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Distribution of weights in the

Interest Rate Derivatives: A Beginner's Module Curriculum

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CHAPTER 1: Interest Rates and Time Value Of Money

1.1 Introduction

Interest rate is the price demanded by the lender from the borrower for the use of borrowed money. In other words, interest is a fee paid by the borrower to the lender on borrowed cash as a compensation for forgoing the opportunity of earning income from other investments that could have been made with the loaned cash. Thus, from the lender's perspective, interest can be thought of as an "opportunity cost' or "rent of money" and interest rate as the rate at which interest (or 'opportunity cost') accumulates over a period of time. The longer the period for which money is borrowed, the larger is the interest (or the opportunity cost). The amount lent is called the principal. Interest rate is typically expressed as percentage of the principal and in annualized terms. From a borrower's perspective, interest rate is the cost of capital. In other words, it is the cost that a borrower has to incur to have access to funds.

1.2 Factors affecting the level of Interest Rate

Interest rates are typically determined by the supply of and demand for money in the economy. If at any given interest rate, the demand for funds is higher than supply of funds, interest rates tend to rise and vice versa. Theoretically speaking, this continues to happen as interest rates move freely until equilibrium is reached in terms of a match between demand for and supply of funds. In practice, however, interest rates do not move freely. The monetary authorities in the country (that is the central bank of the country) tend to influence interest rates by increasing or reducing the liquidity in the system.

Broadly the following factors affect the interest rates in an economy:

Monetary Policy – The central bank of a country controls money supply in the economy through its monetary policy. In India, the RBI's monetary policy primarily aims at price stability and economic growth. If the RBI loosens the monetary policy (i.e., expands money supply or liquidity in the economy), interest rates tend to get reduced and economic growth gets spurred; at the same time, it leads to higher inflation. On the other hand, if the RBI tightens the monetary policy, interest rates rise leading to lower economic growth; but at the same time, inflation gets curbed. So, the RBI often has to do a balancing act. The key policy rate the RBI uses to inject/remove liquidity from the monetary system is the repo rates. Changes in repo rates influence other interest rates too.

Growth in the economy – If the economic growth of an economy picks up momentum, then the demand for money tends to go up, putting upward pressure on interest rates.

Inflation – Inflation is a rise in the general price level of goods and services in an economy over a period of time. When the price level rises, each unit of currency can buy fewer goods and services than before, implying a reduction in the purchasing power of the currency. So, people with surplus funds demand higher interest rates, as they want to protect the returns of their investment against the adverse impact of higher inflation. As a result, with rising inflation, interest rates tend to rise. The opposite happens when inflation declines.

Global liquidity – If global liquidity is high, then there is a strong chance that the domestic liquidity of any country will also be high, which would put a downward pressure on interest rates.

Uncertainty – If the future of economic growth is unpredictable, the lenders tend to cut down on their lending or demand higher interest rates from individuals or companies borrowing from them as compensation for the higher default risks that arise at the time of uncertainties or do both. Thus, interest rates generally tend to rise at times of uncertainty. Of course, if the borrower is the Government of India, then the lenders have little to worry, as the government of a country can hardly default on its loan taken in domestic currency.

1.3 Impact of interest rates

There are individuals, companies, banks and even governments, who have to borrow funds for various investment and consumption purposes. At the same time, there are entities that have surplus funds. They use their surplus funds to purchase bonds or Money Market instruments. Alternatively, they can deposit their surplus funds with borrowers in the form of fixed deposits/ wholesale deposits.

Interest rates receive a lot of attention in the media and play an important role in formulation of Government policy. Changes in the rate of interest can have significant impact on the way individuals or other entities behave as investors and savers. These changes in investment and saving behavior subsequently impact the economic activity in a country. For example, if interest rates rise, some individuals may stop taking home loans, while others may take smaller loans than what they would have taken otherwise, because of the rising cost of servicing the loan. This will negatively impact home prices as demand for homes will come down. Also, if interest rates rise, a company planning an expansion will have to pay higher amounts on the borrowed funds than otherwise. Thus the profitability of the company would be affected. So, when interest rates rise, companies tend to borrow less and invest less. As the demand for investment and consumption in the economy declines with rising interest, the economic growth slows down. On the other hand, a decline in interest rates spurs investment spending and consumption spending activities and the economy tends to grow faster.

1.4 Classification of Interest Rates

Different types of classifications of interest are possible. Based on how interest is computed, interest is classified into simple interest and compound interest.

Simple Interest: Simple interest is calculated only on the principal amount which has not yet been paid. It is calculated by using the formula $I = r \times t \times P$, where I is the simple interest to be paid, r is the interest rate per annum, t is the time period expressed in years for which interest is being calculated and P is the principal amount not yet paid back. Note the difference between I and r. 'I' refers to interest income or simply interest, while 'r' refers to interest rate. It can be easily seen that the simple interest over 2 years on a given principal is equal to double the simple interest in one year; over three years, it is equal to three times the simple interest in one year and so on.

Compound Interest: Compound interest arises when interest is added to the principal, so that the interest that has been added also earns interest for the remaining period. This addition of interest to the principal is called *compounding* (i.e. the interest is compounded). A loan, for example, may have its interest compounded every month. This means a loan with Rs 100 initial principal and 1% interest per month would have a balance of Rs 101 at the end of the first month, Rs 102.01 at the end of the second month, and so on. So, the interest in the first month is Rs 1, while the interest in the second month is Rs 1.01. The frequency with which interest is compounded varies from case to case; it could for example be monthly or quarterly or half-yearly or annually and so on.

In order to define an interest rate fully, and enable one to compare it with other interest rates, the interest rate *and* the compounding frequency must be disclosed. Since most people prefer to think of rates as a yearly percentage, many governments require financial institutions to disclose the equivalent yearly compounded interest rate on deposits or advances. For instance, the yearly rate for the loan in the above example is approximately 12.68%. This equivalent yearly rate may be referred to as annual percentage rate (APR), annual equivalent rate (AER), annual percentage yield, effective interest rate, effective annual rate, and by other terms. For any given interest rate and compounding frequency, an "equivalent" rate for any different compounding frequency exists. Compound interest is explained with an example in Box 1.1.

Compound interest may be contrasted with simple interest, where interest is not added to the principal (i.e., there is no compounding). Compound interest is standard in finance and economics, and simple interest is used infrequently (although certain financial products may contain elements of simple interest).

One other way in which interest rates can be classified is in terms of fixed interest rates and floating interest rates:

Fixed Interest Rate: If the rate of interest is fixed at the time the loan is given and remains constant for the entire tenure of the loan, it is called fixed interest rate.

Floating Interest Rate: Interest rates on commercial loans given to companies or individuals often fluctuate over the period of the loan. Also, loans may have an interest rate over the life of the loan linked to some reference rate, such as PLR (Prime Lending Rate), which varies over time. [1] For example, interest rate on a loan can be fixed at PLR plus 2 percent. As the PLR changes, the interest rate on the loan would change. In such cases, the interest rates are said to be floating rate, or variable rate.

1.5 Present Value, Future Value and Discount Factor

Before understanding the concepts of present value, it is important to have a better understanding of compounding of interest.

As stated earlier, the interest rate is usually quoted in terms of percentage per annum of the loans taken. For example, if a company borrows Rs. 100 crores and promises to return Rs. 106 crores at the end of one year, then the interest rate paid out is 6% per annum (p.a.). If on the other hand, this borrowing company borrows Rs 100 crores for say 3 years at the same 6 % p.a, but is required to pay interest only at the end of three years, he would have to pay more than Rs 118 crores. As you can easily see, what is at work here is compound interest rate. This can be explained through the following illustration.

Box 1.1: Illustration of Compounding of Interest

Suppose Rs.100 is invested in a bank deposit and the bank is paying interest at 6 percent per year on deposits, compounded annually. The interest earned on the investment in a year is given by:

Interest in year 1 = interest rate × initial investment = 0.06 × Rs.100 = Rs.6

You start the year with investment of Rs.100 and you earn interest of Rs.6, so the value of your investment by the end of the year is given by:

Value of investment after 1 year = Rs.100 + Rs.6 = Rs.106

Thus Rs.100 invested grows by the factor (1 +0.06) = 1.06. In general, for any interest rate *r,* the value of the investment at the end of 1 year is (1 + *r*) times the initial investment:

Value after 1 year = initial investment × (1 + *r*)

= Rs.100 × (1.06) = Rs.106

[1] PLR is an interest rate quoted by a commercial bank as an indication of the rate being charged on loans to its best commercial customers. It serves as a benchmark interest rate.

If this money is left in the bank in the year 2 then, Rs.106 will continue to earn interest of 6 percent. So Interest in Year 2 is given by:

Interest in Year 2 = 0.06 × Rs.106 = Rs.6.36

Thus, you start the second year with Rs.106 on which you earn interest of Rs.6.36. By the end of the year 2, the value of your investment will grow to Rs.106 + Rs.6.36 = Rs.112.36.

In the first year your investment of Rs.100 increases by a factor of 1.06 to Rs.106; in the second year the Rs.106 again increases by a factor of 1.06 to Rs.112.36. Thus the initial Rs.100 investment grows twice by a factor 1.06:

Value of investment after 2 years = Rs.100 × 1.06 × 1.06

= Rs.100 × $(1.06)^2$ = Rs.112.36

Thus for an investment horizon of n years, the original Rs.100 investment will grow to

Rs.100 × $(1.06)^r$. For an interest rate of *r* and a horizon of n years, the future value of your investment will be

Future value of Rs.100 = Rs.100 × $(1+r)^n$

In general, **Future value = Present Value ×** $(1+r)^n$

This is called 'annual compounding', as the interest is compounded each year. Similarly, there can be half-yearly or quarterly compounding.

In the above example, we saw that Rs.100 invested today has a value of Rs.106 after a year. This is the concept of future value. We can say Rs.100 invested today has a future value of Rs. 106. Let us now put this in a different way. How much do we need to invest today to get Rs.106 at the end of one year? The underlying concept contained in this question is called the present value of a future payoff.

Present value = PV = FV / $(1+r)^n$

The process of calculating present value from a future value is called discounting. The Present Value of Rs.106 which is to be received after one year from now = $\frac{106}{(1+0.06)}$ = Rs. 100.

The rate of return *r* is the reward that investors demand for accepting a delayed payment.

To calculate present value (also referred to as PV) of an investment, we discount the future cash flows from this investment by the rate of return offered by equivalent investment alternatives in the capital market. This rate of return is referred to as the discount rate**.**

Discount Factors

An n-period discount factor is the present value of one unit of currency that is payable at the end of period n. Thus it is the present value relationship expressed in terms of a future value of Rs. 1 after a given period. A discount factor for any period of discount is given by the formula:

$$\textbf{Discount Factor} = \frac{1}{(1+r)^n}$$

n = the period of discount; and r = interest rate

Using this formula, the two year discount factor, for example, for an investment that yields 6% interest compounded annually is

$$\text{Discount Factor} = \frac{1}{(1+0.06)^2} = 0.889996$$

Similarly, the five-year discount factor for an investment that yields 6% interest compounded annually is:

$$\text{Discount Factor} = \frac{1}{(1+0.06)^5} = 0.747258$$

Discount factors are used to find the present value of certain cash flows generated at a defined point of time in future, by using the following formula:

Present Value = Future Value x Discount Factor

As calculated in the example given in Box 1.1, the future value of the initial investment of Rs 100 after two years is Rs 112.36. Also, we have found that the two year discount factor for an investment that yields 6% interest compounded annually is 0.889996. The present value of the instrument generating a cash flow of Rs. 112.36 at the end of two years can be computed as follows:

PV = 112.36 x 0.889996 = 100

An extension of this can be used to price other securities as well. For example, consider an investment instrument that pays a coupon (interest) every year and pays back the principal investment at the maturity of the security. This principal investment is called face value. Such instruments are also called fixed income security or bonds.

Now let $c_1, c_2, c_3 \ldots c_n$ be the coupon payments received in years 1, 2, 3…n for an n-year coupon paying bond. The security will repay the principal i.e. face value at the end of the n^{th} year. The

PV of this security can be calculated as sum of the present values of each interest payments and the principal payment at the maturity of the bond.

$$PV = \frac{c_1}{(1+r)} + \frac{c_2}{(1+r)^2} + \frac{c_3}{(1+r)^3} + \ldots\ldots + \frac{(c_n + Face\ value)}{(1+r)^n}$$

Illustration:

Consider a five year security, paying interest annually at 6% with initial investment value of Rs.100. The present value of the security can be calculated as:

$$PV = \frac{6}{(1+0.06)} + \frac{6}{(1+0.06)^2} + \frac{6}{(1+0.06)^3} + \frac{6}{(1+0.06)^4} + \frac{(6+100)}{(1+0.06)^5} = \text{Rs. } 100$$

CHAPTER 2: Money and Fixed Income Markets

Money Markets and fixed income markets are the markets for borrowing / lending money and it is in these markets that the interest rates get determined. Conventionally, money can be borrowed or lent between players in two market segments:

- Short term lending/ borrowing market
- Long Term Lending/ borrowing market

Short term borrowing/lending market is usually referred to as Money Market, whereas long term borrowing/lending market is called fixed income market. We discuss both these markets in this Chapter.

