in value are netted into a single amount for that scenario. This is repeated for each of

the 16 scenarios, giving the 16 scenario-wise changes in value (each called a risk array). The highest loss among the 16 scenarios is the initial margin for the next trading day at the portfolio level. The scenarios are generated from the combinations of changes in: (1) underlying asset price; (2) changes in the volatility of underlying; and (3) time decay in option price.

For the changes in underlying asset price, SPAN computes the "price scan range", which is the value-at-risk (VaR) measure with 1-day horizon and 99% confidence interval. Let us explain this with an example. Consider that VaR (1D, 99%) is Rs 25 for an underlying asset price. The correct interpretation of this measure is as follows. Over the next one trading day, the change in the price will be:

Less than or equal to Rs 25 in 99 out of 100 possible cases, which also means

Greater than Rs 25 in 1 out of 100 possible cases

VaR does not tell us the maximum loss or exact loss. Neither does it indicate that there would be loss. It merely states that the price change, which could be profit or loss, would be within the number indicated at the specified confidence level and qualifies this with "less than or equal to" or "greater than" inequalities rather than an exact number.

Because VaR is not an exact measure but qualified with inequalities, SPAN devises the following seven scenarios from the scan range, which is VaR (1D, 99%) measure.

1	No change in price
2	Price up by 1/3 of scan range
3	Price up by 2/3 of scan range
4	Price up by full scan range
5	Price down by 1/3 of scan range
6	Price down by 2/3 of scan range
7	Price down by full scan range

The second factor considered in SPAN is the volatility. For each of the above seven price changes, an upward or downward variation in volatility is also considered, giving a total of 7 × 2 = 14 scenarios. The VaR measure does not cover all possibilities: it covers only 99% (or 99.9%) of possible cases. To safeguard against the omitted possibilities, two more scenarios in the underlying asset price changes are included, which are extreme up moves and extreme down move, giving thus a total of 16 risk scenarios. The Open Position at client level is evaluated in each of the sixteen risk scenarios, and the highest loss in the 16 risk scenarios is the required initial margin for the next trading day from the client. This initial margin derived from SPAN is further subject to the specified minimum amount, prescribed periodically, based on the volatility of the deliverable bond prices.

The VaR measure under SPAN is revised six times during the day to update the changing risk conditions in the market. As the prices become more volatile, the higher margin requirements are computed and vice versa. The initial margin is netted in the manner similar to the settlement netting (see Section 7.3 of this Unit). That is:

- At the Trading Member level: sum the initial margin for proprietary trades and client-level trades, without any offset among them.
- At the Clearing Member level: sum the initial margin for all Trading Members without any offset among them

The initial margin computed as above is applicable between the Clearing Corporation and Clearing Members. Clearing Members can collect higher amount from its Trading Members who in turn can collect still higher amounts from their clients. Such a facility is required because the Clearing Corporation revises and collects initial margin six times during the day whereas Trading Members may not be able to collect revised margins at such frequency from their clients.

Besides the initial margin, there are two more margins at the Clearing Member level: extreme loss margin and delivery margin.

Extreme Loss Margin
Every Clearing Member must deposit an additional margin on the gross open positions at the rate specified periodically by the Clearing Corporation.

Delivery Margin
Delivery margin is collected on the Day of Intent (which is the Last Trading Day) after the intention to deliver and allocations are completed. The margin amount is the VaR margin computed on the invoice price (which includes the accrued interest and conversion factor, unlike initial margin

that does not include them) plus 5% of the face value of the security to be delivered. The delivery margin is applicable from the Day of Intention and released after the settlement is completed, and is collected from both buyer and seller. The mark-to-market margin (see the next section) is applied on the closing price of the security that is delivered.

If the seller fails to deliver the notice of Intention to Deliver, the VaR margin is computed on the invoice price of the costliest security in the basket of Deliverable Bonds, and the mark-to-market is applied on the price of this security.

Initial, extreme loss and delivery margins may be paid by way of acceptable collateral (which is specified periodically by the Clearing Corporation) applicable to the currency derivatives segment.

