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Financial Derivatives

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Paper – XX

Financial Derivatives

Objectives

- To Understand the students about the concept of Derivatives and its types
- To acquaint the knowledge of Options and Futures and
- To know about Hedging and the development position of Derivatives in India.

Unit – I

Derivatives – Features of a Financial Derivative – Types of Financial Derivatives – Basic Financial derivatives – History of Derivatives Markets – Uses of Derivatives – Critiques of Derivatives – Forward Market: Pricing and Trading Mechanism – Forward Contract concept – Features of Forward Contract – Classification of Forward Contracts – Forward Trading Mechanism – Forward Prices Vs Future Prices.

Unit – II

Options and Swaps – Concept of Options – Types of options – Option Valuation – Option Positions Naked and Covered Option – Underlying Assets in Exchange-traded Options – Determinants of Option Prices – Binomial Option Pricing Model – Black-Scholes Option Pricing – Basic Principles of Option Trading – SWAP: Concept, Evaluation and Features of Swap – Types of Financial Swaps – Interest Rate Swaps – Currency Swap – Debt-Equity Swap.

Unit – III

Futures – Financial Futures Contracts – Types of Financial Futures Contract – Evolution of Futures Market in India – Traders in Futures Market in India – Functions and Growth of Futures Markets – Futures Market Trading Mechanism - Specification of

the Future Contract – Clearing House – Operation of Margins – Settlement – Theories of Future prices – Future prices and Risk Aversion – Forward Contract Vs. Futures Contracts.

Unit – IV

Hedging and Stock Index Futures – Concepts – Perfect Hedging Model – Basic Long and Short Hedges – Cross Hedging – Basis Risk and Hedging – Basis Risk Vs Price Risk – Hedging Effectiveness – Devising a Hedging Strategy – Hedging Objectives – Management of Hedge – Concept of Stock Index – Stock Index Futures – Stock Index Futures as a Portfolio management Tool – Speculation and Stock Index Futures – Stock Index Futures Trading in Indian Stock Market.

Unit – V

Financial Derivatives Market in India – Need for Derivatives – Evolution of Derivatives in India – Major Recommendations of Dr. L.C. Gupta Committee – Equity Derivatives – Strengthening of Cash Market – Benefits of Derivatives in India – Categories of Derivatives Traded in India – Derivatives Trading at NSE/BSE – Eligibility of Stocks – Emerging Structure of Derivatives Markets in India -Regulation of Financial Derivatives in India – Structure of the Market – Trading systems – Badla system in Indian Stock Market – Regulatory Instruments.

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UNIT - I

Unit Structure

Lesson 1.1 - Basics of Financial Derivatives

Lesson 1.2 - Forward Contracts

Lesson 1.3 - Participants in Derivative Markets

Lesson 1.4 - Recent Developments in Global Financial Derivative Markets

Learning Objectives

After reading this chapter, students should

- Understand the meaning of financial derivatives.
- Know that what various features of financial derivatives are.
- Understand the various types of financial derivatives like forward, futures, options, Swaps, convertible, warrants, etc.
- Know about the historical background of financial derivatives.
- Know that what various uses of financial derivatives are.
- Understand about the myths of financial derivatives.
- Understand the concept of forward contract.
- Be aware about the various features of a forward contract.
- Know that forward markets as fore-runner of futures markets, and also know about the historically growth of forward market.
- Understand the various differences between futures and forward contracts.
- Know about the classification of forward contracts like hedge contracts, transferable specific delivery, and non-transferable specific delivery (NTSD) and other forward contracts.

Lesson 1.1 - Basics of Financial Derivatives

Introduction

The past decade has witnessed the multiple growths in the volume of international trade and business due to the wave of globalization and liberalization all over the world. As a result, the demand for the international money and financial instruments increased significantly at the global level. In this respect, changes in the interest rates, exchange rates and stock market prices at the different financial markets have increased the financial risks to the corporate world. Adverse changes have even threatened the very survival of the business world. It is, therefore, to manage such risks; the new financial instruments have been developed in the financial markets, which are also popularly known as financial derivatives.

The basic purpose of these instruments is to provide commitments to prices for future dates for giving protection against adverse movements in future prices, in order to reduce the extent of financial risks. Not only this, they also provide opportunities to earn profit for those persons who are ready to go for higher risks. In other words, these instruments, indeed, facilitate to transfer the risk from those who wish to avoid it to those who are willing to accept the same.

Today, the financial derivatives have become increasingly popular and most commonly used in the world of finance. This has grown with so phenomenal speed all over the world that now it is called as the derivatives revolution. In an estimate, the present annual trading volume of derivative markets has crossed US \$ 30,000 billion, representing more than 100 times gross domestic product of India.

Financial derivatives like futures, forwards options and swaps are important tools to manage assets, portfolios and financial risks. Thus, it is essential to know the terminology and conceptual framework of all these financial derivatives in order to analyze and manage the financial risks. The prices of these financial derivatives contracts depend upon the spot prices of the underlying assets, costs of carrying assets into the future and relationship with spot prices. For example, forward and futures contracts are similar in nature, but their prices in future may differ. Therefore, before using any financial derivative instruments for hedging, speculating, or arbitraging purpose, the trader or investor must carefully examine all the important aspects relating to them.

Definition of Financial Derivatives

Before explaining the term financial derivative, let us see the dictionary meaning of 'derivative'. Webster's Ninth New Collegiate Dictionary (1987) states **Derivatives** as:

1. A word formed by derivation. It means, this word has been arisen by derivation.
2. Something derived; it means that some things have to be derived or arisen out of the underlying variables. For example, financial derivative is an instrument indeed derived from the financial market.
3. The limit of the ratio of the change is a function to the corresponding change in its independent variable. This explains that the value of financial derivative will change as per the change in the value of the underlying financial instrument.
4. A chemical substance related structurally to another substance, and theoretically derivable from it. In other words, derivatives are structurally related to other substances.
5. A substance that can be made from another substance in one or more steps. In case of financial derivatives, they are derived from a combination of cash market instruments or other derivative instruments.

For example, you have purchased gold futures on May 2003 for delivery in August 2003. The price of gold on May 2003 in the spot market is ₹ 4500 per 10 grams and for futures delivery in August 2003 is ₹ 4800 per 10 grams. Suppose in July 2003 the spot price of the gold changes and increased to ₹ 4800 per 10 grams. In the same line value of financial derivatives or gold futures will also change.

From the above, the term derivatives may be termed as follows:

The term "Derivative" indicates that it has no independent value, i.e., its value is entirely derived from the value of the underlying asset. The underlying asset can be securities, commodities, bullion, currency, livestock or anything else.

In other words, derivative means forward, futures, option or any other hybrid contract of predetermined fixed duration, linked for the purpose of contract fulfillment to the value of a specified real or financial asset or to an index of securities.

The Securities Contracts (Regulation) Act 1956 defines "derivative" as under:

“Derivative” includes

1. Security derived from a debt instrument, share, loan whether secured or unsecured, risk instrument or contract for differences or any other form of security.
2. A contract which derives its value from the prices, or index of prices of underlying securities.

The above definition conveys that

1. The derivatives are financial products.
2. Derivative is derived from another financial instrument/contract called the underlying. In the case of Nifty futures, Nifty index is the underlying. A derivative derives its value from the underlying assets. Accounting Standard SFAS133 defines a derivative as, ‘a derivative instrument is a financial derivative or other contract with all three of the following characteristics:
 - (i) It has (1) one or more underlings, and (2) one or more notional amount or payments provisions or both. Those terms determine the amount of the settlement or settlements.
 - (ii) It requires no initial net investment or an initial net investment that is smaller than would be required for other types of contract that would be expected to have a similar response to changes in market factors.
 - (iii) Its terms require or permit net settlement. It can be readily settled net by a means outside the contract or it provides for delivery of an asset that puts the recipients in a position not substantially different from net settlement

In general, from the aforementioned, derivatives refer to securities or to contracts that derive from another—whose value depends on another contract or assets. As such the financial derivatives are financial instruments whose prices or values are derived from the prices of other underlying financial instruments or financial assets. The underlying instruments may be a equity share, stock, bond, debenture, treasury bill, foreign currency or even another derivative asset. For example, a stock option’s value depends upon the value of a stock on which the option is written. Similarly, the value of a treasury bill of futures contracts or foreign currency forward contract will depend upon the price or value of the underlying assets, such as Treasury bill or foreign currency. In other words, the price of the derivative is not arbitrary rather it is linked or affected to the price of the underlying asset that will automatically affect the price of the financial derivative. Due to this reason, transactions in derivative markets are used to offset the risk of price changes

in the underlying assets. In fact, the derivatives can be formed on almost any variable, for example, from the price of hogs to the amount of snow falling at a certain ski resort.

The term financial derivative relates with a variety of financial instruments which include stocks, bonds, treasury bills, interest rate, foreign currencies and other hybrid securities. Financial derivatives include futures, forwards, options, swaps, etc. Futures contracts are the most important form of derivatives, which are in existence long before the term 'derivative' was coined. Financial derivatives can also be derived from a combination of cash market instruments or other financial derivative instruments. In fact, most of the financial derivatives are not revolutionary new instruments rather they are merely combinations of older generation derivatives and/or standard cash market instruments.

In the 1980s, the financial derivatives were also known as off-balance sheet instruments because no asset or liability underlying the contract was put on the balance sheet as such. Since the value of such derivatives depend upon the movement of market prices of the underlying assets, hence, they were treated as contingent asset or liabilities and such transactions and positions in derivatives were not recorded on the balance sheet. However, it is a matter of considerable debate whether off-balance sheet instruments should be included in the definition of derivatives. Which item or product given in the balance sheet should be considered for derivative is a debatable issue.

In brief, the term financial market derivative can be defined as a treasury or capital market instrument which is derived from, or bears a close relation to a cash instrument or another derivative instrument. Hence, financial derivatives are financial instruments whose prices are derived from the prices of other financial instruments.

Features of a Financial Derivatives

As observed earlier, a financial derivative is a financial instrument whose value is derived from the value of an underlying asset; hence, the name 'derivative' came into existence. There are a variety of such instruments which are extensively traded in the financial markets all over the world, such as forward contracts, futures contracts, call and put options, swaps, etc. A more detailed discussion of the properties of these contracts will be given later part of this lesson. Since each financial derivative has its own unique features, in this section, we will discuss some of the general features of simple financial derivative instrument.

The basic features of the derivative instrument can be drawn from the general definition of a derivative irrespective of its type. Derivatives or derivative securities are

future contracts which are written between two parties (counter parties) and whose value are derived from the value of underlying widely held and easily marketable assets such as agricultural and other physical (tangible) commodities, or short term and long term financial instruments, or intangible things like weather, commodities price index (inflation rate), equity price index, bond price index, stock market index, etc. Usually, the counter parties to such contracts are those other than the original issuer (holder) of the underlying asset. From this definition, the basic features of a derivative may be stated as follows:

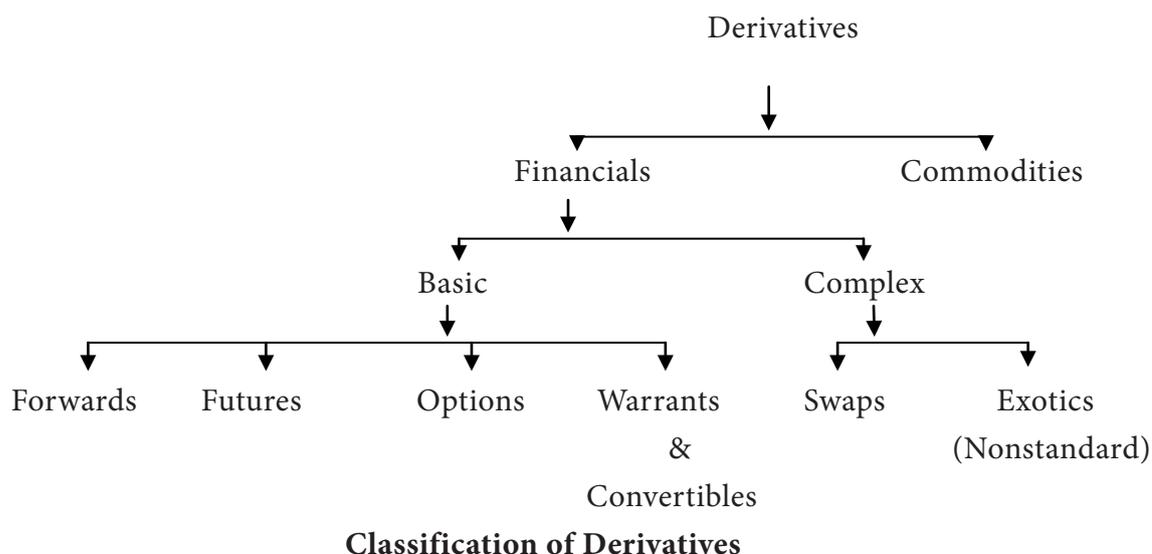
1. A derivative instrument relates to the future contract between two parties. It means there must be a contract-binding on the underlying parties and the same to be fulfilled in future. The future period may be short or long depending upon the nature of contract, for example, short term interest rate futures and long term interest rate futures contract.
2. Normally, the derivative instruments have the value which derived from the values of other underlying assets, such as agricultural commodities, metals, financial assets, intangible assets, etc. Value of derivatives depends upon the value of underlying instrument and which changes as per the changes in the underlying assets, and sometimes, it may be nil or zero. Hence, they are closely related.
3. In general, the counter parties have specified obligation under the derivative contract. Obviously, the nature of the obligation would be different as per the type of the instrument of a derivative. For example, the obligation of the counter parties, under the different derivatives, such as forward contract, future contract, option contract and swap contract would be different.
4. The derivatives contracts can be undertaken directly between the two parties or through the particular exchange like financial futures contracts. The exchange-traded derivatives are quite liquid and have low transaction costs in comparison to tailor-made contracts. Example of exchange traded derivatives are Dow Jones, S&P 500, Nikkei 225, NIFTY option, S&P Junior that are traded on New York Stock Exchange, Tokyo Stock Exchange, National Stock Exchange, Bombay Stock Exchange and so on.
5. In general, the financial derivatives are carried off-balance sheet. The size of the derivative contract depends upon its notional amount. The notional amount is the amount used to calculate the pay off. For instance, in the option contract, the potential loss and potential payoff, both may be different from the value of underlying shares, because the payoff of derivative products differs from the payoff that their notional amount might suggest.

6. Usually, in derivatives trading, the taking or making of delivery of underlying assets is not involved; rather underlying transactions are mostly settled by taking offsetting positions in the derivatives themselves. There is, therefore, no effective limit on the quantity of claims, which can be traded in respect of underlying assets.
7. Derivatives are also known as deferred delivery or deferred payment instrument. It means that it is easier to take short or long position in derivatives in comparison to other assets or securities. Further, it is possible to combine them to match specific, i.e., they are more easily amenable to financial engineering.
8. Derivatives are mostly secondary market instruments and have little usefulness in mobilizing fresh capital by the corporate world; however, warrants and convertibles are exception in this respect.
9. Although in the market, the standardized, general and exchange-traded derivatives are being increasingly evolved, however, still there are so many privately negotiated customized, over-the-counter (OTC) traded derivatives are in existence. They expose the trading parties to operational risk, counter-party risk and legal risk. Further, there may also be uncertainty about the regulatory status of such derivatives.
10. Finally, the derivative instruments, sometimes, because of their off-balance sheet nature, can be used to clear up the balance sheet. For example, a fund manager who is restricted from taking particular currency can buy a structured note whose coupon is tied to the performance of a particular currency pair.

Types of Financial Derivatives

In the past section, it is observed that financial derivatives are those assets whose values are determined by the value of some other assets, called as the underlying. Presently, there are complex varieties of derivatives already in existence, and the markets are innovating newer and newer ones continuously. For example, various types of financial derivatives based on their different properties like, plain, simple or straightforward, composite, joint or hybrid, synthetic, leveraged, mildly leveraged, customized or OTC traded, standardized or organized exchange traded, etc. are available in the market.

Due to complexity in nature, it is very difficult to classify the financial derivatives, so in the present context, the basic financial derivatives which are popular in the market have been described in brief. The details of their operations, mechanism and trading, will be discussed in the forthcoming respective chapters. In simple form, the derivatives can be classified into different categories which are shown in the Fig.



One form of classification of derivative instruments is between commodity derivatives and financial derivatives. The basic difference between these is the nature of the underlying instrument or asset. In a commodity derivatives, the underlying instrument is a commodity which may be wheat, cotton, pepper, sugar, jute, turmeric, corn, soya beans, crude oil, natural gas, gold, silver, copper and so on. In a financial derivative, the underlying instrument may be treasury bills, stocks, bonds, foreign exchange, stock index, gilt-edged securities, cost of living index, etc. It is to be noted that financial derivative is fairly standard and there are no quality issues whereas in commodity derivative, the quality may be the underlying matters. However, the distinction between these two from structure and functioning point of view, both are almost similar in nature.

Another way of classifying the financial derivatives is into basic and complex derivatives. In this, forward contracts, futures contracts and option contracts have been included in the basic derivatives whereas swaps and other complex derivatives are taken into complex category because they are built up from either forwards/futures or options contracts, or both. In fact, such derivatives are effectively derivatives of derivatives.

Basic Financial Derivatives

Forward Contracts

A forward contract is a simple customized contract between two parties to buy or sell an asset at a certain time in the future for a certain price. Unlike future contracts, they are not traded on an exchange, rather traded in the over-the-counter market, usually between two financial institutions or between a financial institution and its client.

Example

An Indian company buys Automobile parts from USA with payment of one million dollar due in 90 days. The importer, thus, is short of dollar that is, it owes dollars for future delivery. Suppose present price of dollar is ₹ 48. Over the next 90 days, however, dollar might rise against ₹ 48. The importer can hedge this exchange risk by negotiating a 90 days forward contract with a bank at a price ₹ 50. According to forward contract in 90 days the bank will give importer one million dollar and importer will give the bank 50 million rupees hedging a future payment with forward contract. On the due date importer will make a payment of ₹ 50 million to bank and the bank will pay one million dollar to importer, whatever rate of the dollar is after 90 days. So this is a typical example of forward contract on currency.

The basic features of a forward contract are given in brief here as under:

1. Forward contracts are bilateral contracts, and hence, they are exposed to counter-party risk. There is risk of non-performance of obligation either of the parties, so these are riskier than to futures contracts.
2. Each contract is custom designed, and hence, is unique in terms of contract size, expiration date, the asset type, quality, etc.
3. In forward contract, one of the parties takes a long position by agreeing to buy the asset at a certain specified future date. The other party assumes a short position by agreeing to sell the same asset at the same date for the same specified price. A party with no obligation offsetting the forward contract is said to have an open position. A party with a closed position is, sometimes, called a hedger.
4. The specified price in a forward contract is referred to as the delivery price. The forward price for a particular forward contract at a particular time is the delivery price that would apply if the contract were entered into at that time. It is important to differentiate between the forward price and the delivery price. Both are equal at the time the contract is entered into. However, as time passes, the forward price is likely to change whereas the delivery price remains the same.
5. In the forward contract, derivative assets can often be contracted from the combination of underlying assets, such assets are oftenly known as synthetic assets in the forward market.
6. In the forward market, the contract has to be settled by delivery of the asset on expiration date. In case the party wishes to reverse the contract, it has to compulsory go to the same counter party, which may dominate and command the price it wants as being in a monopoly situation.

7. In the forward contract, covered parity or cost-of-carry relations are relation between the prices of forward and underlying assets. Such relations further assist in determining the arbitrage-based forward asset prices.
8. Forward contracts are very popular in foreign exchange market as well as interest rate bearing instruments. Most of the large and international banks quote the forward rate through their 'forward desk' lying within their foreign exchange trading room. Forward foreign exchange quotes by these banks are displayed with the spot rates.
9. As per the Indian Forward Contract Act- 1952, different kinds of forward contracts can be done like hedge contracts, transferable specific delivery (TSD) contracts and non-transferable specify delivery (NTSD) contracts. Hedge contracts are freely transferable and do not specific, any particular lot, consignment or variety for delivery. Transferable specific delivery contracts are though freely transferable from one party to another, but are concerned with a specific and predetermined consignment. Delivery is mandatory. Non-transferable specific delivery contracts, as the name indicates, are not transferable at all, and as such, they are highly specific.

In brief, a forward contract is an agreement between the counter parties to buy or sell a specified quantity of an asset at a specified price, with delivery at a specified time (future) and place. These contracts are not standardized; each one is usually being customized to its owner's specifications.

Futures Contracts

Like a forward contract, a futures contract is an agreement between two parties to buy or sell a specified quantity of an asset at a specified price and at a specified time and place. Futures contracts are normally traded on an exchange which sets the certain standardized norms for trading in the futures contracts.

Example

A silver manufacturer is concerned about the price of silver, since he will not be able to plan for profitability. Given the current level of production, he expects to have about 20,000 ounces of silver ready in next two months. The current price of silver on May 10 is ₹ 1052.5 per ounce, and July futures price at FMC is ₹ 1068 per ounce, which he believes to be satisfied price. But he fears that prices in future may go down. So he will enter into a futures contract. He will sell four contracts at MCX where each contract is of 5000 ounces at ₹ 1068 for delivery in July.

Perfect Hedging Using Futures

Date	Spot Market	Futures market
May 10	Anticipate the sale of 20,000 ounce in two months and expect to receive ₹ 1068 per ounce or a total ₹ 21,36,00.00	Sell four contracts, 5000 ounce each July futures contracts at ₹ 1068 per ounce.
July 5	The spot price of silver is ₹ 1071 per ounce; Miner sells 20,000 ounces and receives ₹ 21,42,0000.	Buy four contracts at ₹ 1071. Total cost of 20,000 ounce will be ₹ 21,42,0000.
Profit / Loss	Profit = ₹ 60,000	Futures loss = ₹ 60,000

Net wealth change = 0

In the above example trader has hedged his risk of prices fall and the trading is done through standardized exchange which has standardized contract of 5000 ounce silver. The futures contracts have following features in brief:

Standardization

One of the most important features of futures contract is that the contract has certain standardized specification, i.e., quantity of the asset, quality of the asset, the date and month of delivery, the units of price quotation, location of settlement, etc. For example, the largest exchanges on which futures contracts are traded are the Chicago Board of Trade (CBOT) and the Chicago Mercantile Exchange (CME). They specify about each term of the futures contract.

Clearing House

In the futures contract, the exchange clearing house is an adjunct of the exchange and acts as an intermediary or middleman in futures. It gives the guarantee for the performance of the parties to each transaction. The clearing house has a number of members all of which have offices near to the clearing house. Thus, the clearing house is the counter party to every contract.

Settlement Price

Since the futures contracts are performed through a particular exchange, so at the close of the day of trading, each contract is marked-to-market. For this the exchange establishes a settlement price. This settlement price is used to compute the profit or loss on each contract for that day. Accordingly, the member's accounts are credited or debited.

Daily Settlement and Margin

Another feature of a futures contract is that when a person enters into a contract, he is required to deposit funds with the broker, which is called as margin. The exchange usually sets the minimum margin required for different assets, but the broker can set higher margin limits for his clients which depend upon the credit-worthiness of the clients. The basic objective of the margin account is to act as collateral security in order to minimize the risk of failure by either party in the futures contract.

Tick Size

The futures prices are expressed in currency units, with a minimum price movement called a tick size. This means that the futures prices must be rounded to the nearest tick. The difference between a futures price and the cash price of that asset is known as the basis. The details of this mechanism will be discussed in the forthcoming chapters.

Cash Settlement

Most of the futures contracts are settled in cash by having the short or long to make cash payment on the difference between the futures price at which the contract was entered and the cash price at expiration date. This is done because it is inconvenient or impossible to deliver sometimes, the underlying asset. This type of settlement is very much popular in stock indices futures contracts.

Delivery

The futures contracts are executed on the expiry date. The counter parties with a short position are obligated to make delivery to the exchange, whereas the exchange is obligated to make delivery to the longs. The period during which the delivery will be made is set by the exchange which varies from contract to contract.

Regulation

The important difference between futures and forward markets is that the futures contracts are regulated through a exchange, but the forward contracts are self regulated by the counter-parties themselves. The various countries have established Commissions in their country to regulate futures markets both in stocks and commodities. Any such new futures contracts and changes to existing contracts must be approved by their respective Commission. Further, more details on different issues of futures market trading will be discussed in forthcoming chapters.

Options Contracts

Options are the most important group of derivative securities. Option may be defined as a contract, between two parties whereby one party obtains the right, but not the obligation, to buy or sell a particular asset, at a specified price, on or before a specified date. The person who acquires the right is known as the option buyer or option holder, while the other person (who confers the right) is known as option seller or option writer. The seller of the option for giving such option to the buyer charges an amount which is known as the option premium.

Options can be divided into two types: calls and puts. A call option gives the holder the right to buy an asset at a specified date for a specified price whereas in put option, the holder gets the right to sell an asset at the specified price and time. The specified price in such contract is known as the exercise price or the strike price and the date in the contract is known as the expiration date or the exercise date or the maturity date.

The asset or security instrument or commodity covered under the contract is called as the underlying asset. They include shares, stocks, stock indices, foreign currencies, bonds, commodities, futures contracts, etc. Further options can be American or European. A European option can be exercised on the expiration date only whereas an American option can be exercised at any time before the maturity date.

Example

Suppose the current price of CIPLA share is ₹ 750 per share. X owns 1000 shares of CIPLA Ltd. and apprehends in the decline in price of share. The option (put) contract available at BSE is of ₹ 800, in next two-month delivery. Premium cost is ₹ 10 per share. X will buy a put option at 10 per share at a strike price of ₹ 800. In this way X has hedged his risk of price fall of stock. X will exercise the put option if the price of stock goes down below ₹ 790 and will not exercise the option if price is more than ₹ 800, on the exercise date. In case of options, buyer has a limited loss and unlimited profit potential unlike in case of forward and futures.

In April 1973, the options on stocks were first traded on an organized exchange, i.e., Chicago Board Options Exchange. Since then, there has been a dramatic growth in options markets. Options are now traded on various exchanges in various countries all over the world. Options are now traded both on organized exchanges and over-the-counter (OTC). The option trading mechanism on both are quite different and which leads to important differences in market conventions. Recently, options contracts on OTC are getting popular

because they are more liquid. Further, most of the banks and other financial institutions now prefer the OTC options market because of the ease and customized nature of contract.

It should be emphasized that the option contract gives the holder the right to do something. The holder may exercise his option or may not. The holder can make a reassessment of the situation and seek either the execution of the contracts or its non-execution as be profitable to him. He is not under obligation to exercise the option. So, this fact distinguishes options from forward contracts and futures contracts, where the holder is under obligation to buy or sell the underlying asset. Recently in India, the banks are allowed to write cross-currency options after obtaining the permission from the Reserve Bank of India.

Warrants and Convertibles

Warrants and convertibles are other important categories of financial derivatives, which are frequently traded in the market. Warrant is just like an option contract where the holder has the right to buy shares of a specified company at a certain price during the given time period. In other words, the holder of a warrant instrument has the right to purchase a specific number of shares at a fixed price in a fixed period from an issuing company. If the holder exercised the right, it increases the number of shares of the issuing company, and thus, dilutes the equities of its shareholders. Warrants are usually issued as sweeteners attached to senior securities like bonds and debentures so that they are successful in their equity issues in terms of volume and price. Warrants can be detached and traded separately. Warrants are highly speculative and leverage instruments, so trading in them must be done cautiously.

Convertibles are hybrid securities which combine the basic attributes of fixed interest and variable return securities. Most popular among these are convertible bonds, convertible debentures and convertible preference shares. These are also called equity derivative securities. They can be fully or partially converted into the equity shares of the issuing company at the predetermined specified terms with regards to the conversion period, conversion ratio and conversion price. These terms may be different from company to company, as per nature of the instrument and particular equity issue of the company. The further details of these instruments will be discussed in the respective chapters.

SWAP Contracts

Swaps have become popular derivative instruments in recent years all over the world. A swap is an agreement between two counter parties to exchange cash flows in the future.

Under the swap agreement, various terms like the dates when the cash flows are to be paid, the currency in which to be paid and the mode of payment are determined and finalized by the parties. Usually the calculation of cash flows involves the future values of one or more market variables.

There are two most popular forms of swap contracts, i.e., interest rate swaps and currency swaps. In the interest rate swap one party agrees to pay the other party interest at a fixed rate on a notional principal amount, and in return, it receives interest at a floating rate on the same principal notional amount for a specified period. The currencies of the two sets of cash flows are the same. In case of currency swap, it involves in exchanging of interest flows, in one currency for interest flows in other currency. In other words, it requires the exchange of cash flows in two currencies. There are various forms of swaps based upon these two, but having different features in general.

Other Derivatives

As discussed earlier, forwards, futures, options, swaps, etc. are described usually as standard or 'plain vanilla' derivatives. In the early 1980s, some banks and other financial institutions have been very imaginative and designed some new derivatives to meet the specific needs of their clients. These derivatives have been described as 'non-standard' derivatives. The basis of the structure of these derivatives was not unique, for example, some non-standard derivatives were formed by combining two or more 'plain vanilla' call and put options whereas some others were far more complex.

In fact, there is no boundary for designing the non-standard financial derivatives, and hence, they are sometimes termed as 'exotic options' or just 'exotics'. There are various examples of such non-standard derivatives such as packages, forward start option, compound options, choose options, barrier options, binary options, look back options, shout options, Asian options, basket options, Standard Oil's Bond Issue, Index Currency Option Notes (ICON), range forward contracts or flexible forwards and so on.

Traditionally, it is evident that important variables underlying the financial derivatives have been interest rates, exchange rates, commodity prices, stock prices, stock indices, etc. However, recently, some other underlying variables are also getting popular in the financial derivative markets such as creditworthiness, weather, insurance, electricity and so on. In fact, there is no limit to the innovations in the field of derivatives, Suppose that two companies A and B both wish to borrow 1 million rupees for five- years and rate of interest is:

Company	Fixed	Floating
Company A	10.00% per annum	6 month LIBOR + 0.30%
Company B	11.20% per annum	6 month LIBOR + 1.00%

A wants to borrow at floating funds and B wants to borrow at fixed interest rate. B has low credit rating than company A since it pays higher rate of interest than company A in both fixed and floating markets. They will contract to Financial Institution for swapping their assets and liabilities and make a swap contract with bank.

Both company will initially raise loans A in fixed and B in floating interest rate and then contract to bank, which in return pays fixed interest rate to A and receive floating interest rate to A and from B. Bank will pay floating interest rate and receive. Fixed interest rates and also changes commission from both A and B have the liability in which both were interested.

History of Derivatives Markets

It is difficult to trace the main origin of futures trading since it is not clearly established as to where and when the first forward market came into existence. Historically, it is evident that the development of futures markets followed the development of forward markets. It is believed that the forward trading has been in existence since 12th century in England and France. Forward trading in rice was started in 17th century in Japan, known as Cho-at-Mai a kind (rice trade-on-book) concentrated around Dojima in Osaka, later on the trade in rice grew with a high degree of standardization. In 1730, this market got official recognition from the Tokugawa Shogurate. As such, the Dojima rice market became the first futures market in the sense that it was registered on organized exchange with the standardized trading norms.

The butter and eggs dealers of Chicago Produce Exchange joined hands in 1898 to form the Chicago Mercantile Exchange for futures trading. The exchange provided a futures market for many commodities including pork bellies (1961), live cattle (1964), live hogs (1966), and feeder cattle (1971). The International Monetary Market was formed as a division of the Chicago Mercantile Exchange in 1972 for futures trading in foreign currencies. In 1982, it introduced a futures contract on the S&P 500 Stock Index. Many other exchanges throughout the world now trade futures contracts. Among them are the Chicago Rice and Cotton Exchange, the New York Futures Exchange, the London International Financial Futures Exchange, the Toronto Futures Exchange and the Singapore international Monetary Exchange. They grew so rapidly that the number of shares underlying the option contracts sold each day exceeded the daily volume of shares traded on the New York Stock Exchange.

In the 1980's, markets developed for options in foreign exchange, options on stock indices, and options on futures contracts. The Philadelphia Stock Exchange is the premier exchange for trading foreign exchange options. The Chicago Board Options Exchange trades options on the S&P 100 and the S&P 500 stock indices while the American Stock Exchange trades options on the Major Market Stock Index, and the New York Stock Exchange trades options on the NYSE Index. Most exchanges offering futures contracts now also offer options on these futures contracts. Thus, the Chicago Board of Trades offers options on corn futures, the Chicago Mercantile Exchange offers options on live cattle futures, the International Monetary Market offers options on foreign currency futures, and so on.

The basic cause of forward trading was to cover the price risk. In earlier years, transporting goods from one market to other markets took many months. For example, in the 1800s, food grains produced in England sent through ships to the United States which normally took few months. Sometimes, during this time, the price crashed due to unfavourable events before the goods reached to the destination. In such cases, the producers had to sell their goods at the loss. Therefore, the producers sought to avoid such price risk by selling their goods forward, or on a "to arrive" basis. The basic idea behind this move at that time was simply to cover future price risk. On the opposite side, the speculator or other commercial firms seeking to offset their price risk came forward to go for such trading. In this way, the forward trading in commodities came into existence.

In the beginning, these forward trading agreements were formed to buy and sell food grains in the future for actual delivery at the pre-determined price. Later on these agreements became transferable, and during the American Civil War period, i.e., 1860 to 1865, it became common place to sell and resell such agreements where actual delivery of produce was not necessary. Gradually, the traders realized that the agreements were easier to buy and sell if the same were standardized in terms of quantity, quality and place of delivery relating to food grains. In the nineteenth century this activity was centred in Chicago which was the main food grains marketing centre in the United States. In this way, the modern futures contracts first came into existence with the establishment of the Chicago Board of Trade (CBOT) in the year 1848, and today, it is the largest futures market of the world. In 1865, the CBOT framed the general rules for such trading which later on became a trendsetter for so many other markets.

In 1874, the Chicago Produce Exchange was established which provided the market for butter, eggs, poultry, and other perishable agricultural products. In the year 1877, the London Metal Exchange came into existence, and today, it is leading market in metal trading both in spot as well as forward. In the year 1898, the butter and egg dealers withdrew from the Chicago Produce Exchange to form separately the Chicago Butter and Egg Board,

and thus, in 1919 this exchange was renamed as the Chicago Mercantile Exchange (CME) and was reorganized for futures trading. Since then, so many other exchanges came into existence throughout the world which trade in futures contracts.

Although financial derivatives have been in operation since long, they have become a major force in financial markets only in the early 1970s. The basic reason behind this development was the failure of Brettonwood System and the fixed exchange rate regime was broken down. As a result, new exchange rate regime, i.e., floating rate (flexible) system based upon market forces came into existence. But due to pressure of demand and supply on different currencies, the exchange rates were constantly changing, and often, substantially. As a result, the business firms faced a new risk, known as currency or foreign exchange risk. Accordingly, a new financial instrument was developed to overcome this risk in the new financial environment.

Another important reason for the instability in the financial market was fluctuation in the short-term interests. This was mainly due to that most of the government at that time tried to manage foreign exchange fluctuations through short-term interest rates and by maintaining money supply targets, but which were contrary to each other. Further, the increased instability of short-term interest rates created adverse impact on long-term interest rates, and hence, instability in bond prices because they are largely determined by long-term interest rates. The result is that it created another risk, named interest rate risk, for both the issuers and the investors of debt instruments.

Interest rate fluctuations had not only created instability in bond prices, but also in other long-term assets such as, company stocks and shares. Share prices are determined on the basis of expected present values of future dividends payments discounted at the appropriate discount rate. Discount rates are usually based on long-term interest rates in the market. So, increased instability in the long-term interest rates caused enhanced fluctuations in the share prices in the stock markets. Further volatility in stock prices is reflected in the volatility in stock market indices which causes to systematic risk or market risk.

In the early 1970s, it is witnessed that the financial markets were highly instable; as a result, so many financial derivatives have been emerged as the means to manage the different types of risks stated above, and also of taking advantage of it. Hence, the first financial futures market was the International Monetary Market, established in 1972 by the Chicago Mercantile Exchange which was followed by the London International Financial Futures Exchange in 1982. For further details see the 'growth of futures market' in the forthcoming chapter.

Uses of Derivatives

Derivatives are supposed to provide the following services:

1. One of the most important services provided by the derivatives is to control, avoid, shift and manage efficiently different types of risks through various strategies like hedging, arbitraging, spreading, etc. Derivatives assist the holders to shift or modify suitably the risk characteristics of their portfolios. These are specifically useful in highly volatile financial market conditions like erratic trading, highly flexible interest rates, volatile exchange rates and monetary chaos.
2. Derivatives serve as barometers of the future trends in prices which result in the discovery of new prices both on the spot and futures markets. Further, they help in disseminating different information regarding the futures markets trading of various commodities and securities to the society which enable to discover or form suitable or correct or true equilibrium prices in the markets. As a result, they assist in appropriate and superior allocation of resources in the society.
3. As we see that in derivatives trading no immediate full amount of the transaction is required since most of them are based on margin trading. As a result, large numbers of traders, speculators arbitrageurs operate in such markets. So, derivatives trading enhance liquidity and reduce transaction costs in the markets for underlying assets.
4. The derivatives assist the investors, traders and managers of large pools of funds to devise such strategies so that they may make proper asset allocation increase their yields and achieve other investment goals.
5. It has been observed from the derivatives trading in the market that the derivatives have smoothen out price fluctuations, squeeze the price spread, integrate price structure at different points of time and remove gluts and shortages in the markets.
6. The derivatives trading encourage the competitive trading in the markets, different risk taking preference of the market operators like speculators, hedgers, traders, arbitrageurs, etc. resulting in increase in trading volume in the country. They also attract young investors, professionals and other experts who will act as catalysts to the growth of financial markets.
7. Lastly, it is observed that derivatives trading develop the market towards 'complete markets'. Complete market concept refers to that situation where no particular investors be better of than others, or patterns of returns of all additional securities are spanned by the already existing securities in it, or there is no further scope of additional security.

Critiques of Derivatives

Besides from the important services provided by the derivatives, some experts have raised doubts and have become critique on the growth of derivatives. They have warned against them and believe that the derivatives will cause to destabilization, volatility, financial excesses and oscillations in financial markets. It is alleged that they assist the speculators in the market to earn lots of money, and hence, these are exotic instruments. In this section, a few important arguments of the critiques against derivatives have been discussed.

Speculative and Gambling Motives

One of most important arguments against the derivatives is that they promote speculative activities in the market. It is witnessed from the financial markets throughout the world that the trading volume in derivatives have increased in multiples of the value of the underlying assets and hardly one to two percent derivatives are settled by the actual delivery of the underlying assets. As such speculation has become the primary purpose of the birth, existence and growth of derivatives. Sometimes, these speculative buying and selling by professionals and amateurs adversely affect the genuine producers and distributors.

Some financial experts and economists believe that speculation brings about a better allocation of supplies overtime, reduces the fluctuations in prices, make adjustment between demand and supply, removes periodic gluts and shortages, and thus, brings efficiency to the market. However, in actual practice, above such agreements are not visible. Most of the speculative activities are 'professional speculation' or 'movement trading' which lead to destabilization in the market. Sudden and sharp variations in prices have been caused due to common, frequent and widespread consequence of speculation.

Increase in Risk

The derivatives are supposed to be efficient tool of risk management in the market. In fact this is also one-sided argument. It has been observed that the derivatives market—especially OTC markets, as particularly customized, privately managed and negotiated, and thus, they are highly risky. Empirical studies in this respect have shown that derivatives used by the banks have not resulted in the reduction in risk, and rather these have raised new types of risk. They are powerful leveraged mechanism used to create risk. It is further argued that if derivatives are risk management tool, then why 'government securities', a riskless security, are used for trading interest rate futures which is one of the most popular financial derivatives in the world.

Instability of the Financial System

It is argued that derivatives have increased risk not only for their users but also for the whole financial system. The fears of micro and macro financial crisis have caused to the unchecked growth of derivatives which have turned many market players into big losers. The malpractices, desperate behaviour and fraud by the users of derivatives have threatened the stability of the financial markets and the financial system.

Price Instability

Some experts argue in favour of the derivatives that their major contribution is toward price stability and price discovery in the market whereas some others have doubt about this. Rather they argue that derivatives have caused wild fluctuations in asset prices, and moreover, they have widened the range of such fluctuations in the prices. The derivatives may be helpful in price stabilization only if there exist a properly organized, competitive and well-regulated market. Further, the traders behave and function in professional manner and follow standard code of conduct. Unfortunately, all these are not so frequently practiced in the market, and hence, the derivatives sometimes cause to price instability rather than stability.

Displacement Effect

There is another doubt about the growth of the derivatives that they will reduce the volume of the business in the primary or new issue market specifically for the new and small corporate units. It is apprehension that most of investors will divert to the derivatives markets, raising fresh capital by such units will be difficult, and hence, this will create displacement effect in the financial market. However, it is not so strong argument because there is no such rigid segmentation of invertors, and investors behave rationally in the market.

Increased Regulatory Burden

As pointed earlier that the derivatives create instability in the financial system as a result, there will be more burden on the government or regulatory authorities to control the activities of the traders in financial derivatives. As we see various financial crises and scams in the market from time to time, most of time and energy of the regulatory authorities just spent on to find out new regulatory, supervisory and monitoring tools so that the derivatives do not lead to the fall of the financial system.

In our fast-changing financial services industry, coercive regulations intended to restrict banks' activities will be unable to keep up with financial innovation. As the lines of demarcation between various types of financial service providers continues to blur, the bureaucratic leviathan responsible for reforming banking regulation must face the fact that fears about derivatives have proved unfounded. New regulations are unnecessary.

Indeed, access to risk-management instruments should not be feared, but with caution, embraced to help the firms to manage the vicissitudes of the market.

In this chapter various misconceptions about financial derivatives are explored. Believing just one or two of the myths could lead one to advocate tighter legislation and regulatory measures designed to restrict derivatives activities and market participants. A careful review of the risks and rewards derivatives offer, however, suggests that regulatory and legislative restrictions are not the answer. To blame organizational failures solely on derivatives is to miss the point. A better answer lies in greater reliance on market forces to control derivative-related risk taking.

Financial derivatives have changed the face of finance by creating new ways to understand, measure and manage risks. Ultimately, financial derivatives should be considered part of any firm's risk-management strategy to ensure that value-enhancing investment opportunities are pursued. The freedom to manage risk effectively must not be taken away.

Myths About Derivatives

Myth Number 1

“Derivatives are new, complex, high –tech financial products created by Wall Street's rocket scientists”

Financial derivatives are not new; they have been around for years. A description of the first known option contract can be found in Aristotle's writing tells philosopher from Miletus who developed a financial device, which involves a principle of universal application people reproved Thales, saying that his lack of wealth was proof that philosophy was useless occupation and of no intellect.

Thales had great skill in forecasting and predicted that the olive harvest would be exceptionally good the next autumn. Confident in his prediction, he made agreements with olive –press owners to deposit what little money he had with them to guarantee him

exclusive use of their olive press when the harvest was ready. Hales successfully negotiated low prices because the harvest was in the future and no one knew whether the harvest would be plentiful or pathetic and because the olive-press owners were willing to hedge against the possibility of a poor yield. Aristotle's story about Tales ends as one might guess:" when the harvest –time came, and many [presses] were wanted all at once and of a sudden, he let them out at any rate which he pleased, and made a quantity of money.

Thus he showed the world that philosophers can easily be rich if they like their ambition is of another sort," So Thanes exercised the first known option contracts some 2,500 years ago. He was not obliged to exercise the option if the olive harvest had not been good, hales could have let the option contracts expire unused and limited his loss to the original price and paid for the option.

Most financial derivatives traded today are the: plain vanilla" variety –the simplest form of a financial derivatives that are much difficult to measure, manage, and understand. For those instruments, the measurement and control of risk can be far more complicated, creating the increased possibility of unforeseen losses.

Wall Street's "rocket scientists" are continually creating new complex, sophisticated financial derivative products. However, those products are built on foundation of the four basis types of derivatives Most of the newest innovations are designed to hedge complex risks in an effort to reduce future uncertainties and manage risks more effectively. But the newest innovations require a firm understanding of the tradeoff of risk and rewards. To that end, derivative users should establish a guiding set of principles to provide a framework for effectively managing and controlling financial derivative activities those principles should focus on the role of senior management, valuation and market risk-argument credit measurement and management, enforceability operating systems and controls and accounting and disclosure of risk-management position.

Myth Number 2

"Derivatives are purely speculative, leveraged instrument"

Put another way. This myth is that "derivatives" is a fancy name for gambling. Has speculative trading of derivative products fuelled the rapid growth in their use? Are derivatives used only to speculate on the direction of interest rates or currency exchange rates? Of course not. Indeed, the explosive use of financial derivative products in recent years was brought about by three primary forces: more volatile markets, deregulation and technologies.

The turning point seems to have occurred in the early 1970s with the breakdown of the fixed-rate international currency exchange regime. This was established at the 1944 conference at Bretons Woods and maintained by the International monetary fund. Since then currencies have floated freely. Accompanying that development was the gradual removal of government-established interest-rate ceilings when regulation Q interest-

Rate restrictions were phased out. Not long afterward came inflationary oil price shocks and wild interest-rate fluctuations. In sum, financial markets were more volatile then at any time since the Great Depression. Banks and other financial intermediaries responded to the new environment by developing financial risk-management products designed to better control risk. The first were simple foreign exchange forwards that obligated one counterpart to buy, and the other to sell, a fixed amount of currency at an agreed dated in the future. By entering into a foreign exchange forward contract, customers could offset the risk that large movements in foreign exchange rates would destroy the economic viability of their overseas projects Thus, derivatives were originally intended to be used to effectively hedge certain risks; and in fact, that was the key that unlocked their explosive development.

Beginning in the early 1980s,a host of new competitors accompanied the deregulation of financial markets, and the arrival of powerful but inexpensive personal computers ushered in new ways to analyze information and break down risk into component parts. To serve customers better, financial intermediary's offered an ever-increasing number of novel products designed to more effectively manage and control financial risks. New technologies quickened the pace of innovation and provided banks with superior methods for tracking and simulating their own derivatives portfolios.

Myth Number 3

“The enormous size of the financial derivatives market dwarfs bank capital, there by making derivatives trading an unsafe and unsound banking practice”

The financial derivatives market's worth is regularly reported as more then \$20trillion. That estimate dwarfs not only bank capital but also the nation's\$7trillion annual gross domestic product. Those often quoted figures are notional amounts. For derivatives, notional principal is the amount on which interest and other payments are based. Notional principal typically does not change hands; it is simply quantity used to calculate payments.

While notional principal is the most commonly used volume measure in derivatives markets, it is not on accurate measures of credit exposure. A useful proxy for the actual exposure of derivative instruments is replacement-cost credit exposure. That exposure is

the cost of replacing the contract at current market values should the counterpart default before the settlement date.

For the 10 largest derivatives players among US bank holding companies, derivative credit exposure averages 15 percent of the total assets. The average exposure is 49 percent of assets for those banks' loan portfolios. In other words, if those 10 banks lost 100 percent on their loans, the loss would be more than three times greater than it would be if they had to replace all of their derivative contracts.

Derivatives also help to improve market efficiencies because risks can be isolated and sold to those who are willing to accept them at the least cost. Using derivatives breaks risk into pieces that can be managed independently. Corporations can keep the risks they are most willing to accept them. From a market oriented perspective, derivatives offer the free trading of financial risks.

The viability of financial derivatives rests on the principle of comparative advantage—that is, the relative cost of holding specific risks. Whenever comparative advantages exist, trade can benefit all parties involved. And financial derivatives allow for the free trading of individual risk components.

Myth Number 4

“Only large multinational corporations and large banks have a purpose for using derivatives”

Very large organizations are the biggest users of derivative instruments. However, firms of all sizes can benefit from using them. For example, consider a small regional bank (SRB) with total assets of \$5 million. The SRB has a loan portfolio composed primarily of fixed-rate mortgages, a portfolio of government securities, and interest-bearing deposits that are often repriced. Two illustrations of how SRB can use derivatives to hedge risks are:

First, rising interest rates will negatively affect prices in the SRB's \$1 million securities portfolio. But by selling short a \$1 million treasury-bond futures contract, the SRB can effectively hedge against that interest-rate risk and smooth earnings stream in a volatile market. If interest rates went higher, the SRB would be hurt by a drop in value of its securities portfolio, but that loss would be offset by a gain from the increase in the value of its securities portfolio but would record a loss from its derivative contract. By entering into derivatives contracts, the SRB can lock in a guaranteed rate of return on its securities portfolio and not be as concerned about interest-rate volatility.

The second illustration involves a swap contract. As in the first illustration, rising interest rates will harm the SRB because it received fixed cash on its loan portfolio and variable cash flows with a dealer to pay fixed and received floating payments.

Myth Number 5

“Financial derivatives are simply the latest risk-management fad”

Financial derivatives are important tools that can help organization to meet their specific risk management objectives. As is the case with all tools, it is important that the user understand the tool's intended function and that necessary to undertake various purpose. What kinds of derivative instruments and trading strategies are most appropriate? How will those instruments perform if there is a large increase or decrease in interest rates? Without a clearly defined risk-management strategy, use of financial derivatives can be dangerous. It can threaten the accomplishment of a firm's long-range objectives and result in unsafe and unsound practices that could lead to the organization's insolvency. But when used wisely financial derivatives can increase shareholder value by providing a means to better control a firm 'sriskexposures and cash flow. Clearly, derivatives are here to stay. We are well on our way to truly globule financial markets that will continue to develop new financial innovation to improve risk-management practices. Financial derivatives are the latest risk-management fad. They are important tools for helping organizations to better manage their risk exposures.

Myth Number 6

“Derivatives take money out of productive processes and never put anything back”

Financial derivatives, by reducing uncertainties, make it possible for corporations initiate productive activities that not otherwise be pursued. For example, a company may like to build manufacturing facility in the United states but is concerned about the project's overall cost because of exchange rate volatility between the dollar's ensure that the company will have the cash available when it is needed for investment, the manufacturer should devise a prudent risk –management strategy that is in harmony with its broader corporate objective of building a manufacturing facility un the United states. As part of that strategy, the firm should use financial derivatives to hedge against foreign exchange risk. Derivatives used as a hedge can improve the management of cash flows at the individual firm level.

To ensure that predictive activities are pursued, corporate finance and treasury groups should transform their operations from mundane bean counting to activist financial

risk management. They should integrate a clear set of risk management goals and objectives into the organization's overall corporate strategy. The ultimate goal is to ensure that the organization has necessary resources at its disposal to pursue investments that maximize shareholder value. Used properly financial derivatives can help corporation to reduce uncertainties and promote more productive activities.

Myth Number 7

“Only risk-seeking organization should use derivatives”

Financial derivatives can be used in two ways: to hedge against unwanted risks or to speculate by taking a position in anticipation of a market movement. The olive-press owners, by locking in a guaranteed return no matter how good or bad the harvest, hedge against the risk that the season's olive harvest might not be plentiful. Hales speculated that the next season's olive harvest would be exceptionally good and therefore, paid an up-front premium in anticipation of that event. Similarly, organization actions today can use financial derivatives to actively seek out specific risk and speculate on the direction of interest rate or exchange –rate movements, or they can use derivatives to hedge against unwanted risks. Hence, it is not true that only risk-seeking institutions use derivatives. Indeed, organizations should use derivatives as part of their overall risk management strategy for keeping those risks that they are comfortable managing and selling those that they do not want to others who are more willing to accept them. Even conservatively managed institutions can use derivatives to improve their cash flow management to ensure that the necessary funds are available to meet broader corporate objectives. One could argue that organizations that refuse to use financial derivatives are at greater risk than are those that use them.

When using financial derivatives however, organization should be careful to use only those instruments that they understand and that fit best their corporate risk-management philosophy. It may be prudent to stay away from the more exotic instruments, unless the risk/reward tradeoffs are clearly understood by the form's senior management and its independent risk-management review team. Exotic contracts should not be used unless there is some obvious reason for doing so.

Myth Number 8

“The risks associated with financial derivatives are new and unknown”

The kinds of risks associated with derivatives are no different from those associated with traditional financial instruments, although they can be far more complex. There are

credit risks, market and so on. Risks from derivatives originate with the customer. With few exceptions, the risks are man-made, that is it does not readily appear in nature. For example, when a new homeowner negotiates with a lender to borrow a sum of money, the customer creates risks by the types of mortgage he chooses—risks to himself and the lending company. Financial derivatives allow the lending institution to break up those risks and distribute them around the financial system via secondary markets.

Thus many risks associated with derivatives are actually created by the dealers' customers or by their customers' customers. Those risks have been inherent in our nation's financial system since its inception.

Banks and other financial intermediaries should view themselves as risk managers blending their knowledge of global financial markets with their clients' needs to help their clients anticipate change and have the flexibility to pursue opportunities that maximize their success. Banking is inherently a risky business. Risk permeates much of what banks do, and for banks to survive, they must be able to understand, measure, and manage financial risks effectively.

The types of risks faced by corporations today have not changed. Rather they are more complex and interrelated. The increase in complexity and volatility of the financial markets have paved the way for the growth of numerous financial innovations that can enhance returns relative to risk. But a thorough understanding of a new financial—engineering tools and proper integration into a firm's overall risk-management strategy and corporate philosophy can help to turn volatility into profitability.

Risk management is not about the elimination of risk; it is about the management of the risk. Selectively choosing those risks an organization is comfortable with and minimizing those that it does not want. Financial derivatives serve a useful purpose in fulfilling risk-management objectives. Through derivatives risks from traditional instruments can be efficiently unbundled and managed independently. Used correctly, derivatives can save costs and increase returns.

Today dealers manage portfolios of derivatives and oversee the net, or residual, risk of their overall position. That development has changed the focus of risk management from individual transactions to portfolio exposures and has substantially improved dealers' ability to accommodate a broad spectrum of customer transitions. Because most active derivatives players today trade on portfolio exposures, it appears that financial derivatives do not wind markets together any more tightly than do loans. Derivatives players do not match every trade with an offsetting trade; instead, they continually manage the residual risk of the

portfolio. If a counterpart defaults on a swap, the defaulted party does not turn around and default on some other counterpart that offset the original transaction. Instead, a derivatives default is very similar to a loan default. That is why it is important that derivatives players perform with due diligence in determining the financial strength and default risks of potential counter parties.

Myth Number 9

“Because of the risks associated with derivatives banking regulators should ban their use by any institution covered by federal deposit insurance”

The problem is not derivatives but the perverse incentive banks have under the current system of federal deposit guarantees. Deposit insurance and other deposit reforms were first introduced to address some of the instabilities associated with systemic risk. Through federally guaranteed deposit insurance, the US government attempted to avoid, by increasing depositors' confidence, the experience of deposit runs that characterized banking crises before the 1930s.

The current deposit guarantee structure has, indeed, reduced the probability of large- scale bank panics, but it has also created some new problems. Deposit insurance effectively eliminates the discipline provided by the market mechanism that encourages banks to maintain appropriate capital levels and restrict unnecessary risk taking. Therefore, banks may wish to pursue higher risk strategies because depositors have a diminished incentive to monitor banks. Further, federal deposit insurance actually encourage banks to use derivatives as speculative instruments to pursue higher risk strategies, instead of to hedge, or as dealers.

Since federal deposit insurance discourages market discipline, regulators have been put in the position of monitoring banks to ensure that they are managed in a safe and sound manner. In the present system of federal deposit guarantees, regulatory proposals involving financial derivatives should focus on market-oriented reforms as opposed to laws that might eliminate the economic risk-management benefits of derivatives.

To that end banking regulation should emphasize more disclosure of derivatives positions in financial statements and be certain that institution trading huge derivatives portfolios have adequate capital. In addition, because derivatives could have implication for the stability of the financial system, it is important that users maintain sound risk-management practices.

Regulation have issued guidelines that banks with substantial trading or derivatives activity should follow those guidelines include

- Active board and senior management oversight of trading activities;
- Establishment of an internal risk-management audit function that has independent of the trading function;
- Thorough and timely audits to identify internal control weaknesses; and
- Risk-management and risk-management information system that include stress tests, simulations, and contingency plans for adverse market movements

It is the responsibility of a bank's senior management to ensure that risks are effectively controlled and limited to levels that do not pose a serious threat to its capital position. Regulation is an ineffective substitute for sound risk management at the individual firm level.

Lesson 1.2 - Forward Contracts

Features of Forward Contract

1. It is an agreement between the two counter parties in which one is buyer and other is seller. All the terms are mutually agreed upon by the counterparties at the time of the formation of the forward contract.
2. It specifies a quantity and type of the asset (commodity or security) to be sold and purchased.
3. It specifies the future date at which the delivery and payment are to be made.
4. It specifies a price at which the payment is to be made by the seller to the buyer. The price is determined presently to be paid in future.
5. It obligates the seller to deliver the asset and also obligates the buyer to buy the asset.
6. No money changes hands until the delivery date reaches, except for a small service fee, if there is.

Classification of Forward Contracts

The forward contracts can be classified into different categories. Under the Forward Contracts (Regulation) Act, 1952, forward contracts can be classified in the following categories:

Hedge Contracts

The basic features of such forward contracts are that they are freely transferable and do not specify any particular lot, consignment or variety of delivery of the underlying goods or assets. Delivery in such contracts is necessary except in a residual or optional sense. These contracts are governed under the provisions of the Forward Contracts (Regulation) Act, 1952.

Transferable Specific Delivery (TSD) Contracts

These forward contracts are freely transferable from one party to other party. These are concerned with a specific and predetermined consignment or variety of the commodity.

There must be delivery of the underlying asset at the expiration time. It is mandatory. Such contracts are subject to the regulatory provisions of the Forward Contracts (Regulation) Act, 1952, but the Central Government has the power to exempt (in specified cases) such forward contracts.

Non-Transferable Specific Delivery (NTSD) Contracts

These contracts are of such nature which cannot be transferred at all. These may concern with specific variety or consignment of goods or their terms may be highly specific. The delivery in these contracts is mandatory at the time of expiration. Normally, these contracts have been exempted from the regulatory provisions of Forward Act, but the Central Government, whenever feels necessary, may bring them under the regulation of the Act.

It is evident from the above that the definition of hedge contracts corresponds to the definition of futures contracts while the latter two are not futures contracts, and hence, termed as forward contracts. Since in both hedge contracts and futures contracts, no specification about the underlying asset/commodity is mentioned because such limits are set by the rules of the exchange on which types can or cannot be delivered. If the variety is superior or inferior to the basis variety for delivery, in that case the prices are adjusted by means of premium or discount as the case may be. Such adjustments are popularly known as tendering differences. Thus, on this basis, it may be generalized that every futures contract is a forward contract but every forward contract may not be futures contract.

Other Forward Contracts

Forward Rate Agreements (FRA)

Forward contracts are commonly arranged on domestic interest-rate bearing instruments as well as on foreign currencies. A forward rate agreement is a contract between the two parties, (usually one being the banker and other a banker's customer or independent party), in which one party (the banker) has given the other party (customer) a guaranteed future rate of interest to cover a specified sum of money over a specified period of time in the future.

For example, two parties agree that a 6 percent per annum rate of interest will apply to one year deposit in six months time. If the actual rate of interest proves to be different from 6 percent then one company will pay and other receives the difference between the two sets of interest cash flows.

In forward rate agreement, no actual lending or borrowing is affected. Only it fixes the rate of interest for a futures transaction. At the time of maturity, when the customer actually needs funds, then he has to borrow the funds at the prevailing rate of interest from the market. If the market rate of interest is higher than the FRA interest then the banker will have to pay to the other party (customer) the difference in the interest rate. However, if market interest is lesser than the FRA rate then the customer will have to pay the difference to the banker. This transaction is known as purchase of FRA from the bank.

Sometimes, a customer (depositor) may also make a FRA contract with the bank for his deposits for seeking a guaranteed rate of interest on his deposits. If the market rate on his deposit turns out to be lower than that guaranteed interest rate in the FRA, the bank will compensate him for the difference, i.e., FRA rate minus market interest. Similarly, if the FRA is lower than the deposit rate then the customer will pay difference to the banker. This transaction is known as sale of a FRA to the bank. In this way, purchase of FRA protects the customer against a rise in interest in case of borrowing from the bank. Similarly, sale of FRA will protect the customer from deposits point of view. The bank charges different rates of interest for borrowing and lending, and the spread between these two constitutes bank's profit margin. As a result, no other fee is chargeable for FRA contracts.

Example 1

Suppose three month forward rupee is at ₹ 45 per US dollar. A quotation is given in terms of range. The forward rupee would be quoted at “₹ 48 to ₹ 50”. If the spot rate rises above the maximum, i.e., ₹ 50 then the maximum level is used. If the spot rate falls below the minimum rate, i.e., ₹ 48 then the minimum level will be used.

Example 2

Assume two companies might agree that 8 percent per annum rate of interest will apply to a one-year deposit in fix month's time. If the actual rate proves to be different from 8 percent per annum, one company pays and the other receives the present value of the difference between two sets of interest (cash flows). This is known as a forward-rate agreement (FRA).

Range Forwards

These instruments are very much popular in foreign exchange markets. Under this instrument, instead of quoting a single forward rate, a quotation is given in terms of a range, i.e., a range may be quoted for Indian rupee against US dollar at ₹ 47 to ₹ 49. It means there

is no single forward rate rather a series of rate ranging from ₹ 47 1049 has been quoted. This is also known as flexible forward contracts. At the maturity, if the spot exchange rate is between these two levels, then the actual spot rate is used. On the other hand, if the spot rate rises above the maximum of the range, i.e., ₹ 49 in the present case then the maximum level is used.

Further, if the spot rate falls below the minimum level, i.e., ₹ 47, then the minimum rate will be used. As such we see that these forward range contracts differ from normal forward contracts in two respects, namely, (a) they give the customer a range within which he can earn or use from the exchange rate fluctuations, and (b) further they provide protection to the party from the extreme variation in exchange rates.

Forward Trading Mechanism

Forward contracts are very much popular in foreign exchange markets to hedge the foreign currency risks. Most of the large and international banks have a separate 'Forward Desk' within their foreign exchange trading room which is devoted to the trading of forward contracts. Let us take an example to explain the forward contract.

Suppose on April 10, 2002, the treasurer of an UK Multinational firm (MNC) knows that the corporation will receive one million US dollar after three months, i.e., July 10, 2002 and wants to hedge against the exchange rate movements.

In this situation, the treasurer of the MNC will contact a bank and find out that the exchange rate for a three-month forward contract on dollar against pound sterling, i.e., £I\$ = 0.6250 and agrees to sell one million dollar. It means that the corporation has short forward contracts on US dollar. The MNC has agreed to sell one million dollar on July 10, 2002 to the bank at the future dollar rate at 0.6250. On the other hand, the bank has a long forward contract on dollar. Both sides have made a binding contract/commitment.

Before discussing the forward trading mechanism, let us see some important terminology frequently used in the forward trading.

Long Position

The party who agrees to buy in the future is said to hold long position. For example, in the earlier case, the bank has taken a long position agreeing to buy 3-month dollar in futures.

Short Position

The party who agrees to sell in the future holds a short position in the contract. In the previous example, UK MNC has taken a short position by selling the dollar to the bank for a 3-month future.

The Underlying Asset

It means any asset in the form of commodity, security or currency that will be bought and sold when the contract expires, e.g., in the earlier example US dollar is-the underlying asset which is sold and purchased in future.

Spot-Price

This refers to the purchase of the underlying asset for immediate delivery. In other words, it is the quoted price for buying and selling of an asset at the spot or immediate delivery.

Future Spot Price

The spot price of the underlying asset when the contract expires is called the future spot price, since it is market price that will prevail at some futures date.

Delivery Price

The specified price in a forward contract will be referred to as the delivery price. This is decided or chosen at the time of entering into forward contract so that the value of the contract to both parties is zero. It means that it costs nothing to take a long or a short position. In other words, at the day on writing of a forward contract, the price which is determined to be paid or received at the maturity or delivery period of the forward contract is called delivery price. On the first day of the forward contract, the forward price may be same as to delivery price. This is determined by considering each aspect of forward trading including demand and supply position of the underlying asset. However, a further detail regarding this will be presented in forthcoming chapter.

The Forward Price

It refers to the agreed upon price at which both the counter parties will transact when the contract expires. In other words, the forward price for a particular forward contract at a particular time is the delivery price that would apply if the contract were entered into at

that time. In the example discussed earlier, on April 10, 2002, 0.6250 is the forward price for a forward contract that involves the delivery of US dollar on July 10, 2002.

The Determination of Forward Prices

Forward contracts are generally easier to analyze than futures contracts because in forward contracts there is no daily settlement and only a single payment is made at maturity. Though both futures prices and forward prices are closely related, this will be described in the latter part of this chapter.

It is essential to know about certain terms before going to determine the forward prices such as distinction between investment assets and consumption assets, compounding, short selling, repo rate and so on because these will be frequently used in such computation. We are not discussing these here in detail but the traders must be aware about them thoroughly. A brief view of these terms is explained here as under:

An **investment asset** is an asset that is held for investment purposes, such as stocks, shares, bonds, treasury, securities, etc. **Consumption assets** are those assets which are held primarily for consumption, and not usually for investment purposes. There are commodities like copper, oil, food grains and live hogs.

Compounding is a quantitative tool which is used to know the lump-sum value of the proceeds received in a particular period. Consider an amount A invested for n years at an interest rate of R per annum. If the rate is compounded once per annum, the terminal value of that investment will be

$$\text{Terminal value} = A(1 + R)^n$$

and if it is compounded m times per annum then the terminal value will be

$$\text{Terminal value} = A(1 + R/m)^{mn}$$

where A is amount for investment, R is rate of return, n is period for return and m is period of compounding.

Suppose A = ₹ 100, R = 10% per annum, n = 1 (one year), and if we compound once per annum (m = 1) then as per this formula, terminal value will be

$$100(1 + 10)^1 = 100(1.10) = ₹ 110,$$

if m=2 then

$$100(1 + 0.05)^{2 \times 1} = 100 \times 1.05 \times 1.05 = ₹ 110.25$$

and so on.

Short selling refers to selling securities which are not owned by the investor at the time of sale. It is also called 'shorting', with the intention of buying later. Short selling may not be possible for all investment assets. It yields a profit to the investor when the price of the asset goes down and loss when it goes up.

For example, an investor might contract his broker to short 500 State Bank of India shares then the broker will borrow the shares from another client and sell them in the open market. So the investor can maintain the short position provided there are shares available for the broker to borrow. However, if the contract is open, the broker has no shares to borrow, then the investor has to close his position immediate, this is known as **short-squeezed**.

The **repo rate** refers to the risk free rate of interest for many arbitrageurs operating in future markets. Further, the 'repo' or repurchase agreement refers to that agreement where the owner of the securities agrees to sell them to a financial institution, and buy the same back later (after a particular period). The repurchase price is slightly higher than the price at which they are sold. This difference is usually called interest earned on the loan. Repo rate is usually slightly higher than the Treasury bill rate.

Assumptions and Notations

Certain **assumptions** considered here for determination of forward or futures prices are:

- ▶ There are no transaction costs.
- ▶ Same tax rate for all the trading profits.
- ▶ Borrowing and lending of money at the risk free interest rate.
- ▶ Traders are ready to take advantage of arbitrage opportunities as and when arise. These assumptions are equally available for all the market participants; large or small.

Further, some **Notations** which have been used here are:

T = Time remained upto delivery date in the contract

S = Price of the underlying asset at present, also called as spot or cash or current

K = Delivery price in the contract at time T

F = Forward or future price today

f = Value of a long forward contract today

r = Risk free rate of interest per annum today

t = Current or today or present period of entering the contract

Now, we will discuss the mechanism of determination of forward prices of different types of assets.

The Forward Price for Investment Asset (Securities)

Here we will consider three situations in case of investment assets:

1. Investment assets providing no income
2. Investment assets providing a known income
3. Investment assets providing a known dividend income

Forward Price for An Asset that Provides no Income

This is the easiest forward contract to value because such assets do not give any income to the holder. These are usually nondividend paying equity shares and discount bonds. Let us consider the relationship between the forward price and spot price with an example.

Example

Consider a long forward contract to purchase a share (Non-dividend paying) in three-months. Assume that the current stock price is ₹ 100 and the three-month risk free rate of interest is 6% per annum. Further assume that the three months forward price is ₹ 105.

Arbitrageur can adopt the following strategy

Borrow ₹ 100 @ 6% for three months, buy one share at ₹ 100 and short a forward contract for ₹ 105. At the end of three months, the arbitrageur delivers the share for ₹ 105, the sum of money required to pay off the loan is $100e^{0.06 \times 0.25} = ₹ 101.50$, and in this way, he will book a profit of ₹ 3.50, ($₹ 105 - ₹ 101.50$).

Further suppose that the three-month forward price is ₹ 99. Now, an arbitrageur can one share, invest the proceeds of the short sale at 6 percent per annum for three months, and a long position in a three-month forward contract. The proceeds of short sales will grow to $100e^{0.06 \times 0.25} = ₹ 101.50$, at the end of three months, the arbitrageur will pay ₹ 99 and takes the delivery of the share under forward contract, and uses it to close its short sale position. His net gain is $₹ 101.50 - ₹ 99 = ₹ 2.5$.

Generalization: We call from the previous example using the notations mentioned earlier for investment asset providing no income:

$$F = Se^{rT}$$

where F is forward price of the stock, S is spot price of the stock, T is maturity period (remained), r is risk-free interest rate.

If $F > Se^{rT}$ then the arbitrageur can buy the asset and will go for short forward contract on the asset.

If $F < Se^{rT}$ then he can short the asset and go for long forward contract on it.

Forward Prices for Security that Provides a Known Cash Income

We will consider forward contracts on such assets which provides a known cash income, for example, coupon bearing bonds, treasury securities, known dividend, etc. Let us explain with an example:

Example

Consider a long forward contract to purchase a coupon bond whose current price is ₹ 900 maturing 5 years. We assume that the forward contract matures in one year, so that the forward contract is a contract to purchase a four-year bond in one year. Further assume that the coupon payment of ₹ 40 are expected after six months and 12 months, and six-month and one-year risk free interest rate are 9 percent and 10 percent respectively.

In first situation, we assume that the forward price is high at ₹ 930. In this case, can arbitrageur can borrow ₹ 900 to buy the bond and short a forward contract. Then the first coupon payment has a present value of $40e^{-0.09 \times 0.5} = ₹ 38.24$. So the balance amount ₹ 861.76 (900-38.24) is borrowed @ 10% for year. The amount owing at the end of the year is $861.76e^{0.1} = ₹ 952.39$. The second coupon provides ₹ 40 toward this amount, and ₹ 930 is received for the bond under the terms of the forward contract. The arbitrageur will earn

$$= (\text{₹ } 40 + \text{₹ } 930) - \text{₹ } 952.39 = \text{₹ } 17.61$$

Similarly, in the second situation, we may assume the low forward price at ₹ 905, then in that case the arbitrageur can short the bond and enter into long forward contract. Likewise above, the arbitrageur will earn:

$$\text{₹ } 952.39 - (\text{₹ } 40 + 905) = \text{₹ } 7.39$$

Generalization: From the above example, it can be generalized that such assets which provide known income (i.e. I) during the life of a forward contract, then forward price would be as follows:

$$F = (S - I)e^{rT}$$

In the earlier example, $S = ₹ 900$, $I = 40$, $r = 0.09$ and 0.1 and $T = 1$.

I is calculated as:

$$I = 40e^{-0.09} + 40e^{-0.10 \times 1} = ₹ 74.433$$

$$\text{Then } F = (900 - 74.333)^{0.10 \times 1} = ₹ 912.39$$

This can be an agreement with our calculation, and it applies to any investment asset that provides a known cash income. So we can generalize from the above: If $F > (S - I)e^{rT}$, the investor can earn the profit by buying the asset and shorting a forward contract on the asset. If $F < (S - I)e^{rT}$, an arbitrageur can earn the profit by shorting the asset and taking a long position in a forward contract. Further, if there is no short sale, the arbitrageur who owns the asset will find it profitable to sell the asset and go long forward contract.

Forward Price where the Income is a Known Dividend Yield

A known dividend yield means that when income expressed as a percentage of the asset life is known. Let us assume that the dividend yield is paid continuously as a constant annual rate at q then the forward price for an asset would be $F = S_e^{(r-q)T}$

Example

Let us consider a six-month forward contract on a security where 4 percent per annum continuous dividend is expected. The risk free rate of interest is 10 percent per annum. The asset's current price is ₹ 25. Then we can calculate the forward price as:

$$F = S_e^{(r-q)T}$$

$$F = 25e^{(0.10-0.04) \times 0.5} = ₹ 25.76$$

If $F > S_e^{(r-q)T}$ then an investor can buy the asset and enter into a short forward contract to lock in a riskless profit. If $F < S_e^{(r-q)T}$ then an investor can enter into a long forward contract and short the stock to earn riskless profit. Further, if dividend yield varies during the life of a forward contract the q should be set equal to the average dividend yield during the life of the contract.

Valuing Forward Contracts

On the basis of generalization in different situations, we can find out the value of a forward contract. As we know that the value of a forward contract at the time it is first written (entered) into is zero. However, at later stage, it may prove to have a positive or negative value. In general, the value of a forward contract can be determined as follows:

$$f = (F - K)_e^{-rT}$$

where f is value of a forward contract, F is forward price (current) of the asset, K is delivery price of the asset in the contract, T is time to maturity of contract and r is risk free rate of interest.

Let us examine the equation

We compare a long forward contract that has a delivery price of F with an otherwise identical long forward contract with a delivery price of K . As we know that the forward price is changing with the passage time, and that is why later on, F and K may not be equal which were otherwise equal at the time of entrance of the contract. The difference between the two is only in the amount that will be paid for the security at time T . Under the first contract, this amount is F , and under the second contract, it is K . A cash outflow difference of $F - K$ at time T translates to a difference of $(F - K)_e^{-rT}$ today. Therefore, the contract with a delivery price F is less valuable than the contract with a delivery price K by an amount $(F - K)_e^{-rT}$. The value of contract that has a delivery price of F is by definition, zero.

Similarly, the value of a short forward contract with the delivery price K is $f = (F - K)_e^{-rT}$

Example

Consider a six-month long forward contract of a non-income-paying security. The risk free rate of interest is 6 percent per annum. The stock price is ₹ 30 and the delivery price is ₹ 28. Compute the value of forward contract.

Forward price $F = 30 e^{0.06 \times 0.5} = ₹ 30.90$

Value of forward contract $f = (F - K)_e^{-rT}$

$$= (30.90 - 28)_e^{-0.06 \times 0.5}$$

$$= ₹ 2.90 - 0.09 = 2.8^* \text{ (app.)}$$

Alternatively, using the other equation:

$$f = 30 - 28^{-0.06 \times 0.5}$$

$$f = 30 - 27.16 = 2.84 \text{ (app.)}$$

*The above difference is due to annual compounding.

Using the earlier equation of value of forward contract, we can show the value of long forward contract in all the three situations, which are as under:

(a) Asset with no income: $f = S - K_e^{-rT}$

(b) Asset with known income (I): $f = S - I - K_e^{-rT}$

(c) Asset with known dividend yield at the rate q: $f = S_e^{-qT} - K_e^{-rT}$

Note that in each case the forward price F is the value of K which makes f equal to zero.

Forward Prices Versus Futures Prices

Whether the forward prices are equal to futures prices, this is very important and debatable issue. It is argued that if risk free interest rate is constant and the same for all maturities, in such market situations, the forward price will be same as the futures price for the contract.

However, in actual practice, the interest rates do not remain constant and usually vary unpredictably, then forward prices and futures prices no longer remain the same. We can get sense of the nature of the relationship by considering the situation where the price of the underlying asset is strongly positively correlated with interest rates.

Since in futures contracts, there is daily settlement, so if current price(s) increases, an investor who holds a long future position, makes an immediate profit, which will be reinvested at a higher than average rate of interest.

Similarly when current price(s) decreases, the investor will incur immediate loss, and this loss will be financed at a lower than average rate of interest. However, this position does not arise in the forward contract because there is no daily settlement and interest rate movements will not have any effect till maturity.

It is further argued that when spot (current) prices are strongly positively correlated with the interest rates, futures prices will tend to be higher than the forward prices, similarly,

if spot prices are strongly negatively correlated with the interest rates then forward prices will tend to be higher than the futures prices. It is further observed that though there may be a theoretical difference between forward prices and futures prices due to various factors like taxes, transaction costs, treatment of margin and default risk, but this difference is very small which may be ignored. Thus, in our further discussion in various chapters, both forward contracts and futures contracts are assumed to be the same and the symbol F will be used to represent both futures price and forward price same at time zero.

Lesson 1.3 - Participants in Derivative Markets

The participants in the derivative markets can be broadly classified in three depending upon their motives. These are:

1. Hedgers
2. Speculators
3. Arbitrageurs

Hedgers

Hedgers are those who enter into a derivative contract with the objective of covering risk. Farmer growing wheat faces uncertainty about the price of his produce at the time of the harvest. Similarly, a flour mill needing wheat also faces uncertainty of price of input. Both the farmer and the flour mill can enter into a forward contract, where the farmer agrees to sell his produce when harvested at predetermined price to the flour mill. The farmer apprehends price fall while the flour mill fears price rise. Both the parties face price risk. A forward contract would eliminate price risk for both the parties. A forward contract is entered into with the objective of hedging against the price risk being faced by the farmer as well as the flour mill. Such participants in the derivatives markets are called hedgers. The hedgers would like to conclude the contract with the delivery of the underlying asset. In the example the contract would be settled by the farmer delivering the wheat to the flour mill on the agreed date at an agreed price.