2.1 Money Markets

The term "Money Market" refers to the market where the needs for and the deployment of *short-term* funds are addressed. It is the market for short-term financial instruments that are close substitutes of money. Money Market instruments are those instruments, which have a maturity period of less than one year. The most important feature of a Money Market instrument is that it is liquid and can be converted into cash quickly. Also, it provides an opportunity for balancing the short-term surplus funds of lenders and the short term requirements of borrowers. There is a wide range of participants (banks, primary dealers, financial institutions, mutual funds, trusts, provident funds etc.) dealing in Money Market instruments. In India, the Money Market instruments and the participants of Money Market are regulated by the RBI and the SEBI. Overnight Call Money / Repo are very short-term Money Market products and constitute the most active segment of the Money Market.

The Indian Money Market has come of age in the past two decades. In order to study the Money Market in India and its operations, we first need to understand the various instruments around which the Money Market in India revolves. The Indian Money Market involves a wide range of instruments having maturities ranging from one day to a year. These instruments are typically issued by banks and corporates of various sizes. The Money Market is also closely linked with the Foreign Exchange (FX) Market as certain global companies can raise / invest money in Money Markets across the world. For example, when these companies decide to invest in the Money Market of a certain country, they convert their funds into the currency of that country in the FX Market. Similarly, while taking the returns on their investment out of the country, they convert these returns into the currency of their choice in the FX market.

The following instruments form the bulk of Money Market in India:

- Call/ Notice/ Term Money
- Repo/ Reverse Repo
- Inter Corporate Deposits (ICD)
- Commercial Paper
- Certificate of Deposit
- T-bills

Each of these provides a different kind of mechanism to raise money. Some basic knowledge of these markets is necessary before one begins to understand what interest rate derivatives are and how to trade in them.

Call Money Market: Call Money Market is basically an overnight market in which all banks participate. Even though Call Money Market is basically an overnight market, one can borrow for up to 14 business days (that is, excluding intervening holidays) in this market. If the borrowing tenure is more than one business day, the instrument is called notice money; otherwise, the instrument is called call money. Both the instruments—call money and notice money—are traded in the Call Money Market. [2] This market is a forum for all banks and select financial institutions (such as large non-bank financial companies and mutual funds) to deploy their surplus funds as well as to source funds to finance their deficit on a day-to-day basis. The Call Money Market is typically very liquid and the call money rate (that is, interest rate in the Call Money Market) is a prime indicator of the level of liquidity in the entire financial system. A fall in the call money rates indicates a rise in the liquidity in the financial system and vice versa.

The other key feature of this market is that the borrowings are unsecured; that is, they are not backed by any collateral. Further, call money rates are often quite volatile as the demand for and supply of the short term funds amongst the interbank players often tend to vary widely.

The daily turnover in the Call Money Market runs into billions of rupees. The market is operational between 9.30 am to 12.30 pm on Saturdays and between 9.30 am to 2.30 pm on every other working day.

It is in this market that brokers and dealers borrow money either to finance their own inventory of securities or to cover their customers' margin accounts.

[2] Notice money is called so, because in case the tenure is more than one business day, either the borrower or the lender can revoke the contract by giving a short notice.

Overnight MIBOR: MIBOR rate or Mumbai Interbank Offer Rate is the average of call money rates offered by a set of specific banks on a given day. (Please note that call money rates offered by institutions other than banks are not taken into consideration while calculating MIBOR.) MIBOR is an index and is calculated on a daily basis by the NSE after taking quotes from a specific set of banks on their respective interest rates for overnight funding. This index serves the purpose of providing a reference rate to which various entities can benchmark their short-term interest rates.

Repo: Repo or repurchase agreement is a form of short-term borrowing for dealers in government securities. The dealer sells the government securities to investors, usually on an overnight basis, and makes a commitment to buy them back (on the following day).

For the party selling the security (and agreeing to repurchase it in the future) it is a repo; for the party on the other end of the transaction (that is, buying the security and agreeing to sell them in the future), it is a reverse repurchase agreement (or Reverse Repo). In India, the Repo/Reverse Repo transactions can be done only in Mumbai and only between parties approved by the RBI and in securities approved by the RBI (such as Treasury Bills, Central/State Govt. securities). [3]

Inter Corporate Deposits (ICD): This market is used for short term cash management for large companies. A company can raise money through two variants of the Inter Corporate Deposits:

- **Fixed Rate ICD:** The interest rate of the Fixed Rate ICD is negotiated by the two parties at the beginning of the contract and remains same for the entire term of the ICD. As per the RBI guidelines, the minimum period of the ICD is 7 days and can be extended up to a period of 1 year. The rates generally track Interbank Call Money Market Rates.
- **Floating Rate ICD:** Companies can also borrow through floating Rate ICD which may be benchmarked/ linked to market interest rates like NSE's MIBOR. Like Fixed rate ICDs, Floating Rate ICDs can have tenure of 7 days to a year. Typically borrowers/lenders have the right to exit the transactions after 7 days.

Commercial Paper: Commercial paper is an unsecured promissory note with a fixed maturity ranging from 7 days to 1 year. Commercial Paper is a money-market security issued (sold) by highly rated corporate borrowers, primary dealers and large financial institutions to raise funds to meet their short term debt obligations, and is only backed by the issuers' promise to pay the face amount on the maturity date specified on the note. Since it is not backed by collateral, only firms with excellent credit ratings from a recognized rating agency are able to sell their commercial paper at a reasonable price.

[3] Repo is important concept in the discussions relating to interest rate futures and hence is discussed in greater detail in Chapter 3.

Commercial paper is usually sold at a discount to the face value and is redeemed at the face value at the maturity. The difference between the purchase price (i.e., discounted face value) and the face value is the return earned by the buyer of the commercial paper.

Certificate of Deposit (CD): CDs are issued by scheduled commercial banks or financial institutions. The CDs offer the banks an opportunity to mobilize bulk resources for better fund management. To the investors, they offer a decent cash management opportunity with market related yield and a relatively high degree of safety. Like commercial paper, these are also usually issued at a discount to face value and are redeemable at par on maturity. The RBI allows CDs to be issued up to one-year maturity. However the maturity most quoted in the market is 90 days.

T-Bills: Treasury Bills or T- bills are Money Market instruments issued only by Governments. T-bills are issued to finance the short term requirements of the Government. T-bills are discounted securities, implying that they are issued at a discount to face value. The return to the investor is the difference between the maturity value and the issue price.

There are different types of Treasury bills based on the maturity period such as 3-month, 12-month Treasury bills etc. In India, at present, the active Treasury Bills are the 91-days and 364-days Treasury bills.

Investment in T-Bills has the following advantages over other forms of investments such as bank deposits:

- Zero default risk, since it is a sovereign paper
- High liquidity
- Transparency and simplified settlement
- high degree of tradability and active secondary market (which help the investors in meeting unplanned fund requirements)

2.2 Fixed Income Markets

Fixed income markets are markets where participants can borrow or lend for longer term, typically for one year or longer. In 2008, the size of the international fixed income market was an estimated $67.0 trillion. Fixed income markets in most countries remain decentralized and lack common Exchanges as in the case of stock, future and commodity markets. This has occurred, in part, because no two bond issues are exactly alike, and the number of different securities outstanding is far larger than in other financial markets such as in a stock market.

2.2.1 Fixed Income Securities

The instruments traded in the fixed income market are referred to as fixed income securities. There are two broad categories of Fixed Income Securities. They are:

Bonds: A bond is a fixed interest financial asset issued by governments, companies, banks, public utilities and other large entities to raise funds. A discount bond pays the bearer a fixed amount only at the ending date, while a coupon bond pays the bearer a fixed amount over a specified interval (month, half-year, year, etc.) as well at the end date. Across the world, government bonds dominate the fixed income markets because of their size, liquidity and absence of credit risk--factors which make these bonds relatively more sensitive to interest rates in comparison to other bonds (such as corporate bonds). Even in India, Government bonds account for the bulk of the fixed income market. References to the 'bonds' in this book usually refer to the government bonds.

A debenture (or corporate bond) is a debt instrument used typically by large companies to borrow medium to long-term funds. Debentures are generally freely transferable by the debenture holders. Debenture holders have no voting rights in the companies whose debentures they hold. The interest paid to the debenture holders is a charge against profit in the company's financial statements.

2.2.2 Participants in Fixed Income Markets

There is a wide range of entities who participate in fixed income markets on both sides (selling funds and buying funds). Participants include:

- **Institutional investors:** Institutions such as mutual funds, pension funds, insurance companies, banks etc. invest in the fixed income securities.
- **Governments:** Governments frequently use fixed income markets to finance their deficits.
- **Companies:** Companies use fixed income markets to borrow money for their expansion plans and long term projects.
- **Traders:** Traders participate to take a speculative view in fixed income market.
- **Individuals:** Individual investors sometimes use fixed income market to invest their money.

CHAPTER 3: Government Bonds

3.1 Introduction to Bonds

One way to finance one's investments and consumptions is by taking loans from banks and other institutions. Many corporations and individuals do this. Another way is by selling bonds to investors. Typically governments and big corporations resort to this route. There are of course several companies that take both the routes.

The money collected by the issuer when a bond is issued (or sold) to the public, can be thought of as a kind of loan received by the issuer. In return, the issuer agrees to make specific payments to the bondholders, who are the lenders. The interest rate can be considered as the price of money. As stated earlier, interest rate is expressed in terms of a percentage of the original loan that has to be paid back.

When an investor owns a bond, he/she generally receives a fixed interest payment each year until the bond matures. A bond is a debt security, in which the authorized issuer owes the holders a debt and, depending on the terms of the bond, the issuer is obliged to pay interest (the coupon) and repay the principal at a later date. Thus a bond is like a loan: the issuer is the borrower (debtor), the holder is the lender (creditor), and the coupon is the interest.

The terms of the transaction are pre-determined. They include the rate of interest to be paid by the borrower to the lender, the periodicity of such interest payment, and the repayment of the principal amount borrowed (either in installments or in bullet). In the Indian securities markets, we generally use the term 'bond' for debt securities issued by the Central and State governments and public sector organizations, and the term 'debentures' for instruments issued by the corporate sector.

At the time of every annual budget, governments typically determine an amount that they plan to borrow from the market during the year. This amount is determined based on the deficit (equals the government's expenditure minus the government's revenue) projected for a year at that time. If however there is an unforeseen increase in expenditure beyond what was projected at the time of budgeting (such as stimulus plans for the economy) or an unforeseen decline in revenue due to any reason (such as recession), the government has to borrow more than the planned amount. This additional borrowing is called unplanned borrowing. In India, Government bonds (G-secs) are sovereign securities which are issued by the Reserve Bank of India on behalf of Government of India as part of the government's market borrowing program. Since the government bonds are issued by the Government of India, which is a sovereign entity, there is no default risk.

Bonds of the Government of India with a maturity period of at least 2 years are called government securities or G-secs. The maximum tenure of borrowing can be 30 years. typically

In India the bulk of the borrowing however takes place for a term of 5-15 years. Different types of government securities in India are discussed in Box 3.1. Bonds are typically referred to by their remaining time to maturity. Thus, a government security maturing after 10 years from today irrespective of when it was issued is called a 10 year G-sec.

Box 3.1 Types of Government Securities

Dated Securities are generally fixed maturity and fixed coupon securities usually carrying semi-annual coupons. These are called dated securities because they are identified by their date of maturity. They are also identified by their respective coupons. Thus, 6.90% GOI 2019 is a Central Government security that matures in 2019 and carries a coupon of 6.90% payable half yearly. In this book, G-Sec or govt. bond henceforth will refer to dated securities only.

Zero Coupon bonds are bonds issued at discount to face value and redeemed at par. In India, these were first issued in January, 1994 and were followed by only two subsequent issues in 1994-95 and 1995-96 respectively.

Floating Rate Bonds are bonds with variable interest rate where the coupon is higher than a benchmark rate by a fixed percentage. As the benchmark rate changes, the coupon rate also changes. In some cases, there may be a cap and a floor rate attached; thereby fixing a maximum and minimum interest rate payable on it. In India, the RBI issued a floating rate bond on Nov 07, 2003, the coupon of which was benchmarked to the yield of Government of India 364 day Treasury Bills with a provision that the coupon would be reset every six months.

Bonds with Call/Put Option: For the first time in the history of the Indian Government Securities market, the RBI issued a bond with call and put option in 2002. This bond, due for redemption in 2012, carries a coupon of 6.72 % and has call and put option in year 2007. The implication of the call and put option is that in the year 2007 the bond-holder could sell back (put option) the bond to the Government or Government can buy back (call option) bond from holder.