7.5.2. Mark-to-Market (MTM)

Mark-to-market (MTM) is the second mechanism to support the trade guarantee from the Clearing Corporation. The principle of MTM is to carry forward the Open Position at the current market price ("it is marked to the market") rather than at the old, historical price. It is implemented at daily intervals by valuing the Open Position at the daily settlement price. The difference between the historical price and the current market price is called the mark-to-market profit/loss, and is settled with the client as the mark-to-market margin.

Marking the Open Position to the current market price ensures that the trade does not have large profit/loss accumulated in the books. Since the frequency of MTM is

daily, the profit/loss in the Open Position is not more than the price change over a trading day. The initial margin already collected in the previous day will guard against the loss from the price change today; and the MTM margin collected today will guard against the price change today so that initial margin will now guard against the price change over the next day.

There are two differences between initial margin and MTM margin. First, initial margin is a performance deposit and therefore is always payable to the Clearing Corporation. In contrast, MTM margin is profit/loss on the Open Position and therefore can be payable to or receivable from the Clearing Corporation. Second, initial margin can be in cash or acceptable collateral whereas MTM margin is always in cash.

The following example illustrates the administration of initial margin and MTM margin on the assumption that initial margin is paid in cash and we sold 5 contracts on the trade date as follows.

(1) Sold 2 contracts at 101.5275
(2) Sold 2 contracts at 101.5300
(3) Sold 1 contract at 101.5325

The initial margin per contract is Rs 2,100 for buyer and Rs 2,110 for seller. (VaR has slightly higher margin for short positions because the price can theoretically rise to infinity while it cannot fall to below zero. Accordingly, the possible loss for the shot-seller is higher than for buyer). The total initial margin paid upfront will thus be:

$$5 \times 2{,}110 = 10{,}550$$

At the close of trade date, the following are the settlement price and the revised initial margin applicable to the next trading day.

Trade Date (T)	Settlement Price	Rs 101.5275
	Initial margin for next day	Rs 2,090 for long and Rs 2,095 for short

The Open Position of 5 contracts is now carried forward at the current price of 101.5275 rather than the historical contract prices. The implicit assumption is that we square up the position by buying back the Open Position at the current price of 101.5275 (with settlement of the profit/loss, which is the MTM margin, in cash) and reinstate the Open Position by selling the same quantity at the same price. The profit/loss on the five contracts are:

$$2 \times (101.5275 - 101.5275) \times 200{,}000 / 100 = 0$$
$$2 \times (101.5300 - 101.5275) \times 200{,}000 / 100 = 10$$
$$2 \times (101.5325 - 101.5275) \times 200{,}000 / 100 = 10$$

Total **20**

In the above, the numeral 200,000 is for the Contract Amount; and the numeral 100 is to account for the fact that the prices are quoted for 100 of face value. The MTM is profit of Rs 20, which is credited to the seller's margin account, which already contains Rs 10,550 by way of initial margin. With the MTM credit of Rs 20, the carry-forward price for all the five contracts is uniformly 101.5275. In other words, three old contracts at different prices are replaced with a single contract at the price of 101.5275. This is called "netting by novation". The revised margin for the next trading is Rs 2,095 a contract or Rs 10,475. There is

thus an excess of Rs 95 in the margin account, which can be withdrawn next day.

A. Initial margin	10,550
B. MTM margin (loss is indicated with minus)	20
C. Total available margin (A + B)	10,570
D. Required initial margin for next day	10,475
E. Excess or deficit in margin account (C – D)	95

Note that the excess margin of Rs 95 consists of Rs 20 MTM profit and Rs. 75 as the reduction in initial margin requirement.

On the T+1 day, we withdraw the excess amount of Rs. 95 so that the closing balance in the margin account is Rs. 10,475. We assume that the revised initial margin for the next day is Rs. 2,125 for long and Rs. 2,135 for short position (obviously, the market volatility has gone up so that VaR margin assessed higher amounts); and the settlement price is Rs. 101.5350. Given these values, the MTM profit and the required initial margin for the next day are as follows.

A. Opening balance in margin a/c	10,475
B. Settlement price	101.5350
C. MTM profit/loss: 5× (101.5350 – 101.5275) × 200,000 / 100	–75
D. Closing balance in margin a/c (A + C)	10,400
E. Required initial margin for next day: 5 × 2,135	10,675
F. Excess or shortfall in margin account	–275

The shortfall of Rs. 275 consists of MTM loss of 75 and change in initial margin of Rs. 200. This is how the Open Position is rolled over until the contract is closed or the last trading day, whichever is earlier.