Speculators

Speculators are those who enter into a derivative contract to make profit by assuming risk. They have an independent view of future price behaviour of the underlying asset and take appropriate position in derivatives with the intention of making profit later. For example, the forward price in US dollar for a contract maturing in three months is ₹ 48.00. If one believes that three months later the price of US dollar would be ₹ 50, one would buy forward today and sell later. On the contrary, if one believes US dollar would depreciate to ₹ 46.00 in 1 month one would sell now and buy later. Note that the intention is not to take delivery of underlying, but instead gain from the differential in price.

If only hedgers were to operate in the derivative markets, the number of participants in the market would be extremely limited. A farmer would find it difficult to locate a flour mill with perfectly matched and complimentary requirements in terms of quantity, quality, and timing of the delivery of the asset (wheat in this case).

Similarly, a flour mill would also find it difficult to locate a suitable farmer to supply the exact requirements. If middlemen are permitted to operate, the hedgers need not look for exact match, and instead they can deal with the middlemen who would buy the produce from the farmer in advance with anticipation of higher price in the future at the time of harvest. Such middlemen will be speculating on the future price and bid a current price in a manner that is likely to result in gain for them. By entering into a contract on the derivatives the speculators are assuming risk of price in future.

Speculators perform an extremely important function. They render liquidity to the market. Without speculators in the market not only would it be difficult for hedgers to find matching parties but the hedge is likely to be far from being efficient. Presence of speculators makes the markets competitive, reduces transaction costs, and expands the market size. More importantly, they are the ones who assume risk and serve the needs of hedgers who avoid risk. With speculators around, hedgers find counterparties conveniently.

Arbitrageurs

It would seem that hedgers and speculators would complete the market. Not really so because we assume that different markets are efficient by themselves and they operate in tandem. We describe derivative as the one that derives its price from the underlying asset. Structurally the markets for derivatives and the underlying are separate. For example, agricultural products would be bought and sold in the physical market (mandis), while futures on them are traded on the commodity exchange.

However, there has to be complete harmony between the mandis and commodity exchange. There cannot be any disparity in the prices in the mandis and the commodity exchange.

The third category of participants, i.e. arbitrageurs, performs the function of making the prices in different markets converge and be in tandem with each other. While hedgers and speculators want to eliminate and assume risk respectively, the arbitrageurs take riskless position and yet earn profit. They are constantly monitoring the prices of different assets in different markets and identify opportunities to make profit that emanate from mispricing of products. The most common example of arbitrage is the price difference that may be

prevailing in different stock markets. For example, if the share price of Hindustan Unilever is ₹ 175 in National Stock Exchange (NSE) and ₹ 177 in Bombay Stock Exchange (BSE), the arbitrageur will buy at NSE and sell at BSE simultaneously and pocket the difference of ₹ 2 per share.

An arbitrageur takes risk neutral position and makes profits because markets are imperfect. Naturally, such imperfections cannot exist for long. These imperfections are extremely short-lived. The arbitrageur cashes upon these short-lived opportunities. Such actions restore the balance in prices and remove distortions in the pricing of assets.

Fundamentally the speculators and arbitrageurs fall in the same category in as much as that both are not looking at owning or disowning the underlying asset by delivery like hedgers. Both speculators and arbitrageurs are also trying to render competitiveness to the market, thereby helping the price discovery process. Difference between the two lies in the amount of risk they assume.

While speculators have their opinions about the future price of the underlying asset by making investment, the arbitrageur is concentrating on the mispricing in different markets by taking riskless position with no investment of his own. By his actions an arbitrageur is restoring the balance and consistency among different markets, while speculators only hope for the desirable movement in prices. Arbitrageurs are the ones who prohibit speculators to overbid or underbid the prices in the derivatives as compared to the physical markets.

Functions of Derivative Markets

Derivatives were invented to fulfill the need of hedging against the price risk. It enables transfer of risk from those wanting to avoid it to those who are willing to assume it. Besides hedging, derivatives perform many other important functions which are discussed below.

Enable Price Discovery

First, the derivatives and their market increase the competitiveness of the market as it encourages more number of participants with varying objectives of hedging, speculation, and arbitraging. With broadening of the market the changes in the price of the product are watched by many who trade on the slightest of reasons. Even a minor variation in price prompts action on the part of speculators. Active participation by large number of buyers and sellers ensures fair price. The derivative markets, therefore, facilitate price discovery of assets due to increased participants, increased volumes, and increased sensitivity of

participants to react to smallest of price changes. By increased depth in the market, faster and smooth dissemination of information among different participants, the process of discovery of price becomes more efficient.

Facilitate Transfer of Risk

Hedgers amongst themselves could eliminate risk if two parties face risk from opposite movement of price. As seen earlier, the wheat farmer needing to sell his produce faced a risk from the fall in price, while the flour mill needing to buy wheat was worried about the rise in price. Since risk was emanating from opposing directions of price movement, the convergence of the two was possible. If both the farmer and the flour mill wanted to hedge against price rise the two would not meet. When speculators enter the market they discharge an important function and help transfer of risk from those wanting to eliminate to those wanting to assume risk.

Provide Leveraging

Taking position in derivatives involves only fractional outlay of capital when compared with the position in the underlying asset in the spot market. Assume a speculator is convinced that price of wheat will be ₹ 16 per kg in six months and a farmer agrees to sell at ₹ 15.50 per kg. To take advantage the speculator will have to pay the full price of ₹ 15.50 now and realize ₹ 16.00 six months later. Instead, if a mechanism is available by which he can absolve himself of making the full payment, he will be too glad to enter into a contract. Derivatives, as products, and their markets provide such exit route by letting him first enter into a contract and then permitting him to neutralize position by booking an opposite contract at a later date. This magnifies the profit manifolds with the same resource base. This also helps build volumes of trade, further helping the price discovery process.

Other Benefits

The function of leveraging and risk transfer helps in efficient portfolio management. With a smaller fund at disposal, better diversification can be achieved with part of the fund allocation to derivatives assets. Derivatives provide a much wider menu to portfolio managers who constantly seek better risk return trade off. The range of choices would be far more restricted in the absence of derivatives.

Since very large number of participants become active in the market (due to leveraging), the transaction costs are likely to be lower and lower with derivative markets. Shrinking transaction cost reflected in spread of sell and buy prices is a sure sign of free

market economy, and therefore efficient allocation of resources. Faster and efficient dissemination of information also helps in removing price disparities across geographies.

Derivatives can be extremely useful in smoothening out the seasonal variations in the prices of the underlying assets. Hoarding is viewed as a social stigma. Hoarding used for speculative purposes require scanty trading with large price variation among financially powerful persons acting in concert. Derivatives can help curb hoarding by continuous trading and increasing participation as it requires little capital outlay, leaving the field open to large number of participants reducing the financial muscle power of few engaged in hoarding.

Misuses, Criticism of Derivatives

Derivatives act like a double-edged sword. When used properly and conservatively they are highly effective but when used with indiscretion they are capable of causing miseries. Unfortunately there is no pragmatic way to demarcate the discretion with indiscretion. There is a very fine line that separates calculated risk taking and gambling. The following are often cited as demerits of derivatives.

Increased Volatility

Since derivatives offer extremely leveraged position, a large number of participants are attracted towards the market with nominal capital available with them. Giving rise to speculative tendencies derivative markets are often blamed for causing extreme volatilities in the prices, which are also seen in the spot markets. However, it remains to be seen that such volatility in price would be absent in the spot markets if derivatives were not to exist.

There are several instances in India, especially in the commodities, where the trading in derivatives has been banned. The reason cited for such ban is often the wide and unexplainable divergence between the prices in the spot market for the underlying and in derivatives markets. In such circumstances it is often stated that it is the derivatives market that is distorting the prices in the spot market. The notion that derivatives markets can influence the price in the physical markets at best seems misplaced and lacks conviction. In fact trading in derivatives should be seen as a precursor to what may happen in the spot market. With highly leveraged position it is natural that the volatility in prices would be more than in the spot market, but it would be wrong to state that volatility in derivative will get transferred to physical markets. In fact, volatility in markets is inherently caused by the mismatch of demand and supply.

Increased Bankruptcies

Inherent leverage in derivatives may very easily cause bankruptcies when one assumes a position in derivatives that is totally out of sync with the financial position. Since positions in the financial markets are taken in sequentially one default may trigger a chain and can cause market failure.

Burden of Increased Regulation

With increasing derivative activity it is opined that there is an increasing need for regulation. Since derivatives allow accumulation of large positions with little capital, the disclosure of identities and positions taken is imperative. Also there is increasing need to discourage overly speculative positions to prevent bankruptcies and letting the chain of defaults to set in. Disclosure requirements and need to control has placed onerous responsibilities on the monitoring and regulating agencies. Such requirements and control mechanisms are often disliked by some of the participants in the market because they are seen as impediments in the development of free markets.

Recent failures of some of the financial leaders in the USA in 2008 and 2009 due to excessive and innovative derivatives positions by some investment and commercial banks, leading to their failures, has emphasized the need of government intervention. It may be noted that positions of these financial institutions was in OTC derivatives that did not warrant any disclosures. These positions surfaced only when they assumed disastrous proportions. The actions of government to bail out these institutions are criticized for extreme burden on society as the bail outs are essentially seen as evil of 'privatizing profit and socializing losses'.

Lesson 1.4 - Recent Developments in Global Financial Derivative Markets

The past decade has witnessed an explosive growth in the use of financial derivatives by a wide range of corporate and financial institutions. The following factors which have generally been identified as the major driving force behind growth of financial derivatives are the (i) increased volatility in asset prices in financial markets; the increased integration of national financial markets with the international markets; the marked improvement in communication facilities and sharp decline in their costs; the development of more sophisticated risk management strategies; and the innovations in the derivatives markets, which optimally combine the risk and returns over a large number of financial assets, leading to higher returns, reduced risk as well as transaction costs as compared to individual financial assets. The growth in derivatives has run in parallel with the increasing direct reliance of companies on the capital markets as the major source of long-term funding. In this respect, derivatives have a vital role to play in enhancing shareholder value by ensuring access to the cheapest source of funds. Furthermore, active use of derivative instruments allows the overall business risk profile to be modified, thereby providing the potential to improve earnings quality by offsetting undesired risks.

In the world financial market, aggregate turnover of exchange-traded fixed income contracts rose by 21% in the first quarter of 2005, to \$304 trillion. Increased activity derived from contracts on both short and long rates. Trading on money market contracts, including those on euro dollar, Euribor and euroyen rates, rose by 21% to \$262 trillion, with strong activity for both futures and options. For bond-related instruments, turnover was up by 20% to \$43 trillion. Unlike the previous two quarters, activity in short-term contracts was strong in all regions. Trading increased by 23% in the United States, to \$159 trillion, with futures and options up by 17% and 38%, respectively. Business rose by 18% in Europe, to \$95 trillion, with activity in futures up by 13% and that in options by 41%.

In the long-term interest rate segment, contracts expanded by 20% in the first quarter of 2005 to \$43 trillion. Business was up by 11% in North America to \$15 trillion, and by 27% in Europe to \$25 trillion. In the US market, activity might have been related to hedging needs in connection with an unexpected flattening of the curve in the early part of period, followed by an abrupt self-off at the long end in late February and early March, 2005. In European marketplaces, higher interest rate uncertainty may also have played a role as macroeconomic news from Europe over the period was quite mixed. Business also

returned to growth in the Asia-Pacific region, with turnover up by 10% to \$9.5 trillion. Activity rose by 9% in short-term rate contracts and by 12% in long rate contracts. Business in the short-term segment was stronger in the Pacific region, up by 13%, than in Asia, where it grew by 2% only. Among Asian countries, activity recovered in Japan, up by 19%, after a 27% slide in the previous quarter, while it continued to fall in Singapore, down by 17%.

Turnover of exchange-traded currency derivatives rose to \$2.7 trillion in the first quarter of 2005. Business in futures contracts increased by 14% (to \$2.4 trillion), while activity in currency options surged by 25%. Higher turnover derived mainly from activity in the euro vis-à-vis the dollar, up by 19%. Among other currency pairs, turnover grew significantly for the Japanese yen vis-à-vis the dollar, up by 7%. However, this increase in turnover differed across regions, although the vast majority of activity remains concentrated in US marketplaces. Business was up by 14% in the United States, to \$2.4 trillion, stagnated in Asia (\$30 billion) and fell by 3% in Europe (\$4 billion). Activity kept expanding at high rates in Brazil, with trading in futures and options on the Sao Paulo Mercantile and Futures Exchange (BMF) up by 32%, to \$234 billion.

Increased investment and hedging activity in currency markets was not associated with uncertainty, since implied volatilities for the main currency pairs dropped significantly in the first quarter of 2005. It might instead have reflected realized and expected changes in exchange rate levels, and the need to adjust positions. After a prolonged depreciation, the dollar rose by 4.5% against the euro in the first quarter of 2005. Over the same period, risk reversal indicators derived from currency options started to signal that economic agents had changed their expectations about future exchange rate levels, with the previously expected depreciation of the dollar versus the euro turning toward expectations of stability or slight appreciation.

Global turnover in stock index contracts, which had grown by 17% in the last quarter of 2004, continued to expand in the first quarter of 2005, this time by 7% (to \$26 trillion). Business was overall stronger in the United States, up by 9% (to \$11 trillion), than in Europe, which was up by a relatively weak 5% (to \$6 trillion). Business was particularly stagnant in Germany, where turnover for products related to the DAX index fell sharply. In the Asia-Pacific region, business increased by 5%, to \$9 trillion. Trading continued to expand in the Korean stock market, up by 6%, and in Japan, by 10%. Turnover rose by 13% in Australia.

Options turnover was up by 8%, to \$15 trillion, while business in futures grew by 5%, to \$12 trillion. The stronger growth in the options segment came from both the US and the European markets, where activity in such instruments was up by 7% and 10%, respectively

The increase in equity index trading in the United States and in Europe contrasts with the stability of the underlying indices, up by 0.1% and 2.4% in the first quarter, respectively. Also, it does not seem to be explained by greater uncertainty, as implied volatilities were stable at around 12% in annual terms. Higher turnover may instead have stemmed from investors turning marginally more risk-averse. Estimates of the coefficient of relative risk aversion derived from equity index options tended to rise in the first quarter of 2005, after declining through the previous year.

OTC derivatives, spanning the second half of 2004, show that at the end of the year notional amounts of credit default swaps (CDSs) outstanding totaled \$6.4 trillion, of which \$2.7 trillion represented contracts between reporting dealers. A single-name CDS contract is an insurance contract covering the risk that a specified credit defaults. Following a defined credit event, the protection buyer received a payment from the protection seller to compensate for credit losses.

In return, the protection buyer pays a premium to the protection seller over the life of the contract. In aggregate, positions in the global OTC derivatives market recorded a robust expansion in the second half of 2004. Overall amounts outstanding were up by 12.8%, to \$248 trillion at the end of December. The growth in the latter half of the year was slightly higher than in the first six months, when positions had risen by 11.6%. After falling by 20% in the previous two surveys, gross market values increased by 43%, to \$9.1 trillion as of end-December, 2004. Even after taking account of legally enforceable bilateral netting agreements, the rate of expansion was still 40%, at \$2.1 trillion.

Trading on the international derivatives exchanges was buoyant in the second quarter of 2006. Combined turnover measured in notional amounts of interest rate, and currency contracts increased by 13% to \$484 trillion between April and June 2006, following a 24% rise in the previous quarter. The high rate of growth in the first quarter had been caused by a surge in activity in US money market derivatives, which reverted to a more normal pace in the following three months.

Trading volumes rose in all risk categories. Activity in contracts on short-term interest rates increased by 15%, while trading in derivatives on stock price indices and on government bonds grew by a more moderate 6% and 5%, respectively. Turnover in futures and options on foreign exchange increased by 21%, outpacing activity in the other risk categories. However, with a turnover of merely \$4.2 trillion, or less than 1% of total volume traded on the international derivatives exchanges, the FX segment remains of limited importance as this type of risk tends to be traded over the counter.

Trading volumes in the OTC derivatives market continued to expand at a rapid pace between 2004 and 2007. Average daily turnover of interest rate and non-traditional foreign exchange derivatives contracts reached \$2,090 billion in April 2007, 71% higher than three years before (see table). This corresponds to an annual compound rate of growth of 20%, which is in line with the growth recorded since 1995.

Global OTC derivatives market by instrument 1
Average daily turnover in April, in billions of US dollars

Instrument	1998	2001	2004	2007
A. Foreign exchange instruments	97	67	140	291
Cross-currency swaps	10	7	21	80
Options	87	60	117	212
Other	0	0	2	0
B. Interest rate instruments 2	265	489	1025	1686
FRAs	74	129	233	258
Swaps	155	331	6211	210
Options	36	29	171	215
Other	0	0	0	1
C. Estimated gaps in reporting	13	19	55	113
D. Total	375	575	1220	2090

1. Adjusted for local and cross-border double-counting. 2 Single currency interest rate contracts only.

Growth was particularly strong in the FX segment, where average daily turnover in cross currency swaps and foreign exchange options increased by 108% to \$292 billion in April 2007, thus outstripping growth in “traditional” instruments such as spot, forward and FX swap contracts (71%). While options remained the main “nontraditional” FX instrument in the OTC market, accounting for slightly less than three quarters of total turnover, the instrument with the fastest rate of growth (279%) was actually cross- currency swaps, whose turnover increased to \$80 billion. In part, this growth could be explained by the hedging of foreign currency bonds. April 2007 saw a large issuance of dollar-denominated bonds by non-resident issuers, some of whom may have hedged their obligations in the swap market.

More moderate growth than in FX contracts was recorded in the interest rate segment, where average daily turnover increased by 65% to \$1,686 billion. The euro remained the leading currency in this segment, although the gap vis-à-vis the US dollar narrowed. In

the reporting period, 39% of turnover took place in euro-denominated contracts, and 32% in dollar. However, their combined share has fallen by nearly 10 percentage points since 2004, as turnover growth in several non-core markets has outstripped that in the two leading currencies. For example, average daily trading volumes of sterling-denominated interest rate derivatives increased by 91%, compared to rates of growth of 42% and 53%, respectively, in the euro and the dollar. Turnover in contracts denominated in the yen almost tripled, bringing that currency's share in total turnover to over 8%, from 4.5% three years before. To some extent, rapid growth in the yen market reflects a catching-up since for many years activity in that market had been hampered by low and stable interest rates. Rates had remained at virtually zero for more than five years, which had contributed to a dearth of activity in derivatives on short-term Japanese interest rates. Futures turnover increased by 46% in the second quarter of 2006, while options volumes soared by 130%. This contrasts with the mid-1990s, when contracts denominated in yen briefly accounted for over one fifth of worldwide turnover in exchange-traded money market derivatives.

Activity was also buoyant in some smaller currencies but more muted in the US dollar and the euro. Rapid increases in turnover during the second quarter of 2006 were also recorded in contracts on short-term Australian interest rates (44%), followed by derivatives on rates in the New Zealand dollar (28%), pound sterling (26%) and Canadian dollar (22%). Trading volumes in futures and options on short-term US dollar and euro interest rates grew by a more moderate 13% each.

Heavy trading during the sell-off in May and June 2006 lifted turnover in stock index contracts to a new high. Turnover measured by notional amounts reached \$46 trillion between April and June, 6% higher than in the first quarter of this year. In contrast to the preceding three months, the rise in activity was genuine and not merely the result of valuation effects. Turnover growth in stock index contracts was particularly strong in some English-speaking countries, above all Canada (47%), the United States, the United Kingdom and Australia (all 19%). Rapid growth was also recorded in contracts on Swedish equity indices (18%). Trading in euro-denominated contracts rose by almost one third in terms of the number of contracts traded, but increased by only 8% in terms of notional amounts. Weaker activity was recorded in Korea, where trading in stock index contracts declined by 11% in terms of both the number of contracts and notional amounts.

Sharp movements in the US exchange rate led to a 23% rise in turnover in futures and options on foreign exchange in the second quarter. Trading volumes in euro FX contracts listed on the Chicago Mercantile Exchange reached \$750 billion in May alone. During the quarter as a whole, activity in this contract rose by almost one third, while turnover in yen derivatives was up 23%. Jointly these two contracts account for more than one half of

worldwide turnover in exchange-traded currency derivatives. Even more rapid growth was recorded in some emerging markets, for example in Russia (82%) and Korea (67%), even though the two currencies concerned did not experience any extraordinary volatility in the period under review. Turnover in Turkey increased by 172%, albeit from a low base. The Turkish lira was affected particularly strongly by the sell-off in May and June.

The number of commodity contracts traded on the international derivatives exchanges (notional amounts are not available) grew by 10% in the second quarter. In the previous three months, activity had increased by 18%, mainly reflecting a 37% surge in activity in energy derivatives as oil prices had reached new highs. Trading in that product category continued to expand in the second quarter, in line with further price increases, but growth slowed to 8%. Turnover in contracts on agricultural commodities rose by 10% and that in derivatives on base metals by 7%.

Rapid growth (21%) was recorded in the precious metals segment of the commodity derivatives market. Turnover in futures and options on gold soared to over 6,000 contracts (measured in 100 ounce contract equivalents to account for a shift towards smaller-sized contracts) in May alone. This was more than one fifth above the previous monthly high in late 2005. In June, turnover in gold contracts declined to 4,700. The monthly pattern of turnover in gold contracts contrasts with that of contracts on silver or non-precious metals, which peaked in April and subsequently declined. This is puzzling because price developments were largely similar.

Credit Default SWAPS

At the end of 2004 the notional amounts outstanding of CDSs totaled \$6.4 trillion, nearly 50% more than the size of the market for equity index-related products but still significantly less than that of interest rate or exchange rate-related products (\$187 trillion and \$30 trillion, respectively). Despite its relatively small size, the development of the CDS market has been so far quite exceptional, compared to what has been observed for other risk categories. The growth Of Credit-related derivatives in the three years ending June 2004 amounted to 568%, against 121% for all OTC products.

Of the \$6.4 trillion of notional amounts outstanding, \$2.7 trillion concerned contracts between reporting dealers. For both protection bought and protection sold, over 800% of the outstanding contracts between reporting dealers and non-dealers were with non reporting financial institutions. In terms of maturity of outstanding contracts, more than 70% of the single-name contracts had a maturity between one and five years, close to the corresponding number for multi-name contracts (60%).

Dealers bought net protection from non-dealers amounting to \$178 billion, of which \$149 billion was with non-reporting financial institutions. Nearly two thirds of these latter contracts were multi-name. The net market value of all outstanding contracts was \$4 billion, with \$89 billion in contracts with a gross positive market value and \$93 billion in contracts with a negative market value.

Looking forward, the growth of credit derivatives could be further boosted by the recent launch of a credit derivatives fixing, relating to the ilrxx family of CDS indices. The availability of a fixing will produce a widely supported reference and settlement tool for the credit derivatives market. It will reassure investors that the prices quoted by individual traders are close to the market-wide consensus prices (much in the same way as Libor rates support the pricing of interest rate swaps), thereby enhancing transparency, and consequently volumes, of CDSs and cash-settled credit-related options.

Sizeable Increase in Gross Market Values

Gross market values jumped significantly, by 43%, in the second half of 2004, to \$9 trillion. Interest rate contracts, which represent the largest OTC segment, were up by 34%, to \$5.3 trillion. The increase was quite small for dollar-related products, only 3%, to \$1.5 trillion, but amounted to 65% and 26% for euro- and sterling-related products, to \$2.9 trillion and \$237 billion respectively. The surge in gross market values was particularly strong for foreign exchange products, 80%, to \$1.6 trillion, and for equity-related products, 70%, to \$0.5 trillion.

Compared to interest rate products, both segments are, however, smaller components of the overall derivatives market. Across all risk categories, the ratio of gross market values to notional amounts outstanding went up from 2.9% as of end-June 2004 to 3.7% as of year-end. Taking account of legally enforceable bilateral netting agreements does not bring down the expansion in gross market values. Nevertheless, gross market values - thus calculated - increased only marginally (from 0.7% to 0.8%) as a ratio to overall notional amounts.

Growth in OTC markets was not matched on exchanges. The 12.8% rise in business in OTC markets in the second half coincided with a drop in activity, of 11.8%, on the exchanges.

When comparing activity in the exchange-traded and OTC segments, it is important to recall that notional amounts outstanding in the OTC market should tend to grow faster, since hedging or trading in this segment generally involves the writing of new contracts, which leads to a natural build-up of notional amounts outstanding. Hence, the gap in the

development of no amounts outstanding between the two markets has become particularly sizeable since mid-2003 between end-June 2003 and end-December 2004, amounts outstanding grew by 46% in OTC markets, against 22% in exchanges. By contrast, over the previous 18-month period, both segments had grown by approximately 55%.

Derivatives Market India

The most notable development concerning the secondary segment of the Indian capital market is the introduction of derivatives trading in June 2000. SEBI approved derivatives trading based on Futures Contracts at both BSE and NSE in accordance with the rules/byelaws and regulations of the Stock Exchanges. A beginning with equity derivatives has been made with the introduction of stock index futures by BSE and NSE. Stock Index Futures contract allows for the buying and selling of the particular stock index for a specified price at a specified future date.

Stock Index Futures, inter alia, help in overcoming the problem of asymmetries in information. Information asymmetry is mainly a problem in individual stocks as it is unlikely that a trader has market-wide private information. As such, the asymmetric information component is not likely to be present in a basket of stocks. This provides another rationale for trading in Stock Index Futures.

Also, trading in index derivatives involves low transaction cost in comparison with trading in underlying individual stocks comparing the index. While the BSE introduced Stock Index Futures for S&P CNX Nifty comprising 50 scripts. Stock Index Futures in India are available with one month, two month and three month maturities While derivatives trading based on the Sensitive Index (Sensex) commenced at the BSE on June 9, 2000,, derivatives trading based on S&P CNX Nifty commenced at the NSE on June 12, 2000. SIT is the first attempt in the development of derivatives trading.

The product base has been increased to include trading in futures and options on S&P CNX Nifty Index, futures and options on CNX IT index, Bank Nifty Index and single securities (118 stock as stipulated by SEBI) and futures on interest rate.

The index futures and index options contracts traded on NSE are based on S&P CNX Nifty Index, CNX IT Index and the CNX Bank Index, while stock futures and options are based on individual securities. Stock Futures and Options are available on 118 securities. Interest rate future contracts are available on Notional 91 day t-bill and Notional 10 year bonds (6% coupon bearing and zero coupon bond). While the index options are European style, stock options are American style.

At any point of time there are only three contract months available for trading, with 1 month, 2 months and 3 months to expiry. These contracts expire on last Thursday of the month and have a maximum of 3-month expiration cycle. A new contract is introduced on the next trading day following the expiry of the near month contract. All the derivatives contracts are presently cash settled. The turnover in the derivatives segment has witnessed considerable growth since inception.

In the global market, NSE ranks first (1st) in terms of number of contracts traded in the Single Stock Futures, second (2nd) in Asia in terms of number of contracts traded in equity derivatives instrument. Since inception, NSE established itself as the sole market leader in this segment in the country with more than 99.5% market share.

Summary

In this chapter, first we have taken a look at the basics of derivatives. Derivatives are the instruments which derive their value from the underlying assets. The underlying assets can be commodity, currency, stock, stock index, interest rate bearing securities, etc. Financial derivatives are forward, futures, option, swaps and other exotic derivatives. Forward is a specific contract between two parties who agree to trade at some future date, at a stated price and quantity. No money exchange hands at the time the deal is signed. Futures are the standardized contract traded on the futures exchanges to buy or sell assets at a specified future date and at a specified rate. Options are the right to buy or sell any assets at a rate (strike price) at a specified future date, but not obligation for the buyer. Options are of two types: call option and put option. The chapter has described the history and phenomenal growth in financial derivatives and kinds of futures contracts that are traded. In 1848, futures contracts came into existence with the establishment of Chicago Board of trade. Option was traded at Chicago Board options market in 1977.

In addition, this chapter also discusses the other derivatives like warrants and convertibles. Warrants are like an option contract where the holder has the right to buy shares of a specified company during the given period. Convertibles are the hybrid securities which combine the basic attributes of fixed interest and variable return securities, popular among them are convertible bonds, debentures, preference shares, etc. Finally, the chapter concluded with the classification of derivatives. Derivatives are classified as financials and commodities as major categorization. Financials can be further divided into basics and complex derivatives. Basic includes forwards, futures options and warrants and convertible securities, whereas complex involves swaps and exotics derivatives. The chapter also discussed about the ten myths of financial derivatives because financial derivatives have changed the face of finance by creating new ways to understand measure and manage risks.

Ultimately financial derivatives should be considered part of any firm's risk-management strategy to ensure that value enhancing investment opportunities are pursued.

These myths include:

1. Derivatives are new complex, high tech. financial products,
2. Derivatives are purely speculative and highly leveraged instruments,
3. Financial derivatives are simply the latest risk associated with derivatives, banking regulators should ban their use by any institution covered by federal deposit insurance,
4. Only large multinational corporations and large banks have a purpose for using derivatives,
5. Financial derivatives are simply the latest risk-management fad and 6. Derivatives take money out of productive processes and never put anything back.

Solved Problems

1. An investor enters into a short gold futures contract when the futures price is 60 cent per pound. One contract is for delivery of 60,000 pounds. How much the investor gain or lose if cotton price at the end of the contract is: (a) 58.20 cent per pound (b) 61 30 cent per pound?

Solution

(a) In case of price £58.20

Investor is obligated to sell 60 cent per pound, something that is worth 58.20 cent per pound. So there is a gain to investor per pound. So there is a gain to investor

$$\text{Gain} = (\text{£}0.6000 - \text{£}0.5820) \times 60,000 = \text{£}1080$$

(b) In case of price £61.30

The investor is obligated to sell for 60 cent per pound, something that is worth 61.30 cent per pound. So there is net loss to investor.

$$\text{Loss} = (\text{£}0.6130 - \text{£}0.6000) \times 60,000 = \text{£}780$$

2. Suppose an investor write a put (selling a put) on stock with a strike price of ₹ 50 and expiration date in three months. The current price of BILT stock is ₹ 51. What you committed to yourself? How much could you gain or loss?

Solution

You have sold a put option. You have agreed to buy 100 BILT shares for ₹ 50 per share. If party on other side charge to exercise. The option will only be exercised by counter party is price of BILT share is below ₹ 50. Suppose party exercise when price is ₹ 30. You have to buy at ₹ 50 that are worth only ₹ 30, so loss to investor or writer will be ₹ 20 per share or ₹ 2000.

The worst that can happen is that the price of BILT decline to zero during the three-month period. The highly unlikely event would cost you ₹ 5000. In return for the possible future closed, you receive the premium amount from the buyer of option.

3. The current stock price is ₹ 49 and a three-month call with a stock price 50, losing ₹ 3.90 (premium amount). You have ₹ 9800 to invest. Identify two alternative strategies. Briefly outline advantages and disadvantages of each?

Solution

Strategy

- (a) First strategy would be to buy 300 shares.
(b) Second strategy would be to buy 3000 shares.

If share price goes upward movement, the second (b) strategy will give rise to greater gains. For example, if share price goes up to ₹ 60 you gain = $[3000 \times (\text{₹ } 60 - \text{₹ } 50)] - \text{₹ } 11700 = \text{₹ } 18,300$ (₹ 11,700 as premium amount) and from first strategy $[300 \times (\text{₹ } 60 - \text{₹ } 49)] = \text{₹ } 3300$ from strategy (a).

However, if price of shares goes down to ₹ 45, the loss on second strategy will be less as compared to strategy second.

$$\text{Strategy (a) Loss} = 300 \times (\text{₹ } 49 - \text{₹ } 45) = \text{₹ } 1200$$

$$\text{Strategy (b) Loss} = 3000 \times (\text{₹ } 50 - \text{₹ } 45) = \text{₹ } 1500$$

Or whole investment will gone in losses.

4. An investor own 10,000 shares worth ₹ 50 each. How put options can be used to provide insurance against decline in value of investor holding?

Solution

Investor should buy 100 put option contract with a exercise/strike price of ₹ 50 each and expiration date of four months. If at the end of fourth month, the share price goes less than ₹ 50, investor should exercise the option and sell the share at ₹ 50 each. In this way, investor can hedge risk of fall in price of stock.

5. A speculator based in USA who in February 2003 thinks that pound sterling will strengthen in next two months. How can we use futures contract for speculating? What can be alternatives strategies for speculator? The future price is \$1.6420 (per pound). Total amount of speculation is \$3,75,000.

Solution

Alternatives:

- (i) Speculator purchase of 3,75,000 in the hope that it can be sold later at a profit. The sterling once purchased will be kept in a interest bearing account.
- (ii) Take a long position in six 1MM (International Monetary Market) April futures contract on pound sterling. [value of each contract is £62,500]

Outcomes

- (i) Exchange rate \$1.7000 in two months. Investor will earn = $(\$6,37,500 - \$6,18,000) = \$19,500$ by using alternative (i) and $(\$6,37,500 - \$6,15,750) = \$21,750$.
- (ii) Exchange rate \$1.6000 in two months. Loss to speculator $(\$6,00,000 - \$6,18,000) = \$18,000$ by using alternative (i) and $(\$6,00,000 - \$6,15,750) = \$15,750$ by using alternative (ii).

6. Differentiate between

- (a) Entering in along futures contract when the future price is ₹ 500.
- (b) Taking along position in call option with a strike price of ₹ 500.

Solution

In case of (a) investor is obligated to buy at ₹ 500 [because future have obligation to buy or sell.

In case of (b) investor has the option to buy at ₹ 500 [options have right for buyer not obligation to buy or sell.

7. Suppose an investor has written 200 futures contract on silver. How can he use call options to provide insurance against a decline in value of net position?

Solution

Investor has written 20 futures contract, means he is obligated to sell at a specified future price. Investor can use call option to provide insurance against a decline in value. He can write a call option and can lock into a predetermined future price, which he believes to be right. On expiration he can sold his share to option buyer at a price if prices goes below the specified level.

8. A farmer expects to have ₹ 50,000 of live hogs to sell in three months. The live hogs futures contract on Multi Commodity Exchange (MCX) is for delivery of ₹ 25,000 of hogs. How can the farmer use futures for the hedging?

Solution

Farmer expects to have ₹ 50000 hogs at a future date. He can use futures for hedging in the way that today in MCX. He will take short position on two futures contracts of live hogs. So he can hedge risk by taking a short position at a specified future price. On the due date he can deliver the live hogs or close out position by offsetting or reverse trading.

Self Assessment Questions

1. Explain the term 'financial derivative'. What are its important features?
2. Explain the different types of financial derivatives along with their features in brief.
3. Bring out the historical development of financial derivatives.
4. What are warrants and convertible securities? Also explain the critiques of derivatives with suitable examples.
5. Compare and contrast between forward, futures, options and swaps.

6. Write short notes on:
 - a. Forward contracting
 - b. Swaps and their features
 - c. Options and their types
7. Write a detailed note on uses of financial derivatives.
8. Define the forward contract. Also discuss the features of forward contract.
9. Compare and contrast between forward contracts and futures contracts with suitable examples.
10. Write a detailed note on classification of forward contracts with examples.
11. Define forward contract and discuss the trading mechanism of forward market.

Unit - II

Unit Structure

Lesson 2.1 - Basics of Options

Lesson 2.2 - Fundamental Determinants of Option's Price

Lesson 2.3 - Options Trading Strategies

Lesson 2.4 - Interest rate SWAPS

Lesson 2.5 - Currency SWAPS

Learning Objectives

This chapter is aimed at providing an understanding of

- Basic concept of options
- Terminology used in describing options
- Call and put options, and their payoffs
- Types of options
- What is meant by money nests of options
- How to read options quotations
- How options are traded and settled
- How are options different from forward and futures contracts
- Understand the basic concept of swaps
- Understand why and how swaps evolved
- Be able to distinguish between different types of interest rates and currency swaps
- Be able to familiarize with the terminology of swap
- Know how to hedge interest rate risk and exchange rate risk through swaps
- See swap as a tool of reducing financing cost besides hedging tool
- Know how to value swap as pair of bonds and/or as series of forward contracts.
- Appreciate the roles of intermediary to a swap deal

Lesson 2.1 Basics of Options

Introduction

An option is a unique instrument that confers a right without an obligation to buy or sell another asset, called the underlying asset. Like forwards and futures it is a derivative instrument because the value of the right so conferred would depend on the price of the underlying asset. As such options derive their values inter alia from the price of the underlying asset. For easier comprehension of the concept of an option, an example from the stocks as underlying asset is most apt.

Consider an option on the share of a firm, say ITC Ltd. It would confer a right to the holder to either buy or sell a share of ITC. Naturally, this right would be available at a price, which in turn is derived from the price of the share of ITC? Hence, an option on ITC would be priced according to the price of ITC shares prevailing in the market. Of course this right can be made available at a specific predetermined price and remains valid for a certain period of time rather than extending indefinitely in time.

The unique feature of an option is that while it confers the right to buy or sell the underlying asset, the holder is not obligated to perform. The holder of the option can force the counterparty to honor the commitment made. Obligations of the holder would arise only when he decides to exercise the right. Therefore, an option may be defined as a contract that gives the owner the right but no obligation to buy or sell at a predetermined price within a given time frame. It is the absence of obligation to perform for one of the parties that makes the option contract a substantially different derivative product from forwards and futures, where there is equal and binding obligation on both the parties to the contract. This unique feature of an option makes several applications possible that may not be feasible with other derivative products.

Terminology of Options

Before we discuss how an option contract works it would be useful to familiarize with the basic terms that are often used in describing and using options. These basic terms are described below.

Call Option

A right to BUY the underlying asset at predetermined price within specified interval of time is called a CALL option.

Put Option

A right to SELL the underlying asset at predetermined price within a specified interval of time is called a PUT option.

Buyer or Holder

The person who obtains the right to buy or sell but has no obligation to perform is called the owner/holder of the option. One who buys an option has to pay a premium to obtain the right.

Writer or Seller

One who confers the right and undertakes the obligation to the holder is called seller/writer of an option.

Premium

While conferring a right to the holder, who is under no obligation to perform, the writer is entitled to charge a fee upfront. This upfront amount is called the premium. This is paid by the holder to the writer and is also called the price of the option.

Strike Price

The predetermined price at the time of buying/writing of an option at which it can be exercised is called the strike price. It is the price at which the holder of an option buys/sells the asset.

Strike Date/Maturity Date

The right to exercise the option is valid for a limited period of time. The latest time when the option can be exercised is called the time to maturity. It is also referred to as expiry/maturity date.

These terms would become clearer when the two basic options, call and put are described in detail.

Call Option

Assume that share of ITC is currently trading at ₹ 180. An investor, John, believes that share is going to rise at least to ₹ 220 in the immediate future of the next three months. John does not have adequate funds to buy the shares now but is expecting to receive substantial money in the next three months. He cannot afford to miss an opportunity to own this share. Waiting for three months implies not only a greater outlay at a later point of time, but also means foregoing of substantial potential gains. Another investor, Mohammad, holds contrary views and believes that optimism of John is exaggerated. He is willing to sell the share.

What can John do under these circumstances where he cannot buy the shares on an outright basis now? He possibly could borrow to acquire the stock of ITC. This is fraught with risk of falling prices. Amongst the many alternatives that may be available to John is included an instrument called call option. He can instead buy a call option from Mohammad (assuming he is willing to confer the same) stating that John has a right to buy a share of ITC from Mohammad at a price of, say, ₹ 190 at any time during the next three months. This would be a call option (the option to buy). John is the holder of the option, while Mohammad is the writer/seller of the option. In case John decides to buy the share (exercise the option) he would pay ₹ 190, the strike/ exercise price. The period up to which John can exercise this option is three months. Note that John has the option, which he may not exercise, but Mohammad has no such choice and he stands committed to deliver the share and receive ₹ 190 from John, irrespective of the price of ITC share at that time. Naturally, Mohammad would not provide such a right for free as he is obligated to perform at the option of another. Therefore, Mohammad would charge some fee, called option premium, to grant this right to John. This premium is determined inter alia by the price of the underlying asset, the ITC share. We shall discuss later how this premium is decided.

We now discuss the circumstances when John would exercise his option. He would use this right only when the actual price of the ITC share has gone beyond ₹ 190 (the exercise price). Imagine it has moved to ₹ 200. By exercising the option he stands to gain immediately ₹ 10, as he gets one share from Mohammad by paying ₹ 190 and sells immediately in the market at ₹ 200. Logically, John would not exercise the option if the price remained below ₹ 190. In any case he loses the premium paid. If the price remains below ₹ 190, Mohammad would not be asked to deliver and the upfront premium he received would be his profit.

We may generalize the outcome of a call option in the following manner.

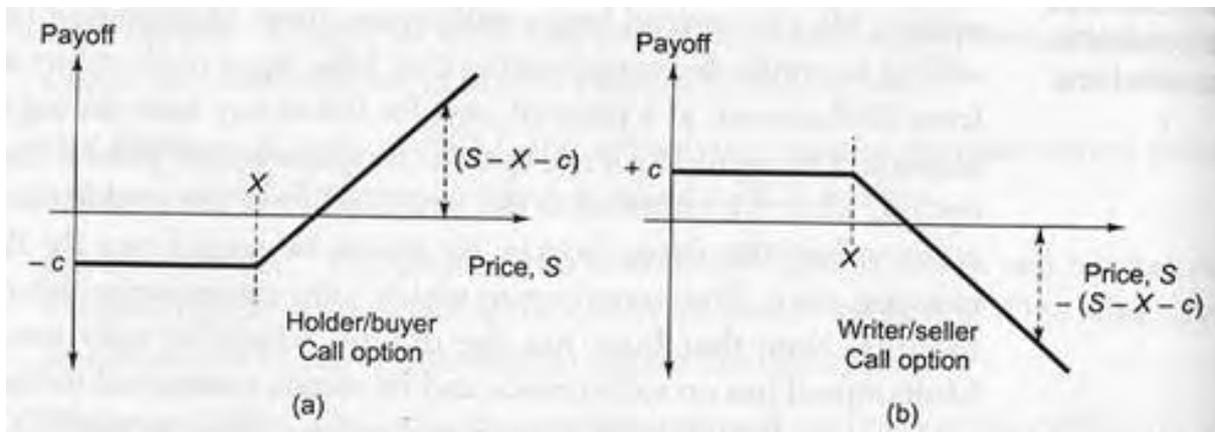
As long as the price of the underlying asset, S , remains below the strike price, X the buyer of the call option will not exercise it; and the loss of the buyer would be limited to the premium paid on the call option c and if the price is more than exercise price the holder exercises the option and generates profit equal to the difference of the two prices. Alternatively,

When	$S < X$	Buyer lets the call expire	Loss = premium c
	$S = X$	Buyer is indifferent	Loss = premium c
	$S > X$	Buyer exercises the call option	Gain = $S - X - c$

Mathematically, the value of the call is given by Equation (2.1)

$$\text{Value of the call option} = \text{Max}(0, S - X) - c \quad (2.1)$$

A graphical depiction of the payoff of the holder and the writer of the call option is easier to comprehend and is presented in Figure



Put Option

Put option is similar to call option except the fact that it is an option to sell. Again we take a small example from stock markets to clarify how put option works.

Again assume that share of ITC is currently trading at ₹ 180. An investor, John, in possession of the share (it is not necessary to have the share to enter into an options contract) believes that the share is likely to fall to ₹ 150 in the immediate future of the next three months. John is not sure of the fall but would like to exit from his investment at ₹ 175.

He is seeking protection against the heavy fall in the price. Another investor, Mohammad, holding contrary views believes that the pessimism of John is exaggerated. He is willing to buy the share at ₹ 175 since he feels that is the lowest it can go.

John believes ITC is a good long-term buy but is unsure when the scrip would show its potential. He does not want to exit unnecessarily. Under these circumstances John can buy a put option (the right to sell to Mohammad stating that he has a right to sell a share of ITC to at a price of ₹ 175 at any time during the next three months. In case John decides to sell the share (exercise the option) he would receive ₹ 175, the strike/exercise price in the next three months. John has the option, which he may or may not exercise, but Mohammad has no such choice and he stands committed to pay the agreed price and claim the share. Like in the call option, Mohammad would not grant such a right for free and charge some fee, called option premium. This premium is determined inter alia by the price of the underlying asset, the ITC share.

John would exercise his option only when it is profitable to do so. The option would become profitable when the actual price of the ITC share falls below ₹ 175 (the exercise price). Imagine that it has moved to ₹ 160. By exercising the option John stands to gain immediately ₹ 15 by placing the share to Mohammad and realize ₹ 175 from him and using the proceeds to acquire a share of ITC from the market at ₹ 160. This keeps his earlier position intact and yet gives ₹ 15 as profit. Logically, John would not exercise the option if the price remains above ₹ 175. However, under all circumstances he loses the premium paid.

We may generalize the outcome of a put option in the following manner.

As long as the price of the security remains below the strike price the buyer of the option will exercise it because he stands to gain; otherwise his loss would be limited to the premium paid on the put option p .

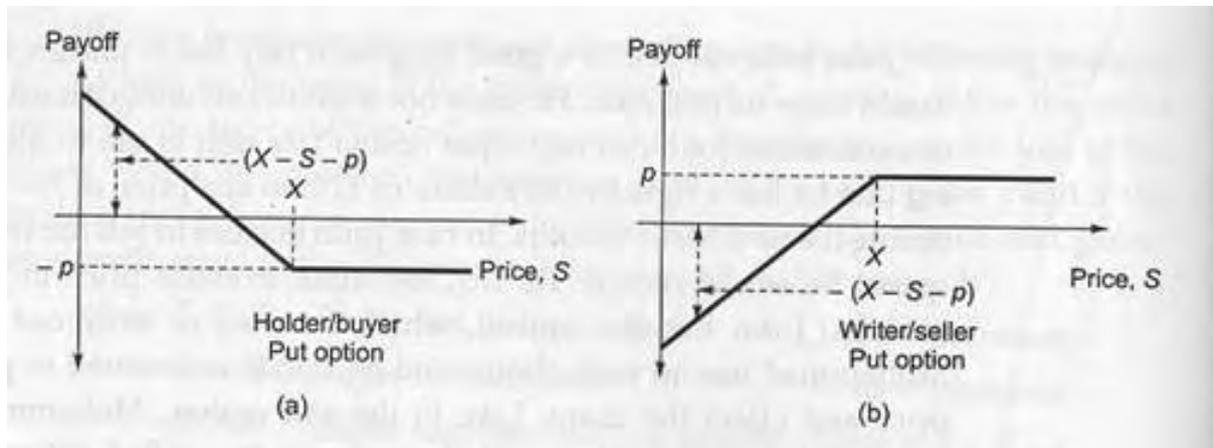
When $S < X$	Buyer exercises the option	Gain = $X - S - p$
When $S = X$	Buyer is indifferent	Loss = premium, p
When $S > X$	Buyer lets the contract expire	Loss = premium, p

Mathematically, the value of the put is given by Equation 2.2.

$$\text{Value of the put option} = \text{Max}(0, X - S) - p \quad (2.2)$$

The graphical view of the payoff for put option, holder and writer is shown in Figure (a) and (b).

The payoff diagrams for call and put options as depicted in Figures and respectively, reveal that the payoff of options is not linear. While it may be unbounded at one end the other end is limited to loss/gain equal to the premium of option. This non-symmetrical non-linear payoff results from feature of 'right but no obligation' and makes options different from other derivative products.



Types of Options

Options have several features, certainly more than forwards and futures making several differentiations possible in the basis products of calls and puts. Based on several considerations the options can be categorized in a number of ways, such as:

- Based on nature of exercise of options
- Based on how are they generated, traded, and settled
- Based on the underlying asset on which options are created

Nature of Exercise: American Versus European

Based on the timing of exercise the options can be either American or European. American options can be exercised at any point of time before the expiry date of the option, while European options are exercisable only upon maturity.

Nature of Markets: OTC Versus Exchange Traded

Options can also be categorized as OTC or exchange traded depending upon where and how they are created, traded, and settled. Options may be like it forward contracts, which are specific and negotiated by two contracting parties mutually with direct negotiations, known as OTC, or they can be like futures which may be bought and sold on the specific exchanges where the two contracting parties may not be known to each other but instead

enter into a contract on the floor/screen of an exchange. In the exchange-traded options the contracts need to be standardized, while an OTC product is tailor-made to the requirements of the parties concerned.

The standardization of option contract would be in at the discretion of the exchange and is done in terms of **Quantity of Underlying Asset** Only specific quantity of the underlying asset could be traded on the exchange and need to be predetermined.

Strike Prices

Only specific strike prices can be handled in a standardized product traded on the exchanges. OTC products can have any strike price as agreed by the two contracting parties.

Expiration Dates

Like strike price the expiration dates too must be known before trading can take place in options at the exchanges.

Nature of Exercise of Option Whether the options are American or European in nature too must be known to traders in options.

Ways of Settlement

Options can be settled either by delivery of underlying asset or by cash settlement, which is closing out by exchanging the differential of price at initiation and closing out. Cash settlement at the expiry is done by exchanging difference between the exercise price and price of the underlying asset. It can also be settled by the cancellation of the contract by entering into an equal and opposite contract to the original one.

Nature of Underlying Assets

Like forwards and futures, options too can have any asset as underlying. Options on stocks, indices, commodities, currencies, and interest rates are available either OTC or on exchanges. Though not available in India as of now, options on commodities are traded internationally on agricultural products, live stock, food products, energy, and metals.

Options are also available on various currencies, such as US dollar, euro, yen, pound, etc. in major exchanges in the USA and Europe as also other parts of the world. Options on currencies are mostly OTC.

Besides, options are also traded on the exchanges on futures contracts rates. Options on futures have futures contract as underlying asset, which give the buyer a right to buy (call) or sell (put) the specified futures contract within or at specified time. Naturally, the expiry of the futures contract must extend beyond that of option contract.

Similarly, options can also be traded on interest rates, either on cash assets such as treasury bonds and notes, or on interest rate futures contracts. These options serve the same purposes as do the options on stocks and indices.

Options on stocks and stock indices are most common. Several exchanges across the world offer options on indices and stock. National Stock Exchange (NSE) in India offers options on several indices such as Nifty, a broad-based index of 50 stocks from banking, information technology, infrastructure, etc.

Presently these options cover limited exercise prices and cover periods up to three months. However, internationally options for longer periods of up to two to three years are also available. NSE attempts to provide minimum j five strike prices—two ITM, one ATM, and two OTM at any point of time).

Naked (Uncovered) and Covered Option

Naked or uncovered options are those which do not have offsetting positions, and therefore, are more risky. On the other hand, where the writer has corresponding offsetting position in the asset underlying (he option is called covered option. Writing a simple uncovered (or naked) call option indicates toward exposure of the option writer to unlimited potential losses. The basic aim is to earn the premium. In period of stable or declining prices, call option writing may result in attractive profits by capturing the time value of an option. The strategy of writing uncovered calls reflects an investor's expectations and tolerance for risk.

A covered option position involves the purchase or sale of an option in combination with an offsetting (or opposite) position in the asset which underlies the option. As observed earlier, the writer of the call option incurs losses when stock prices rise, and put writers incur losses when prices fall. In such situation, the writer can cover the short put with a short position and short call with a long position in the underlying asset. This can be stated as:

Covered call sale = Short call + Long futures

Covered put sale = Short put + Short futures

The Underlying Assets in Exchange-Traded Options

Various assets, which are actively traded on the recognized exchanges, are stocks, stock indices, foreign currencies and futures contracts. These have been explained in brief here as under:

Stock Options

Options on individual shares of common stock have been traded for many years. Trading on standardized call options on equity shares started in 1973 on CBOE whereas on put options began in 1977. Stock options on a number of over-the-counter stocks are also available. While strike prices are not because of cash dividends paid to common stock holders, the strike price is adjusted for stock splits, stock dividends, reorganization, recapitalizations, etc. which affect the value of the underlying stock.

Stock options are most popular assets, which are traded on various exchanges all over the world. For example, more than 500 stocks are traded in United States. One contract gives the holder the right to buy or sell 100 shares at the specified strike price. In India, the National Stock Exchange and Bombay Stock Exchange have started option trading in certain stocks from the year 2001.

Foreign Currency Options

Foreign currency is another important asset, which is traded on various exchanges. One among these is the Philadelphia Stock Exchange. It offers both European as well as American option contracts. Major currencies which are traded in the option markets are US dollar, Australian dollar, British pound, Canadian dollar, German mark, French franc, Japanese yen, Swiss franc, etc. The size of the contract differs currency to currency. This has been explained in more detail in the chapter on currency option.

Index Options

Many different index options are currently traded on different exchanges in different countries. For example, the S&P 100 index at CBOE and Major Market Index at AMEX are traded in the US options markets. Similarly, in India, such index options have been started on National Stock Exchange and Bombay Stock Exchange. Like stock option, index option's strike price is the index value at which the buyer of the option can buy or sell the underlying stock index. The strike index is converted into dollar (rupee) value by multiplying the strike index by the multiple for the contract. If the buyer of the stock index option intends to

exercise the option then the stock must be delivered. It would be complicated to settle a stock index option by delivering all the stocks that make up that particular index. Hence, instead, stock index options are cash settlement contracts. In other words, if the option is exercised, the exchange assigned option writer pays cash to the option buyer, and there will be no delivery of any share.

The money value of the stock index underlying an index option is equal to the current cash index value multiplied by the contracts multiple. This is calculated as:

Rupee value of the underlying index = Cash index value x Contract multiples

For example, the contract multiple for the S&P 100 is \$100. So, assume, the cash index value for the S&P 100 is 750 then the dollar value of the S&P 100 contracts is $750 \times 100 = \$75,000$.

Futures Options

In a futures option (or options on futures), the underlying asset is a futures contract. An option contract on futures contract gives the buyer the rights to buy from or sell to the writer a specified future contract at a designated price at a time during the life of the options. If the futures option is a call option, the buyer has the right to acquire a long futures position.

Similarly, a put option on a futures contract grants the buyer the right to sell one particular future contracts to the writer at the exercise price. It is observed that the futures contract normally matures shortly after the expiration of the option. Futures options are now available for most of the assets on which futures contracts are on the Euro dollar at CME and the Treasury bond at the CBOT.

Interest Rate Options

They are another important options contract, which are popular in the international financial markets. Interest rate options can be written on cash instruments or futures. There are various debt instruments, which are used as underlying instruments for interest rate options on different exchanges. These contracts are referred to as options on physicals. Recently, these interest rate options have also gained popularity on the over-the-counter markets like on treasury bonds, agency debentures and mortgagebacked-securities. There are governments, large banking firms and mortgage-backed-securities dealers who make a market in such options on specific securities.

Leaps Options

These options contracts are created for a longer period. The longest time before expiration for a standard exchange traded option is six-months. However, Long Term Equity Anticipated Securities (LEAPS) are option contracts designed to offer with longer period maturities even up to 39 months. These LEAPS options are available on individual stocks and some indexes. Usually, they are designed for a particular purpose.

Flex Options

It is a specific type of option contract where some terms of the option have been customized. The basic objective of customization of some terms is to meet the wide range of portfolio strategy needs of the institutional investors that cannot be satisfied through the standard exchange-traded options. FLEX options can be created for individual stocks, stock indexes, treasury securities, etc. They are traded on an option exchange and cleared and guaranteed by the clearing house of that exchange. The value of FLEX option depends upon the ability to customize the terms on four dimensions, such as underlying asset, strike price, expiration date and settlement style (i.e., American vs European). Moreover, the exchange also provides a secondary market to offset or alter positions and an independent daily marking of prices.

Exotic Options

The option contracts through the OTC market can be customized in any manner desired by an institutional investor. For example, if a dealer can reasonably hedge the risk associated with opposite side of the option sought, it will design an option as desired by the customer. OTC options are not limited to only European or American type of options, rather a particular option can be created with different exercise dates as well as the expiration date of the option. Such options are also referred to as limited exercise options, Bermuda options, Atlantic options, etc. Thus, more complex options created as per the needs of the customers are called exotic options which may be with different expiration dates, exercise prices, underlying assets, expiration date and so on.

Lesson 2.2 - Fundamental Determinants of Option's Price

An option's price is affected by a variety of factors in the financial markets but let us try to identify the important factors. To this end, let us start with what we know about an option's price - it is made up of intrinsic value and time value. Chapter 8) Intrinsic value is the difference between its exercise price and the current price of the underlying asset, or symbolically

$$IW = S_t - X$$

Where S_t is the spot price of the asset and X is the exercise price of the asset. Therefore, one can see that the higher the spot price of the asset relative to the exercise price, the higher (lower) will be a call (put) option's value because the strike price X remains unchanged and as spot price moves up, the intrinsic value goes up and hence the option's value will also go up. Consider the intrinsic value of a call option with an exercise price of ₹ 100. As the spot price rises over ₹ 100, the intrinsic value increases, thereby also increasing the option price. This can be noted from Table

Spot price and intrinsic value of a call option

Spot price (₹)	Intrinsic value
90	0
95	0
100	0
105	5
110	10
115	15
120	20
125	25

So the first factor identified by us is the spot price of the underlying asset and as it increases, the call option's price will also increase. In contrast to the call option, a put option will lose its value as the spot price increases. This makes sense since as the spot price rises, the incentive for exercising the put option will come down and the holder will choose to allow the put to lapse.

The next part of the intrinsic value is defined by exercise price X. Now for a call option, the lower the strike price, the more beneficial it is for the buyer and vice versa for a put option. As options are struck at higher (lower) exercise prices, they will become lesser (more) useful for the buyer to profit from the call (put) option. Consider two October call options on Infosys - one with a strike price of ₹ 1620 and the other with a strike price of ₹ 1740. If these two options are available, any buyer would like to pay the minimum possible amount and consequently chooses the 1620 call over the 1740 call.

Therefore, the price of the call with a lower exercise price will be more than the call with a higher exercise price. A similar logic (but in opposite direction) applies in the case of put option, i.e., options at higher strikes will be preferred by put buyers since they can sell the underlying stock at higher prices. The same can be observed from the real world prices of options that are given in Table on the Infosys stock when the spot is trading at ₹ 1820.30.

Call option prices of on Infosys (Oct. 26, 2004)

Exercise price	Option price
1620	203.50
1650	170
1680	142
1710	110.95
1740	80.65

The second part of an option's price is the time value - given as the difference between option price and the intrinsic value. The time value is the amount that the buyers are willing to pay for the possibility that the option may become profitable to exercise sometime before expiration. In other words, option buyers believe that the price may be unattractive today but price fluctuations in the future may make the option profitable. Therefore, longer the time to expiry, the greater is the probability that at expiry the asset price will be significantly different from the exercise price and hence higher will be the option's price, which is exactly reflected in the real world prices depicted in Table

Time to expiry and option prices

Option details	Option price
Infosys October I 770 call	53.70
Infosys November 1770 call	82.20
RIL October 580 call	0.50
RIL November 580 call	6.05

The greater the expected movement in the price (higher the volatility) of the underlying asset, the greater the chance of the asset rising largely over (for a call) or below (for a put) the exercise price at expiry which leads to profitable exercise and hence the more valuable the option for its holder. This movement in the asset prices is termed as volatility. One may wonder higher volatility may also work against the holder, i.e., higher volatility may lead to a steeper fall (rise) in the underlying asset price but an option buyer need not worry about this and it will not hurt him since he will not exercise the option to buy (sell) the underlying asset.

To understand the role of volatility, consider the following example.

Assume that a stock is currently traded at ₹ 100 and a call option on this stock with a strike price of ₹ 100. The payoff of this option is dependent on the price of the stock at expiry. Consider that the stock can assume the prices as given in Table but the probability of the stock assuming that value is dependent on its volatility.

Volatility and option prices

Current price	Likely prices	Call payoff	Probability of low volatility	Probability of high volatility
100	80	0	0.10	0.30
	90	0	0.20	0.10
	100	0	0.40	0.20
	110	10	0.20	0.10
	120	20	0.10	0.30

Price of the call if volatility is low will be equal to:

$$0 \times 0.10 + 0 \times 0.20 + 0 \times 0.40 + 10 \times 0.20 + 20 \times 0.10 = ₹ 4$$

Price of the call if volatility is high will be equal to:

$$0 \times 0.30 + 0 \times 0.10 + 0 \times 0.20 + 10 \times 0.10 + 20 \times 0.30 = ₹ 7$$

So it is clear from the above example that higher the volatility, higher will be the option's price.

Interest rates will also affect the option prices but the role of interest rates in option pricing is quite complex. Intuitively we can say that when an investor buys a call option

instead of the stock itself, he can save capital that can be invested in a risk-free asset. Consequently, the higher the rate of interest, the higher will be the value of a call option. We can summarize the effect of each factor on the option's value as given in Table.

Factor affecting option prices

Factor	Call option's value	Put option's value
Increase in underlying asset's value	Increase	Decreases
Increase in strike price	Decrease	Increases
Increases in variance of underlying asset	Increases	Increases
Increase in time to expiration	Increases	Increases
Increases in interest rates	Increases	Decreases
Increase in dividends paid	Decreases	Increases

Option Pricing Methods

After the seminal paper of Black and Scholes in 1973, several other methods of option pricing were proposed in the literature. Although these methods differ in nuances, they are almost similar in approach and these approaches can be classified under the following heads:

1. **Game theory approach:** A portfolio comprising an option and the stock is constructed in such a way that the final value of the portfolio is independent of the stock's price, which is the only cause for uncertainty. When this uncertainty is removed using risk-neutral valuation and arbitrage arguments, the options price can be determined.
2. **Replicating portfolio:** In this method, a portfolio is constructed and this consists of the stock and buying/selling a risk-free zero-coupon bond. The portfolio will be constructed such that it mirrors the option payoffs for every state. Invoking the arbitrage arguments, the option price is determined as equivalent to the value of the replicating portfolio.

We will illustrate the second method with the help of Example 2.1:

Example 2.1

Consider a stock which is currently trading at ₹ 100 and in exactly one year, the stock price will be either ₹ 80 or ₹ 120. We do not have any a priori probabilities. If the interest rate is 5%, what is the price of a call option on t-is stock with a strike price of ₹ 110 and expiry in one year's time?

Solution

We will construct a replicating portfolio that mimics the option's expiry payoff. This portfolio comprises a position in the underlying stock and a risk-free debt security. Now the question is: what combination of stock and debt security generates the same returns as a call option?

We know that at expiry the call will be worth ₹ 10 (120 - 110) if the stock goes up and zero if the stock moves down.

Let us assume that we need to buy Δ number of shares and a zero-coupon bond of a current value of B . The initial value of this portfolio will be:

$$\Pi_0 = \Delta \cdot 100 + B \quad (9.1)$$

The final value of the portfolio after one period will be:

$$\Pi_1 = \Delta \cdot 120 + B \times e^{0.05 \times 1}$$

If the stock goes up and

$$\Pi_1 = \Delta \cdot 90 + B \times e^{0.05 \times 1}$$

If the stock price goes down

Since the portfolio is mimicking the payoff of the call option, we can write the above equation as:

$$\Delta \cdot 120 + B \times e^{0.05 \times 1} = 10$$

$$\Delta \cdot 90 + B \times e^{0.05 \times 1} = 0$$

And

If we substitute the value of $B \times e^{0.05 \times 1}$ as $-\Delta \cdot 90$ from equation (9.3) in equation (9.2), we obtain $\Delta \cdot 120 - \Delta \cdot 90 = 10$ or $\Delta = 1/3$ and $B = -28.54$ (the negative sign shows that the bond has to be sold short).

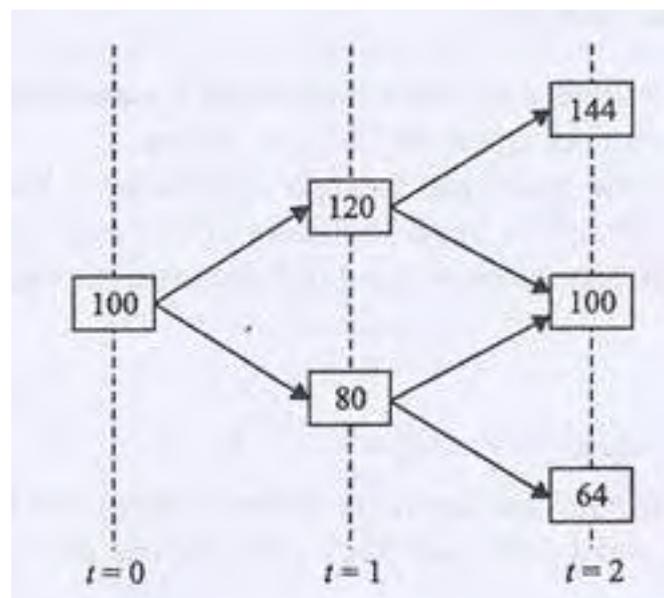
$$\Pi_0 = 1/3 \cdot \Delta \cdot 100 - 28.54 = 4.79$$

Which is nothing but the option's price?

The same approach that we used in this example lies at the heart of the Binomial Option Pricing Model (BOPM), a rigorous and a powerful tool for pricing a wide variety of options. John Cox, Stephen Ross and Mark Rubinstein introduced this model in an influential paper published in the Journal of Financial Economics.

Binomial Option Pricing Model

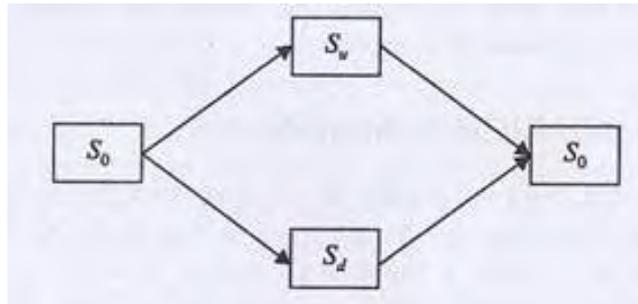
The binomial model of stock price movements is a discrete time model, i.e., time is divided into discrete bits and only at these time points are stock prices modeled. The binomial approach assumes that the security price obeys a binomial generating process, i.e., at every point of time there are exactly two possible states - stock can move up or down. A priori it is not known which of the two states will occur but the amount by which it can go up or down is assumed as known. Figure shows a binomial tree.



Two – period binomial tree.

Let us understand the binomial tree's terminology. The tree depicted in Figure is a two- period binomial tree and the stock price changes two times. Each point where two lines meet is termed as a node, which represents a possible future price of the stock. The tree is called as binomial because the spot price at every node can either move up or down. If we denote the stock price at the beginning as S_0 and S_u as the stock price in an up state and S_d as the stock price in a down state, then we can define the up factor as S_u/S_0 and down factor as S_d/S_0 . The probability that the stock price will move from one node to another is called as transition probability. The binomial trees as given by Cox, Ross and Rubinstein, CRR here after have some important characteristics, which are given below:

1. Length of the time interval remains constant throughout the tree, i.e., if the interval between the nodes is in months, it will be months everywhere and if it is in terms of years, it will be years everywhere.
2. Volatility remains constant throughout the tree.
3. Transition probability remains the same in the entire tree.
4. The trees are recombining, i.e., an up move followed by a down move will take the stock to the same value as a down move followed by an up move.



A Recombining Tree

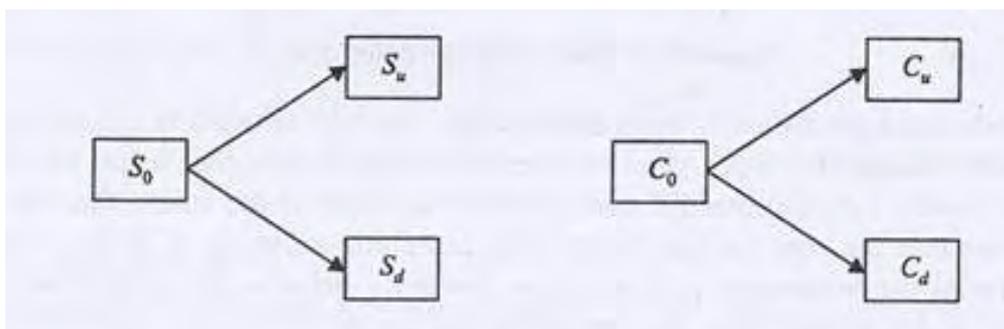
Single Period Binomial Model

Assume that a stock price follows a binomial model and we are interested in finding the price of a European option that expires at the end of one period.

As explained earlier in the numerical example, formulate a hedge portfolio that exactly imitates the payoff of the call option in all the states. This hedge portfolio at t_0 comprises Δ number of shares and a risk-less zero-coupon bond maturing to the par value B by the time t_1 . Therefore, **at time t_0**

$$\text{Value of Portfolio } \Delta \cdot S_0 + e^{-rT} \cdot B \quad (2.4)$$

Since this is a replicating portfolio, the value of the portfolio will be equal to C_u , the option's value in case it moves up and C_d in case stock price moves down.



At time T we can note that if the stock price moves up:

$$\Delta \cdot S_u + B = C_u \quad (2.5)$$

and if the stock price moves down:

$$\Delta \cdot S_d + B = C_d \quad (2.6)$$

By solving the above equations we can obtain B and A. From equation (2.5) we can find that $B = C_u - \Delta \cdot S_u$ and now substitute this in equation (2.6) for B and solve we get

$$\Delta = \frac{C_u - C_d}{S_u - S_d} \quad \text{and} \quad B = \frac{S_u \cdot C_d - C_u \cdot S_d}{S_u - S_d}$$

Now if we substitute the values of Δ and B in equation (2.4) we obtain

$$C_0 = \frac{C_u - C_d}{S_u - S_d} \cdot S_0 + e^{-rT} \cdot \frac{S_u C_d - C_u S_d}{S_u - S_d}$$

Rearranging the terms, we get:

$$C_0 = \frac{S_0 - e^{-rT} \cdot S_d}{S_u - S_d} \cdot C_u + \frac{e^{-rT} \cdot S_u - S_d}{S_u - S_d} \cdot C_d$$

Multiplying both sides by e^{rT} we get:

$$e^{rT} C_0 = \frac{e^{-rT} \cdot S_0 - S_d}{S_u - S_d} \cdot C_u + \frac{S_u - e^{-rT} S_0}{S_u - S_d} \cdot C_d$$

In the above equation, the LHS is nothing but the expected value of the option's price in a risk-neutral world after a period T. Now if we can denote

$$p = \frac{e^{-rT} \cdot S_0 - S_d}{S_u - S_d}$$

$$1 - p = \frac{S_u - e^{-rT} S_0}{S_u - S_d}$$

Then $e^{rT} C_0 = p \cdot C_u + (1 - p) \cdot C_d$

$$C_0 = e^{-rT} \{p \cdot C_u + (1 - p) C_d\}$$

Multi-Period Binomial Model

Earlier we considered that the time between now and the maturity day of the option is one period but the binomial model can be used to price an option wherein the life of the

option may be divided into any number of periods or steps. The procedure of pricing the option remains the same:

- **Finding the value of the option at the terminal nodes.**
- Setting the price of the option at the nodes preceding the terminal nodes using the one- period pricing formula, i.e.,
- $C_0 = e^{-rT} \{pC_u + (1 - p) Cd\}$
- Repeat the process till we reach the initial node. This process of moving from the terminal node to the initial node and pricing the option is known as backward induction.

In order to understand the multi-period binomial model, let us consider a numerical example.

Example 2.2

The spot price of the asset is ₹ 100 and the strike price of the stock is ₹ 105 and an annual volatility of 25%. Assuming 5% risk-free interest rate, price the option in three time steps.

Solution

This question involves pricing the option in three time steps, i.e., we have to model the stock price three times or once every four months. First we have to determine the up factor and the down factor which are related to volatility, time to expiry and number of steps these are given by CRR as:

$$u = e^{\sigma\sqrt{T/n}}$$

$$d = e^{-\sigma\sqrt{T/n}}$$

The transition probability is given as:

$$p = \frac{e^{r.T/n} - d}{u - d}$$

Where r = Risk-free return, per annum

T = Time to expiry of the option, and

n = Number of time steps

σ = Annual volatility.

Another important adjustment often forgotten by most is to make the appropriate adjustment to the interest rate.

In our example, the rate is given in annual terms and we are going to model the price of the stock at four-month intervals; so we have to use the 4-month interest rate in finding u, d and p

$$u = e^{0.25 \times \sqrt{(1/3)}} = 1.1553$$

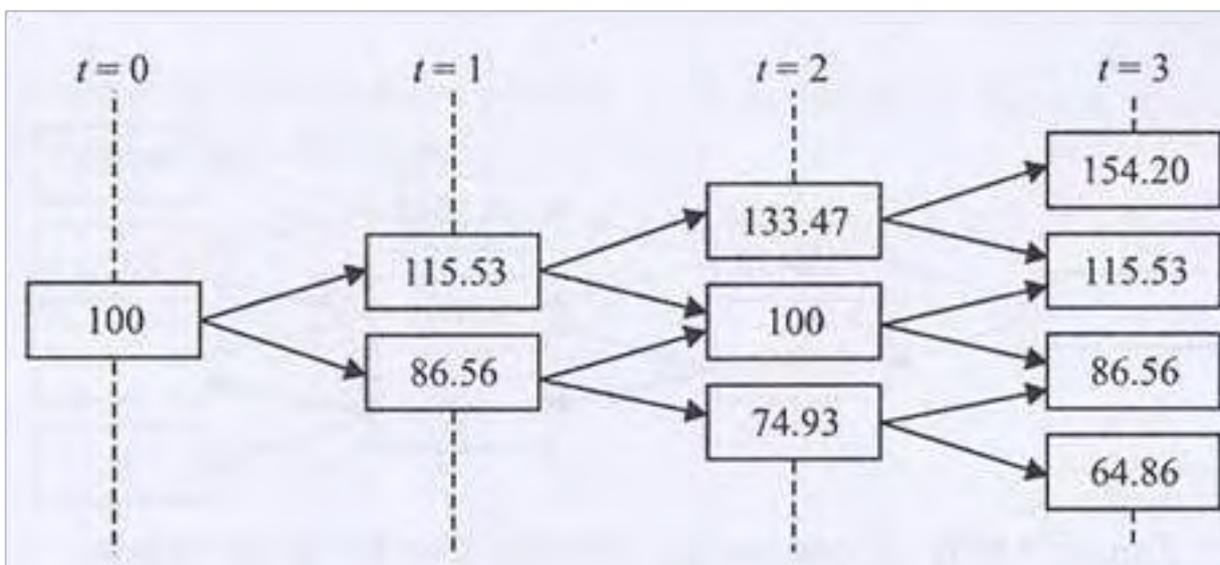
$$d = e^{-0.25 \times \sqrt{(1/3)}} = 0.8656$$

and

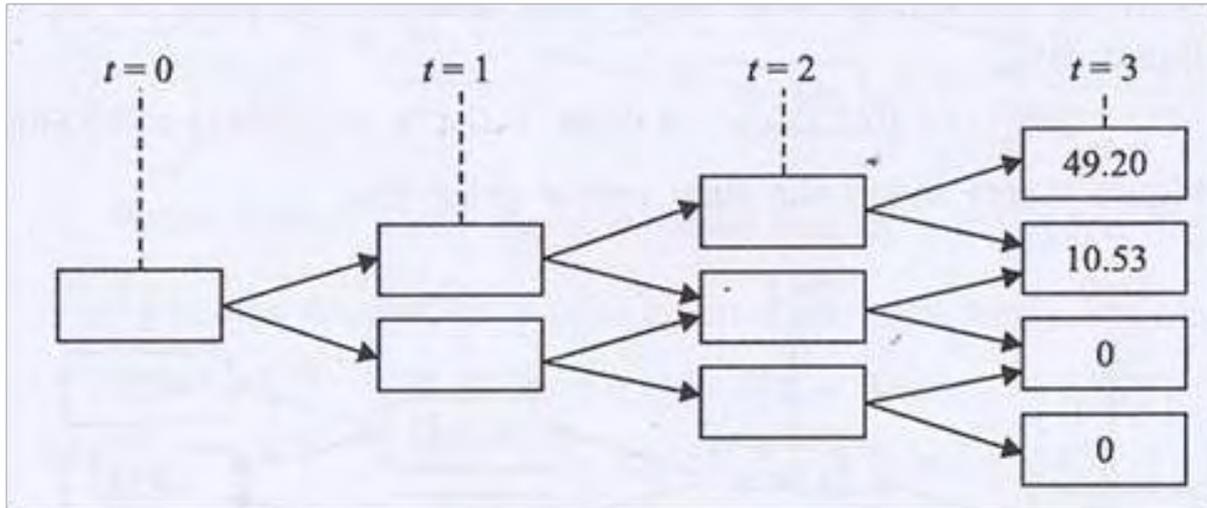
$$p = \frac{e^{0.05\frac{1}{3}} - 0.8656}{1.553 - 0.8656} = 0.5219$$

We have drawn the binomial tree of the stock price in Figure (a). The time to maturity of the option is divided into three steps and the stock price is shown at various points of time. Now we are ready to compute the option's price following the backward induction rule.