3.2 Characteristics of Bonds

Face Value/ Par Value/Principal Amount: Face value is the amount of money that the issuer pays the holder of the bond when the bond matures. A newly issued bond usually sells at the face value. When a bond trades at a price above the face value, it is said to be selling at a premium and when a bond sells below face value, it is said to be selling at a discount. If a bond trades at the face value, it is said to be trading at par.

Maturity Date: Maturity date of a bond is the date in the future on which the investor's principal will be repaid.

Term to maturity: This concept is relevant for bonds that are already issued. At any point of time, the term to maturity of a bond is the amount of time left for the bond to mature. Thus, the term to maturity changes every day from the date of issue of the bond till its maturity.

Coupon amount: Coupon amount is the sum of money that the bondholder receives as interest payments at pre-defined regular intervals (typically semi-annual). When the coupon amount is expressed as a percentage of face value it is called coupon rate. Thus,

Annual coupon amount= Face value x Coupon rate

It may be noted that the coupon rates are fixed at the time of issuance of the bond. While coupon rates are expressed in annualized terms, coupon amounts depend on the coupon payment frequency. Please see the illustration given below.

Illustration:

Consider a Government of India 2020 6% bond with a face value of Rs 100. This is a Central Government bond maturing in the year 2020 and pays coupons at the rate of 6%. The annual coupon amount here is Rs 6 (6 % X 100); but since government bonds pay coupons semiannually, the investor would receive coupon amount of Rs 3 (Rs 6/2) every six months until maturity. In the year of maturity (i.e., 2020), the investor will receive the principal of Rs 100.

3.3 Concept of yield

The yield of a bond is the return that the investor receives on his investment in the bond. There are various ways to measure yield for making investment decisions. The two most commonly used measures of yield are the coupon yield and the yield to maturity. A bond's coupon yield at any given time is given by the coupon amount as a percentage of the bond's price at that point of time:

Coupon yield % = (Coupon amount/Price) X 100

Clearly, for a given coupon amount, the coupon yield of a bond is inversely proportional to its price; as the bond's price rises, the bond's coupon yield falls and vice versa.

Illustration:

- Suppose one buys a bond at a price of Rs 100, which is also its face value, with a 10% coupon rate (that is, coupon amount of Rs 10). In this case, the coupon yield of the bond is also 10%, since the coupon amount (Rs 10) is 10 percent of the price (Rs.100). Thus, in case the price of a bond is equal to its face value, the coupon yield is equal to the coupon rate.
- Since the coupon amount remains unchanged (in this case, at Rs 10), the coupon yield of a bond changes as the price of the bond varies with time. If the price of the bond goes down to Rs.80, for example, then the coupon yield goes up to 12.5%, using the formula given above. Conversely, if the bond price goes up to Rs.120, the yield shrinks to 8.33%.

Yield to maturity (YTM) is that rate at which if all the future cash flows (interest payments as well as the ultimate principal repayment) are discounted to their present value, the sum of all these discounted present values equals the price of the bond. In other words, it is the internal rate of return (IRR) for the investor who buys the bond. Calculation of yield to maturity assumes that the bond is held till maturity. It may be noted that like in the case of coupon yield, the YTM will equal the coupon rate if and only if the bond is trading at par. The YTM of a bond is not constant over its lifetime and it changes as the bond price changes. YTM is a very important concept for trading bonds and interest rate futures (IRF). Henceforth, when we mention yield, we mean YTM, unless otherwise specified.

Illustration:

Let y be the yield to maturity of the bond; its time to maturity be 2 years, c be the coupon amount and P be the face value.

According to the definition of YTM, we can determine YTM by solving the following equation.

Curent bond Price = $c/ (1+y) + c/ (1+y)^2 + P/ (1+y)^2$

The Left Hand Side of the above equation is the current price of the bond, while the Right Hand Side is the present value of all the cash flows.

Hence if we have the price of the bond, the annual coupon payment and the face value of the bond, we can calculate the YTM from the above equation.

3.4 Relationship between Bond Price and Interest Rate

The prices of bonds are affected by many factors, the most important of them being the changes in the interest rate in the economy. How does this happen? The first thing to note is that coupon rates keep pace with the interest rates in the economy. When interest rates rise in the overall economy, the coupon rates of newly issued bonds rise as well. Similarly, when interest rates in the overall economy fall, the coupon rates on new bonds fall.

Let us see with an example what happens to bond prices when the interest rate in the overall economy changes. If the interest rate drops, the coupon rates of the new bonds will be lower than the older bonds. Thus the bonds that were issued paying the higher, older rate will provide more income than a bond paying the newer, lower rate. For example, suppose there is a bond paying 7% coupon and hence providing Rs. 7 of income each year. Now suppose interest rates fall and as a result, the coupon rates of the new bonds also fall to say 5 percent. These bonds with 5% coupon rates provide only Rs. 5 per year. So, the investors will obviously demand the bond with Rs 7 coupon income to get the extra income. As the demand for the bond with Rs 7 coupon income increases, its price would rise beyond Rs 100 i.e. face value. Now, when the price increases, the bond's yield drops. This happens until the yield of the bond with Rs 7 coupon income, falls to match the new interest rate of 5 percent. The opposite would happen when interest rates rise. The upshot of this exercise is that when interest rates decline, the bond prices rise and when interest rates rise, bond prices decline. There are two things to note here. First, when interest rates change, bond prices change instantly. Second, the larger the change in interest rate, the larger will be the change in bond prices.

3.4.1 Duration

The term duration has a special meaning in the context of bonds. It is a measurement of how long, in years, it takes for an investment in a bond to be repaid by its internal cash flows. It is also an important measure because bonds with higher durations carry more price risk and have higher price volatility than bonds with lower durations. In other words, for the same change in yield, the price of a bond with higher duration changes by a larger amount than that of a bond with smaller duration.

Fredrick Macaulay, in 1938, first propounded the idea of duration, and we call his measure Macaulay's duration. **Macaulay duration** in years is the weighted average of time periods at which the cash flows (coupon amounts as well as principal) are received. So, for a two-year

bond with 4 coupon payments every six months, the Macaulay duration is the weighted average of 0.5, 1, 1.5 and 2 years. The weight assigned to any time period is the present value of the cash flow at that time period as a share of present value of all cash flows put together; the discount factor for arriving at the present value being the yield of the bond. In very simple terms, Macaulay Duration signifies the time it takes for a bond to pay itself out to the investor.

The other measure of Duration is **Modified Duration**. Modified Duration is a measure of the sensitivity of a bond's value to the absolute change in its yield. More specifically, it is the percentage change in value of a bond for a 100 basis point change in yield. Modified duration is, therefore, a direct measure of the interest rate sensitivity of a bond. The higher the modified duration of a bond, greater the percentage change in price for a given change in yield.

Modified Duration of a bond is estimated as follows:

$$\frac{\text{Percentage change in bond price}}{\text{Change in yield in basis points}} \times 100$$

Note that 1 basis point is equal to one-hundredth of 1 percent. Thus, 25 basis points are equal to 0.25 percent and 50 basis points are equal to 0.5 percent and so on.

Let us illustrate how the duration of a bond is measured. Suppose the yield of a bond changes from 5 % to 4.5 % and as a result, the bond price rises from 100 to 105. Thus, with 50 basis points decline in yield, the price of the bond rises by 5 percent. The Duration of the bond would therefore be 10, using the formula given above.

Let us take another example. Suppose there are two bonds: one with 10 year duration and the other with 5 year duration. With the same 100 basis points change in the yield, the percentage change in the price of bond with 10 year duration will be twice that of the bond with 5 year duration.

The following points need to be noted.

- Duration represents the length of time needed to recapture the purchase price of a bond from the present value of the bond's expected cash flows.
- The higher the coupon, the shorter the duration. In Table 3.1, let us take bonds with 5 year maturity. It can be seen that the duration of the 8 percent coupon (4.06) is less than the duration of 6 percent coupon (4.27). As the coupon rate rises, the duration gets shortened.
- The higher the yield, the shorter the duration.
- A pure discount bond has duration equal to the maturity. For all other bonds, duration is less than maturity.

•

Table 3.1:

Maturity (in years)	Duration (in years) of Bonds with different coupon rates (Assuming bond is purchased at par)			
	6%	**8%**	**10%**	**12%**
1	0.96	0.94	0.93	0.92
3	2.71	2.62	2.54	2.46
5	4.27	4.06	3.86	3.68
10	7.44	6.8	6.23	5.73
15	9.8	8.65	7.69	6.88
20	11.56	9.9	8.58	7.52
30	13.84	11.31	9.46	8.08
40	15.1	11.96	9.8	8.25

From the above table, following generalizations can be made:

- The higher the coupon the shorter the duration. This is because the final redemption payment accounts for a smaller percentage of the bond's current market value.
- For bonds of less than 5 years maturity, duration expands rapidly as maturity expands. For 5-15 years maturity, duration continues to expand but at a considerably slower rate. Beyond 15 years maturity, duration grows very slowly as maturity rises.

3.4.2 PVBP

Present Value of One Basis Point (PVBP) is another term often used to quantify the relationship between bond price and interest rate. It is the change in price in absolute terms (and not in percentage terms) of a bond for one basis point (0.01%) change in the yield. PVBP can be easily calculated from the bond's duration using the following formula:

$$\text{PVBP of a Bond} = \frac{\text{Absolute change in bond price}}{\text{Change in yield in basis points}}$$

It can therefore be shown that:

$$\text{PVBP} = \text{Modified Duration} \times 0.0001 \times \text{Price of the bond.}$$

3.5 Other Bond Terminology

3.5.1 Accrued Interest

Coupon payments occur at periodic intervals. When a bond is sold on a day that falls between two coupon payment dates, the buyer of the bond gets the full interest payment due for the latter coupon payment date. However the seller has a right over the interest payment for the period for which he was holding the bond i.e. from the date of the last coupon payment he

received till the settlement date of the trade. Hence at the time of sale, the buyer pays the seller the bond's price plus accrued interest.

Accrued interest calculation is done by multiplying the annual coupon amount by the ratio of the number of days between the last coupon payment and the settlement date (n) and the number of days in a year (d)

Accrued Interest = Annual Coupon amount × (n/d) = Coupon rate x (n/d) x face value

The calculation of the days between two interest payment dates (n) and the number of days in a year depend on the day count convention followed in the market. These conventions vary from country to country (Please see Box 3.2). In India, 30/360 European convention is used.

Box 3.2: Day Count Conventions

Different markets use different conventions for calculating (a) the number of days that have elapsed between last coupon payment and settlement date and (b) the number of days in a year.

The following are the most popular conventions:

We take the example of a bond with Face Value 100, coupon 12.50%, last coupon paid on 15th June, 2008 and settlement date of 5th October, 2008.

Actual/360

In this method, the actual number of days elapsed between the two dates is divided by 360, i.e. the year is assumed to have 360 days. Using this method, accrued interest is 3.8888.

Actual/365

In this method, the actual number of days elapsed between the two dates is divided by 365, i.e. the year is assumed to have 365 days. Using this method, accrued interest is 3.8356.

Actual/Actual

In this method, the actual number of days elapsed between the two dates is divided by the actual number of days in the year. If the year is a leap year AND 29th of February falls between the two dates, then 366 is used in the denominator, else 365 is used. Using this method, accrued interest is 3.8356.

30/360 European

Under this method, each month is assumed to have 30 days and the year 360 days. If the coupon date or the settlement date falls on the 31st of any month, the following adjustment is done: the last coupon dates and the settlement dates that occur on the 31st of a month are taken as the 30th of the same month.

30/360 American

This method is the same as 30/360 European with the following exception. This exception relates to the settlement date falling on 31st of a month: if the last coupon date is earlier than the 30th of a month, the settlement date is taken as the 1st of the next month and if the last coupon date is on or after 30th of the month, then the settlement date is taken as the 30th of the same month.

Illustration of convention followed in India:

Assume that a bond with a face value of Rs 100 is issued on 1st of June 2006 and matures on 1st of June 2016. It pays 6% annualized coupon. Coupons are paid biannually on 1st June and 1st December. As of 1st September 2009, the accrued interest can be calculated as:

AI = 6% x (90/360) x 100 = Rs. 1.5

We are using a fraction of 90/360 because of the convention, although the actual number of days that elapsed since the last payment of coupon is 92 days and the total number of days is the year 2009 is 365 days.

3.5.2 Clean Price/Dirty Price

When investors buy a bond in the market, what they pay is known as the dirty price. The dirty price includes the accrued interest that the seller is entitled to receive. The clean price, on the other hand, is the dirty price of the bond minus the accrued interest.

Dirty Price = Clean Price + Accrued Interest

Therefore, Clean Price = Dirty Price – Accrued Interest

Calculation of dirty price and clean price is crucial for bond trading and interest rate futures. When bonds are traded, the quotes are made in clean price. At the time of settlement, however, accrued interest is added to the clean price and bonds are settled at dirty price. The buyer of the bond will pay the dirty price to the seller of the bond.