Clearing Corporation will settle the amounts arising out of change in initial margin and mark-to-market profit/loss by 10:30 AM (or other specified time) with the Clearing Members without netting the amounts across the clients and Trading Member. For the Clearing Member, however, the gross settlement amount as above can be netted with the settlement amount of currency futures segment.

Key Concepts

Process of clearing, settlement and risk management

Clearing: offsetting for each client; gross position across clients; gross position across Trading Members; multilateral netting across Clearing Members

Settlement: physical delivery of security; intent to deliver; allocation to long positions; auction for non-intent; buy-in auction for short-delivery; and financial close-out; penalties for settlement fails

Risk management: initial margin and SPAN methodology; extreme loss margin; delivery margin; mark-to-market

Exercise

1. Which of the following statements is true?
    a. Clearing precedes settlement
    b. Settlement precedes clearing
    c. Settlement precedes trade
    d. None of the above
    (**Answer: see Section 7.1)**
2. Which of the following statements is true for Netting?
    a. Proprietary trades are offset
    b. Buy and sell trades of the same client are offset
    c. Both (a) and (b)
    d. None of the above
    (**Answer: see Section 7.2)**
3. Which of the following statements is true for Netting?
    a. Buy and sell trades of the different clients are offset
    b. Client trades are offset with proprietary trades
    c. Both (a) and (b)
    d. None of the above
    (**Answer: see Section 7.2)**
4. Initial margin is paid by
    a. Buyer alone
    b. Seller alone
    c. Both buyer and seller
    d. None of the above
    (**Answer: see Section 7.5.1)**
5. Mark-to-market margin is paid by
    a. Buyer
    b. Seller

c. Whichever party that have negative value on Open Position
d. None of the above

(**Answer: see Section 7.5.2)**

This page has
been left blank
intentionally

CONTENTS

Unit 8: Regulation and Compliance

8.1. Regulation

Like currency derivatives, interest rate derivatives are jointly regulated by Reserve Bank of India (RBI) and Securities and Exchange Board of India (SEBI). Within the statutory regulations of RBI and SEBI, the Exchanges and Clearing Corporations will frame the operational rules and procedures under their bye-laws. In addition to these, there are rules and procedures governed by various statutes and administered by specified bodies, including the Institute of Chartered Accountants in India (ICAI). The following shows the summary of statutory regulations and operational rules.

Entity	Authority/Statute	Scope
RBI	Government Securities Act 2006	All dealing in government securities
	Reserve Bank of India Act 1934; and Banking Regulation Act 1949	All dealings by RBI-supervised entities
SEBI	Securities Contract	All exchange-traded

	(Regulation) Act 1956; and SEBI Act 1992	contracts
Exchanges	Bye-laws of the Exchange	Operational rules and procedures for trading, settlement & risk management
Depositories	Depositories Act 1996	Demat accounts
ICAI	Chartered Accounts Act 1949; and Companies Act 1956	Accounting and disclosure on use of derivatives by corporations

RBI's role in regulation of government securities is primary and fundamental and covers all activities while that of SEBI is limited to the Exchanged-traded contracts on them.

8.2. RBI

Anything related to the government securities, both in primary and secondary market, is primarily regulated by RBI. In addition, RBI regulates the investment in debt securities by foreign institutional investors. The following are the RBI regulations in different areas.

Product
The product features, deliverable bonds and settlement method (see Sections 4.1, 4.6 and 4.7) are jointly defined by RBI and SEBI.

Residents
Residents (as defined in Foreign Exchange Management Act 1999) are allowed to freely buy or sell interest rate futures for hedging and speculation.

RBI-supervised Entities and Entities Supervised by Other Regulatory Bodies

RBI-supervised entities (i.e. banks, primary dealers and urban and state cooperative banks) should obtain prior permission from the RBI to deal in interest rate futures; and naked short-sale is allowed only for banks and primary dealers. Entities supervised by other regulators (e.g. SEBI, Insurance Regulation and Development Authority, etc) should similarly obtain prior permission of the concerned regulator.