Stage I: Calculate the terminal value of the option. If the stock price is ₹ 154.20 then the option with a strike price of 105 will have a value of 49.20 (154.20 minus 105). Similarly if stock price is ₹ 115.53, options value will be ₹ 10.53. The option price tree is shown in Figure



(a) Three period binomial tree for a call option

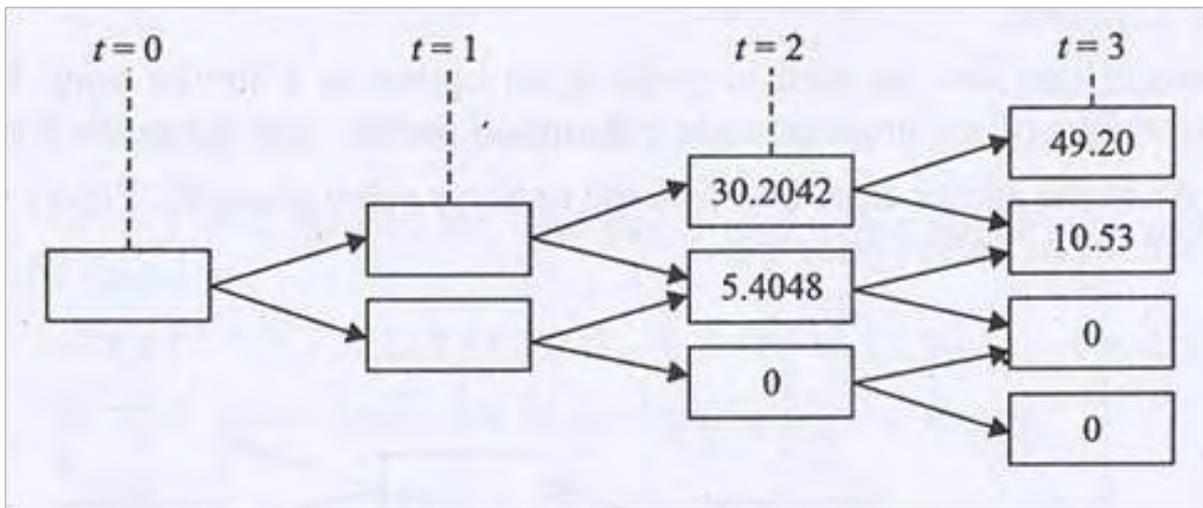


(b) Three period binomial tree for call option

Stage II: Following the backward induction process, we can find the value of the option at $t = 2$. Figure (c) shows the same

$$C_{uu} = e^{-0.05 \times 1/3} [0.5219 \times 49.2 + 0.478 \times 10.53] = 30.2042$$

and $C_{ud} = e^{-0.05 \times 1/3} [0.5219 \times 10.53 + 0.478 \times 0] = 5.4048$

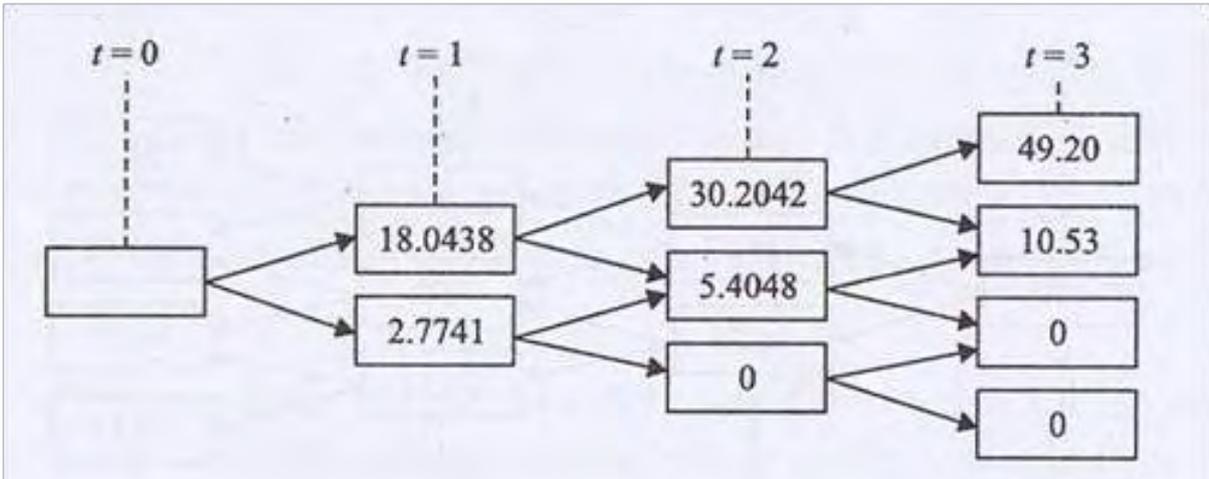


(c) Three period binomial tree for call option

Stage III: Repeating the computations once again at $t = 1$, the tree can be restated as shown in Figure (d):

$$C_{u} = e^{-0.05 \times 1/3} [0.5219 \times 30.2042 + 0.478 \times 5.4048] = 18.0438$$

And $C_{d} = e^{-0.05 \times 1/3} [0.5219 \times 5.4048 + 0.478 \times 0] = 2.7741$

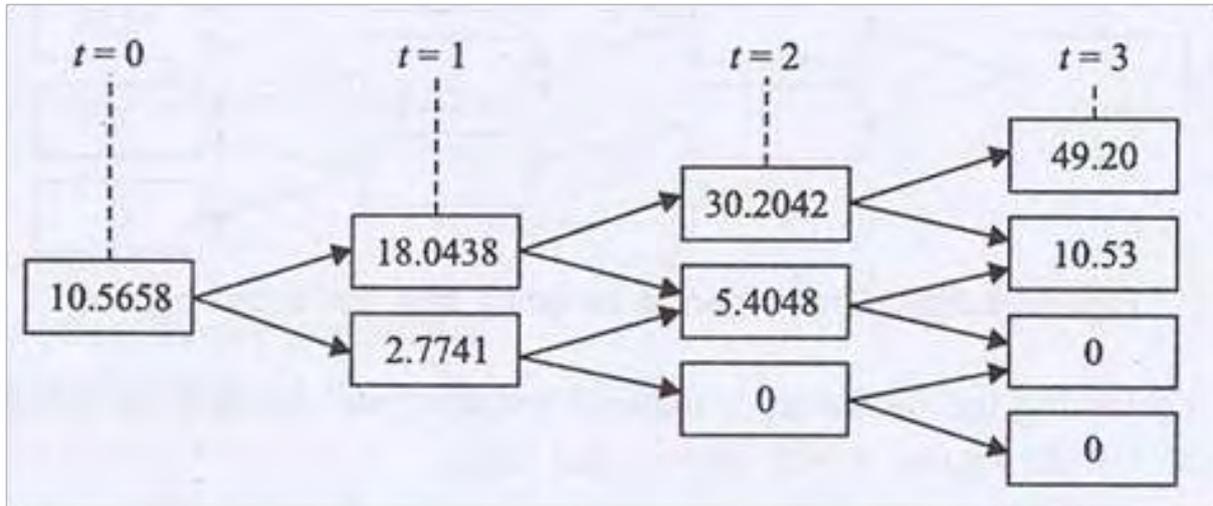


(d) Three period binomial tree for call option

Stage IV: Now we reached the final stage from where initial price of the option can be found as:

$$C_0 = e^{-0.05 \times 1/3} [0.5219 \times 18.0438 + 0.478 \times 2.7741] = 10.5658$$

Figure (e) shows the final option price tree.

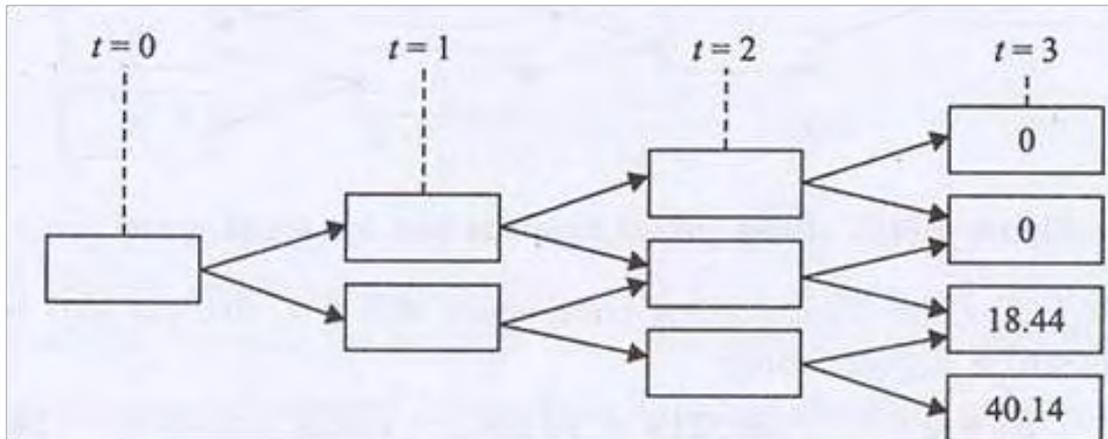


(e) three periods binomial trees for call option

European Put Option

The binomial model can also be used to price a put option in a similar way. The following example shows pricing of a European style put option for the data given in Example 2.3.

Stage 1: As in the earlier case, first find the option's value at expiry. Fig (a) depicts the initial option price tree.



(f) Three period binomial tree for a put option

Stage II: Following the recursive process, find the value of the put option at $t = 2$. Figure (b) shows the same.

$$P_{ud} = e^{-0.05 \times 1/3} [0.5219 \times 0 + 0.478 \times 18.44] = 8.6686$$

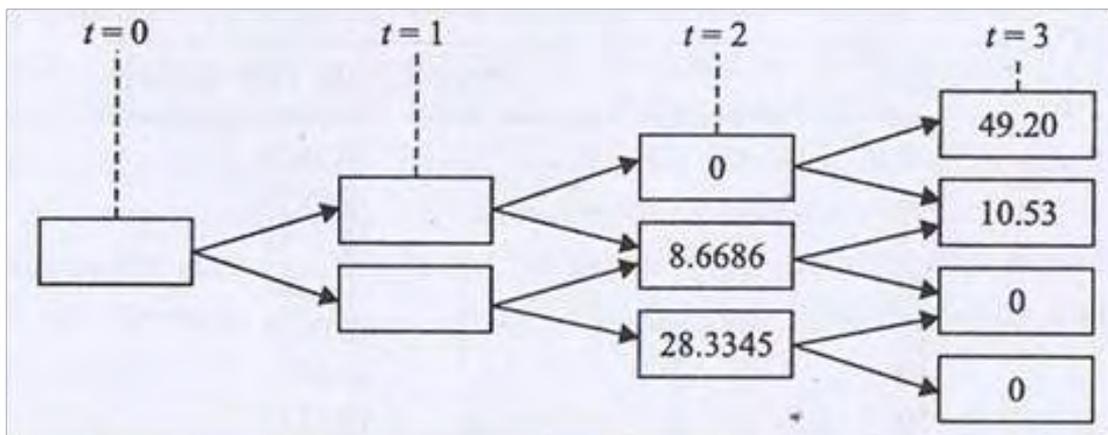
$$\text{and } P_{dd} = e^{-0.05 \times 1/3} [0.5219 \times 18.44 + 0.478 \times 40.14] = 28.3345$$

Three period binomial for a put option

Stage III: Repeating the computations once again at $t = 1$, the tree looks like Figure (c).

$$P_u = e^{-0.05 \times 1/3} [0.5219 \times 0 + 0.478 \times 8.6686] = 4.0751$$

$$\text{and } P_d = e^{-0.05 \times 1/3} [0.5219 \times 8.6686 + 0.478 \times 28.3345] = 17.7694$$

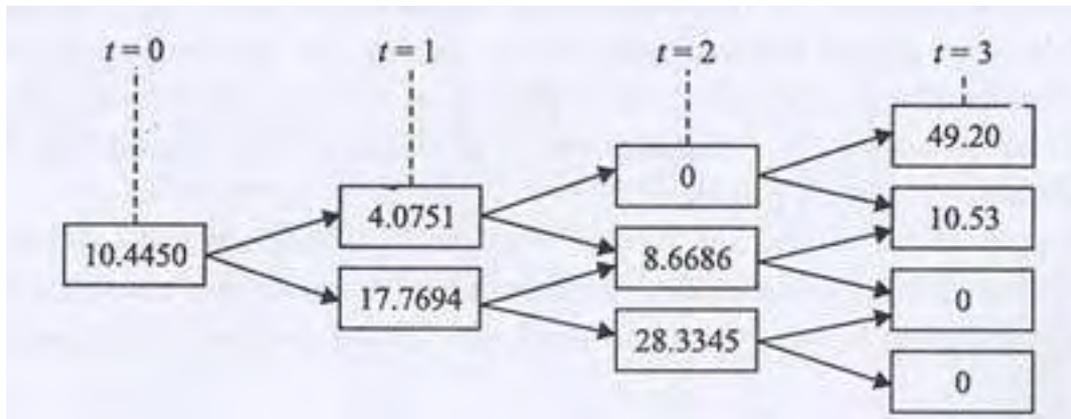


(g) Three period binomial tree for a put option

Stage IV: Now we have reached the final stage from where initial price of the option can be found as:

$$P_0 = e^{-0.05 \times 1/3} [0.5219 \times 4.0751 + 0.478 \times 17.7694] = 10.4450$$

The final option price tree is depicted in Figure (d).



(h) Three period binomial tree for a put option

Now that we could price both call and put options using binomial models, let us see what happens to the option's price if we increase the number of steps from 3 to 4. The option price becomes ₹ 10.0993 and if the steps are 5, then it becomes ₹ 10.2452. Table gives the price of the call option along with the number of steps that go into its computation:

Effect of time steps on binomial option's price

Steps	Price of the call option
3	0.5658
4	10.0993
5	10.2452
10	10.1388
20	10.0924
40	10.0323
50	10.0133
100	9.9601
150	9.9854
200	9.9924
300	9.9876
500	9.9831
1000	9.9814

The option price changes as the number of steps are varying and this is because the binomial model is discrete and it does not consider many intermediate stock prices, leading to this kind of discrepancies. Generally it is resolved by using a large number of time steps, i.e., shrinking the time interval and modeling as many stock prices as possible but it demands tremendous computations and when the number of steps increases, the option price converges to a particular price, i.e., the option price stabilizes at a particular level and the difference between values obtained by increasing the number of steps becomes very small. Here in this example, the price stabilized around ₹ 9.98. Also, one can note that as the time period becomes smaller and smaller, we move from the discrete world of Cox, Ross and Rubinstein to the continuous world of Black - Scholes.

Black—Scholes Option Pricing Model (BSOPM)

Chronologically speaking, BSOPM was introduced much earlier than binomial option pricing, but for ease of understanding we first considered the binomial model. Infact, Black—Scholes provided the first ever closed form of solution for pricing the European calls in 1973 and published the path-breaking paper titled “The pricing of options and corporate liabilities” in Journal of Political Economy. Prof. Scholes and Prof. Merton were awarded the Nobel Prize for their contributions in option pricing.

The data inputs to this model are current stock price, exercise price, expected volatility, interest rate and time to expiry. The pricing intuition remains the same - construct a replicating hedge portfolio comprising a long position in stock and a short position in a zero-coupon bond.

The hedge portfolio will be constituted in such a way that at any given point of time its value will always be equal to the option's price at that time. If the option's price differs from the hedge portfolio's value, then arbitrageurs' actions will bring back the equilibrium relationship. The proportion of stocks and bonds will be determined by the Black—Scholes formula.

As the formula depends on constantly changing factors like volatility, current market price of the stock, etc., the portfolio mix has to be constantly adjusted so that it will reflect the current outputs of Black—Scholes. Hence this portfolio is called as dynamic portfolio and the act of maintaining the portfolio in balance is called as hedge rebalancing.

The mathematical derivation of the Black—Scholes model is quite complicated and requires understanding of a sophisticated branch of mathematics called as stochastic calculus, the details of which are out of the scope of this book. So the detailed mathematical

derivation of BSOPM is provided as an appendix to this chapter. The famous Black—Scholes formula for option pricing is given below:

$$C = S \cdot N(d_1) - X \cdot e^{-rt} \cdot N(d_2) \quad (2.7)$$

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + (r + \sigma^2/2) \times t}{\sigma \cdot \sqrt{t}} \quad (2.8)$$

$$d_2 = rd_1 - \sigma \cdot \sqrt{t} \quad (2.9)$$

Where $N(.)$ = Cumulative normal distribution function

\ln = Natural logarithm,

S = Spot price of the stock,

X = Exercise price of the option,

r = Annual risk-free rate of return,

t = Time to expiry of the option, and

σ = Annual volatility of the stock.

If t is in years, then σ and r should also be expressed in annual terms.

Since the calculation of option price through the Black—Scholes formula involves many intermediary computations, a systematic procedure may be useful:

1. It is better to start with equation (2.8). So,
 - a. Work out $\ln(S/X)$
 - b. Calculate $(r + \sigma^2/2)$
 - c. Find $\sigma \cdot \sqrt{t}$
 - d. Compute d_1
2. Calculate d_2 from equation (2.9).
3. Find cumulative normal distribution values either using $N(d)$ tables given at the end of this book or using the numerical formulae
4. Now calculate the price of the option by substituting the respective values in equation

Example 2.4

The current price of a stock is ₹ 90 per share. The risk-free interest rate is 8% (annualized, continuous compounding). If the volatility of the stock is 23% p.a., what is the price of the ₹ 80 call option expiring in 6 months?

Solution

Performing the above mentioned steps:

1. (a) $\ln(90/80) = 0.1178$

(b) $\zeta r = \frac{\sigma^2}{2} \leq = (0.08 + (0.23 \times 0.23/2)) = 0.1064$

(c) $\sigma \cdot \sqrt{t} = 0.1626$

(d) Find the value of the numerator in d1L II 1

$$\ln(S/X) + \zeta r = \frac{\sigma^2}{2} \cdot t = 0.1178 + 0.1064 \times 0.5 = 0.171$$

Now, divide this with 0.1626, which gives $d_1 = 0.171/0.1626 = 1.0517$

2. $d_2 = d_1 - \sigma \cdot \sqrt{t} = 1.0517 - 0.1626 = 0.8891$

3. $N(1.0517) = 0.8535$ and $N(0.8891) = 0.8130$

4. $C = S \cdot N(d_1) - X \cdot e^{-rt} \cdot N(d_2) = 90 \times 0.8535 - 80 \times e^{-0.08 \times 0.5} \times 0.8130$
 $= ₹ 14.3253 = 14.33$

European Put Option Pricing

B-S initially provided the formula for pricing European style call options on assets without any intermediate income. Simultaneously, in an article in Bell Journal of Economics and Management Science, Robert Merton (1973) provided an elegant analysis in which he provided explicit formulas for pricing put options and suggested adjustments to take care of dividend payments.

The price of the European put option can be computed using the formula given in equation

$$P = X e^{-rt} \cdot N(-d_2) - S \cdot N(-d_1) \quad (2.10)$$

All the terms that appear in this formula are as explained in the above section. It can be noted that $N(-d_2)$ is the same as $1 - N(d_2)$ and $N(-d_1)$ is the same as $1 - N(d_1)$.

Example 2.5

Using the information provided in the previous example, find the price of a put option.

Solution

We can start with the computation of d_1 and d_2 but if we make use of the fact that $N(-d_2)$ is the same as $1 - N(d_2)$ and $N(-d_1)$ is the same as $1 - N(d_1)$, then the put option's value is given as:

$$\begin{aligned} P &= 80 \times e^{-0.08 \times 0.5} \times (1 - 0.8130) - 90 \times c(1 - 0.8535) \\ &= 1.1884 = 1.19 \end{aligned}$$

B-S Model Assumptions and Limitations

Just as with most other models in finance, BSOPM is also based on some assumptions, which are as follows:

- (a) **Frictionless markets.** More precisely it means there are no transaction costs, short-selling is permitted, existence of similar borrowing and lending rates and infinitely divisible assets. This is not a severely restrictive assumption since the intention is to separate the effect of market forces on option prices.
- (b) **The asset pays zero dividends.** This is also not an implausible assumption at least in the short run. But subsequent models in the literature proposed some adjustments to the basic BSOPM to incorporate dividend/intermediate income.
- (c) **The option is European style.**
- (d) **Asset prices follow a geometric Brownian motion.** In other words, asset returns are normal and stationary. Many critics called this assumption as the biggest hole in the B-S formula, including its inventor Prof. Fisher Black in an influential article in the Journal of Applied Corporate Finance in 1989.

But this way of making simplifying assumptions to describe the complex real world more well-mannered is followed in many disciplines of Sciences and also in economics and finance from ages, and in that spirit this model is not an exception. More importantly, despite these seemingly deficient assumptions, the model does a reasonable job in pricing a variety of derivative instruments.

But the real utility of BSOPM is that it provides us a mechanism to hedge an option and the cost of hedging gives us insights into the likely price of the option. In the B-S model, all the data inputs are directly observable except volatility. In the next section, we will see some important ways of estimating volatility.

Lesson 2.3 - Options Trading Strategies

Options Trading Strategies

- Building Blocks of Derivatives
- Options Trading Strategies
- Directional Strategies
- Volatility Strategies
- Horizontal Spreads
- Other Trading Strategies

Building Blocks of Derivatives

Now that we are armed with the knowledge of option greeks, we are well equipped to appreciate and understand the various option trading strategies, their motives and the possible consequences. We will start with the basic and simple strategies, also known as the building blocks of derivatives.

The following are the basic elementary strategies:

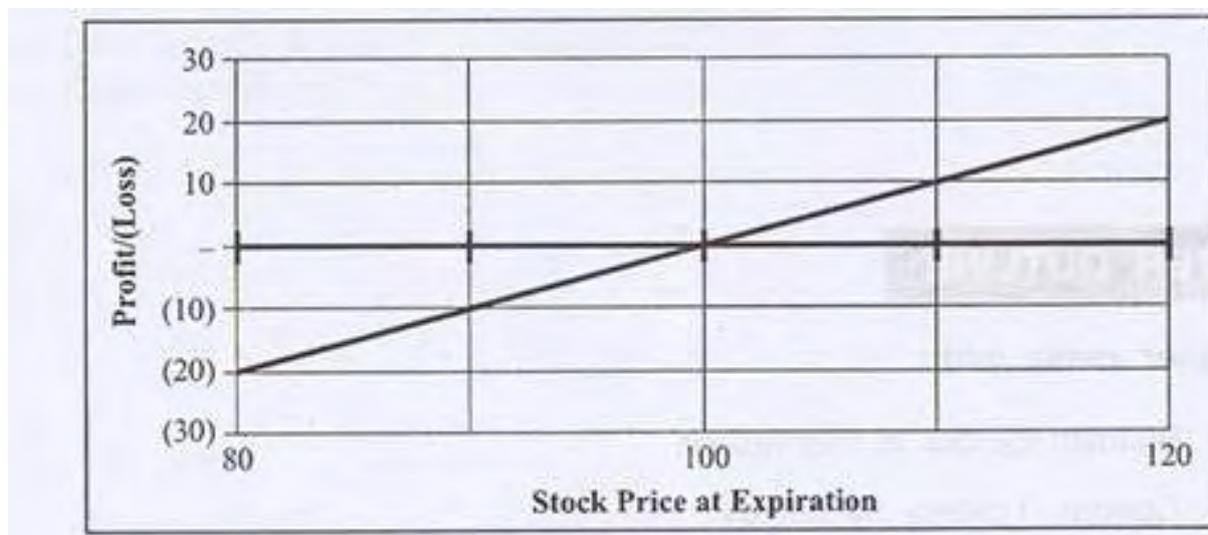
- Long call
- Long put
- Short call
- Short put

To these we can also add long stock and short stock; we will have six basic strategies termed as the building blocks. Let us see each of them in detail. In this section we will discuss these strategies and other advanced strategies. Throughout our discussion on option strategies, we will make use of greeks and profit/loss diagrams as they are our eyes and ears to discern all options-based strategies.

Long Stock

When an investor expects that a particular stock will rise, until the advent of derivatives investors will buy that stock as they have only that choice to profit from their

bullish expectations. In this case, the investor theoretically has unlimited profit; potential and losses are limited to the price he paid while acquiring the stock. Hence, if the stock price rises over what he paid for, he will be gaining and vice versa. The payoff for a stock is shown in Figure



Profit/Loss diagram

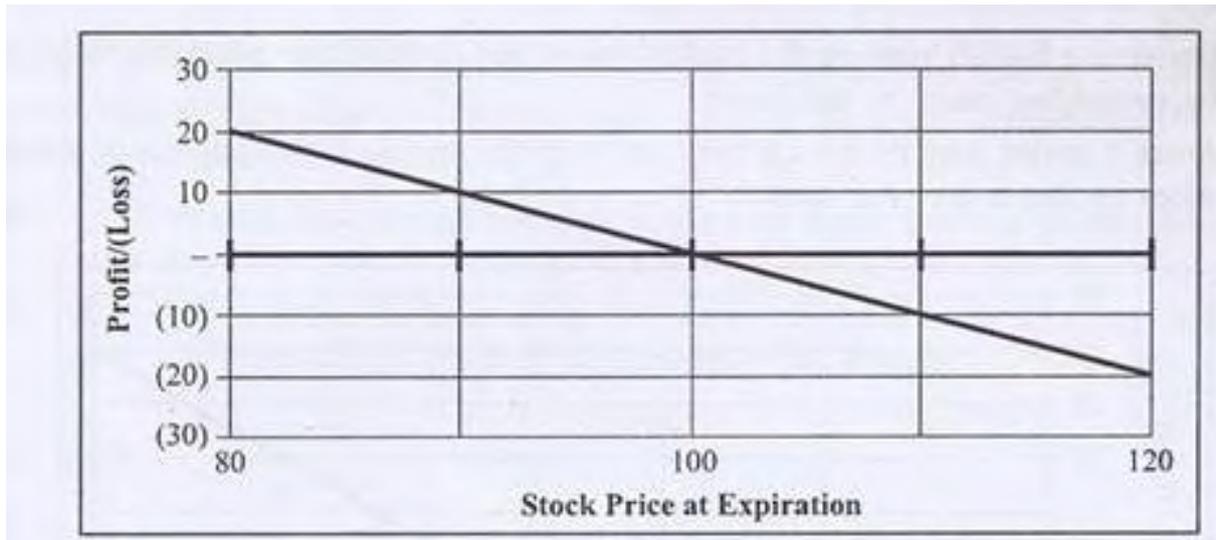
Short Stock

This strategy will be resorted to when one is having bearish expectations or when one expects the stock price to come down. Though this is currently not permitted in India for everyone, the mechanics of short selling involve the following:

- (a) Borrowing the stock for a specified period from someone who holds it; for instance, a broker.
- (b) Selling the borrowed stock now at the current market price.
- (c) At the end of investment horizon, the stock will be bought from the market and will be returned to the broker/stock lender.

This is a bearish strategy involving limited profits but unlimited losses because at maximum the stock price may decline to zero and this extreme case represents the maximum profit potential.

On the other hand, if price moves against the seller then he has to put up with unlimited losses as prices are unbounded on the upside (i.e., they can go up to infinity theoretically).



Short stock profit/ (loss) diagram

Long Call

Buying call options is the simplest and a popular form of entering into the derivatives market. By definition, call option buyer has the right to buy the stock at the strike price until the expiration date. An investor will buy a call option with the expectation of a price rise. The advantages of a call option over buying a stock are two fold:

- (a) Leverage, and
- (b) Limiting the downside risk.

Consider a call option on a stock with the following data:

Strike price = ₹ 100	Current market price = ₹ 100
Time to expiry = 90 days	Volatility = 25%
Interest rate = 5%	

The payoff diagram for this option is shown in Figure.

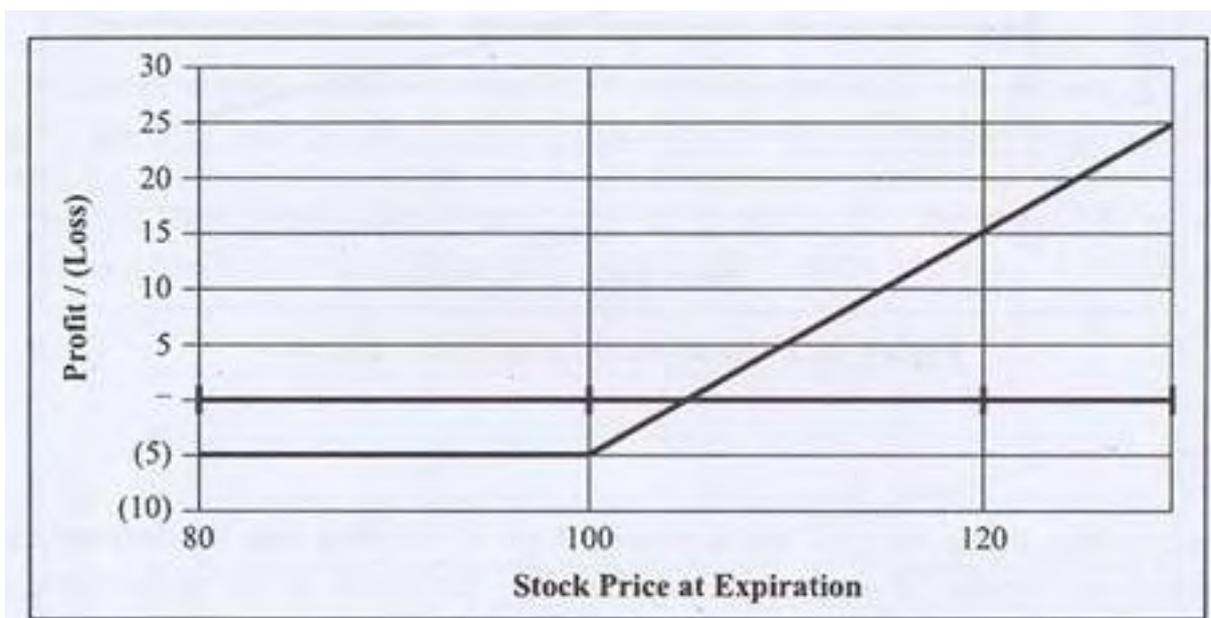
Now, in order to buy 100 shares, the investor has to invest ₹ 10,000 and if the stock gains ₹ 5 over the next day, his gain will be ₹ 500 (100 shares x 5 per share) and return on investment = 5% over a day $\{(500/10000) \times 100\}$.

But if the investor bought 100 options, he will pay ₹ 555.50 as option premium and the gain for the same ₹ 5 over next day will take the price of the option to ₹ 8.723 or ₹ 3.168 gain for each option, in which case the profits will be 3.168 x 100 316.80, translating into a return of 57% over the day.

Therefore, call options entail investors to realize large percentage of gains for a modest advance in the underlying price. But leverage is a double-edged sword and a ₹ 5 decline over the next day will cause the option price to fall to ₹ 3.11 and the percentage losses would be around 45%. Therefore, the price of a larger reward is a larger risk. But the call buyer's losses are limited to the premium paid while the stock buyer's risk is the entire investment of ₹ 10,000. Hence the call option can be viewed as a sort of insurance in case the stock falls instead of going up. Thus, a call option provides the following benefits to the buyer:

Translate a bullish view on the market into actual position and retain the ability to buy the underlying stock in the future.

- Insure a major part of the capital due to losses arising from declines in the market prices of the underlying stock.



Long call profit/(loss) diagram

To know more about the risks and rewards associated with a long call option, let us make use of the Greeks and the profit/loss diagram. Table presents the greeks for the above mentioned data:

Option Greeks for the long call option

Option Fair Value	Delta	Gamma	I-Day Theta	Vega	Rho
5.52	0.565	0.0319	-0.034	0.196	0.1240

For ATM and ITM options, at expiry gains/losses of every rupee in the underlying stock will be reflected as gains/losses in the option prices. At expiry, the position will break-even at the strike price plus option's premium. A delta of 0.565 indicates that one call option is equivalent to holding 56.5% of the underlying asset.

The option has a gamma of 0.0319 and a Vega of 0.196 while theta is -0.034 . The Greeks give insights into the underlying risks as well as motives of holding options that are not otherwise obvious. Positive gamma indicates that deltas become more positive when underlying stock price increases and will be beneficial to the option buyer. In other words, if the actual volatility increases the buyer will be benefitted.

Similarly, a positive Vega implies that the option holder will benefit from any increases in implied volatility. In fact the option price will increase by ₹ 0.196 for a 1% increase in implied volatility.

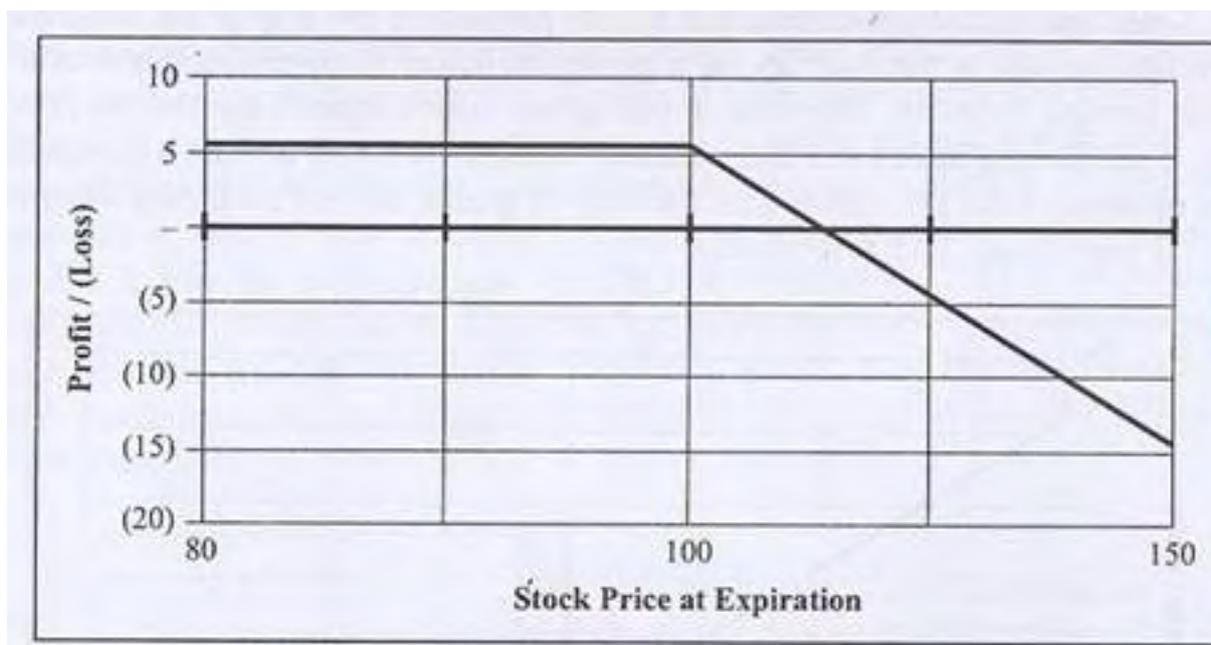
Hence we can understand that option buyer is having a bullish view on underlying's volatility along with a bullish view on the underlying's direction. But the option buyer is exposed to theta risk - the option loses its value by ₹ 0.034 everyday, even when all other things remain the same. This may not seem as an innocuous number but remember that this is well before 90 days to expiry and that theta increases rapidly as expiry date comes near.

Therefore, an option buyer has to note that:

- ▶ An increase in underlying's price and increase in actual and/or implied volatility will be beneficial.
- ▶ The elapsing time will fritter away the premium, and this hurts the buyer more when there is no increase in volatility or the underlying's price.

Short Call

When an investor sells a call option, he definitely expects that the stock price will not rise. Though the outlook of the investor is not very positive, he is not utterly bearish since in order to profit the market need not decline; even if it stands still, he will gain the premium. So, a call seller's view on the market is generally neutral to bearish. Similar to the view on underlying's direction, a short trader in options expects that the underlying's volatility will also decline. Let us see the Greeks in Table to decipher more clearly the consequences of this strategy.



Short call profit/(loss) diagram

Option Greeks for the short call option

Option Fair Value	Delta	Gamma	I-Day Theta	Vega	Rho
5.52	-0.565	-0.0319	0.034	-0.196	-0.1240

The profit/loss diagram in Figure shows that the call seller is having a limited profit and the losses are unlimited. Hence this is a high-risk strategy because utmost what he can gain is the option premium while he can lose an unlimited amount. The greeks show that the short call has a negative delta, suggesting that any rise in underlying's price will hurt the option seller because the option price increases with an increase in underlying's price. The short call is also exposed to the twin risks, gamma and vega risk, i.e., if underlying volatility and/or implied volatility increases, the position will lose money. On the positive side, the call seller will benefit from time decay, as theta is positive. So the call seller will be waiting for the option to reach the phase when theta rapidly increases without the underlying stock rallying.

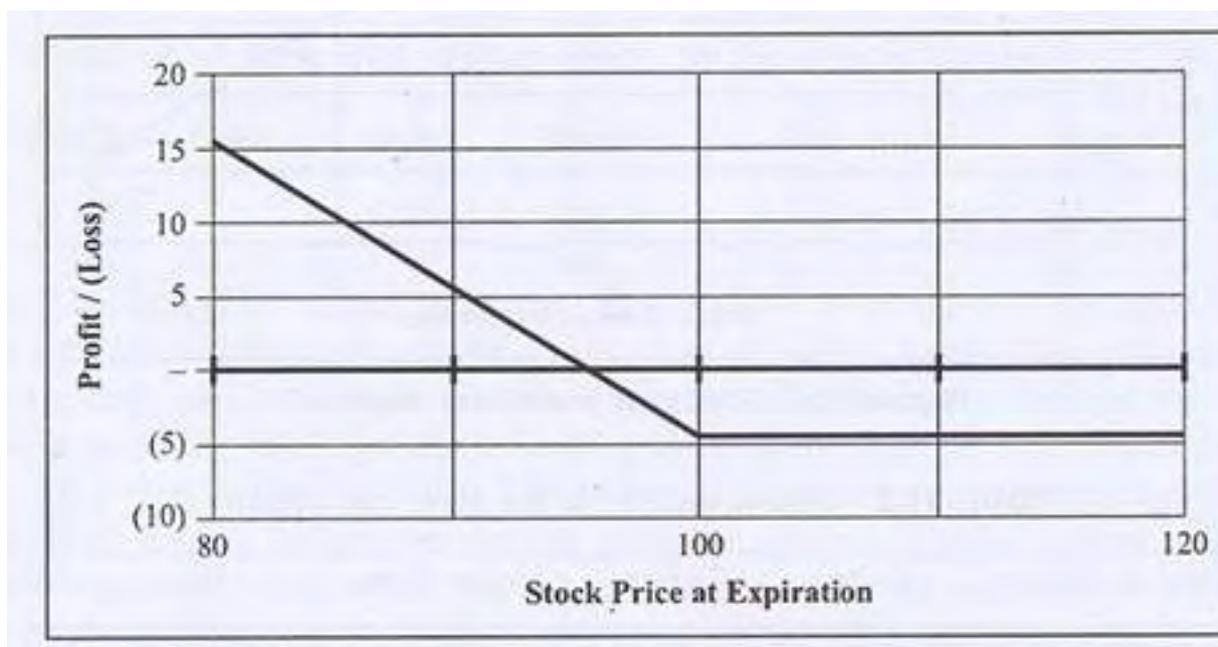
We can summarize that a call seller expects the market to be neutral or bearish and will benefit from:

- A decline in underling's price,
- A decline in actual or implied volatility, and
- Theta or the passing by of time.

Long Put

By buying a put option, an investor is expressing a bearish view on the direction of the underlying's price. Put options are extremely useful tools in markets where short selling is not permitted legally. Though futures can also serve as an alternative means of short selling, they offer no protection if the investor's reading of the market pulse is wrong. A put option holder, if he is also long in the underlying stock, is ensured that a large part of the current market value is not lost. Since options are instruments that expose the holders not only to the underlying asset price's direction but also to the volatility, so a put option holder is expressing a neutral to bullish view on the implied volatility. Therefore, a put option holder expects the market price of the underlying to decline and anticipates that volatility would increase (or at least will remain same).

Let us understand the put option with the help of greeks and the profit/loss diagram given in Table and Figure respectively



Long put profit/ (loss) diagram

Option Greeks for the long put option

Option Fair Value	Delta	Gamma	I-Day Theta	Vega	Rho
4.44	-0.45	0.033	-0.022	0.196	-0.091

A put holder is having significant profit potential and the losses are limited to the amount paid as the option premium. At expiry, the break-even point occurs at a price equal to the strike price minus option premium and before expiry the BEP is even higher. It can

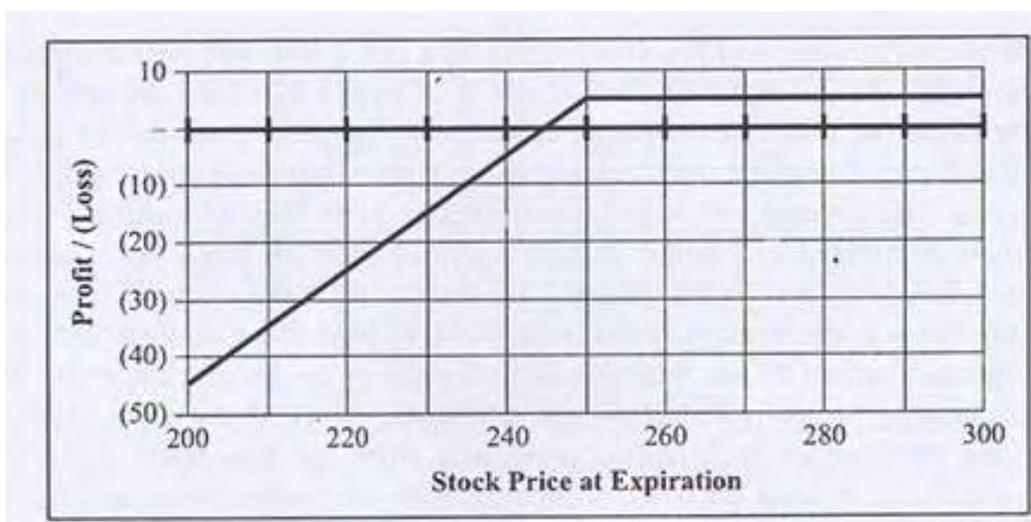
be noticed that delta of the option is negative at 0.45. Therefore, if the market price rises by ₹ 1.00, the option will start losing ₹ 0.45. Our premise on volatility exposure of put holders comes out of the fact that gamma and Vega for long puts are positive. Therefore, they will be benefited if there is all in implied volatility and/or the underlying stock experiences extreme price swings. But as in long calls, all Greek that is working against the put holder is theta. Since it is negative, it is indicative of the erosion of the time value of the option. In summary we can say that a long put will benefit:

- When the underlying's price declines and/or.
- From an increase in actual and/or implied volatility.

But a put option holder has to be wary of time decay.

Short Put

The seller of a put option has an obligation to buy the underlying asset at the exercise price. Therefore, the put seller expects that the underlying's price will definitely not decline though he may not be sure about the price rising, he should be certain that the stock will not go down. Put writing can also be considered as a strategy of acquiring the underlying asset at or below the going market price. For instance, when the market price of a stock is ₹ 264 and if a 250 strike put option with 75 days to expiry is trading at ₹ 5.24, the buyer of the stock has to pay ₹ 250 to buy the stock (assume $r = 5\%$ and volatility = 25%). If an investor expects that prices will not go beyond ₹ 250, then by selling this put he can actually get the stock at a price less than ₹ 250 (because he will earn a premium of ₹ 5.24, which will reduce the cost of purchase of the stock). However, the seller will be hurt if the price falls significantly before the expiry.



short put profit/ (loss) diagram

Option Greeks for the short put option

Option Fair Value	Delta	Gamma	I-Day Theta	Vega	Rho
5.42	-0.276	-0.011	0.056	-0.392	0.134

As in the case of a short call, the put writer also assumes significant losses for a limited gain of the option premium this can be noted from Figure. The short put has a negative delta from Table, implying that the option writer will lose if the underlying stock price rises and will gain if the underling's price declines. In addition to a negative delta, a short put has a negative gamma and Vega. Therefore, if the volatility increases, put writer will lose and if volatility decreases, put writer will be benefited. So, ideally put writer desires a market price decline associated with a volatility decline, in which case it is doubly beneficial. On the other hand, the position will gain from a positive theta and this gain increases as time to expiry approaches.

In conclusion, we can say that a put seller will benefit from:

- Decline in the underling's price.
- Decline in actual and/or implied volatility.
- Time decay.

These are known as the basic building blocks since they form the basis for constructing a variety of esoteric spreads and combinations that will yield different payoffs depending on the view on underlying market's direction and volatility. Now let us start understanding some simple strategies like combining calls and puts with the underlying stock.

Options Trading Strategies

Options Trading in Combination with the Underlying Covered Call Writing

This is a conservative strategy and involves writing of a call option and simultaneously buying the underlying stock. As the writer of a call option is obligated to deliver the underlying stock at the exercise price, the writer of the naked call expects the stock price to end up below the exercise price at expiry. But if the stock price ends up higher than the exercise price, the writer will suffer losses. The covered call writer tries to hedge these losses by actually holding the underlying stock. A covered call writer is more cautious than the stock buyer since a stock buyer has unlimited gains and losses whereas a covered call writer is more concerned with what he already has and this strategy protects the investor from price declines upto an amount equal to the option premium he has received. But of course

in the bargain the writer of the call is actually exchanging his unlimited profits to a constant profit if the stock rises. Covered writing provides the investor with additional income from his investment portfolio, which protects his securities, at least partially, from a decline in market price and the premium received will lower the break-even point on the stock.

Assume that an investor holds 100 shares of a particular stock and the current market price of the share is ₹ 100. He is concerned about the slight weakening trend in price of this stock and decides to protect the moderate downfall by writing a call option at a strike price of ₹ 105 expiring in 90 days. He collects ₹ 7 as premium and in the deal he has protected his investment against mild declines up to ₹ 93(100 - Premium).

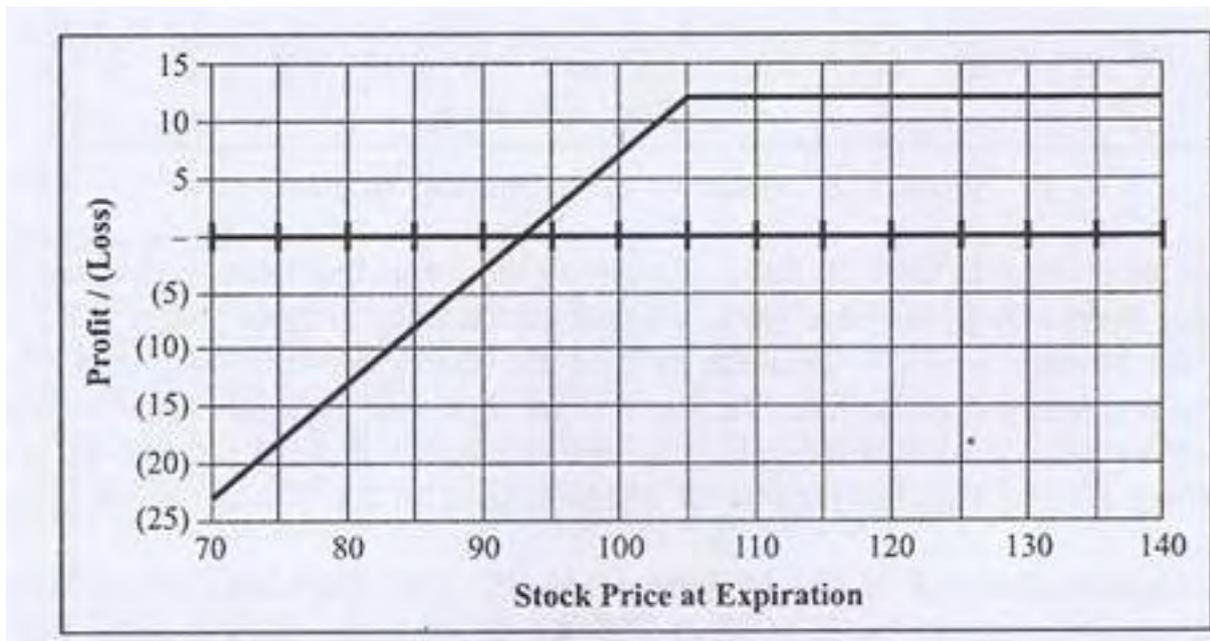
To this extent these losses will be compensated by the option premium he has received. Now let us chart the profit/loss diagram for the covered call the same is shown in Figure.

It may be noticed that as the stock price increases over ₹ 105, the call option will be exercised and he has to deliver the share at ₹ 105. Therefore, his effective selling price will become ₹ 105 + 7 (being the premium received) = ₹ 112. If the stock ends up at more than ₹ 112, he has to bear the opportunity loss as he cannot realize this higher price because he has committed to sell the share at ₹ 105 by virtue of the sold call option.

If the stock price is below ₹ 105,, the call seller will retain the full amount of option premium since the option will not be exercised and the returns will be higher vis-à-vis the exclusive stock position. The break-even point is lower than the unheeded position—for the covered call it will be at ₹ 93 but for the stock only position it will be ₹ 100. Infact at the break-even point of the stock only position, the covered call will generate a return of 7.52% (unanalyzed). So it appears to be a better strategy than the stock only position if the expected price is to remain more or less unchanged.

Covered call is a less risky strategy compared with either uncovered call writing or buying the stock alone. In the naked call writing, the seller has to bear greater risks as losses are unlimited if the stock price rises substantially and the returns are capped at the premium received whereas buying the stock alone dives unlimited losses as well as gains but it entails larger initial investment.

Generally the covered call writer sells OTM options in order to secure a part of the price appreciation along with the premium. Looking at the profit/loss diagram of the covered call writer reminds us of the profit/loss diagram for a short put. We will see the relationship between these two a little later in this chapter.



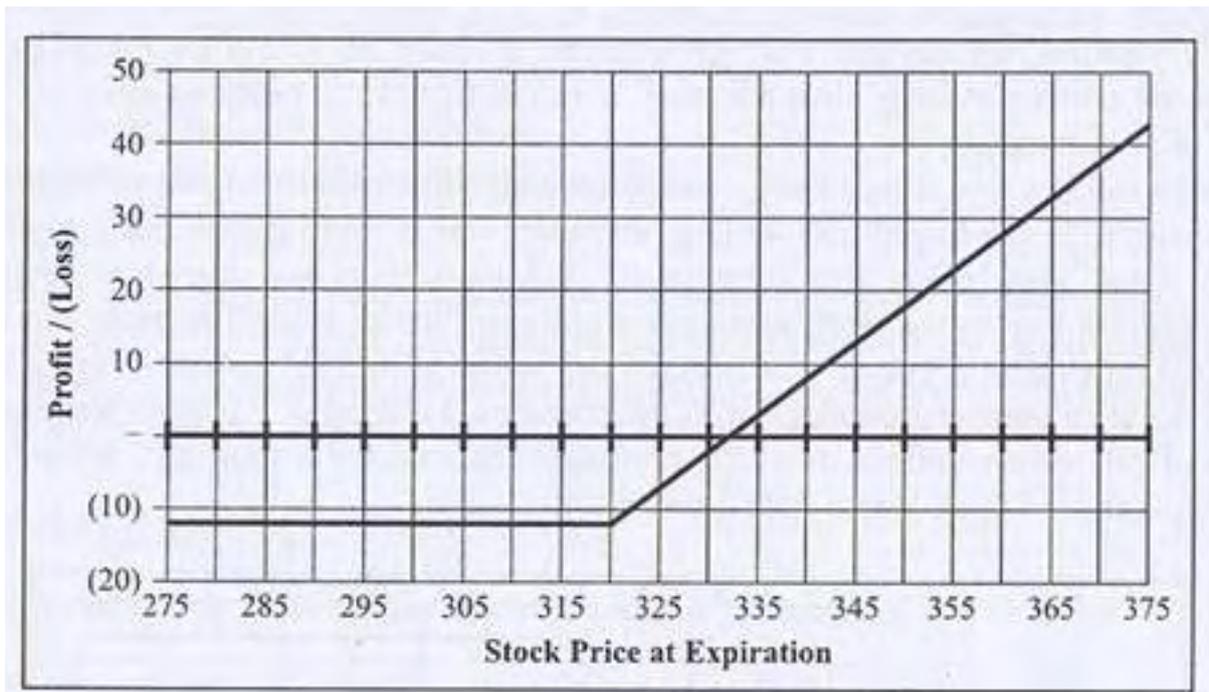
Covered call writing profit/(loss) diagram

Protective Put

We have seen that when an investor is long in the stock, he can protect his investment's downside risk against moderate price changes by writing a call option. The size of the protection will be equivalent to the premium received.

However, the investor has to give up all the upside potential when stock price moves up significantly. Also, the losses are only pared down slightly when price moves down substantially. So, instead of writing a call option if the investor buys a put option along with a long position in the stock, his benefits are two-fold - if the stock price declines sharply below the strike price, he will not suffer any losses because the put option will become in-the-money and the portfolio will gain; but if the stock price moves up significantly, he will retain all the profits that are associated with the long stock position and the portfolio gains will be equal to the stock gains less the premium paid.

Therefore, a protective put ensures that the unlimited gains associated with stock price rally will accrue to the buyer and if the stock price moves down, the unlimited losses associated with stock are nullified by the long put option and the twin benefits come at a cost equal to the put option's premium. The same inferences can be made from the profit/loss diagram shown in Figure.



Protective put profit/(loss) diagram

Suppose an investor holds 100 shares of Neptune Industries that have appreciated substantially in value ever since he acquired them. Current market price of these shares is ₹ 325 per share and the investor wants to continue to hold the shares for their long-term prospects. However he is concerned about their decline if a far and wide forecasted market correction comes about. In order to lock-in the gains, the investor buys 100 ATM put options at a price of ₹ 7.00 per option. This assures him of a selling price of ₹ 320 per share if the stock price declines.

Now what happens if the stock price falls to, say, ₹ 290? The stocks will be worth only ₹ 29,000 instead of ₹ 32,500 - all of ₹ 3,500 in the stock's value. But he can exercise the put option and will gain ₹ 3,000 $\{(320 - 290) \times 100 \text{ options}\}$. So the portfolio will be worth ₹ 31,300 (32,000 — 700 being the premium) and if the stock price rises to ₹ 350, then the put options will be allowed to lapse and the investor will lose ₹ 700, which is the option premium paid, and the stocks will be worth ₹ 35,000. The net portfolio value will be ₹ 34,300.

Effectively, a put option added to a long stock portfolio ensures a minimum value for the portfolio or the strike price less option premium becomes the value of the portfolio. However, a protective put may be of less utility if only a marginal decline in the underlying stock price is expected, i.e., if the expected movement is less than the put's premium, it may be better to absorb the losses rather than hedge the stocks with put options.

From the above discussion of these basic strategies, it is clear that options traders can benefit or can get hurt when the underlying market moves in a particular direction and/or volatility itself changes. So, depending on the expertise a trader has, he can benefit from either direction or volatility or both by combining the basic building blocks. Accordingly derivatives offer all trading strategies with varied risk-reward characteristics. These strategies can be broadly classified as (for ease of exposition only) directional strategies, volatility strategies, and horizontal spreads.

Directional Strategies

Directional strategies are designed to speculate on the direction of the underlying market. So, they are simply trades that reflect the views of traders on the direction of the underlying market like 'bullish view' (prices will rise) or 'bearish view' (prices will decline). Options can be combined in such a way that investors will have exposures only to the market direction while remaining neutral to the volatility. Therefore, directional strategies allow traders not to worry about volatility changes and to make use of their expertise in predicting the market direction.

It may appear that these are not very special strategies as one can always speculate about the direction of the market with the help of the underlying assets directly or with the help of futures. But it has to be noted that these two instruments allow traders to benefit only when their predictions about the direction turn out to be right; but if their predictions or beliefs do not turn up right, they will have to put up with unlimited losses. With options you get the best of both worlds - have unlimited gains if you predict the market direction correctly otherwise content with the limited losses. Also, as discussed in the earlier sections, options provide the investors with ample leverage, which is another possibility that trading with the underlying assets alone would not be providing.

Bull Vertical Spread

Among the directional strategies vertical spreads are quite common and these involve two options with different strike prices on the same underlying for the same maturity. Vertical spreads are characterized by limited risk and profit potential. These spreads are termed as vertical spreads since the spread consists of two options that appear one below the other (not necessarily immediately below) in the options price quotations published in the business press, are organized in an ascending order of strike prices.

A bull vertical spread involves buying a call option and simultaneously selling a call option on same stock with the same expiry but with a higher strike price. A bull spread can

be created with put options too and the principle remains the same - buy the lower strike option and sell the higher strike option. So, in a bull spread:

Long call strike < Short call strike

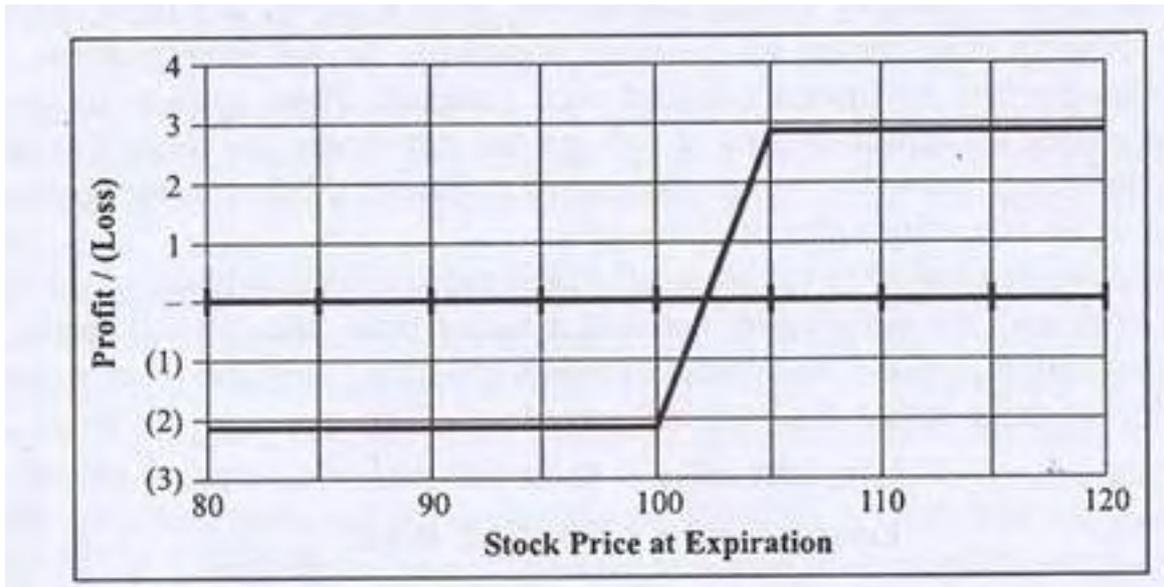
Long put strike < Short put strike

Bull call spread is somewhat similar to a covered call but instead of holding shares, the investor owns an ITM call option. This strategy permits the trader to initiate the position even though he is tentative of his bullish expectations. This is because in the worst case the call option he holds may expire worthless. Of course bull vertical spread can be constructed so as to reflect his varying bullish expectations, viz., if the investor is very bullish, he can select the strike prices which are farther apart, and if he is cautious of his expectations, the strike prices will be closer to each other. Also, the more ITM the long call, the more wary the trader is. Depending on the composition of the spreads and with respect to the spot price, a spread is termed as ATM if it has one ITM and one OTM option, whereas in an ITM vertical both options are currently ITM, and an OTM vertical is one where both options are currently OTM. Consider the following data:

Stock price	100
Time to expiry	90 days
Volatility	25%
Interest rate	5%
Option price X=100	5.55
Option price X = 105	3.40

If an investor constructs a 100/105 bull spread, he pays ₹ 5.55 for the long call and receives ₹ 3.40 from the short call option, resulting in a net outflow of ₹ 2.15. Since there is a net outflow of money, this type of spreads is sometimes termed as debit spreads. It is evident that the investor is reducing the price of the option that was bought and aims to profit from his bullish views. Since the trader is adding another option to the original position by selling another call at a higher strike, he is actually limiting his gains and so also the risks. The maximum loss occurs when the purchased option expires out-of-the-money and the loss is equal to the net premium paid. The profit is highest when the sold option becomes in-the-money and the gains are equal to the difference between the two strike prices less the premium paid. Hence the breakeven point is (this is also clear from the profit/loss diagram

Lower exercise price + Net premium paid



Bull call spread profit/(loss) diagram

For our example, let us see the cash flow consequences under different scenarios:

- When the stock price is below ₹ 100: In this situation, both options expire worthless and the net loss would be the net premium paid and will equal to ₹ 2.15.
- When the stock price is between ₹ 100 and ₹ 105: At expiry, the investor exercises the ₹ 100 call and sells the stock in the market at the going price. Since the breakeven point is ₹ 102.15, he will exercise the option as long as the stock is in the range of ₹ 100 and ₹ 102.15.
- When the stock price is above ₹ 105: In this situation, both options are in-the-money and the investor will exercise the ₹ 100 call and simultaneously the higher call sold by him will also be exercised by the counterparty. The total gain will be ₹ 5 and net gain will be ₹ 2.85, considering ₹ 2.15 being the net premium paid to initiate the position. So as long as the stock ends up higher than the sold call option, this represents the gains to the bull spread holder.

Now let us see what insights the Greeks provide us. Table provides the greeks for the bull vertical spread.

Option Greeks for the bull vertical spread

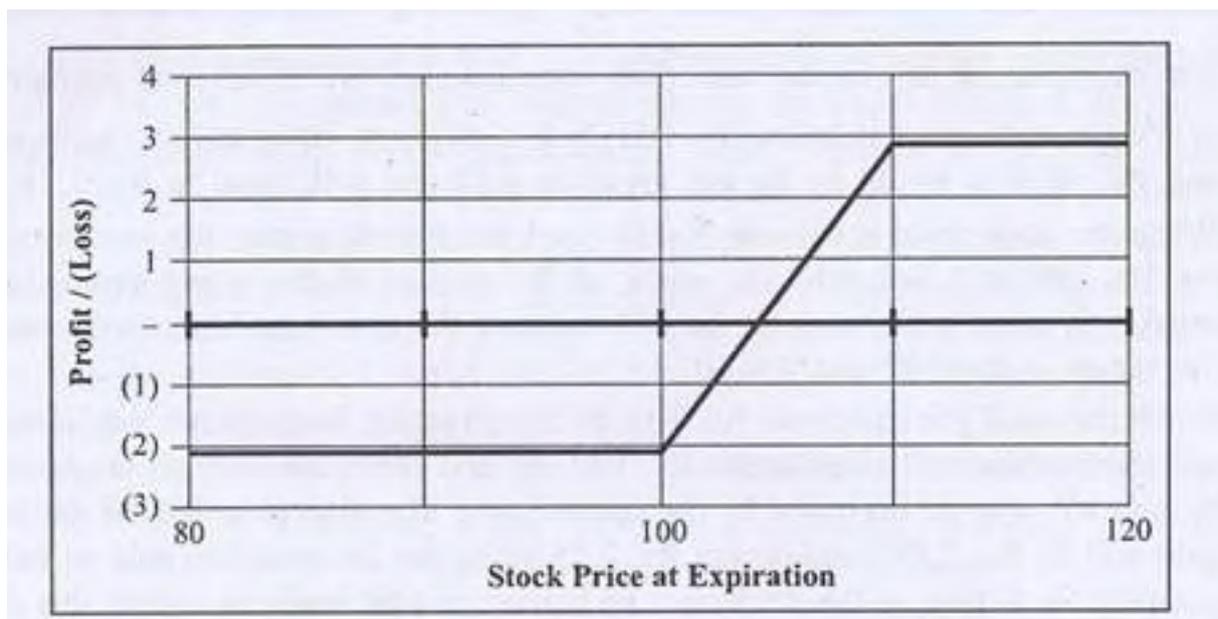
	Price	Delta	Gamma	Theta	Vega
Long call option	-5.55	0.565	0.031	-0.034	0.196
Short call option	3.40	-0.415	-0.031	0.033	-0.193
Net	-2.15	0.15	0	-0.001	0.003

The Greeks make our comprehension of the strategy much more thorough - the investor is exposed only to the market direction with a positive delta of 0.15 and all other greeks are negligible with a zero gamma and an insignificant vega, implying that the position is neither exposed to actual volatility nor to implied volatility. The best part of this bullish strategy is that time decay is almost zero.

Generally, with a long option position, the holder is subjected to massive time decays, but with a bull spread, the position has a long bias towards the market without being wrecked by time decay. In this case, the delta is just 0.15, meaning that the traders' exposure is only 15% of the underlying but if he desires more exposure to the underlying, this can be achieved by driving the delta to any desired value. For example, if the trader intends to have a delta equivalent to that of the underlying stock, i.e., 1.0, all he has to do is add more bull spreads. In this case he needs around 6 to 7 sprads ($1.0/0.15 = 6.67$).

In a similar way, bull vertical spreads can be constructed using put options instead of call options. This is done by selling the higher strike option and buying the lower strike put option. Since we are writing an ITM put and buying an OTM put option, there will be a cash inflow.

Hence these spreads are also termed as credit spreads. The more ITM the two exercise prices, the more aggressive is the spread. The profit/loss diagram for the bull put spread is depicted in Figure. The nature of the strategy and the consequences are as discussed in the case of bull call spread.



Bull put spread profit/(loss) diagram

Bear Vertical Spreads

When the outlook for the market direction is bearish, an investor can benefit by trading bear vertical spreads using either call options or put options. In a bear vertical spread the strike prices are chosen as follows:

Long call strike > Short call strike

Long put strike > Short put strike

A bear spread is a versatile strategy when an investor expects the market to decline but is unsure of the amount by which it will fall. An aggressive spread can be constructed by using more out-of-the-money options. When an investor initiates a bear put spread as in the case of a bull call spread, he pays the premium. So a bear put spread is also a debit spread. If the underlying security rises subsequently, the loss will be limited to the net premium paid. For instance, an investor who is having a bearish view on the market can profit from his forecast by using a bear spread, which entails less investment than that involved in a long put option.

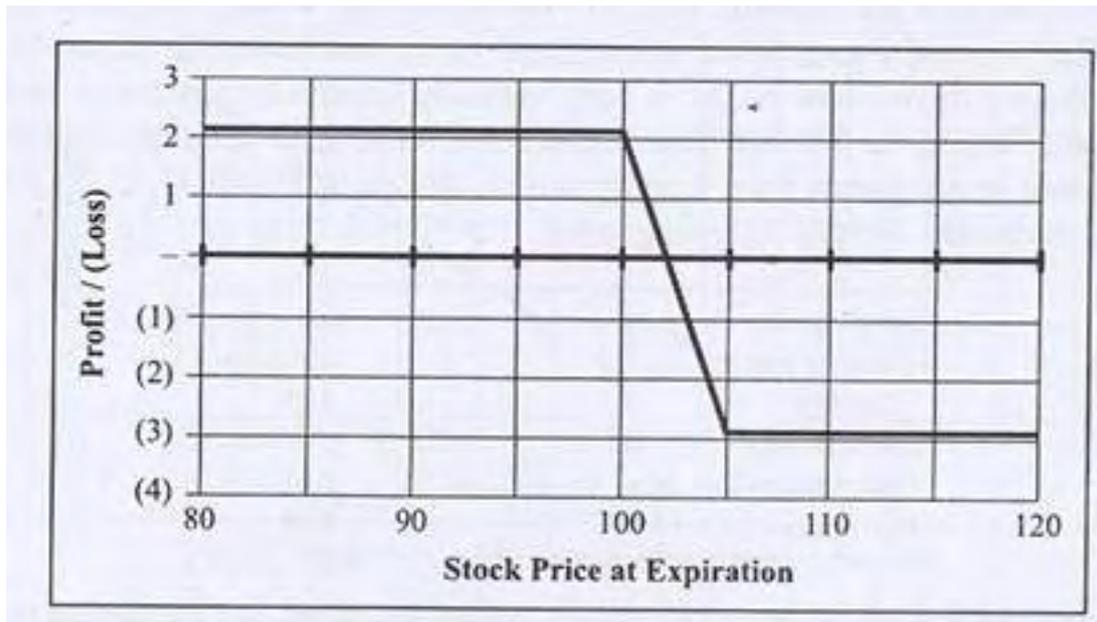
Assume that the investor expects the earlier stock to come down and he constructs a bear spread with the following information:

- Buy a 105 put option at ₹ 7.33
- Sell a 100 put option at ₹ 4.44
- Net premium paid is ₹ 2.89

The short put does two things - reduce the cost of buying the 105 put option and limits the profits at expiry. At expiry if the stock price falls below ₹ 100, then both the puts will be exercised (long put will be exercised by the investor the 105 and the buyer of 100 put will also exercise it) and this will result in ₹ 5 as inflow to the spread holder. However, since he paid a premium of ₹ 2.89, his net gain will be ₹ 2.11 (5 - 2.89). On the other hand, if the stock ends up between ₹ 100 and ₹ 105, the investor will exercise the 105 long put and the 100 short put will be allowed to lapse. Since the breakeven point is ₹ 102.11, to limit the losses the investor will exercise the option as long as the stock is between ₹ 102.11 to ₹ 105. The last possibility is when the stock price is over ₹ 105 and in this case both options will be worthless and this represents the worst case for the bear spread buyer and he has to bear a maximum loss of ₹ 2.89 being the initial premium paid by him. So, the bear put spread has a limited upside and a limited downside risk which can be observed from the profit/loss diagrams given in Figure

	Price	Delta	Gamma	Theta	Vega
Long call option	-7.33	-0.612	0.033	-0.02	0.193
Short call option	4.44	0.45	-0.033	0.022	-0.196
Net	-2.89	-0.162	0	0.002	-0.003

Option Greeks for the bull vertical spread



Bear put spread profit/(loss) diagram

The option Greeks for the bear put spread are presented in Table.

The net delta of the spread is around -0.16 , implying that the position will benefit if the market price of the stock falls. Gamma and Vega are almost zero. Hence the position is neutral to volatility and is exposed only to the market direction. Importantly, theta for the spread is negligible (though for this spread it is infinitesimally positive). This is a major benefit over simply buying a put option, which is also a bearish strategy that is subjected to serious time decay losses.

To sum up, we can say that the vertical spreads (bull/bear) achieve the following:

- Provide a position that benefits if market rises/declines • Unaffected by volatility changes
- Time decay losses are almost negligible

Volatility Strategies

Option markets actually facilitate securitization of risk. Hence options are one of the most important and accessible tools to construct strategies that benefit from the traders' knowledge of volatility changes without bothering about direction of the underlying price. Therefore, volatility strategies benefit investors who have their expertise in forecasting volatility but may not be proficient in forecasting the direction of the market. The following are the important volatility trading strategies.

Straddles

This is the most popular strategy to trade volatility since this gives the buyer exposure only to volatility with insignificant exposure to the underlying asset. Therefore, without bothering about the market direction, one can take positions on changes in market expectations of price volatility alone. A long straddle comprises buying a call option and a put option on the same stock with the same strike price and expiry. Prima facie it may appear foolish to buy a call and a put on the same underlying at the same strike and for the same expiry, but the real purpose is to stay neutral to the market and get exposure only to volatility. Hence a long call and a long put will just achieve that - remain unexposed to the underlying, but since the buyer has paid the premium and is long in two options, he is long volatility (option buyers are in fact buyers of volatility). In other words, the straddle buyer expects the volatility to rise from the current levels.

The profit and loss diagram for a long straddle is shown in Figure. In this case, the straddle was constructed for the following data:

Stock price	60
Time to expiry	90 days
Volatility	25%
Interest rate	5%
Call option X = 60	2.81
Put option X = 60	3.15

It may be noticed that by buying a call option, and a put option, the investor is setting lower and upper breakeven points for his position and the breakeven points corresponds to strike price \pm total premium paid.

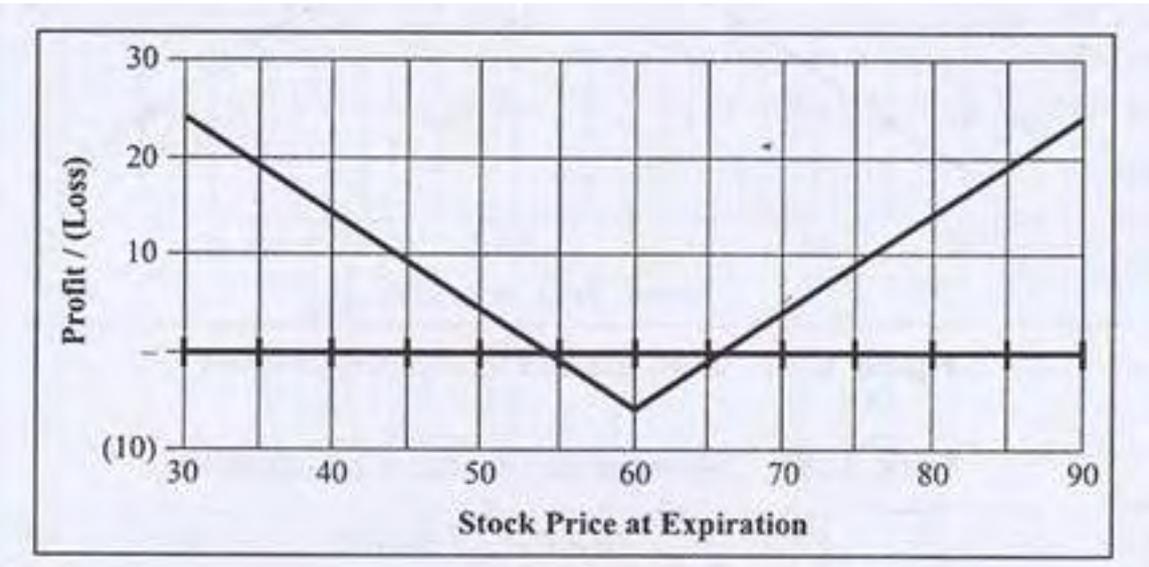
The total premium paid by the straddle buyer is ₹ 5.96. Hence the lower BEP is $60 - 5.96 = 54.04$ and the upper BEP is $60 + 5.96 = 65.96$. This implies that the trade will be

profitable if the price of the stock moves outside this range. So, the straddle buyer will be benefitted even if the stock moves up or down but it should move significantly beyond the breakeven points. He will be incurring losses if the stock remains range-bound and moves in the range depicted between the lower and upper BEPs. The greeks for the long straddle are given in Table.

Option Greeks for the long straddle

	Price	Delta	Gamma	Theta	Vega
Long call option	-2.81	0.513	0.053	-0.02	0.117
Long put option	-3.15	-0.505	0.057	-0.013	0.117
Net	-5.96	0.008	0.110	-0.033	0.234

The delta of straddles can be insignificantly positive, negative or zero. Here the delta is slightly positive at 0.008 but for all practical purposes this value is insignificant. In general, if the delta is near 0.01, the position can be considered as delta neutral. Since long straddle involves buying options, the gamma is almost doubled. Similar to delta, the gamma of the straddle depends on where the stock price is compared to the strike price. The gamma of a straddle is highest when it is made from ATM options because gamma for an option is highest when the stock price is equal to the strike price. A positive gamma signifies that the straddle buyer wants the stock price to change significantly. The higher the positive gamma, the more positive delta will become as the stock price surges up, on the contrary more negative delta will be as the stock price falls. As the stock price moves away from the strike price of the straddle, gamma starts to decrease. When the stock price moves, the options become either ITM or OTM, and their gamma drops accordingly.

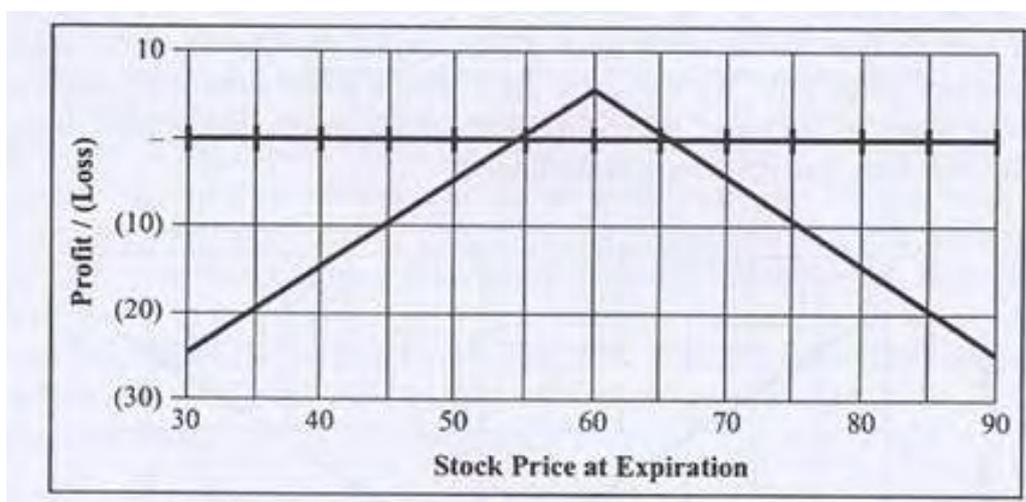


Long straddle profit/(loss) diagram

Similarly, the Vega of the position is doubled and, positive stands at 0.234 i.e., if the volatility of the underlying stock changes by 1%, the position will profit by ₹ 0.234. Assume that the implied volatility increases to 45% after initiating the position. Then the position will gain in value by an amount of $20\% \times 0.234 = ₹ 4.68$ for each straddle. This is almost equal to the initial premium paid by the straddle owner. So, straddle buyers look for such a kind of volatility changes.