3.5.3 Cost of Carry

Cost of carry in bonds is similar to cost of carry in equities market. In equity markets for example, if SBI is trading at 2180 in cash market and one month futures of SBI are trading at 2195, then cost of carry for SBI is

Cost of carry for SBI = Cost of Futures of SBI- Cost of SBI in cash market

= 2195-2180 = Rs. 15

Cost of carry of a bond is also equal to the cost incurred for holding a bond over a period of time. It has two components: cost of funding and coupon accrued. Cost of carry is given by the difference between the cost of funding the bond and the interest accruing to the bond holder. The two components are defined below.

1. Cost of funding is the interest that the investor has to pay for the period he holds the bond, assuming that he borrows money to buy the bond. For this purpose, the repo rate is typically taken as the interest rate.

2. Coupon accrued is the interest accruing to the bond holder. This is the coupon amount that accrues to the bond holder during the period he holds the bond. Coupon accrued is the interest that has accrued but not yet been paid on a bond. It is calculated by multiplying the coupon amount (=face value of the bond x coupon rate) and the time fraction elapsed since the interest started accruing.

Cost of carry = Cost of funding – Coupon accrued = (Bond Price x repo rate x time) – (Face value of the bond x coupon rate x time)

Illustration:

From the example given in section 3.5.1 , the cost of carry between 1st September and 1st December is (assuming repo rate of 5% and Bond price of Rs. 100):

Cost of carry till 1st Dec 2009 = (100 x 5% X 3/12) – (100 X 6% x 3/12) = Rs. -0.25

The concept of Repo has been explained in section 3.6.

3.6 Repo and Cost of Funding

Repo or a repurchase agreement is a Money Market instrument. It allows a borrower to use a financial security as collateral for a cash loan at a fixed rate of interest. In a repo, the borrower agrees to sell immediately a security to a lender and also agrees to buy the same security from the lender at a fixed price at some specified later date, which is akin to a forward price. In the case of a repo, this forward price of the bonds is set in advance at a level, which is different from the spot price and the difference depends on (i) repo interest, (ii) coupon rate of the security and (iii) period of repo.

3.6.1 Repo Rate

Repo rate is the rate at which a bank can borrow money from another bank or from a central bank of the country in the event of scarcity of funds. In India, for example, whenever the banks have any shortage of funds they can borrow from the Reserve Bank of India (RBI) at the prevailing repo rate. Factors affecting the repo rate include the credit worthiness of the borrower, liquidity of the collateral and comparable rates of other Money Market instruments. Repo rates tend to be lower if:

- The borrower is highly creditworthy; or
- The collateral is very liquid; or
- The comparable rates of other Money market instruments are relatively low.

In a repo transaction, there are two legs of transactions viz. selling of the security and repurchasing of the same. In the first leg of the transaction, sale price of the security is usually based on the prevailing market price for outright deals. In the second leg of the transaction (which is on a future date), the repurchase price of the security is pre-determined based on current price of the security, the prevailing repo rate and the coupon rate of the security.

3.6.2 Advantages of using repo

Repos can provide a variety of advantages to the financial market in general, and debt market in particular; significantly:

- Repo is a tool for funding transactions. It enables security dealers to deal in higher volumes than otherwise.
- For institutions and corporate entities, repos provide a source of relatively inexpensive finance.
- Central banks can use repo and reverse repo as an integral part of their open market operations with the objective of injecting/withdrawing liquidity into and from the market and also to reduce volatility in short term in particular in call money rates.

CHAPTER 4: Interest Rate Derivatives

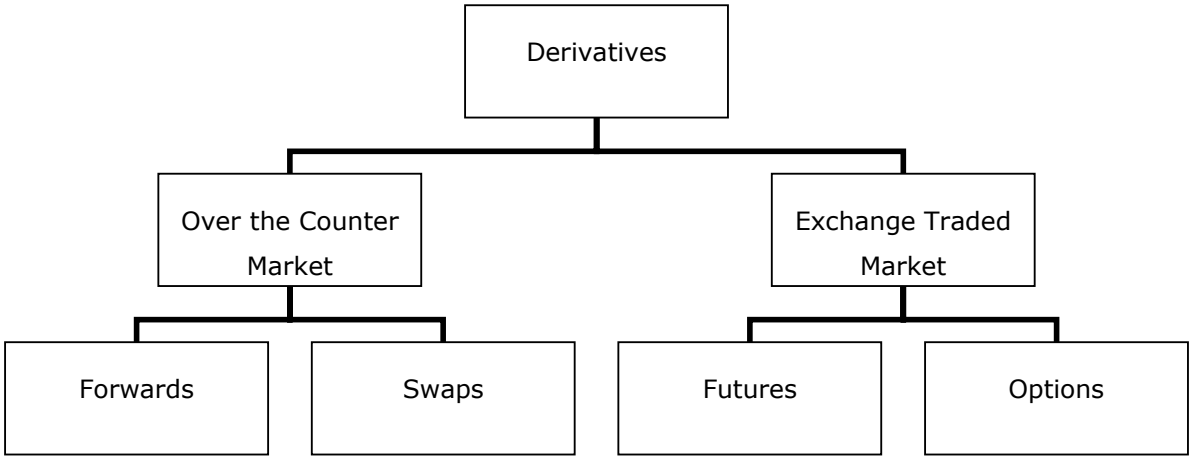
Now that we have understood the basics of bonds, let us try and understand interest rate derivatives, which are investment products that derive their profits and losses based on the movement of bond prices (equivalently on movements in interest rates).

Derivative is a product whose value is derived from the value of one or more basic variables, called bases (underlying asset, index, or reference rate). The bases can be equity, currency, commodity, any asset or interest rate. Depending on the base, derivatives can be classified as equity derivatives, foreign exchange derivatives, commodity derivatives, and interest rate derivatives. In this chapter, we give a brief overview of various interest rate derivative products. These products can be broadly classified as either OTC or Exchange traded products.

As per SEBI guidelines, derivatives include:

a. a security derived from a debt instrument, share, loan, whether secured or unsecured, risk instrument or contract for differences or any other form of security;

b. a contract which derives its value from the prices, or index of prices, of underlying securities;



4.1 OTC Derivatives

Over-the-counter (OTC) derivatives are private, bilateral contracts in which two parties agree on how a particular trade or agreement is to be settled in the future. OTC contracts on Interest Rate instruments have been prevalent in the Indian market since 1999 and have been used by institutions mainly to hedge their interest rate exposure. OTC trading is mostly done through the telephone. For OTC derivatives, the agreements are usually designed under the framework of an International Swaps and Derivatives Association (ISDA) agreement.

Only derivatives in the form of forwards and swaps are allowed by the RBI in the OTC market. Some of the popular derivatives traded globally in the OTC market are discussed below:

4.1.1 Forwards

A forward contract is the simplest derivative instrument. It is a private agreement between two parties in which one party (the buyer) agrees to buy from other party (the seller) an underlying asset, on a future date at a price established at the start of the contract. Therefore it is a commitment by two parties to engage in a transaction at a later date with price set in advance. The buyer is called the long and the seller is called the short.

When a forward contract expires, there are two possible arrangements that can be used to settle the obligation of the parties. These two settlements are following:

1) Physical Delivery: In this mechanism, the forward contract is settled by the physical delivery of the underlying asset by the seller to the buyer on the agreed upon price while entering into the contract.

2) Cash Settlement: An alternative procedure, called cash settlement permits the long and short to pay the net cash value of the position on the delivery date. There are three scenarios possible. Depending on what scenario prevails on the expiry date, the net payoffs are determined for both the parties:

    a. Spot Price (ST) > Forward Price (FT): Short will pay long the difference between spot price and forward price i.e. ST-FT.

    b. Spot Price (ST) = Forward Price (FT): The net payoff is zero, i.e. no party needs to pay other party.

    c. Spot Price (ST) < Forward Price (FT): Long will pay Short the difference between forward price and spot price i.e. FT -ST.

A special kind of forward contract is called forward rate agreement (FRA). FRA is a forward contract in which one party agrees to lend to another party a specified amount at a future date for a specific period of time at an interest rate agreed upon today. FRAs are used more frequently by banks for hedging their interest rate exposures, which arise from mismatches in their tenure of their assets and liabilities. FRAs are also used widely for speculative activities.

4.1.2 Interest rate swap

In an interest rate swap, each counterparty agrees to pay either a fixed or floating rate denominated in a particular currency to the other counterparty at regular intervals (say six months) over a defined period of time (say five years). The fixed or floating rate is multiplied by a notional principal amount (say, Rs 1 crore). This notional amount of Rs 1 crore is generally

not exchanged between counterparties, but is used only for calculating the size of cash flows to be exchanged.

The most common interest rate swap is one where one counterparty A pays a fixed rate (the swap rate) to counterparty B, while receiving a floating rate (usually pegged to a reference rate such as London Inter-Bank Offer Rate or LIBOR). Thus, A pays fixed rate to B (A receives variable rate) and B pays variable rate to A (B receives fixed rate).

Consider the following swap in which Party A agrees to pay Party B periodic fixed interest rate payments of 8.65%, in exchange for periodic variable interest rate payments of LIBOR + 70 basis points (0.70%). Note that there is no exchange of the principal amounts and that the interest rates are on a 'notional' (i.e. imaginary) principal amount. Also note that the interest payments are settled in net; for example, Party A pays 8.65% - (LIBOR+0.70%). The fixed rate (8.65% in this example) is referred to as the swap rate.

At the point of initiation of the swap, the swap rate is fixed so that the sum of the present value of the cash inflows for A is equal to sum of the present value of the cash outflows for A. This kind of swap is called a **Plain Vanilla Swap**.

Interest rate swaps can be used by hedgers to manage their fixed or floating assets and liabilities. They can also be used by speculators to profit from changes in interest rates. Interest rate swaps are very popular and highly liquid instruments. In India, one counterparty of the transaction has to be a bank and banks can offer these derivatives to corporates only for hedging the underlying exposures of the corporate. Also, neither of the parties involved in the transaction is allowed to have any options (put or call) embedded in the contract. In India, aside from Plain vanilla Swaps, the following swaps are currently allowed by the RBI:

- Cross-Currency Swaps
- G−Sec Linked Swaps

Discussions on these two swaps are beyond the scope of this book.

4.2 Exchange Trades Contracts

Exchange-traded derivatives (ETD) are those derivative products that are traded via Exchanges, which may or may not be specialized in derivatives trading. For Exchange traded derivatives, the Exchange acts as an intermediary to all transactions. Exchange provides a platform where buyers and sellers can come together and the orders are matched. Once the orders are matched, the Exchange becomes the buyer to the seller and the seller to the buyer. Thus it protects both the parties to the transaction against counterparty risk. To be able to do so, it takes initial margin from both sides as collateral. As time passes, the margin required from the parties changes on a day to day basis depending on the price movement of the

transaction. Like OTC derivatives, the Exchange traded derivatives can be used for hedging or speculation. Exchange traded derivatives are usually in the form of a future or an option contracts on equity stocks, indices, currency and interest rates.

4.2.1 Futures

Like a forward contract, a futures contract is an agreement between two parties in which the buyer agrees to buy an underlying asset from the seller at a future date at a price that is agreed upon today. However, unlike a forward contract, a futures contract is not a private transaction but gets traded on a recognized Stock Exchange. In addition, a futures contract is standardized by the Exchange. All the terms, other than the price, are set by the Stock Exchange (rather than by the individual parties as in the case of a forward contract). Also, both the buyer and the seller of the futures contracts are protected against the counter party risk by an entity called the Clearing Corporation. [4] Currently in India futures are being traded on equities, commodities, FX and interest rate products. The next chapter explains the mechanism of interest rate futures in India.

4.2.2 Options

Like forwards and futures, options are derivative instruments that provide the opportunity to buy or sell an underlying asset on a future date. An option is a derivative contract between a buyer and a seller, where one party gives to the other the right, but not the obligation, to buy from (or sell to) the First Party the underlying asset on or before a specific day at an agreed-upon price (called the strike price). In return for granting the option, the party granting the option collects a payment from the other party. This payment collected is called the "premium" or price of the option. As of now, trading in options on interest rate products is not allowed in India.

4.3 Key Terminology for Futures Market

To understand the futures market well, one needs to know certain terminology associated with it. The following gives a brief description of the same:

Cash Market/Spot Market/Physical Market: It is the market for underlying securities (bonds in the current case). This can be an exchange traded market or an over the counter market. Settlement in cash market typically happens in one or two days.

Futures Price: Price at which a market participant can buy/sell the underlying at a future date.

Expiry Date: Last day of settlement for a derivative contract.

[4] NSSCL (National Securities Clearing Corporation Limited) is one such clearing corporation. It is a subsidiary of NSE. Futures traded on NSE are settled via NSCCL.

Mark to Market: In the futures market, at the end of each trading day, the margin account is adjusted to reflect the investor's gain or loss depending upon the futures closing price. This is called the mark-to-market process.