Non-residents and Foreign Institutional Investors (FII) – *Exposure Limits*

The following exposure limits will apply to FII's registered with SEBI

- Purchase/Long Position: total position in cash and interest rate futures should not exceed the limit specified for investment in government securities
- Sell/Short Position: short position can be maintained only for hedging (and not for speculation) and the gross short position should not exceed the total long position in government securities in cash and interest rate futures

CSGL Account

Under the Government Securities Act 2006, the following entities are allowed to open Constituent Subsidiary General Ledger (CSGL) Account (see Section 6.1) with Public Debt Office (PDO), RBI on behalf of their constituents, who maintain Gilt Account.

- Scheduled commercial banks
- Primary dealers

- Scheduled urban cooperative banks that satisfy the following three criteria: (a) minimum net worth of Rs 200 Cr; (b) minimum capital to risk-adjusted asset ratio (CRAR) of 10%; and (c) belong to the States that have signed MOU with the RBI
- Scheduled state cooperative banks that have a minimum net worth of Rs 100 Cr
- Two depositories in India (namely, NSDL and CDSL)
- Clearing Corporation of India Ltd (CCIL) and other Clearing Corporations notified by RBI
- Stock Holding Corporation of India Ltd (SHCIL)
- National Bank for Agriculture and Rural Development (NABARD)

The CSGL Account Holder must ensure the following

- The "Know Your Customer" norms are applied to the Gilt Account Holder (GAH)
- GAH is entitled to hold government securities under the General Loan Notification and specific loan notification issued by RBI
- GAH maintains only one Gilt Account. A suitable declaration to this effect must be obtained from the GAH before the account is opened. However, GAH may open an additional depository account with the depositories.
- Every debit in Gilt Account would require authorization from GAH, and the right to set off cannot be applied in the Gilt Account.
- Prior permission of RBI is required for the following value-free-transfer (VFT): (a) transfer to own account with depositories; (b) transfer for

margining purposes; (c) transfer of Gilt Account from one CSGL holder to another

8.3. SEBI

Within the broad regulatory framework specified by RBI, SEBI will further specify the regulations governing the Exchange-traded interest rate futures, as follows.

Membership Eligibility

There is no separate membership facility for interest rate futures, and membership in the Currency Derivatives Segment of Futures & Options will automatically enable trading in interest rate futures. The minimum net worth as of the latest balance sheet should be Rs 1 Cr for Trading Member (TM) and Rs 10 Cr for Clearing Member (CM).

Product Features

As specified in Sections 4.1 to 4.4 and are subject to review and change from time to time

Position Limits

As specified in Section 6.2.4 and are subject to review and change from time to time

Risk Management Limits

As specified in Sections 7.5.1 and 7.5.2 and are subject to review and change from time to time

Surveillance and Disclosure

The Exchange and Clearing Corporation will conduct the backtesting for the effectives of margining method twice in a year and communicate the results to SEBI

8.4. Exchange and Clearing Corporation

Within the regulatory framework specified by SEBI, the Exchange and Clearing Corporation will specify the detailed rules and procedures for trading, clearing, settlement (including auction settlement) and risk management. They are described in Unit 6.

It may be noted that Exchange may further "tighten" but cannot dilute the scope of SEBI Regulations. The following examples illustrate the "tightening" of regulations by Exchange/Clearing Corporation.

- *Number of contracts and their maturity*: Regulations allow a maximum of four contracts with the longest expiry date up to a year, but Exchange may list only one or two contracts for the nearest Expiry dates, depending on the liquidity
- *Delivery Period for Settlement*: Regulations allow that delivery can be made on any business day during the Contract Month with prior notice of two business days, but Exchange may restrict the delivery to the last business day
- *Margining*: Regulations may specify a minimum amount of, say, Rs 100, but the Clearing Corporation may specify *more than* Rs 100.

8.5. Institute of Chartered Accountants in India (ICAI)

ICAI is a statutory body to define the accounting, presentation and disclosures by corporations. Its accounting Standard, AS 30, specifies the accounting for all

derivative transactions. The summary of derivatives accounting treatment is as follows.