So far so good, all the greeks are working for the straddle buyer except one - theta. The net theta is negative at 0.033. This is not unusual because the straddle buyer is long in two options. So theta will also double up and is slowly eating into the initial investment. Since the position loses due to time decay and theta is highest for options that are near to expiration, few traders afford to maintain/hold straddles for long periods or till expiration. By and large investors hold straddles for a short time period and close out the position as soon as volatility changes. A straddle is an effective strategy particularly before important economic events like budgets or any company-specific events (like a judgment in a court case) that may have either a highly favourable/unfavourable impact on the price of the underlying stock but the investor is unsure of the direction. Unfortunately if nothing happens and if the volatility and the underlying stock price remain stable, the trader has to unwind his position before being ruined by time decay.

With a short straddle, the seller expects just the opposite of the buyer - the volatility will come down in future. A short straddle comprises simultaneous selling of a call option and a put option. If the strike prices are close to the market price, then the net delta will be close to zero. Hence the writer's exposure to the underlying market is negligible or neutral. The position will be most profitable when the stock finishes at the strike price and both options expire worthless. The profit/loss diagram for a short straddle is depicted in Figure along with the greeks in Table which are exactly opposite in sign to that of a long straddle.



Short straddle profit / (loss) diagram

Option Greeks for the short straddle

	Price	Delta	Gamma	Theta	Vega
Short call option	2.81	-0.513	-0.053	0.02	-0.117
Short put option	3.15	0.505	-0.057	0.013	-0.117
Net	5.96	-0.008	-0.110	0.033	-0.234

It is very much evident that writing straddles is very risky since the upside is limited only to the amount of premium collected from the two options but the downside is unlimited and the risks are substantial if a large price move occurs. The theoretical price of the spread is ₹ 5.96 that will be received by the seller. The delta is slightly negative, which can be considered as neutral. Since two options were sold, gamma is negative and this means that if extreme movements occur in the price of the underlying, the position will experience grave losses in both the directions. Like the gamma, the vega for the short straddle is also doubly negative. If the volatility rises from 25% to 26%, the straddle's price rises to ₹ 6.19 and this is the price the seller has to pay to close his position and in the process he will incur a loss of ₹ 0.234 per straddle.

The theta for the options stands at 0.033 and is positive. Hence among all the greeks only theta works for the straddle seller and he gains from time decay and this time decay will increase as time passes by. The heaviest decay is experienced by the straddle near expiration. Hence many traders may be interested in writing straddles that are near to expiry. However, they will be wary of gamma as it will be highest for options that are closer to maturity. Short straddles may be suitable strategies particularly when the volatilities are near the historic high levels.

Strangles

Strangle is another combination to trade volatility and is very much similar to a straddle but the virtue of a strangle is that it costs far less than a straddle. In a strangle, the two options have different strike prices and are normally OTM options. Since the options are out-of-the-money, they cost less while a straddle is constructed usually with ATM options that have the highest time value.

Therefore, a long strangle involves:

- (i) An OTM long call option
- (ii) An OTM long put option

A strangle comprises a long position in a call as well as in a put option. The strike price of the put option will be less than that of a call option's strike price and they will have the same expiry date, i.e., both of them are OTM and the farther they are from the current market price, the cheaper the strangle will be.

Consider the following example wherein a strangle is established with the following information:

Stock price	60
Time to expiry	90 days
Volatility	25%
Interest rate	5%
Call option X = 65	1.42
Put option X = 55	0.87

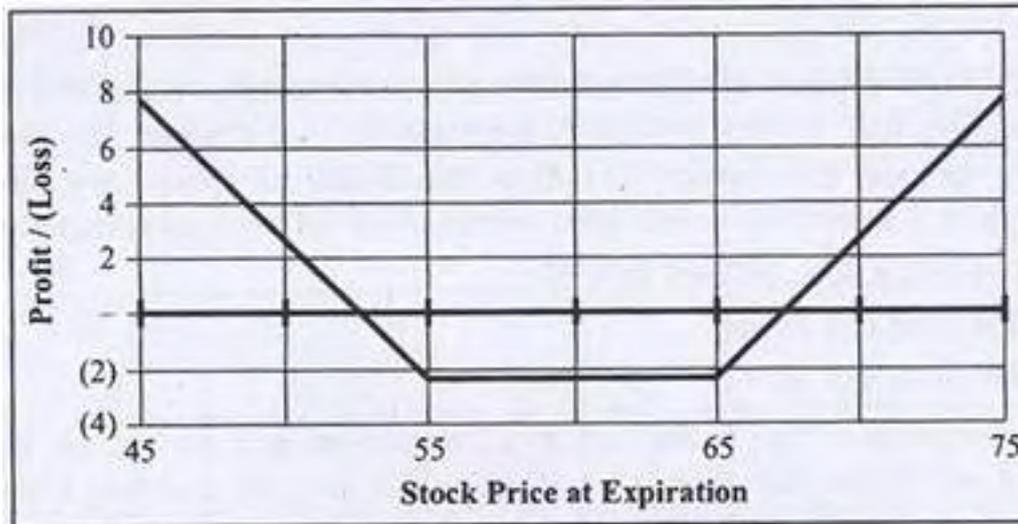
The total premium paid in this case is ₹ 2.29 and this is the maximum loss that will be incurred by the buyer in the worst case while the profits are unlimited beyond the breakeven points on either side, i.e., whether the stock moves up or down which can be noted from Figure. This is one reason why these spreads are termed as straddles and strangles as these positions profit on both sides. Long straddles and strangles make money if the stock price moves up or down significantly. A strangle buyer expects the volatility to go up and he will start gaining if the price of the underlying stock goes beyond the upper BEP or falls below the lower breakeven point. Even if the underlying does not move and the volatility increases, then also he will be gaining. The maximum loss is incurred when the price of the stock is in the range of strike price \pm total premium paid.

Option Greeks for the long strangle

	Price	Delta	Gamma	Theta	Vega
Long call option X = 65	-1.42	0.323	0.047	-0.017	0.106
Long put option X = 55	-0.87	-0.205	0.038	-0.01	0.082
Net	-2.29	0.118	0.085	-0.027	0.188

To understand more about the strategy let us make use of the greeks given in

The net delta is positive at 0.118 and this exposes the buyer to the underlying market to the extent of 11.8%. If the trader wants exposure only to the volatility, then he can choose the calls and puts in such a way that delta can be made negligible.



Long strangle profit/(loss) diagram

The gamma for the position is positive since both options were purchased and is equal to 0.085. This implies that extreme price movements will benefit the buyer in both directions. The vega for the combination is 0.188. This implies that the strangle buyer will gain if implied volatility increases. Lastly, theta for the strangle is negative at 0.027 and this is of concern for the buyer since if nothing changes and the market is stable, the strangle buyer will be losing everyday due to time decay.

Hence many traders will take them off within a short period of time after initiating the position but strangles can be held for a little longer than straddles as theta is less than that of straddles.

The seller of a strangle is betting that volatility will be low and it is a preferred way to sell volatility since the position remains delta-neutral over a wide range of prices. In a short strangle, the investor simultaneously sells OTM call and put options on the same underlying stock with the same expiry date. The maximum gain is the total premium received which happens when the stock closes between the strike prices. But beyond the breakeven points, losses are unlimited.

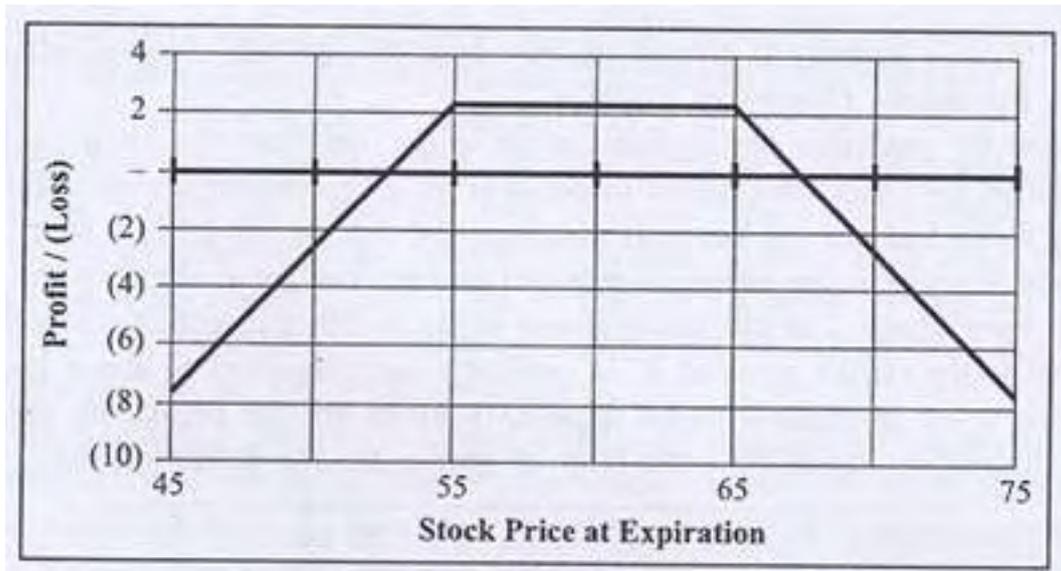
The short strangle benefits from two sources:

- Fall in volatility of the underlying and/or
- Time decay due to passage of time

The consequences will become much more clearer if we look at the greeks along with the profit/loss diagram given in Table and in Figure respectively.

Option Greeks for the short strangle

	Price	Delta	Gamma	Theta	Vega
Long call option X = 65	1.42	-0.323	-0.047	0.017	-0.106
Long put option X = 55	0.87	0.205	-0.038	0.01	-0.082
Net	2.29	-0.118	-0.085	0.027	-0.188



Short strangle profit/(loss) diagram

As can be observed, a short strangle is a risky strategy as the losses are unlimited on either side but the gains are at best equal to the premiums received from both the options sold. Though the delta is positive, it can be forced to zero if desired. The gamma is negative and this indicates that as the price volatility increases, the position will incur losses on either side. The strangle seller has a negative vega position. Hence if implied volatility is muted, the seller will benefit. Finally, the seller will be benefitting from a positive theta even if all other things remain unchanged.

Butterfly

The best way to sell volatility is to sell an option but when we sell an option, we inherently assume a position in the underlying market also. Hence a pure volatility trader may wish to be neutral to the market and would like to have a position that reflects his view on volatility alone. This is possible with the help of strategies discussed above, viz., straddles and strangles. But these strategies are very risky, particularly for selling volatility. It is very clear from the profit/ loss diagrams that beyond the breakeven points, the losses are unlimited on both sides and for comprehending this, one need not actually dip into the greeks. Using options skillfully we can reduce these unlimited losses in short straddles and

strangles too. For instance, if a trader is having a bearish view on the volatility and he is assuming a short straddle to gain from his view and he is also concerned about the losses, he can actually pare down these losses by buying two out of the money options (a call and a put option) as some sort of protection on either side of the breakeven points. But this comfort is achieved at the cost of sacrificing some of the potential profit.

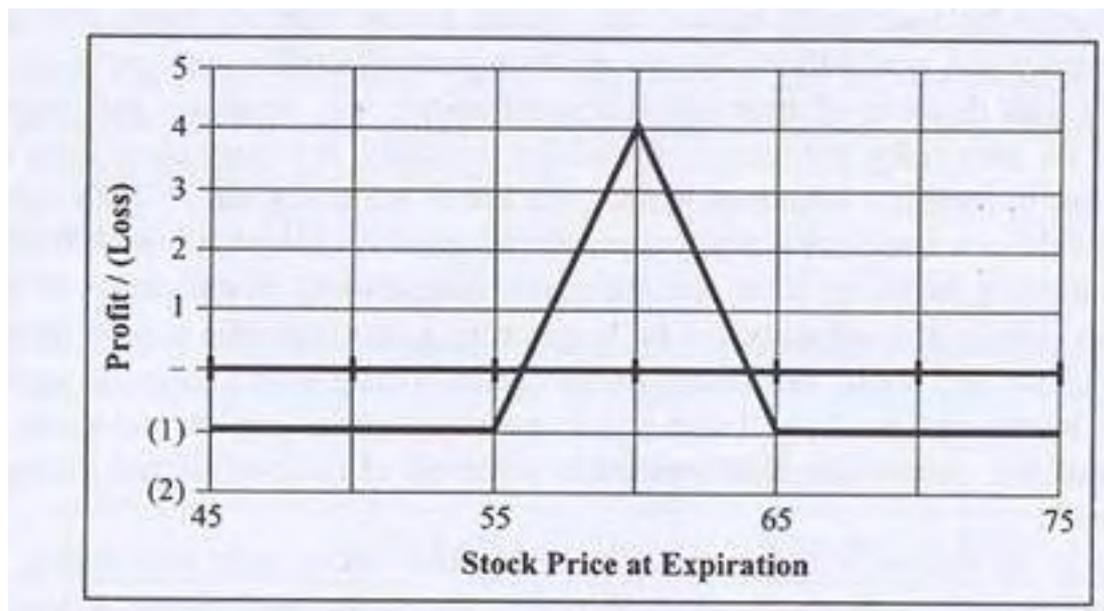
A butterfly is an options strategy using multiple puts and/or calls speculating on future volatility without having to guess in which direction the market will move. A long butterfly comprises three types of either puts or calls having the same expiration date but different exercise prices (strikes). For example, with the underlying asset trading at ₹ 100, a long butterfly strategy can be built by buying puts (or calls) at ₹ 95 and ₹ 105, and selling (shorting) twice as many puts (or calls) at ₹ 100. A long butterfly can also be created by selling a Put and a call that are ATM and buying a put at the lowest strike and a call at the highest strike. Such a strategy is termed as iron butterfly, probably named after the popular rock group of the sixties (Tompkins (1994)).

A long butterfly generates profits that are far lesser than that of a short straddle. So, this is meant for those investors who intend to profit from a forecast of a range-bound trading of the underlying stock and are not keen on assuming the risks involved in a short straddle. The maximum profit is equal to the premium received and the real gains occur in the last few days to expiry from time decay. The maximum losses occur in either direction when the stock ends at a price equal to the (strike price of ATM options - net premium) or above the (strike price of ATM options + net premium). Infact these two points are the breakeven points. To make sense of this discussion, let us take the help of Greeks for the following data:

Stock price	60	55 put	1.78
Time to expiry	90 days	60 call	4.51
Volatility	25%	60 put	3.84
Interest rate	5%	65 call	2.53

Option Greeks for the long butterfly

	Price	Delta	Gamma	Theta	Vega
Long 55 put	-1.78	-0.264	0.031	-0.017	0.096
Short 60 call	4.51	-0.565	-0.037	0.027	-0.117
Short 60 put	3.84	0.445	-0.038	0.02	-0.117
Long 65 call	-2.53	0.389	0.036	-0.025	0.114
Net	4.04	0.005	-0.008	0.005	-0.024



Long butterfly profit/(loss) diagram

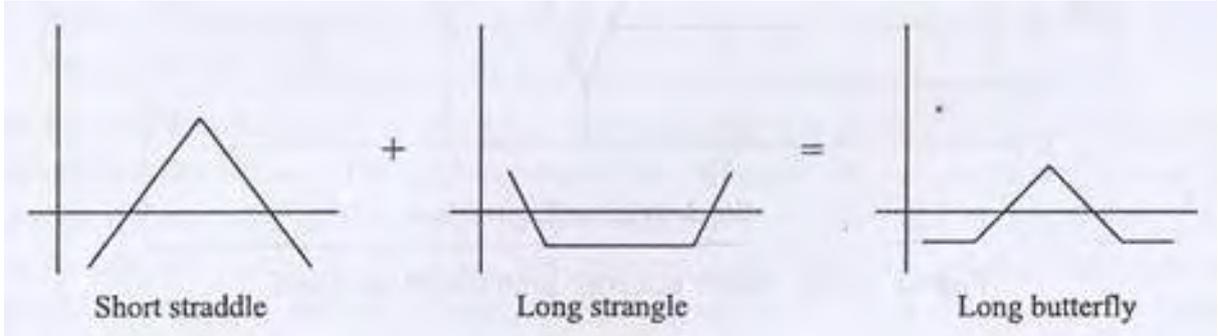
Long butterfly is an interesting strategy in that it is generally a short volatility strategy though this is a long position. The strategy diagram in Figure shows very clearly that losses are limited on both side and so are the profits. From the greeks in Table it can be noted that the delta of the position is positive but very insignificant in magnitude. Hence for a small change in the underlying, the position is unaffected. Just as with the premium, the delta of a long butterfly is also interesting - delta is positive when the stock price is below the middle strike of the butterfly, neutral when the stock price is at the middle strike and negative when it is above the middle strike. Hence in this example the delta is almost zero since the current price of the stock is equal to that of the mid strike (straddle's strike price). Therefore, the butterfly maximizes its value when the price of the stock is at the middle strike and if the price of the stock is below the middle strike, it has to rise for the butterfly to make money; hence the positive deltas. But if the price of the stock is above the middle strike, it has to fall for the butterfly to make money; so the deltas are negative.

The position is having a positive theta and a negative vega. Therefore, a long butterfly will profit from time decay. If the underlying is near about ₹ 60, the profits are maximum and will accelerate most rapidly in the last few days before expiry. For instance, net theta before three days is 0.259. It is important to note that theta will be positive when the price of the stock is at the middle strike, indicating that elapsing time helps the long butterfly realize its maximum benefit and at the outer strikes theta is negative, indicating that the butterfly is losing value as time passes.

However, the position is vega negative. Hence any increase in implied volatility will be unfavorable. The impact is felt more on the two ATM options than those that are OTM.

The extent of losses will depend to a large extent on the amount of time to expiry and how near is the price of the underlying to the exercise price. When the underlying's price is at the middle strike, the vega of the long butterfly is negative, meaning that any rise in the implied volatility will be a losing proposition. This is intuitively appealing since a butterfly's value depends on the likelihood that the stock price will be at its middle strike at expiration and higher volatility decreases the possibility of the stock remaining at the middle strike price. As a result, the butterfly will lose out when implied volatility rises. Considering the vega, a long butterfly will be initiated by a trader when the implied volatility is near to historic highs. Finally, looking at the butterfly's structure it can be understood that a butterfly is nothing but a combination of

- Short straddle + Long strangle, or
- Bear call spread + Bull put spread



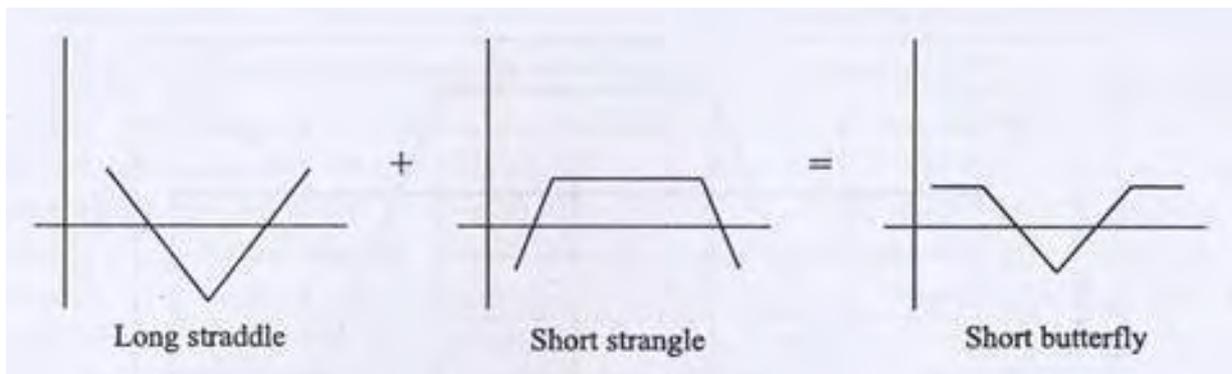
Long butterfly = Short straddle + Long Strangle

A short butterfly strategy is just the opposite. It is a limited-risk, limited-gain strategy to translate a bullish view (betting on an increase in) on the volatility of the underlying. A short butterfly is established by buying a put and a call that are ATM and selling a put and a call that are OTM. By buying the ATM options and selling OTM options, the position has its greatest loss when the underlying does not move, and gains are maximized when the underlying moves beyond either of the outside exercise prices. Therefore, a short butterfly strategy profits as equally from a large move up as it does from a large move down. The profit/loss diagram for a short butterfly with the following data is depicted by Figure

Stock price	60
Time to expiry	90 days
Volatility	25%
Interest rate	5%
55 put	1.78

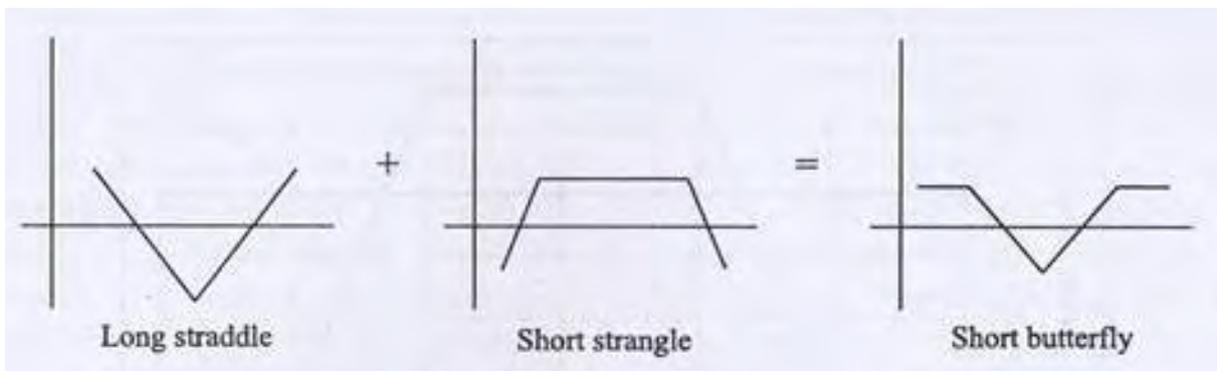
60 call	4.51
60 put	3.84
6	
5 call	2.53

The short butterfly is established by going long in the 60 ATM call and put options while selling the 55 put and 65 call OTM options. Short butterfly can also be constructed using only call options or only put options. These strategies are termed as regular butterflies. A regular call butterfly involves a long position in two ATM 60 call options and a short position in one 55 call and a 65 call option. Similarly, the regular butterfly from only put options include long position in two ATM 60 puts and a short position in one 55 put (OTM) and one 65 put which is an ITM put option. The profit/loss diagrams of regular butterflies will be the same as that of iron butterflies and is shown in Figure.



Short butterfly profit/(loss) diagram

A short butterfly can also be visualized as a combination of short strangles and a short straddle. This will become obvious if we juxtapose the profit/loss diagrams of these two strategies and compare it with the diagram of short butterfly. Figure shows the same.



Short butterfly = Long straddle + Short strangle

Condors

A condor is nothing but a modified butterfly. The major difference between a butterfly and a condor is that while the butterfly's body (the trapezoidal shape of the option profit/loss diagram shown in Figure) consists of buying two units of ATM options, the condor's body uses separate strikes and is therefore wider. This means that it has a wider area in which its body produces a profit.

Therefore, by using a condor rather than a butterfly, the range in which the maximum profit can be realized is stretched out and in the process, the breakeven points also get extended

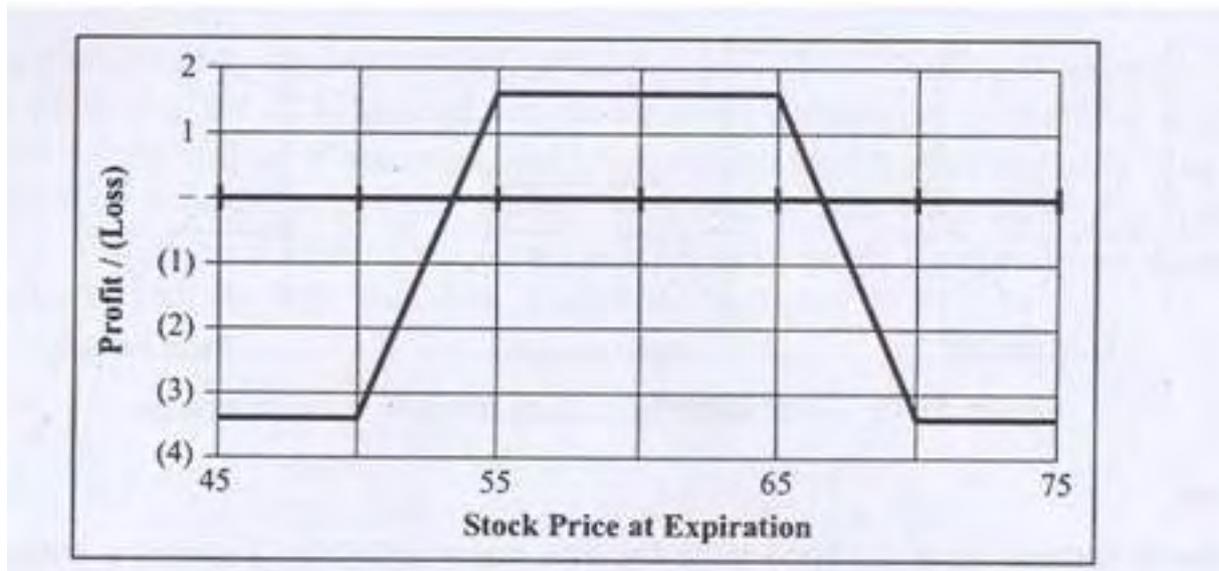
Stock price	60
Time to expiry	90 days
Volatility	25%
Interest rate	5%
50 put	0.261
55 put	0.875
65 call	1.42
70 call	0.33

A long condor is established by:

- Selling 55 put option
- Selling 65 call option
- Buying 50 put option
- Buying 70 call option

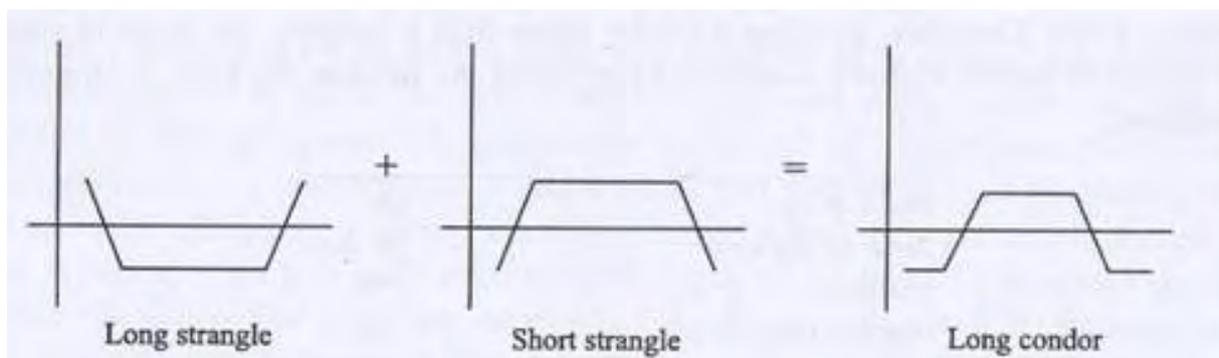
The two options that make up the body of the condor are the first OTM call and first OTM put options instead of the ATM options while the wings of the condor are made up of deep OTM options.

However, in the case of a butterfly, the options used to insure are just OTM options. As can be noted, the two long positions will give rise to a long strangle and the two short positions will give rise to a short strangle. In other words, a condor can be understood as the combination of a long strangle plus a short strangle shown in Figure.



Long condor profit/(loss diagram)

Long condor = long strangle + short strangle



	Price	Delta	Gamma	Theta	Vega
Buy 50 put	-0.17	-0.057	0.015	-0.004	0.031
Sell 55 put	0.875	0.205	-0.038	0.01	-0.082
Sell 65 call	1.42	-0.323	-0.047	0.017	-0.106
Buy 70 call	-0.495	0.149	0.03	-0.009	0.066
Net	1.63	-0.026	-0.04	0.014	-0.091

From Table one can note that the long condor involves a cash inflow of ₹ 1.63 per condor which is the maximum profit and occurs when the stock ends up between ₹ 55 and ₹ 65. The position suffers the maximum loss when the stock is at or below ₹ 50 and at or above ₹ 70. At ₹ 50, all the options excepting the 55 put will expire worthless and since this option is written by the condor owner, he has to buy the stock at ₹ 55 when the spot market

price is ₹ 50. In the bargain he will be losing ₹ 5 but since he received ₹ 1.63 as the premium, his net loss will equal ₹ 3.37 ($-5 + 1.63 = ₹ -3.37$). Similarly, if the stock ends up at ₹ 70, all the options will be allowed to lapse except the 65 call which was sold.

The condor buyer will be assigned this option and he has to deliver the underlying at ₹ 65 when the going price is ₹ 70, resulting in a loss of ₹ 5. But since he received ₹ 1.63 as premium, his losses will be pared to ₹ 3.37 ($-5 + 1.63 = ₹ -3.37$). The breakeven point on the lower side is at ₹ 53.37 ($55 - 1.63 = ₹ 53.37$) and ₹ 66.63 ($65 + 1.63 = ₹ 66.63$) on the other side.

In essence, a condor buyer expects that stock prices remain range-bound more clearly between the strikes of the short strangle. i.e., ₹ 55 and ₹ 65 since only in this area his profits are maximum. But if the stock ends up outside this range, it is certain that one of the options will be in-the-money and he will start losing money beyond the breakeven points.

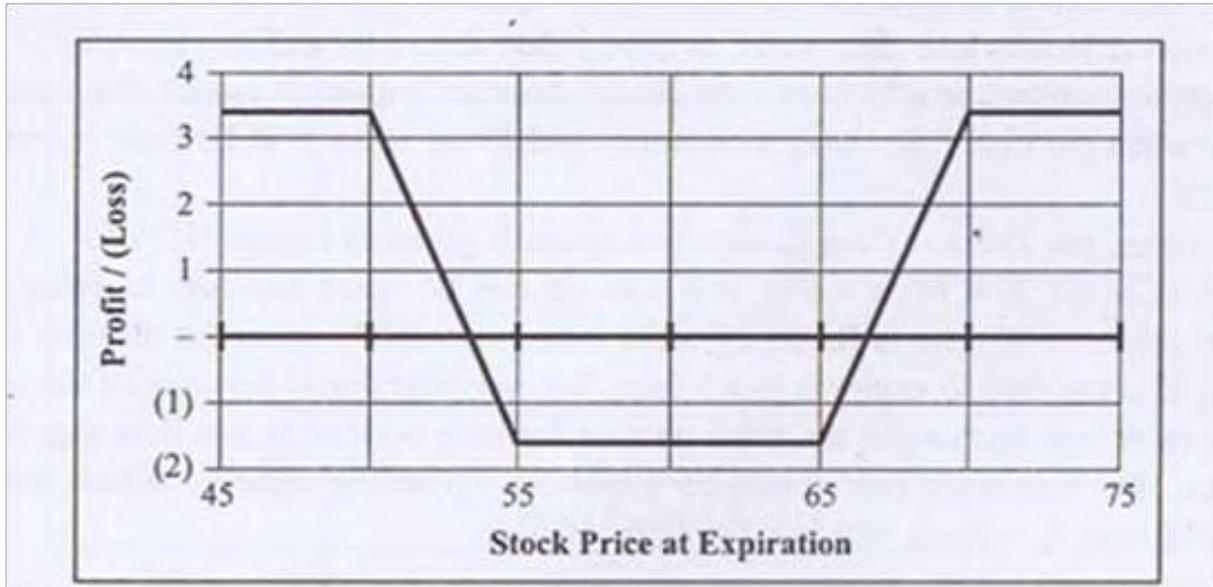
Table presents the Greeks and the net delta of the position is almost negligible but the gamma is almost five times that of a butterfly, which makes the condor more sensitive to price swings.

Since the position involves selling less OTM options, and buying deep OTM options, the position will be benefited if implied volatility decreases and the benefits are more than that for a butterfly since the vega is more negative for condor than for a butterfly. In addition to this, the position will benefit from positive theta and theta benefits will increase as the spread's expiry date nears by. However, the profits are generally low since it involves selling OTM options that are traded at low prices.

A short condor involves the following:

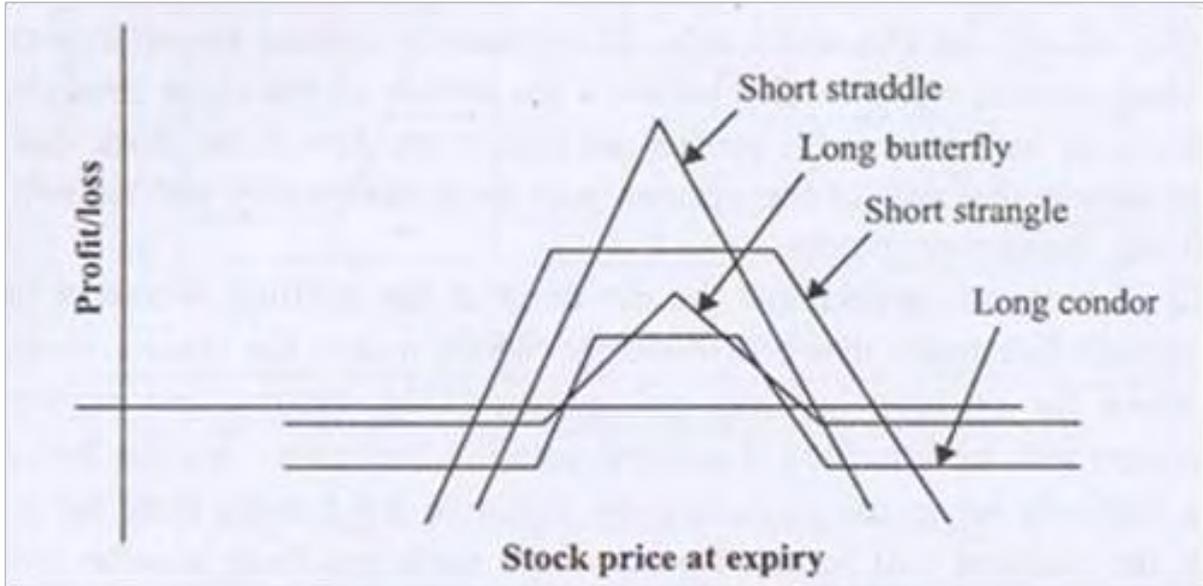
- Buying 55 put option
- Buying 65 call option
- Selling 50 put option
- Selling 70 call option

The profit/loss diagram is as shown in Figure, with the maximum loss being limited to the premium paid while the profits are also limited on either side equaling to ₹ 3.37 when the stock ends up at or falls below ₹ 50 and at or over ₹ 70, i.e, the strike prices of the sold options become a key reference point from where profits will be maximum. Therefore, the seller will make money if there is a drastic fall or rise in the stock price.



Short condor profit/(loss) diagram

Since we have seen almost all of the important volatility strategies, let us try to compare each of them against the profits and risks involved with them. To facilitate our analysis, let us bring all the profit/loss diagrams together:



Comparison of volatility strategies

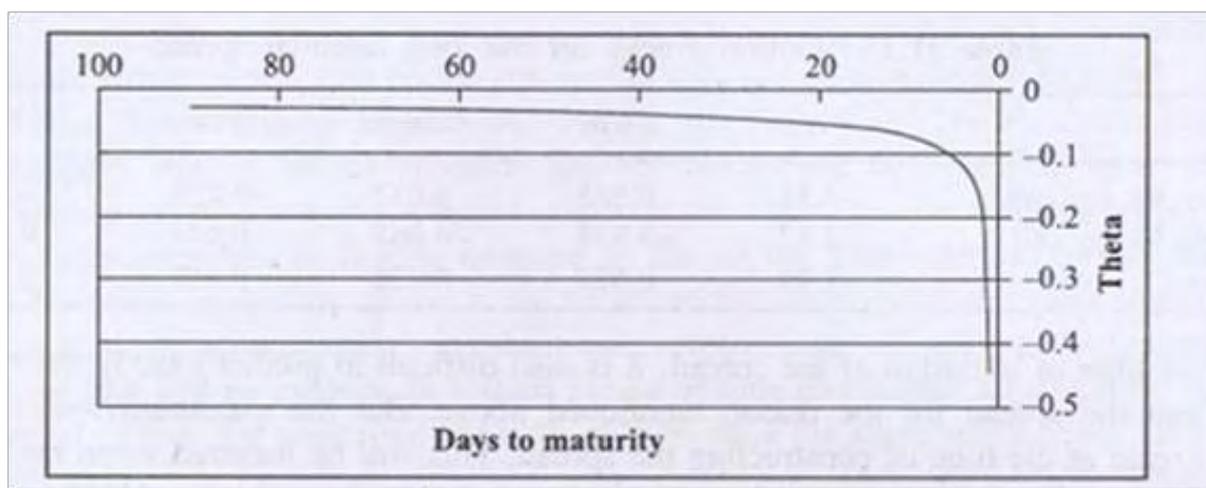
It is clear that the straddles are most rewarding strategies for trading volatility, followed by strangles, butterflies and then condors. The higher profits with straddles are associated with higher risks also and theoretically the risks are unlimited for straddles and strangles. In fact with strangles, the profitable zone was extended but the probability of higher losses is also increased. While butterflies cut down the unlimited losses, they also

reduce the potential profits. And finally, the condor is a low-risk and low-profit strategy. Similar inferences can also be drawn for volatility buying strategies too.

Horizontal Spreads

These spreads allow investors to gain from the time decay of options with minimal risks. These spreads are also termed as calendar spreads or time spreads. To fix our thoughts we know that all long option contracts lose their value as expiry date draws by and this is captured by theta. Similarly, option writers benefit from time decay. Another important aspect about theta is that it is higher when the option is closer to maturity and lower when it is far from maturity.

For instance, the Theta - Time to expiry diagram is given in Figure for an ATM call option with (S 60, X = 60, r = 5%, $\sigma = 35\%$) it can be noted that loss of value when the option is to expire in 90 days is ₹ 0.027 while it becomes 0.037 when the maturity is 45 days and it is 0.105 if the time to expiry is just 5 days. We can infer that if the price of the underlying remains more or less unchanged the price decline for long options is less than that for a short dated option. So it appears that it will be profitable by selling options, which are close to maturity, and buying options that are far from maturity.

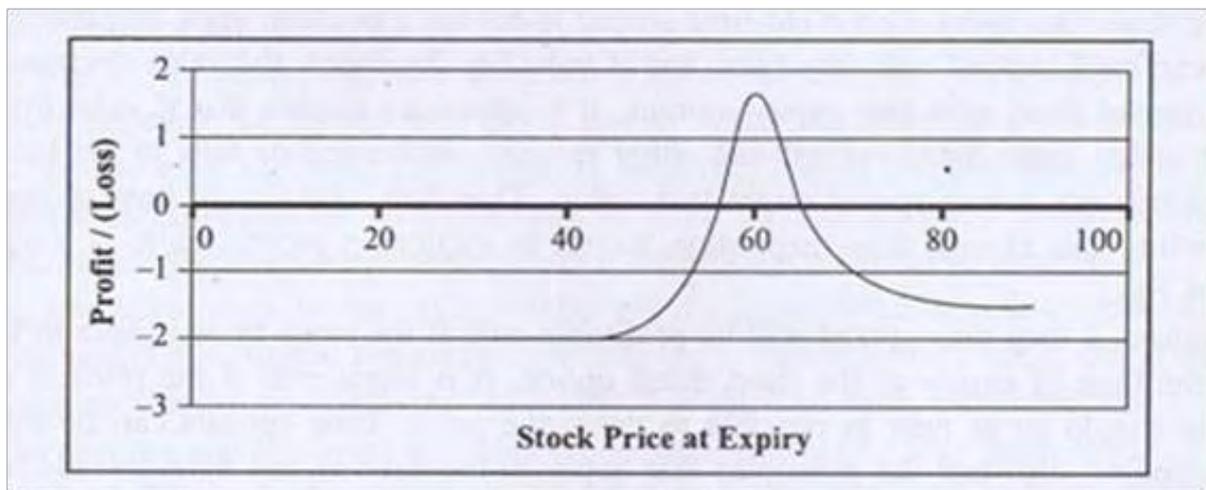


Theta vs time to expiry

Long time spreads or long calendar spreads use the same principle - write an option that is expiring in a short period of time, simultaneously buying an option with the same exercise price and with a life that is longer than the option written. In a neutral market, i.e., when the market is moving in a narrow range, time spreads will be a good strategy to make money without the risk of naked sold position. Assume we established a long calendar spread with the following options:

Stock price	60
Volatility	35%
Interest rate	5%
Long 60 call option	90 days to expiry
Short 60 call option	30 days to expiry

We will understand the time spread with the help of profit/loss diagram and greeks. As the time spread involves two expiry months, it is not possible to construct an accurate profit/loss profile at the expiry of the written option. At the time of initiation, the value of the purchased option, as at expiry of the sold option, can only be estimated using BSOPM or similar such pricing models.



Long calendar spread

Option Greeks for the long calendar spread

	Price	Delta	Gamma	Theta	Vega
Buy 90 day call	-4.51	0.565	0.037	-0.027	0.117
Sell 30 day call	2.52	-0.538	-0.065	0.044	-0.068
Net	-1.99	0.027	-0.028	0.017	0.049

At the time of initiation of the spread, it is also difficult to predict exactly the maximum profit from the spread for the reason mentioned above. But the maximum loss is the net premium paid at the time of constructing the spread. This will be incurred when the long call has little time value at expiry, i.e., when the stock has risen/fallen very sharply. The spread has two breakeven points - one point is to the left of the strike price and the other to the right of the strike price. If the stock moves significantly, the spread will lose money.

The profit will be maximum when the stock price remains more or less unchanged from the strike price till expiry of the short-dated call. Then the written call will not be exercised and the buyer will capture fully the time value of the sold call option. Generally there is a misconception with time spreads, i.e., some investors think that the long call option's value will remain unchanged but it is not so. Infact what happens is that the value of the long call will depreciate at a lower rate than the theta gains of the written option Figure presents the profit/loss diagram.

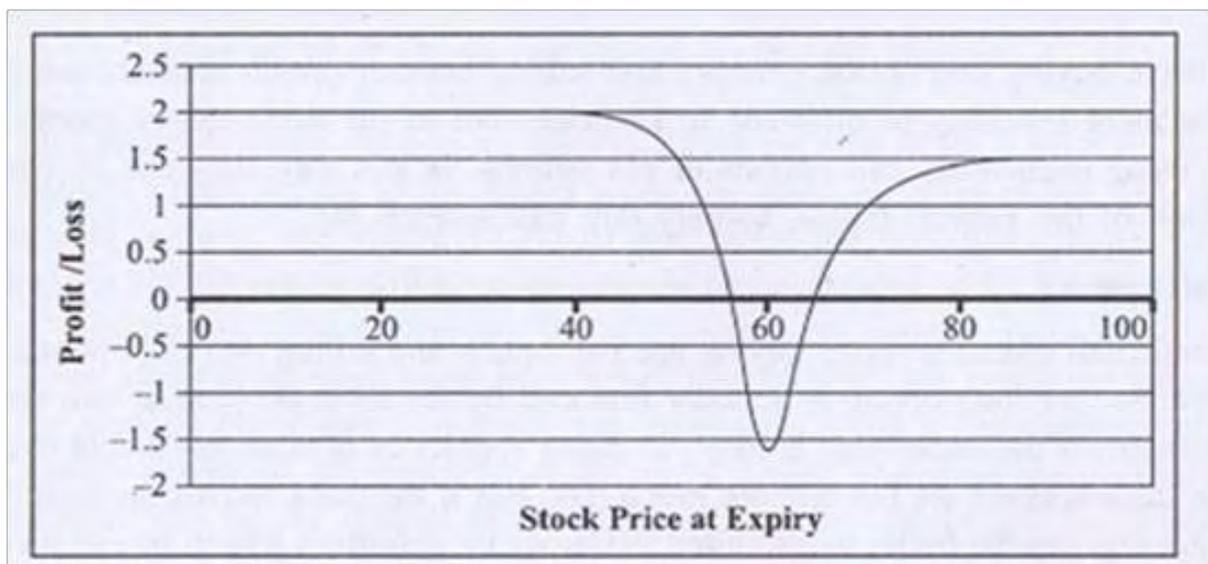
From Table we can note that the delta of the spread is negligibly negative at 0.027. This is because the spread involves two ATM call options and for ATM options, deltas are around 0.5. However, since one option is long and the other is short to a large extent, the deltas are offsetting each other. Therefore, the net delta is almost zero and the spread can be construed as almost delta-neutral. If the stock price is less than the exercise price, the spread will have positive deltas and when the stock price is greater than the exercise price, the spread delta will be negative (to be profitable, the stock price has to come down near to its strike price). The gamma of the spread is negative and this means the spread will be a losing proposition for price swings in either direction.

Since the theta is positive, the spread gains from passage of time. The positive theta indicates that this ATM time spread will benefit if the stock stays where it is (equal to the strike price) and time flies away. This ATM time spread is having a positive vega, signifying that the spread benefits if implied volatility rises, and if volatility decreases, the value decreases. Since the time spread deals with two expiry months, it is important to note that if volatility rises in the short option (near dated option) and either remains unchanged or falls in the long option (far dated option), a time spread might lose value. Therefore, one should have a fair idea of how volatility can change from expiration month to expiration month, as it is a significant source of risk.

Therefore, a long time spread will be profitable only if the stock price is near to the strike price at the time of expiry of the short dated option. It is immaterial if the price is above or below but should be as near as possible to the strike price. Time spreads can be established with put option; also and the principles that apply in the case of call time spreads hold here also. A time spread made up of put options, the investor will buy the long dated put option and write a short dated put option. Both options have the same strike price. Since the put prices are generally lower than the call option prices, it may appear a bit inexpensive to buy put spreads. However, the percentage returns are not as attractive as that of call time spreads since at the time of expiry of the sold option the spread may not be as valuable as a call spread. In this case also, the profit/loss diagram will have a similar profile. The maximum risk is the amount he pays initially, as the premium and the spread will be

beneficial when the stock remains unchanged or above the exercise price till the expiry of the written option.

Short calendar spread is exactly opposite to that of the long calendar spread. Instead of buying a far dated option, the option is sold and another option with the same exercise price but of near maturity is purchased. So, a short time spread using call options involve purchasing a call option that will be expiring in a short period of time and selling a call option that has a longer period of time for expiration but both of them have the same strike price. Through this spread, one expects to gain from a decline in the underlying stock price before the expiration of the sold call option. Actually the near term call option that is purchased will protect the trader from any price rises over the short term. The profit loss diagram for a short time spread is shown in Figure.



Short time spread

When the spread is established, there is a cash inflow of ₹ 1.99 and the delta of the spread is slightly negative at 0.027 shown in Table. But as discussed earlier, the delta value is dependent on, where the stock price is relative to the strike price. Since the spread involves two ATM calls (in opposite directions), the delta is almost zero. Gamma of the spread is positive, meaning the spread will make money when the underlying stock price changes steeply. The theta for the short call spread is negative. This is because the spread includes a long position in an option which will expire in a few days of time and for such options theta is highest. Hence the seller loses money even if the stock price remains unchanged. The spread is having a negative Vega. So the seller will benefit if implied volatility reduces after the position is initiated and if the implied volatility increases, the spread will start losing out. Time spreads also reveal another interesting aspect probably. For the first time, we came across a position where the gamma and the vega are working to each other, i.e., they

have opposite signs for long and short time spreads whereas in all other strategies that were discussed thus far have these two working together i.e., have the same sign.

Option Greeks for the Short calendar spread

	Price	Delta	Gamma	Theta	Vega
Sell 90 day call	4.51	-0.565	-0.037	0.027	-0.117
Buy 30 day call	-2.52	0.538	0.065	-0.044	0.068
Net	1.99	-0.027	0.028	-0.017	-0.049

Other Important Strategies

We will see some more volatility strategies that are popular with traders but the main feature of these strategies is that their profit/loss profiles that are not symmetrical. Unlike the strategies we have already considered viz., straddles, butterflies.

Ratio and Back Spreads

These involve buying one option contract and selling another option contract but of different features or more precisely of different strike prices but of the same expiry month. They can be set up using exclusively call options or put options. In this way, they can be considered as an extension of the vertical trades, namely bull call spreads etc.

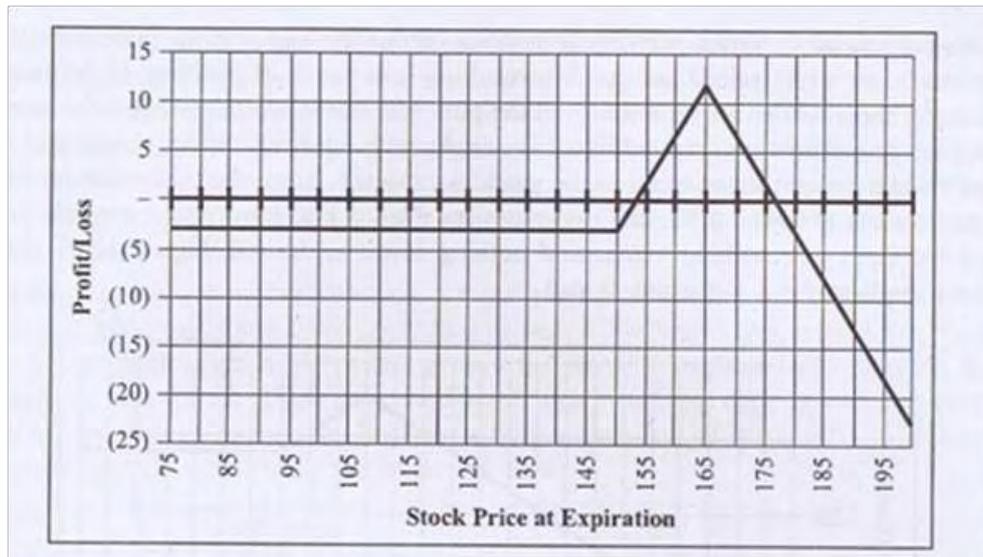
Ratio Call Spread

A 1 by 2 ratio call spread involves buying one call option and selling two call options at a higher strike price. So, the long option is actually financed by the short position in two options. This strategy benefits if the underlying is likely to move slightly or is relatively stable over the short term; then these spreads are not without much risk. But if the stock moves up sharply, the extra short option exposes the trader to unlimited risk since by definition a ratio spread involves shorter than long options. Let us see this more closely with the help of an example

Stock price	155
Time to expiry	90 days
Volatility	23%
Interest rate	6%
150 call	₹ 11.12
165 call	₹ 4.08

Option Greeks for the ratio call spread

	Price	Delta	Gamma	Theta	Vega
Buy 1 150 call	-11.12	0.68	0.02	-0.051	0.274
Sell 2 165 calls	8.16	-0.74	-0.042	0.092	-0.576
Net	-2.96	-0.06	-0.022	. 0.041	-0.3020



Ratio call spread profit/ (loss) diagram

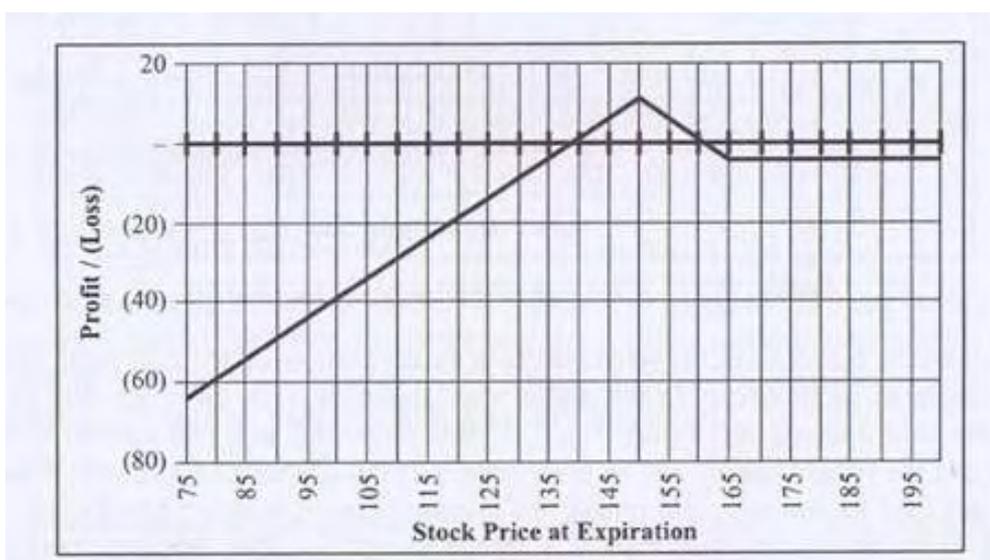
At the time of establishing the spread, there is a cash outflow of ₹ 2.96 from Table and the maximum profit occurs to the trader when the stock ends up at ₹ 165 (the strike price of the sold options) see Figure. At this price, the sold call options will not be exercised and the bought option will be in-the-money by an amount of ₹ 15.00. If we deduct the premium paid for initiating the spread, the maximum profit works out to ₹ 15 - 2.96 = ₹ 12.04. If the stock price falls, there is a limited loss of ₹ 2.96, being the premium paid to initiate the spread. There are two breakeven points, i.e., 165 ± maximum profit. If the underling's price moves up, the trader faces unlimited losses. The more the number of naked options, the larger will be the amount of losses. Therefore, the spread will be profitable only if the stock is expected to move slightly but if a strong upward move is expected, the trader may incur serious losses.

The delta of the spread is slightly negative at 0.06, but is of no concern since it is negligibly low. So the position can be construed as delta neutral. This call viewed from another perspective also - buying a 150 call and selling a 165 call is nothing but a 150/165 bull call spread which has bullish bias. To this we added a short 165 call which has a bearish bias neutralizing the bullish view of the bull call spread. Therefore, the resultant spread will

be neutral to the market direction. The spread is having a negative gamma and it indicates that delta will move to hurt the trader when stock price moves up or down. For instance, when the stock price moves up by ₹ 2, the short calls will lose ₹ 2.96 while the long call will gain only ₹ 1.36, resulting in a loss of ₹ 1.60. And if the stock price falls, the trader will neither be gaining nor losing as his losses in the event of stock decline are capped at ₹ 2.96. The spread is having a negative Vega. Therefore, the spreader would like the implied volatility to stay still or to decline and if implied volatility increases, the spread will lose out at the rate of ₹ 0.302 per 1% increase in implied volatility. As with all the volatility selling strategies, this will be beneficial when the volatility is at historic highs. The trader will also benefit from time decay since the theta is positive for the ratio call spread but it has to be noted that the more closer the current price of the stock to the short's strike price, the less will be the theta value and hence lower will be the time decay gains.

Ratio Put Spread

A ratio put spread involves buying the higher strike price put option and selling two lower strikes priced put options, resulting in a net short position. If the stock price rises sharply, there will be less risk since all the puts will expire worthless but if the stock price declines, the spread will result in unlimited losses. As with ratio call spread, this spread is likely to benefit when a slight down trend in the stock is expected. Since the maximum profit occurs when the stock is at lower strike, the trader desires the stock to move more towards the strike price of the short put; nothing higher and nothing lower is desired. Figure shows the profit/loss diagram for a Ratio put spread.



Ratio put spread profit/(loss) diagram

Option Greeks for the ratio put spread

	Price	Delta	Gamma	Theta	Vega
Buy 1 165 put	-12.18	-0.678	0.024	-0.024	0.288
Sell 2 150 puts	8.06	0.668	-0.042	0.056	-0.548
Net	-4.12	-0.01	-0.018	0.032	-0.26

From Table one can see that a put ratio spread is also a debit spread, meaning there is a cash outflow when the spread is initiated and the spread is neutral to the market since the delta is almost zero. The gamma of the spread is negative, which implies that the spread will have positive deltas when stock price declines and will have negative deltas when stock price rises resulting in losses for the trader. This is another volatility selling strategy.

Since the Vega is negative, any increase in implied volatility will impact the spread unfavorably but the trader will gain from positive theta. Here again, if the stock price is near to the long strike price, theta benefits will be lower.

Back Spreads

A back spread is established by buying more options than the number of sold options while a ratio spread involves more number of options written than the number of options purchased.

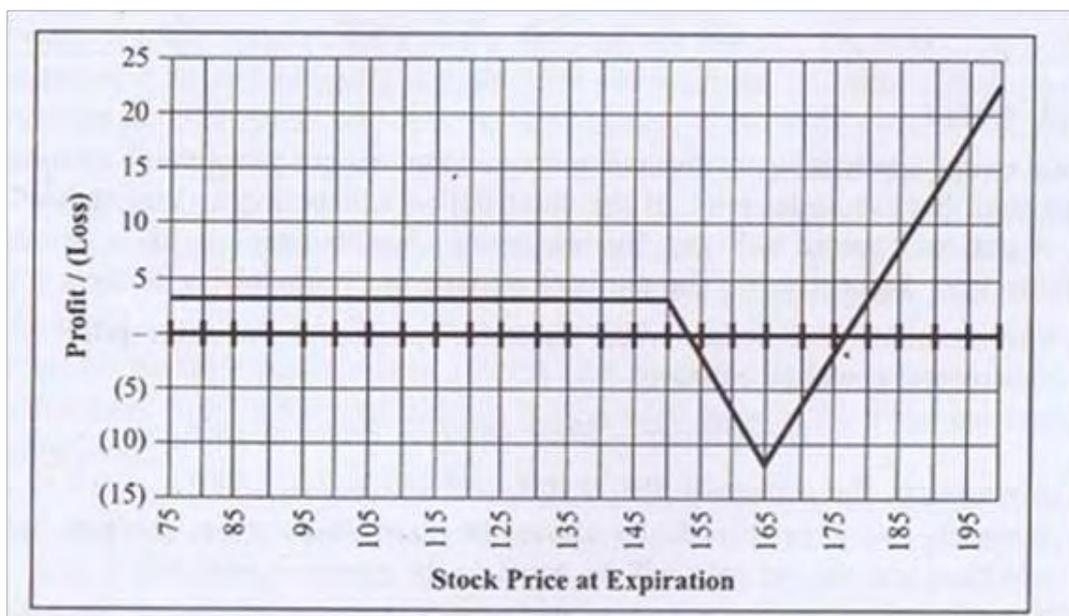
Conventionally, the 'ratio' is defined as the number of options written divided by the number of options bought and it is generally represented as '1 against 2' or '1 by 2', meaning two options are sold against one bought option.

There is no limit to the ratio, hence innumerable ratio spreads are possible but for our discussion we will make use of the 1 by 2 spreads. Tompkins (1994) refer to these as leaning volatility strategies since at inception they may be delta neutral and appear as volatility trades but the spread inherently involves some speculation on the underling's volatility.

Call back spread: Call back spreads are just the mirror images of the ratio call spreads. In the case of ratio call spread, the position will lose if the underlying moves sharply but in the case of call back spreads; the trader desires the stock to make a large jump so that his profits will be maximized. These are established with two long options and one short call option. The strike price of the long options is higher than that of the short option. Consider the call back spread created with the following data:

Stock price	155
Time to expiry	90 days
Volatility	23%
Interest rate	6%
150 call	₹ 11.12
165 call	₹ 4.08

The profit/loss diagram is shown in Figure and the greeks are given by Table. One can note that the spread is a credit spread, as at the time of initiation there is a cash inflow and this is because the sold option is in-the-money. Therefore, there is a higher intrinsic value and hence a cash inflow. If the stock price declines to ₹ 150 or even below the trader have nothing to worry as all the options will expire without being exercised and the trader keeps the premium lie received at the time of initiation. The spread will have maximum loss of ₹ 12.04 occurring when the stock ends up at the strike price of the long options. At ₹ 165, both the long calls will expire worthless and the sold call will be exercised by the counterparty to the short call. So the stock has to be delivered at ₹ 150 when the price at expiry is ₹ 165, entailing a loss of ₹ 15. But since he received ₹ 2.96 as the premium, his net losses will amount to ₹ -15.00 + 2.96 -12.04. There are two breakeven points at long strike price \pm maximum loss, i.e., 165 ± 12.04 . The breakeven points are at 152.96 and 177.04.



Call back spread profit /(loss) diagram

From the Greeks of the call back spread, it is clear that the spread is delta neutral though the delta is positive at 0.06. The gamma is positive at 0.022, implying that the spread will benefit if the stock experiences price upswings, and if the stock jumps down, there is no

harm but the profits will be limited to the premium received. The spread will benefit from an increase in implied volatility as is evident from the positive vega. Assuming the spread is initiated to gain from volatility increases, the spread will benefit more if the stock price is close to the long option's strike price because the vega will be higher and the position will benefit more if the implied volatility rises as expected.

However, the spread's main threat is from theta. Since there are more long options than short options, theta will be more negative. The closer the stock price is to the strike price of the long call option, the more will be the theta effect. So, near to expiry, the position will benefit from vega but will suffer from theta. Hence a call back strategy involves vega-theta tradeoff.

Option Greeks for the call back spread

	Price	Delta	Gamma	Theta	Vega
Buy 2 165 calls	-8.16	0.74	0.042	-0.092	0.576
Sell 1 150 call	11.12	-0.68	-0.020	0.051	-0.274
Net	2.96	0.06	0.022	-0.041	0.3020

Put Back Spread

A put back spread involves buying two put options and selling one put option—all with the same expiry months, but the strike price of the short option will be higher than that of the long options. A put back spread will gain the maximum when the stock is likely to move down substantially from Figure. The put back spread has the following features:

- The maximum loss occurs when the stock ends up at the strike price of the long options and it will be equal to:

$$(\text{Long strike} - \text{Short strike}) - \text{Premium received}$$

Accordingly, the maximum loss in this case will be ₹ 10.88.

- When the stock price ends up above the short strike price, the puts will expire worthless and the net gain will be equal to the premium received.
- But the gains are unlimited when the stock ends below the lower breakeven point, which is given by (Long strike price - Maximum loss). In this case, the gains will be unlimited when the stock ends below ₹ 139.12.

Option Greeks for the put back spread

	Price	Delta	Gamma	Theta	Vega
Buy 2 150 puts	-8.06	-0.668	0.042	-0.056	0.548
Sell 1 165 put	12.18	0.678	4.024	0.024	4.288
Net	4.12	0.01	0.018	-0.032	0.26

The Greeks in Table indicate that the spread is delta neutral since the short put's delta offsets more than the negative delta of the two long put options. The gamma of the spread is positive. Hence it might be beneficial if the price swings down; the delta will also move in the same direction and the spread will benefit. For instance, if the stock price moves down to say ₹ 130 before five days to expiry, both the put options will become in-the-money and the long options will generate a positive inflow of ₹ 40 and the short put will make the trader to pay ₹ 35 to the counterparty, leading to a net profit of ₹ 5 per spread and the net delta will be -1 ($-1 \times 2 + 1 = -1$). Negative delta for a put option means that the position will benefit if the stock price declines.

Similarly, the spread will benefit if the implied volatility increases as the spread is having a positive vega. But the only greek that is working against the put back trader is the theta. Since the spread involves buying more options, the trader has to put up with time decay losses.

Ratio or the back spreads may not be initiated directly but they may evolve from the basic strategies see Table. For instance, if a trader has established a bull put spread which is initially neutral to volatility and the trader expects to benefit from upward stock price movement, after the stock has moved up and if the trader believes volatility will come down, subsequently he can adapt the bull put spread to a put back spread by adding one more put option, as ratio and back spreads are nothing but a combination of the vertical spreads and basic options.

Ratio/back spread equivalence

Ratio/back spread	Vertical spread plus basic building block
Ratio call	Bull call plus short call
Ratio put	Bear put plus short put
Call back	Bear call plus long call
Put back	Bull put plus long put

Key Terms

Back spread	Collar	Ratio spread
Bear call	Condor	Straddle
Bear put	Covered call	Srangle
Bull call	Delta neutral	Time spreads
Bull put	Directional trades	Volatility trades
Butterfly	Gamma neutral	
Calendar	Protective put	

Summary

In this chapter we have seen a small set of the various strategies that are possible with options and their combinations. The kind of payoff profiles that are possible with options and the underlying assets are innumerable and probably for any desired risk-reward profile, one can formulate a strategy. The popularly used strategies are classified based on the view one has on underlying's direction and volatility. Accordingly, various permutations and combinations are possible. It is very much difficult to comment upon the motives, payoffs and risks involved in any given strategy without looking at the greeks. So in comprehending these option strategies, one has to pay attention to the greeks and profit/loss diagrams. Table capsulates the strategies discussed in this section for easy and quick reference.

Summary of option strategies

Option	Description	Remarks	View on volatility	view on underlying's price
Buy a call	Strongest bullish option position	Loss limited to premium paid	↑	↓
Sell a call	Neutral bearish option position	Profit limited to premium received	↓	↑
Buy a put	Strongest bearish option position	Loss limited to premium paid	↓	slight upward
Sell a put	Neutral bullish option position	Profit limited to premium received	↑	↓
Covered Call	Buy future/stock & sell put.	Collect premium on calls sold.	↔	↑
Covered Put	Sell future / Stock & sell put	Collect premium of puts sold.	↑	↓

Bull Call Spread	Buy a call of lower strike & sell a call of higher strike price.	Limited loss and profit strategy	↔	↑
Bull Put Spread	Buy put of lower strike and sell another put with higher strike price	Limited loss and profit strategy	↔	↑
Bear Call spread	Buy a call of higher strike price & sell a call of lower strike rice	Limited loss and profit strategy	↔	↓
Bear Put Spread	Buy a put of higher strike price & sell a put of lower strike price	Limited loss and profit strategy	↔	↓
Straddle Purchase	Buy put & call	Options will lose time value premium quickly.	↑	↔
Sell Straddle	Sell call & put	Profit limited to premium received	↓	↔
Sell a Strangle	Sell out of the money put & call	Maximum use of time value decay	↓	↔
Buy a Strangle	Buy an OTM call and a put	Can be held for longer time vis-a-vis straddles	↑	↔
Calendar	Sell near month, but far month, same strike price.	Near month time value decays faster.	↔	↔
Butterfly	Buy at the money Call (Put) & Sell 2 out of the money calls (Puts) & buy out of the money Call (put)	Profit certain if done at credit	↓	↔
Ratio Call	Buy Call & Sell Calls of higher strike price	Neutral, slightly bullish	↔	Movement to the strike of short call
Ratio Put	Buy put and sell two puts of lower strike price	Neutral, slightly bearish	↔	Movement to the strike of short put
Call Back	Long call and two short calls with lower strikes	Limited losses and unlimited gains if stock moves up	↑	↑
Put Back	Long put and two short puts of higher strikes	Limited losses and unlimited profits if stock moves down	↑	↓

Solved Problems

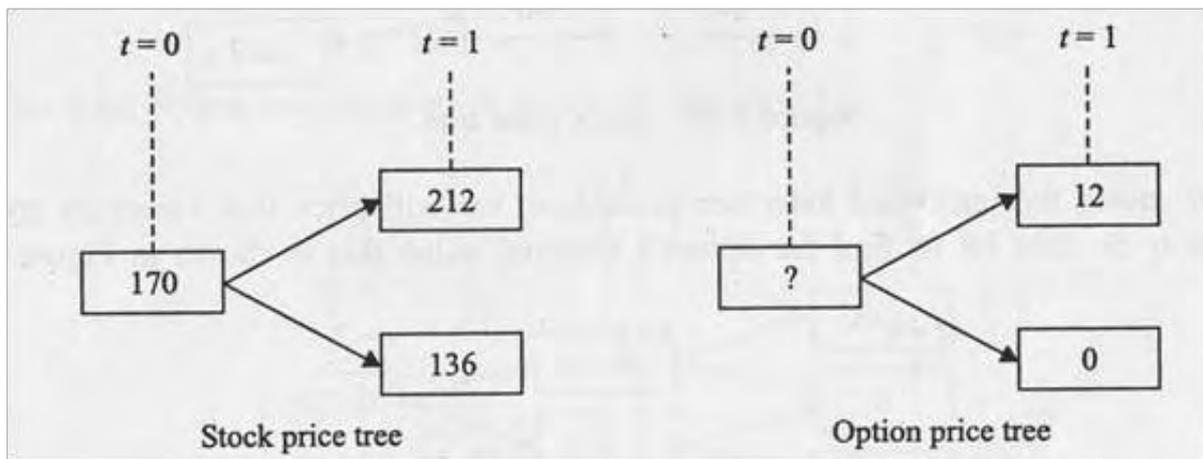
1. The current price of a stock is ₹ 170 and that the one-period interest rate is 10% with no compounding. After one period, the price of the stock will be either ₹ 212 or ₹ 136. Using an arbitrage argument, calculate the price of a European call option which expires in one period with an exercise price of ₹ 200.

Solution

In this example, $S = 170$, which can either move to ₹ 212 or decrease to ₹ 136 since the risk-free rate of return is 10% and the strike price is ₹ 200. This risk-less hedge and arbitrage-free pricing involves investing in the stock that offsets the position in the call, such that the portfolio value is known with certainty irrespective of whether the stock price increases or decreases.

Assume the position consists of I sold call, which is offset by holding A units of the asset

The value of the 'A' is determined such that it will make the portfolio risk-less. This means that the value of the portfolio will be same for both an increase and decrease in the asset price.



Portfolio is risk-less i.e. the value of the portfolio remains the same whether stock price moves up or down therefore $212\Delta - 12 = 136\Delta$ or $\Delta = 12/76$, i.e., to hedge I short call it will be necessary to hold $12/76$ units of the stock, in which case whether there is an up or down movement, the portfolio has a value of ₹ 21.47 as at the expiry of the option. In the absence of arbitrage, a risk-less portfolio should earn the risk-free rate of interest and since we know the final (expiry) value of the portfolio, we can find the same at the initial point,

i.e., at $t = 0$. Therefore, the PV of the risk-less portfolio will be $= e^{-rT}$. Value of PF at expiry $= e^{-0.10 \times 1} \times 21.47 = 19.43$.

The fair value of the option can now be calculated using the known value of the portfolio of assets at the initiation of the deal at $t = 0$:

Value of the asset portfolio - Option premium = Value of risk-less portfolio

$12/76 \times 170 - \text{Option premium} = 19.43$

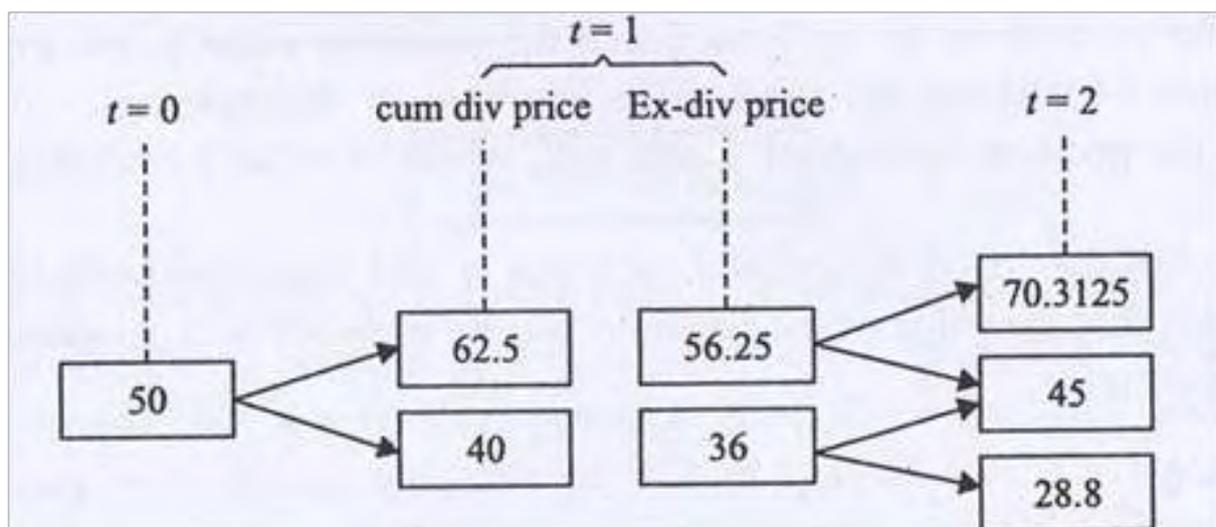
Option premium = 7.41

2. A stock is currently trading at ₹ 50. Over the next two months, the stock will either move up by 25%, or down by 20%. The risk-free rate is 1.00% per month. In exactly one month, the stock will pay a dividend which will be equal to one-tenth (or 10%) of the stock price at that time. If all writes a two-month, two-period option with $X = 50$, find the price of a two-month American call and a put option.

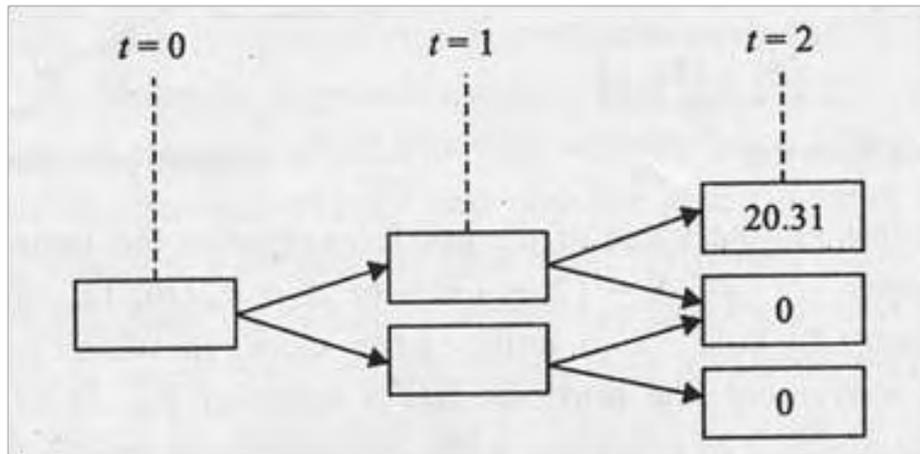
Solution

$$u = 1.25; d = \frac{1}{1.25} = 0.80 \text{ and } p = \frac{e^{0.01} - 0.80}{1.25 - 0.80} = 0.4668$$

The binomial stock price tree is as given in the following figure.



Now using the backward induction procedure, we will price this American style call option. So first let us find the option's terminal value this is shown in the following figure.

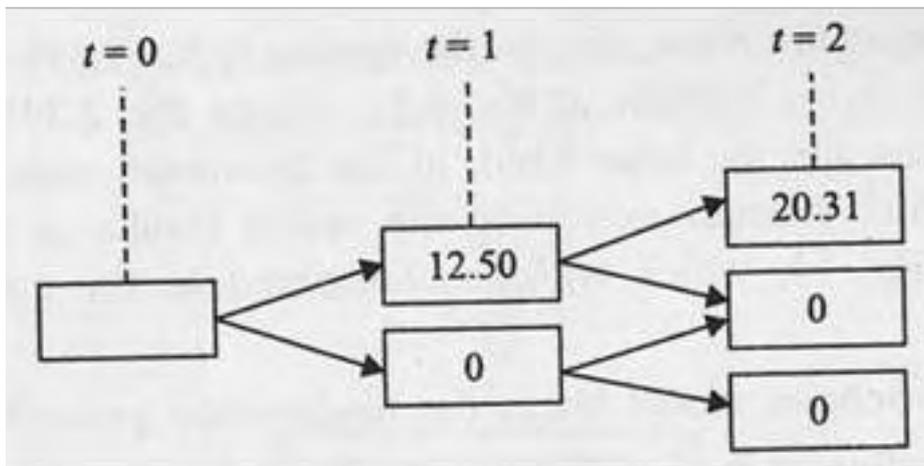


Then using the one-period formula, we will find the option's value at $t = 1$.

$$P_u = e^{-0.01} [0.4668 \times 20.31 + 0.5332 \times 0] = 9.3859$$

and $p_d = 0$

So the updated option tree will be as given in the following figure for a European style

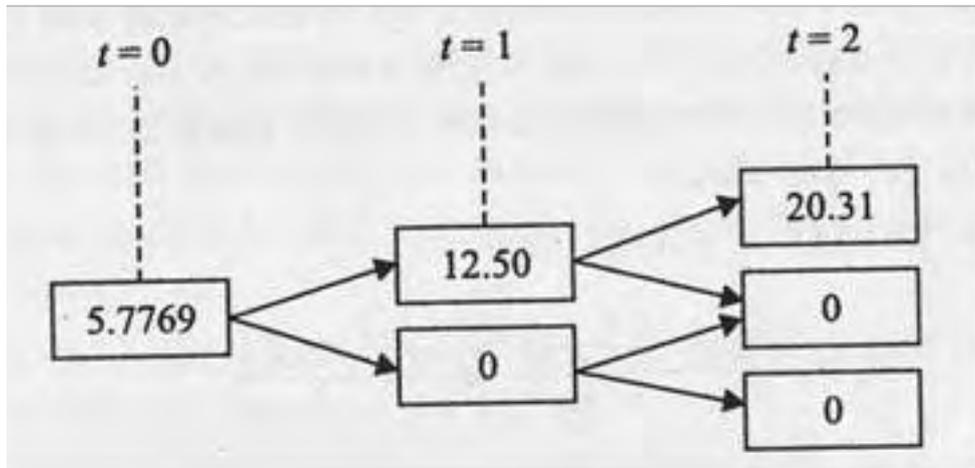


But since this is an American style call option, we have to verify whether it will be beneficial to exercise the option at $t = 1$. We also know from Chapter 8, that an option with early exercise feature can be exercised just prior to the moment the stock goes ex-dividend. Therefore, if we exercise the option, it will lead to a cash inflow equivalent to ₹ $62.5 - 50 = 12.50$, which is greater than the theoretical price of ₹ 9.3859 . Hence from this node onwards, the value of the option is treated as 12.50 for subsequent calculations.