For example, if an Investor A agrees to buy 2000 bonds from another investor B on 30th June 2011. If on December 10, 2009, the futures price falls to Rs. 99 from Rs 100 on December 9, 2009, the mark to market loss for A on December 10, 2009 is (100-99) x2000 = Rs. 2000 (loss). A's loss is B's profit. So, the profit for B is Rs. 2000.

In the next chapter, we will focus on exchange traded interest rate derivatives in India.

CHAPTER 5: Interest Rate Futures in India

5.1 Interest Rate Futures (IRF)

Let us proceed to a discussion in some detail the first exchange traded derivatives on interest rates in India, namely the 'interest rate futures' or IRF. The history of IRF in India is given in Box 5.1.

While the name 'interest rate futures' suggests that the underlying is interest rate, it is actually bonds that form the underlying instruments. An important point to note is that the underlying bond in India is a "notional" government bond which may not exist in reality. In India, the RBI and the SEBI have defined the characteristics of this bond: maturity period of 10 years and coupon rate of 7% p.a. The rationale behind using a notional bond is discussed in section 6.1. It is also worthwhile noting that several other countries have adopted the concept of notional bond, although the characteristics of the notional bonds can and do vary from country to country.

One other salient feature of the interest rate futures is that they have to be physically settled unlike the equity derivatives which are cash settled in India. Physical settlement entails actual delivery of a bond by the seller to the buyer. But because the underlying notional bond may not exist, the seller is allowed to deliver any bond from a basket of deliverable bonds identified by the authorities. Details of the deliverable bonds are discussed in section 5.3.3.

Like any other financial product, the price of IRF is determined by demand and supply, which in turn are determined by the individual investor's views on interest rate movements in the future. If an investor is of the view that interest rates will go up, he would sell the IRF. This is so, because interest rates are inversely related to prices of bonds, which form the underlying of IRF. So, expecting a rise in interest rates is same as expecting a fall in bond prices. An expectation of rising interest rates (equivalently of falling bond prices) would therefore lead the investor to sell the IRF. Similarly, if an investor expects a decline in interest rates (equivalently, a rise in bond prices), he would buy interest rate futures.

Box 5.1 History of Interest rate futures

In the wake of deregulation of interest rates as part of financial sector reforms and the consequent volatility in interest rates, a need was felt to introduce hedging instruments to manage interest rate risk.

In 1999, the Reserve Bank of India took the initiative to introduce Over-the-Counter (OTC) interest rate derivatives, such as Interest Rate Swaps (IRS) and Forward Rate Agreements (FRA). Encouraged by the satisfactory experience, particularly with the IRS, the NSE introduced the exchange-traded interest rate futures (IRF) contracts in June 2003; but the market response was tepid. [5]

Before the introduction of IRF, banks and companies had only OTC market to hedge their risks, which proved to be disadvantageous for smaller companies and banks. Since counterparty risks of these entities could not be addressed, they had to pay a premium which impacted the size and scope of their transactions. Introduction of IRF promises to remove this disadvantage by addressing the counterparty risk.

In August 2008, a technical advisory committee was formed to look into the operational aspects of the IRF. Based on the report submitted by this technical committee, the joint committee of SEBI and RBI recommended introduction of the IRF in the Indian market in a new format. The NSE has introduced this format of IRF in August 2009.

5.2 Rationale of IRFs

It is not just the financial sector, but also the corporate and household sectors that are exposed to interest rate risk. Banks, insurance companies, primary dealers and provident funds bear significant interest rate risk on account of the mismatch in the tenure of their assets (such as loans and Govt. securities) and liabilities. These entities therefore need a credible institutional hedging mechanism. Interest rate risk is becoming increasingly important for the household sector as well, since the interest rate exposure of several households are rising on account of increase in their savings and investments as well as loans (such as housing loans, vehicle loans etc.). Moreover, interest rate products are the primary instruments available to hedge inflation risk, which is typically the single most important macroeconomic risk faced by the household sector. It is therefore important that the financial system provides different agents of the

[5] In June 2003, NSE introduced Interest Rate Futures (IRF) on three underlying contracts viz., notional 10-year coupon bearing bond, notional 10-year zero coupon bond and 91-day Treasury bill. Discussions on the reasons for tepid response by the market to the introduction of these products are beyond the scope of this book.

economy a greater access to interest rate risk management tools such as exchange-traded interest rate derivatives.

Benefits of Exchange traded IRF

Interest rate futures provide benefits typical to any Exchange-traded product, such as

Standardization – Only contracts with standardized features are allowed to trade on the exchange. Standardization improves liquidity in the market. The following features are standardized:

- Only certain expiry dates are allowed in India viz. last working day of the months of March, June, September and December.
- The size of contract can only be in multiples of a certain number called the lot size. The lot size currently in India is Rs. 2 lakhs.
- Only some specific bonds can be used for delivery.

Transparency – Transparency is ensured by dissemination of orders and trades for all market participants. Also, competitive matching of orders of buyers and sellers boosts transparency. Transparency improves the efficiency of the market in terms of discovery of competitive price and liquidity.

Counter-party Risk – Counterparty risk is mitigated by the exchange as explained in the previous chapter (section 4.2). The credit guarantee of the clearing house addresses counter party risk thereby improving the confidence of investors leading to wider participation.

5.3 IRF: Contract Specifications

As stated earlier, only the standardized IRF contracts can be traded on the Exchange. Standardization is done both in terms of the features of the product and the mechanism of its trading and settlement. Various features of standardization are discussed in this section.

5.3.1 Product Features

The features of the product are as follows:

- **Underlying bond:** Underlying bond is a notional 10 year, 7% coupon-bearing Government of India bond.
- **Lot size:** The minimum amount that can be traded on the exchange is called the lot size. All trades have to be a multiple of the lot size. The interest rate futures contract can be entered for a minimum lot size of 2000 bonds at the rate of Rs. 100 per bond (Face Value) leading to a contract value of Rs. 200,000.

- **Contract cycle:** New contracts can be introduced by the Exchange on any day of a calendar month. At the time of introduction, the duration of any contract can vary from 1 month to 12 months. The expiry has to be on one of the four specific days of a year, specified by the regulator. Expiry cannot happen on any other date. The set of expiry dates available in a year constitute the expiry cycle or contract cycle. The expiries specified in the current contract cycle are the last business days of March, June, September and December. (Contracts are referred to by their respective expiry months. For example, December 2009 contract means a contract expiring in December 2009.) These four contract expiries have been chosen as they coincide with the quarterly financial accounting closure followed by Indian companies. Thus, at any given time, a maximum of four contracts can be allowed for trading on the exchange (Viz., March, June, September and December contracts). Currently, at NSE only two contracts are allowed to be traded.

5.3.2 Trading Aspects

- **Tick size:** The tick size of the futures contract is Rs. 0.0025. Tick size is the minimum price movement allowed for a futures contract.

- **Trading hours:** Interest Rate Futures are available for trading from 9 am till 5 pm on all business days.

- **Last Trading Day:** The last trading day for a futures contract is two business days before the **expiry date** (i.e. the last business day of the expiry month). For example the last trading date for December 2009 contract is 29th Dec 2009, because the last business day of December 2009 is the 31st.

5.3.3 Settlement Aspects

- **MTM Settlement and Physical settlement:** For IRF, settlement is done at two levels: mark-to-market (MTM) settlement which is done on a daily basis and physical delivery which happens on any day in the expiry month. These two concepts have been explained in detail in next section.

- **Final Settlement Dates:** Final settlement which involves physical delivery of the bond can happen only the expiry date. If an investor wants to liquidate his position (i.e., sell if they have bought already or vice versa), however they can do so on any trading day before the last trading day, which has been defined above. All investors with an open short position as of the expiry day are assumed to be delivering the bond on the expiry day, which is two business days after the last trading day.

- **Delivery Basket of bonds:** As stated earlier, the underlying notional bond may not exist in reality and therefore, a basket of bonds is identified which qualify for delivery,

any one of which can be used for delivery in lieu of the notional bond. The seller of the futures has the option to choose which particular bond to deliver. Only certain identified bonds can be used for delivery. We elaborate on this in the next section. The eligibility criteria for the basket of bonds are:

- They have to be Central Government securities,
- Maturing at least 7.5 years but not more than 15 years from the first day of the delivery month. The Exchange can decide on any maturity basket within this period.
- With a minimum total outstanding stock of Rs 10,000 crore.

The Table 5.1 summarizes the contract specifications.

Table 5.1: A Summary of Contract Specification

Symbol	10YGS7
Market Type	Normal
Instrument Type	FUTIRD
Unit of trading	1 lot – 1 lot is equal to notional bonds of FV Rs.2 lacs
Underlying	10 Year Notional Coupon bearing Government of India (GOI) security. (Notional Coupon 7% with semiannual compounding.)
Tick size	Rs.0.0025 or 0.25 paise
Trading hours	Monday to Friday (On all business days) 9:00 a.m. to 5:00 p.m.
Contract trading cycle	Four fixed quarterly contracts for entire year, expiring in March, June, September and December.
Last trading day	Two business days preceeding the last business day of the delivery month.
Delivery day	Last business day of delivery month
Settlement	Daily Settlement - Marked to market daily Final Settlement - Physical settlement in the delivery month

5.4 Settlement and Risk Management

In case of exchange traded derivative contracts, the Clearing Corporation acts as a central counterparty to all trades. This principle is called `**novation**'. This means that for settlement, the parties entering into a futures contract have obligations not towards each other, but towards the exchange on which the contract is traded. Thus the exchange becomes the seller to all contract buyers and the buyer to all contract sellers. Novation thus entails risk of either party to contract defaulting. To mitigate this risk, the exchange imposes (a) margin

requirements and (b) puts position limits on both the parties. The margin requirement, the position limits and settlement methods are discussed below.

5.4.1 Margin Requirement

Broadly two types of margins are required from each investor entering into a futures contract; namely, Initial Margin and Extreme Loss Margin. When the investors enter into a futures contract, they have to deposit cash or liquid assets equal to the total of these two margins. The initial margin is arrived at by taking various scenarios of market price movements to protect the exchange against the default risk of the parties and is subject to a minimum of 2.33% of the value of the futures contract. Extreme loss margin on the other hand is equivalent to 0.3% of the contract amount. When an IRF contract enters into the expiry month, the investors are required to post additional margin. This is done because the potential default amount increases during the expiry month and the Exchange has to protect itself against such rise in risk. More elaborate discussions on margin requirements are beyond the scope of this book.

5.4.2 Position Limits

As a risk management strategy to guard against heavy build-up of positions with one particular entity, the exchange imposes limits on the size of positions that can be taken by various entities.

Client Level: The gross open positions of a client across all contracts should not exceed 6% of the total open interest or Rs 300 crores, whichever is higher.

Trading Member Level: The gross open positions of the trading member across all contracts should not exceed 15% of the total open interest of the entire market or Rs. 1000 crores, whichever is higher. [6]

Clearing Member Level: No separate position limit is prescribed at the level of the clearing member. However, the clearing member should ensure that his own trading position and the positions of each trading member clearing through him is within the limits specified above.

FIIs: The sum of gross long position in (a) the debt market and (b) the IRF market should not exceed their individual permissible limit for investment in government of India securities as prescribed from time to time. Further, short position in Interest Rate Futures contract should not exceed the sum stated above.

[6] The gross open position of a trading member (or broker) is the sum of the exposure (long and short) of all his clients.

5.4.3 Settlement Methods

As discussed above settlement is done at two levels, viz. MTM settlement which is done on a daily basis and physical settlement which is done during the expiry month.

Mark-to-Market (MTM) Settlement

To cover for the risk of default by the counterparty for the clearing corporation, the futures contracts are marked-to-market on a daily basis by the Exchange. Mark to market settlement is the process of adjusting the margin balance in an investor's account each day for the change in the value of the contract from the previous day. This process helps the clearing corporation in managing the counterparty risk of the future contracts by requiring the party incurring a loss due to adverse price movements to part with the loss amount on a daily basis. Simply put, the party in the loss position pays the clearing corporation the margin money to cover for the shortfall in cash.

To ensure a fair mark-to-market process, the clearing corporation computes and declares the official price for each day for determining daily gains and losses. This price is called the "daily settlement price" and represents the closing price of the futures contract for a given day. The daily settlement price (i.e., closing price for any IRF contract of any given day) is the weighted average trading price of the contract at the end of the day (See Box 5.2). The MTM gains and losses are calculated everyday by computing the difference between the futures settlement price of that day and of the preceding day. These gains (or losses) of each client are credited into (or debited from) that particular client's account.

Box 5.2: Daily Settlement Price

The Daily Settlement Price would be the closing price of the 10 year notional coupon bearing GoI securities futures contract on the trading day.