- All derivative transactions must be brought into the balance sheet though they are to be settled after the balance sheet date
- The value of derivative in the balance sheet is its "fair value", which is its current mark-to-market (or liquidation) value, and not its notional amount. For example, if the notional is Rs 10 Cr and the mark-to-market value is Rs 2 lakhs, then the derivative would be accounted for in the balance sheet at Rs 2 lakhs.
- The fair value will be taken to the Profit/Loss Account except for transactions qualifying as Hedging Transactions
- Hedging Transactions are those that eliminate the interest rate risk in the asset or liability or highly forecast transaction. To be qualified as a hedging transaction, it must pass the hedge effectiveness test, which is test to prove that the derivative will effectively offset the profit/loss in the underlying hedged item within the limit of 80 – 125%. The hedge effectiveness test must be passed at the beginning of hedge ("prospective test") and during the life of the derivative contract, based on the past changes in the price/value of hedging item and hedging derivative ("retrospective test"). The profit/loss on the underlying hedged item and hedging derivative must be taken together into the Profit/Loss Account. If the underlying hedged item is a highly forecast transaction, its profit/loss will not be accounted in balance sheet. In such cases,

the profit/loss on the hedging derivative need not be taken to Profit/Loss Account but stored in a separate account under Equity, which will be taken into Profit/Loss Account when the forecast transaction materializes. This facility is provided to avoid volatility in earnings caused by realized profit/loss in hedging derivative and unrealized profit/loss on the forecast transaction. This is called "hedge accounting". If the hedge effectiveness test is failed, the hedge account has to be discontinued, and the profit/loss on the hedging derivative will have to be taken into Profit/Loss Account.

For the RBI-supervised entities, RBI has further restricted the scope of hedge accounting as follows.

- Hedged item can be only government security that is categorized in either Available-for Sale (AFS) or Held-for-Trading (HFT). It cannot be any other security or in other category.
- If the hedge effectiveness test is passed, the changes in the value of hedged item and hedging instrument can be offset. If the net amount is loss, it should be taken into Profit/Loss Account; and if it is profit, it should be ignored.
- If the hedge effectiveness test is not passed, the setoff between hedged item and hedging instrument is not allowed. The hedged item must be marked to the market, as per the norms applicable to the category (i.e. AFS or HFT), and the hedging derivative should be marked to the market on a daily basis with losses provided for and

gains ignored for the purpose of Profit/Loss Account.

- Gains from close-out or settlement of derivative cannot be taken into Profit/Loss Account but carried forward under "Other Liability" and is to be used for meeting depreciation provisions on the investment portfolio.

8.6. Compliance and Disclosure: RBI Regulations

For the RBI-supervised entities, the following additional regulations apply.

Capital Adequacy

The net open positions in futures would attract capital adequacy. The capital adequacy is calculated in two steps. First, the net open position is converted into credit-equivalent exposure by multiplying the net notional of futures with a conversion factor, which is linked to the maturity of the futures contract, as follows.

Original Maturity	Conversion Factor
Less than one year	0.5%
One year and less than two years	1%
For each additional year thereafter	1%

Second, the credit-equivalent exposure is multiplied with a risk weight, which is 100%. The resulting risk-weighted exposure is the amount on which capital has to be provided 9%.

Example: The notional of net open position in futures is Rs 50 Cr, and the maturity of the futures contract is less than one year. The credit equivalent exposures, risk-weighted credit equivalent exposure and capital requirement are as follows.

Credit-equivalent exposure:

50 × 0.5% = 0.25

Risk-weighted credit-equivalent exposure:

0.25 × 100% = 0.25

Capital requirement:

0.25 × 9% = 0.0225

Thus, an amount of Rs 2.25 lakh of the bank's capital is set aside as cushion against the loss from the futures position.

ALM Classification

In the asset-liability management (ALM) reports, the futures should be treated as a combination of long and short positions in the underlying notional bond, as follows.

Futures should be reported as risk-sensitive asset/liability in the maturity bucket, corresponding to the delivery date of the futures; and as risk-sensitive liability/asset in the maturity bucket, corresponding to the tenor that is equal to the sum of futures delivery date and the life of the underlying notional bond.

For example, if there is a short futures position with delivery date of 6M and the notional underlying has a tenor of 10Y, then it should be classified as risk-sensitive asset in 6M maturity bucket and risk-sensitive liability in 10.5Y maturity bucket.