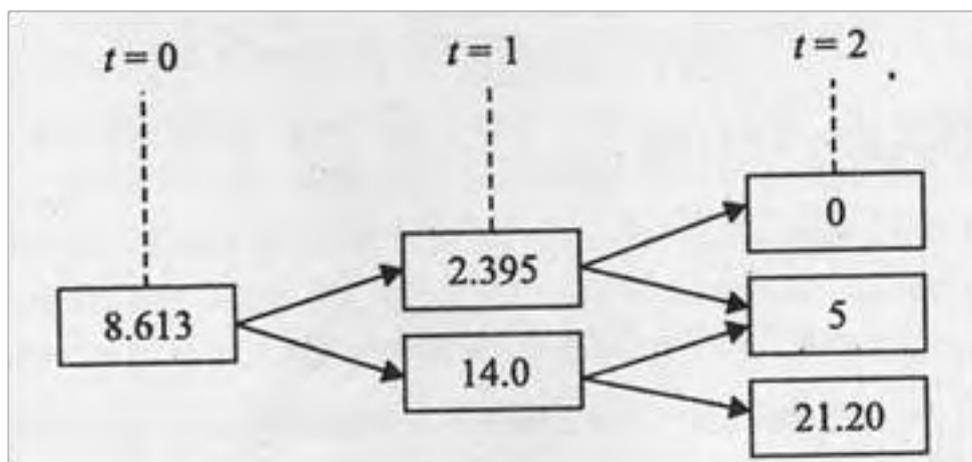
So the value of the option at $t = 0$ is given as:

$$P_0 = e^{-0.01} [0.4668 \times 12.50 + 0.5332 \times 0] = 5.7769$$

The final option tree diagram is shown in the following figure



Similarly, the put option price can be found as shown in the following figure



At $t = 1$, the computed option price in the upstate is ₹ 2.395 whereas exercising the option will result in an outflow of ₹ 6.25. Hence ₹ 2.395 will be the price for further calculations. On the other hand, in the downward node, the calculated option price is ₹ 13.505 whereas exercising the option results in a positive cashflow of ₹ $50 - 36 = ₹ 14$, which will be considered as the option price for further calculations.

3. Show that Black-Scholes model obeys the fundamental put-call parity.

Solution

According to put-call parity, the call and put prices are linked as:

$$C - P = S - Xe^{-rt}$$

The B-S values of C and P are as follows:

$$C = S N(d_1) - Xe^{-rt} N(d_2)$$

and
$$P = Xe^{-rt} N(-d_2) - S N(-d_1)$$

Substituting the above values in the RHS of put-call parity, we get:

$$\begin{aligned} C - P &= \{S N(d_1) - Xe^{-rt} N(d_2)\} - \{Xe^{-rt} N(-d_2) - S N(-d_1)\} \\ &= S \{N(d_1) + N(-d_1)\} - Xe^{-rt} \{N(d_2) + N(-d_2)\} \text{ since } N(x) + N(-x) = 1 \\ &= S\{1\} - Xe^{-rt} \{1\} = S - X e^{-rt} \end{aligned}$$

Hence we can say that B - S model obeys put - call parity.

4. The current stock price for ACG Ltd is ₹ 85. A European call option with an exercise price of ₹ 85 will expire in 160 days. The yield on a 160-day Treasury bill is 5.18%. The standard deviation of annual returns on ACG's stock is 44%. Compute the premium for a call option on this stock.

Solution

$$T = 160/365 = 0.4384 \text{ years}$$

$$\begin{aligned} d_1 &= \frac{\{ \ln(S/X) + (r + 0.5\sigma^2) \times T \}}{\{\sigma \sqrt{T}\}} \\ &= \frac{\{ \ln(1) + (0.0518 + 0.5 \times [0.44^2]) \times 0.4384 \}}{\{0.44 \sqrt{0.4384}\}} \\ &= \frac{(0 + 0.1486 \times 0.4384)}{(0.44 \times 0.6621)} \end{aligned}$$

$$N(d_1) = 0.58706$$

$$\begin{aligned} d_2 &= d_1 - \sqrt{T} \\ &= 0.2236 - 0.44 \sqrt{0.4384} \\ &= 0.2236 - 0.2913 = -0.0677 \end{aligned}$$

$$N(d_2) = 0.47210$$

$$\begin{aligned} C &= S_0 N(d_1) - Xe^{-rT} N(d_2) \\ &= 85 \times 0.58706 - 85 \times e^{-0.05128 \times 0.4384} \times 0.47210 \end{aligned}$$

$$\begin{aligned}
&= 49.901 - 85 \times 0.97777 \times 0.47210 \\
&= 49.900 - 39.236 \\
C &= ₹ 10.67
\end{aligned}$$

5. You wish to purchase a call option on a local warehouse having an expiration date of one year and an exercise price of ₹ 10,00,000. The warehouse owner will not sell you such an option but is willing to sell the warehouse for ₹ 11, 00,000. The current risk-free interest rate is 9% per year, and insurance on a one-year, ₹ 10,00,000 loan would be ₹ 10,000 How would you create a synthetic call option on the warehouse?

Solution

Buy the warehouse	-	₹ 11, 00,000
Obtain a loan		₹ 9, 17,431.2
		(PV of ₹ 10, 00,000 at 9%)
Purchase insurance	-	₹ 10,000
Net cost of the synthetic call	-	₹ 1, 92,568.8

6. Consider the following options on a single stock:

	Calls		Put C
	A	B	
Months of expiration	3	9	3
Continuous yearly risk-free rate (R_f) (Treasury Bills)	10.00%	10%	10.00%
Discrete yearly R_f	10.52%	10.52%	10.52%
Standard Deviation of stock returns	40%	40%	40%
Exercise price	₹ 55	₹ 55	₹ 55
Option price	₹ 2.56	-	₹ 6.20
Stock price	₹ 50	₹ 50	₹ 50
Cash Dividend	₹ 0	₹ 0	₹ 0

- (a) Why should call B Sell for more than Call A?
- (b) Is the put-call parity model working for options A and C?
- (c) How would you trade call A, the stock, and risk-free security in order to replicate the expiration date outcomes of put C?

- (d) Calculate the Black – Scholes values of call A and call B.
 (e) Interpret what Nd_1 and Nd_2 mean.

Solution

Call B has longer time to expiration. There is a greater chance that the call will be exercised at a positive value.

(a) ₹ 50 – ₹ 55 / (1.052^{0.25}) = ₹ 3.64

Actual difference = ₹ 2.56 – ₹ 6.20 = ₹ 3.64

(b) Buy 1.0 call, sell short 1.0 stock, but debt now worth ₹ 55 / (1.1052^{0.25})

(c) Call A data

$$d_1 = \frac{\ln(50/55) + 0.25(0.10 + 0.4^2/2)}{0.4\sqrt{0.25}} = -0.25$$

$$d_2 = \frac{\ln(50/55) + 0.25(0.10 + 0.4^2/2)}{0.4\sqrt{0.25}} = -0.45$$

$$Nd_1 = 0.5 - 0.0987 = 0.4013$$

$$Nd_2 = 0.5 - 0.1736 = 0.3264$$

$$V_c = ₹ 50(0.4013) - \frac{₹ 55}{e^{(0.1)(0.25)}}(0.3264) = ₹ 256$$

Call B Data

$$d_1 = \frac{\ln(50/55) + 0.75(0.10 + 0.4^2/2)}{0.4\sqrt{0.75}}$$

$$d_2 = d_1 - \sigma\sqrt{T} = -0.23$$

$$Nd_1 = 0.5 - 0.0438 = 0.5438$$

$$Nd_2 = 0.5 - 0.091 = 0.409$$

$$V_c = ₹ 50(0.5438) - \frac{₹ 55}{e^{(0.1)(0.75)}}(0.409) = ₹ 6.32$$

- (d) To replicate the instantaneous pay off of the call, one shall buy Nd_1 shares and issue Nd_2 units of debt which is now worth $P_x / e^{R_{fx}T}$

7. Consider the information provided below:

Options on XYZ Stock					
	Call Options				Put Options
	A	B	C	D	E
Current Market Price of:					
Option	₹ 16.12	₹ 10.62	₹ 8.31	₹ 10.50	₹ 7.25
Stock	₹ 80	₹ 80	₹ 80	₹ 80	₹ 80
Option Information					
Exercise Price	₹ 70	₹ 80	₹ 90	₹ 90	₹ 70
Months to Expiration	3	3	3	6	3
Market Information					
Continuous yearly risk-free return, R_f – Expected cash Dividends	12%	12%	12%	12%	12%
Standard Deviation of Stock Returns	0	0	0	0	0
	60%	60%	60%	60%	60%

- (a) Calculate the Black-Scholes value of each option.
- (b) Taking call A and put E have identical terms, use the put call parity model to value the put, given the Black-Scholes value of call A. Comment on why the put's value is the same as found in part (a)
- (c) Interpret what the term N_{d1} and N_{d2} mean for call A and put E.

Solution

(a) For call A

$$d_1 = (0.13353 + 0.075) / (0.3) = 0.70$$

$$N_{d1} = 0.7580$$

$$d_2 = (0.13353 - 0.015) / (0.3) = 0.40$$

$$N_{d2} = 0.6554$$

$$V_c = ₹ 80(0.7580) - \frac{₹ 70}{e^{(0.12)(0.25)}} (0.6554)$$

(b) For call B

$$d_1 = (0.0 + 0.075) / (0.3) = 0.25$$

$$N_{d1} = 0.5987$$

$$d_2 = (0.0 - 0.015) / (0.3) = 0.05$$

$$N_{d2} = 0.48$$

$$V_c = ₹ 80(0.5987) - = \frac{₹ 70}{e^{(0.12)(0.25)}} (0.48)$$

$$= ₹ 10.62$$

(c) For call C:

$$d_1 = (-0.11778 + 0.075) / (0.3) = 0.14$$

$$N_{d1} = 0.4443$$

$$d_2 = (-0.11778 - 0.015) / (0.3) = 0.44$$

$$N_{d2} = 0.33$$

$$V_c = ₹ 80(0.4443) - = \frac{₹ 90}{e^{(0.12)(0.25)}} (0.33)$$

$$= ₹ 6.72$$

(d) For call D:

$$d_1 = (-0.11778 + 0.015) / (0.4243) = 0.08$$

$$N_{d1} = 0.5319$$

$$d_2 = (-0.11778 - 0.03) / (0.4243) = -0.35$$

$$N_{d2} = 0.3632$$

$$V_c = ₹ 80(0.5319) - = \frac{₹ 90}{e^{(0.12)(0.25)}} (0.3632)$$

$$= ₹ 11.77$$

8. Vimal Gupta wrote March 175 naked put option on ABC Textile stock. When the option was written, the stock sold for ₹ 180 per share. The option premium was ₹ 3. How much margin did Vimal have to deposit?

Solution

The margin required on a naked put option is the larger of two computations:

Method 1:

Option premium

$$= ₹ 3 \times 100 \text{ shares} \quad ₹ 300$$

$$20\% \text{ of stock's market value} \quad ₹ 3600$$

$$= 20\% \times ₹ 180 \times 100 \text{ shares}$$

Less amount by which stock's market

Price exceeds put's exercise price	
= (₹ 180 - ₹ 175) x 100 shares	500
Total	₹ 3400

Method 2:

Option premium	
= ₹ 3 x 100 shares	₹ 300
10% less of stock's market value	
= 10% x ₹ 180 x 100	₹ 1800
Total	₹ 2100

As the margin calculated by method 1 is greater than that of Method 2, Gupta will have to deposit ₹ 3400.

9. Refer to problem (12), what will happen to the theoretical option price if the expected price volatility is 40% rather than 25%

Solution

Applying the Black - Scholes model:

$$d_1 = \frac{\ln(47/45) + [0.5(0.4)^2]0.5}{0.40\sqrt{0.5}}$$

$$= 0.4719$$

$$d_2 = 0.4719 - 0.40\sqrt{0.5}$$

$$= 0.1891$$

From a normal distribution table:

$$N(0.4719) = 0.6815 \text{ and}$$

$$N(0.1891) = 0.5750$$

Then

$$C = 47(0.6815) - 45(e^{-(0.10)(0.5)})(0.5750) = ₹ 7.42$$

Notice that higher the assumed expected price volatility of the underlying stock. Price, the higher the price of the call option.

10. Consider a three month call option on ABC Company's stock with an exercise price of ₹ 45. If ABC is currently selling at ₹ 50 and the risk-free interest rate is 5%, what will be the price of the option? Apply the Black-Scholes model to find call option value by assuming the standard deviation of the rate of return of ABC stock to be 0.4

Solution

Applying the Black-Scholes model:

$$d_1 = \frac{\ln \left(\frac{50}{45} \right) + \left[0.05 + \frac{(0.4)^2}{2} \right] (0.25)}{0.40 \sqrt{0.25}}$$

$$= 0.6896 = 0.69$$

$$N(d_1) = 0.5 + 0.2549 = 0.7549$$

Similarly,

$$d_2 = 0.6893 - (0.4) \sqrt{0.25} = 0.4893 = 0.49$$

and

$$N(d_2) = 0.5 + 0.1879 = 0.6879$$

with the appropriate values substituted into the Black – Scholes equation, the call option price is:

$$(50)(0.7549) - (45) (e^{-(0.05)(0.25)}) (0.6879) = ₹ 7.18$$

Lesson 2.4 - Interest Rate Swaps

Introduction

Need is the mother of invention is a general saying and the evolution of swap as a financial instrument is the classical and a rather recent example of the proverb. There is near unanimity among the financial experts that swaps developed out of the constraints and the regulatory controls with respect to cross-border capital flows faced by large corporations in the 1970s. When multinational corporations operating in various countries could not remit funds back and forth among their subsidiaries due to exchange controls exercised by various governments on the capital flows, they came out with innovations of back-to-back or parallel loans among themselves. Upon removal of restrictions on the capital flows, these loans later developed into a full financial product called swaps. Since then the market has grown to be as large as 414 trillion' in 2009 as the amount of principal involved in swap transactions and continues to further grow at a rapid rate.

Parallel loans involve four parties—two multinational corporations and two subsidiaries in two different countries. Imagine IBM as one USA-based company with a subsidiary in London and British Telecom as another company having operations in New York. The subsidiary of British Telecom needs money in US dollar, while the subsidiary of IBM in London has fund requirements in British pound. Due to regulatory controls neither IBM USA nor British Telecom can fund their subsidiaries. To overcome the problem British Telecom can arrange funds in British pound to fund the requirement of the subsidiary of IBM in London.

Similarly, IBM USA may raise funds in US dollar to fund the operations of British Telecom in New York. Such an arrangement is called back-to-back or parallel loans. These amounts would be re-exchanged at maturity at a rate determined in advance. Besides overcoming regulatory controls, there were other economical advantages that caused the development of swaps as full blown financial product and became popular even after the removal of regulatory controls. By this simple arrangement, each firm has access to capital markets in foreign country and makes use of their comparative advantage of borrowing in different capital markets. The growth of the swaps has been so phenomenal that in 1984 a need for standardization, uniform practices for documentation, trading, and settlement was felt leading to the formation of International Swaps and Derivatives Association (ISDA).

Back-to-back/parallel loans posed several difficulties of finding matching parties with identical needs in terms of amount of principal, timing, and duration of loans, periodicity and nature (fixed or variable) of interest payments, all of which must match to conclude a successful deal. Solutions to these problems were found by intermediary banks, and they later became dealers in swaps from mere arrangers of swaps between two parties. Back-to-back loans were an example of financial swap, which had its origin in the 1970s. By the early 1980s the same principle was adopted to develop another swap arrangement based on interest rates known as interest rate swap.

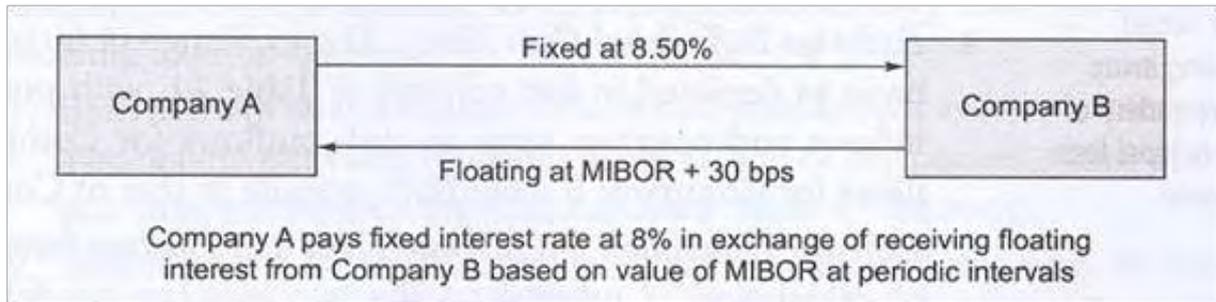
Swap, in the simplest form, may be defined as an exchange of future cash flows between two parties as agreed upon according to the terms of the contract. The basis of future cash flow can be exchange rate for currency/ financial swap, and/or the interest rate for interest rate swaps. Apart from interest rates and currency rates, the formula for determination of the periodic cash flows can be equity returns, commodity prices, etc. In essence one of the cash flow would be fixed, called fixed leg, while the other called floating leg would be variable depending upon the value of the variable identified for the swap.

Interest Rate SWAPS

If the exchange of cash flows is done on the basis of interest rates prevalent at the relevant time, it is known as interest rate swap. The simplest example of interest rate swap is a forward contract where only one payment is involved. In a forward transaction of any commodity the buyer acquires the commodity and incurs an outflow of cash equal to the forward price, F . If the buyer after acquiring the commodity were to sell it for the spot price S , then there would be a cash inflow of S . From the cash flow perspective a forward contract for the buyer is a swap transaction with inflow of S and outflow of F . Likewise, the seller would have equivalent cash flows in the opposite direction. Therefore, a forward contract can be regarded as a swap with a single exchange of cash flow; alternatively swap can be viewed as a series of several forward transactions taking place at different points of time.

Features of SWAP

Usually, interest rate swaps involve payment/receipt of fixed rate of interest for receiving/paying a floating rate of interest. The basis of exchange of cash flows under interest rate swap is the interest rate. This fixed-to-floating swap, commonly known as 'plain vanilla swap', is depicted in-Figure, where Company A agrees to pay Company B fixed interest rate of 8.5011/o in exchange of receiving from it the interest at 30 bps (100 bps = 111/6) above the floating interest rate, Mumbai Inter Bank Offer Rate (MIBOR), at predetermined intervals of time.



‘Plain Vanilla’ Interest Rate Swap

Assuming that the swap between Company A and Company B is (a) for a period of three years, (b) with semi-annual exchange of interest, (c) on notional principal of ₹ 50 crores the cash flows for Company A for 6 semi-annual periods for an assumed MIBOR would be as per Table. What is received/paid by Company A is paid/received by Company B.

With the context of the example just described, the following salient features of the swap may be noted.

1. *Effective Date* All the cash flows pertaining to fixed leg are known at the time of entering the swap at $T = 0$, referred as effective date.
2. *Resetting of Floating Leg Cash Flow* The cash flow for floating leg of the swap is determined one period in advance when the floating rate becomes known. Therefore, at the time of entering the swap both the amounts of interest are known. The first receipt of cash flow at $T = 6$ months is known at $T = 0$ and is done at MIBOR of 8% plus 30 bps. The date on which the next floating rate payment is decided is called reset date.

Cash Flow under Swap for Company A

Cash flow (₹ in Lakh)

Time (Months)	Assumed MIBOR	Fixed Leg	Floating Leg	Net
0	8.00%			
6	8.15%	-212.50	207.50	-5.00
12	8.20%	-212.50	211.25	-1.25
18	8.45%	-212.50	212.50	0.00
24	8.30%	-212.50	218.75	6.25
30	8.50%	-212.50	215.00	2.50
36	8.75%	-212.50	220.00	7.50

3. *Notional Principal* No principal amount is exchanged either at initiation or conclusion of the swap. It remains a notional figure for determination of amount of interest on both the legs.
4. *Exchange Differential Cash Flow* The exchange of interest is done on net basis as depicted in last column of Table, with positive sign as cash inflows and negative signs as cash outflows for Company A. The cash flows for Company B would be opposite to that of Company A.
5. *Different Convention to Calculate Fixed and Floating Interests* The method of calculation of interest on the two legs can be defined in the swap agreement being an over-the-counter (OTC) product between two parties. However, the convention is to calculate the two legs of interest are different and as follows:

For Fixed Leg : Actual/365, and

For Floating Leg : Actual/360

(As is the practice in the money markets)

To illustrate, if actual number of days in the six-month period is 182, amount of interest for both the legs for the first cash flow would be somewhat different than those shown in Table

For Fixed Leg: Principal \times Interest rate $\times \frac{\text{No. of days}}{365}$

$$50,00,000 \times 0.085 \times \frac{182}{365} = ₹ 2,11,918$$

For Floating Leg: Principal \times Interest rate $\times \frac{\text{No. of days}}{360}$

$$50,00,000 \times 0.085 \times \frac{182}{360} = ₹ 2,09,805$$

For simplicity of exposition, in the example 180 days are assumed for all semi-annual periods with 360-day year.

Need of SWAP Intermediary—the SWAP Dealer/Bank

The illustration above assumed perfect matching of needs of Company A and Company B. How does Company A and Company B locate each other is a big question? Normally firms do not disclose their specific needs of loans, borrowings, interest rates, etc. Even the routine transactions of buying and selling the foreign currency in the forward market are rarely done by importers and exporters directly. All of them resort to banks for buying and selling foreign currency.

Apart from difficulties in locating each other if Company A and Company B were to have the swap arrangement directly there would be the following likely problems.

1. Both of them would assume default risk (also known as counterparty risk) associated with swap on each other, as one of the parties to the transaction may not honour the commitments made in the swap.
2. Matching of needs in terms of principal amount of borrowing, its timing, periodicity of payment of interest, and final redemption of the borrowing, etc. would be a difficult task.

These difficulties in the swap need to be overcome; else the swap market would remain extremely small. In fact, the growth in the swaps is primarily attributed to the roles the banks have played as swap intermediaries. Following are the functions of swap intermediary.

Facilitating the SWAP Deal

The difficulties in finding a matching counterparty can be reduced if an intermediary is involved. The intermediary or the swap dealer is normally a bank who has widespread network. Due to deep knowledge of financial markets, network of large number of customers, and exact understanding of client's needs it is easier for banks to locate matching counterparties. Like the forward rates are offered by banks to facilitate the foreign exchange transaction, few banks offer ready market for firms to enter and exit the swap deals.

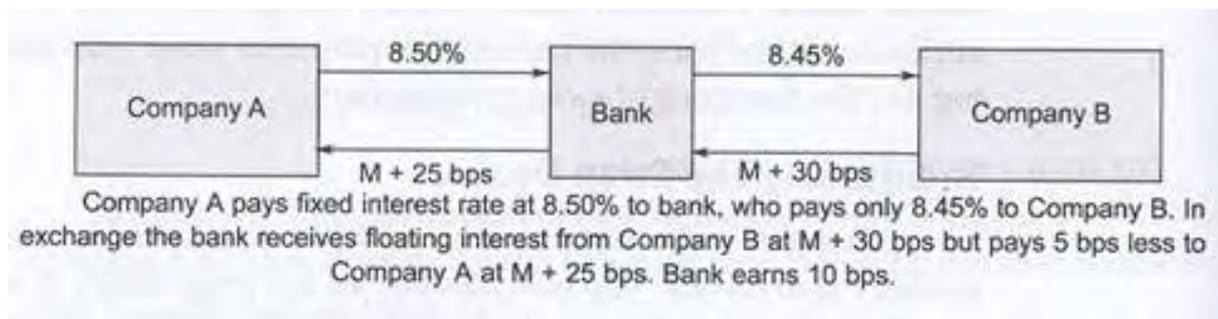
Warehousing

Banks are performing the role of market maker in swaps. One can obtain a quote on demand for a swap deal with bank without waiting for a matching counterparty. There are several requirements to be matched. For example, one party may look for interest rate swap for ₹ 100 crore on semi-annual basis for three years, while the counterparty may want swap for ₹ 80 crore on quarterly basis for 2-1/2 years only. Here the bank may take exposure of ₹ 20 crore in the hope of finding another suitable party. This is called warehousing where bank may enter swaps on its own. The bank carries the risk of interest rate fluctuations till a matching counterparty is found. This risk is normally covered through interest rate futures. Hedging through interest rate futures has to be done only for net exposure in swaps as banks are likely to have a portfolio of swaps which can nullify the interest rate risk for major part of exposure.

Assuming Counterparty Risk

Most important of all, banks mitigate the counterparty risk for both the parties to the swap by becoming the counterparty to each of them. In the example depicted in Figure Company A would be far more comfortable if the counterparty were a bank rather than Company B. Same would be true for Company B. By becoming counterparty the overall risk to the swap transaction, which normally is large due to its long term nature, stands reduced substantially.

Of course, for providing a facilitating role and assuming the counterparty risk, the swap broker needs to earn remuneration. This has to be borne by the two parties to the swap transaction. However, each of the party stands to gain in terms of having an exact deal, desired timing, and reducing counterparty risk. The benefits are worth the cost.



'Plain Vanilla' Interest Rate Swap with Intermediary

Figure depicts the swap transaction with bank as intermediary charging 5 bps from each party, as each of them receives 5 bps less that what they would receive without the intermediary (Figure).

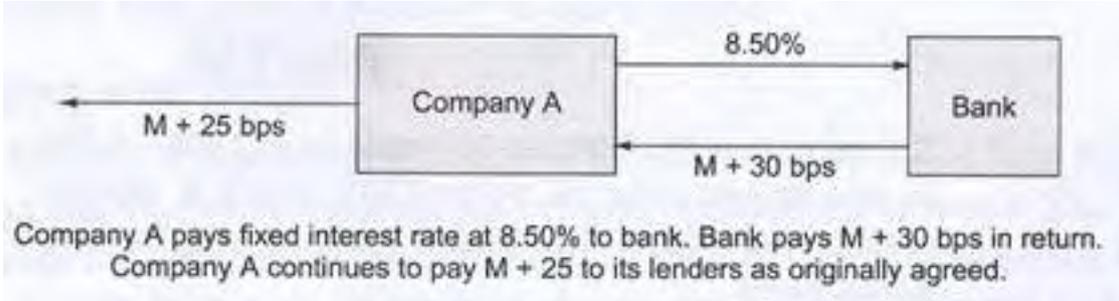
Applications of SWAPS

Having explained the mechanism of the swap transaction, let us focus on what swaps can achieve. Swaps can be used to (a) transform the floating rate liability to fixed rate liability and vice versa, (b) transform floating rate assets to fixed rate asset and vice versa, (c) hedge against fluctuating interest rates, and most importantly (d) reduce cost of funds. We examine each of them.

Transforming Nat-are of Liabilities

Interest rate swaps are generally used for creating synthetic, fixed, or floating rate liabilities with a view to hedge against adverse movement of interest rates. Let us consider

Company A, which has borrowed from the market on floating rate basis at MIBOR + 25 bps. It pays to its lenders at floating rate. Further, the company considers that interest rates would rise in future. In view of rising interest rates it would like to have liability that is fixed in nature rather than variable. Therefore, it decides to enter into a swap with the bank paying fixed 8.50% and receiving MIBOR +30bps as depicted in figure



Swap to Transform Floating Rate liability to Fixed rate

What is the result of this swap? It simply transforms the liability to a fixed payment at 8.450/u p.a. as shown below.

Payment to lenders	MIBOR+25bps
Less: Receipt from Bank under swap	- (MIBOR + 30 bps)
Payment to Bank under swap	8.50%
Net payment, Fixed	8.45%

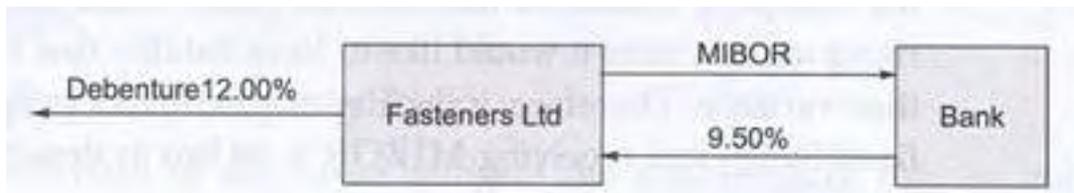
Similarly, any firm can transform its fixed rate liability to floating rate by entering the swap with bank for paying floating and receiving fixed. Naturally, the firm would use such a swap when it believes that interest rates are likely to fall in future and locking-in a fixed rate would prove advantageous.

Example 3.1 Changing Nature of Liability from Fixed to Float

Five years back, Fasteners Ltd had raised loans through 10-year debenture issue worth ₹ 100 crore with fixed interest of 12%. After the issue the interest rates remained constant for sometime. But now they have been at around 10% and are likely to come down further. Fasteners Ltd wish to contain the cost of funding for the remaining 5 years. A bank has offered a swap rate of 9.5001o_9.60010 against MIBOR for a period of 5 years. Depict the swap arrangement and find out the new nature of liabilities the firm can have.

Solution

Fasteners Ltd has liability on a fixed interest of 12%I. By entering swap with the bank it may transform the liability from fixed rate to floating rate based on MIBOR. Under the swap arrangement, Fasteners Ltd can receive fixed and pay MIBOR. The bid rate of swap (9.50%I) would be applicable. The swap arrangement is shown below (see Figure E 3.1).



The cost of funds for Fasteners Ltd would be = 12.00% - 9.50% + MIBOR MIBOR + 2.50% In case interest rates fall below 9.50%, which is expected, the firm would end up paying lesser interest than what it is paying now. The interest rate payable would be market based.

Transforming Nature of Assets

Assets provide income to investing firms based on the interest rates. If the interest rates fall the income too falls. In the circumstance of falling interest rates the firms would like to change the complexion of assets that are on floating rate to fixed rate. Similarly, in times of rising interest rates firms earning interest would like to remain with the market trend rather than get a fixed rate.

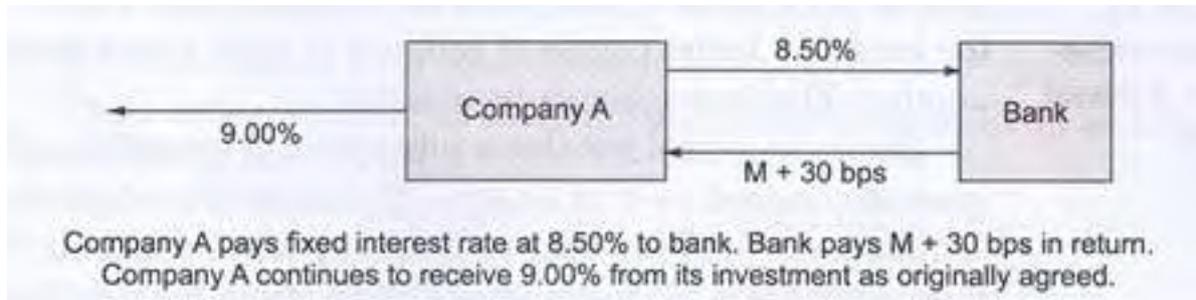
Now assume that Company A has made an investment by subscribing to bonds carrying 9% fixed coupon. Bonds have still some years to mature but the interest rates are showing a rising trend, which is expected to continue. Company A faces a potential loss of income.

What can Company A do? Changing the portfolio of bonds by selling fixed rate bonds and buying floating rate bonds is one solution. An easier way is to enter the swap as depicted in Figure, where it receives floating and pays fixed rate. By doing so the nature of income transforms from fixed 9.00%

to MIBOR + 80 bps as shown:

Receipt from investments	9.00%
Less: Payment to Bank under swap	-8.50%

Receipt from Bank under swap	MIBOR + 30 bps
Net Receipts, Floating	MIBOR + 80 bps



Swap to Transform Fixed Rate Asset to Floating Rate

If MIBOR moves beyond 8.20% in future, Company A would benefit from the situation.

Similarly, another can transform its floating rate income to fixed rate income by having the swap. Naturally, firms would use such a swap when they believe that interest rates are likely to fall in future.

Hedging With SWAPS

The examples of changing the nature of liabilities and/or assets from fixed to floating and vice versa demonstrate hedging applications of swaps. The need to change the complexion of assets and liabilities arises only when the firms stand to gain from such an exercise. Swaps can be fruitfully used to hedge against the adverse interest rate situations as condensed in the Table.

Hedging Strategies with swaps

Nature	Risk	Hedging Action
Assets		
Fixed Rate	Rising interest rates	Swap to transform nature of asset from fixed rate to floating rate
Floating Rate	Falling interest rates	Swap to transform nature of asset from floating rate to fixed rate
Liabilities		
Fixed Rate	Falling interest rates	Swap to transform liability from fixed rate to floating rate
Floating Rate	Rising interest rates	Swap to transform the liability from floating rate to fixed rate

There are other ways to hedge against adverse situations but at times swap could prove more efficient. For example, a firm may have borrowed on fixed rate basis for 10 years. After a few years if the interest rates start downward movement the possible recourse with the firm is to approach the lender to change the nature of loan from fixed to variable. This would be resisted by the lender. A better course of action is to enter into a swap arrangement with another. The firm achieves its objective.

Similarly, a fund may have subscribed to a portfolio of fixed rate bonds to generate desired level of income. If interest rates rise subsequent to the subscription, the fund loses the opportunity to raise income. One of the alternatives available is to change the portfolio from fixed to floating rate bonds. It may pose serious limitations like availability of such bonds, transaction costs associated with change of portfolio, etc. An attractive alternative is to enter the swap to transform the nature of asset from fixed to floating, where it receives cash flow based on floating rate in exchange of paying the fixed rate. More importantly the swap transaction remains off balance sheet, thereby, keeping the much desired confidentiality.

Reducing Cost of Funds

The most important use of swaps, which seems to be primarily responsible for the popularity and growth of swaps, is its potential to save cost for the firms.

An example will illustrate how swaps can be used to reduce cost. Assume that a highly rated Firm AAA can raise funds in the fixed rate market at 10% and in the floating rate market at MIBOR + 100 bps. The current rate of MIBOR is 8%. Another firm comparatively lower rated at A can mobilize capital at 12% and MIBOR + 200 bps in the fixed rate and floating rate markets respectively.

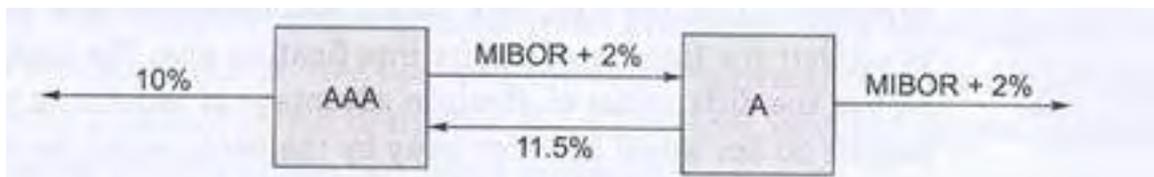
Clearly, Firm AAA has advantage over Firm A in both kinds of the markets—fixed and floating—as can be seen below.

	Firm AAA	Firm A	Advantage AAA
Fixed Rate	10%	12%	200 bps
Floating Rate	MIBOR+ 100 bps	MIBOR+200 bps	100 bps

We further assume that Firm AAA is interested in borrowing at floating rate (at MIBOR + 100 bps) and Firm A wants to borrow in the fixed rate market (at 12%). Notice that for lower rated firm the spread in the fixed rate market is greater. Both the firms can set up the swap as follows:

1. Firm AAA goes to fixed rate market to borrow at 10% rather than tapping floating rate market at MIBOR + 10 bps.
2. Firm A mobilizes funds from floating rate market at MIBOR + 200 bps rather than mobilizing from fixed rate market at 121%.
3. Having accessed different market as against their original choice now Firm AAA and Firm A enter a swap where
 - (a) Firm AAA pays Firm A floating at MIBOR + 200 bps
 - (b) Firm A pays Firm AAA fixed at 11.51%

These actions and the resultant impact on cost of funds for Firm AAA and Firm A are shown in



Cost of Funds for Both the Firms

	AAA	A
Payment to investors	10%	MIBOR+ 2%
Payment to counterparty	MIBOR + 2%	11.5%
Receipt from counterparty	11.5%	MIBOR+ 2%
Cost of borrowing (1 + 2-3)	MOOR + 0.5%	11.5%
IMPACT		
	Firm can raise funds at MIBOR + 0.50% as against MIBOR + 1% without the gaining 0.50% gaining 0.50%	Firm can raise funds at 11.5% as against 12% without the swap; swap; gaining 0.50%

Interest Rate Swap—Reducing Cost of Funds

As against fixed payment of 10.00% to its original lenders Firm AAA pays floating at MIBOR + 200 bps and receives 11.5% fixed. This not only transforms the liability from fixed to floating rate the firm wanted in the first place, but also reduces the cost to MIBOR + 50 bps as against MIBOR + 100 bps that it would have incurred without the swap thereby gaining advantage of 50 bps. Similarly, Firm A too can transform its liability to fixed rate as it desired and also reduce the cost of funds to 11.50% as against 12.00%, which it would incur if it were to go the market directly. The swap again gives an advantage of 50 bps.

Cost Example 3.2 Interest Rate Swap to Reduce Funding

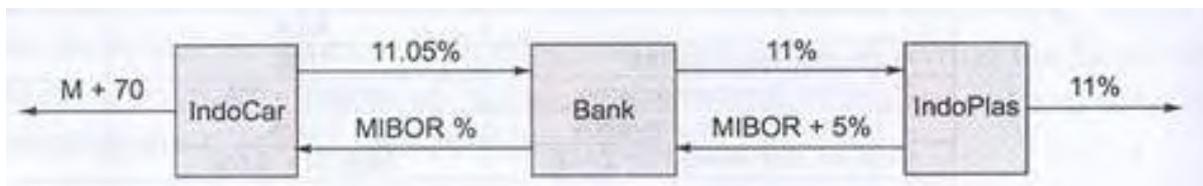
Two Indian firms IndoPas and IndoCar are contemplating to raise finance of ₹ 100 crore each. They have been offered following loans by a bank

	Fixed Rate	Floating Rate
IndoPas	12.00%	MIBOR + 70 bps
IndoCar	11.00%	MIBOR + 30 bps

Another bank acting as swap intermediary is willing to work out a swap arrangement for a fee of 5 bps from each firm. IndoCar believes that interest rate would fall and hence, wants to raise funds in the floating rate basis. IndoPas feels otherwise and likes to raise funds on fixed interest rate basis. What swap can be arranged between the two parties? What would be the saving in financing cost of each firm?

Solution

The absolute advantage for IndoCar is 100 bps in fixed rate market while it is 40 bps in the floating rate market. Though IndoCar wants to raise finance at floating rate, the firm must access the fixed rate market and then enter into a swap deal with IndoPas to convert the fixed rate liability into floating rate. The total benefit to be availed is 60 bps the differential of absolute advantage of IndoCar in the two markets. Of this benefit 10 bps would be taken away by the bank, while the remaining 50 bps may be shared equally by both the parties through a swap. One such structure is presented below (see Figure E).



	IndoCar	IndoPas
Payment to investors	11%	MIBOR + 0.7%
Payment to Bank	MIBOR + 0.05%	11.05%
Receipt from Bank	11%	MIBOR%
	MIBOR%	MIBOR+5% I
Cost of borrowing (1 + 2 - 3)	MIBOR + 0.05%	11.75%

Interest Rate Swap: A Schematic View with Intermediary

The aggregate cost of funds for IndoCar would be NIB OR + 5 bps a saving of 25 bps if it had accessed the floating rate market at MIBOR + 30 bps. Similarly, IndoPlas obtains funds at 11.75% against 12% otherwise, without the swap deal resulting in an advantage of 25 bps.

Rationale for Swap-the Comparative Am/Antage

The remarkable aspect about the swap was its ability to reduce the cost of funds for both the firms, as we see in the Figure. Normally one expects that one would gain at the expense of the other. But in a swap both the parties were able to reduce the cost of funds. The explanation lies in theory of comparative advantage.

Even though Firm AAA had absolute advantage in both kinds of borrowing with respect to Firm A, what is of significance is the comparative advantage. Firm AAA had absolute advantages of 200 bps in the fixed rate market and 100 bps in the floating rate market.

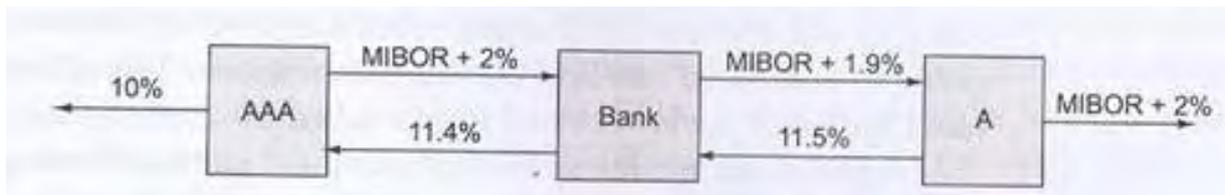
Alternatively, we can say that Firm AAA has comparative advantage of 100 bps (difference of two absolute advantages) in the fixed rate market. Put another way, Firm A has relative advantage in floating rate market. The comparative advantage of 100 bps is available for exploitation by both the firms.

Therefore, it makes sense for Firm AAA to access the fixed rate market, where it had greater absolute advantage, and then enters into the swap to transform the fixed rate liability into a floating rate liability.

Similarly, Firm A must access the floating rate market and then enter into the swap to transform the floating rate liability into the fixed rate. The combined advantage of both would remain fixed at 100 bps and the swap between the two would determine who gets how much of the benefit. Of course, it would depend upon the negotiating powers of the two firms involved.

The aggregate advantage remains fixed at 100 bps. In case of a direct deal between Firm AAA and Firm A as depicted in Figure, the benefit was shared equally by both.

In case such a deal is structured by an intermediary and serving as counterparty to each of them part of the benefit would be sacrificed by each of the party. This benefit goes to the bank. One such deal where the bank gets 20 bps (10 bps from each) is depicted in Figure and Table.



Interest Rate Swap-A Schematic View with Intermediary

Sharing Benefits of Swap

	AAA	A
Payment to investors	10.00%	MIBOR+ 2.00%
Payment to Bank	MIBOR + 2.00%	11.40%
Receipt from Bank	11.40%	MIBOR + 1.90%
Cost of Borrowing (1+2+3)	MIBOR + 0.60%	11.60%
Cost with direct access to the market	MIBOR + 1.00%	12.00%
Savings	40 bps	40 pbs
Earning for the bank	11.50% - 11.40% + (M + 2.00%) - (M + 1.90%) =0.20% or 20 bps	

The exploitation of the comparative advantage by the firms is a clear case of arbitrage on the credit rating. The fixed rate market demanded a greater premium from the lower rated firm than did the floating rate market, forcing the firm to access floating rate market. The premium demanded by higher rated firm for fixed rate was lower than the market making the swap deal attractive.

The question that arises is how a competitive market can allow this aberration to take place. The answer appears to lie in the information gap the market has for Firm AAA and Firm A. Lenders while lending on floating rate basis have opportunity to review every six months and the spread is usually a smaller one for the firm rated higher. In the fixed rate market the spread would be larger for lower rated firms. Lenders could rely more on Firm AAA than they could on Firm A. The spread in the two markets are unequal due to unequal rating of the firms. The differential of spread reflects the differential of likely default of Firm AAA relative to Firm A.

Theory of comparative advantage has been used to devise swap transaction in such a manner that both parties in the swap reduce their costs of funds. Generally, a firm with higher credit rating is able to procure funds at lower rates of interest than a firm with lower credit rating, irrespective of whether the borrowing is on fixed or floating rate basis. The

firm with higher credit rating is said to enjoy the absolute advantage over the firm with lower credit rating in both fixed rate and floating rate markets. The advantage of higher rated firm over the lower rated firm is called the credit quality spread.

Despite credit quality spread in both fixed rate and floating rate markets, it may be beneficial for the higher rated firm to engage in a swap deal with the lower rated firm due to the likelihood that the spread in both the markets may not be even. The differential of the absolute advantage measures the comparative advantage, which in turn forms the basis of swap deal. This comparative advantage is the aggregate benefit that both parties to the swap deal can share in proportion of bargaining powers of each.

Swaps are, therefore, a product resulting from arbitrage on credit rating. The question is will this credit arbitrage continue? Very much yes, as long as gaps in information and credibility remain.

Types of Interest Rate SWAPS

With the bank as intermediary and each party deals with the bank rather than each other. Interest rate swaps (IRS) can be categorized as follows.

Fixed-to-Floating

In the fixed-to-floating rate swaps the party pays fixed rate of interest to the bank or swap dealer and in exchange receives a floating rate interest determined on the basis of a reference/benchmark rate at predetermined intervals of time.

Such a swap is used by a firm which has floating rate liability and it anticipates a rise in the interest rates. Through the swap the firm will cancel out the receipts and payments of floating rate and have cash outflow based on the fixed rate of interest.

Floating-to-Fixed

In this kind of swap the party pays floating rate of interest to the bank or swap dealer and in exchange receives a fixed rate interest at predetermined intervals of time.

Such a swap is used by a firm who has fixed rate liability and it anticipates a fall in the interest rates. Through the swap the firm will cancel out the receipts and payments of fixed rate liability and have cash outflow based on the floating rate of interest.

Basis SWAP

In contrast to the fixed-to-floating or floating-to-fixed where one leg is based on fixed rate of interest, the basis swaps involve both the legs on floating rate basis. However, the reference rates for determining the two legs of payment are different. Basis swaps are used where parties in the contract are tied to one asset or liabilities based on one reference rate and want to convert the same to other reference rate. For example, if a firm having liabilities based on T-bills rate wants to convert it to MIBOR-based rate, then the firm can enter a basis swap where it pays MIBOR-based interest to the swap dealer in exchange of receiving interest based on T bills rate.

Lesson 2.5 - Currency Swaps

Currency SWAPS

In a currency swap the exchange of cash flows between counterparties take place in two different currencies. Since two currencies are involved, currency swaps become different from interest rate swaps in its uses functionality, and administration. The first recorded currency swap was initiated in 1981 between IBM and World Bank.

Where the exchange of cash flows is in two different currencies on the basis of a predetermined formula of exchange rates, it is known as currency swap. More complex swaps involve two currencies with fixed and floating rates of interest in two currencies. Such swaps are called 'cocktail swaps'.

Hedging Against Exchange Rate Risk

Currency swaps cover different kind of risk. It is way of converting liabilities or assets from one currency to another. While in case of interest rate swaps assets or liabilities are transformed from fixed interest rate to floating or vice versa providing hedge against fluctuating interest rates, the currency swaps provide a hedge against exchange rate risks as it transforms liability/asset from one currency to another.

Let us consider an example to see how multinational firms face currency risks and how can these be overcome through a swap deal.

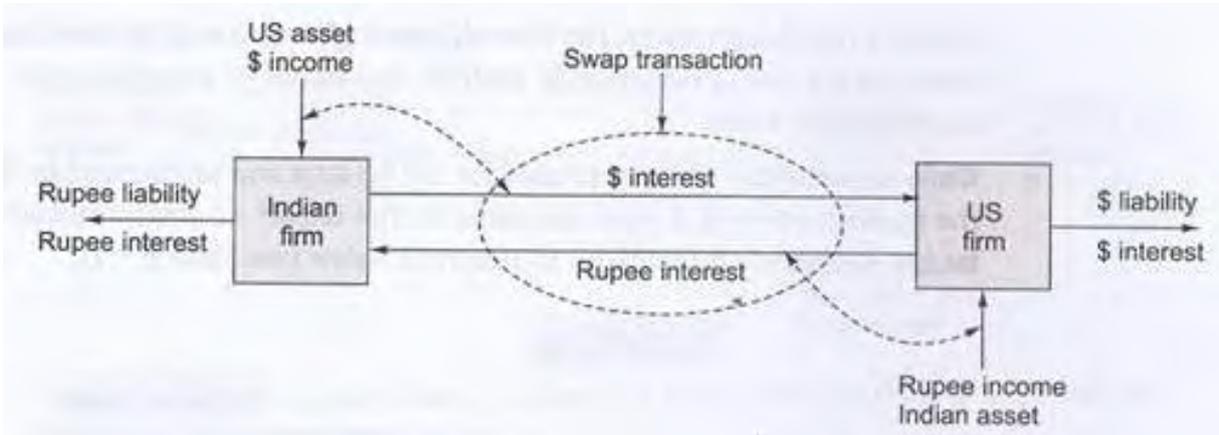
Assume that an Indian firm needs funds for its US operations. The firm raises funds in Indian rupees and commits to serve the interest obligation and the final repayment in Indian rupees. The funds raised in rupees are converted in US dollar to acquire assets in the USA. These assets provide income in US dollar. The Indian firm is facing a risk if rupee strengthens (dollar depreciates) in the currency markets as it receives lesser rupee amount for the fixed return earned in US dollar.

Similarly, an US firm which needs to acquire assets in India while raises dollar funds in USA, faces the same risk. Its earnings would be in Indian rupees and the liabilities need to be serviced in US dollar. Like the Indian firm the US firm also faces a risk of shortfall in US dollar if dollar appreciates (or rupee depreciates).

The vulnerability of both, the Indian firm and the US firm, is due to uncertainty of exchange rate movement, which may take place in either direction. While depreciation of dollar harms the Indian firm it benefits the US firm. In case dollar appreciates, the US firm is at loss while the Indian firm gains. The risks for both the firms arise because it is not known what direction exchange rates would take. Even though it is possible to make an estimate of the likely direction of exchange rates based on many theories, such as purchasing power parity (PPP) and interest rate parity (IRP), we are concerned here with the unexpected and adverse movement of exchange rates as all forecasts factor in the likely movement while making estimates.

The element of risk can be removed if the Indian firm and the US firm enter into a swap as depicted in Figure, which would reveal that the Indian firm has financed its US operations by creating rupee liability. This liability to be serviced by income generations in US dollar faces currency exchange rate risk. Likewise, the US firm having funded Indian operations through US dollar loan would be serviced by rupee income and needs to be converted to US dollar for payment of interest and principal in future whenever they fall due. Under the swap transaction the mismatch of cash inflow and cash out flow in different currencies for both the firms can be eliminated, by US firm agreeing to pay rupee generated out of its Indian operations to Indian firm in exchange of Indian firm agreeing to pay dollar generated out of its US operations.

Thus the rupee asset income flows to the Indian firm, facilitating service of rupee liability. In exchange, US dollar asset income flows to the US firm to meet its US dollar obligations. Both the firms avoid the conversion of currencies from one to another eliminating the exchange rate risk. Through the swap both the firms will have assets and liabilities translated in the same currency eliminating the currency risk.



Currency Swap-Converting Asset/ Liability from One Currency to Another

Example 3.3 Swaps to Hedge Against Exchange Rate Risk

Assume that an Indian software firm Inso Ltd wants to acquire a US firm with a cost of \$2.00 crore. For the purpose it raises the required capital of ₹ 90 crore (current exchange rate of ₹ 45/\$) at 12%. The US acquisition is expected to yield 15% return. At the same time a US engineering firm USENG Inc. is negotiating a joint venture to contribute US \$ 2.00 crore which promises to yield 15% return in India. USENG Inc. raises the required dollar at a cost of 8%. Assume that all liabilities need annual payments.

1. Examine the risk faced by Inso Ltd and USENG Inc. if the Rupee appreciates to 44, 42, 40, 38, and 36 per \$ for next five years. Rupee depreciates to 46, 48, 50, 52, and 54 per \$ for next five years
2. Show how a swap arrangement between the two can help eliminate the risk of exchange rate fluctuations.

Solution

Inso Ltd is targeting annual profit of ₹ 270 lakh as shown below.

Income in US dollar	= 15% of \$ 200 lakh	= \$ 30 lakh p.a.
Equivalent rupee		= ₹ 1,350 lakh p.a.
Interest payment	= 12% of ₹ 9,000 lakh	= ₹ 1,080 lakh p.a.
Anticipated profit	= 1350 - 1,080	= ₹ 270 lakh p.a.

If Indian rupee appreciates, Inso Ltd would receive lesser income than expected and hence, carries risk of reduction in profit due to appreciation of rupee, liability being fixed in rupee.

Similarly, USENG Inc. is targeting annual profit of \$ 14 lakh as shown below.

Income in rupee	= 15% of ₹ 9,000 lakh	= ₹ 1,350 lakh p.a.
Equivalent dollar		= \$ 30 lakh p.a.
Interest payment	= 8% of \$ 200 lakh	= \$ 16 lakh p.a.
Anticipated profit	= 30 - 16	= \$ 14 lakh p.a.

If Indian rupee depreciates, the firm will receive lesser annual income than expected and hence, face a risk of reduction in profit to the extent of depreciation in rupee, liability being fixed in dollar.

While appreciation of rupee is good for the US firm and detrimental to the Indian firm, the position reverses if rupee depreciates. The impact on the spreads of both the firms for the exchange rate scenario is presented below (see Table E).

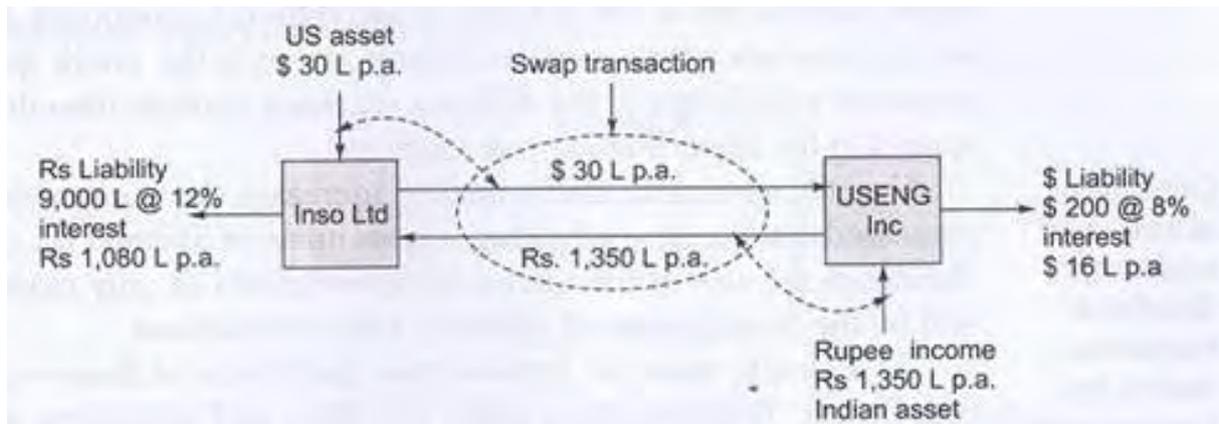
All figures (in lakh)

Year	Exchange Rate (₹/\$)	Indian Firm			US Firm		
		Income	Equivalent	₹	Income	Equivalent	\$
		US \$	Spread		₹	t \$	Spread
5	54.00	30.00	1,620.00	540.00	1,350.00	25.00	9.00
4	52.00	30.00	1,560.00	480.00	1,350.00	25.96	9.96
3	50.00	30.00	1,500.00	420.00	1,350.00	27.00	11.00
2	48.00	30.00	1,440.00	360.00	1,350.00	28.13	12.13
1	46.00	30.00	1,380.00	300.00	1,350.00	29.35	13.35
Now	45.00	30.00	1,350.00	270.00	1,350.00	30.00	14.00
1	44.00	30.00	1,320.00	240.00	1,350.00	30.68	14.68
2	42.00	30.00	1,260.00	180.00	1,350.00	32.14	16.14
3	40.00	30.00	1,200.00	120.00	1,350.00	33.75	17.75
4	38.00	30.00	1,140.00	60.00	1,350.00	35.53	19.53
5	36.00	30.00	1,080.00		1,350.00	37.50	21.50

2. By entering into a swap arrangement both the firms can eliminate the volatility of spread. Under the swap arrangement at current rate of ₹ 45 per \$:

- US firm will pay Indian firm ₹ 1,350 lakh annually earned out of its joint venture in India.
- Indian firm will pay \$30 lakh annually earned out of acquisition in the USA.

A schematic diagram of the swap arrangement is shown in Figure E. The spread after the swap arrangement becomes fixed for both the firms irrespective of exchange rate. The US firm will lock-in a return of \$ 16 lakh and the Indian firm will assure profit of ₹ 270 lakh after the swap arrangement. Without the swap the income for both the firms in the USA and India were subject to fluctuations due to currency exchange rate as reflected in Table E. After the swap as shown in Figure E the spreads for two firms would become stable in respective currencies as demonstrated in Table E.



Currency Swap-Converting Asset/Liability from One Currency to Another

Figures (in lakh p.a.)

Cash flows after swap	Inso Ltd.	USENG Inc.
Income earned abroad	+\$30	+ ₹ 1,350
Paid to counterparty	-\$30	- ₹ 350
Received from counterparty	+ ₹ 1,350	+\$30
Interest obligation	- ₹ 1,080	-\$16
Spread	+ ₹ 270	+\$14

Reducing Cost of Funds with Currency SWAP

Like interest rate swaps, currency swaps can also be used to reduce funding cost for multinational firms needing funds in different currencies. Again the guiding principle is theory of comparative advantage. In the interest rate swap the comparative advantage emanated from differential pricing in the floating rate and fixed rate markets. Here the comparative advantage will result from two distinct and separate markets governed by altogether different sets of rules and operating in vastly different economic conditions.

Though the exchange rate mechanism provides a link among these markets and economies, the link is a frail one as compared to the strong linkages the capital and debt markets have in a single economy. The quality spread in domestic markets is based on the credit rating of the parties. In the international markets the credit rating for the same firm may vary substantially across nations, as firms are generally better known in their own country and lesser known in a foreign country.

Further, exchange control regulations of the land may discourage borrowing to the non-residents by stipulating a higher rate. Therefore, the comparative advantage is likely to be more pronounced in two markets in two different economies, as compared to similar

markets of the same economy. As such the credit quality spread is expected to be larger in the different currency markets than the credit quality spread in the fixed/floating rate markets.

Greater spread in credit quality increases the comparative advantage. Increased comparative advantage opens up more avenues for currency swaps. However, the size of the market may be limited as only multinational firms will be the beneficiaries of currency swap transactions.

As a simple example consider two multinational firms—one Indian and one British. Both the firms enjoy excellent and equivalent credit rating in their countries. However, their funding requirements are confined to their own countries. Now they need to raise funds across nations for their ever increasing needs of expansion, and to capitalize on the interest rate differentials that may exist in various currencies.

Following is the cost of capital for two firms in India and Britain in their respective currencies.

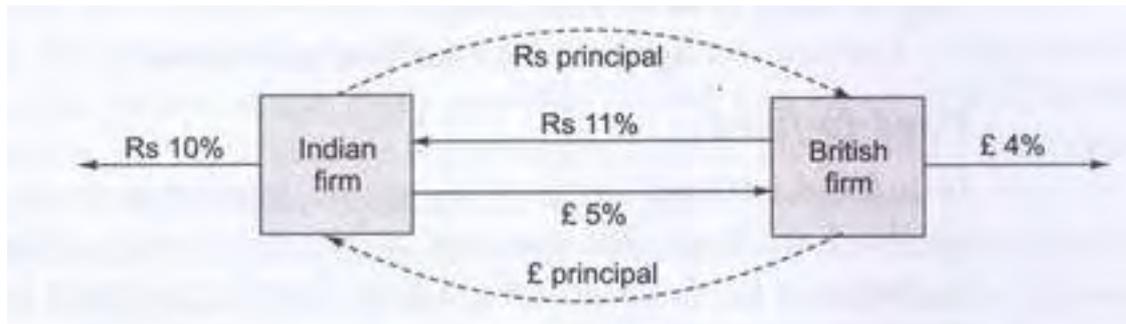
	Indian Market Rupee Market	British Market Pound Market
Indian Firm	10%	6%
British Firm	14%	4%
Advantage - British Firm	-4%	2%

Clearly and naturally, the Indian firm enjoys an advantage over the British firm in India and the British firm commands more credibility in Britain as compared to the Indian firm. Notice that the absolute advantage may not be in favour of the same firm as was the case in the interest rate swap. The comparative advantage here is 6%. If the two firms borrow in the required currency the total cost of funds will be 20%, i.e. the Indian firm borrows pound at 6% and the British firm borrows rupee at 14%. However, if they borrow as per the comparative advantage theory and exchange each other’s commitment, the total cost of funds can be reduced to 14% with British firm borrowing pound at 4% and Indian firm borrowing rupee at 10%. Both the firms can benefit by 6% in aggregate if they enter into a swap arrangement wherein

- (a) Indian firm mobilizes funds in rupees in the Indian market at 10%,
- (b) Indian firm lends the rupee funds to British firm at ho/n,
- (c) British firm raises funds in the British market in pound at 4%

- (d) British firm lends the same funds to the Indian firm at 5%,
- (e) Exchange the interest payment periodically, and
- (f) Finally, exchange the principal upon redemption.

The schematic diagram of the swap arrangement and cost of funds for both the firms is shown in Figure.



	Indian firm	British firm
1. Payment to investors	Rupee 10%	Pound 4%
2. Payment to counterparty	Pound 5%	Rupee 11%
3. Receipt from counterparty	Rupee 11%	Pound 5%
Cost of borrowing (1 + 2 + 2)	Pound 4%	Rupee 10%

Currency Swap to Reduce Cost of Funds

It was assumed in the example that the Indian firm and the British firm exchanged the principal amount of borrowing and as a natural outcome will have to exchange the repayment at the time of redemption.

However, it is not essential to do so as both the firms can use the spot market for buying and selling the required currencies independent of each other, both at the time of raising funds and at its redemption.

Through the swap the Indian firm is now able to obtain pound funds at 4% as against 6% in the absence of swaps—a benefit of 2%. Similarly, the British firm has access to rupee funds at 10% as against 14%—a benefit of 4%. The aggregate benefit is equal to the comparative advantage of 6%, which may be shared by the two firms depending upon negotiating skills and strength of the two firms involved.

Distinguishing Features of Currency SWAP

It may be seen that currency swap is similar to parallel loan. However, swaps are better because they may be entered with the financial intermediary saving the trouble of finding the counterparty with matching needs as also reducing the counterparty risk.

Though working on the same principle of comparative advantage, operationally currency swaps become different than interest rate swaps. Under currency swap the cash flows are as follows:

1. Exchange of principal at the time of setting the swap deal at the current spot rate
2. Exchange of periodic interest payments
3. Exchange of the principal back upon maturity

Under interest rate swap there is no exchange of principal at the beginning of swap or at its conclusion.

Currency swaps may be classified as following

In a fixed-to-fixed currency swap the interest rates in the two currencies involved are fixed. For example, a British firm may raise loan in pound and exchange it for dollar to an US firm. Interest payment may be made by the British firm in dollar while receiving pound interest from the US firm. The US firm would do the reverse, making interest payment in pound and receiving dollar interest. The interest rate in US dollar and pound both are fixed.

(a) Fixed-to-Floating

In a fixed-to-floating currency swap the interest rate in one of the currencies is fixed while other is floating. In the earlier example if the British firm made interest payment in dollar at a fixed rate while receiving pound interest based on London Inter Bank Offer Rate (LIBOR) from the US firm, such a swap would be fixed to floating. Such swaps not only transform the nature of asset/ liability from one currency to another but also change it from fixed rate to floating rate. It becomes a complex tool for hedging against currency risk as well as interest rate risk.

(b) Floating-to-Floating

In a floating-to-floating currency swap both the interest rates are floating but in different currencies. In the earlier example if the British firm made interest payment in

dollar based at prime rate in the USA while receiving pound interest based on LIBOR from the US firm, such a swap would be floating-to floating.

Valuation of Swaps

Pricing of the swap is an important issue for two reasons. First, as stated earlier banks function as warehouse of swaps and are ready to offer swap to the desired customers. For this they are required to quote the swap rates for paying and receiving a fixed rate of interest for receiving/paying the benchmark variable rate. The other reason for valuing the swap is for the purpose of cancellation of an existing swap. For reasons of economy a firm may like to cancel the obligations or part thereof by paying or receiving the value of the swap at that point of time.

Valuing Interest Rate Swap

As stated earlier, an interest rate swap consists of fixed rate cash flow and floating rate cash flow in the opposite direction. At the time of inception of the swap the present value of these payments must be equal in the opinions of both the parties to the swap else they would not agree to it.

Therefore, at inception the value of swap is zero implying that the present values of cash inflows and outflows are equal and its aggregate flow is zero.

However, the circumstances would change after the swap is initiated. The value of an interest rate swap at any time is the net difference between the present value of the payments to be received' and the present value of the payments to be made. It becomes positive to one party and is equivalently negative to the other party. This tells how much cash the two parties must exchange to nullify the remaining obligations in the swap.

From the valuation perspective a swap transaction may be interpreted in at least two ways. It can be thought of either as a pair of bonds or a series of forward agreements. Any of the interpretation of the swap helps in its initial pricing as well as its valuation, if and when one wants a premature closure. We take the pricing of swap by both methods by treating the swap as pair of bonds or as a series of forward agreements.

Swap as Pair of Bonds

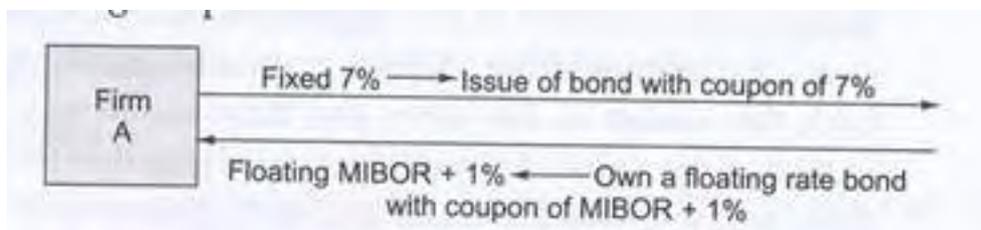
The most common interpretation of interest rate swaps is to consider the inflows and outflows of interest at periodical intervals equivalent to that of bonds. In an interest

rate swap one leg of transaction is on a fixed rate and the other leg is on the floating rate of interest. We also know that if one owns a bond he receives interest and if one issues a bond he pays the interest. Therefore, a swap comprises the following.

1. The cash inflow equivalent to the interest on the bond owned
2. The cash outflow equivalent to paying the interest on the bond issued Interest rate swap

Therefore, a swap is a pair of bonds—one issued and the one owned. A swap where one pays fixed and receives floating can be viewed as combination of having issued a fixed rate bond, paying the fixed coupon rate and simultaneously owning a floating rate bond, receiving a floating rate as per the market conditions, as depicted in Figure.

While setting up the swap the coupon rate (the fixed leg receipts/payments) is fixed in such a manner that the values of cash inflows and cash outflows are equal and both the parties to the swap arrangement are in equilibrium, the net present value of the cash flows being zero. This forms the basis of fixing the initial price of the swap determined in terms of fixed rate of interest payable or receivable upon exchange of a floating benchmark rate. For Firm A in Figure the equivalent of MIBOR may be taken as 6%, at the time of initiating swap.



Swap as Pair of Bonds

However, the interest rates are dynamic and the value of cash flows as determined at the start of swap will not remain same as time elapses. The value of the swap will depend upon the behaviour of bond prices with respect to changes in the interest rates.

Following rules about bond prices may be handy while valuing swaps.

1. The value of fixed rate bond will increase with the fall in interest rates.
2. The value of fixed rate bond will decrease with increase in interest rates.
3. The value of floating rate bond remains equal to par value as coupon rate is aligned with market rates on each periodic payment of interest.

4. The value of floating rate bond changes subsequent to payment of each interest, if the interest rate structure has changed since then, but again gets aligned to the par value on the next payment of interest.

Since the change in value of the floating rate bond will only be nominal and temporary (it changes only during the two interest payments), the value of swap determined on the basis of difference in the present values of the fixed and floating legs, is predominantly dependent upon the value of fixed rate bond.

The value of the bond with fixed rate payments will be equal to sum of coupon payments and the notional principal amount discounted at an appropriate rate. The discount rate to be used for each coupon payment is known from the term structure of interest rates.

The value of the fixed interest payment leg, V_c , is given by Equation 3.1.

$$V_c = \sum_{i=1}^n \frac{c_i}{1+(r_i)^n} + \frac{P}{1+(r_i)^n} \quad (3.1)$$

Where C_i = Coupon payment at time, i ; r = Discount rate for period, i ;

n = number of periods remaining; and P = Notional principal amount.

Similarly, we can find the value of the floating rate bond V_f which is equal to present value of the next interest payment and the principal. As we know that the value of the floating rate bond converges to the par value on each payment date, the value of the floating leg can be expressed as Equation 3.2.

$$V_f = \frac{F_1}{(1+r_1)} + \frac{P}{(1+r_1)} \quad (3.2)$$

Where F_1 = Next payment of interest; r_1 = discount rate for period 1; and P = Notional principal amount.

And the value of the swap for one receiving fixed and paying floating will be equal to the differential of the fixed leg and floating rate cash flows given as Equation 3.3.

Value of swap PV of fixed coupon bond - PV of floating rate bond or

$$V_s = V_c - V_f$$

$$V_s = \sum_{i=1}^n \frac{c_i}{1+(r_i)^n} + \frac{P}{1+(r_i)^n} - \left(\frac{F_1}{(1+r_1)} + \frac{P}{(1+r_1)} \right) \quad (3.3)$$

Let us consider a simple example of valuation of swap assuming it to be a pair of bonds. Assume that two years ago Firm A has entered a 5-year interest rate swap where it receives fixed 8% and pays MIBOR + 1%. For simplicity of exposition we assume annual payments. There are three remaining annual payments.

Since the time of the swap, the interest rates have moved upwards causing the value of the swap to change. Note that the value of the swap was zero two years ago when it was set up. Assume that the payment of the floating rate determined one period in advance is at the rate of 9.5% (MIBOR was at 8.50% then). The term structure of interest rates as on today is as follows:

1 year	:	10%
2 years	:	10.5%
3 years	:	11%

We find the value of the floating rate bond for an assumed principal payment of ₹ 100 by discounting the interest (₹ 9.50) and the principal (₹ 100) at 10%.

$$\text{Value of the floating rate bond} = 109.50/1.10 = ₹ 99.545$$

The value of fixed rate bond can be found by discounting the three cash flows at the appropriate discount rate given by term structure, would be

$$V_c = \frac{8}{(1+0.10)} + \frac{8}{(1+0.105)^2} + \frac{8}{(1+0.11)^3} + \frac{100}{(1+0.11)^3}$$

$$= 7.273 + 6.552 + 5.849 + 73.119 = ₹ 92.793$$

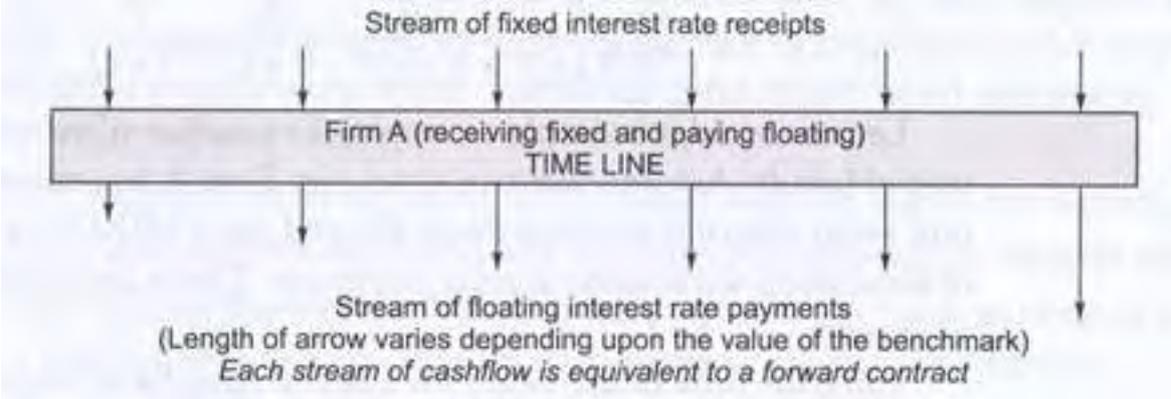
$$\begin{aligned} \text{The value of swap} &= \text{PV of inflow} - \text{PV of out flow} \\ &= 92.793 - 99.545 = - ₹ 6.752 \end{aligned}$$

The present value of inflow of the fixed leg for Firm A is ₹ 92.793 and that of floating rate outflow is ₹ 99.545. The swap can be cancelled if Firm A pays ₹ 6.752 now to the counterparty.

SWAP as Series of Forward Contracts

In a swap regular payments of interest are made and received by the counter- parties. Next cash flow of interest can be considered as forward transaction. Similarly, all subsequent cash flows are regarded as future dated delivery commitments. The timings of each cash

flow is known in advance and hence, swap can be regarded as a series of forward contracts maturing on specified dates with the amounts of respective interest payments as shown in Figure. Swap is a single contract encompassing several forward contracts.



Swap-as Series of Forward Contracts

The objective achieved by swap can also be achieved by booking several forward contracts of interests (known as FRAs covered in the previous Chapter). However, forward contracts are normally not available for far extended dates in future. Even if they do, they suffer from poor liquidity and expensive pricing. Swap quotes and contracts are available for much longer periods as a bundle of several forward contracts and may be cheaper than the sum of the series of independent forward contracts.

The valuation of swap requires computation of present values of fixed rate leg and the floating rate leg. While the interest payments of fixed rate leg are known for the entire remaining duration of the swap, the cash flows of the floating rate leg is known for only the next immediate payment. For all subsequent periods the cash flows for the floating rate leg will be determined only one period in advance. Hence, all the payments cannot be known today. This poses problem in valuation of swap when we assume it to be a series of forward rate agreements.

Treating the swaps as series of the forward rate agreements, swap arrangement of the above example can be viewed as shown below.

Period 't'	Year 'y'	Firm Receives %	Firm Pays %
1	3	8.00	9.50 fixed at t = 0
2	4	8.00	Rate to be determined at t = 1; y = 3 say r_1
3	5	8.00	Rate to be determined at t = 2; y = 4 say r_2

With the given term structure of interest rates the floating rate payments are implied. The term structure of the interest rate is given below.

One-year yield investment starting today:	${}_0r_1 = 10.00\%$
Two-year yield investment starting today:	${}_0r_2 = 10.50\%$
Three-year yield investment starting today:	${}_0r_3 = 11.00\%$

Where ${}_0r_n$ implies the interest rate for the investment period starting at 0 and ending at the n^{th} period.

The forward rates of interests are built in the term structure of interest rates. The implied forward rate can be calculated on the argument of equivalence of investment under two strategies of

- (a) Direct investment for planned horizon, and
- (b) Making investment now and rolling it over from period to period to cover the entire planned horizon.

From the above data, we may have either direct investment for 2 years at 10.5%, i.e. ${}_0r_2$ or invest for one year at 10%, i.e. at ${}_0r_1$ and then roll over the matured amount for another year at one-year rate one year from now, i.e. ${}_1r_2$ both the strategies must yield the same end value of the investment. Given this condition we have the following relationship.

$$(1 + {}_0r_1) \times (1 + {}_1r_2) = (1 + {}_0r_2)^2$$

Or $1.10 \times (1 + {}_1r_2) = (1.105)^2$

Or ${}_1r_2 = 11.002\%$

The present term structure of interest rate implies that market expects one year investment yield one year later at 11.002%. The investor can invest for two-year period at 10.5% and get ₹ 1.2210. Alternatively, he can invest for one year at 10% and get ₹ 1.10 after one year. This amount would be reinvested at 11.002% for one more year to give ultimate wealth of ₹ 1.2210. Therefore, the second interest payment for the floating rate (to be decided one year from now) is expected to be 11.002%.

Using the same logic that a three-year investment should be equivalent to a two-year investment rolled over for another year at the rate prevailing for one-year investment after two years, i.e. ${}_2r_3$, and we have

$$(1 + {}_0r_2)^2 \times (1 + {}_2r_3) = (1 + {}_0r_3)^3$$

Or $1.1052 \times (1 + {}_2r_3) = (1.11)^3$

Or ${}_2r_3 = 12.007\%$

With estimated floating rate payments as derived from term structure of interest rates, we shall now estimate the value of the swap as:

$$\text{Net Present Value of forward agreement} = \frac{\text{Amount of fixed leg} - \text{Amount of floating leg}}{(1 + \text{Discount rate})^2}$$

$$\text{Value of first swap payment} = \frac{(8.00 - 9.50)}{1.10} = -1.364$$

$$\text{Value of second swap payment} = \frac{(8.00 - 11.002)}{1.105^2} = -2.458$$

$$\text{Value of third swap payment} = \frac{(8.00 - 12.007)}{1.11^3} = -2.930$$

The value of swap comes to - ₹ 6.752 as computed with the assumption of swap as pair of bonds.

Swap Quotes and Initial Pricing

Many banks in the international markets play a role of market maker for swaps. These banks quote two-way swap rates in terms of fixed rate of interest for receiving and paying floating rates of interest. A bid rate is the fixed rate of interest the bank will pay to receive floating; and ask or offer rate is the fixed rate of interest bank will receive for paying floating. The average of two rates is known as swap rate. At swap rate the value of the swap is zero i.e. the values of fixed and floating rates are equal.