Daily Settlement price is the Volume Weighted Average Price (VWAP) of

- Trades in the last 30 minutes subject to at least 5 trades for a minimum aggregate notional Face value of Rs. 10 crs, failing which
- Trades in the last 60 minutes subject to at least 5 trades for a minimum aggregate notional Face value of Rs. 10 crs, failing which
- Trades in the last 120 minutes subject to at least 5 trades for a minimum aggregate notional Face value of Rs. 10 crs

In the absence of trading in the above stipulated time frame the theoretical price, to be determined by the Exchanges, would be considered as Daily Settlement Price. Theoretical pricing is calculated on the basis of the prices of bonds from the delivery basket.

Physical Settlement

During the expiry month, the contract is settled by physical delivery of deliverable grade securities using the electronic book entry system of the existing Depositories (NSDL and CDSL) and Public Debt Office (PDO) of the RBI. The delivery of the deliverable grade securities takes place on the last business day of the delivery month. The short position holder in an expiring futures contract holds the right to decide which security to deliver from the basket.

CHAPTER 6: An Explanation of Key Concepts in IRF

6.1 Why a Notional Bond is being used as Underlying

We have already seen that the underlying for bond futures in India is a notional 10 year government bond with a coupon payment of 7% p.a. Such a bond may not actually exist. So, let us understand why such a notional underlying has been selected.

If futures were to be introduced on each of the government bonds, then there would be a large number of interest rate futures contracts trading on each bond and as a result, the liquidity would be poor for many of these futures. So a single bond futures has been identified which pays 7% p.a. as coupon rate and has maturity of 10 years. All bonds have been assigned a multiplier called 'conversion factor' which brings that bond on par with the theoretical bond available for trading. We will learn more about the conversion factor in subsequent sections.

If the bond future were to be based on an actual bond issue, it could potentially raise the activity in the futures market to such a large extent as to cause severe shortages of this actual bond for delivery at expiry. To avoid this danger of shortages to meet the delivery requirement, the Exchange allows a specific set of bonds--rather than a single bond--with different coupons and expiry dates to be used for satisfying the obligations of short position holders in a contract. Thus, while the purpose of a notional underlying bond is to ensure liquidity, the purpose of having a basket of bonds is to ensure that there delivery is not affected by short supply, which would have arisen in case of a single bond.

Now, why choose a bond with a 7% coupon rate? The coupon rate of 7 % has been chosen for the hypothetical bond because the yields on government bonds are generally close to 7 % and hence there would not be much difference in yield between the delivered bond and the hypothetical underlying.

6.2 Conversion Factor

As stated earlier, the Reserve Bank of India has identified a set of bonds to be allowed for delivery by the investor having short position in the IRF to the long position holder on the settlement day. These are called deliverable bonds. All these bonds have differing maturities and coupon rates. To facilitate delivery, however, it is necessary to make them comparable with each other and all of them comparable with the notional bond as of the first day of the expiry month. For achieving this, the RBI has specified the use of conversion factor. The NSE publishes 'conversion factor' for each of the deliverable bond and for each expiry at the time of introduction of the contract. For a particular expiry month, the conversion factors do not change over time.

Conversion factor when multiplied by the futures price (whose underlying is the notional bond) converts it to the actual delivery price for a given deliverable bond. Thus conversion factors are used to take care of the differences between various bonds and thereby bring all the bonds at par for settlement.

6.3 Invoice Price

Following the short futures position holder's intimation to the Exchange of his intent to give delivery of the bond, the physical settlement of the trade is conducted. In physical settlement, the short investor gives one of the bonds from the basket of deliverable bonds and gets cash amount from the buyer of the bond. When futures are traded, they are quoted in clean price terms; accrued interest is not included in the traded futures price. But for the purpose of settlement dirty price is taken into account, which includes accrued interest. The concepts of clean price and dirty price have been discussed in section 3.5.2.

Thus, on any given day, the futures settlement price of that day multiplied by the conversion factor gives the clean price of the bond for that day; this value plus the accrued interest value gives the invoice price or dirty price of the bond for that day. The buyer has to pay this price to the seller for getting delivery of the bond.

Invoice price = (Futures settlement price x Conversion factor) + Accrued Interest

Illustration:

For a futures contract on bonds with face value of Rs. 100, suppose:

Futures settlement price is Rs.90,

Conversion factor for the bond to be delivered is 1.3800,

Accrued interest on this bond at the time of delivery is Rs. 3.

The cash received by the party with the short position (and paid by the party with the long position) is then

Invoice price = **(1.3800 x 90.00) + 3.00 = Rs.127.20**

6.4 Cheapest to deliver bond

The short position holders of IRFs are allowed to decide which bond they would like to give to the buyers on the settlement date. They have a choice to deliver different grades of underlying bonds at specific delivery or expiry points. The sellers will choose that bond from the basket

which leads to maximum profit or minimum loss for them. This bond is called the cheapest to deliver bond (CTD) because it is the least expensive bond in the basket of deliverable bonds.

The sellers of the IRF have to acquire bonds to deliver them to the buyers. For them, the cost of acquiring the bonds for delivery = Quoted price of the bond + Accrued Interest. On the other hand, when they deliver these bonds to the buyers of the IRF, the price that they receive = (Futures settlement Price x Conversion factor) + Accrued interest.

The difference between the two accounts for the profit / loss of the seller of futures.

Profit of seller of futures = (Futures settlement Price x Conversion factor) - Quoted Spot Price of delivered bond

Loss of seller of futures = Quoted Spot Price of delivered bond – (Futures settlement Price x Conversion factor)

Clearly, the cheapest to deliver bond is identified by calculating the profits/losses using the formulas given above, for each of the deliverable bonds and choosing that bond which maximizes the profit (in case there is at least one profit making deliverable bond) or minimizes the loss (in case all deliverable bonds are loss making).

Illustration: Determining Cheapest to Deliver Bond

Consider a party with a short position in IRF having to deliver a bond and there are three options available to it with spot prices as mentioned below. Let us assume that the current futures settlement price is Rs.110.

Table 6.1: Determining cheapest to deliver bond: an Example

Futures settlement Price (A) : 110			
Deliverable Bond (B)	**Quoted Spot Price (C)**	**Conversion Factor (D)**	**Profits of Seller =(AxD)-C**
1	109.55	0.88	=(110x0.88)-109.55 = -12.75
2	106.01	0.84	=(110x0.88)-106.01 = -13.61
3	102.09	0.83	=(110x0.88)-102.09 = -10.79

As can be seen from the last column in Table 6.1, the difference between futures settlement price (after adjusting by the conversion factor) and the bond price is resulting in a loss for all the three bonds under consideration. This loss is lowest for bond 3 and hence, bond 3 will be the cheapest to deliver bond. Typically, all market participants know what the cheapest to

deliver bond is at any given point of time and so the futures price tracks the price of the cheapest to deliver bond (after adjusting for conversion factor). [7]

6.5 Bond Basis

'Bond basis' provides a way to track the movement in the IRF prices relative to the movement in CTD's price. The bond basis is defined as the difference between a bond's price in the cash market and the converted futures price. The converted futures price is the current futures price multiplied by conversion factor of the bond in consideration.

This value of bond basis is also called Gross bond basis.

Gross bond basis = Bond price – (Futures price x conversion factor for that bond)

If we add the cost of carry to the gross bond basis, we get net basis for a bond. Thus

Net Bond Basis = Gross Bond basis + Cost of Carry till the delivery date

Where Cost of Carry = Cost of financing the bond - Coupon payment receivable from the bond

Net basis for a bond is typically greater than or equal to zero. If it is lower than zero, then there is an arbitrage opportunity, which is discussed in next chapter.

[7] The CTD can change over time as the prices of bonds change.

CHAPTER 7: Applications and Trading of Interest Rate Futures

In this section, we discuss how to use IR Futures both to generate superior returns and also to hedge risks. First, let us discuss who all participate in the IRF market?

7.1 Participants in the Interest Rate Futures market

The participants in the IRF market are broadly classified into three groups, depending on what is the purpose of their participation.

Hedgers: Companies and institutions having exposure to interest rates--because of their holdings of government bonds or their borrowing (liabilities) and lendings (assets)--hedge the risk arising from adverse interest rate movement by using IRF. These entities are called hedgers. The different applications of hedging are discussed in 7.2.

Speculators: Speculators participate in the future market to take up the price risk, which is avoided by the hedgers. They take calculated risk and gain when the prices move as per their expectation.

Arbitrageurs: Arbitrageurs closely watch the bond and futures markets and whenever they spot a mismatch in the alignment in the prices of the two markets, they enter to make some profit in a risk-free transaction.

7.2 Hedging Applications of IR Derivatives

One way to hedge a position in the spot bond market is to take an opposite position in the IRF market. This ensures that a change in interest rates will not affect the value of a portfolio and this strategy is also called Interest rate immunization**.**

IR derivatives in general and IR futures in particular have huge hedging applications unlike equity derivatives. This is because, almost every economic entity has an exposure to interest rate fluctuation in some form or the other. Also, given its very nature, interest rates get affected by a number of macro-economic factors. Hence, hedging through IR derivative becomes crucial. This is particularly so in turbulent times, when economic uncertainty is high.

As we have discussed, individuals, corporate, banks and insurance companies all are exposed to interest rate risk. So they need interest rate futures to hedge their risks.

Broadly the various uses of the IR derivatives are as mentioned below:

Asset-liability management: Banks typically have lot of government bonds and other long term assets (loans given to corporates) in their portfolio, while their liabilities are

predominantly short-term (deposits made by individuals range from 1 to 5 years). To address the risk resulting from the asset-liability mismatch, they generally sell IRF and thereby, hedge the interest rate risk. On the other hand, for the insurance companies and several big corporates, the tenure of their liabilities is longer than that of their assets. So, they buy IRF to hedge the interest rate risk.

Investment portfolio management: Mutual funds and similar asset classes having a portfolio of bonds can use IR futures to manage their interest rate exposure in turbulent times.

7.3 Speculation strategies

Let us now focus on a few simple speculation strategies:

7.3.1 Long Only Strategy

In the view of some investors, by consistently having a long position in assets, particularly in bonds, one can achieve fair returns. They hold this view for IRF also, as IRF has the bond as its underlying. These investors buy IRF and repeatedly roll them over before each expiry. This strategy is called Long Only Strategy.

7.3.2 View Based Trading

In contrast to Long Only investors, some investors take both long and short positions in the IRF market, depending on their views on interest rate movements in future. If they expect interest rates to go up, they sell IRF and if they have the opposite expectation, they buy IRF. If the interest rate movement turns out to be the way the investor expected, he would make profit; otherwise, he would make losses.

Expectation	Position
Interest Rates ↑	Short Futures
Interest Rates ↓	Long Futures

Illustration: View Based Trading

A trader expects a long term interest rate to rise.

• On 5th Oct 2009, the trader sells 250 contracts of the Dec 2009 10 Year futures on NSE at Rs. 93.50

Closing out the Position:

• 15th Oct 2009- Futures market Price – Rs. 92.75

• Trader buys 250 contracts of Dec 2009 at Rs. 92.75 and squares off his position

• Therefore total profit for trader is 250 x 2000 x (93.5000-92.75) or Rs 3,75,000.

7.4 Arbitrage strategy

Frequently, the price of a bond in spot market and price of futures may not be aligned with each other because of some distortions in the supply/demand factors. The arbitrage strategy employed to gain risk-free profits by exploiting the non-alignment (or mis-pricing of futures relative to spot bond prices) is called cash/futures arbitrage. Cash/Futures arbitrage is also called basis arbitrage or cash and carry arbitrage.

Smart market participants take advantage of such situations to make risk free profits. It involves buying a bond in cash (spot) market and selling futures simultaneously or vice versa. It should be noted that the cost of carry has to be considered while calculating the profits. Net basis is an important parameter to track arbitrage in IRF market. As mentioned in the last chapter, net basis is typically positive. If net basis turns negative, however, an arbitrage opportunity arises, which can be exploited to make risk-free profits. The example below illustrates one such opportunity.

Illustration: Trading involving arbitrage

Suppose on Oct 5, 2009, 7.94% 2021 G-Sec is trading at Rs 99. The interest rate futures, which has a notional 7% 10 year G-Sec as underlying is trading at Rs 93.50. Following details are available:

- Last Coupon was paid on 24th May 2009, i.e. 131 days back in 30/360 convention.
- Next Coupon will be paid on 24th Nov 2009, i.e. after 49 days (30/360 convention).
- Accrued Interest as of 5th Oct 2009 is Rs 2.89 (7.94 x 131/360).
- Conversion factor is 1.0722.
- Futures Expiry: 31st December 2009
- Number of days for futures settlement after next coupon date: 37 days.
- Actual number of days from trade date to futures settlement date: 87
- Number of days from trade date to futures settlement date in 30/360 convention: 86
- Interest to accrue between the next coupon payment and the futures' expiry will be Rs 0.82 (=7.94 x 37/360).
- Assume that money market rate is 4% p.a.
- Assume that cost of short term financing is 4.5% p.a.

Does an arbitrage opportunity exist?