Ceiling on Total Brokerage

The existing cash market norm of 5% ceiling on a single broker for the transactions during a year will apply to the futures market.

Disclosures

The following disclosures need to be made as a part of the notes on accounts to the balance sheet.

1. Notional amount of futures traded during the year (instrument-wise)
2. Notional amount of futures outstanding on balance sheet date (instrument-wise)
3. Notional amount of futures outstanding and not effective for hedge (instrument-wise)
4. MTM vale of futures outstanding and not effective for hedge (instrument-wise)

Reports

The following compliance reporting applies to the RBI-supervised entities.

By	To	Periodicity	Report
CSGL Holder	RBI	Weekly	Transactions between its constituents; and between itself and its constituents
CSGL Holder	RBI	Quarterly	Constituent-wise holdings
NBFCs	RBI	Half-yearly	Total turnover in interest rate futures separately for purchases and sales
Primay Co-operative Banks	RBI	Monthly	Activity during the month; outstanding positions at month-end; hedges that are highly effective and otherwise

For banks and all-India financial institutions, the following reports are to be submitted to the RBI at monthly intervals.

1. Outstanding Futures Positions

Settlement Date	Underlying interest rate exposure	Number of contracts	Open Interest

2. Activity During the Month

Notional outstanding at the beginning of the month	Notional transacted during the month	Notional reversed during the month	Notional outstanding at the end of the month

The above has to be indicated for each delivery date of futures contract; and for each underlying

3. Analysis of "Effective" Hedges

Size of portfolio hedged	Change in MTM of hedged portfolio since the inception of hedge	Change in MTM of futures since the inception of hedge	PVBP of hedged portfolio	PVBP of futures

4. Analysis of “NOT Effective” Hedges

Size of portfolio hedged	**Change in MTM of hedged portfolio since the inception of hedge**	**Change in MTM of futures since the inception of hedge**	**Duration for which the hedge was effective**	**Remarks to restore hedge effectiveness**

Key Concepts

Regulators: RBI (which has primary regulatory powers on all activities in government securities) and SEBI (which has regulatory powers on Exchange-traded interest rate derivatives)

CSGL Accounts: regulated exclusively by RBI

Residents: hedging and speculation allowed; among RBI-supervised entities, naked short-sale allowed only for banks and primary dealers.

Non-residents and FIIs: total long positions (cash plus derivatives) must be within the limit specified by RBI; short position in bond derivatives cannot exceed the total long positions

Hedge Accounting: defined by ICAI in their accounting standard AS 30, which is further modified by RBI for RBI-supervised entities

Exercise

1. The regulator for the primary market of government securities is:
    a. Reserve Bank of India
    b. Securities and Exchange Board of India
    c. Government of India
    d. Stock Exchanges

    (**Answer: see Section 8.2**)
2. The regulator for the secondary market of government securities is:
    a. Reserve Bank of India
    b. Securities and Exchange Board of India
    c. Government of India
    d. Stock Exchanges

    (**Answer: see Section 8.2**)
3. The regulator for the Exchange-traded interest rate derivatives is:
    a. Reserve Bank of India
    b. Securities and Exchange Board of India
    c. Clearing Corporation
    d. Stock Exchanges

    (**Answer: see Section 8.2**)
4. Which of the following category of market participants can use interest rate derivatives?
    a. Mutual funds
    b. Foreign institutional investors
    c. Retail investors
    d. All of the above

    (**Answer: see Section 8.2**)

5. Which of the following category of market participants can short-sell bond futures?
    a. Mutual funds
    b. Foreign institutional investors
    c. Retail investors
    d. All of the above

    (**Answer: see Section 8.2**)

LIST OF ABBREVATIONS

ABS	Asset Backed Securities
AFS	Available for Sale
AI	Accrued Interest
AIBD	Association of International Bond Dealers
ALM	Asset Liability Management
APR	Actual Percentage Rate
AS	Accounting Standard
BEY	Bond Equivalent Yield
BP	Basis Point
CA	Contract Amount
CC	Carry Cost
CC	Clearing Corporation
CCIL	Clearing Corporation of India Ltd.
CCP	Central Counterparty
CCR	Continuously Compounded Rate
CD	Certificate of Deposit
CDO	Collateralized Debt Obligation
CDSL	Central Depository Services (India) Ltd.
CF	Conversion Factor
CI	Carry Income
CLN	Commodity Linked Note
CM	Clearing Members
CME	Chicago Merchantile Exchange
CP	Commercial Paper