In order to determine the initial swap rate we equate the present values of the cash flows of the fixed rate bond and floating rate bond. The cash flows of the fixed rate bond are known for the entire duration of the swap. The cash flows pertaining to the floating rate are not known.

As Series of Forward Contracts

How do we price a swap? We again use the term structure of interest rates to derive the cash flows of the floating rate leg, as they are the best estimates available.

Let us consider an example for quoting a two-year swap with annual exchange of cash flows. The pricing will be done in the form of % interest of the fixed leg to be received/paid for paying/receiving a benchmark floating rate of interest. Internationally the benchmark is LIBOR. However, here we assume exchange of MIBOR for fixed coupon for five years.

To equate the present values of the two legs we need to estimate the cash flows pertaining to the floating rate bond. The cash flows of the floating rate bonds are decided normally one period in advance, implying that next payment is equal to prevailing MIBOR. The remaining payments will have to be estimated.

The term structure of interest rates provides the best estimates of the likely pay out for the floating leg payments, using equivalence of direct investment for planned horizon or rolling over periodically.

Therefore, the PV of the floating rate leg is equal to

$$\frac{{}_0r_1}{(1+{}_0r_1)} + \frac{{}_1r_2}{(1+{}_0r_2)^2} + \frac{{}_2r_3}{(1+{}_0r_3)^3} + \frac{{}_3r_4}{(1+{}_0r_4)^4} + \frac{{}_4r_5}{(1+{}_0r_5)^5} \quad (3.4)$$

Assuming a fixed payment of interest of X in the fixed leg the PV of the fixed rate leg is

$$\frac{X}{(1+{}_0r_1)} + \frac{X}{(1+{}_0r_2)^2} + \frac{X}{(1+{}_0r_3)^3} + \frac{X}{(1+{}_0r_4)^4} + \frac{X}{(1+{}_0r_5)^5} \quad (3.5)$$

For initial pricing we have to equate the cash flows of fixed and floating rate and solve for the only unknown X

With the term structure of interest rate we can arrive at the discount factors and floating rate payments as implied forward rates, as shown in Table.

Finding Floating Rate Payments

Year	Interest Rate	Implied Forward Rte Given by	Implied Forward Rate	Discount Factor
1	${}_0r_1 = 6.5\%$	$(1 + {}_0r_1) = (1 + {}_0r_1)$	${}_0r_1 = 6.500\%$	0.9390
2	${}_1r_2 = 7.0\%$	$(1 + {}_0r_1) \times (1 + {}_0r_2) = (1 + {}_0r_2)^2$	${}_1r_2 = 7.502\%$	0.8734
3	${}_2r_3 = 7.5\%$	$(1 + {}_0r_2)^2 \times (1 + {}_2r_3) = (1 + {}_0r_3)^3$	${}_2r_3 = 8.507\%$	0.8050
4	${}_3r_4 = 8.0\%$	$(1 + {}_0r_3)^3 \times (1 + {}_3r_4) = (1 + {}_0r_4)^4$	${}_3r_4 = 9.514\%$	0.7350
5	${}_4r_5 = 8.5\%$	$(1 + {}_0r_4)^4 \times (1 + {}_4r_5) = (1 + {}_0r_5)^5$	${}_4r_5 = 10.523\%$	0.6650

Putting the values in two equations we get

$$\begin{aligned} & X (0.9390 + 0.8734 + 0.8050 + 0.7350 + 0.6650) \\ &= 6.500 \times 0.9390 + 7.502 \times 0.8734 + 8.507 \times 0.8050 + \\ & \quad 9.514 \times 0.7350 + 10.523 \times 0.6650 \end{aligned}$$

Or $4.0174 x = 0.3349$

$$X = 0.0834 \text{ equivalent to } 8.34\%$$

The swap rate will be 8.34% for paying or receiving MIBOR. To this equilibrium swap rate the dealer/bank will add its spread to cover its administrative cost and as well as the counterparty risk.

Assume that bank wants to add 40 bps, as spread the swap quote of the bank would be 8.14%-8.54%. This means bank will pay 8.14% fixed for receiving MIBOR, and receive 8.54% fixed for paying MIBOR. As the tenure of the swap becomes longer the spread increases.

As a Pair of Bonds

Same result would be obtained if we treat swap as a pair of fixed rate and floating rate bond. The values of the two bonds must be equal at the inception of the swap making net present value (NPV) equal to zero, cash flows of the two bonds being opposite.

The value of fixed rate bond with coupon of X would be equal to 4.0174x for the term structure used above. The value of the principal would, however, be 0.6650 x R if R is the principal. Since floating rate bond adjusts to the par value at each coupon date, the value of the floating rate bond would be equal to its par at the inception of the swap. Equating the two we get

$$100 \times 0.6650 + 4.0174 \times X = R$$

If R is taken as ₹ 100, the value of X the coupon of the fixed rate bond would be

$$X = \frac{1-0.6650}{4.0174} \times 100 = 8.34$$

The swap rate then can be written as

$$\text{Swap Rate} = \frac{1 - \text{Last discount factor}}{\text{Sum of all discount factors}} \quad (3.6)$$

Example 3.4 Value of Interest Rate Swap

A firm had entered into a swap arrangement for a notional principal of ₹ 1 crore with a bank where the bank paid 9% fixed and received MIBOR semi annually. It has 3 more years to go and has just exchanged the cash flow. The 6-month MIBOR for the next payment of interest was reset at 8%. Next day the markets exhibited a fall and the 6-month MIBOR fell to 7%, leading the firm to believe that it is overpaying. It wants to cancel the swap arrangement. How much should the firm ask the bank to pay to cancel the swap deal?

Solution

The value of the swap for the firm is determined on the basis of discounted cash flows. Since the rates have changed the discount rate used would be 7%; the prevalent market rate. The value of the cash outflows on the fixed basis discounted at 7% is ₹ 115.63 as shown below (see Table E).

Fixed leg payment - Cash outflow	9.00%
Present 12-month MIBOR	7.00%
Next Interest payment on floating rate	8.00%

Present Value of Cash Flow of the Fixed Leg

Months	Years	Cash Flow	DCF at 7.00%
6	0.50	4.50	4.42
12	1.00	4.50	4.35
18	1.50	4.50	4.27
24	2.00	4.50	4.20
30	2.50	450	4.13
36	3.00	104.50	94.25
Present Value of Fixed Leg			115.63

The present value of the inflow at floating rate would be next interest, payment known decided a period in advance plus face value of ₹ 100 discounted at 7/a. This amount works out to ₹ 100.48 (see Table E):

Value of Floating Leg

Interest to be received after 6-rn	4.00
Principal to be received after 6-m	100.00
	104.00
Present Value at 7.00%	100.48

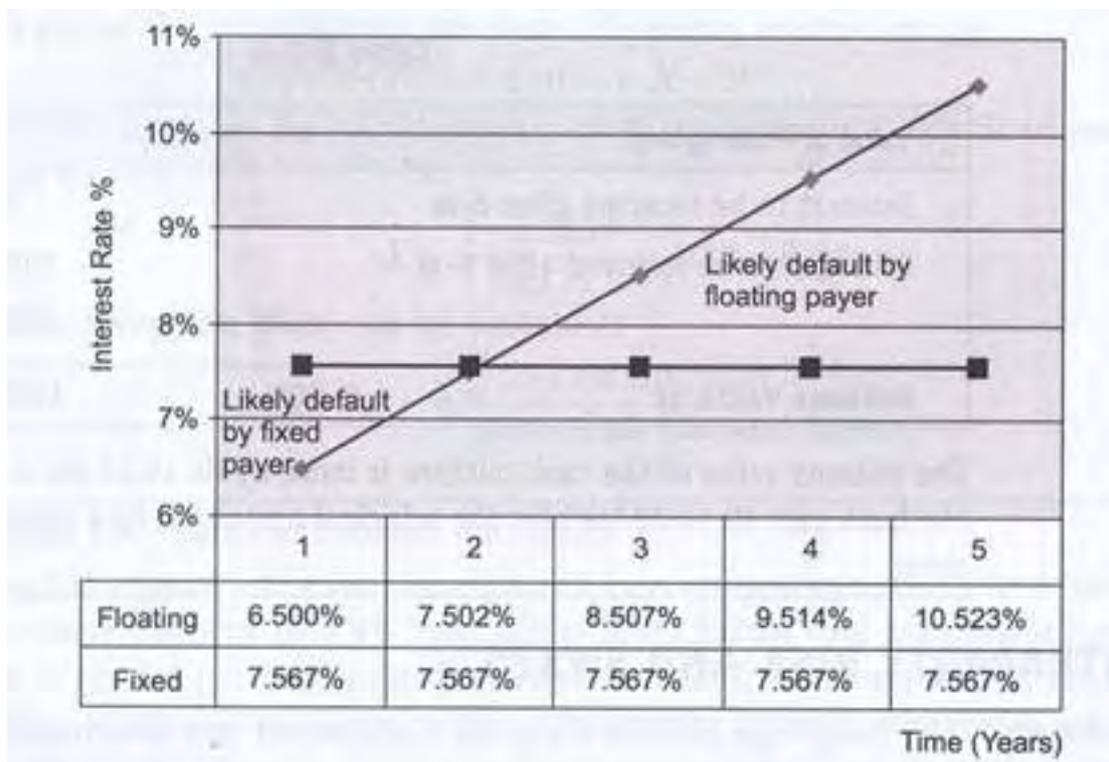
The present value of the cash outflow is more by ₹ 15.15 for a principal of ₹ 100. If the bank pays ₹ 15.15 lakh for the principal amount of ₹ 1 crore, the firm may exit the swap.

Counterparty Risk and Swaps

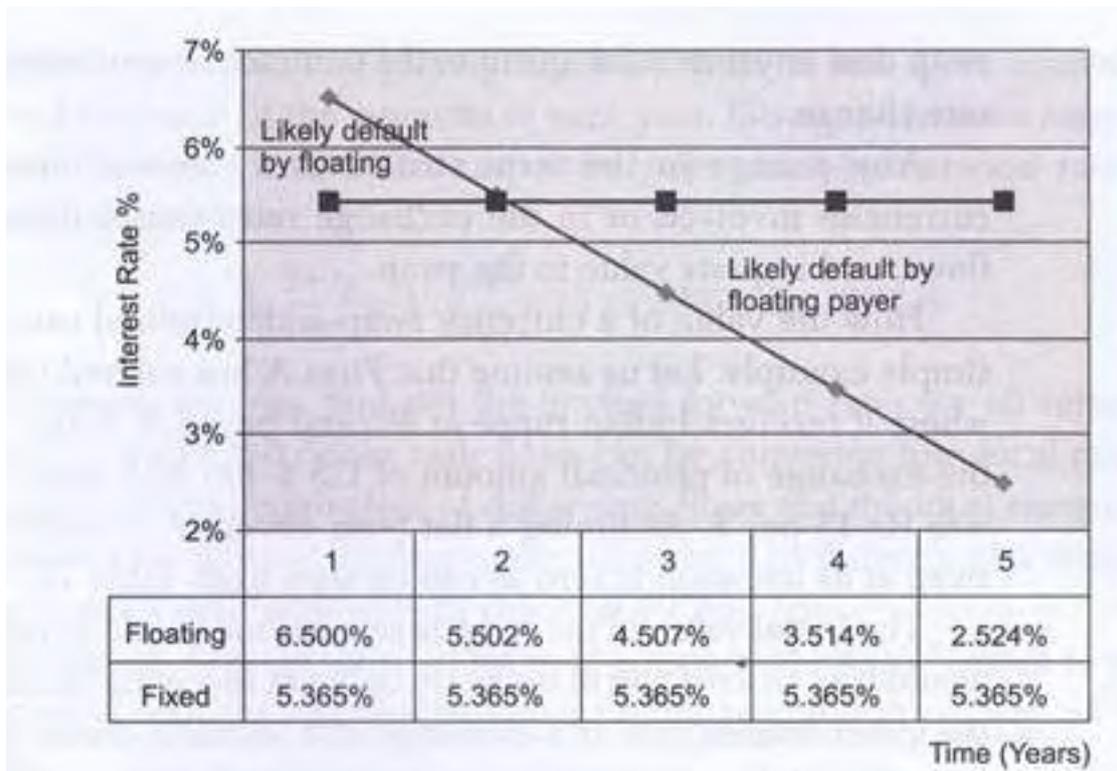
The swap rate of 8.34% can be interpreted as a weighted average of the floating rate payments over the period of swap. It is like YTM of a bond, which equates all cash flows of the bond to its price with a single discount rate. The floating rate payments are based on the implied forward rates. The two legs of fixed and floating payments are not equal but the aggregate of these payments become equal at the conclusion of the swap deal

The floating rate payments will be either more or less than the fixed rate payments, depending upon the direction of the term structure of interest rates.

If the term structure of interest rate is upward sloping then the floating rate payments will keep increasing with time. Initially the floating leg will be smaller than the fixed leg, and as the time passes floating rate payments start increasing and exceed the fixed leg payments. This is shown in Figure. Similarly, if the term structure of interest rates is downward sloping, the floating rate payments will be higher than the fixed leg during the initial years of swap and reduce subsequently as shown in Figure. Eventually, at the end of the swap the pay out on both the legs would be equal in either case.



Swap Payment (Upward Sloping Term Structure)



Swap Payment (Downward Sloping Term Structure)

This has important implication with regard to counterparty risk in a swap deal.

In case of upward sloping term structure of interest rates, the fixed rate payer pays more than what he receives in the early part of the swap. There is net cash outflow during initial years of the swap deal, and hence fixed rate payer is the only party likely to default in the initial years. In the later stages of the swap the floating rate payment exceeds the fixed rate payments and hence the floating rate payer is more likely the default party.

The situation reverses if the term structure of interest rates is downward sloping. The intermediary faces default risk from floating rate payer in the initial part of the swap, while fixed rate payer is more likely to default in the later stages of the swap deal. The intermediary must take appropriate steps to contain this risk as it serves as counterparty to both the parties in the swap deal.

Valuing Currency Swap

We can price currency swap on the same lines and principle as that of interest rate swap, i.e. equating the value of cash inflows with the value of cash outflows. These cash flows are in different currencies, domestic and foreign and need to be converted to the domestic currency. If the present values of cash flows of domestic currency and foreign

currency are V_d and V_f respectively, and the spot rate is S then the value of the swap, which pays domestic and receives foreign currency, is given by

$$V_s = S \times V_f - V_d \quad (3.7)$$

The initial pricing of the swap is set such that the present values of foreign and domestic currency cash flows are equal, and the value of swap is zero. The most common currency swaps involve exchange of principal in the beginning, periodic payment of interest on predetermined interest rates at predetermined intervals, and re-exchange of principal at the end of the swap contract. We have to value these cash flows to know the worth of the swap deal any time subsequent to the contract, as spot rates as well as risk-free rate change.

Any change in the term structure of interest rates in either of the currencies involved or in the exchange rates causes disequilibrium in cash flows, and imparts value to the swap. How the value of a currency swap is determined can be seen through a simple example. Let us assume that Firm A has entered into a five-year swap where it receives Indian rupee at 8% and pays US dollar at 4% annually on the exchange of principal amount of US \$100 lakh when the exchange rate was ₹ 45 per \$. Assuming a flat term structure of interest the value of the swap at its initiation is zero as can be seen from Table.

The initial value of the swap is zero as one would expect because no deal would take place if any of the party believes receiving less and paying more in the given interest rate and exchange rate scenario. Firms receiving and paying rupee/dollar must feel equivalence in both the currencies at the current interest rates and exchange rates so as to enter into a swap deal.

Initial Value of Swap

Rs (in lakh)

Year	₹ Interest and Principal	US \$ Interest and Principal	PV (₹) Discounted at 8%	PV (Us \$) Discounted at 4%
1	360.00	4.00	333.33	3.85
2	360.00	4.00	308.64	3.70
3	360.00	4.00	285.78	3.56
4	360.00	4.00	264.61	3.42
5	360.00	4.00	245.01	3.29
5	4,500.00	100.00	3,062.62	82.19
Total			4,500.00	100.00
Equivalent domestic currency @ ₹ 45/\$				4,500.00
Swap value				0

Valuation of swap can also be done on the basis of treatment of payments as series of forward contracts. The forward rates can be worked out from the interest rate structure using interest rate parity. The cash flow of interest of \$ 4 lakh in year ₹ 1-5 and principal of \$100 lakh in year 5 are equivalent to forward contracts of the amounts in each year. Given the interest rates of 8% and 4% for rupee and dollar respectively the one-year forward rate using interest rate parity is

$$F_1 = S_0 \frac{1+r_d}{1+r_f} = 45 \frac{1.08}{1.03} = 45 \times 1.0385 = ₹ 46.43\$$$

Likewise, one can find out the implied forward rates for all subsequent periods at which the dollar cash flows can be converted into local currency. The differential of equivalent of dollar cash flows and the local currency will be the net cash flows of the firm under the swap. The differential is discounted at the interest rate applicable to rupee (see Table).

Assuming swap as series of forward contracts the value comes to zero in conformity with the calculation based on the assumption of swap as pair of bonds.

Let us calculate the value of swap assuming that the domestic interest rate has gone up from 8% to 10%, while the dollar interest rate remains same at 4%. Note that the absolute values of the cash flows pertaining to the interest and principal as fixed at the time of setting up of the swap deal do not change.

Currency Swap as Series of Forward Contracts

Figures (in lakh)

Year	₹ Interest and Principal	US \$ Interest and Principal	Implied forward Rate (₹ / \$)	Equivalent ₹	Value of Forward	PV of Forward
1	360.00	4.00	46.73	186.92	173.08	160.26
2	360.00	4.00	48.53	194.11	165.89	142.22
3	360.00	4.00	50.39	201.58	158.42	125.76
4	360.00	4.00	52.33	209.33	150.67	110.75
5	360.00	4.00	54.35	217.38	142.62	97.06
5	4,500.00	100.00	54.35	5,434.56	-934.56	-636.05
Total						0.00

With the change in the domestic interest rates the discounted value of the rupee cash flow changes as shown in Table.

Value of the Swap with Change in Interest Rate

Year	₹ Interest and Principal	US \$ Interest and Principal	PV (₹) Discounted at 10%	PV (Us \$) Discounted at 4%
1	360.00	4.00	327.27	3.85
2	360.00	4.00	297.52	3.70
3	360.00	4.00	270.47	3.56
4	360.00	4.00	245.88	3.42
5	360.00	4.00	223.53	3.29
5	5,000.00	100.00	3,104.61	82.19
Total			4,469.29	100.00
PV in equivalent rupees			5,000.00	
Value of swap				-530.71

As may be seen from Table, with the rise in the interest rates in rupee the discounted value of the rupee cash flow falls and if the firm is paying rupee the value of the swap becomes negative ₹ 531 lakh. For a firm that receives rupee and pays \$ the value of the swap is positive ₹ 531 lakh. These values can be used to reverse the positions in the swaps taken earlier.

Value of Currency Swap as Series of Forward Contracts

Figures (in lakh)

Year	₹ Interest and Principal	US \$ Interest and Principal	Implied forward Rate (₹/\$)	Equivalent ₹	Value of Forward	PV of Forward
1	360.00	4.00	52.88	211.54	148.46	134
2	360.00	4.00	55.94	223.74	136.26	112.61
3	360.00	4.00	59.16	236.65	123.35	92.67
4	360.00	4.00	62.58	250.30	109.70	74.92
5	360.00	4.00	66.19	264.74	95.26	59.15
5	5,000.00	100.00	66.19	6,618.61	-1,618.61	-1,005.03
Value of the swap						-530.70

The same value of the swap is obtained if transactions under the swap are regarded as series of forward contracts. One can calculate

1. The implied forward rates as per interest rate parity,

2. Convert the foreign currency cash flows to domestic currency at implied forward rate, and
3. Discount the differential of payments at domestic interest rate. This is shown in Table. The value of the swap comes to - ₹ 531 lakh.

Example 3.5 Value of Currency Swap

A swap was entered by an Indian firm with a bank converting its rupee liability into British pound, where the firm received 10% on Indian rupee and paid 5% on British pound. The amount of principals involved are ₹ 120 million and £ 1.5 million fixed at the then exchange rate of ₹ 80/£. The swap has 4 semi-annual payments to follow. Assume the next payment is due after 6 months from now and term structure in Indian rupee and British pound is flat at 9.00% and 5.50% respectively, for the next 2 years. If the current exchange rate is ₹ 82.00/£, what is the value of the swap for the Indian firm and the bank?

Solution

The semi-annual payment of interest is $0.05 \times 120 = ₹ 6$ million. The final payment would be ₹ 126.00 million along with the principal amount. With 9% flat term structure on continuous compounding the present value of the receivable by the firm from the bank would be

PV of rupee cash flow =

$$6.0 \times e^{-0.09 \times 0.5} + 6.0 \times e^{-0.09 \times 1.0} + 6.0 \times e^{-0.09 \times 1.5} + 126.0 \times e^{-0.09 \times 2.0}$$

PV of rupee cash flow = $5.7360 + 5.4836 + 5.2423 + 105.2440 = ₹ 121.7059$ million

PV of rupee cash flow in pound terms = $121.7059/82.00 = £ 1.4848$ million

PV of pound cash flow =

$$0.045 \times e^{-0.055 \times 0.5} + 0.045 \times e^{-0.055 \times 1.0} + 0.045 \times e^{-0.055 \times 1.5} + 1.545 \times e^{-0.055 \times 2.0}$$

PV of pound cash flow = $0.0438 + 0.0426 + 0.0414 + 1.3841 = £ 1.5119$ million

PV of pound cash flow in rupee terms = $82.00 \times 1.5119 = ₹ 123.9735$

Value of the swap for (in millions)	Firm		Bank	
	Rupee leg	- 121.70	- 1.4842	+ 121.71
Pound leg	+ 123.97	+ 1.5119	- 123.97	- 1.5119

Other Swaps

Swap implies interchange. It need not be on interest rate or currencies alone. The basic idea of the swap is to have the interchange based on different parameters so that the complexion of asset of liability changes from fixed to variable or vice versa, as may be needed.

Commodity Swaps

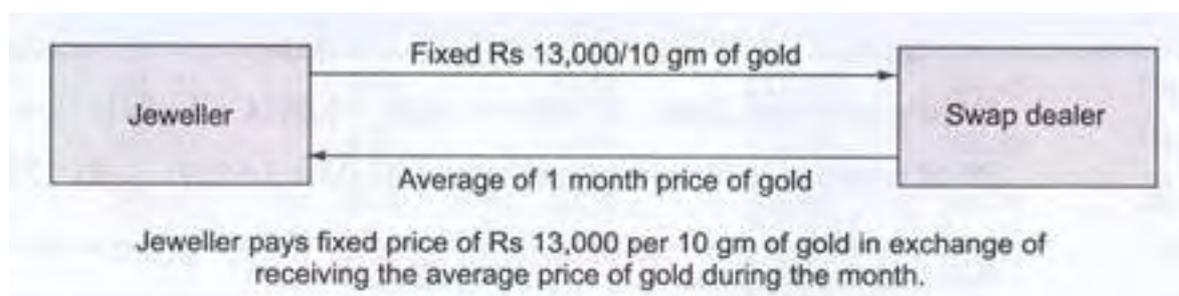
Prices of commodities change continuously. If the prices of output were fixed the profit would be variable. By entering into futures contract traders can render stability to profits.

However, futures as a hedging tool remains a short- term measure, as the hedging period is limited to the maximum maturity of futures contracts available at any point of time. Swaps, being OTC product can ensure a level of profit for the longer period.

Consider a case of a jeweller who makes ornaments using gold. Gold prices change almost continuously but the prices of the product cannot change that often, causing the profit of the jeweller to fluctuate.

By entering into a swap where the jeweller pays a fixed rate for gold but receives cash flow determined on the basis of current price of gold, the cost can be fixed. A plain vanilla swap with monthly cash flows where, jeweller pays, fixed rate (₹ 13,000 per 10 gm) but receives on the basis of monthly average price is depicted in Figure. This swap would provide the hedge against the fluctuating price of gold.

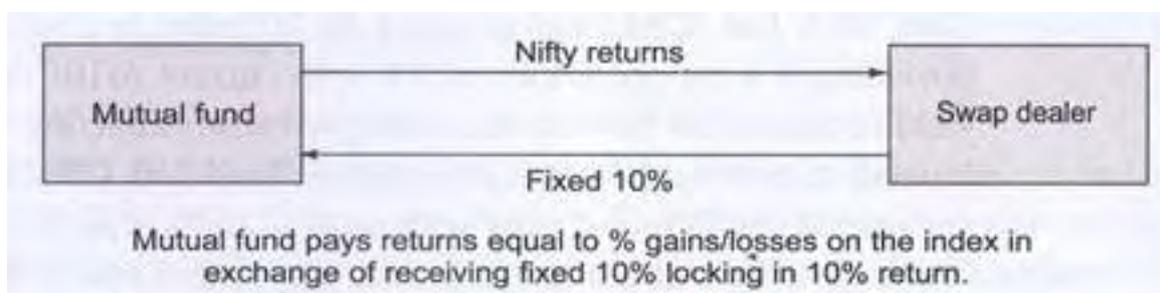
Like other swaps this swap can be done for a notional quantity of gold that need not be exchanged. The life of the swap contract too can be fixed. More complex swaps can be where the two legs are on different commodities, different currencies.



'Plain Vanilla' Commodity Swap

Equity SWAPS

Under equity swap one party pays a fixed rate of return, while it receives a return based on the stock market index of the preceding period. The stock market returns are variable. For example, consider a mutual fund owning a portfolio of stocks. It is concerned about providing some minimum returns to the members of the fund. In order to achieve this objective it can enter into a swap for the part value of the portfolio where it pays to swap dealer returns based on an index say Nifty (the index of National Stock Exchange) determined at specified periodicity as agreed in the swap, while receiving a fixed rate of return, say 10%. This is shown in Figure.



'Plain Vanilla' Equity Swap

By such a swap the mutual fund locks in a return of 10% on the value of the swap. The part of the portfolio would then be transformed from equity to bonds. Again we do not exchange the principal and it remains only notional, serving the purpose of computation of cash flows. In the event of negative returns in a period, the mutual fund would in fact receive on both the legs of the swap.

Innovations in the swaps are taking place at a fast pace. Swaption, the options on swaps, are also becoming popular. A call swaption gives one the right to pay a fixed payment of interest and a put swaption gives the holder a right to receive a fixed rate of interest. In each case the holder pays a nominal front-end premium to cover, the risk of rising interest rate or falling interest rate.

With regard to comparison with other derivatives such as options and futures, swap is OTC product taking into account the specific needs of counterparties with financial institutions and banks serving as intermediaries.

The advantage and popularity of swaps rests on the validity of theory of comparative advantage of international trade. Theory of comparative advantage would predict disappearance of swaps as an instrument of reduced financing cost as with time the opportunities of credit arbitrage should vanish. However, the increasing volumes of

swap transactions defy the logic. As long as imperfections in the capital markets persist, swaps would continue to grow. These imperfections have their roots in controls, incentives, and protection exercised by various governments making access to capital markets discriminatory. Governments may prohibit non-resident firms to access to capital markets or may offer subsidized loans to promote development. Such aberrations based on domicile of the firms are likely to continue and would offer scope for swaps, as tools of reducing financing cost, to take place.

Summary

Swaps came into being to overcome the regulatory controls over capital flows across borders when MNCs resorted to mutual parallel loans to fund their operations overseas. Later, when capital controls were removed they developed into full blown financial products.

Swap may be defined as exchange of series of cash flows, based on a parameter, at periodic intervals for a fixed period. When the cash flow is based on interest rates it is called interest rate swap. When exchange of cash flow is based on exchange rates it is called currency swap. In an interest rate swap one leg of cash flow is based on fixed interest rate on a notional principal, while the other leg of the cash flow, called floating leg, is based on a market-based floating rate. No principal is exchanged either at initiation or conclusion of swap. Only differential of the cash flow is exchanged.

Interest rate swap can alter the complexion of nature of liability or asset from fixed rate to floating rate or vice versa, without necessity of disturbing the original contract. Interest rate swaps serve as hedging tool against the interest rate risk. Faced with rising **interest** rates, a firm can alter the liability of a loan on floating rate to fixed rate with swap entered with a bank without disturbing the original loan contract. Besides working as a tool to hedge against the interest rate risk, a swap has potential to save funding cost. This is due to the fact that different firms have unequal credit spreads in fixed and floating markets for borrowing. The differential in the spread, referred to as comparative advantage, can be utilized for the benefit of two firms to reduce borrowing cost.

A swap normally requires exact matching of needs of the two counterparties in terms of amount, maturity, timing, and periodicity of interest payments which are difficult to fulfill and constrain the development of market. Another drawback is that swap give rise to counterparty risk. Banks, by acting as a facilitator, provide the much needed depth to the swap markets. They also fill the gaps in matching needs and act as counterparties to a swap transaction. The ready market of swaps provided by banks also makes entry and exit from swap easier.

Currency swaps have same applications as that of interest rate swap. They can be used to transform the assets/liabilities from one currency to another, hedge against exchange rate risk and reduce funding cost for MNCs raising funds in different currencies. Unlike interest rate swaps where no principal is exchanged, in currency swaps the principal amount is exchanged at initiation of swap and re-exchanged upon its termination. During the swap the interest rates, either fixed or floating, are exchanged in two different currencies.

At the initiation of swap the value of the swap is always zero as the present values of the two opposite legs are equal. The value of the swap is determined on the basis of interest rate scenario in interest rate swaps. While the cash flow of the fixed leg is known in advance, the payments on the floating legs are decided only one period in advance and are reset at periodic intervals. Changing interest rate scenario creates value. For valuation the swap may be either treated as pair of fixed rate and floating rate bonds or as series of forward agreements. The value of swap would be dependent upon the term structure of interest rates.

Besides interest rate and currency swaps, many other swaps are possible. When commodity price decides the cash flows it is called commodity swap. Equity returns decide the cash flows in equity swaps. Innovations in the field of swaps are continuous and newer products are being developed from time to time. Being an OTC product the modifications in the terms and conditions of the swaps are aplenty.

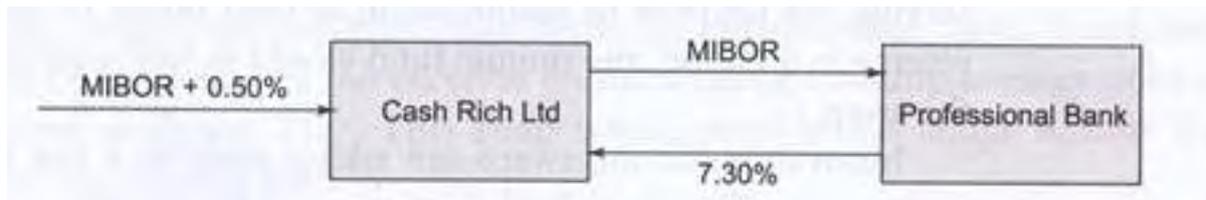
Solved Problems

1. Changing Nature of Asset from Floating to Fixed Rate

Cash Rich Ltd (CRL) has invested ₹ 50 crore in market linked securities providing it a current return of 8% with current MIBOR of 7.50%¹⁰. Of late, yield in the market have started falling adversely affecting the income of CRL. It needs to protect the same. Professional Bank Ltd, CRL's banker has offered a 3-year MIBOR based swap with rates at 7.30%-7.40%. Should CRL accept the swap what income can it lock-in for next 3 years? What would be the advantage of the swap? Depict the swap arrangement.

Solution

CRL has current income at 50 bps above MIBOR currently at 7.50%. Since MIBOR is likely to fall, it is advisable for them to accept the swap with the bank. The swap arrangement is depicted below (see Figure E).



CRL can receive fixed rate and pay MIBOR. The bid rate of swap (7.30%) would be applicable.

$$\begin{aligned} \text{The income for CRL would be} &= \text{MIBOR} + 0.50\% + 7.30\% - \text{MIBOR} \\ &= 7.80\% \end{aligned}$$

By entering swap with the bank CRL may transform the asset from floating rate to fixed rate. In case MIBOR falls to less than 7.30% CRL would have the benefit of the swap.

By entering the swap CRL does not need to alter its investment portfolio.

2. Reducing Cost of Funds with Interest Rate Swap

Company P and Company Q have equal requirement of funds of ₹ 50 Crore each. They have been offered following rates in the fixed and floating rate markets for debt.

	Fixed Rate	Floating Rate
Company P	10.00%	MIBOR + 50 bps
Company Q	12.00%	MIBOR + 150 bps

Company P wants funds at floating rate while Company Q is happy to raise funds at fixed rate basis. A bank is willing to act as intermediary with 20 bps as its remuneration. Depict a swap sharing the gains of swap equally and find out the cost of funds for Company P and Company Q. what would be the saving in financing cost of each firm?

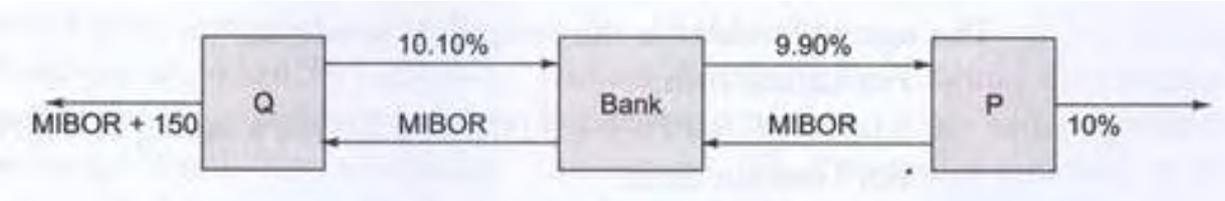
Solution

The absolute advantage for Company P is 200 bps in fixed rate market, while it is 100 bps in the floating rate market. Therefore, the comparative advantage is 100 bps which needs to be shared among the bank, Company P, and Company Q. With the bank wanting 20 bps the remaining 80 bps are shared equally at 40 bps each between Company P and Company Q

Though Company P wants to raise finance at floating rate, the firm must access the fixed rate market and then enter into a swap deal with the bank to convert the fixed rate liability into floating rate. Similarly, Company Q can access floating rate market and enter swap with bank to convert floating rate liability into fixed rate liability.

One such structure is presented in Figure E.

The aggregate cost of funds for Company P would be MIBOR + 10 bps; a saving of 40 bps if it had accessed the floating rate market. Similarly, Company Q obtains funds at 11.6011/6 against 12% otherwise without the swap deal resulting in advantage of 40 bps. The bank earns 20 bps in the fixed rate payments and receipts.



	Company Q	Company P
1. Payment to investors	MIBOR + 1.50%	10.00%
2. Payment to bank	10.10%	MIBOR
3. Receipt from Bank	MIBOR	9.90%
Cost of borrowing (1+2+3)	11.60%	MIBOR + 0.10%

3. Reducing Cost of Funds with Currency Swap

A British firm and a German firm have equal requirement of funds. They have been offered following rates in the fixed and floating rate markets for debt:

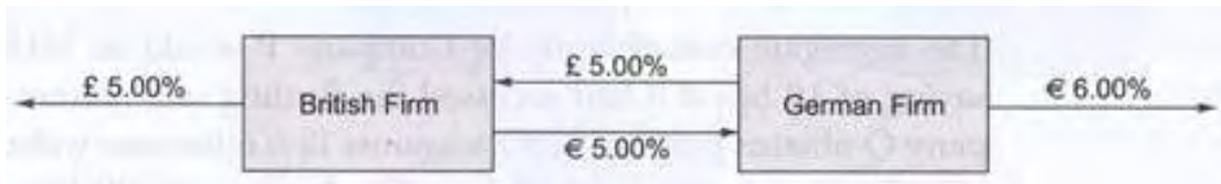
	Pound Market	Euro Market
British Firm	5.00%	5.50%
German Firm	6.50%	6.00%

British firm needs euro funding obtainable at 5.50% and German firm requires pound available at 6.500/0. Demonstrate how both the firms can reduce their cost of funds by having a swap of cash flows.

Solution

The absolute advantage for British firm is 150 bps in pound market, while it is at advantage of 50 bps in the euro market. Therefore, the comparative advantage is 100 bps, which needs to be shared between the German and British firms. With equal sharing, the advantage to each would be 50 bps.

The British firm must access pound market and the German firm must borrow in euros, and then exchange cash flows in pounds and euros, pay interest in respective currencies to each other and re-exchange the principal cash flows on maturity. Swap arrangement is shown below (see Figure E).



The cost of funds after the swap deal would be:

For British Firm

$£ 5.00\% - £ 5.00\% + € 5.00\% = € 5.00\%$; a saving of 0.50%

For German firm:
 $€ 6.00\% - € 5.00\% + £ 5.00\% = € 6.00\%$; a saving of 0.50%

4. Value of Interest Rate Swap

A firm has a swap under which it pays fixed interest at 9% and receives floating on semi-annual basis. The swap has 14 months to go with next payment falling due after 2 months. The rate for the floating payment fixed 4 months ago is 10.10%. If the term structure for next 15 months is flat at 10.10% what is the value of the swap for the firm?

Solution

The value of the fixed leg of the swap would consist of interest payments at 9% (₹ 4.50 semi-annual) after 2, 8, and 14 months. If considered as a bond, the final payment would also involve payment of a principal of ₹ 100.00. The present value discounted at 10.10% (term structure is flat) for all the payments is ₹ 101.5161, as shown below:

PV of fixed cash flow

$$\begin{aligned} &= 4.50 \times e^{-0.101 \cdot 2/12} + 4.50 \times e^{-0.101 \cdot 8/12} + 104.50 \times e^{-0.101 \cdot 14/12} \\ &= 4.4249 + 4.2070 + 92.8842 = ₹ 101.5161 \end{aligned}$$

Similarly, payment for floating leg is determined 4 months ago at 10.10% would be ₹ 5.50 to be made after 2 months. The next payment would be decided then. It implies that floating rate payment marks itself to par then. Therefore, value of the floating leg would be

$$\text{PV of floating cash flow } 105.50 \times e^{-0.101 \cdot 2/12} = ₹ 103.2965$$

Therefore, the firm paying fixed and receiving floating would have a value of ₹ 2.78 (103.30-101.52) per ₹ 100 of the notional amount or 2.78%

Self Assessment Questions

1. Review the assumptions and limitations of the BS option-pricing model.
2. What are the features of the option-pricing model proposed by Cox, Ross and Rubinstein?
3. The current stock price of a Venus Ltd. is ₹ 37.50 and that one period from now it will either be selling for either ₹ 25.00 or ₹ 56.25. Further you are aware that Venus Ltd. does not pay dividends and that ₹ 100 invested in a zero coupon bond now will be worth ₹ 105 at the end of the period. Consider a European put option with strike price ₹ 40 that expires at the end of the period. Determine the parameters r , u and d for the one period binomial model. Use these parameters to price an ATM call option on this stock.
4. Consider the binomial model for an American call and put on a stock whose price is ₹ 125. The exercise price for both the put and the call is ₹ 110. The annualized volatility is 32%, the risk-free rate is 10% and the options expire in 90 days. If the stock pays a ₹ 2.50 dividend in 30 days, compute the price of these options using a four period tree. Draw the stock tree and the corresponding trees for the call and the put. Explain when, if ever, each option should be exercised.
5. Graph the payoffs (90 days before expiry date) for each of the following strategies as functions of the underlying asset price:
 - a. A long straddle.
 - b. A long strangle.

- c. A bull spread.
 - d. A bear spread.
 - e. A butterfly spread.
6. Bring out the differences between:
 - a) Bull call spread and a bull put spread; and
 - b) Iron butterfly and a regular butterfly.
 7. Compare and contrast the volatility selling strategies.
 8. What do you understand by option contract? Illustrate with an example.
 9. Explain features of an option.
 10. How are option contracts settled? Illustrate.
 11. What do you understand by parallel loans? Explain with an example.
 12. Describe features of an interest rate swap.
 13. Explain the value of interest rate swap.
 14. How would you convert a floating rate liability into a fixed rate liability using swap?
Draw a schematic diagram to explain your answer.
 15. If an enterprise has invested funds in securities providing floating rate of income, what risk does it face? How would you hedge such risk using an interest rate swap?
 16. What are the problems in arranging a swap and how are they overcome by swap intermediary/bank?
 17. Explain hedging of fixed rate and floating rate loans using swap.
 18. What is a currency swap and how is it different operationally from an interest rate swap?
 19. Currency swaps can be used to convert assets/liabilities from one currency to another. Explain with a suitable example.
 20. How are currency swaps and interest rate swaps used for reducing cost?

UNIT - III

Unit Structure

Lesson 3.1 - Futures Market

Lesson 3.2 - Pricing of Futures

Lesson 3.3 - Theories of Futures Prices

Learning Objectives

After reading this chapter, students should

- Understand the concept of financial futures contracts.
- Know about the various types of futures contracts like interest rate futures, foreign currency futures, stock index futures, bond index futures, etc.
- Understand the various operators in futures markets like hedgers, speculators, spreaders, arbitrageurs, etc.
- Know the functions of futures market.
- Be aware about the growth of futures markets worldwide as well as in India. Understand the mechanism of futures market trading.
- Know about the role and functions of clearinghouse, stock exchanges, etc.
- Be familiar with the concept of margins and their types like initial margin and maintenance margins, how do margins flow from investor or trader to clearinghouse.
- Understand how futures contracts are closed.

Lesson 3.1 - Futures Market

Introduction

In the last two decades, the futures markets have experienced a remarkable growth all over the world in size, trading volume and acceptance by the business community. New contracts with new products along with entirely new possibilities in the futures markets have become the reality now. Futures trading were started in the mid-western part of the USA during 1970s, but today it is traded throughout the world, and 24 hours a day. Most common underlying assets used in futures markets today are commodities, agricultural products, metals, energy products, weather, electricity, interest rates, foreign exchange, equities, stock index, and so on. In fact, today the futures markets have become an integral part of the financial markets all over the world.

Futures

A futures contract, or simply called futures, is a contract to buy or sell a stated quantity of a commodity or a financial claim at a specified price at a future specified date. The parties to the futures have to buy or sell the asset regardless of what happens to its value during the intervening period or what happens to be the price on the date when the contract is implemented.

Both the parties to the futures have a right to transfer the contract by entering into an offsetting futures contract. If not transferred until the settlement/specified date, then they have obligations to fulfill the terms and conditions of the contract. Futures are traded on the exchanges and the terms of the futures contracts are standardized by the exchange with reference to quantity, date, units of price quotation, minimum change in price (tick), etc.

Futures can be in respect of commodities such as agricultural products, oil, gas, gold, silver, etc., or of financial claims such as shares, debentures, treasury bonds, share index, foreign exchanges, etc.

In a futures contract, the parties fix the terms of the transaction and lock in the price at which the transaction will take place between them at future date. The futures contract,

as they appear to be, providing for the physical delivery of the asset, however, in practice most of the futures are settled by and offsetting futures contract. If a particular futures is not settled by the party himself then it will be settled by the exchange at a specified price and the difference is payable by or to the party. The basic motive for a future is not the actual delivery but the hedging for future risk or speculation. Further, in certain cases, the physical asset does not exist at all. For example, in case of Stock Index Futures, the Index is the weighted average price and cannot be delivered. So, such futures must be cash settled only.

Futures are traded at the organized exchanges only. Some of the centers where futures are traded are Chicago Board of Trade, Tokyo Stock Exchange, London International Financial Futures Exchange (LIFFE), etc. The exchange provides the counter-party guarantee through its clearing house and different types of margins system. Futures contracts are marked to market at the end of each trading day. Consequently, these are subject to interim cash flows for adverse or favourable price movement. With reference to trading in Stock Index Futures, SEBI has provided that the participating parties have to deposit an initial cash margin as well as that difference in traded price and actual price on daily basis. At the end of the settlement period or at the time of squirring off a transaction, the difference between the traded price and settlement price is settled by cash payment. No carry forward of a futures contract is allowed beyond the settlement period. National Stock Exchange (NSE) has issued the Futures and Options Regulations, 2000 which are applicable to the derivative contracts (both futures and options) traded at the NSE.

Types of Financial Futures Contracts

There are different types of contracts in financial futures which are traded in the various futures financial markets of the world. These contracts can be classified into various categories which are as under:

Interest Rate Futures

It is one of the important financial futures instruments in the world. Futures trading on interest bearing securities started only in 1975, but the growth in this market have been tremendous. Important interest- bearing securities are like treasury bills, notes, bonds, debentures, euro-dollar deposits and municipal bonds. In this market, almost entire range of maturities bearing securities is traded. For example, three- month maturity instruments like treasury bills and euro-dollar time deposits, including foreign debt instruments at Chicago Mercantile Exchange (CME), British Government Bonds at London International Financial Futures Exchange (LIFFE), Japanese Government Bonds at CBOT, etc. are traded.

This market is also further categorized into short-term and long-term interest bearing instruments. A few important interest rate futures traded on various exchanges are: notional gilt-contracts, short-term deposit futures, treasury bill futures, euro-dollar futures, treasury bond futures and treasury notes futures.

Foreign Currencies Futures

These financial futures, as the name indicates, trade in the foreign currencies, thus, also known as exchange rate futures. Active futures trading in certain foreign currencies started in the early 1970s. Important currencies in which these futures contracts are made such as US-dollar, Pound Sterling, Yen, French Francs, Marks, Canadian dollar, etc. These contracts have a directly corresponding to spot market, known as interbank foreign exchange market, and also have a parallel interbank forward market. Normally futures currency contracts are used for hedging purposes by the exporters, importers, bankers, financial institutions and large companies.

Stock Index Futures

These are another major group of futures contracts all over the world. These contracts are based on stock market indices. For example, in the US markets, there exist various such futures contracts based on different indices like Dow Jones Industrial Average, Standard and Poor's 500, New York Stock Exchange Index, Value Line Index, etc. Other important futures contracts in different countries are like in London market, based on the Financial Times—Stock Exchange 100 share Index, Japanese Nikkei Index on the Tokyo Futures Exchange and on the Singapore International Monetary Exchange (SIMEX) as well. Similarly, in September, 1990, Chicago Mercantile Exchange began trading based on Nikkei 225 Stock Index and Chicago Board of Trade launched futures contracts based on the TOPIX index of major firms traded on the Tokyo Stock Exchange.

One of the most striking features of these contracts is that they do not insist upon the actual delivery, only trader's obligation must be fulfilled by a reversing trade or settlement by cash payment at the end of trading. Stock Index futures contracts are mainly used for hedging and speculation purposes. These are commonly traded by mutual funds, pension funds, investment trusts, insurance companies, speculators, arbitrageurs and hedgers.

Bond Index Futures

Like stock index futures, these futures contracts are also based on particular bond indices, i.e., indices of bond prices. As we know that prices of debt instruments are inversely

related to interest rates, so the bond index is also related inversely to them. The important example of such futures contracts based on bond index is the Municipal Bond Index futures based on US Municipal Bonds which is traded on Chicago Board of Trade (CBOT).

Cost of Living Index Futures

This is also known as inflation futures. These futures contracts are based on a specified cost of living index, for example, consumer price index, wholesale price index, etc. At International Monetary Market (1MM) in Chicago, such futures contracts based on American Consumer Price Index are traded. Since in USA, the inflation rates in 1980s and 1990s were very low, hence, such contracts could not be popular in the futures market. Cost of living index futures can be used to hedge against unanticipated inflation which cannot be avoided. Hence, such futures contracts can be very useful to certain investors like provident funds, pension funds, mutual funds, large companies and governments.

Evolution of Futures Market in India

- Organized futures market evolved in India by the setting up of “Bombay Cotton Trade Association Ltd.” in 1875. In 1883, a separate association called “The Bombay Cotton Exchange Ltd.” was constituted.
- Futures trading in oilseeds were started with the setting up of Gujarati Vyapari Mandali in 1900. A second exchange, the Seeds Traders’ Association Ltd., trading oilseeds such as castor and groundnuts, was setup in 1926 in Mumbai. Then, many other exchanges trading in jute, pepper, turmeric, potatoes, sugar, and silver, followed.
- Futures market in bullion began at Mumbai, in 1920.
- In 1940s, trading in forwards and futures was made difficult through price controls till 1952 when the government passed the Forward Contract Regulation Act, which controls all transferable forward contracts and futures.
- During the 1960s and 70s, the Central Government suspended trading in several commodities like cotton, jute, edible oilseeds, etc. as it felt that these markets helped increase prices for commodities
- Two committees that were appointed—Datwala Committee in 1966, and Khusro Committee in 1980, recommended the reintroduction of futures trading in major commodities, but without much result.

One more committee on Forwards market, the Kabra Committee was appointed in 1993, which recommended futures trading in wide range of commodities and also up

gradation of futures market. Accepting partially the recommendations, Government permitted futures trading in many of the commodities.

Operators/Traders in Futures Market

Futures contracts are bought and sold by a large number of individuals, business organizations, governments and others for a variety of purposes. The traders in the futures market can be categorized on the basis of the purposes for which they deal in this market. Usually financial derivatives attract following types of traders which are discussed here as under:

Hedgers

In simple term, a hedge is a position taken in futures or other markets for the purpose of reducing exposure to one or more types of risk. A person who undertakes such position is called as 'hedger'. In other words, a hedger uses futures markets to reduce risk caused by the movements in prices of securities, commodities, exchange rates, interest rates, indices, etc. As such, a hedger will take a position in futures market that is opposite a risk to which he or she is exposed. By taking an opposite position to a perceived risk is called 'hedging strategy in futures markets'. The essence of hedging strategy is the adoption of a futures position that, on average, generates profits when the market value of the commitment is higher than the expected value. For example, a treasurer of a company knows the foreign currency amounts to be received at certain futures time may hedge the foreign exchange risk by taking a short position (selling the foreign currency at a particular rate) in the futures markets. Similarly, he can take a long position (buying the foreign currency at a particular rate) in case of futures foreign exchange payments at a specified futures date.

The hedging strategy can be undertaken in all the markets like futures, forwards, options, swap, etc. but their modus operandi will be different. Forward agreements are designed to offset risk by fixing the price that the hedger will pay or receive for the underlying asset. In case of option strategy, it provides insurance and protects the investor against adverse price movements. Similarly, in the futures market, the investors may be benefited from favourable price movements.

Long Hedging Using Futures

Example

Silver is an essential input in the production of most types of photographic films and papers and the price of silver is quite volatile, for a manufacturer XYZ Ltd., there is

considerable risk, because profit can be dramatically affected by fluctuations in the price of silver. Suppose XYZ Ltd. need 20,000 ounces of silver in two months and prices of silver on May 10 are:

Contract	Price (₹)
Spot	1050
July	1070
September	1080

One contract on COMEX traded is of 5000 ounces. Fearing the prices of silver may rise unexpectedly, XYZ Ltd. enters into a futures contract at ₹ 1070 in July delivery. He, therefore, locked into futures price today and long hedge in silver will be as follows:

A Long Hedge in Silver Futures

Date	Cash Market	Futures market
May 10	Anticipates the need for 20,000 ounces of silver in two-month and pay ₹ 1070 per ounce or total amount to ₹ 21,400.00	Buys four 5000 ounce of silver in July futures contract at ₹ 1070 per ounce.
July 10	The spot price of silver is now ₹ 1080 and XYZ Ltd. have to pay ₹ 21,600,000	Because futures contract, at maturity, the futures and spot prices are equal and four contracts are sold at ₹ 1080 per ounce.
Profit / Loss	Loss ₹ 2,00,000	Futures profit ₹ 2,00,000

Net wealth change = 0

Since on expiration date spot price and futures price converge, XYZ Ltd. has hedged its position by entering into futures contract.

Speculators

A speculator may be defined as an investor who is willing to take a risk by taking futures position with the expectation to earn profits. The speculator forecasts the future economic conditions and decides which position (long or short) to be taken that will yield a profit if the forecast is realized. For example, suppose a speculator has forecasted that price of gold would be ₹ 5500 per 10 grams after one month. If the current gold price is ₹ 5400 per 10 grams, he can take a long position in gold and expects to make a profit of ₹ 100 per 10 grams. This expected profit is associated with risk because the gold price after one month

may decrease to ₹ 5300 per 10 grams, and may lose ₹ 100 per 10 grams. Speculators usually trade in the futures markets to earn profit on the basis of difference in spot and futures prices of the underlying assets. Hedgers use the futures markets for avoiding exposure to adverse movements in the price of an asset whereas the speculators wish to take position in the market based upon such movements in the price of that asset. It is pertinent to mention here that there is difference in speculating trading between spot market and forward market. In spot market a speculator has to make an initial cash payment equal to the total value of the asset purchased whereas no initial cash payment except the margin money, if any, to enter into forward market. Therefore, speculative trading provide the investor with a much higher level of leverage than speculating using spot markets. That is why, futures markets being highly leveraged market, minimums are set to ensure that the speculator can afford any potential losses.

Speculators can be classified into different categories. For example, a speculator who uses fundamental analysis of economic conditions of the market is known as fundamental analyst whereas the one who uses to predict futures prices on the basis of past movements in the prices of the asset is known as technical analyst. A speculator who owns a seat on a particular exchange and trades in his own name is called a local speculator. These, local speculators can further be classified into three categories, namely, scalpers, pit traders and floor traders. Scalpers usually try to make profits from holding positions for short period of time. They bridge the gap between outside orders by filling orders that come into the brokers in return for slight price concessions. Pit speculators like scalpers take bigger positions and hold them longer. They usually do not move quickly by changing positions overnights. They most likely use outside news. Floor traders usually consider inter commodity price relationship. They are full members and often watch outside news carefully and can hold positions both short and long.

Arbitrageurs

Arbitrageurs are another important group of participants in futures markets. An arbitrageur is a trader who attempts to make profits by locking in a risk less trading by simultaneously entering into transactions in two or more markets. In other words, an arbitrageur tries to earn riskless profits from discrepancies between futures and spot prices and among different futures prices. For example, suppose that at the expiration of the gold futures contract, the futures price is ₹ 5500 per 10 grams, but the spot price is ₹ 5480 per 10 grams. In this situation, an arbitrageur could purchase the gold for ₹ 5480 and go short a futures contract that expires immediately, and in this way making a profit of ₹ 20 per 10 grams by delivering the gold for ₹ 5500 in the absence of transaction costs.

The arbitrage opportunities available in the different markets usually do not last long because of heavy transactions by the arbitrageurs where such opportunity arises. Thus, arbitrage keeps the futures and cash prices in line with one another. This relationship is also expressed by the simple cost of carry pricing which shows that fair futures prices, is the set of buying the cash asset now and financing the same till delivery in futures market. It is generalized that the active trading of arbitrageurs will leave small arbitrage opportunities in the financial markets. In brief, arbitrage trading helps to make market liquid, ensure accurate pricing and enhance price stability; it involves making profits from relative mispricing.

Spreaders

Spreading is a specific trading activity in which offsetting futures position is involved by creating almost net position. So the spreaders believe in lower expected return but at the less risk. For a successful trading in spreading, the spreaders must forecast the relevant factors which affect the changes in the spreads. Interest rate behaviour is an important factor which causes changes in the spreads. In a profitable spread position, normally, there is large gain on one side of the spread in comparison to the loss on the other side of the spread. In this way, a spread reduces the risk even if the forecast is incorrect. On the other hand, the pure speculators would make money by taking only the profitable side of the market but at very high risk.

Functions of Futures Market

Apart from the various features of different futures contracts and trading, futures markets play a significant role in managing the financial risk of the corporate business world. Recently, financial executives and treasurers are frequently using the various tools available to control their corporate risks and exposures. Financial derivatives instruments, in this respect, have been very useful, popular and successful innovations in capital markets all over the world. Recently, it is noted that financial futures markets have been actively functioning in both developed as well as developing countries.

Futures markets like any other market or industry serve some social purposes. In the past section of this chapter, we have seen that futures markets have been recognized as meeting the needs of some important users like hedgers, speculators, arbitrageurs, spreaders, etc. In the light of those, we will discuss the uses of financial futures market in the society as a whole in the context of risk transference, price stabilization, price discovery, price registration, etc.

Hedging

The primary function of the futures market is the hedging function which is also known as price insurance, risk shifting or risk transference function. Futures markets provide a vehicle through which the traders or participants can hedge their risks or protect themselves from the adverse price movements in the underlying assets in which they deal. For example, a farmer bears the risk at the planting time associated with the uncertain harvest price his wheat will command. He may use the futures market to hedge this risk by selling a futures contract. For instance, if he is expected to produce 1000 tons of wheat in next six months, he could establish a price for that quantity (harvest) by selling 10 wheat futures contracts, each being of 100 tons. In this way, by selling these futures contracts, the farmer intends to establish a price today that will be harvested in the futures. Further, the futures transactions will protect the farmer from the fluctuations of the wheat price, which might occur between present and futures period.

Not only this, this futures market also serves as a substitute for a cash market sale because a cash market sale was impossible since the wheat was not in existence. In this example, we see that the farmer (trader) sells wheat in the futures market which is a temporary substitute of a futures anticipated cash market transaction. In this way, the futures market also serves as substitute futures anticipated futures cash market transactions.

Such above-said examples can be quoted for futures financial markets like interest rate futures contracts which protect the financial institutions such as commercial banks, insurance companies, mutual funds, pension funds, etc. from the adverse changes in the values of their assets and liabilities due to interest rates movements. Similarly, currency futures contract protect the exporters, importers and others who deal in the foreign exchange market, against exchange rate fluctuations. Stock index futures contracts protect the other investors from the adverse changes in portfolio value.

In brief, futures markets hedging activities are very much useful for society since they control, shift, avoid, reduce, eliminate and manage efficiently various types of risks. Further, derivatives enable the investors to modify suitably the risk characteristics of their portfolios, or to shift risk on to those who are willing to assume it for higher profits. In the absence of futures markets, the cost of risk to economy could be higher and might be worse off.

Price Discovery

Another important use of futures market is the price discovery which is the revealing of information about futures cash market prices through the futures market. As we know

that in futures market contract, a trader agrees to receive or deliver a given commodity or asset at a certain futures time for a price which is determined now. It means that the futures market creates a relationship between the futures price and the price that people expect to prevail at the delivery date. In the words of M.J. Powers and D. Vogel, as stated in their book entitled, "Inside the Financial Futures Market", futures markets provide a mechanism by which diverse and scattered opinions of the futures are coalesced into one readily discernible number which provides a consensus of knowledgeable thinking. It is evident from this statement that futures prices provide an expression consensus of the today's expectations about a specified future time. If these expectations are properly published then they also perform an information or publicity function for the users and the society. By using the information about the futures prices today, the different traders/observers in the market can estimate the expected spot price in the future time of a given asset. In this way, a user of the futures prices can make consumption or investment decisions more wisely.

Further, price discovery function of the futures market also leads to the inter temporal inventory allocation function. According to this, the traders can compare the spot and futures prices and will be able to decide the optimum allocation of their quantity of underlying asset between the immediate sale and futures sale. The uses of price discovery function can be explained by an example, supposing, a mine operator is trying to take a decision whether to reopen a marginally profitable gold mine or not. If, we assume that the gold ore in the mine is not of the best quality and so the yield from the mine will be relatively low. The decision will depend upon the cost incurred on mined and refined of gold and the price of the gold to be obtained in futures. Hence, the crucial element in this decision is the futures price of gold. The miner can analyze the gold prices quoted in the futures market today for determining the estimate of the futures price of the gold at a specified futures period. In this situation, the miner has used the futures market as a vehicle of price discovery.

It is evident from the above that price discovery function of futures market is very much useful for producers, farmers, cattle ranchers, wholesalers, economic agents, etc. who can use futures market estimates information of futures cash prices to guide their production or consumption decisions.

Financing Function

Another important function of a futures market is to raise finance against the stock of assets or commodities. Since futures contracts are standardized contracts, so, they make it easier for the lenders about the assurance of quantity, quality and liquidity of the underlying asset. Though this function is very much familiar in the spot market, but it is

also unique to futures markets. The reason being the lenders are often more interested to finance hedged asset stock rather than un-hedged stock because the hedged asset stock are protected against the risk of loss of value.

Liquidity Function

As we see that the main function of the futures market deals with such transactions which are matured in the future period. They are operated on the basis of margins which are determined on the basis of rides involved in the contract. Under this the buyer and the seller have to deposit only a fraction of the contract value, say 5 percent or 10 percent, known as margins. It means that the traders in the futures market can do the business a much larger volume of contracts than in a spot market, and thus, makes market more liquid. That is why the volume of the futures markets is much larger in comparison to the spot markets. This is also known as gearing or leverage factor. It means that a trader in the futures markets can gear up his capital 10 times and 20 times if the margin/deposit is 10 percent and 5 percent respectively, resulting in his profit or loss, as a proportion of his capital is 10 times or 20 times magnified. Gearing is the British term and in American parlance it is known as leverage. This is explained by the following example:

Example

A speculator estimates a price increase in the silver futures market from the current futures price of ₹ 7500 per kg. The market lot being 10 kg, he buys one lot of futures silver for ₹ 75,000 (7500x 10). Assuming the 10 percent margin, the speculator is to deposit only ₹ 7500. Now supposing that a 10 percent increase occurs in the price of silver to ₹ 8250 per kg. The value of transaction will also increase, i.e., ₹ 82,500, and hence, incurring profit of ₹ 7500(82,500-75,000) on this transaction. In other words, the speculator earns in this transaction ₹ 7500 on the investment of ₹ 7500, being 100 percent profit on investment, and vice-versa.

From the above example, it is evident that futures markets operations are highly risky due to gearing effect. So they are more attractive for the speculators.

Price Stabilization Function

Another important function of a futures market is to keep a stabilizing influence on spot prices by reducing the amplitude of short term of fluctuations. In other words, futures market reduces both the heights of the peaks and the depth of the troughs. The major causative factors responsible for such price stabilizing influence are such as, speculation,

price discovery, tendency to panic, etc. A detail discussion on price stabilization function of futures market will be made in the forthcoming chapters.

Disseminating Information

Apart from the aforementioned functions of the futures markets like risk-transference (hedging), price discovery, price stabilization, liquidity, and financing, this market is very much useful to the economy too. Futures markets disseminate information quickly, effectively and inexpensively, and, as a result, reducing the monopolistic tendency in the market.

Further, such information disseminating service enables the society to discover or form suitable true/correct/equilibrium prices. They serve as barometers of futures in price resulting in the determination of correct prices on spot markets now and in futures. They provide for centralized trading where information about fundamental supply and demand conditions are efficiently assimilated-and acted on.

The financial futures markets have generated employment opportunities by creating a significant number of jobs and attracted a considerable volume of transactions from non-residents. Indirectly, it is another way of generating foreign exchange for the countries. Further the futures markets act as 'starter form of investment resulting in a wider participation in the securities markets. They attract young investors and act as catalysts to the growth of securities markets. They enable individuals and managers of funds to devise or design strategies for proper assets allocation, yield enhancements and reducing risks. For example, futures markets quotations are also useful to other sectors of society besides speculators and hedgers. Which goods or commodities are to be produced and in which financial assets the investment is to be made, such decisions are assisted by the futures market prices.

Further, some individuals may not engage in certain clearly beneficial forms of economic activity if they were forced to bear all of the risks of that activity themselves. Futures markets enable the society to reach the position of pare to optimality by developing complete markets. It means that in financial markets, no other set of securities can make some investors better off without making at least one other investor worse off. In other words, the securities market is said to be complete if the patterns of returns can be created whose returns a portfolio of existing securities cannot duplicate. In brief, the futures markets enhance economic activities in the society in general, resulting in growth of economic development of the country.

Basic Mechanism of a Futures Contract

A futures contract calls for the delivery of the specified quantity at the specified rate on specified date. Or, before the maturity date it can be squared off. In India, the financial derivatives (futures) are compulsorily squared off on the maturity date. However, in case of commodities futures, delivery is made, if required, by the transfer of warehouse receipt. An investor can buy (a long position) or sell (a short position) a futures contract.

The profit or payoff position of a futures contract depends on the differences between the specified price (of the futures contract) and the actual market price prevailing on the maturity date. For example, if an investor has purchased a futures contract in HLL at the rate of ₹ 300 and one contract in for 500 shares. The value of the contract is ₹ 1,50,000 (₹ 300 x 500). Now, on the maturity date the rate is ₹ 310. The value of the contract is ₹ 1,55,000 and his profit is ₹ 5,000. Similarly, if the rate is ₹ 296, then his loss is ₹ 2,000. Further, that if the investor has sold initially, then his loss and profit position would be ₹ 5,000 and ₹ 2,000 respectively. This can be summarized as follows

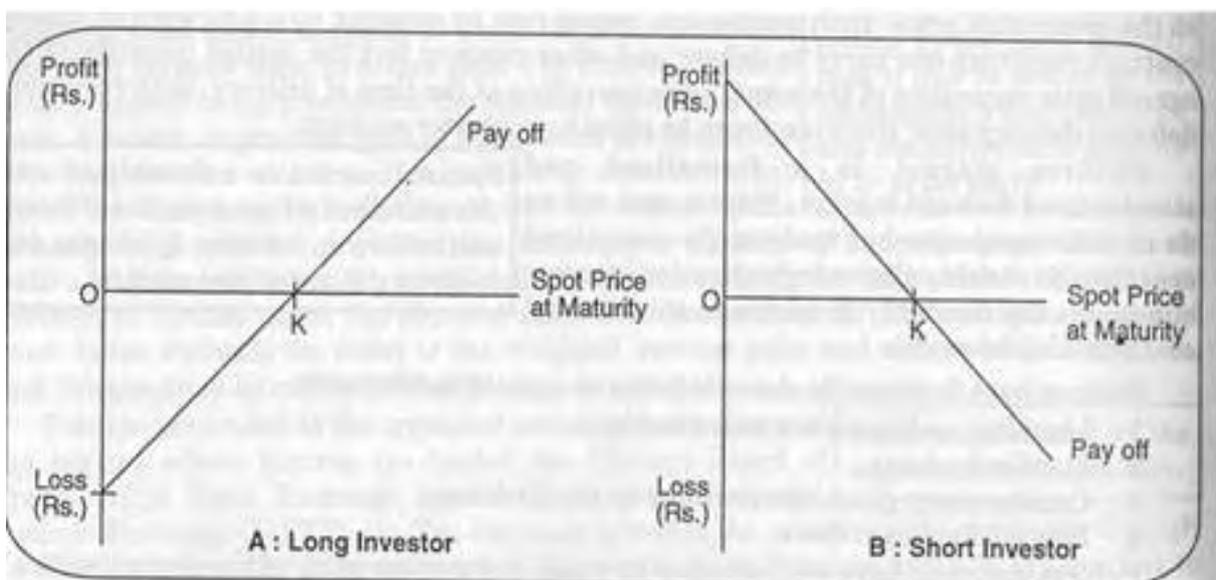
For Long investor: Profit = Spot price at Maturity – Futures Price

Loss = Futures Price – Spot Price at Maturity

For Short investor: Profit = Futures price – Spot Price at Maturity

Loss = Spot Price at Maturity – Futures Price

A futures contract is zero sum game. Profit to one party is the loss of the other party. Simple reason being that every long position is represented by a short position in the market. The pay off positions of the long investor and short investor in futures are shown in Figure



In Figure (A), K is the strike price. The figure shows that as the spot price at maturity increases, the profit of the long investor also increases. This break-even level is one when spot price is equal to strike price. Similarly, Figure (B) shows that maximum profit to short investor appears if the spot price is 0.

Thus profit decreases and Loss increases as the spot price increases. The breakeven appears when the spot price is equal to the strike price. The diagrams for buyer and seller are mirror image of each other.

Financial futures can be classified into Shares and Shares Indices Futures, Bond Futures, Currency Futures and Interest Rate Futures. Discussion on Shares and Shares Indices Futures is taken up first, followed up by currency futures and interest rate futures.

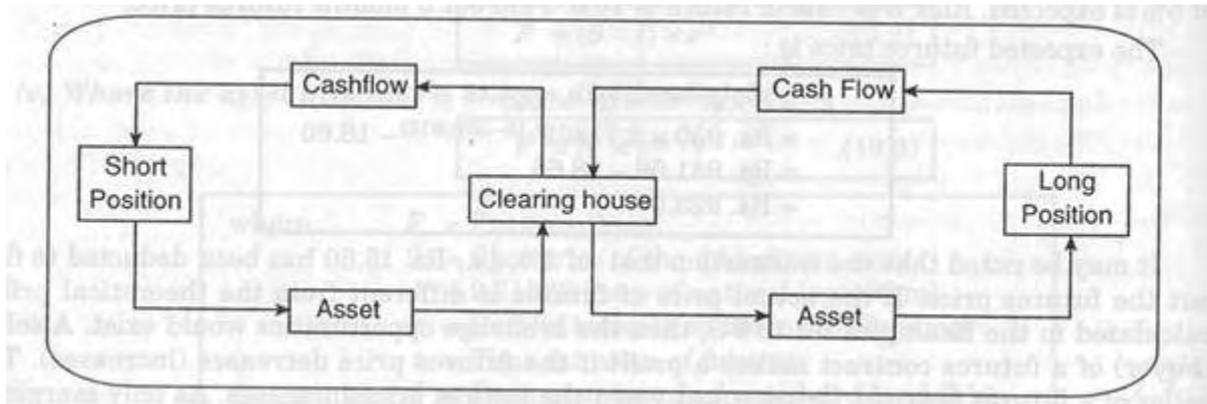
Contract Size of Futures Contracts

One contract of futures includes a specific number of units of underlying asset. For example, at present, a futures contract in NIFTY is consisting of 100 units. So, if NIFTY Futures is traded at 3,750, then the value of one contract is ₹ 3, 75,000. In case of stock futures, the value of one futures contract need not be less than ₹ 2, 00,000. Number of shares included in one futures contract is changing from time to time.

Futures Trading and Role of Clearing House

Futures are traded at computerized on-line stock exchanges and there is no one-to-one contact between the buyers and sellers of futures. In case of default by either party, the counter-guarantee is provided by the exchange. In this scenario, the role of the stock exchange clearing house becomes imperative.

Unlike shares trading, where position of the defaulting party is actioned and the loss is recovered through the broker of the party, the situation in futures trading is different. When a deal by a seller or buyer of a particular contract is finalized, on the basis of quotes, etc., the clearing house emerges but invisibly. Impliedly, the clearing house becomes the seller to a long offer and buyer to a short offer. The clearing house is required to perform the contract to both the parties i.e., to deliver the underlying asset to the long positions holder and to pay to the short position holder, The net position of the clearing house always remains zero because it does not trade on its own but only on behalf of other parties. So, the clearing house becomes a party to two contracts at a time and is bound to perform its obligation under both the contracts. The position of the clearing house is shown in Figure.



Figures show that the position of the clearing house is only neutral and provides a link between the buyers and sellers. Clearing house makes it possible for buyers and sellers to easily square off their positions and to make the net position zero. The zero net position of a party means that neither the original position nor the squaring off is to be fulfilled.

As the clearing house is obligated to perform to both parties, it protects its interest by imposing margins on the parties.

Initial Margin and Mark to Market

In the discussion on payoff positions in futures, it has been shown that the ultimate profit or loss position of a party to a futures contract depends on the spot price of the underlying asset on the maturity date. As the parties are betting on the future spot price of the asset, their expectations may not come true and they may suffer loss. In view of this position, SEBI has provided that the buyer as well as the seller, both have to deposit an initial margin with the stock exchange broker on the date of the transaction. If the initial value of the futures contract is ₹ 1,50,000 and the initial margin is 10%, then buyer and seller both have to deposit ₹ 15,000 each with their respective brokers. From the date of the transaction till the squaring off date or maturity date, the futures price may rise or fall, as a result of which a party may incur loss. The futures contracts are to be mark to market on daily basis i.e., additional margin money is to be deposited with the broker in view of the loss occurring till a particular date. For example, in the above case, the value of contract falls to ₹ 1, 45,000 next day, and then mark to market margin of ₹ 5,000 is to be deposited. So, instead of waiting until the maturity date for the parties to book losses, SEBI requires all positions to recognize losses on daily basis as these accrue. This daily setting is called mark to market, where the maturity date does not govern the accrual of losses. Margin system is one basic difference between the forwards and futures. The forwards are simply kept till the maturity date without any intervening cash flows whereas the futures follow pay-as-you-go system.

Convergence Property

As futures contracts mature and are compulsorily settled on the specified maturity date, the futures price and the spot price of the underlying asset on that date must converge. This may be called the convergence property. If the two prices are not equal then every investor would like to make profit by capitalizing the opportunity. But then, who will lose? On the date of the settlement, the two prices would almost be same.

For example, an investor takes a long position in Nifty Futures (1 month) and holds that position till maturity. The sum of daily settlements (mark to market) would be equal to $FT - F_0$ where F_0 is initial futures price at contract time and FT is futures price on maturity. As explained above, FT will be equal to ST due to convergence property, where ST is spot price of asset on maturity. So, the profit on maturity is $S - F_0$ and it tracks changes in the price of the underlying asset. In Table, the convergence property and its effect on profit/loss on NIFTY futures have been shown.

Gradual Profit/Loss on Futures Contracts

Day	Futures Price	Profit / Loss	Cumulative Profit
0	3650	-	-
1	3680	30	30
2	3685	5	35
3	3695	10	45
4	3685	-10	35
5	3690	5	40
6	3692	2	42

Due to the convergence property, the spot price of NIFTY on Day 6 could be 3692 and profit at settlement is $(3692-3650)$ i.e., ₹ 42 per unit. The same profit is also shown by column 3 and 4. The net receipts in mark to market are also ₹ 42.

So, the convergence property states that the futures prices and spot prices are equal on the maturity date. However, before maturity, the futures prices may differ substantially from current spot prices. So, from the point of view of the investor, if the futures contract and the asset are held until maturity, he bears no risk because on the maturity date, the asset value is equal to the current future price. Risk is eliminated because on that day, the futures prices and spot prices are equal. However, if the futures contract and assets are to be liquidated earlier, the investor in this case bears 'basis risk'. The reason being that future price and spot price are not in perfect lock up position at all times before maturity, and the profit/loss on one may not perfectly offset the loss/profit on the other.

Open Interest

In case of futures contracts, for every long position, there is simultaneously a short position. Open interest is a technical term used to refer to the number of contracts outstanding. In order to find out the open interest, the long and short are not added, rather the total long or short contracts are defined as open interest. The net position of the clearing house is always zero. Calculation of open interest is made in a very special way. Suppose, A, B, C, D, E and F are different investors. '+' refers to buying a futures contract and a '-' refers to selling of a futures contract on the same underlying asset. Different cases of

Transactions and the calculations of open interest [Oil have been shown in Table.]

Calculation of Open Interest in Futures

Case I	Case II	Case III	Case IV	Case V	Case VI
+A, -B	+A, -B	+A, -B	+A, -B	+A, -B	+A, -B
	+C, -D	+C, -A	+B, -A	+C, -D	+C, -D
				+E, -F	+E, -C
OI = 1	OI = 2	OI = 1	OI = 0	OI = 3	OI = 2

In practice, when trading in particular futures begins, the OI is zero. As time passes and more and more transactions take place, net OI positions fluctuate. As maturity date approaches, most of the parties square off their transactions and the net OI position may become zero. It may come down to zero even before the maturity date. If still some positions are left, these will be cash settled or delivery settled as the case may be, on the maturity date.

Lesson 3.2 - Pricing of Futures

If an investor wants to acquire shares in a particular company, he can acquire these shares today itself at the current price or he can take a long position in futures. In either case, he will be having the asset on some date in future. No doubt, the market determined cost of acquiring the asset in either of these strategies must be equal. So, there is some relationship between the current price of the asset, cost of holding it in future and the futures prices today. This relationship can be explained by taking cash flow positions at time O and time 't' in both strategies. Say, S in the spot rate, F is the futures price and r is the risk-free rate of interest, the position can be shown as follows:

		Initial Cash Flow	Cash Flow at Time 'T'
<i>Strategy I:</i>	Buy Asset now :	$-S_0$	S_T
<i>Strategy II:</i>	1 Long Futures :	—	$S_T - F_0$
	Invest $F_0/(1+r)^t$:	$-F_0/(1+r)^t$	F_0
	Net Position :	$-F_0/(1+r)^t$	S_T

Table shows that the cash flow position at time 't' is same in both strategies. However, the initial cash flow positions are $-S_0$ and $-F_0/(1+r)^t$. In order to eliminate the arbitrage opportunities; these two values should also be same, S.

$$S_0 = F_0/(1+r)^t$$

$$F_0 = S_0 \times (1+r)^t$$

This gives the relationship between the current spot price and the futures price. This is known as Spot-Futures Parity or Cost of Carry Relationship. The expected dividend (income) from the asset during the futures period can also be incorporated in the analysis. So, pricing of futures contract depends on the following variables:

- (i) Price of the underlying asset in the cash market,
- (ii) Rate of return expected from investment in the asset, and
- (iii) Risk-free rate of interest.

The mechanism of pricing of futures can be explained as follows: Suppose,

- (i) In cash market, the underlying asset X is selling at ₹ 100.
- (ii) The expected return from the asset is 3% per quarter.
- (iii) The risk free rate of borrowing or lending is 8% p.a. or 2% per quarter.
- (iv) The futures contract period is also a quarter.

What should be the price of futures?

say, S = Current spot price of the asset

F Futures price

r = % Financing cost per futures period

y = % Yield on investment per futures period

Now, $F = S + S(r - y)$

Suppose, the investor borrows funds to purchase one unit of asset 'X' resulting in no initial cash outlay for his strategy. At the end of 3 month's period, ₹ 3 will be received from holding the asset 'X' and would be required to pay interest (financing cost) of ₹ 2.