The net basis here is:

Spot price – (futures price X conversion factor) + cost of carry = 99 – (93.5 X 1.0722) + (99 X 4.5 % X 87/365) – (100 X 7.94% X 86/365) = -2.06

Since net basis is negative, there is an arbitrage opportunity that can be exploited through simultaneous trades in the spot bond market and the IRF market. The arbitrageur buys the G-sec in cash market and sells an IRF with an underlying notional bond simultaneously as described above.

Cash outflow at the beginning = Bond's Price + Accrued Interest = 99 + 2.89 = 101.89

Cash inflow at the expiry = (Futures Settlement Price x Conversion Factor) + Accrued Interest till futures' expiry + Future Value of Interim Coupon

= (93.5 x 1.0722) + 0.85 + 3.97 x {1+ 4% x (37/365)} = 105.09

(Note: If there is a coupon between settlement of the bond and the futures' expiry date, one has to take into account the future value of the coupon amount, which is equal to the coupon amount plus the interest arising from reinvesting the coupon amount.)

Here Rs. 3.97 (i.e. 7.94/2) is the coupon amount and the future value of the coupon is 3.97 x (1+4% x 7/365). We are assuming that the coupon amount of the bond can be reinvested at the money market rate of 4%. It may be noted that we are using actual/365 notation to work out the future value of the coupon amount, because money market operates under that convention

Implied return = (105.09 - 101.89) / 101.89 x (365 / 87) **=** 13% p.a., which is higher than the cost of financing the investment (4.5 %) and hence, there is an arbitrage opportunity.

It can also be shown with another example that if the net basis for a bond is positive, there would no arbitrage opportunity.

Number of days for futures settlement after next coupon date: 7 days.

- Interest to accrue between the next coupon payment and the futures' expiry will be Rs 0.15 (7.94 x 7/360).
- Assume that money market rate is 4% p.a.
- Assume that cost of short term financing is 4.5% p.a.

Does an arbitrage opportunity exist?

The net basis here is:

Spot price – (futures price X conversion factor) + cost of carry = 99 – (93.5 X 1.0722) + (99 X 4.5 % X 57/365) – (100 X 7.94% X 56/365) = -1.77

Since net basis is negative, there is an arbitrage opportunity that can be exploited through simultaneous trades in the spot bond market and the IRF market. The arbitrageur buys the G-sec in cash market and sells an IRF with an underlying notional bond simultaneously as described above.

Cash outflow at the beginning = Bond's Price + Accrued Interest = 99 + 2.89 = 101.89

Cash inflow at the expiry = (Futures Settlement Price x Conversion Factor) + Accrued Interest till futures' expiry + Future Value of Interim Coupon

= (93.5 x 1.0722) + 0.15 + 3.97 x {1+ 4% x (7/365)} = 104.373

(Note: If there is a coupon between settlement of the bond and the futures' expiry date, one has to take into account the future value of the coupon amount, which is equal to the coupon amount plus the interest arising from reinvesting the coupon amount.)

Here Rs. 3.97 (i.e. 7.94/2) is the coupon amount and the future value of the coupon is 3.97 x (1+4% x 7/365). We are assuming that the coupon amount of the bond can be reinvested at the money market rate of 4%. It may be noted that we are using actual/365 notation to work out the future value of the coupon amount, because money market operates under that convention

Implied return = (104.373 - 101.89) / 101.89 x (365 / 56) **=** 15% p.a., which is higher than the cost of financing the investment (4.5 %) and hence, there is an arbitrage opportunity.

It can also be shown with another example that if the net basis for a bond is positive, there would no arbitrage opportunity.

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2 APPENDIX I: Important Formulae

I.1 Bonds

Discounting and Present Value

For a single cash flow:

$$\text{Future Value} = \text{Present Value} \times (1+r)^n$$

$$\text{Present Value} = \frac{\text{Future Value}}{(1+r)^n}$$

$$\text{Discount Factor} = \frac{1}{(1+r)^n}$$

For a bond (which involves multiple cash flows):

$$PV = \frac{c_1}{(1+r)} + \frac{c_2}{(1+r)^2} + \frac{c_3}{(1+r)^3} + \ldots\ldots + \frac{(c_n + \text{Face value})}{(1+r)^n}$$

Accrued Interest and Clean Price

Accrued interest (AI) calculation is done by multiplying the coupon amount by the ratio of the number of days between the last coupon payment and the settlement date (n) and the number of days in between two consecutive regular coupon payment dates (d)

$$\text{Accrued Interest} = \text{Annual Coupon Amount} \times (n/d)$$

$$\text{Clean Price} = \text{Dirty Price} - \text{Accrued Interest}$$

Yield to maturity (or simply yield) Calculations

Yield (y) is computed by using the following equation:

$$\text{Bond Price} = \frac{c_1}{(1+y)} + \frac{c_2}{(1+y)^2} + \frac{c_3}{(1+y)^3} + \ldots\ldots + \frac{(c_n + \text{Face value})}{(1+y)^n}$$

Duration

Modified Duration is a measure of sensitivity of bond prices to changes in interest rates.

$$\text{Modified Duration} = \frac{\text{Percentage change in bond brice}}{\text{Change in yield in basis points}} \times 100$$

Present Value Basis Point (PVBP) is the change in price of bond for one basis point change in interest rate.

PVBP of a Bond = Modified Duration x 0.0001 x Price of the bond

I.2 Bond Futures

Invoice Price

Invoice price is the price paid out by the buyer of the futures to the seller of futures for taking physical delivery of the bond.

Invoice Price = (Futures Settlement Price x Conversion Factor) + Accrued Interest

Cost of Carry

Cost of carry = Cost of funding – Coupon accrued = (Bond Price x repo x time) – (Face value of bond x coupon rate x time)

Basis

Gross basis of a bond= Bond price – (Futures price x conversion factor for that bond)

If we add the cost of carry to the gross bond basis, we get net basis for a bond. Thus

Net Basis of a bond = Gross Bond basis + Cost of Carry

Cheapest to deliver (CTD)

The cheapest to deliver bond is the bond that minimizes difference between the Quoted Spot Price of bond and the Futures Settlement Price (adjusted by the conversion factor). CTD can be identified by calculating the profit and loss for the seller arising from the delivery of each of the deliverable bonds and choosing the bond that gives maximum profit or minimum loss.

3 APPENDIX II: Useful Excel Functions

Function	Description
ACCRINT	Returns the accrued interest for a security that pays periodic interest
DISC	Returns the discount rate for a security
DURATION	Returns the duration of a bond taking as inputs the characteristics of a bond and the yield of a bond.
EFFECT	Returns the effective annual interest rate
FV	Returns the future value of an investment
IRR	Returns the internal rate of return for a series of cash flows
NPV	Returns the net present value of an investment based on a series of periodic cash flows and a discount rate
PV	Returns the present value of an investment
PRICE	Returns the price of a bond taking as inputs the characteristics of a bond and the yield of a bond. The price returned is the clean price.
YIELD	Returns the yield of a bond taking as inputs the characteristics of a bond and the clean price of a bond.

4 APPENDIX III: Glossary of Terminology

Accrued Interest in the context of IRF is the interest that has accumulated since the principal investment or since the most recent coupon payment, if there has been any already.

Basis is the difference between the spot price and the futures price (See gross basis and net basis below).

Basis point is one-hundredth of a percentage point or 0.01 %.

Cheapest to Deliver (CTD): Since a futures contract permits the seller to select the precise asset to deliver to the buyer, the cheapest to deliver is the asset that is most profitable for the short to deliver. The futures price tracks the CTD instrument.

Clean Price is the price of a bond excluding any interest that has accrued since issue or the most recent coupon payment as opposed to the dirty price, which is the price of a bond including the accrued interest.

Conversion Factor is a number that helps bring the deliverable bond on par with the notional bond.

Cost of Carry is the cost of "carrying" or holding a position. In a long position, the cost of carry is the funding cost paid minus the cash inflows (dividends or coupons).

Coupon or Coupon rate of a bond is the (annual) interest rate stated on the bond; it is expressed as a percentage of the principal (face value of the bond). It is the interest rate that a bond issuer will pay to a bondholder. For example, a Rs 100 face value bond with a coupon of 7% will pay Rs 7 every year.

Day count convention is the convention used to calculate coupon and interest payments. Typical convention used in India is 30/360 i.e. every month is assumed to be 30 days and every year to be 360 days.

Delivery Basket is the set of bonds that can be used for delivery by a short position holder against his futures contract.

Discounting is the process of getting present value from a future value.

$$\text{Present Value} = \frac{\text{Future Value}}{(1+r)^n}$$

Duration of a bond is a weighted average of the maturity of all the income streams from a bond.

Frequency refers to the time interval at which coupons of a bond are paid. It is typically annual, semiannual, quarterly or monthly. In the context of compound interest, frequency refers to the time interval at which interest gets compounded.

Gross Basis is the difference between bond price and futures price after adjusting for conversion factor. Gross basis = Bond price – (Futures price x Conversion factor).

Invoice Price is the price that the buyer of a future pays the seller for taking delivery of the bond. Invoice price is different for different bonds.

Modified Duration is the approximate percentage change in price for a 1 percentage point change in yield.

Net Basis is gross basis (see above) plus cost of carry for the bond.

Net present value (NPV) of an asset is defined as the total present value (PV) of an entire series of future cash flows generated by the asset. These cash flows could be inflows or outflows. Each cash inflow / outflow is discounted back to its present value (PV); they are then summed up to obtain NPV.

Present Value (PV) is the discounted future cash flow. (See discounting)

PVBP (or Present value of one basis point) is the change in the price of a bond for one basis point change in the yield/interest rates.

Redemption value or Face Value is the value paid out at the maturity of the bond. It is also called principal.

Repo or Repurchase Agreements are short-term Money Market instruments. Repo is nothing but collateralized borrowing and lending. In a repo, securities are sold in a temporary sale with a promise to buy back the securities at a future date at specified price.

In Reverse Repo, securities are purchased in a temporary purchase with a promise to sell it back after a specified number of days at a pre-specified price.

Swap Rate is the market determined fixed rate which one party pays to receive a floating rate in return.

Yield or Yield to Maturity (YTM) is that rate of interest at which if all the future cash flows are discounted, the sum of the present value of these cash flows equals the market traded price (also called dirty price or full price).

MODEL TEST

INTEREST RATE DERIVATIVES: A BEGINNER'S MODULE

Q:1 During the settlement month on a particular day, futures settlement price is Rs. 101.3. For the deliverable bond and conversion factor is 0.854 and the accrued interest is Rs. 3.33. What is the invoice price? [1 Mark]

(a) 89.84
(b) 96.93
(c) 91.52
(d) 94.32

Q:2 In interest rate futures trading Conversion factor determines the [1 Mark]

(a) Theoretical value of the yield of the bond
(b) The accrued interest on the bond in consideration
(c) Price received by the buyer
(d) Theoretical price of the futures

Q:3 If repo is 1.25% p.a. and a bond is paying coupon of 4.87% p.a., what is the cost of carry of the bond over one year? Assume the bond is trading at Rs. 100. [2 Marks]

(a) 2.61
(b) 6.76
(c) -3.62
(d) -7.08

Q:4 Interest rate swaps can be used by [1 Mark]

(a) Speculators only
(b) Hedgers only
(c) Hedgers & Speculators both

Q:5 What is the duration of a bond for which 4.92% change in the bond price corresponds to 1.20% change in the bond's yield? [2 Marks]

(a) 5.01
(b) 6.82
(c) 4.10
(d) 4.54

Q:6 Which of the following would be a valid expiry month for interest rate futures in India [1 Mark]

(a) April
(b) August
(c) March
(d) November

Q:7 If an investor is getting Rs. 100 at the end of 1 years, what is the present value of that cashflow? Assume interest rate is 7.00% p.a. [2 Marks]

(a) 93.99
(b) 89.16
(c) 90.36
(d) 93.46

Q:8 If the last coupon was paid out 135 days back and annual coupon rate is 8.90%, what is the dirty price of a bond whose clean price is Rs. 99.14? Assume face value of Rs. 100 and 30/360 day count convention. [2 Marks]

(a) 102.61
(b) 102.65
(c) 105.28
(d) 102.48

Q:9 If a bond is issued at 100 and is currently trading at 96.01, then it is trading at [2 Marks]

(a) discount
(b) par
(c) Maturity value
(d) premium

Q:10 Which of the following is not a criteria for bonds to be part of the delivery basket [1 Mark]

(a) Maximum tenure of the bonds should be12 years
(b) Minimum Outstanding stock should be of Rs. 10000 crore
(c) Only Central Government bond Securities allowed
(d) Minimum maturity of the bonds should be 6 years

Q:11 RBI issues bonds with different maturities [1 Mark]

(a) FALSE
(b) TRUE

Q:12 If an investor is getting Rs. 600 at the end of 4 years, what is the present value of that cashflow? Assume interest rate is 10.00% p.a [2 Marks]