CP	Clean Price
CRISIL	Credit Rating and Information Services of India Ltd.
CSD	Cash Settlement Date
CSGL	Consituent Subsidiary General Ledger
CTD	Cheapest to Deliver
CX	Convexity
DCF	Day Count Fraction
DP	Dirty Price
DP	Depository Participants
DSP	Daily Settlement Price
DVP	Delivery versus Payment
DY	Discount Yield
EAR	Effective Annual Rate
ELN	Equity Linked Note
EPI	Early Pay-in
EU	European Union
EX	Exchange
EXP	Exponential
EY	Effective Yield
FAS	Financial Accounting Standard
FIMMDA	Fixed-Income and Money Market Derivatives Association
FIS	Fixed Income Securities
FLT	Market Rate
FRA	Forward Rate Agreement
FSD	Futures Settlement Date
FX	Foreign Exchange

FXD	Fixed Rate
GAH	Gilt Account Holder
GDP	Gross Domestic Product
GOI	Government of India
GSecs	Government Securities
HFT	Held for Trading
HPR	Holding Period Return
IA	Invoice Amount
IAS	International Accounting Standard
ICAI	Institute of Chartered Accountants in India
ICMA	International Capital Market Association
IOC	Immediate or Cancel
IP	Invoice Price
IPA	Issuing and Paying Agent
IPMA	International Primary Market Association
IRD	Interest Rate Derivatives
IRF	Interest Rate Futures
IRO	Interest Rate Option
IRR	Internal Rate of Return
IRS	Interest Rate Swap
ISDA	International Swaps and Derivatives Association Inc.
ISMA	International Securiteis Markets Association
IST	Indian Standard Time
KRD	Key Rate Duration
LBD	Last Business Day
LN	Natural Logarithm
LR	Long Term Rate

LT	Long Term
LTD	Last Trading Day
MBS	Mortgage Backed Securities
MD	Modified Duration
MIBOR	Mumbai Interbank Offer Rate
MMY	Money Market Yield
MoU	Memorandum of Understanding
MSS	Market Stabilization Scheme
MTM	Mark to Market
NABARD	National Bank for Agricultural and Rural Development
NBFCs	Non-banking Financial Companies
NC	Notional Coupon
NCD	Next Coupon Date
NDS	Negotiated Dealing System
NSDL	National Securities Depository Ltd.
NSE	National Stock Exchange
OCO	Once Cancels the Other
ON	Overnight
OTC	Over the Counter
PCD	Previous Coupon Date
PCM	Professional Clearing Member
PD	Primary Dealers
PDO	Public Debt Office
PVBP	Price Value of a Basis Point
RBI	Reserve Bank of India
RD	Rupee Duration

RDM	Retail Debt Market
RFQ	Request for Quote
SCB	Scheduled Commercial Banks
SCM	Self Clearing Members
SD	Settlement Date
SEBI	Securities and Exchange Board of India
SGL	Subsidiary General Ledger
SHCIL	Stock Holding Corporation of India Ltd.
SLR	Statutory Liquidity Ratio
SP	Settlement Price
SPAN	Standard Portfolio Analysis of Risk
SR	Short Term Rate
ST	Short Term
SWIFT	Society for Worldwide Interbank Financial Telecommunication
TB	Treasury Bills
TILA	Truth In Lending Act
TM	Trading Member
TM-CM	Trading Member cum Clearing Member
UA	Underlying Asset
UK	United Kingdom
US	United States
VAR	Value at Risk
VFT	Value Free Transfer
VWAP	Volume Weighted Average Price
WDM	Wholesale Debt Market
YTM	Yield to Maturity

This page has
been left blank
intentionally

National Institute of Securities Markets
(Established by the Securities and Exchange Board of India)
Plot 82, Sector 17, Vashi, Navi Mumbai – 400 705
www.nism.ac.in