In the example given above,

$$\begin{aligned} F &= 100 + 100 (.02 - .03) \\ &= ₹ 99 \end{aligned}$$

So, the futures price should be ₹ 99. What happens if the futures price is ₹ 92 or ₹ 107? The position can be explained as follows:

In case, the futures contracts are available at ₹ 92 (i.e., less than the theoretical price of ₹ 99), the investor should buy one future contract for ₹ 92 and should sell one unit of asset X for ₹ 100 and invest the money @ 8% p.a. for 3 months. After 3 months, he will receive the proceeds of ₹ 102 (₹ 100 + ₹ 2). He will spend ₹ 92 to purchase an asset (out of futures contract). Besides, he will not receive the yield of ₹ 3 from the asset. So, his cost is ₹ 95 (92 + 3). His gain would be ₹ 7 (₹ 102 - 95).

Similarly, if the futures contract price is ₹ 107, he should sell the futures contract at ₹ 107 and should borrow ₹ 100 now to buy one unit of asset 'X' in the spot market. After 3 months, his proceeds would be ₹ 110 (107 + 3) and payment would be ₹ 102 (100 + 2). He would be able to make a profit of ₹ 8.

So, if the futures price is other than the theoretical price of ₹ 99, it would give rise to arbitrage opportunities. In case of price of ₹ 92 or ₹ 107, investors can look for a riskless arbitrage profit of ₹ 7 or ₹ 8. The demand and supply forces would react to this arbitrage opportunity and the futures price would settle around the equilibrium level of ₹ 99.

In the above analysis, the cost of carry (i.e., the interest amount) has been considered in an over simplified way. In the pricing of futures, the interest effect is taken up on the basis of continuous compounding. The procedure for pricing the futures can be standardized in 3 different situations as follows:

(a) When the asset provides no income:

$$F = S \times e^{rt} \quad \dots (13.1)$$

(b) Where the asset provides known dividend:

$$F = (S - I) \times e^{rt} \quad \dots (13.2)$$

(c) Where the asset provides a known dividend yield:

$$F = S \times e^{(r - q)t} \quad \dots (13.3) \text{ Where,}$$

F = Futures Price

S = Spot price of the underlying asset.

e = 2.71828 (base of natural logarithm)

r = Rate of interest on borrowing/lending

t = Time duration of futures

I = Present value of expected dividend @ 'r'

q = Dividend yield.

Differences Between Forwards and Futures

Apparently, forwards contracts and futures contracts seem to be similar, Both relate to a contract to be fulfilled on a future date at the Pre specified rate for a specific quantity.

However, there are a number of differences between the forwards and the futures. The forwards contracts are private bilateral contracts. These are traded off-exchanges and are exposed to default risk by either party. Each forward contract is unique in terms of size, time and types of assets, etc. The price fixation may not be transparent and is not publicly disclosed. A forward contract is to be settled by delivery of the asset on the specified date.

On the other hand, futures contract is a contract to buy or sell a specified quantity of a commodity or a specified security at a future date at a price agreed to between the parties. Since these contracts are traded only at organized exchanges, these have built-in safeguard against default risk, in the form of stock brokers or a clearing house guarantee.

The idea behind futures contracts is to transfer future changes in the prices of commodities from one party to another. These are trade able and standardized contracts in terms of size, time and other features. These contracts are transparent, liquid and trade able at specified exchanges. Futures also differ from forwards in that former are subject to daily margins and fixed settlement period.

Both forwards and futures contracts are useful in cases where the future price of the commodity is volatile. For example, in case of agricultural products, say sugarcane, the peasant's revenue is subject to the price prevailing at the time of harvesting. Similarly, the sugar-mill is not sure whether it will be able or not to procure required quantity of sugarcane at the reasonable price.

Both parties can reduce risk by entering into a forward or futures contract requiring one party to deliver and other party to buy the settled quantity at the agreed price regardless of the actual price prevailing at the time of delivery. Both result in a deferred delivery sale. However, it can be offset by a counter contract.

Futures market is a formalized and Futures market is a formalized and standardized forward market. Players and sellers do not meet by chance but trade in the centralized market. No doubt, the standardization process eliminates the flexibility available in the informal contacts (i.e., forwards).

Futures have four specific characteristics as against the forwards:

1. Liquidity, as futures are transferable.
2. Standard volume.
3. Counter-party guarantee provided by the Exchange.
4. Intermediate cash flows.

Futures contracts have evolved out of forwards and possess many of the characteristics of forwards. In essence, futures are like liquid forward contracts. As against forwards, futures as a technique of risk management, provide several services to the investors and speculators as follows

- (i) Futures provide a hedging facility to counter the expected movements in prices.
- (ii) Futures help indicating the future price movement in the market.
- (iii) Futures provide an arbitrage opportunity to the speculators.

The Operation of Margin

In addition to the clearing house, there are some other safeguards for futures contracts, important among these are requirements for margin and daily settlement. In this section, we will discuss the margin requirement applicable in case of investor and as a trader of the clearing house. As we know that two parties are directly trading an asset in the futures market for a certain price there are obvious risks for backing out of any of the parties to the contract. It is also possible that one of them may not have the financial resources to honour the contract. That is why one of the important roles of the exchange is to organize the futures trading in such a way that the default risk will be minimum. This is why margins come into picture.

The Concept of Margin

Before entering into a futures contract, the prospective trader (investor) must deposit some funds with his broker which serves as a good faith deposit. In other words, an investor who enters into a futures contract is required to deposit funds with the broker called a margin. The basic objective of margin is to provide a financial safeguard for ensuring that the investors will perform their contract obligations. The exchanges set minimum margins but the brokers may require larger margins if they are concerned about an investor's financial situation because they are ultimately responsible for their clients' losses. The amount of margins may vary from contract to contract and even broker to broker. The margin may be deposited in different forms like cash, bank's letter of credit and treasury securities. Normally the investor who posts this margin retains the title of the securities deposited as margin. The margin account may or may not earn interest. Some brokers may simply pay them money market interest rates on their margin account. However, most of the brokers usually do not pay interest on margin in money. This loss of interest is the cost of margin requirement.

Types of Margin

There are three types of margin such as initial margin, maintenance margin and variation margin. The initial margin is the original amount that must be deposited into account to establish futures position. It varies from stock to stock. To determine the initial margin, the exchange usually considers the degree of volatility of price movements in

the past of the underlying the asset. After that, the exchange sets the initial margin so that the clearing house covers losses on the position even in most adverse situation. The initial margin approximately equals the maximum daily price fluctuation permitted by the exchange for that underlying asset.

The exchange has the right to increase or decrease the quantum of initial marginal depending upon the likely anticipated changes in the futures price. For most of the futures contracts, the initial margin may be 5 percent or less of the underlying asset's value. After proper completion of all the obligations associated with a investor's futures position, the initial margin is returned to trader.

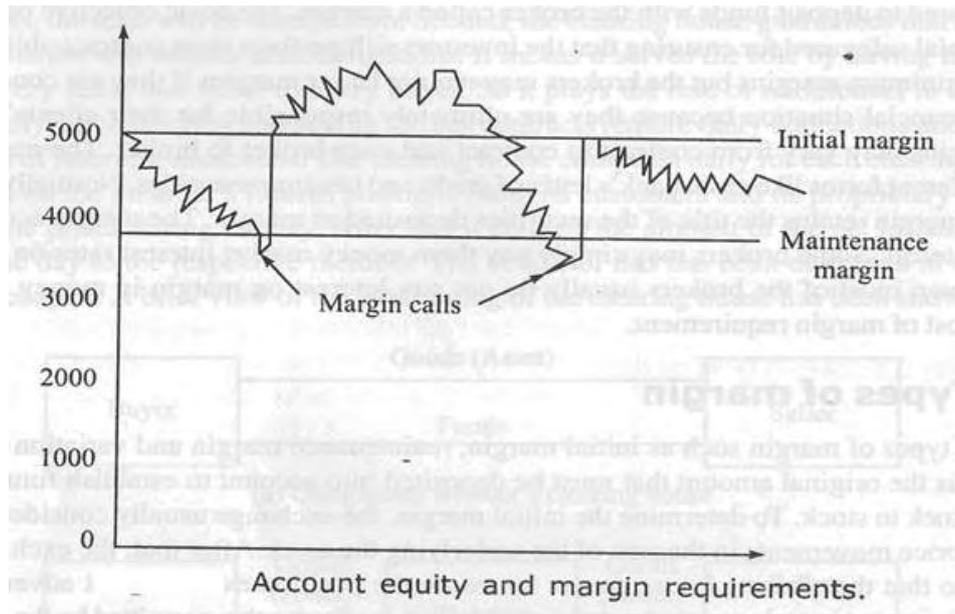
The Maintenance Margin

The maintenance margin is the minimum amount which must be remained (kept) in a margin account. In other words, so much minimum, balance in the margin account must be maintained by the investor. This is normally about 75 percent of the initial margin. if the futures prices move against the investor resulting in falling the margin account below the maintenance margin, the broker will make a call, i.e., asking the client to replenish the margin account by paying the variation. Hence, the demand for additional fund is known as a margin call.

For example, assume that the initial margin on a futures contract is ₹ 5,000 and the maintenance margin ₹ 3,750 (75% of the initial margin). The next day assume that the party has sustained a loss of ₹ 1,000, reducing the balance in margin to ₹ 4,000. Further assume that on the next day the price decreased and sustained loss is ₹ 500. Thus, the balance remained in the margin account to ₹ 3,500, below the maintenance margin. In this situation, the broker will make a call (margin call) to replenish the margin account to ₹ 5,000, the level of initial margin.

The Variation Margin

It refers to that additional amount which has to be deposited by the trader with the broker to bring the balance of the margin account to the initial margin level. For instance, in the above mentioned example, the variation margin would be ₹ 1500 (₹ 5000— ₹ 3500), i.e., the difference of initial margin and the balance in the margin account, the same has been shown in Fig. If the investor does not pay the initial margin immediate, the broker may proceed to unilaterally close out the account by entering into an offsetting futures position.



Margins and Marking-to-Market (Daily Settlement)

It has been observed that the initial margin, sometimes, is even less than 5 percent which seems to be very small considering the total value of the futures contract. This smallness is reasonable because there is another safeguard built in the system, known as daily settlement marking-to-market. In the futures market, all the transactions are settled on daily basis. Thus, the system of daily settlement in the futures market is called marking-to-market. The traders realize their gains or losses on the daily basis to understand this process of daily settlement, let us see Table.

If we examine Table, it is observed that on June 11, the balance in the margin account falls \$340 below the maintenance margin level. This requires a margin call to the participant for depositing an additional margin of \$1340.

The Table assumes that the trader does in fact provide this margin by close of the trading on June 12. It is also noted that on June 12, 19, 20 and 21, trader has excess margin. The Table also assumes that excess margin is not withdrawn. On June 24, the trader decides to close out the position by shorting the two contracts, being futures price on that day \$392.30, and the trader has suffered accumulative loss of \$1540 in this contract.

The basic purpose of the mark-to-marking is that the futures contracts should be daily marked or settled and not at the end of its life. Every day, the trader's gain (loss) is added or (subtracted), the margin on the case may be. This brings the value of the contract back to zero. In other words, a futures contract is closed out and rewritten at a new price every day.

Operation of Margins for a Long Position in Two Gold Futures Contracts

Day	Futures price (\$)	Daily gain (Loss) (\$)	Cumulative gain (Loss) (\$)	Margin account balance (\$)	Margin call (\$)
June 3	400.00				
June 3	397.00	(600)	(600)	4,000	
June 4	396.00	(180)	(780)	3,400	
June 7	398.20	420	(360)	3,640	
June 8	397.10	(220)	(580)	3,420	
June 9	396.70	(80)	(660)	3,340	
June 10	395.40	(260)	(920)	3,080	
June 11	393.30	(420)	(1,340)	2,660	1,340
June 14	393.60	60	(1,280)	4,060	
June 15	391.80	(360)	(1,640)	3,700	
June 16	392.70	180	(1,460)	3,880	
June 17	387.00	(1,140)	(2,600)	2,740	1,260
June 18	387.00	0	(2,600)	4,000	
June 21	388.10	220	(2,380)	4,220	
June 22	388.70	120	(2,260)	4,340	
June 23	391.00	460	(1,800)	4,800	
June 24	392.30	260	(1,540)	5,060	

The initial margin is \$2000 per contract or \$4000 in total and the maintenance margin is \$1500 per contract or \$3,000 in total. The contract is entered into on June 3 at \$400 and closed out on June 24 at \$392.30. The numbers in column 2, except the first and the last, are the futures price at the close of trading.

Closing a Futures Position (Settlement)

There are four ways to close the futures position, namely, physical delivery, cash settlement, offsetting and exchange of future for physicals (EFP).

Physical Delivery

One way of liquidating of futures position is by making or taking physical delivery of the goods/asset. The exchange has provided alternatives as to when, where and what will be delivered. It is the choice of the party with a short position. When the party is ready to deliver, it will send a notice of intention to deliver to the exchange. The price is settled

which normally most recent with a possible adjustment for the quality of the asset and chosen delivery location. After that, the exchange selects a party with an outstanding long position to accept delivery. Let us see how physical delivery works.

Let us take an example of particular futures contract: Silver traded on COMEX where a short-trader is required to make delivery of 5000 troy ounce (6 percent more or less) of refined silver bar cost in heights of 1000 to 1100 ounces each and at 0.999 fineness. Which should bear the serial number and identifying stamp of a refiner approved by the COMEX exchange? At the beginning of the delivery month on the exchange-designated notice days, say, December 99 contract, exchange rules requires that all traders having open positions in December 1999 contract notify their member brokers to take or make delivery for this. In turn, the brokers will inform to the clearing house of their customer's intention. After this notification, the clearing house matches longs and shorts usually by matching the oldest short to the oldest long position, until all short quantities are matched. Delivery notices are then to all the traders through their brokers indicating to whom their delivery obligations runs and when, where and in what quantities is to be made. Some exchanges impose heavy penalty in case of default by any party. When delivery is satisfactory made then the clearing house notify and accord the same. In case of financial futures, delivery is usually made by wire transfer.

Cash Settlement/Delivery

This is relatively new procedure followed for setting futures obligations is through cash delivery. This procedure is a substitute of physical delivery and hence, do not require physical delivery. The exchange notifies about this where cash delivery as the settlement procedure. There are certain financial futures like stock indices futures, certain treasury securities, euro-dollar, time deposits, municipal bonds, etc. When a cash settlement contract expires, the exchange sets its final settlement price equal to the spot price of the underlying asset on that day. In other words, it is simply marked-to-market at the end of the last trading day to handover the underlying assets. Since cash settlement contracts are settled at the spot price, their futures prices are converged to the underlying spot prices. Therefore, the prices of cash settlement contracts behave just like the prices of delivery contracts at their expiration period.

Offsetting

The most common and popular method of liquidating the open futures position is to effect an offsetting futures transaction or via a reversing trade which reverses the existing open position. For example, the initial buyer (long) liquidates his position by selling

(going short) an identical futures contract (which means same delivery month and same underlying asset). Similarly, the initial seller (short) goes for buying (long) an identical futures contract. After executing these trades, these are reported to the clearing house then both trade obligations are extinguished on the books of the brokers and the clearing house. No doubt, the clearing house plays a significant role in facilitating settlement by offset. In comparison to the physical delivery, this method is relatively simple which requires good liquidity in the market, and entails only, the usual brokerage costs.

For example, there are two parties X and Y. X has an obligation to the clearing house to accept 10,000 bushels of cotton in September and to pay ₹ 180 per bushels. For them at that time. X does not wish to actually receive the oats and want to exit the futures market earlier.

Similarly, Y has a obligation to the clearing house to deliver 10,000 bushels of cotton in September and to receive ₹ 180 per bushels. Both party can reverse or offset their position in that way whereby buyer becomes seller and seller becomes the buyer. Before the due date i.e., September, X will sell September contract for cotton at ₹ 190 per bushels Y will buy at ₹ 190 per bushels.

Exchange of Futures for Physicals (EFP)

This is another method of liquidating the futures contract in a form of physical delivery, called exchange of futures for physicals. In this method, a party who holds a futures contract may like to liquidate his position that is different from those the exchange offers. For example, a party may like to deliver the assets before the specified futures period, or may deliver the asset at different place, or deliver outside the normal trading hours, etc.

In simple terms, the contracts fulfilled by the parties on non-contract terms under this technique. For example, a party with a long gold futures position may wish to take delivery in Los Angeles rather than in New York, as the contract specifies. Further, the EFP system permits to exchange a futures position for a cash position that meets both the parties' preferences, of course, for EFP, the party must find another party willing to make the trade.

The exchanges allow the parties to deliver under non-contract terms, and without going through the trading pits. However, both the short and the long in an EFP transaction must notify the exchange and the clearing house of the said EFP agreement so that the clearing house can make proper book entries to extinguish the respective short and long positions on its books.

The Exchange of Futures for Physicals (EFP) differs in certain respects from the offsetting method. First, the trader actually exchanges the asset in physical form. Second, such agreements are not performed/closed by a transaction on the floor of the exchange. Third, the two trades negotiate privately the price and other terms of the contract which are usually different from the specifications. Since these agreements are negotiated outside the trading pit, so they are also called ex-pit transaction. Further, regulatory authorities and exchange rules require that all the futures trading be liquidated in the pit, hence, the EFP is the one recognized exception to this general rule. These contracts are also known as against actual or versus cash transactions.

Example

Delivery using an Exchange of Futures for physicals, A is holding long January Comdex Metal futures contract and B is holding short January Comex Metal futures. Both A and B live in Chicago and prefer to close out their positions with delivery in Chicago rather than New York as specified in Comex metal contract. Under EFP A will transfer his long futures position to B at a price \$400 per ounce. Broker of both parties submit an EFP order with information to Comex. At the same time B agrees to sell 100 ounces of metal in Chicago at a price \$400 per ounce. B delivers the 100 ounces of gold at 2.00 am, if A and B wish, transaction will be recorded in Exchange next morning.

Lesson 3.3 - Theories of Futures Prices

There are several theories which have made efforts to explain the relationship between spot and futures prices. A few important there are as follows:

The Cost-of-Carry Approach

Some top economists like Keynes and Hicks, have argued that futures prices essentially reflect the carrying cost of the underlying assets. In other words, the inter-relationship between spot and futures prices reflects the carrying costs, i.e., the amount to be paid to store the asset from the present time to the futures maturity time (date). For example, food grains on hand in June can be carried forward to, or stored until, December.

Carrying costs are of several types, important among these are:

1. Storage costs
2. Insurance costs
3. Transportation costs
4. Financing costs

Storage Costs refer to those expenses which are done on storing and maintaining the asset in safe custody. It includes rent of the warehouse and others expenses associated with like deterioration, pilferage, normal wastage, etc. In case of financial instruments, the costs incurred on keeping the securities in a bank vault or with custodians.

Insurance Costs refer to amount incurred on safety of the assets against fire, accidents and others. For example, stored wheat be protected against fire, water damage, weather, natural disaster, etc. So insurance is necessary for protection against such hazards. Thus, premium and other costs incurred on insurance is called insurance costs.

In some cases, carrying costs also include the transportation costs. When the futures contract matures the delivery of the assets is given at a particular place which may be far away from the warehouse of stored goods. Obviously, transportation costs will be different from location to location and also to the nature of the commodities.

Another important carrying cost is cost of financing the underlying asset. For example, if gold costs ₹ 5000 per 10 grams and the financing rate are one percent per month then the financing charge for carrying the gold forward is ₹ 50 per month (1% of 5000).

Apart from the carrying cost on an underlying asset, there can be possibility of earning a yield on storing the asset. Such yield is known as 'convenience yield' from holding stocks. For example, in case of wheat, there could arise extra yield due to low production of wheat due to bad weather in futures.

Thus, up to a certain level, stock holding has a yield in the event of stock out and unanticipated demand. This may be termed as a negative carrying cost. Hence, the net marginal carrying cost for any given asset may be expressed as:

$$C_t = C_{gt} - Y_t$$

Where, C_T is net carrying cost of that quantity, C_{gt} is gross carrying cost of that quantity, Y_t is convenience yield of that quantity and t is time period of storage.

The Cost-of-Carry Model in Perfect Market

The following formula describes a general cost-of-carry price relationship between the cash (spot) price and futures price of any asset:

$$\text{Futures price} = \text{Cash (spot) price} + \text{Carrying cost}$$

In addition, the formula assumes the conditions of perfect competition which are as under:

1. There are no information or transaction costs associated with the buying and selling the asset.
2. There is unlimited capacity to borrow and lend.
3. Borrowing and lending rates are the same.
4. There is no credit risk. No margin is required on buying and selling the asset.
5. Goods can be stored indefinitely without loss to the quality of the goods.
6. There are no taxes.

Before discussing the various rules of carrying cost, let us see cash-and-carry arbitrage. In this, the trader buys the goods at the cash price and carries it to the expiration of the futures contract. Let us take an example as given in Table.

Cash-and-Carry Gold Arbitrage Transactions

Prices for the analysis	(₹)
Spot price of gold (per 10 grams)	5,000
Futures price of gold (for delivery 6 months)	5,300
Interest rate 8% per annum	
Other carrying cost assumes	NIL
Transaction	Cash flows (₹)
t = 0 Borrow ₹ 5,000 for six months @ 8% p.a.	+5,000
Buy 10 grams of gold at the spot rate	-5,000
Sell a futures contract for ₹ 5,300 for delivery after six months	0
Total Cash flows	0
T = 1 Remove the gold from storage	0
Deliver the gold against the futures contract	+5,300
Repay loan including interest for 6 months (5000 + 200)	-5,200
Total cash flows	100

(r = 0 & T = 1 refer to present and future period respectfully)

Some financial experts have suggested certain rules relating to cost-of-carry which have briefly given as follows:

Rule I. The futures price must be less than or equal to the spot price of the asset plus the carrying charges necessary to carry the spot asset forward to delivery. Mathematically, we can express it as follows:

$$F_{0,t} \leq S_0 (1 + C)$$

Where $F_{0,t}$ is the futures price at $t = 0$ for delivery at $t = 1$, S_0 is the spot price at $t = 0$ and C is the cost-of carry, expressed as fraction proportion of the spot price.

Rule 11. The futures price must be equal to or greater than the spot price plus the cost-of-carrying the goods to the futures delivery date.

Mathematically,
$$F_{0,t} \geq S_0 (1 + C)$$

If the prices do not obey this rule, there will be arbitrage opportunity. Both the above rules are opposite to each other which are also known as cash and carry arbitrage, and reverse cash and carry arbitrage. Together above two rules, it implies to Rule III.

Rule III. The futures price must equal the spot price plus the cost-of-carrying the spot commodity forward to the delivery date of the futures contract.

Mathematically,
$$F_{0,t} = S_0 (1 + C)$$

This is applicable under the conditions of the perfect market.

Rule IV The distant futures price must be less than or equal to the nearby futures price plus the cost- of-carrying the asset from the nearby delivery date to the distant delivery date.

Mathematically,
$$F_{0,d} \leq F_{0,n} (1 + C) \quad d > n$$

Where $F_{0,d}$ is the futures price at $t = 0$ for the distant delivery contract maturing at $t = d$, $F_{0,n}$ is the futures price at $t = 0$ for the nearby delivery contract maturing at $t = n$ and C is the percentage cost-of-carrying the asset from $r = n$ to $t = d$.

It is observed that if this relationship did not hold then a trader may purchase the nearby futures contract and sell the distant contract. He will then accept the delivery on nearby contract and carry the asset until the delivery of the distant contract, and thereby earning a profit.

Rule V. The nearby futures price plus the cost-of-carrying the asset from the nearby delivery date to the distant delivery date cannot exceed the distant futures price.

Mathematically,
$$F_{0,d} \geq F_{0,n} (1 + C) \quad d > n$$

Following the same pattern of argument for spot and futures prices, we may use for above also.

Rule VI. The distant futures price must equal the nearby futures price plus the cost-of-carrying the asset from the nearby to the distant delivery date.

Mathematically,
$$F_{0,d} = F_{0,n} (1 + C) \quad d > n$$

It should be noted that if above relationships are not fulfilled or violated, the traders would immediately recognize all the arbitrage opportunities until prices are adjusted. However, the basic rules (Rule III and VI) developed above provide a very useful framework for analyzing the relationship between cash and futures prices and spreads between futures prices.

The Cost-of-Carry Model In Imperfect Market

We have seen the relationship between the spot price and futures price in the conditions of perfect market which is rare in actual practice. There are various imperfections in real markets which disturb the relationship of Rule III and Rule VI. Among the various imperfections, five are important which have been discussed here in after:

Direct Transaction Cost

In actual practice, when a trader makes the spot or futures transactions he has to pay a fee; known as brokerage fee or commission. In other words, transaction costs refer to all such costs which have to be borne by the trader to buy or sell a particular asset for spot or futures. These costs are transaction fees, exchanges charges and fee, fee for arranging funds, etc. It is also called as the round- trip fee.

Unequal or Differential Borrowing and Lending Rates

It refers to that market situation where the rates of interest on borrowing and lending are different and they are not equal. Normally, in real market, borrowing rates are higher than the lending rate. These differentials of borrowing and lending rates serve to widen the no-arbitrage boundaries.

Restriction on Short- Selling

This is another market imperfection. Earlier, we have assumed that traders can sell assets short and use the proceeds from the short sale without any restrictions. Due to inherent risks in short sales, there are restrictions on short selling virtually in all markets.

Bid-Ask Spread

It is another market imperfection because we see in actual practice that the trader tries to sell the asset at higher price than to purchase the same. The difference between bid price and ask price is called bid-ask spread.

Storage Problem

It is another market imperfection because except gold, most of the commodities cannot be stored very well at all. The storability of a commodity is very important in futures market trading. If a commodity cannot be stored then full arbitrage opportunity will not be available in the market.

Let us see the futures prices after adjusting the above market imperfections.

After transaction cost, equation will be

$$(a) F_{0,t} \leq S_0 (1 + T) (1 + C)$$

(Where T is transaction cost in cash and carry arbitrage)

$$(b) F_{0,t} \geq S_0 (1 - T) (1 + C)$$

(Reverse cash and carry arbitrage) Combining the above equations, we get

$$S_0 (1 - T) (1 + C) \leq F_{0,t} \leq S_0 (1 + T) (1 + C)$$

There will be no-arbitrage bounds. Which means within which the futures price must remain to prevent arbitrage. If the futures price goes beyond these boundaries, arbitrage is possible. Hence, the futures price can wonder within the bounds without offering arbitrage opportunities. For example, in our earlier example; if transaction cost is 3 percent and carrying cost is 8 percent then

$$(a) F_{0,t} = 5000 (1 + 0.03) (1 + 0.08) = ₹ 5562 \text{ and}$$

$$(b) F_{0,t} = 5000 (1 - 0.03) (1 + 0.08) = ₹ 5238.$$

This is shown in Table and in Fig.

Illustration on No-arbitrage Bounds

Price for analysis:

Spot Price of Gold (10 grams) = 5000

Interest rate @ 8% (p.a.) = 8%

Transaction cost (1) = 3%

No arbitrage futures price in perfect markets (one year basis):

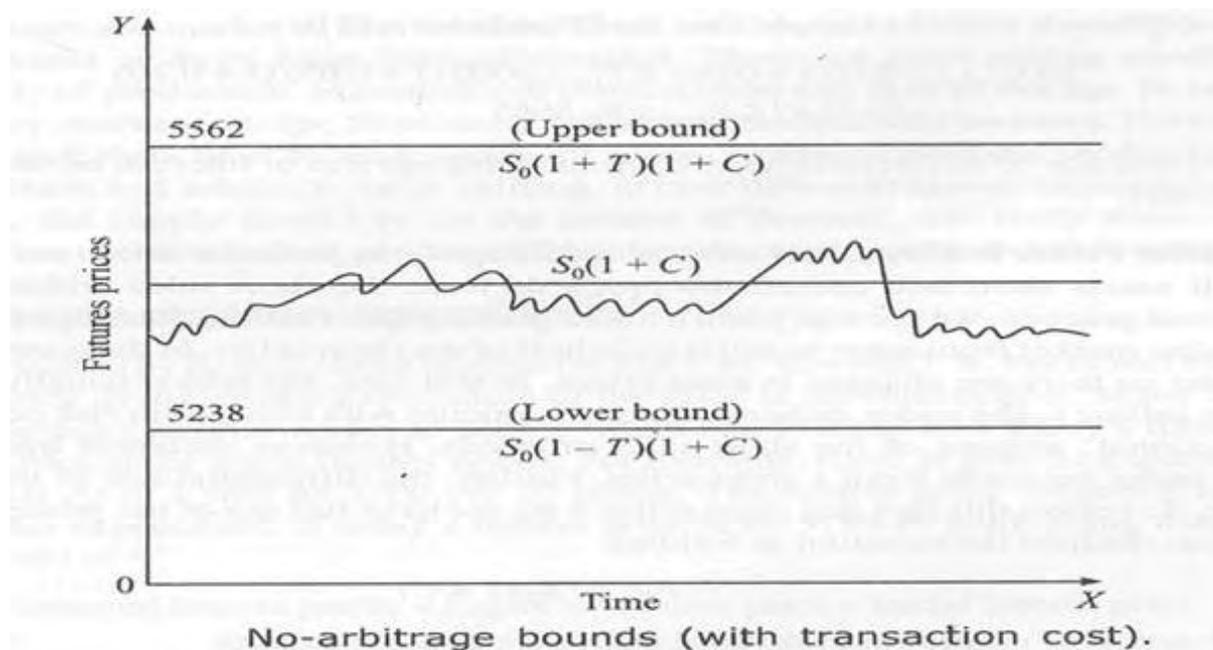
$$F_{0,t} = S_0(1 + C) = 5000 + 400 = 5400$$

Upper no-arbitrage bound with transaction cost (one year):

$$\begin{aligned} F_{0,t} &\leq S_0 (1 + T) (1 + C) \\ &= 5000 (1.03) (1.08) = ₹ 5562 \end{aligned}$$

Lower no-arbitrage bound with transaction cost (one year):

$$\begin{aligned} F_{0,t} &\geq S_0 (1 - t)(1 + C) \\ &= 5000 (1 - 0.03) (1.08) = ₹ 5238 \end{aligned}$$



If the futures price stays between the bounds, no arbitrage is possible. If the futures price crosses the boundaries the traders will immediately act in the market to exploit arbitrage opportunities. For example, if the futures price is too high then the arbitrageurs will buy the spot and sell the futures. This action will raise the price of spot goods relative to futures price, as a result, the futures price will drive back within the no-arbitrage boundaries.

Sometimes, we see in the market that transaction costs are not equal for all the investors. For example, for a retail investor, the transaction cost may be higher, even double than an arbitrageur, floor trader or a member of an exchange. Let us presume that for a retail investor, the transaction cost is double, i.e., $2T$ instead of T , then for this trader, the no-arbitrage bounds would be twice and much wider.

Differences in transaction costs will give rise to the concept of quasi-arbitrage. Those traders which have lower transaction costs than others, are called quasi-arbitrageurs. They have relatively lower bounds than the others. Thus, in actual practice, futures prices move within the no-arbitrage bounds of the lowest transaction cost trader. In other words, the traders with higher transaction costs will not be able to exploit any arbitrage opportunities.

Adjusting the Equal Borrowing and Lending Rates

As we have seen in the perfect capital market conditions that all the traders can borrow and lend at the risk free rate, but in real market, this is not possible, and even the borrowing rate and lending rates of interest are also different.

Thus, if these borrowing and lending rates are not same and are different, then they require adjustment to reflect the fact. Normally, we assume that for a trader, the borrowing rate will be higher than lending rate, hence, we assume, lending rate to be C_L and borrowing rate is C_B .

Now, the equation will be with different rates of interest:

$$S_{0,n} (1 - T) (1 + C_L) \leq F_{0,t} \leq S_0 (1 + T) (1 + C_B)$$

These differential rates will serve to widen the no-arbitrage boundaries, for example, assuming $C_B = 10\%$ and $C_L = 6\%$ in our earlier example then the boundaries will be

$$5000(1 - 0.03) (1 + 0.06) \leq F_{0,t} \leq 5000 (1 + 0.03) (1 + 0.10)$$

$$₹ 5147 \leq F_{0,t} \leq ₹ 5665$$

It is evident that due to differential borrowing and lending rates of interest, no-arbitrage boundaries have been widened.

Adjusting the Restrictions on Short Selling

In perfect market, we have assumed that traders can sell assets short and use all the proceeds from the short sales without any restriction. However, in actual practice, we see that when a trader goes for short selling then his broker has to arrange the assets from the market from other to sell it on behalf of the short seller, in that case, the risk of broker increases. If later on there are changes in asset prices. In that case, the broker usually does not give full amount of short selling to the trader, rather keeps some amount with himself for risk point of view. This is known as 'fractional' amount of the short sales proceeds. However, different traders face different restrictions on using proceeds from a short seller. Further, the differential use of those funds leads to quasi-arbitrage. To reflect this fact that short seller does not have full use of the proceeds, but only some fraction f , we can readjust the equation as follows:

$$F_{0,t} \geq fS_0 (1 + C)$$

where f is the fraction of usable funds derived from the short sales ranging between 1 to 0. With restrict short sales, our no-arbitrage bounds will be

$$fS_{0,t} (1 + C) \leq F_{0,t} \leq S_0 (1 + C)$$

With other market imperfections, our no-arbitrage bounds will be

$$fS_0 (1 + T) (1 + C_L) \leq F_{0,t} \leq S_0 (1 + T) (1 + C_B)$$

The above equation seems to be complicated and far from our simple perfect capital market no- arbitrage relationship. However, these two are closely related. For example, if we assume the following:

$T=0$ There are no transaction cost.

$C_B = C_L = C$ Borrowing and lending rates are equal.

$f= 1.0$ Traders have full use of short sales proceeds.

Then, it reduces the earlier equation to

$$\begin{aligned} fS_0 (1 + T) (1 + C_L) &\leq F_{0,t} \leq S_0 (1 + T) (1 + C_B) \\ &= (1.0)S_0 (1 - 0) (1 + C) \leq F_{0,t} \leq S_0 (1 + 0) (1 + C) \\ &= S_0 (1 + C) \leq F_{0,t} \leq S_0 (1 + 0) (1 + C) \\ &= S_0 (1 + C) \leq F_{0,t} \leq S_0 (1 + C) \\ &= F_{0,t} \leq S_0 (1 + 0) (1 + C) \end{aligned}$$

This final expression is simple equation of the perfect capital markets version of our cost-of-carry model.

The Concept of a Full-Carry-Market

The concept of a full-carry-market refers to the degree of restriction relating to the underlying asset. For example, nature of restriction on short selling, supply of goods, non-seasonal production and consumption, etc. will determine the degree of full-carry-market. So it varies asset to asset and market to near-market. There are five main factors that affect market prices and move them towards or away from full-carry-market. These are short selling conditions, supply condition, seasonality of production, and seasonality of consumption and ease of storage. In other words, to promote the full-carry-market concept, these restrictions/conditions should be eased. For example, short selling to be fully eased; there must be large supply of goods, in case of seasonal production, there must be ample stock of goods and subject to large shifting, in case of non-seasonal consumption goods like petroleum products, the supply should be on the pattern of demand, and lastly there must be high storability capacity in case of seasonal goods to make regular supply without any interruption.

The Expectation Approach

This approach is advocated by distinguished luminaries like J. M. Keynes, J. R. Hicks and N. Kalidor who argued the futures price as the market expectation of the price at the futures date. Many traders/investors, especially those using futures market to hedge, would like to study how today's futures prices are related to market expectations about futures prices. For example, there is general expectation that the price of the gold next April 1 will ₹ 5200 per 10 grams. The futures price today for July 1 must be somewhat reflects this expectation. If today's futures price is ₹ 5180 of gold, going long futures will yield an expected profit of

$$\begin{aligned}\text{Expected futures profit} &= \text{Expected futures price} - \text{Initial futures price} \\ ₹ 20 &= ₹ 5200 - ₹ 5180\end{aligned}$$

Any major deviation of the futures prices from the expected price will be corrected by speculative activity. Profit seeking speculators will trade as long as the futures price is sufficiently faraway from the expected futures spot price. This approach may be expressed as follows:

$$F_{0,t} = E_0 (S_t)$$

Where $F_{0,t}$ is Futures price at time $t = 0$ and $E_0 (S_t)$ is the expectation at $t = 0$ of the spot price to prevail at time t .

The above equation states that the futures price approximately equals the spot price currently expected to prevail at the delivery date, and if, this relationship did not hold, there would be attractive speculative opportunities. In simple terms, the futures price are influenced to some extent on expectations prevailing at the current time. Under this hypothesis, if markets are operating properly then

$$\text{Current futures price} = \text{Expected futures spot price}$$

This is also known as hypothesis of unbiased futures pricing because it advocates that the futures price is an unbiased predictor of the futures spot price, and on an average, the futures price will forecast the futures spot price correctly.

We have seen above that on an average' or 'approximately' words have been used to equalize the current futures price with the expected futures spot price. Why does this relationship hold only approximately? There are two arguments to the question. Firstly, it is due to transaction costs, and secondly due to risk aversion of the traders. Transaction costs

can keep the futures price from exactly equaling the expected futures spot price. This has already been discussed in detail in the previous section of this chapter.

Futures Prices and Risk Aversion

In this section, we will discuss the 'Risk Aversion' in more detail with its two theories, namely the theory of Normal Backwardation and Theory of Capital Asset Pricing Model (CAPM). Traders in futures markets can be classified roughly into two categories, i.e., hedgers and speculators. Hedgers have a preexisting risk associated with the asset and enter the market to cover that risk. Speculators, on the other hand, trade in the market in the hope to earn profit which is a risky venture. In general, all the investors are risk averse; however, they incur risk willingly only if the expected profit from bearing the risk will compensate them from risk exposure.

The Theory of Normal Backwardation

Backwardation, in general, refers to a market in which the futures price is less than the cash (spot price). In such case, the basis is positive, i.e., basis is cash price - futures price. This situation can occur only if futures prices are determined by considerations other than, or in addition, to cost-of-carry factors. Further, if the futures prices are higher than the cash prices, this condition is usually referred to as a 'contango' market; and the basis is negative. Normal backwardation is used to refer to a market where futures prices are below expected futures spot prices.

Another way of describing the can tango and backwardation market is that the former (can tango) is one in which futures prices are reasonably described most of time by cost-of-carry pricing relationship, whereas later (backwardation) is one in which futures prices do not fit a full cost-of-carry pricing relationship. In other words, futures prices are consistently lower than those predicted by the cost-of-carry pricing formula.

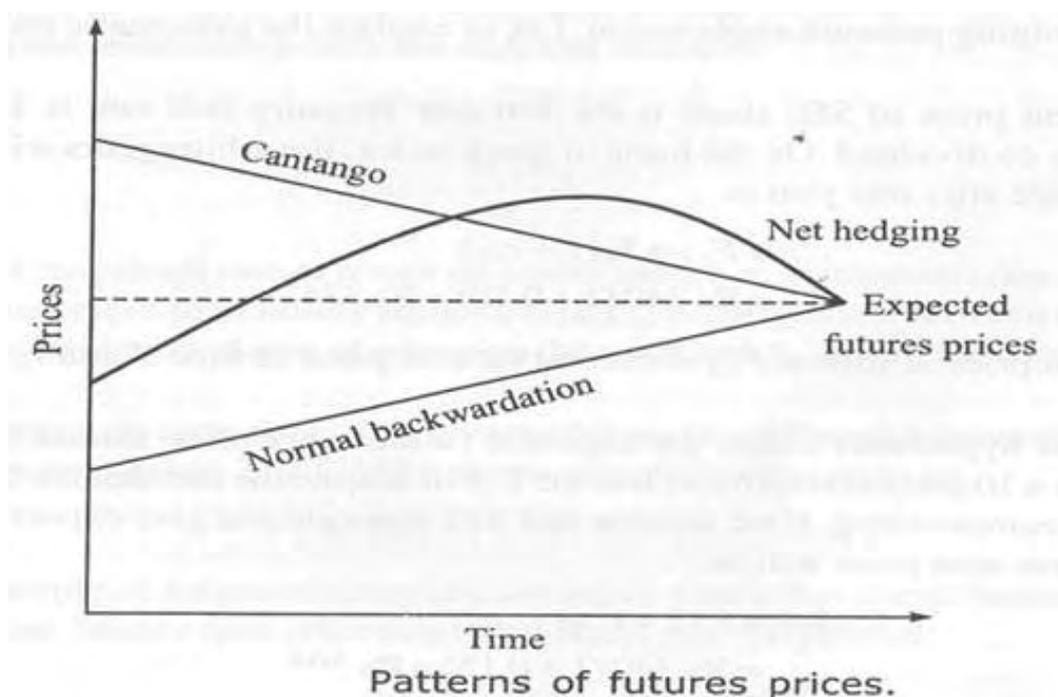
It has been observed in many futures markets that the trading volume of short hedging (sales) exceeds the volume of long hedging (purchases), resulting in net short position. In such situation, Keynes has argued that, in order to induce long speculator to take up the net-short-hedging volume, the hedgers had to pay a risk premium to the speculators. As a result, the futures price would generally be less than the expected futures spot price, by the amount of risk premium which can be stated in equation as:

$$F = E - r$$

Where, F is futures price for a futures date, E is expected price at that date and r is risk premium.

In brief, the theory of normal backwardation state that futures prices should rise overtime because hedgers tend to be net-short and pay speculators to assume risk by holding long positions.

Figure illustrates the price patterns of futures which is expected under different situations. If the traders correctly assess the futures spot price so that the expected futures spot price turns out to be the actual spot price at the maturity. If the futures price equals the expected futures spot price then it will lie on the dotted line. However such situations, sometimes, do not occur, and alternative conceptions exist like normal backwardation and can tango. If speculators are net long then futures prices must rise over the life of the contract if speculators to be compensated for bearing risk. Futures prices then follow the path as labelled normal backwardation in Fig. It is to be noted that this line will terminate at the expected futures spot price.



If speculators are net short and are compensated for bearing the risk then the futures prices must follow the path of can tango as shown in Fig. The fall in futures prices will give the short speculators the compensation that induced them to enter the market. Final possibility, as shown in Fig., is known as net hedging hypothesis. According to it, net position of the hedgers might change over the life of the futures contract. In the beginning, the hedgers are net short and the speculators are net long, then the futures price lies below

the expected futures spot price. Later on, over-time the hedgers gradually change their net position, being net long, and hence, requiring the speculators to be net short. In such situation for having their compensation for risk, by the speculators, the futures price must lie above the expected futures spot-price, as it did in can tango shown in Fig.

Futures Prices and the Capital Asset Pricing Model (Systematic Risk Explanation)

The Capital Asset Pricing Model (CAPM) has been widely applied to all kinds of financial instruments including futures contracts. In general, the higher the risk of an investment, the higher the expected return demanded by an investor. The expected return demanded by the holders of futures positions is reflected in the difference between futures prices and expected future spot prices. This risk return model can be used for other assets like stocks and bonds. The CAPM leads to the conclusion that there are two types of risk in the economy; systematic and unsystematic.

Unsystematic risk is not so important since it can be almost completely eliminated by holding a well-diversified portfolio. Systematic risk or market risk cannot be diversified away. So as per this model, the investors should be compensated only for systematic risk. In general, an investor requires a higher expected return than the risk-free interest rate for being the systematic risk.

Systematic-Risk Explanation

It is observed that, sometimes, the futures prices differ from expected futures spot prices even after adjusting for systematic risk because of unevenly distributed demand by hedgers for futures positions. For example, if hedgers are dominating in the market through short sales then long hedgers will receive an expected profit in addition to any systematic risk premium. This theory is called hedging pressure explanation. Let us explain the systematic risk explanation by an example.

Suppose the current price of SBI share is ₹ 340 and Treasury Bill rate is 10 percent per year, assuming that SBI pays no dividend. On the basis of stock index, the arbitrageurs will guarantee that the futures price of SB1 share after one year is:

$$\begin{aligned} &= F_{t,T} = S_t(1 + r_{t,T}) \\ &= ₹ 340 (1 + 0.10) = ₹ 374 \end{aligned}$$

Where S_t is current spot price at time t , $F_{t,T}$ current futures price at time T and $r_{t,T}$ is rate of return at time

If the unbiasedness hypothesis holds, the expected futures spot price should be ₹ 374. It means that SBI share will have a 10 percent return just like the T. Bill despite the fact that the SBI is a riskier stock. So, higher risk must be compensated. If we assume that SBI share should give expected return 15 percent then the expected futures spot price will be

$$\begin{aligned} E_t(S_T) &= S_t(1+r_{t,T}) \\ &= ₹ 340(1+0.15) = ₹ 391 \end{aligned}$$

Where $E_t(S_T)$ is expected futures spot price at time T and $r_{t,T}^*$ is expected rate of return on stock.

Thus, in this example, the futures price is less than the expected futures spot price in equilibrium.

Futures price < Expected futures spot price or

$$\begin{aligned} F_{t,T} &< E_t(S_T) \\ ₹ 374 &< ₹ 391 \end{aligned}$$

This result implies that, on average, a long futures position will provide a profit equal to ₹ 17 (391 - 374). In other words, ₹ 17 expected profit on the futures position will compensate the holder for the risk of synthetic stock (synthetic stock = T-bill + Long futures), that is above the risk of T-Bill.

In brief, implies that the difference between the futures price and the expected futures spot price is the same as the difference between the expected profit on riskless securities and that on a pure asset with the systematic price risk as the futures contract. Thus, we would expect that

$$\begin{aligned} &= \frac{E_t(S_T) - F_{t,T}}{P_t^*} \\ &= r_{t,T}^* - r_{t,T} \end{aligned}$$

where P_t is price of a pure asset with the same price risk as the underlying asset of the futures contract, $r_{t,T}$ is expected rate return on that asset and is premium of pure asset with same risk as futures over the riskless rate:

The price of such a pure asset at t, P, can easily be calculated at the present value of the expected futures price of the underlying asset:

$$P_t = \frac{E_t(S_T)}{1+r_{t,T}^*}$$

Where S_t is price of a pure asset.

If the underlying asset of a futures contract is a pure asset then P_t^* will be equal to P_t , and vice-versa. The discount rate $r_{t,T}^*$ can be determined with the CAPM too.

CAPM defines the relationship between risk and return as:

$$r_i^* = r_f + B_i(r_m^* - r_f)$$

$$B_i = \frac{\rho_{im} \sigma_i}{\sigma_m}$$

where r_i^* is expected (required) rate of return on a pure asset i , r_m^* is expected rate of return on the market in portfolio, r_f is riskless return (essentially equal to $r_{t,T}$), ρ_{im} is correlation between asset return and market return, σ_i is standard deviation of rate of return on the asset and σ_m is standard deviation of rate of return on market portfolio.

The expected return on each pure asset is earned from the difference between the current spot price and expected futures spot price. The CAPM shows this difference as to be

$$E_t(S_t) - P_t^* = r_i^* P_t^* + \beta_i (r_m^* - r_f) P_t^*$$

Our earlier principle of futures pricing shown above states that the difference between the futures price and the expected futures spot price must also equal this differential:

$$E_t(S_t) - F_{t,T} = \beta_i (r_m^* - r_f) P_t^*$$

The earlier equation has an important view that futures prices can be unbiased predictor of futures spot price only if the asset has zero systematic risk, i.e., $B_i = 0$. In such situation, the investor can diversify away the risk of the futures position. In general, futures prices will reflect an equilibrium bias. If $B_i > 0$, bearing positive systematic risk, in such case, $F_{t,T} < E_t(S_T)$, and if $B_i < 0$, a long futures position has negative systematic risk, such a position will yield an expected loss, so $F_{t,T} > E_t(S_T)$. This situation purely reflects the CAPM. In brief, according to CAPM, the expected return on a long futures position depends on the beta of the futures contract if $B_i > 0$, the futures price should rise overtime; if $B_i = 0$, the futures price should not change, and if $B_i < 0$, the futures price should fall over time and vice-versa in the case of short futures.

An Integrated Approach

The various theories presented earlier, sometimes, present controversial view, e.g. one theory states that futures price are based on carrying costs whereas other one argues purely on expectations or forecast. A number of empirical studies have attempted to verify the reliability of these theories and have resulted in greater clarity and better applicability. In this section, an attempt is made to integrate the various stands of these theories here in brief:

1. Futures prices of those assets which have continuous production or continuous storage capacity broadly follow the carrying cost approach.
2. Those goods or assets which are of discontinuous production or storage nature (perishable nature) should follow expectation approach.
3. It was also observed that the expectations also influence the futures prices of continuous production or storage products. It was seen that the carry cost approach determines the maximum limit of spread but not the minimum limit. Further, fluctuations within the maximum limit are often related to expectation approach.
4. It is also observed that expectations may predominate, sometimes, even in continuous production or storage markets, for such periods indicated in the present by some futures events like ongoing strike, railway disruption, futures labour unrest weather conditions, expected election, etc. which are expected to change the market situation.
5. It is also noticed that the normal backwardation approach tends to exist in those markets which are relatively thin, where speculators are induced to enter in the market.

Comparison of Forward and Futures Contracts

S. No.	Forwards	Futures
1	Private contracts between the two parties; bilateral contracts	Traded on organized exchanges
2	Not standardized (customized)	Standardized contract
3	Normally one specified delivery date	Range of delivery dates
4	Settled at the end of maturity. No cash exchange prior to delivery date	Daily settled. Profit/Loss are paid in cash

5	More than 90 percent of all forward contracts are settled by actual delivery of assets	Not more than 5 percent of the futures contracts are settled by delivery
6	Delivery or final cash settlement usually takes place	Contracts normally closed out prior to the delivery
7	Usually no margin money required	Margins are required of all the participants
8	Cost of forward contracts based on bid-ask spread	Entail brokerage fee for buy and sell orders
9	There is credit risk for each party. Hence, credit limits must be set for each customer	The exchange's clearing house becomes the opposite side to each futures contract, thereby reducing credit risk substantially

Trading Secrets of the Professionals

Selected trading secrets of the professionals, based more on their failures than their triumphs, have been identified as a world of wisdom. We know that the same mistakes made 50 and 100 years ago continue to be made every day. Technology may change, but human nature never does. Ultimately, the markets are the best teachers, however. A trader may not use all of these secrets, but if he can absorb just a portion, there is no doubt about success. If he disregards, what's presented below, he may lose in the financial desert.

Secret 1: The Trend is Your Friend

So, don't buck it. The way to make the big money is to determine the major trend and then follow it. If the market will not go in the desired direction, then a trader must go its way. When he is in a bear market, and the major trend is down, the plan should be to wait for rallies and sell short; not try to pick the bottom. In a major bear market, he can miss the bottom several times on the way down and end up losing all his money. The same applies (in reverse) in a major bull market. Always go with the tide, never buck it. It is important to note that in a major bear market it is safer to sell when the market has fallen 50 points from the top, than when it is down just 10. The reason is, at a 50-point drop, the support is gone, and those who bought the dips have lost all hope, are demoralized, and in a leveraged market are at the point where they must try to exit the same door at the same time. The result at times can be an avalanche. There are many examples of markets that have trended long and far, made some people rich and wiped others out, we may hear about the poor

traders who lost their money drawn from provident fund, sale of real estate etc. We can almost guarantee that such traders were bull headed and fought the trend until they run out of money.

So, how does a trader do this, stick with the trend and not fight it? Well, it isn't easy. That's why most people don't make money in futures. They need to have strong willpower. Once they can see the trend of the market, they should not change their mind until the "tape" shows the change. In any major move there will, of course, be corrective moves against the trend at times. Some news will develop which will cause a sharp correction, but it will be followed by a move right back in the direction of the major trend. If they listen to this news they will be tempted to liquidate prematurely. Avoid the temptation and listen to no one but the market. One way to do this is to never set a fixed price in mind as a profit objective. The majority of people do this, and there's no good reason for it - it's a bad habit based on hope.

Do not set a fixed time to liquidate either. This is the way the amateurs do it. They buy silver at, because their broker told them it's going to ₹ 8000. Well, it gets to ₹ 7800 turns and heads south again, and they're still holding looking for ₹ 7800, watching and waiting as their unrealized profit melts. This is just plain bull-headedness; one can see the opposite as well. The market closes at ₹ 7700; it looks strong and is fundamentally and technically sound. The amateur has his order sitting to sell at ₹ 8000, because this is his price. The market gaps up on the open the next day at ₹ 8100 and his broker is pleased to report he sold ₹ 100 better at this price. However, this is a form of top picking, and who is smarter than the market? The market probably gapped up above ₹ 8000 cases like this one, where the open was sharply higher, but was the low of the day. The market never looked back until it hit ₹ 10,000. This is all a version of bucking the trend, which is something not to be recommended. Conditions do change, and one must learn to change his mind when they do. A wise man changes his mind, a fool never. Just be sure if a trader changes his position it must be based on sound reasoning. There is no way one can possibly know in advance how much profit to expect. The market determines that. The mission is to determine the trend, hope on for the ride, and stay on until the indicators suggest the trend has changed, and not before.

Secret 2: When Market is "Cheap" or "Expensive" there Probably is Reason

This one goes hand in hand with "don't buck the trend." The intelligent traders always make money selling short low priced markets which are the public's favourite and in which a large long interest had developed. Alternatively, they cash in on expensive markets when "everyone" is bailing out because the public thought the market high enough for a "healthy" reaction. Always remember, it's not the price that's important, it's the market action.

Secret 3: The Best Traders are the Hardest to Do

A trader needs, to have guts and be aggressive on entry. He needs to quickly cut losses when the market is not acting right. The news will always sound the most bullish at the top, and appear to be the most hopeless at the bottom. This is why the technical tone of the market is so important. If the news is good, but the market has stopped going up, ask why, and then heed the call. Bottoms can be the most confusing. The accumulation phase, where the smart money is accumulating a position, can be marked by reactions, cross-currents, shakeouts, and false reversals. After the bottom is in place, many traders will be looking for the next break to be a buyer. After all, the market has been so weak so long, the odds favour at least one more break, right? But it never comes. The smart money won't let it. The objective after the bottom is in place is to move the market up to the next level, and the best time to buy may actually feel quite uncomfortable.

Secret 4: Have a Plan Before Trade, and then Work It!

If a trader has a plan and follows it, he avoids the emotionalism which is the major enemy of the trader. He must try to stay calm during the heart of the session, and remain focused. To do this, he has to be totally organized prior to the opening bell. His daily mission, should he decide to accept it, is to make money each day or, barring this, at least not lose much. In normal markets, he should take normal profits. In those unusual markets which occur rarely, he needs to go for abnormal profits. This is one of the keys to success. He must always limit losses on trades which are not going according to plan.

This takes willpower and is as essential a quality as having plenty of money. In fact, it is more important than having plenty of money. Money is not to hold on with, this is for the sheep and a trader doesn't want to be sheared. If big risks are required, don't take the trade, wait for opportunities where he could enter very close to his risk point. In this way his risk per trade is small in relation to the profit potential.

When it's not going right, when in doubt, get out. If a trader has a compass in the middle of the desert, and the oasis is north, he shouldn't get fooled into following the mirage to the west. There is nothing better than getting out quickly when one is wrong!

Secret 5: Be Aggressive When Taking Profit and/or Cutting Losses if there is a Good Reason To Do So

A good trader will act without hesitation. When something is not right, he will liquidate early to save cash and worry. Never think too much, Just do it! And, doesn't limit

his price—go at the market! Many times a market will give one optimal opportunity to act and that's it—goes with it. The way to benefit through tuition is to act immediately!

Secret 6: No Regrets

When an intelligent trader liquidates a trade based on sound reasoning, he never regrets his decision. Go on, and if it was a mistake to get out, just learn from it. We all make them. By taking mistakes seriously, one will lose perspective and become too cautious in the future. Try not to think about the price to be entered. This is irrelevant. If the market isn't acting right, don't try to "get out at break even after commissions." This can get very expensive.

Secret 7: Money Management is the Key

Think about this daily. One needs not to have a high win to loss ratio, but average win must be higher than average loss if one wants to succeed. To do this, there must be (at least some) "big hits" to offset the inevitable numerous (and hopefully, small) losses which are going to happen.

It is noted that a trader by being able to just cut losses early, by even a small increment in amount per trade, this can make a major difference to the bottom line. This takes decisiveness, so be decisive if the trade is not acting right. Waiting a "few more ticks" is generally not a recipe for success.

One more point there: it is bad practice to cancel or extend a stop loss order. One should never do this. It's OK to cancel a profit taking order at times, but the sooner a trade is stopped the better. When one gets out of a bad position quickly, and with a minimum of trauma, not only is his capital base maintained, but his judgment will improve. Without a well-defined risk point, there's no judgment, what it's called is hope.

Secret 8: Success Comes Easier When You Specialise

Every market seems to have its own nature, its own personality. Some markets tend to make tops and bottoms with a fast run up and reverse (called an inverted V top or a V bottom). Some have rounding tops and bottoms, some double tops and bottoms, some have tops and bottoms with a long consolidation. A trader can read a market better when he becomes familiar with its idiosyncrasies. Familiarity comes from concentration and experience. There are plenty of markets out there to be picked up one for each temperament.

Secret 9: Patience Pays!

Some people are in too big a hurry to get rich and as a result they go broke. Don't try to get rich in a few months. Don't try to catch all the fluctuations. Market movements of importance require weeks and even months to get ready. There's generally plenty of time to buy or sell one or two days, or longer, after a big move gets under way. There are times when a man or woman with nerve, knowledge, and a bit of luck can turn a small amount of money into a fortune. However, this cannot be done continually. The best trades come along only rarely. One needs to have patience to wait for the right trades. When they come, one must have the patience to not be overanxious and get in too soon or overtrade. Remember, every act, either opening or closing a trade, must have a sound basis behind it. Never trade for the thrill of it.

One last point on patience: once one is out of the market with a big profit, shouldn't be in too big a hurry to get back in. The best opportunities may be coming, but they're not there every day. One needs the patience to wait. Big account balances lead to the temptation to lay for less than desirable trades. If one makes a good profit, look at it this way: he can now afford to wait a few weeks or months for the signs of the next big mover.

Secret 10: Guts are as Important as Patience and More Important than Money!

Some traders are too bold and as a result overtrade. However, some have trouble pulling the trigger. This is a weakness which must be corrected. One must train oneself to trade so there is no hope, no fear. When one enters or exits a position, one should do it decisively and without emotion. This is particularly important after a tough losing streak. Sometimes the traders who suffer a string of losses, though they still have some money left, and when the best opportunity of the year comes along (one they identified) they did not have the guts to act. In cases like this, guts are more valuable than money. Hence, the traders should have the guts to press hard when they are right. They also need the fortitude to cash in when it is most pleasurable.

Secret 11: The "Tape" (The Quote Machine) Will Trick You

It's impossible for the man who stands over "the ticker" day by day to identify a big move before it starts. The tape will fool him every day while accumulation is taking place (and it takes time to accumulate or distribute a large position). The tape (the quote machine) is there to fool traders. "The tape moves in mysterious ways, the multitude to deceive." Prices can look the weakest/ strongest at the strongest/ weakest times. Watching quotes all day will cause trader to constantly change his mind and trade too often, and this increases

his percentage of being wrong. If he gets in wrong, the quote machine will tend to keep him in wrong longer than he should be because every tick his way will renew his hopes. If he gets in right, and he watches, the screen too closely, there will come a minor move which, in the long run means nothing, which will get him out. As a result he will lose a good position.

Secret 12: Be Skeptical

In other words, it pays to be a contrarian. To be successful, a trader needs to be a student of human nature and do the opposite of the general public. Sell on his first clues of weakness, and doesn't wait until "everyone" is bailing out. The tip giver may be good-intentioned, but tips will invariably influence in the wrong direction. Remember, the market doesn't beat a trader rather a trader beats himself. Following tips and not the market is just another sign of human weakness.

Secret 13: Be Time Cognizant

Know how much time the move has taken to get to the point it's at. This is important, because the longer a market moves in one direction, the greater the velocity of the buying or selling will be as the final stage approaches. In many cases, the significant portion of a major move takes place in the final 48 hours. One should watch the volume closely after a market has made a long-term move. Volume tends to run higher than normal at the end of a move. This is the "distribution zone," where the smart money is unloading their position to a public who is frenzied by news.

Actually, it's important to know what "zone" the market is in. Market phases tend to act in a similar manner. Many times, at the bottom, a market can rally on small volume. This indicates there really isn't much for sale. The bottom can follow a period of panicky conditions, pessimism, and apathy. Even the prior bulls will start to sound more cautions, and hint it could get worse before it gets better. It seems nobody is interested in buying. This is the time to watch moving averages closely. If they flash a buy signal, immediately cover shorts and start to buy. Tops are the opposite of bottoms. It seems nobody notices the market is saturated, yet the market may top going up. After the first break from the top, many times there will be a low volume "failure test of the high." Once the market fails at a lower high, if the trader is not out already, this could be his last best chance to liquidate.

As a general rule, the big money is made in the last stage of a bull market, when prices are feverishly active. The big profits on the short side are made in the last stage of a bear market, when everyone wants to sell and it seems no one wants to be a buyer. It is always darkest before the dawn and brightest at noon just before the sun starts to recede.

Secret 14: The Market's Reaction to the News is Crucial

It's not the news, but how the market reacts to the news, that's important. In other words, it's the news that sets the public perception. Be alert for divergences between the news and market action. It all has to do with expectation versus reality. Look for the divergence between what's happening and what people think is supposed to happen. When the big turn comes, the general public will always be looking the wrong way. There are certain ways to analyze reactions to news (or even a lack of news).

Consider the following:

- If bad news is announced, and the market starts to sell off in large volume, it's good bet the market's going lower.
- If the market doesn't have much of a reaction to good news, it's probably been discounted.
- Moves of importances invariably tend to begin before there is any news to justify the initial price move. Once the move is under way, the emerging fundamentals will slowly come to light. A big rally (decline) on NO NEWS is always very bullish (bearish).
- It is generally not good practice to buy after a lot of very bullish news, or to sell after an extremely bearish report. Both good and bad news are many times already discounted in price. Of course, one should always consider whether the trend is down or up when the news is made known. A well-established trend will generally continue regardless of the news.
- When unexpected news occurs (news which the market has not had time to prepare for) and the market opens in a wide range or "gaps" lower or higher, sell out longs, or cover shorts and wait. Watch the market for 30 minutes to an hour. If the market opened sharply lower, with heavy selling, and was notable to trade much lower than that, it's into support and can be bought at the market with a tight risk point. Watch the market closely at this point. Note the tone of the rally. If it is small and the market is able to again fall under the levels made when the bad news came out (or above the good) it is safe to assume the market is going lower (higher).

Secret 15: Never Trade When Sick or Tired

Good health is essential to success. If a trader is not feeling good, he should close out positions and start over again when he does. Rest is equally essential to success. It is

probably a good idea to periodically close out all trades, get entirely out of the market and go on vacation. The market will still be there at return. Some of the most traders trade their best right after a vacation. If one sticks to something too long without rest, judgment will become warped. Traders who are continually in the market day in and day out lose their perspective and will ultimately lose.

Secret 16: Overtrading is One of Your Greatest Enemies

Overtrading is the “greatest evil.” It is the cause of more losses than anything else. The average novice trader really doesn’t have a clue as to how much money is needed to be successful, and he or she invariably buys (or shorts) more than prudence dictates. He may be right in his analysis, or determination of the major trend, but due to too big a position is forced to liquidate at the margin calls. When he’s liquidating so are he other novices, and that’s when the smart money moves in. The money runs out just at that critical time when it is ripest to enter. The over-trader is exhausted and misses the profit opportunity he had once seen clearly in those more optimistic days.

Be conservative, keep cool, and avoid the temptation to trade more contrit⁵ than margin can reasonably support in normal markets. This is especially important at tops and bottoms where the excitement, the rumours, and the news are at fever pitch- Human nature has a tendency towards overconfidence at tops and bottoms. Study charts, and don’t let good judgment be influenced by hopes or fears.

Secret 17: Keep a Cool Head During “Blowoffs”

Markets nearly always culminate at the top in the same way. When close to the end of a major move, markets can become wild. Volume is huge, activity is feverish and erratic, and the imagination blossoms. If a trader has the vision to ride the trend to this point his pay day has come. However, in extreme markets men and women of reason lose all sense of proportion. They start to believe the propaganda that the world will literally run out of this or that. It never happens. The history of the world shows that there has never been a time when a great demand for any commodity has not led to a supply in excess of demand.

Extreme markets are not the time to pyramid. They are the time to become alert for the end. All good things come to an end, and a trader will be to jump before the big bump. There will be a time when the herd will want to all exit out the same door at the same time. Make sure one should have already left the room. When everyone wants to sell, and all buying support disappears, profits can run into losses fast. In the stock market crash of 1987, profits made in the first ten months of the year were wiped out in three days.

How does a trader turn his paper profits into cash in a runaway market? In blowoff markets the corrections are generally short and sweet. The market is feverish and everyone is bullish (the bears have already thrown in the towel). The public is buying madly. Weeks may go by without a major correction. One will hear of fortunes being made, and if someone is fortunate enough to be on the move, his paper profits will grow geometrically. The end may be near, but nobody can see it. In fact, only about 10 per cent of those with big paper profits will ever cash in near the top.

The Golden Rules in this type of market are: first, it does not pay to take a loss amounting to more than two consecutive days' fluctuations. If the market goes against for two days it's likely to go more. Secondly, be alert for a morning when the market opens off dramatically without any news. It may weekly rally, but the rally will fail. This is the first sign of the end. The market has reached the saturation point where it's run out of buyers. Supply has finally overwhelmed demand. Third, watch for a failure test of the high. Many times after the first break the market will have a secondary rally which will fail under the high. If a trader fails to get out on the first break, this is his last good chance.

Secret 18: Never Let a Good Profit Turn Into a Loss

There is one of the trading sins which has ruined many hopes. If a trader has a decent profit in any position, and he is sure it is going to grow, the stop won't be hit. Should the market continue to move in favour, keep moving the stop to lock in some profit. The objective is to always protect principal in every way possible, and when he is fortunate enough to start accumulating paper profits, lock 'em in.

Secret 19: When In Doubt, Get Out!

If it's not acting right, according to plan, get out. If the market has not started to move in favour within a reasonable amount of time, get out. A trader's judgment will deteriorate the longer he hangs on to a losing position and at extremes he will do the wrong thing. One of the old timers once said something to the effect: "I am prudent enough not to stand in the middle of the railroad tracks while I decide if the headlight I see is a freight train or an illusion."

Secret 20: Diversify

Distribute risk among a variety of trades and markets. Divide capital into tenths and never risk more than a maximum of 10 per cent on any one trade. One good profit will often totally erase four or five small losers. But if a trader takes big losses and small profits

he will have no chance of success. He should concentrating on active, liquid markets which will allow him to enter and exit when he wants to with a minimum of slippage.

Secret 21: Pyramid Correctly

The big money can only be made by a pyramiding a good position in a trending market. A trader has an excellent opportunity to use leverage and his unrealised profits to create a larger position than otherwise possible. Pyramiding takes both courage and self-control. The “weak hands” seldom make the big money, primarily because they do not have the guts to pyramid and maximise the opportunities they are correct about (or they do not have the smarts to do it right).

Be advised, there is a right way and a wrong way to pyramid. The traders should never reverse pyramid (that is, add a greater number of contracts than their initial position as the market moves their way). First risk should be greatest risk. It is generally better to decrease the size of position through the journey, not increase it. In this way, a trader has the opportunity to increase his profitability without dramatically increasing his risk. Other useful pyramid rules are:

- ▶ Never try to pyramid after a long advance or decline. The time to begin a pyramid is when the trend first turns up or down after a long move., Technical indicators can help here.
- ▶ It is always safer to pyramid after a market moves out of accumulation and/or distribution. In other words, a breakout from consolidation. Remember, the longer the time it takes prior to the breakout, the greater the move one can expect.

Secret 22: Watch for Those “Breakouts From Consolidation”

A trader needs to know what kind of market he is in. In a consolidating market money can be made by scalping small moves back and forth. However, one won't make the big money with this kind of market action, and one should never attempt to pyramid. Big profits can be made in the runs between accumulation and distribution. One can make more money by waiting until a commodity plainly declares its trend, than by getting in before the move starts. Too many traders are fixated on picking the top or bottom and as a result miss the big picture. Get the idea of prices out of head and concentrate on market action. Forget about picking tops and bottoms.

The longer the consolidation the better. When a market has remained for a long time in a narrow range, a breakout from the range becomes more significant. The market is

telling that a major shift in the supply/demand fundamentals is taking place. Because it has taken a long time to form, there is more fuel available for the coming move. This is the best type of market to play to the hilt!

One last point here: remember there is no Holy Grail and at times there will be false breakouts. Watch for them. It's most likely false if the market again trades into the consolidation range. The best ones will never retrace into the breakout range, but it is OK for a market to trade back to the upper or lower edge of the range before resuming new trend action. There is no question it was false once it breaks through to the other side. When this happens, a reversal play is the best course of action.

Secret 23: Go With the Relative Strength

It is important to follow the trend of each market and to always buy the strong one and sell the weak one. This is especially important for related markets. Silver and gold are both precious metals and will generally move in the same direction. They will move at different speeds, however. The trader needs to judge a market by its own signs, and always sell the weak one and buy the strong.

Secret 24: Limit Moves are Important Indicators of Support and Resistance

When a market moves "bid limit up," or "offered limit down" (for those market which still have limits), this is a level where a trader theoretically is unable to be a buyer or a seller. There is more demand at the limit up price than available supply, and vice versa. The market should continue in the direction of the limit move. On corrections, it should find support above the limit price (or below if a limit down type move). Watch for this. If a market again trades under the limit bid price, or above the limit offered, go with the flow. These are reasonably risked trades, since it is an indication the previous support or resistance is now absent. If anyone can now buy a market where it previously was unable to be bought (of sell where he previously couldn't) this is a major sign of weakness or strength.

Secret 25: Never Average a Loss

This is critical. There are some traders who have had great success averaging down. When a stock they liked got cheaper, they bought more. When the long-term trend turned back up, they make out like bandits. A leveraged market is different, however, averaging a loss may work four times out of five, but that fifth will wipe the trader out. It is a bad habit to get into.

Look at it this way: if a trader makes a trade, and it starts to go against him, then he is wrong—at least temporarily. Why buy or sell more to average the loss? When it's getting worse day by day, why should he potentially compound the problem? Stop the loss early before it is eternally too large, and don't make it worse. If a trader could avoid three weaknesses—overtrading, failing to place a stop loss, and averaging a loss—he will be successful.

Summary

This chapter has introduced the mechanism of pricing the futures contracts in different situations. The chapter further explains the relationship between forward prices and futures prices whether the forward prices are equal to futures prices, this is very important issue and debatable. It is argued that if the risk-free interest is constant and the same for all maturities, in such market situations, the forward price will be same as the futures price for the contract. Next section deals with the pricing of stock index futures and futures prices of stock indices. A stock index can be regarded as investment assets, which pays dividends. Next section deals with the pricing of foreign currencies in situations if $F < S e^{(r - r_f)T}$, similarly, suppose $F > S e^{(r - r_f)T}$, what will be the investor trading strategy. The chapter further describes the futures on commodities in cases where (a) commodities as investment assets (like gold, silver) and (b) consumption commodities etc., as described such commodities which are not held for investment purposes. The arbitrage arguments used to determine futures prices must be considered and examined carefully.

The chapter describes how futures prices and spot prices are converged. The basic reason of convergence is that if the futures price is above the spot price during the delivery period, this will rise to a clear arbitrage opportunity for the trader in the market which may be followed as (a) short a futures contract, (b) buy the underlying asset and (c) make delivery. And due to arbitrage process futures price will tend to fall.

There are three theories (models) which explain the pricing of futures. The cost-of-carry approach, given by Keynes and Hicks, argued that futures prices essentially reflect the carrying cost of the underlying assets. It means the inter-relationship between spot and futures prices reflect the carrying costs, i.e., the amount to be paid to store the asset from the present time to the futures maturity period. This approach is explained in two ways: cost-of-carry model in perfect markets and the cost-of-carry model in imperfect market. The next approach to futures pricing is the expectation approach, which argues the futures price as the market expectation of the price at the futures date. According to this theory, expected futures profit is equal to expected futures price minus initial futures price. Another theory of futures pricing is normal backwardation. Backwardation, in general, refers to a market in

which the futures price is less than the cash or spot price. In such case the basis is positive. Basis is referred to cash price minus futures price. Further, if the futures prices are higher than the cash prices, this situation is usually referred to as a contango market, and the basis is negative. Normal backwardation is used to refer to a market where futures prices are below expected futures spot prices.

Chapter further throws light on the relationship between futures prices and the capital asset pricing model (CAPM), which is widely applied to all kinds of financial instruments including futures contracts. The expected return on each pure asset is earned from the difference between the current spot price and expected futures spot price.

The chapter ends with the discussion on integrated approach which explains that futures prices of those assets which have continuous production or continuous storage capacity broadly follow the carrying cost approach. The assets or goods which are of discontinuous production or storage should follow expectation approach and normal backwardation approach tends to exist in those markets which are relatively thin, where speculators are induced in the market.

Solved Problems

1. Suppose that you enter into a short futures contract to sell August gold for ₹ 520 per gram on the XYZ Exchange. The size of the contract is 10 Kg. The initial margin is ₹ 5,00,000 and the maintenance margin is ₹ 3,00,000. What change in the future price will lead to a margin call? What happens if you do not meet the margin call?

Solution

There will be a margin call when ₹ 2,00,000 has been lost from the margin account. This will occur when the price of gold increases by $\frac{₹ 2,00,000}{10 \text{ kg.}} = ₹ 20,000$. The price of gold must, therefore, rise to ₹ 540 per gram for there to be a margin call. If the margin call is not met, your broker closes out your position.

2. A company has a \$10 million portfolio with a beta of 1.2. It would like to use futures contracts on the XYZ Index to hedge its risk. The index is currently standing at 270 and each contract is for delivery of \$ 500 times the index. What is the hedge that minimizes risk? What should the company do if it wants to reduce the beta of the portfolio to 0.6?

Solution

The value of the contract is

$$108.46875 \times 1000 = 1,08,468.75$$

The number of contracts that should be shorted is:

$$= \frac{60,00,000}{1,08,468.75} \times \frac{8.2}{7.6} = 59.7$$

Self Assessment Questions

1. What is a financial futures contract? Discuss the growth of financial futures with examples.
2. Explain the importance of futures markets in context to economic growth of a country.
3. What is futures contracting? Explain with examples. Also discuss the types of financial futures contracts.
4. Discuss the types of traders in futures markets with suitable examples.
5. What is futures market? Discuss the functions of futures market.
6. Write a note on futures market trading mechanism.
7. How a futures position can be closed? Discuss with the help of suitable examples.
8. Write a note on role of clearing house.
9. Define the term 'margin' in context to futures contract.
10. Differentiate forward contract from future contract.

Unit - IV

Unit Structure

Lesson 4.1 - Hedging Strategy Using Futures

Lesson 4.2 - Basis Risk and Hedging

Lesson 4.3 - Stock Index

Learning Objectives

After reading this chapter, students should

- Understand the concept of hedging.
- Know about the nature and features of hedging.
- Know about the multipurpose concept of hedging.
- Understand about the basic long and short hedges.
- Aware about the cross hedging along with its equation.
- Understand about the concept of basis risk and hedging and difference between basis risk and price risk.
- Know about the mechanism of devising a hedging strategy, which includes (a) deciding on the futures contract, (b) which futures contract and (C) which contract month.
- Be aware about the concept of hedge ratio and its estimation.
- Understand the various steps involved in management of a hedge.

Lesson 4.1 Hedging Strategy Using Futures

Introduction

Today, the corporate units operate in a complex business environment. Managers often find that the profitability of their organizations heavily depends upon on such factors which are beyond their control. Important among these are external influences like commodity prices, stock prices, interest rates, exchange rates, etc.

As a result, modern business has become more complex, uncertain and risky. So, it is essential for the executives of the firms to control such uncertainty and risk so that the business can be run successfully. An important function of futures market is to permit managers to reduce or control risks by transferring it to others who are willing to bear the risk. In other words, futures markets can provide the managers certain tools to reduce and control their price risks. So the activity of trading futures with the objectives of reducing or controlling risk is called hedging.

In this chapter, we will discuss the nature of hedging, fundamentals of hedging and how futures hedges can be tailored to the need of the hedger. In other words, we will consider here different issues associated with the way the hedges are set up. When is a short futures position appropriate? When is a long futures position appropriate? Which futures contract should be used? What is the optimal size of the futures position appropriate?

Example 1

Firm A is a manufacturer of automobile cars of different gradation. For this A requires auto parts which he imports from USA. A is of the view that the prices of imported parts will increase in futures, thereby increasing the cost of cars, which can have significant affect on the profit profile of this firm. So there is a considerable risk that prices will raise in future.

Consequently the firm wants to avoid such risk which it bears from increasing the price of imported parts. So he want to hedge this risk in futures by entering into derivative market. In derivative market, he can lock today for futures prices of the imported parts and can hedge the risk which he bears.

Example 2

A farmer expects that there will be 5000 quintals of food grains, which he will harvest in coming month. But he fears that price of grain could fluctuate in coming month. So farmer suspects of heavy losses in coming month. He can enter into derivative/futures market today and sell the grain for delivery in next month at an acceptable price and can hedge the price fluctuation risk. This kind of hedging is known as anticipating hedging.