(a) 412.30
(b) 409.50
(c) 407.82
(d) 409.81

Q:13 An investor goes long interest rate futures at 100.13 as he feels interest rates will go down. What will be his profit / loss if the futures price moves to 99.06? [1 Mark]

(a) Profit of Rs. 2.84
(b) Loss of Rs. 1.07
(c) Profit of Rs. 1.07
(d) Loss of Rs. 2.84

Q:14 If the last coupon was paid out 75 days back and annual coupon rate is 10.20%, what is the dirty price of a bond whose clean price is Rs. 101.66? Assume face value of Rs. 100 and 30/360 day count convention. [2 Marks]

(a) 105.70
(b) 106.05
(c) 105.57
(d) 103.79

Q:15 For interest rate futures expiring on 31st December 2009, delivery can start from [1 Mark]

(a) 29th December 2009
(b) 31st December 2009
(c) 29th November 2009
(d) 1st December 2009

Q:16 If IR futures price is 99.17 and the CTD bond 's price is 97.28. What is the net basis if the conversion factor for the CTD bond is 0.8773 and cost of carry for the bond till futures settlement is 0.09 (i.e. cost of repo minus accrued interest)? [3 Marks]

(a) 10.37
(b) 7.37
(c) 6.99
(d) 8.46

Q:17 What is the duration of a bond for which 5.50% change in the bond price corresponds to 1.10% change in the bond's yield? [2 Marks]

(a) 5.00
(b) 4.28
(c) 3.52
(d) 6.32

Q:18 Buyer of a forward contract will gain if the price of the underlying asset is higher than the price at which he had entered in the transaction [1 Mark]

(a) TRUE
(b) FALSE

Q:19 In an exchange traded derivatives, Exchange is the counterparty to buyers and sellers once the trade is executed [1 Mark]

(a) TRUE
(b) FALSE

Q:20 For a bond trading at premium to its par value [2 Marks]

(a) Yield < Coupon rate
(b) Yield = Coupon rate X Price
(c) Yield > Coupon rate
(d) Yield = Coupon rate

Q:21 The purpose of conversion factor is to: [1 Mark]

(a) Make the seller earn profits in the bond he delivers
(b) Make the seller of the futures contract indifferent to the bond he delivers
(c) Make the seller minimise his loss for the bond he delivers
(d) Reduce the transaction cost for the buyer

Q:22 Settlement of forward Contracts can take place by
[1 Mark]

(a) Cash Settlement Only
(b) Physical Settlement only
(c) Either Physical or Cash Settlement

Q:23 If a bond is issued at 100 and is currently trading at 110.99, then it is trading at
[2 Marks]

(a) discount
(b) premium
(c) Maturity value
(d) par

Q:24 If an investor is getting Rs. 1000 at the end of 5 years, what is the present value of that cashflow? Assume interest rate is 9.00% p.a. [2 Marks]

(a) 649.93
(b) 648.29
(c) 646.82
(d) 645.86

Q:25 In interest rate futures contracts closing price of the futures contracts on a day is calculated as [1 Mark]

(a) Weighted average price of the Cheapest to deliver bond for the last half hour
(b) Weighted average price of the futures for the last half hour
(c) Weighted average price of the Cheapest to deliver bond for the last one hour
(d) Weighted average price of the futures for the last one hour

Q:26 For OTC derivatives, the agreements are usually designed under the framework of
[1 Mark]

(a) NSE Agreement
(b) SEBI Agreement
(c) International Swaps and Derivatives Association agreement
(d) RBI Agreement

Q:27 An investor goes long interest rate futures at 97.4 as he feels interest rates will go down. What will be his profit / loss if the futures price moves to 99.06? [1 Mark]

(a) Profit of Rs. 3.35
(b) Loss of Rs. 1.66
(c) Profit of Rs. 1.66
(d) Loss of Rs. 3.35

Q:28 If a bond is issued at 100 and is currently trading at 93.9., then it is trading at [2 Marks]

(a) discount
(b) premium
(c) Maturity value
(d) par

Q:29 A derivative can have only stocks as underlying assets [1 Mark]

(a) FALSE
(b) TRUE

Q:30 In a futures contract all the terms, other than the price, are set by the Stock Exchange [1 Mark]

(a) FALSE
(b) TRUE

Q:31 If IR futures price is 100.46 and the CTD bond 's price is 101.8. What is the gross basis if the conversion factor for the CTD bond is 0.8747? [3 Marks]

(a) 11.24
(b) 11.43
(c) 12.58
(d) 13.93

Q:32 Coupon for a bond is [2 Marks]

(a) Face value X Coupon Rate
(b) Face value + Coupon Rate
(c) Face value / Coupon Rate
(d) Face value - Coupon Rate

Q:33 If IR futures price is 97.48 and the CTD bond 's price is 98.57. What is the net basis if the conversion factor for the CTD bond is 0.874 and cost of carry for the bond till futures settlement is 0.38 (i.e. cost of repo minus accrued interest)? [3 Marks]

(a) 13.14
(b) 13.96
(c) 12.56
(d) 13.75

Q:34 During the settlement month on a particular day, futures settlement price is Rs. 97.23. For the deliverable bond and conversion factor is 0.8803 and the accrued interest is Rs. 0. What is the invoice price? [1 Mark]

(a) 88.05
(b) 87.15
(c) 85.59
(d) 89.99

Q:35 If IR futures price is 100.68 and the CTD bond 's price is 99.36. The conversion factor for the CTD bond is 1.1269 and cost of carry for the bond till futures settlement is 2.97 (i.e. cost of repo minus accrued interest). Is there an arbitrage in buying the CTD and selling the IRF? [3 Marks]

(a) Yes
(b) No

Q:36 If Interest rate is 8%, then what is the 1 year discount factor [1 Mark]

(a) 0.93
(b) 0.45
(c) 0.63
(d) 0.81

Q:37 A 10 year Gsec bond pays semi annual coupon. It had paid a coupon on 20-Sep-2009. If today is 07-Mar-2010, how many days have passed since the last coupon date based on 30/360 European convention. [1 Mark]

(a) 167
(b) 105
(c) 23
(d) 12

Q:38 If an investor is getting Rs. 100 at the end of 3 years, what is the present value of that cashflow? Assume interest rate is 7.00% p.a. [2 Marks]

(a) 81.63
(b) 80.96
(c) 83.49
(d) 79.70

Q:39 If IR futures price is 97.93 and the CTD bond 's price is 97.04. What is the gross basis if the conversion factor for the CTD bond is 0.9712? [3 Marks]

(a) 0.22
(b) 2.01
(c) 0.57
(d) 1.93

Q:40 If an investor invests Rs. 300 at 3.00% p.a. (compounded annually) for 1 years, future value of the investment? [3 Marks]

(a) 308.58
(b) 305.00
(c) 309.00
(d) 300.18

Q:41 If IR futures price is 101.62 and the CTD bond 's price is 102.37. The conversion factor for the CTD bond is 0.9664 and cost of carry for the bond till futures settlement is 0.21 (i.e. cost of repo minus accrued interest). Is there an arbitrage in buying the CTD and selling the IRF? [3 Marks]

(a) Yes
(b) No

Q:42 An investor goes long interest rate futures at 102.73 as he feels interest rates will go down. What will be his profit / loss if the futures price moves to 103.37? [1 Marks]

(a) Profit of Rs. 0.64
(b) Loss of Rs. 2.12
(c) Profit of Rs. 2.12
(d) Loss of Rs. 0.64

Q:43 The theoretical bond which is the underlying for interest rate futures has a coupon of [1 Mark]

(a) 7.50%
(b) 7%
(c) 6.50%
(d) 6%

Q:44 Seller of the option receives the premium from the buyer of the option [1 Mark]

(a) TRUE
(b) FALSE

Q:45 If IR futures price is 100.12 and the CTD bond 's price is 99.12. The conversion factor for the CTD bond is 1.1389 and cost of carry for the bond till futures settlement is -0.14 (i.e. cost of repo minus accrued interest). Is there an arbitrage in buying the CTD and selling the IRF? [3 Marks]

(a) No
(b) Yes

Q:46 During the settlement month on a particular day, futures settlement price is Rs. 98.84. For the deliverable bond and conversion factor is 0.8716 and the accrued interest is Rs. 1.8. What is the invoice price? [1 Mark]

(a) 90.62
(b) 87.81
(c) 88.83
(d) 87.95

Q:47 If a bond is issued at 100 and is currently trading at 107.01, then it is trading at [2 Marks]

(a) Maturity value
(b) par
(c) premium
(d) discount

Q:48 If the last coupon was paid out 86 days back and annual coupon rate is 10.10%, what is the clean price of a bond whose dirty price is Rs. 103.91? Assume face value of Rs. 100 and 30/360 day count convention [2 Marks]

(a) 103.98
(b) 105.52
(c) 105.26
(d) 101.50

Q:49 If a bond price changes from 101.725 to 99.89 for an yield change of 0.50%. What is the PBVP of the bond? [2 Marks]

(a) 0.0249
(b) 0.0367
(c) 0.0203
(d) 0.0540

Q:50 An investor shorts interest rate futures at 101.88 as he feels interest rates will go up. What will be his profit / loss if the futures price moves to 101.86? [1 Mark]

(a) Profit of Rs. 0.02
(b) Profit of Rs. 2.69
(c) Loss of Rs. 2.69
(d) Loss of Rs. 0.02

Q:51 Which of the following is not a criteria for bonds to be part of the delivery basket [1 Mark]

(a) Maximum tenure of the bonds should be 12 years
(b) Minimum tenure of the bonds should be 8 years
(c) Only Central Government bond Securities allowed
(d) Minimum Outstanding stock should be of Rs. 1000 crore

Q:52 If a bond price changes from 107.608 to 99.76 for an yield change of 1.20%. What is the PBVP of the bond? [2 Marks]

(a) 0.0376
(b) 0.0654
(c) 0.0388
(d) 0.0434

Q:53 An investor goes long interest rate futures at 99.83 as he feels interest rates will go down. What will be his profit / loss if the futures price moves to 101.1? [1 Mark]

(a) Loss of Rs. 2.48
(b) Profit of Rs. 2.48
(c) Profit of Rs. 1.27
(d) Loss of Rs. 1.27

Q:54 If the last coupon was paid out 149 days back and annual coupon rate is 2.60%, what is the clean price of a bond whose dirty price is Rs. 100.13? Assume face value of Rs. 100 and 30/360 day count convention [2 Marks]

(a) 101.64
(b) 100.09
(c) 101.14
(d) 99.05

Q:55 If an investor invests Rs. 300 at 7.00% p.a. (compounded annually) for 4 years, future value of the investment? [3 Marks]

(a) 398.87
(b) 393.24
(c) 396.91
(d) 401.48

Q:56 If the last coupon was paid out 89 days back and annual coupon rate is 10.70%, what is the accrued interest for a face value of Rs. 100? Assume 30/360 day count convention. [2 Marks]

(a) 129.12
(b) 2.65
(c) 53.25
(d) 12.88

Q:57 A 10 year Gsec bond pays semi annual coupon. It had paid a coupon on 08-Dec-2009. If today is 14-May-2010, how many days have passed since the last coupon date based on 30/360 European convention [1 Mark]

(a) 156
(b) 59
(c) 136
(d) 115

Q:58 For interest rate futures expiring on 31st March 2010 delivery can start from [1 Mark]

(a) 29th March 2010
(b) 31st March 2010
(c) 28th Feb 2010
(d) 1st March 2010

Q:59 If IR futures price is 101.76 and the CTD bond 's price is 101.14. The conversion factor for the CTD bond is 1.0205 and cost of carry for the bond till futures settlement is -1.4 (i.e. cost of repo minus accrued interest). Is there an arbitrage in buying the CTD and selling the IRF? [3 Marks]

(a) Yes
(b) No

Q:60 The Expiry day of an interest rate futures contract is [1 Mark]

(a) Any day before the start of the delivery month
(b) Last business day of the delivery month
(c) Last day of the delivery month
(d) Last trading day of the delivery month

Correct Answers :

Question No.	Answers	Question No.	Answers
1	(a)	31	(d)
2	(c)	32	(a)
3	(c)	33	(d)
4	(c)	34	(c)
5	(c)	35	(a)
6	(c)	36	(a)
7	(d)	37	(a)
8	(d)	38	(a)
9	(a)	39	(d)
10	(d)	40	(c)
11	(b)	41	(b)
12	(d)	42	(a)
13	(b)	43	(b)
14	(d)	44	(a)
15	(d)	45	(b)
16	(a)	46	(d)
17	(a)	47	(c)
18	(a)	48	(d)
19	(a)	49	(b)
20	(a)	50	(a)
21	(b)	51	(d)
22	(c)	52	(b)
23	(b)	53	(c)
24	(a)	54	(d)
25	(b)	55	(b)
26	(c)	56	(b)
27	(c)	57	(a)
28	(a)	58	(d)
29	(a)	59	(a)
30	(b)	60	(c)