Example 3

A corporate treasurer intends to borrow money in middle of March for a three-month period. The treasurer may fear that interest rates will have risen by the date of borrowing. Rise in interest rate would add to the cost of borrowing.

A futures position is taken so that there would be an offsetting profit in the event of rise in interest rates. So, in this example, treasurer can do hedging by selling three-month interest rate futures.

Hedging Concepts

Hedging, in its broadest sense, is the act of protecting oneself against futures loss. More specifically in the context of futures trading, hedging is regarded as the use of futures transactions to avoid or reduce price risk in the spot market. In other words, a hedge is a position that is taken as a temporary substitute for a later position in another asset (or liability) or to protect the value of an existing position in an asset (or liability) until the position is liquidated. According to this concept, the firm seeks hedging whether it is on the asset side or on the liability side of the balance sheet.

Example

In the month of March, 2003, a Jute mill anticipates a requirement of 10,000 candies of Jute in the month of July, 2003. Current price of jute is ₹ 1000 per candy. Based on this price, the company has entered into other financial arrangements. It is of great importance to the mill that, at the time of jute is actually purchased, price is not changed substantially higher than ₹ 1000 per candy. To avoid this, it buys 10,000the jute futures market, where current price of jute is ₹ 1050 per candy. In the month of July, the price of jute has risen sharply with the current spot price being ₹ 1500 per candy. The corresponding futures price for July jute is found to be ₹ 1470 per candy.

At this point of time jute mill has two options:

1. It can sell its futures contract on market at prevailing rate of ₹ 1470, and buys its requirement from spot market. Profit/Loss profile of this transaction will be as follows:

Jute purchased = ₹ 1000 per candy

Sale proceeds = ₹ 1470 per candy

Profit from sale = ₹ 470 per candy and current price of jute ₹ 1500 per candy to be paid and lid cost of candy to mill is ₹ 1030 per candy.

So futures transaction has ensured the minimization of upward price risk a mere for ₹ 30 per candy.

2. The mill could take delivery of jute directly from futures market. In this case the mill would pay ₹ 1000 per candy, but for taking delivery there may be possibilities of not delivery of same variety of jute.

It is observed from the above example that by buying futures the firm has hedged against the upward price risk.

The Multi-Purpose Concept of Hedging

Earlier hedging was taken to be only one kind (known as routine or naive hedging), whereby the trader always hedged all his transactions purely for covering all the price risks. However, this concept was challenged by Hollbrook Working, in his article “New Concepts Concerning Futures Markets and Prices” and propounded the multi-purpose concept of hedging which is widely accepted. According to this concept, the hedging can be used for many other purposes

Carrying Charge Hedging

According to this approach, the stockist watch the price spread between the spot and futures prices, and if the spread covers even carrying costs then the stockist buy ready stocks. It means that the traders may go for hedging if the spread is adequate to cover carrying costs whereas earlier view was that hedges are used to protect against loss on stock held. Thus, according to H. Working, “it is not primarily whether to hedge or not, but whether to store or not”.

Operational Hedging

According to this view, hedgers use the futures market for their operations and use the same as substitute for cash or forward transactions. They think that the futures markets are more liquid and have lower difference between 'bid' and 'ask' prices.

Selective or Discretionary Hedging

As per this concept, the traders do not always (in routine) hedge themselves but only do so on selected occasions when they predict adverse price movements in futures. Here the objective is to cover the risk of adverse price fluctuation rather to avoid price risk. So they use hedging technique selectively at the time of adverse price movements.

Anticipatory Hedging

This is done in anticipation of subsequent sales or purchases. For example, a farmer might hedge by selling in anticipation of his crop while a miller might hedge by buying futures in anticipation of subsequent raw material needs.

In brief, it is evident that now hedging is not used only for reducing or controlling the price risk but it also serves other purposes for the market participants. However, largely, the hedging is used to eliminate or reduce the price risk in our further discussion.

The Perfect Hedging Model

The perfect hedge is referred to that position which completely eliminates the risk. In other words, the use of futures or forward position to reduce completely the business risk is called perfect hedge, for example, a jewellery manufacturer wants to lock in a price for purchasing silver for the coming June. This he can do by going long June silver futures, if silver prices rise, the risk of increased cost of silver will be offset by the profits earned on the futures position. Similarly, if the silver prices fall, the savings on the silver purchase will be offset by futures losses.

In either case, the net silver cost is locked in at the futures price. However, it should be noted that only price risk is covered and not the quantity risk—the uncertainty about the quantity that will be sold or purchased at some futures date. No doubt, availability of quantity of the asset at futures date may also influence the determination of futures prices.

Example

Suppose a firm has an inventory of 100 kg of silver and it intends to sell in June. The current spot price of silver is ₹ 7500 per kg but firm is worried that the price of silver will fall between now and June. To hedge itself against this possibility, the firm enters into 100 kg of short position in June silver futures at a futures price of ₹ 7600 per kg. Firm is now protected against falling silver prices because the futures position will protect the firm and firm will gain if silver prices do fall.

To see how the firm is hedged, consider what happens to its revenue under two price scenarios:

1. In first scenario, spot silver price rise to ₹ 7700 per kg.
2. In second scenario, silver falls to ₹ 7400 per kg in June.

Silver Inventory and Sales Revenue

Scenario (P_T)	Silver revenues ($Q_T \times P_T$)	Profit / loss [$Q_T(F_{tT} - P_T)$]	Net Revenue
I. ₹ 7700	₹ 7,70,000	100(₹ 7600 - ₹ 7700) = - ₹ 10,000(Loss)	₹ 7,60,000
I. ₹ 7400	₹ 7,40,000	100(₹ 7600 - ₹ 7400) = ₹ ₹ 20,000(Profit)	₹ 7,60,000

In both the scenarios, firm locks in today's futures price of ₹ 7600 per kg. When silver prices rise, there will be an off-setting futures loss; when silver prices fall, an off-setting gain will occur. But it is to be noticed that the firm does not lock in current spot price of ₹ 7500 per kg.

Short inventory hedge can also be shown in general terms

Scenario	Revenues	Profit / loss	Net Revenue
P_T	$Q_T P_T$	$Q_T(F_{tT} - F_{T,T})$ = $Q_T(F_{tT} - P_T)$	$Q_T F_{t,T}$

We assume in this illustration that the firm sells its inventory at silver in the spot market. The firm would get the same result if it delivered its silver into futures market to fulfill its short position; because the futures settlement price at expiration equals to spot price (NT) due to convergence effect on the prices.

Above examples shows the two basic steps in futures hedging:

1. Hedger determines how its profits are affected by change in commodity price, security price interest rate or exchange rate.
2. Hedger enters into a futures position with the opposite exposure. As a result, risk is eliminated.

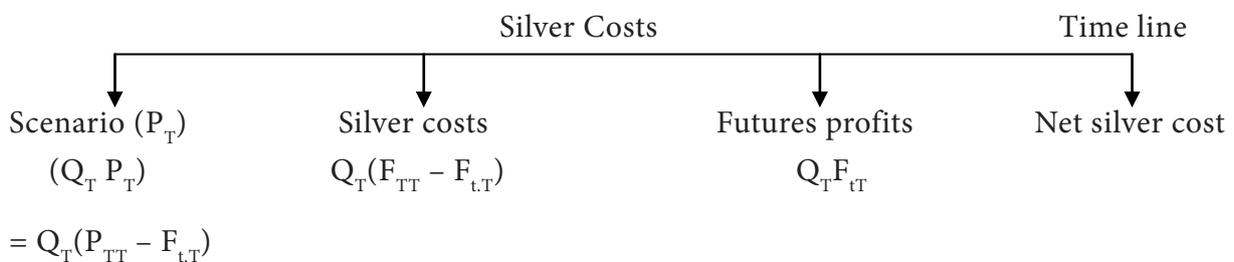
Several conditions must be fulfilled before a perfect hedge is possible. In brief, these are as under:

1. The business firm must know exactly the effect of change in price on the profit, and further this relationship must be linear.
2. There must be futures or forward contracts available in the market with the following features.
 - a) It is written on the underlying asset which will affect the firm's profit.
 - b) The expiration date of the contract should be the same on which the firm's profits will be affected by the price of the said asset.
 - c) It specifies a quantity equal to which will affect the firm.

How a Perfect Hedge Works

Let us denote t is today period (present), T is date in June on which purchased will be effected, Q_T is the quantity of silver to be purchased, P_T 'S price at the time T , F_{TT} is futures price at the time T and $F_{t,T}$ is futures price at time t .

The net cost to the manufacturer is the price of the silver less the profit on the futures position



Here $P_{TT} = F_{t,T}$ because delivery date convergence, and

Net silver cost = Silver costs - Futures profit

$$Q_T F_{t,T} = Q_T P_T - Q_T (P_{t,T} - F_{t,T})$$

It is observed that the above hedge meets all the requirements of a perfect hedge. The manufacturer know that silver cost at T(June) will be $Q_T P_T$ which is linear function of the silver price because every rupee change in the silver price will change $Q_T P_T$ by Q_T . By entering into the long futures at time t, the manufacturer establishes that his costs at time T will be $Q_T F_{tT}$. He, thus, locks in today's futures price for his silver purchase. Note that, here the gain or losses have been computed on the futures position as it were a forward position.

The Basic Long and Short Hedges

Basically, the hedging refers to by taking a position in the futures that is opposite to a position taken in cash market or to a future cash obligation that one has or will incur. Thus, the hedges can be classified into two categories: short hedges and long hedges.

Short Hedge

A short hedge (or a selling hedge) is a hedge that involves short position in futures contract. In other words, it occurs when a firm/trader plans to purchase or produce a cash commodity sells futures to hedge the cash position, in general sense, it means being short' having a net sold position, or a commitment to deliver', etc. Thus, here the main objective is to protect the value of the cash position against a decline in cash prices. A short hedge is appropriate when the hedger already owns all and expects to sell it at sometime in the futures. Once the short futures position is established, it is expected that a decrease (increase) in the value of the cash position will be fully or partially compensated by a gain (loss) on the short futures position.

Example

A US exporter who knows that he will receive German mark in three months from a German company. Exporter will realize gain if the mark increases its value in relation to the US dollar and a loss if the mark decreases its value relative to the US dollar. A short futures position leads to a loss if mark increases in value and a gain if it decreases in value. It has the effect of offsetting the exporter's risk.

Example

A miner, who is manufacturer of silver and having a mine, wants to take a decision whether to open the mine or not. It is based upon the price of silver in futures because production of silver takes two months. He wants to plan his profitability for his firm. If the silver prices fall, he may suspend production of silver. Today is June 10. The price of silver

in spot market on June 10 is ₹ 1050 Per kg and August ₹ 1060 per kg will be satisfactory price for him. To establish the price of ₹ 1060 per kg, the miner decides to enter in silver futures market. By hedging, he can avoid the risk that silver prices might fall in next two months. Anticipating the sale to be 50,000 kg silver in two months, he sells ten 5000 kg. futures contracts for August delivery at ₹ 1060 per kg.

Short Hedge Position of Silver Manufacturer

Spot market	Futures market
June 10 Anticipate the sale of 50,000 kg silver in two months and expected to receive ₹ 1060 per kg or ₹ 53,00,000 for total contract	June 10 Sell ten futures contract for August delivery at ₹ 1060 per kg
August 10 Spot price of silver is now ₹ 1070 per kg, the miner sells 50,000 kg silver ₹ 5,35,000 for whole contract Profit = ₹ 5,00,000	August 10 Buys futures contract at ₹ 1070 amounting to ₹ 5,35,00,000 Futures loss = ₹ 5,00,000

In this example, the miner has hedged his risk perfectly by selling futures in June for delivery in August on the maturity/delivery date he sells in spot market and earn a profit of ₹ 5,00,000 and in futures market miner has a loss of same amount thereby offsetting and prices hedging against price fall risk.

Long Hedge

Oil other hand, a long hedge (or a buying hedge) involves where a long position is taken in a futures contract. The basic objective here is to protect itself against a price increase in the underlying asset prior to purchasing it in either the spot or forward market. A long hedge is appropriate when a firm has to purchase a certain asset in futures and wants to lock in a price 110w. It is also called as being long' or having a net bought position or an actual holding of the asset. It is also known as inventory hedge because the firm already holds the asset in inventory.

Example

A fund manager anticipates to receipt of \$1 million on January 10 and intends to use it to buy a balanced portfolio of UK equities. He fears that one month later, stock prices

will rise before the money is received. He can go in futures market and buy today futures contract at 2200, current index (I TSE 100) is at 2200. He can close out his position by selling March 18, FTSE contract.

Long Hedge using Futures

Spot market	Futures market
<p>December 10</p> <p>Anticipate receipt of \$1 million on January 10</p> <p>Current FTSE 100 index is at 2200 fears a rise in the index</p>	<p>December 10</p> <p>Buys March 18 ETSE index futures contract at a price of 2200. He thereby commits himself to pay $(2200 \times \text{£} 18 \times \text{£} 25) = \text{£}9,90,000$.</p> <p>Stock in futures date</p>
<p>January 10</p> <p>The new FTSE index at 2300</p> <p>Requires additional £ 45000 in order to buy the stock that \$1 million would have been bought on December 10</p> <p>Loss = £45000 in spot market</p>	<p>Close out position by selling at a price of 2300. He notionally receipt of £10,35,000 upon maturity of contract profit from futures £45,000</p> <p>Profit £45,000 in futures market.</p>

In the above example, fund managers used stock index futures to hedge his risk of price fluctuation in coming one month.

The terms ‘long’ and ‘short’ apply to both spot and futures market and are widely used in the futures trading. A person who hold stocks of an asset is obviously regarded as ‘being long’ in the spot market but it is not necessary to actually hold stock. Similarly, it is in the case of ‘short’, where one who has made a forward sale, regarded as ‘being short’ on the spot market. In brief, the position of long and short hedges is shown in Table.

Long Vs Short Hedging

	Short hedger	Long hedger
Position in spot market	Long	Short
Protection need against	Price fall	Price rise
Position in futures market	Short	Long

Example

A farmer anticipates a bumper crop amounting to 150 quintals, which he expects to harvest in the month of January. It is October and current price of crop is ₹ 10,000 per

quintal. This price is acceptable to the farmer and give him a sufficient return. But he is apprehensive of fall in price by the time crop will be ready. He, therefore, sells 150 quintals on the commodity futures market at it current price of ₹ 9500 per quintal. In the month of January, price of crop have in fact risen. Current spot price is ₹ 11,000 per quintal. Now, farmer has two alternatives:

1. He can buy back 200 quintals of January crop on the futures market at a present futures price of ₹ 10,500. He can then deliver his actual crop of pepper in spot market at the ruling rate of ₹ 11,000 per quintal. As a result farmer will have following profit/loss:

January contract sale @ ₹ 9500 per quintal. January contract buys @ 10,500. So, there is a net loss of ₹ 1000 per quintal. Further he sells his output @ 11,000 in the spot market and by deducting the loss on futures market position of ₹ 1,000, net price obtained by former is ₹ 10,000 per quintal.

2. He can deliver in the futures market @ ₹ 9500 per quintal.

This situations; where sale of futures by those hedging against price fall is called short hedge and taken guarding against downward price movements.

Cross Hedging

All the hedged positions discussed earlier used futures contracts which are undertaken on the assets whose price is to be hedged and that expires exactly when the hedge is to be lifted.

Sometimes, it is seen that the firms wish to hedge against in particular asset but no futures contract available. This situation is called as asset mismatch. Further, in many cases, same futures period (maturity) on a particular asset is not available, it is called a maturity mismatch.

Referring to the different situations referred earlier, there is still possibility to hedge against price risk in related assets (commodities or securities) or by using futures contracts that expire on dates other than those on which the hedges are lifted. Such hedges are called cross hedges. In actual practice and in real business world, it will be rare for all factors to match so well. Thus, across hedge is a hedge in which the characteristics of the spot and futures positions do not match perfectly.

Mismatch situations which make the hedge a cross hedge:

- The hedging horizon (maturity) may not match the futures expiration date.
- The quantity to be hedged may not match with the quantity of the futures contract.
- The physical features of the asset to be hedged may differ from the futures contract asset.

In general, one cannot expect a cross-hedge to be as effective in reducing risk as a direct hedge. However, cross hedges are commonly used to reduce the price risk. Now, the question is which futures contracts are good candidates for a cross hedge. For example, if we want to hedge a portfolio of silver coins then a silver futures contract will be more effective cross-hedge rather than a gold futures contract. Thus, if the price of the underlying asset and the price of correlated asset, one can analyze the nature of hedging. If perfectly correlated, it is perfect, in closely correlated, it is cross hedge, and in negatively correlated, there will be no hedging, rather more risk will be added by taking a position in the futures.

Cross Hedging Silver Coins With Silver Futures

Example

Suppose a firm has a collection of 100 kg of rare silver coin and the firm is concerned that value of those coins will drop over the next six months. There is no silver coin futures contract but we know the price of silver futures. Therefore, we consider cross hedging the value of our coin collection with a short position in silver futures expiring in the three months. The current silver futures price is ₹ 7600 per kg. Also the relationship between the price of silver coins and silver futures is:

$$\text{Silver coin price} = 100 + 1.20 (\text{Silver futures}) + e$$

Where error term, e take on values of only - 10, 0 and 10 and both silver coin price and silver futures price are in kg. From the above equation, it is clear that on average the silver coin price is 20 percent more volatile than silver futures price. Because each ₹ 1 movement in the silver futures price is associated with a ₹ 1.20 movement in silver coins price. So size of futures position:

$$\begin{aligned} \text{Size of futures position} &= \text{Hedge ratio} \times \text{Size of cash position} \\ &= 1.2 \times 10\text{kg} = 12 \text{ kg} \end{aligned}$$

To see how this cross hedge might work, we calculate the hedged value of contract. We consider two values for spot silver price in three months, ₹ 7500 and ₹ 7650 and three levels (e) -10,0 and 10.

Case 1

Silver Futures Price ₹ 7500

Basis error	Coin value	Futures profit	Hedged value
e = - 10	10 kg[100+1.2(7500)-10] =10(9090) = 90,900	=12(7600-7500) = + ₹ 1200	₹ 92,100
e = 0	10 kg[100+1.2(7500)+0] =10(9100) = 91,000	12(7600-7500) = + ₹ 1200	₹ 92,200
e = 10	10 kg[100+1.2(7500)+10] =91,100	=12(7600-7500) = + ₹ 1200	₹ 92,300

Case 2

Silver Futures Price ₹ 7650

Basis error	Coin value	Futures profit	Hedged value
e = - 10	10 kg[100+1.2(7650)-10] =10(9090) = 92,700	=12(7600-7650) = - ₹ 600	₹ 92,100
e = 0	10 kg[100+1.2(7650)+0] =10(9280) = 92,800	12(7600-7650) =- ₹ 600	₹ 92,200
e = 10	10 kg[100+1.2(7650)+10] =10(9290) = 92,900	=12(7600-7650) = -₹600	₹ 92,300

No matter what the spot price of silver in next three months, the hedged value of contract (silver coin) equals ₹ 92,200 plus or minus 100. The unhedged value of contract can range from ₹ 91,500 to ₹ 92,900. Thus a cross hedging reduces the risk of position.

Example

Consider the problem faced by a film manufacturer that uses silver, a key ingredient in manufacturing photographic film. Film production is process industry, with more or less continuous production. COMEX silver futures trade for delivery in January, March, July, September and December. Suppose the film manufacture needs silver in February, April and June. So hedging horizon and futures expiration date do not match perfectly. Second, consider the difference in quality of silver required by the firm for production of film but

Silver Inventory Revenue Hedging

Scenario Delhi/ Mumbai	New silver revenue	Futures profits	Net revenue
7700/7750	7,75,000	100 (7600 - 7700) = -10,000	₹ 7,65,000
7400/7450	7,45,000	100 (7600 - 7400) = 20,000	₹ 7,65,000

The coefficient h in equation indicates that on an average spot will move b' rupees for every rupee move in futures price. A cross hedging strategy must adjust for the relationship between movements in the spot and futures prices. This can be done by choosing the correct hedge ratio.

$$\text{Hedge ratio} = \frac{\text{Quantity of futures position}}{\text{Quantity of cash position}}$$

Hedge ratio has been further explain later on in this chapter.

Lesson 4.2 - Basis Risk and Hedging

The Concept of Basis Risk and Hedging

Understanding basis risk is fundamental to hedging. It is noted earlier that basis is the difference between the spot price (cash price) and futures price of an underlying asset. If the spot price is higher than the futures price, then the basis will be called as positive or over and vice-versa. This concept in equation form is as under:

$$\text{Basis}_{tT} = \text{Cash price}_t - \text{Futures price}_{tT}$$

If the futures prices and cash prices always change by the same amount then the basis will not change and it will be zero. It means there could be no change in the basis, if Futures price = Cash price, then

$$\text{Basis}_{tT} = \text{Futures price} - \text{Cash price} = 0$$

There is basis risk when the changes in futures prices and cash prices are not equal.

Further in this case, if the magnitude (in units) of the cash futures positions are identical then any loss (gain) in the value of the cash position will be totally offset by the gain (loss) in the value of the futures position. Prior to expiration, the basis may be positive or negative. For example, low-interest rate currency or gold or silver assets, usually futures price is greater than the spot price, which means that basis is negative and vice-versa.

When the change in spot price is more than the change in futures price, the basis will increase which is known as a strengthening of the basis. Similarly, if the change in spot price is less than the change in futures price, the basis will decrease; it is referred to as a weakening of the basis. Let us see the following:

It is observed from Table that change in spot price is 60 (7560-7500) whereas change in futures price is 10 (₹ 7590— ₹ 7580), and change in 50 (-30 + 80), is a situation of strengthening the basis.

Basis Position of Silver (Price ₹ per kg)

Scenario	Cash price	Futures price	Basis
April 8, 2002	7500	7580	—80
May 10, 2002	7560	7590	—30
Change	+60	+10	+50

To examine the basis risk, let us use the following notations:

S_1 = Spot price at time t_1

S_2 = Spot price at time t_2

F_1 = Futures price at time t_1

F_2 = Futures price at time t_2

b_1 = Basis at time t_1

b_2 = Basis at time t_2

From the example given in Table, the basis will be

$$b_1 = S_1 - F_1 = 7500 - 7580 = -80$$

$$b_2 = S_2 - F_2 = 7560 - 7590 = -30$$

Let us consider a situation of a hedger who knows that the asset will be sold at time t_2 and takes a short futures position at time t_1 . The price realized for the asset is S_2 and the profit on the futures position is $F_1 - F_2$. The effective price that is obtained for the asset with hedging is, therefore,

$$S_2 + (F_1 - F_2) = F_1 + b_2$$

From our example, this will be ₹ 7550.

$$\begin{aligned} \text{₹ } 7560 + (\text{₹ } 7580 - \text{₹ } 7590) &= \text{₹ } 7580 + (-30) \\ 7560 - 30 &= 7580 - 30 \end{aligned}$$

Thus, the value of F_1 is known at time t_1 , b_2 were also known at this time, a perfect hedge would result. The hedging risk is the uncertainty associated with the b_2 . This is known as basis risk. Similarly, we can consider the next situation where a company knows it will buy the asset at time t_2 and initiate a long hedge at time t_1 . The price paid for the asset's S_2 and the loss on the hedge is $F_1 - F_2$. The effective price which will be paid with hedging is, therefore,

$$S_2 + (F_1 - F_2) = F_1 + b_2$$

This is the same expression as we have seen earlier. The value of F_1 is known at time t_1 and the term b_2 represents basis risk.

Basis risk for the investment assets like securities arises mainly from uncertainty as to the level of the risk-free interest rate in the futures whereas in the case of consumption assets, in balances between supply and demand, difficulties in storing, convenience yield, etc. also provide the additional source of basis risk.

Basis risk = Spot price of asset to be hedged - Futures price of contract used

Suppose spot price of the share of XYZ Ltd. at the time of hedge initiated is ₹ 2.50 and futures price is ₹ 2.20 respectively. And at the tie of closing at hedge prices are ₹ 2.00 and

₹ 1.90 respectively. So basis will be:

$$b_1 = S_1 - F_1 = 2.50 - 2.20 = 0.30$$

$$b_2 = S_2 - F_2 = 2.00 - 1.90 = 0.10$$

Also consider a hedger who knows that the shares will be sold at time t_2 and takes a short futures position at time t_1 . Effective price that is obtained for the assets with hedging is, therefore,

$$\begin{aligned} S_2 + (F_1 - F_2) &= F_1 + b_2 \\ &= 2.00 + 2.20 - 1.90 = 2.20 + 0.10 \\ &= 4.20 - 1.90 \quad 2.30 \\ &= 2.30 = 2.30 \end{aligned}$$

Value is ₹ 2.30 and where b_2 represents the basis risk.

Basis Risk Versus Price Risk

We have already seen that the basis b is the difference between the cash or spot price s and the futures price F

$$B_{t,T} = S_t - F_{t,T}$$

A change in the basis, therefore, is:

$$\Delta b_{t,T} = \Delta S_t - \Delta F_{t,T}$$

Example

Suppose futures price on March 1 in cent per yen is 0.7800 and spot and futures prices when contract is closed out are 0.7200 and 0.7250, respectively.

$$\text{Basis risk} = 0.7200 - 0.7250 = -0.0050$$

If the changes in futures and spot prices were assumed to be equal then there would be no change in the basis.

$$\begin{array}{ll} \text{If} & \Delta S_t = \Delta F_{t,T} \\ \text{Then} & \Delta b_{t,T} = \Delta S_t - \Delta F_{t,T} = 0 \end{array}$$

When changes in futures and cash price are not equal, which is normal in practice, then there will be basis risk. Thus, basis risk is defined as the variance of the basis, i.e., $\sigma^2(b_{t,T})$ which will be equal to

$$\sigma^2(b_{t,T}) = \sigma^2(S_t - F_{t,T})$$

It can be rewritten as:

$$\sigma^2(b_{t,T}) = \sigma^2(S_t) + \sigma^2(F_{t,T}) - 2\rho\sigma(S_t)\sigma(F_{t,T})$$

where σ^2 is the variance, or is the standard deviation and ρ is the correlation coefficient between the futures and spot price series.

From the above, it is revealed that the basis risk is zero when the variances of the futures and cash prices are identical and the correlation coefficient between cash and futures prices equals to one. Let us explain this by an example. If the variance of futures and cash prices are both to ₹ 25 and there is perfect correlation between the spot and futures prices, i.e., $\rho = 1$, then

$$\sigma^2(b_{t,T}) = 25 + 25 - 2 \times 1 \times 5 \times 5 = 50 - 50 = 0$$

Let us further assume that there is perfect correlation between spot and futures prices (i.e. $\rho = 1$), and if it equals only 0.50, basis risk will not be zero. In that case the basis risk will be

$$\sigma^2(b_{t,T}) = 25 + 25 - 2 \times (0.5)(5)(5) = 50 - 25 = 25$$

Similarly, a difference between the variance of the futures and cash prices will result in some basis risk. However, in real world situation, the magnitude of the basis risk depends mainly on the degree of correlation between cash and futures prices, i.e., the higher the correlation, the less the basis risk.

As we see that perfect correlation between the cash and futures prices is very rare, the hedgers, then, always assume some basis risk. So to reduce their exposure to price risk (or to the variance of spot prices), they must accept in return an exposure to basis risk. In brief, it is evident that for a hedge to be attractive, the basis risk should be significantly less than the hedger's price risk.

Hedging Effectiveness

As noted earlier that the objective of the hedging is to reduce the exposure to price risk, and so the hedgers trade price risk for basis risk. Thus, one measure of anticipated hedging effectiveness (H.E.) is to compare the basis risk with the price risk. The smaller the anticipated basis risk in comparison to the anticipated price risk, the more effective is the hedge. This can be stated as follows:

$$\text{H.E.} = 1 - \frac{\sigma^2 (b_{t,T})}{\sigma^2 (S_t)}$$

i.e., 1 minus the ratio of the expected variance of the basis to the expected variance of cash prices.

This means that the closer the H.E., the more effective the hedge. However, H.E. is only a way of judging how good a particular hedge is likely to be a priori. It should not be confused with the concept of an optimal hedge.

Devising a Hedging Strategy

In this section, we will discuss the concepts and principles involved in designing a specific hedging strategy. So, different issues concerning to it like how to select a futures contract for hedging, how to determine and calculate the optimal hedge ratio, how to design and manage a hedging strategy and so on will be discussed.

Deciding on the Futures Contract

The basic objective of an hedging strategy is to minimize risk or to maximize hedging effectiveness. In this respect, the first step towards designing a particular hedging strategy

is to decide about the futures contract to be undertaken. For this purpose, two aspects are considered: first, what kind of futures to use, and second, which contract month of that futures to be used.

Which Futures Contract

While deciding about the futures contract to be undertaken, the hedger must consider that the correlation between the cash and futures prices must be very high. When hedging an asset on which no futures contract is traded, the choice is more difficult. Thus, first starting point to select a futures contract is to select such assets which are inter-related. In other words, evaluating the correlation coefficients of various price risk associated with, for example, with jet fuel, heating oil, gasoline, crude oil, etc. Likewise, with gold we can use gold coins, bullion, silver, silver coins, etc.

Which Contract Month

The second important consideration in designing a hedging strategy is to select the contract month. We see that futures contracts are available in the market of different months. So the selection of month of a futures contract will depend upon the such period where the futures and spot prices are highly correlated. Obviously, the prices of the near month contract are the most highly con-elated with cash price. Thus, using the near month futures contract will reduce basis risk (or variance of the basis) the most. Since it is seen that the variance of the basis increases as the price correlation between cash and futures price decreases. Hence, hedging with the near month futures contract is preferable because it minimizes the basis variation.

It should be noted that the principle of choosing the futures contract should be applied in the context of specific hedging situations. Matching cash and futures obligations in different situations will be another way of dominating or minimizing basis risk. This strategy, of course, will be useful only if the duration of a hedger's cash obligations is fixed and known in advance, and there exist a matching futures contract where the hedger can not estimate his cash obligation with certainty, then in this situation he will not be able to pursue a matching strategy, but may want to hedge continuously.

Thus, hedging in a continuous cash obligation, there can be two alternatives:

- (a) Hedging with a nearby futures and rolling the hedge forward,
- (b) Hedging with a more distant futures contract, and rolling it less frequently.

Both the alternatives have their own mechanism depending upon the hedging objective. For example, using a more distant contract usually increases basis risk because its price will be less correlated with spot market prices. But the brokerage cost and other transaction costs will be more due to frequent sales and purchases in the market. No specific rule can be made to decide between these alternatives. However, the hedgers in most cases, prefer to hedge with a futures contract that has a high price correlation either with the near month or the second month contract.

Hedging Objectives

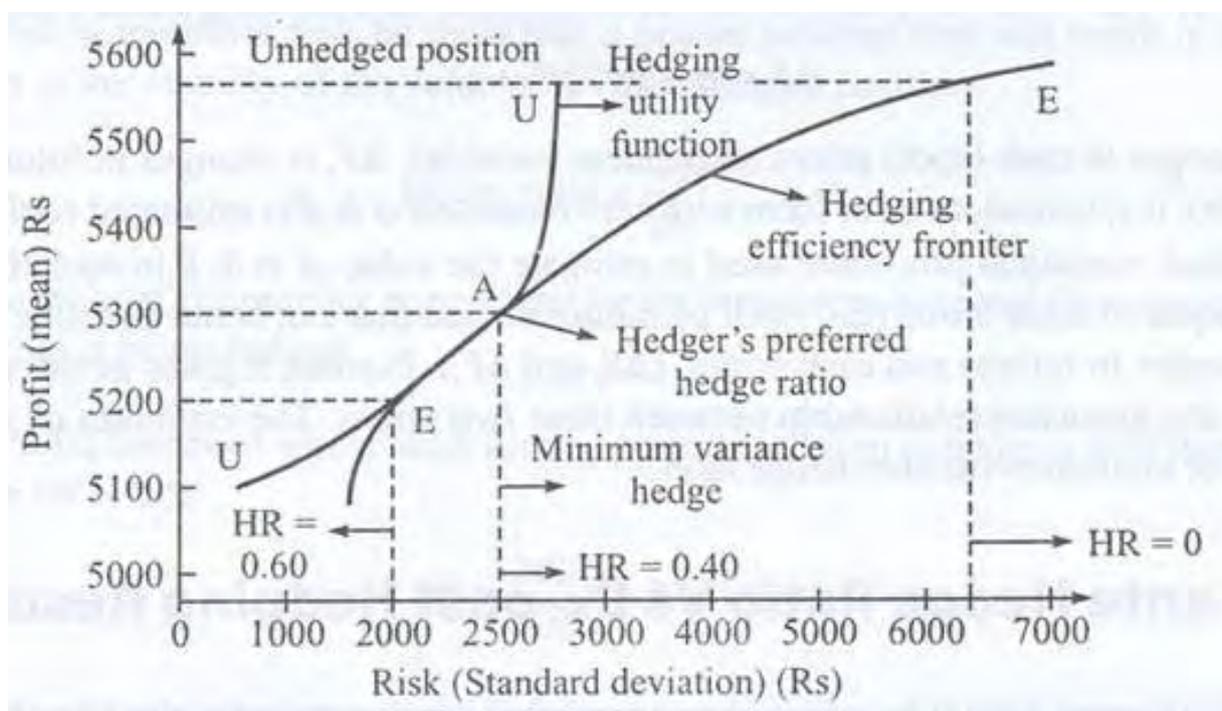
In the prior discussion of hedging strategies, we have assumed the only objective of hedging is to minimize the risk. However, sometimes, the hedgers may be willing to assume more risk in order to earn more profit because eliminating all price risk will lead to eliminating the profit of the firm, which may not be good at all the time. Thus, the hedgers may use such hedging ratio other than the minimum-variance hedge ratio, or willingly may go for under hedging.

Undoubtedly the decision relating to hedging ratio or how much to hedge will depend upon the hedger's risk preference. The lesser he hedges, the more risk he assumes. Not only this, the hedger may change his hedging strategy later on due to his strong belief about the futures price movements. So hedging objective is a relative concept and much depends upon the risk and return. In other words, it is the tradeoff between profits and risk reduction through hedging because it is observed that risk could be reduced but at the cost of lost profits.

Figure depicts trade off between risk and profit at the different level of hedge ratios. The hedger may choose the risk and return combination that he most prefers, or that he finds optimal. In this figure, line EE represents the hedging efficiency frontier: the most efficient combinations of risk and return that can be achieved by varying the hedge ratio. The line UU represents the highest level of utility which the hedger can achieve by hedging (being on the efficient frontier EE). The slope of UU represents how the hedger values change in risk relative to changes in profits. The value replaces on changes in risk versus changes in profit will determine his decision.

For example, at the point E, the hedge ratio is 0.60 where the expected profit is ₹ 5200 at ₹ 2000 standard deviation. Further, if he chooses the hedge ratio 0.40, by doing so he will increase risk to ₹ 2500 (by standard deviation). Point A where UU and EE touch (or tangent), indicates the hedger's optimal ratio ($\beta = 0.40$). This hedge strategy yields a profit of ₹ 5300 and a standard deviation of ₹ 2500, which yields a profit utility to the hedger.

In brief, the hedge can remain completely unhedged ($\beta = 0$), or can adopt the minimum-variance hedge ($\beta = 0.60$) yielding lower utility than that it would be at a hedge ratio of 0.40.



Management of the Hedge

After establishing an hedge, it is essential to manage it effectively. So regular monitoring and making adjustments are the key factors in managing of the hedge. There also needs to be a systematic evaluation of the effectiveness of the hedge relative to its anticipated (or excrete measure). Further, if the desired results are not being achieved from the hedging then the reasons should be identified and necessary steps be taken to improve hedge effectiveness in the futures. To manage effectively the hedging, following steps are taken:

Monitoring the Hedge

Continuous monitoring on the performance of an hedging is essential. For this purpose, the following information should be available regularly on an up-to-date basis:

Cash Position

The hedger must get the information of the current size of the cash position being hedged. What are the changes in its magnitude since the inception of hedge? What are the

gains or losses on this position to date? What are the reasons of such deviation, if any?

Futures Position

Likewise cash position, the information regarding the size of futures position, profits and losses incurred to date on this position, etc. be collected for further consideration.

Margins

All such information concerning the margin like the total amounts of funds dedicated to margin requirements, net financing to-date, ng costs to- and further, the availability of funding arrangements to meet futures margin calls, etc. should be available continuously.

Basis Movements

All such information regarding the changes in basis should be collected to see whether they are consistent with a priori expectations or there is any major deviations at the particular time intervals.

New Information

Sometimes, new events occur in the market or there are new information regarding the underlying assets which cause to change in the prices either of the spot or futures must be noted and analyzed further to evaluate their impact on hedging strategy followed by the firm.

Lesson - 4.3 Stock Index

The Concept of Stock Index

Before discussing the concept of stock index futures, we should know about the term stock index. A stock index or stock market index is a portfolio consisting of a collection of different stocks. In other words, a stock index is just like a portfolio of different securities' proportions traded on a particular stock exchange like NIFTY S&P CNX traded on National Stock Exchange of India, the S&P 500 Index is composed of 500 common stocks, etc.

These indices provide summary measure of changes in the value of particular segments of the stock markets which is covered by the specific index. This means that a change in a particular index reflects the change in the average value of the stocks included in that index. The number of stocks included in a particular index may depend upon its objective, and thus, the size varies index to index. For example, the number of stocks included in SENSEX is 30 whereas 500 stocks are covered in Standard and Poor's 500. There are, however, some common features of these stock indices which are as under:

Common Features

1. A stock index contains a specific number of stocks, i.e., specification of certain sector number of stocks like 30, 50, 100, 200, 500 and so on.
2. Selection of a base period on which index is based. Starting value of base of index is set to large round like 100, 1000, etc.
3. The method or rule of selection of a stock for inclusion in the index to determine the value of the index.
4. There are several methods commonly used to combine the prices of individual stock like arithmetic average, weighted average, etc.
5. There are three types of index construction like price weighted index, return equally weighted index and market capitalization weighted index.
6. A stock index represents the change in the value of a set of stocks which constitute the index. Hence, it is a relative value expressed as weighted average of prices at a specific date.

7. The index should represent the market and be able to represent the returns obtained by a typical portfolio of that market.
8. A stock index acts as a barometer for market behaviour, a benchmark for portfolio performance. Further, it also reflects the changing expectations about the market.
9. The index components should be highly liquid, professionally maintained and accurately calculated. In the present section, we will not discuss the mechanism of construction of a stock index. However, it is beneficial to understand thoroughly the details of construction of an stock index particularly in which the investor is interested to trade. Because when the differences and interrelationships among the indexes are understood, it will be easier to understand the differences among the futures contracts that are based on those indexes.

Stock Index Futures

A stock index futures contract, in simple terms, is a futures contract to buy or sell the face value of a stock index.

Diversity of indexes, Thursday, May 28, 1998*. Range for underlying indexes

	High	Low	Close	Net Chg.	From Dec. 31	% Chg.
Di Indus (DJX)	89.93	89.01	89.70	+0.33	+10.82	+13.4
Di Trans (DTX) DJ	395.89	331.19	333.70	+0.45	+8.05	+2.5
Util (DUX)	281.15	277.03	280.78	+3.36	7.71	+2.8
S&P 100 (OEX)	535.08	530.41	534.04	+2.04	+74.10	+16.1
S&P 500 -AM. (SPX)	1009.73	1089.06	1097.59	+5.36	+127.16	+13.1
CB-Tech (TXX)	256.92	253.34	254.86	-0.59	+39.07	+18.1
CB-Mexico (MEX)	105.55	104.22	104.53	-0.78	-22.45	-17.7
CB-Lps Mex (VEX)	10.56	10.42	10.45	-0.08	-2.25	-17.7
MS Multinti (NFT)	603.64	598.34	601.76	+1.14	+70.21	+13.2
GSTI Comp (GTC)	171.36	169.07	170.31	+0.05	+26.85	+18.7
Nasdaq 100 (NDX)	1218.16	1200.24	1214.83	+5.37	+224.03	+22.6
NYSE (NYA)	567.91	562.67	567.10	+3.17	+55.91	+10.9
Russell 2000 (RUT)	455.81	450.26	455.81	+5.55	+18.79	+4.3
Lps S&P 100 (OEX)	107.02	106.08	106.81	+0.41	+14.82	+16.1
Lps S&P 500 (SPX)	109.97	108.91	109.76	+0.54	+12.72	+13.1
S&P Midcap (MID)	358.63	354.91	358.52	+3.58	+25.15	+7.5
Major Mkt (XML)	945.83	936.61	943.38	+4.10	+106.53	+12.7
HK Fltg (HKO)	173.78	173.78	173.78	-2.02	-40.78	-19.0
HK Fixed (HKD)	-	-	174.17	-2.02	-40.87	-19.0

1W Internet (LIX)	326.39	319.28	324.65	+1.64	+64.40	+24.8
AM-Mexico (MXY)	119.33	117.23	117.41	-1.38	-24.12	-17.0
Institut'I-A.M. (XII)	610.44	604.79	608.96	+1.89	-441.20	-42.0
Japan (JPN)	-	-	163.33	+1.31	+5.69	+3.6
MS Cyclical (CYC)	529.65	525.83	527.92	+0.30	+52.91	+11.1
MS Consumr (CMR)	495.33	489.82	494.52	+3.87	+48.88	+11.0
MS Hi Tech (MSH)	556.41	547.79	552.87	-0.26	+105.35	+23.5
Pharma (DRG)	632.15	626.09	628.92	-2.60	+95.18	+17.8
Biotech (BTK)	164.28	160.72	163.67	+2.38	+1.25	+0.8
Comp Tech (XCI)	523.40	516.06	518.55	-2.10	+79.56	+18.1
Gold/Silver (XAU)	76.73	74.90	76.29	+1.49	+2.10	+2.8
OTC (XOC)	881.56	869.79	879.12	+3.23	+141.17	+19.1
Utility (UTY)	308.88	304.45	308.86	+4.39	-1.17	-0.4
Value Line (VLE)	951.89	942.89	951.24	+8.21	+74.40	+8.5
Bank (BKX)	844.09	835.97	842.70	+4.80	+87.35	+11.6
Semicond (SOX) Top	271.09	265.43	267.75	+1.09	+4.12	+1.6
100 (TPX)	1046.94	1037.26	1044.39	+3.59	+134.77	+14.8
Oil Service (OSX)	104.67	100.79	104.67	+1.90	-9.70	-8.5
PSE Tech (PSE)	336.20	332.14	335.05	+1.98	+44.49	+15.3

* Source: The Wall Street Journal, May 29, 1998.

American Standard and Poor's 500 index, although recently there has been remarkable growth in the stock index futures trading all over the world.

The changes of stock index futures prices are very similar to that of the underlying stock index. This has been observed by the various studies conducted in this respect. Comparing the returns on futures indexes and cash indexes, it has been found that there is very little difference between these two indexes. However, the volatility of the futures indexes is somewhat greater than the cash stock indexes.

The Standard and Poor's 500 (S & P500) index is based on a portfolio of 500 different stocks: 400 industrials, 40 utilities, 20 transportation and 40 financials. The weights of the stocks in portfolio at any given time reflect the stock's total market capitalization. (Stock price x No. of shares outstanding). The index accounts for about 80 percent of market capitalization of all the stock listed on New York Stock Exchange.

Specification of Stock Index Futures Contracts

All the stock index futures contracts are traded on the specified stock exchanges. For example, Standard and Poor's 500 Futures contract has the following specifications:

Standard and Poor's 500 futures contract specifications:

1. Contract : Standard and Poor's 500 index
2. Exchange : Chicago Mercantile Exchange
3. Quantity : \$500 times the S&P 500 index
4. Delivery months : March, June, September, December
5. Delivery specifications : Cash settlement according to the value of the index at the opening on the Friday after the last day of trading
6. Minimum price movements : 0.05 index points, or \$25 per contract

In India, both the BSE and the NSE have introduced one month contracts on the sensx and NIFTY respectively. At any point of time, index futures of different maturities would trade simultaneously on the exchanges. Both BSE and NSE have introduced three contracts on BSE sensitive index for one, two and three months\maturities. Tick size on BSE has proposed of 0.1 index point for trading in sensx futures. Every index point for trading of sensx contract is priced at ₹ 50,0.1 point would be equivalent to ₹ 5.

Settlement Procedures or Delivery

Stock index futures are nearly always settled for cash delivery, in contrast to most futures contracts where physical delivery of an underlying asset is called for. Thus, in the stock index futures contract, no physical delivery (shares or securities certificates) are delivered by the seller (short). This means that all the futures positions which are open at the close of the final trading day of the futures contract are settled by a cash transfer. This amount is determined by reference to the cash price at the close of trading in the cash market in the last trading day in the futures contract. Probably the stock index futures were the first to employ cash settlement as a substitute for physical delivery. The reason being that it is very difficult to deliver (for example the 500 proportions of various stocks in S&P Index 500) all the stocks which is more cumbersome and costly than the cash settlement. Further, if any investor is interested in actual delivery of a stock, he can easily purchase the same from the cash market. Hence, the settlement in futures index contracts is convenient and less costly. Further the effect of the cash settlement forces the futures prices of stock index futures to be identical to the cash stock index at the settlement.

The Stock Index Futures Prices

Stock index futures, like most other financial futures, are also traded in a full carry market. It means that cost-of-carry model provides (which we have been already discussed

in detail in Chapter 4) a virtually complete understanding of the stock index futures pricing. As per this, futures price must be equal to the spot price plus other cost of carrying charges, and if the conditions of this model are not fulfilled or violated then arbitrage opportunities will arise. A trader (or investor) would buy the stocks that underlie the futures contract and sell the futures and will carry the same until the futures expiration. When the stocks are priced very low relative to the futures, the cash-and-carry strategy is attractive.

We have already seen in Chapter 4 that the basic cost-of-carry model for a perfect market with unrestricted short selling is as follows:

$$F_{t,T} = S_t (1 + C)$$

where $F_{t,T}$ futures price at t for delivery at futures time T , S is spot price at time t (today or current) and C is the percentage cost of carrying the asset from t (current) to T (futures). This model can be applied to the stock index futures contracts with some little modifications.

The Cost-of-Carry Model for Stock Index

The cost-of-carry model as described in Eq. (8.1) can be easily applied to the commodities and such assets where no futures cash income is available. In case of stock index futures, holding of the stocks gives dividends to the owner, because the companies usually declare the dividends out of their usual profits to the shareholders. However, each of the indexes is simply a price index. The value of any index at any time depends solely on the price of the stocks, not the dividends that the underlying stocks might pay. Since the futures prices are tied or influenced directly to the index values, the futures prices do not include dividends.

Since Eq. (8.1) of futures price does not include dividends, thus, it must be adjusted to include the dividends that would be received between the present and the futures expiration date of the futures contract. The trader will receive dividends from the stock which will reduce the value of the stocks. Thus, the cost of carrying is the financing costs for stocks, less the dividends to be received while the stock is being carried.

Example

Let us explain the above concept with an example. Assume that the present time is zero and an investor decides to purchase one share of State Bank of India (SBI) for ₹ 300, as currently trading in the market. For this he borrows from the market ₹ 300 to buy this

stock. We assume that the SBI will declare after six months 6 percent dividend which will be further invested the proceeds for another six months at the rate of 10 percent.

$$\text{Total profit} = P_1 + 19.80 - 330$$

where P_1 is current value of the stock at the expiration.

If the current value of the SBI at expiration is ₹ 320 then the profit from this transaction to the investor will be ₹ 9.80 ($320 + 19.80 - 330$). From the aforementioned example, we can generalize to understand the total cash inflows from a cash-and-carry strategy. The futures prices must be equal to the price of the shares underlying stock index plus the cost of carrying the stock minus the futures value of the received dividends. So, in the stock index futures valuation, two considerations are most important like carrying cost and dividend income to be received on the underlying stocks. Then Eq. (8.1) will be modified as under:

Cash Flows from carrying Stock

(i)	Present period (t)	Borrow ₹ 300 for one year at 10%	+300
		Buy one share of SBI	-300
(ii)	Between the period (six months)	Received dividends at 6%	+18
		Invest ₹ 15 for six months at 10%	-18
(iii)	Expiration period (T) (after one year)	Collect proceeds from dividends	+19.80
		Sell SBI share for loan payment	+ P_1
		Repayment of debt (principle + interest)	-330

$$F_{t,T} = S_t(1 + c) - \sum_{i=1}^n D_i(1+r_i)$$

where $F_{t,T}$ is stock index futures price at time t for a futures contract which expires at time T, S_t is the value of the stocks underlying the stock index at time t, C is the percentage cost of carrying the stocks from time to the expiration at time T, D_i is the ith dividend and r_i is the interest earned on carrying the ith dividend from the time of receipt until the futures expiration at time T.

From the Eq. (8.2), we can observe that the cash-and-carry trading opportunity requires that the futures price must be less than or equal to the cash inflows at the futures expiration. Similarly, on the other hand, in the reverse cash-and-carry trading opportunity requires that the futures price must be equal or more than futures cash inflows at the expiration. Thus, it can be concluded that the futures price of a stock index futures contract

must be equal to price of the shares underlying the stock index plus the cost of carrying the stock to the futures expiration, minus the futures value of the dividends the stock will pay before expiration. Equation (8.2) is also known as no-arbitrage equation and such trading strategies are also called index arbitrage.

Theoretical Value or Fair Value for Stock Index Futures

A stock index futures price has its fair value when the entire cost of buying the stock and carrying them to expiration is covered, i.e., the purchase price of the stocks plus interest, less the futures value of the dividends. Thus, in the cost-of-carry model the futures price must equal this entire cost-of-carry.

Example

Calculation of fair or theoretical (or no arbitrage) price. Assume on November 1, 2002, BSE sensitive index is 3200. What is theoretical price on that date for the December, 2002 sensitive index futures contract, which matures on December, 2002? Further assume, the borrowing cost for short period is 10 percent and expected dividend (return) available annualized is 4 percent based on historical yields.

$$\begin{aligned}
 \text{Carrying period} &= 44 \text{ days from November 1, 2002 to December 15, 2002} \\
 \text{Fair value} &= F_{t,T} = S_t (1 + c) - \\
 F_{t,T} &= S_t S_t (C_i - D_i) \\
 &= 3200 + 3200(0.10 - 0.04) \\
 &= 3200 + 23.14 = 3223.14
 \end{aligned}$$

The example observed how to calculate the futures theoretical value BSE index (sensitive) using actual cash index actual and the actual borrowing and dividend rates. In this case, the theoretical BSE index value is 3223.14, is greater than the cash index value of 3200 by 23.14 points because the borrowing (financing cost) rate is higher than the dividend yield. The theoretical value of the futures contract, therefore, is ₹ 1,61,157 (₹ 50x 3223.14).

Further if index futures for the above period from now are trading at a level above 3223.14, the investor can buy index and simultaneously sell index futures to lock in the gain equivalent to the futures price-fair price. However, it should be noted that the cost of transportation, taxes, margins, etc. are not taken into consideration while calculating the fair value. Similarly, if index is at a level below the fair' value, it will trigger severe arbitrage. This arbitrage between the cash and the futures market will continue till the prices between both markets get aligned.

It should also be further noted that the cost-and-carry model gives an approximate index about the true futures price (theoretical value). But in the market, the observed price is an outcome of price discovery mechanism through the forces of demand supply and others. These forces may change from time to time resulting in difference between the fair price and actual price of the index futures, and thus, leads to arbitrage opportunities in the market. However, market forces of arbitrageurs will quickly restore parity when the variation becomes wide.

Earlier we have observed the calculation of the theoretical value of stock index futures contract, and then, the arbitrage opportunities available on such contracts. Stock arbitrage, in reality, may not be as easy and cost-less as explained earlier. There are several reasons observed for the difference between the actual and theoretical futures prices.

A few important explanations for the observed differences are stated below in brief.

1. We may make error in estimating theoretical futures values due to assumed variables like dividend yield, interest rate, etc. Further, the cash index value may have been either wrong or not up-to- date.
2. Trading in the stock markets incurs transaction costs. This involves commission to the brokers, execution costs and others. These costs result in the different valuation of futures prices whereas cash prices do not usually based on these.
3. The asset underlying a stock index futures contract is in reality more concept than an asset. In other words, it is difficult to buy the large number of securities needed in the proportions required to duplicate exactly a stock index futures.
4. The reported value of the cash stock index may almost be correct due to 'sale' price quotations. Index quotations are based on the last sale prices of the shares included in that index, which sometimes may not be the current quotes.
5. All proceeds from the short sales are usually not available to potential arbitrageurs, as normally, observed in the case of small or retail investors.
6. Sometimes, it is also difficult to borrow the required stock to short an entire cash portfolio.
7. Finally, it is evident that the theoretical values are calculated on the assumption of constant dividend yield over the holding period, which sometimes in reality may not be true. The actual dividend yield usually vary and further, there is a seasonality in dividends too.

Besides the observed relationship of differences between the actual and theoretical values of stock index futures, there is also consistency found between these, but within the transaction costs bounds. The difference exceeds two index points on only three days. However, it has been noted that the stock index arbitrage has been highly successful in maintaining the theoretical relationship between cash and futures stock index prices.

Fair Futures Prices and No-Arbitrage Bands

As already observed, the fair futures price is based upon arbitrage, and in case of stock index futures, it would be cash-and-carry arbitrage. It means that the futures price should be such that there is no arbitrage profit from buying stock (with borrowed money) and simultaneously selling futures. However, an arbitrageur's net gain will occur only if it covers the transaction costs too. The actual futures price can deviate from the fair arbitrage pressure that tends to prevent deviations of actual futures prices within a range (the no-arbitrage band) rather than equality with the theoretical prices. In other words, transaction costs may lead to fair prices to be in band and arbitrage occurs only when the actual futures price moves outside the no-arbitrage band. This we will see in the following example:

Example

Assume that on November 1, 2002, the BSE Sensex Index is 3000. The three-month interest rate is 10 percent per annum, and the expected rate of dividend yield over the next three-months is 6 percent per annum. Calculate the theoretical future price, for a futures contract maturing in three months time. Further determine an arbitrage profit be made if the actual futures price were (a) 3050, (b) 3000 and there were no transactions costs. Also examine if the total transactions costs (Commissions, bid-offer spreads, stamp duty, etc.) amounted to ₹ 1000 per ₹ 1,50,000 (₹ 50 x 3000) of one futures contract of stock, would arbitrage profits still be available?

Solution

$$\text{Fair Value } F_{t,T} = S_t S_t (C_i - D_i) \frac{T - t}{365}$$

$$\begin{aligned} \text{The fair futures price will be} &= ₹ 3000 + ₹ 3000 (0.10 - 0.06) \frac{3}{12} \\ &= ₹ 3000 + ₹ 30 = ₹ 3030 \end{aligned}$$

- (a) If the actual futures price were ₹ 3050 then the futures would be over-valued in the absence of transactions costs. Thus, a profit is available from a long cash-and-carry arbitrage which provides buying stock and selling futures. It means there will be guaranteed profit from the stock and futures of 50 index points (amounting to ₹ 50

$x 50 = ₹ 2500$ per ₹ 1,50,000 of stock and one futures contract). The corresponding cost-of-carry is 30 index points ($30x ₹ 50 = ₹ 1500$). So there is a net profit of 20 index points, i.e., ₹ 1000 ($20 x ₹ 50$) in this contract.

- (b) If the actual futures price were 3000, the futures would be undervalued, so the stock should be sold and futures be purchased (short cash and carry). In this contract, there is neither profit nor loss from the stock and futures position because net cost-of-carry accrues ($30x ₹ 50 = ₹ 1500$) as profit and is 30 index points ($30x ₹ 50 = ₹ 1500$).

If the total transactions costs were ₹ 1000, there would be no net profit remaining in case (a) and only ($₹ 1500 - ₹ 1000$) = ₹ 500 in case of (b).

The futures price has to divide by 20 index points from its fair value before any arbitrage profits become available. Thus, in the present case, there will be a no-arbitrage band of 20 points either side of the fair futures price, i.e., ₹ 3010— ₹ 3050. Futures prices within this band do not induce arbitrage since they offer no arbitrage profit.

It should be noted that in the absence of transactions costs, cash-and-carry arbitrage would keep the actual futures price equals to the fair price because undervalued futures would be bought and overvalued futures would be sold by the arbitrageurs, hence, pushing the price up and down. Further, in the absence of the transaction costs, the cash-and-carry arbitrage merely keeps the futures price within the no-arbitrage band, and there will be no further buying or selling by the arbitrageurs. But if the futures price falls below the bottom of the no-arbitrage band, arbitrageurs would purchase futures until the futures price reaches the bottom of the band, at which point arbitrage would stop, and vice versa. Once the futures price is within the band, arbitrage opportunities would cease.

Stock Index Futures as a Portfolio Management Tool

Funds managers or money managers use stock index futures basically for three purposes; hedging, asset allocation and yield enhancement. These are discussed here in this section.

Stock Index Futures as a Hedging Tool

First of all, we should know who need the stock index futures for using them as a hedging tool. All such investors, specifically managing a huge pool of funds or public funds like pension funds, mutual funds, life insurance companies, investment and finance companies, banks, endowment funds, public provident funds, etc. would like to reduce their

fund's exposure to a fall in stock values caused due to uncertainties about futures market developments. This can be done by selling the shares and repurchasing them at a later time, but this strategy is not so appropriate because it would incur substantial transaction costs. As a result, funds managers prefer to hedge with stock index futures instead of altering their portfolio structure, directly and repeatedly. Hedging is also done through stock index options but this will be discussed in other chapter concerning to the 'options'.

Before proceeding to the discussion regarding hedging, one needs to understand some background on risks relating to stock investments and portfolio management.

There are two types of risks associated with holding a security:

1. Systematic risk
2. Unsystematic risk

All the stocks are exposed to such factors which are not controlled by the firm itself, these are called market risk factors like changes in the interest rates, inflation rates, government trade policies, economic activities, political factors, changes in tax laws and so on. Such risk is termed as market risk or systematic risk.

On the other hand, unsystematic or firm specific risk is related to the particular firm or an industry. This risk can be diversified by having diversified portfolio of many shares. Market risk cannot be eliminated by diversification since each of the stock moves with the market to some degree. Thus, stock index futures can be used to hedge or manage this risk.

Measuring Market Risk

Beta is a measure of the systematic risk. It measures the sensitivity of the scrip (asset) vis-à-vis index movements. Beta (β) is defined as the Covariance (Cov.) between a stock's return and the return on the overall market divided by the variance (var) of return on the market.

The formula of a beta (β) of a security (i) is as under:

$$\beta_i = \frac{Cov(R_i, R_m)}{Var(R_m)}$$

where R_m is return on market portfolio (or market return) and R_i is return on the security (i).

Stock betas can be estimated with the regression equation (also called linear regression line) as follows:

$$R_{i,t} = a + b \times R_{m,t} + e_{i,t}$$

where $R_{i,t}$ is observed returns over a period t for stock i , a is the constant return, b is the estimate of the beta of stocks, $e_{i,t}$ is the usual error term and R_m return on market portfolio (or market return).

In brief, from Eq. (8.3), it is observed that the estimate of a stock's beta shows the value of that stock is likely to change relative to change in the value of the market portfolio (or a particular stock index). It also shows the stock's relative volatility.

A portfolio of stocks has its own beta. Individual betas are used to calculate the portfolio beta. It is weighted average of the betas of the individual scrips in the portfolio where weights are based on the proportion of investment of scrips in the portfolio. If the value of a beta is more than one, the stock is more volatile than the market, and if beta is less than one, then stock will be less volatile than the market. Further detail on this model can be studied from the CAPM and Sharpe Single Index Model.

The Minimum-Variance Hedge Ratio

As discussed in the preceding chapter, hedging that the hedger is to determine the appropriate hedge ratio (HR)—which is the ratio of the futures position to the cash position being hedged.

We have seen that a benchmark ratio is the minimum-variance hedge ratio (HR) or the value of HR that can be expected to reduce the fluctuations in the total portfolio to the minimum possible. In this section, we will discuss the determination of HR in the context of the 'stock index futures contracts'.

$$HR = \frac{\text{Value of hedged portfolio}}{\text{Price of the futures contract}} \times B_i$$

$$HR = \frac{\% \text{ change in weighted average portfolio price}}{\% \text{ change of future index}}$$

Example

Value of BSE index	= 3000
Value of portfolio	= 6,08,000
Risk-free interest rate	= 10 percent per annum
Dividend yield on index	= 6 percent per annum
Beta of the portfolio	= 1.5

We assume that a futures contract on the BSE index with four months to maturity is used to hedge the value of the portfolio over the next three months. Our futures contract is for delivery of ₹ 50 times the index.

Calculate the HR from the above information also calculate the gain on short futures position if index turns out to be 2700 in three months.

Solution

Current futures price of the index:

$$\begin{aligned}F_{t,T} &= S_t S_t (C_i - D_i) \frac{T-t}{365} \\ &= ₹ 3000 + ₹ 3000 (0.10 - 0.06) 4/12 \\ &= ₹ 3000 + ₹ 40 = ₹ 3040\end{aligned}$$

Price of the futures contract = ₹ 50 x 3040 = ₹ 1,52,000

Using Eq. (8.4) the HR or number of the futures contracts that should be shorted to hedge the portfolio is:

$$\text{HR} = \frac{6,08,000}{1,52,000} \times 1.5 = 6$$

Suppose the index turns out to be 2700 in three months. The futures price will be

$$\begin{aligned}&= 2700 + 2700(0.10 - 0.06)1/3 \\ &= 2700 + 36 = 2736\end{aligned}$$

The gain from the short futures position is, therefore,

$$6 \times (3040 - 2736) \times 50 = ₹ 91,200$$

In the example, the loss on index is 10 percent. The index pays a dividend of 6 percent per annum or 1.5 percent per three months. When dividend are taken into account, an investor in the index would cash. Therefore earn 9 percent in the three-month period. The risk free interest is approximately 2.5 percent per three months. Since the portfolio has a β of 1.5, expected return of portfolio will be equal to:

$$\begin{aligned} &= \beta \times (\text{Return on portfolio} - \text{Risk free interest rate}) \\ &= 1.5 \times (\text{Return on index} - \text{Risk free interest rate}) \end{aligned}$$

Using the formula, the expected return on the portfolio is:

$$\begin{aligned} &= 2.5 + 1.5 \times (9.0 - 2.5) \\ &= 2.5 + (-17.25) = 14.75\% \end{aligned}$$

The expected value of the portfolio (inclusive of dividends) at the end of the three months is, therefore,

$$₹ 6,08,000 \times (1 - 0.1475) = ₹ 5,18,320$$

It follows that the expected value of the hedger's position including the gain on the hedge is:

$$₹ 5,18,320 + ₹ 91,200 = ₹ 6,09,520$$

Changing Beta

Sometimes, the stock index futures contracts are used to change the beta of a portfolio to some value other than zero. For example, we want to reduce to beta of the portfolio from 1.5 to 0.75, then in that situation, the number of the contracts would be changed, and now they will be 3 instead of 6. In general, to change the beta of the portfolio from β to β^* where $\beta > \beta^*$, a short position is

$$(\beta - \beta^*) = \frac{\text{Value of hedged portfolio}}{\text{Price of the futures contract}}$$

Rolling the Hedged Forward

Sometimes, it happens that the expiration date of the hedge is later than the delivery dates of all the futures contracts that can be used. In this situation, the hedger must then roll the hedge forward. In other words, it means that closing out one futures contract and

taking the same position in a futures contract with a later delivery date. Hence, the hedge can be rolled forward many times. Consider a company which intends to use a short hedge to reduce the risk associated with the price to be received for an asset at time T. Assume, if there are futures contracts 1, 2, 3, n (not all necessary in existence at the present time), the company can use the following strategy:

Time t_1 = Short futures contract 1
 Time t_2 = Close out futures contract 1
 = Short futures contract 2
 Time t_3 = Close out futures contract 2
 = Short futures contract 3
 Time T_n = Close out futures contract (n - 1)
 = Short futures contract n
 Time T = Close out futures contract n

Let us explain this by an hypothetical example:

Example

Suppose in April 2002 a company realize that it will have 1,00,000 barrels of oil to sell in June 2003 and it decides to hedge its risk with a hedge ratio of 1.0. The current spot price is \$19. Futures contract are traded for every month of the year up to one year in future, we suppose that only the first six delivery months have sufficient liquidity to meet the company's needs. Company, therefore, shorts 100 October 2002 contract. In September, it rolls the hedge forward into Marc 2003 contract. In February 2003, it rolls the hedge forward again into the July 2003 contract. The contract size is 1000 barrels.

Company uses the following strategy to hedge the risk:

April 2002:	The company shorts 100 October 2002 contracts.
September 2002:	The company closes out the 100 October 2002 contracts. The company shorts 100 March 2003 contracts.
February 2003:	The company closes out the 100 March 2003 contracts. The company shorts 100 July 2003 contracts.
July 2003:	The company closes out the 100 July 2003 contracts. The company sells 1,00,000 barrels of oil.

It is evident from the above that when there is no liquid and futures contract which matures later than the expiration of the hedge, a strategy known as rolling the hedge forward may be followed.

This involves entering into a sequence of futures contracts as shown above. Rolling the hedge will be appropriate if there is a close correlation between changes in the futures prices and the changes in spot prices.

Asset Allocation by the Funds Managers

The term asset allocation refers to the distribution of portfolio assets among equity shares, bonds, debentures and other money market instruments. It means that how to divide funds among broad asset classes like 60 percent in equities and 40 percent in treasury bills is an asset allocation decision.

Usually it does include changing of the assets from one equity to other equity asset rather concentrates on asset allocation from equity to debt or treasury bills and /vice versa. Further asset allocation focuses on the macro level commitment of funds to various asset classes and the shifting of funds among these major asset classes.

It is often preferable to use stock index futures to change the portfolio mix, even though portfolio managers structure and restructure their portfolio by buying and selling the different assets using futures because it is cheaper. It has been noted that equity stock index and interest rate futures trading cost are less in comparison to the direct trading in stocks.

Let us see this with an example given in Table.

Transaction Costs Associated with Stock versus Stock Futures Index

Particulars	Stocks	Stock index futures
Average price per share/contract	\$60	\$35
Number of shares/units	2933*	500
Market value of portfolio/contract	\$1,76,000	\$1,76,000
Round-trip commission per share/contract	\$0.07**	\$15
Commission cost	\$205.31	\$15
Bid/ask spread costs	0.125	0.05 index point or
	index points/share	I tick per contract
	2933 x 0.125 = 366.33	500 x 0.05 = \$25

Total transaction cost commission plus bid/ask spread	\$571.94	\$40
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* The precise number of shares that would equal in portfolio of stock with the average stock price to the value of one futures contract is 2933.333 (\$176000/\$60).

** Commission that would be paid by large investment invest

Yield Enhancement

Yield enhancement refers to the portfolio strategies of holding a 'synthetic' stock index fund that is capable of earning higher return than a cash stock index fund. A portfolio consisting of a long position in stock inc.ex futures and treasury bills will produce the same return (with the same risk) structured as stock portfolio to mirror the stock index underlying the futures. However, a portfolio of stock index futures and treasury bills (synthetic stock) can be constructed to outperform the corresponding stock portfolio (higher return with the similar risk), if stock index futures are correctly priced or their actual value is higher or lower than their theoretical (fair) value. In this way, with the use of stock index futures, a yield enhancement strategy be followed to enhance the return on a portfolio.

Speculation and Stock Index Futures

After discussing the case of arbitrage and hedging, let us now consider the speculating with stock index futures. As we know that basic objective of the speculators is to earn super profit by going either bullish or bearish in the market. Index futures permits them an ideal instrument where the vagaries of individual stocks, settlement cycles, etc. do not have so much of an impact as they do on specific stock. The speculators can select a strategy where they can have a bullish view and go long on futures. Similarly, they can have a bearish view and go short in futures.

Earlier before the stock index futures came into existence, the speculators had two alternatives. Firstly, they can select the liquid stocks which would move with the index so that they can take a position in them for the expected move. But this move would be too risky. Secondly, they can select the entire stocks as in the index and trade in all of them. The basic of liquid stocks may mimic the index to some extent but still individual stock variations will affect the returns, and moreover, it is too costly with high amount of commission, etc. But now with the introduction of stock index futures, such limitations mentioned are taken care of. Now the speculators can take up either long position on the contract, paying a small margin, and seek to ride the expected trend and vice-versa for the bearish view-sell short index contract and cover when the index falls lower.

Stock Index Futures Trading in Indian Stock Market

As discussed in Chapter 5, SEBI Board accepted the recommendations of Dr. L.C. Gupta Committee on May 11, 1998 and approved introduction of derivatives trading in India in the phased manner. The recommendation sequence was stock index futures, index options and options on stocks. The Board also approved the suggestive bye-laws recommended by the Committee for regulation and control of derivatives trading in India. As a result, both the stock exchanges, National Stock Exchange of India (NSE) and Bombay Stock Exchange of India (BSE) took the initiative to introduce futures trading in India. The brief particulars of their products are given here as under.

NSE's N FUTIDX NIFTY (NIFTY)

The National Stock Exchange of India introduced futures named 'NIFTY' on June 12, 2000. The salient features of this instrument are

1. Name of the instrument is N FUTIDX NIFTY.
2. The underlying index S&P CNX NIFTY (NSE 500).
3. Contract size. The index futures will be quoted as per the underlying asset which means that it will quote just like the Nifty in points. The value of the contract (contract size), a multiplier of 200 is applied to the index. It means that the value of a contract will be (₹ 200x index value) on that particular date. The multiplier can be thought of as the market lot for the futures contract. This can be changed from time to time.
4. NSE has introduced three contracts for one month, two months and three months maturities. These contracts of different maturities may be called near month (one month), middle month (two months) and far month (three months) contracts. The month in which the contract will expire is called the contract month, for example, contract month of April 2003 contract will be April, 2003.
5. Expiry. Each contract would have a specific code for representation purpose on the system. All these contracts will expire on a specific day of the month and currently they are fixed for the last Thursday of the month. As soon as the near month contract expires, middle contract will become near and so on.
6. Tick size/price step. Tick size is the minimum difference between two quotes of similar nature. Since the index futures would be traded in term of index points, the tick size is to be defined in points only. The Nifty tick size is ₹ 0.05 which will be converted into points.

7. Position limits. Present, both types of contracts as for speculation and hedging purposes are allowed to be traded. However, these are subject to change from time to time.
8. Trading hours. Trading hours are 10.30 a.m. to 3.30 p.m.
9. Margins. NSE fixes the minimum margin requirements and price limits on daily basis which are subject to change periodically.
10. Settlement. Position remaining open at the close of business on the last day of trading are marked-to-market according to the official opening level of the NSE-NIFTY on the following day. There is daily settlement also on the closing of futures contract.
11. Volumes and open interest. Futures contracts have a unique way of reporting volumes and it is called open interest. It provides the information about the number of outstanding/unsettled positions in the market as a whole at a specific point of time. In the futures market, total long positions would be equal to the total short positions, hence, only one side of the contracts are counted for determining the open interest position. Major stock exchanges of the world Imblish the open interest position regularly

BSE's BSX

The Bombay Stock Exchange introduced stock index futures trading on June 9, 2000 with the name of the instrument as BSX with the underlying BSE Sensitive Index (SENSEX). The features regarding its trading are more or less same with the NSE's NIFTY index futures. A few important features are given in brief here as under:

1. Date of start	June 9, 2000
2. Security name	BSX
3. Underlying security	BSE Sensitive Index (SENSEX)
4. Contract size	Sensex value x 50
5. Tick size	0.1 point of Sensex (equivalent to ₹ 5)
6. Minimum price fluctuation	₹ 5
7. Price band	Not applicable
8. Expiration months	Three months
9. Trading cycle	A maximum of three months, the near month, next month and far month
10. Last trading day/Expiry day	Last Thursday of the month or the preceding trading day.

11. Settlement	in cash on T + 1 Basis.
12. Final settlement	Index closing price on the last trading days
13. Daily settlement price	Closing of futures contract price
14. Trading hours	9.30 am to 3.30 pm
15. Margin	Up front margin on daily basis.

Crosshedges and Changing Volatilities of an Asset Position

A cross hedge occurs if the characteristics of the cash asset underlying the futures contract differs from the cash instrument being hedged. A number of factors affect the degree of a cross hedge for a given position. The extent of a stock portfolio cross hedge is affected by the relative stock composition and relative stock weights of the cash and futures positions; any differences in the size between the cash and futures positions also affect the hedge. For a T-bond futures hedge one must consider the effect of the coupon, the time to maturity of the cash position, whether the bond possesses default risk, and the relative size of the underlying cash position. If any of these factors differ from the characteristics of the futures contract or the cheapest-to-deliver cash bond for pricing the futures, then a cross hedge exists. The extent of a cross hedge can be measured by the size of the correlation coefficient between the changes in value of the cash and futures position. The lower the correlation coefficient is the greater the difference in two positions. When a low correlation exists, the futures contract is not a good instrument to use for hedging purposes.

Cross hedges arising from some of these characteristics, such as coupon differences, have a minimal effect on the performance of the hedge when the cash and futures prices still move nearly in tandem. Cross hedge factors affecting the volatility on the position (e.g., the maturity of the cash bond) are dealt with by adjusting the number of futures contracts employed in the hedge (as shown in the next chapter). However, the effect of quality difference, such as hedging corporate bonds with Treasury bond futures, depends on whether there is a major change in the perceived risk in the economy during the hedge period, which would significantly alter the basis. Consequently, the difficulty of overcoming cross hedge effects depends upon the particular characteristic(s) that differ between the futures and cash positions, whether the factors remain stable over time, and the economic environment at the time of the hedge. For example, hedging one currency with the futures contract of another currency often causes significant cross hedge risk because of the differing economic conditions in the two countries.

Liquidity also can be an issue in measuring the basis for a given security, since thinly traded issues often have reported prices that differ from their true prices, especially when

the market changes but the thinly traded issue does not trade. Moreover, cash prices typically are reported in terms of bid prices and ask prices rather than transaction prices, and the newspaper prices occur at a different time of day than the close of the futures market; both of these factors affect the apparent stability of the basis.

In reality, most hedges involve some type of a cross hedge risk, since the cash asset typically differs from the underlying cash instrument priced by the futures contract. The greater the deviation of any of the factors from the underlying cash instrument, the greater the basis risk. For example, the effect of a large change in the shape of the term structure needs to be considered when the maturities of the cash bond and the cheapest to-deliver bond for the futures contract differ. The creation of the 1-note futures contracts with shorter maturities was undertaken in order to provide a more appropriate hedging vehicle under these circumstances.

Also note that care must be taken when hedging the prime rate. Because the prime is an administered rate, it does not usually change in the same manner as market rates; in fact, the prime rate is slow to react to downward changes in interest rates. Hence, it is sometimes difficult to hedge the prime in an effective manner, especially over the short term.

A Cross hedge

ABC Mutual Fund holds ₹ 5 crores in stocks, with the portfolio configured to match the XYZ 100 index. The Fund’s money manager forecasts an increase in volatility in the market, which increases the probability of a major market decline. To reduce risk the money manager sells XYZ 500 futures. Although the XYZ 500 futures do not match the XYZ 100 price movements exactly, the money manager decides that this type of a cross hedge is the best strategy to use in this situation.

Date	Cash Market	Futures Market
Jan 12	Stock portfolio of ₹ 5 crore, with the XYZ 100 = 325.09	Sell 287 June XYZ 500 futures, with the XYZ 500 futures = 348.20 for a value of ₹ 4,99,66,700
April 26	The XYZ 100 declines to 315.82 for a portfolio value of ₹ 4,85,74,240 = ₹ 5 crore x (315.82/325.09)	Buy back the XYZ 500 futures at 335.25 for a value of ₹ 4,81,08,375
Chance Loss of ₹ 14,25,726		Gain of ₹ 18,58,325 —287 x 500 x (348.20— 335.25)

Net gain: ₹ 4,32,565

The cross hedge generates a gain of ₹ 4,32,565. The large deviation between the loss in the cash portfolio and the futures gain shows the relative ineffectiveness of this cross hedge.

Table shows a cross hedge between a cash portfolio mimicking the XYZ 100 cash index and the XYZ 500 futures contract. As shown in the example, cross hedges create net gains or losses that often vary to a greater extent than is the case when the characteristics of the futures and cash securities are nearly equivalent.

Strategies For Hedging

Hedging typically is associated with reducing risk (Reducing price volatility). However, those who employ futures markets have different strategies and different goals in order to implement a hedging programme. Market participants practice four overlapping strategies:

- ▶ Reduction of risk: the primary use of futures for hedging is to reduce the price variability associated with the cash asset position. Naive, regression, and duration methods determine the appropriate number of futures contracts for a hedge position. The objective of the regression and duration methods is to minimize the risk associated with a cash position.
- ▶ Selective hedging: hedging only during those time periods when a forecast determines that the cash position will lose money is called selective hedging. If the forecasts are correct then risk is minimised during the hedged periods; meanwhile the asset earns positive returns during the un hedged periods. If the forecasts are incorrect, then risk is not reduced. Many institutions employ some type of market timing to decide when to use selective hedging
- ▶ “Speculating on the basis”: when the returns from the hedge are a consideration in whether the hedge will be undertaken, then this approach is equivalent to predicting the change in the basis during the hedge period.
- ▶ Optimal risk-return hedging: the optimal hedge decision considers both the reduction in risk and the return from the combine cash-futures position. Such an optimal position is associated with portfolio analysis.

The above strategies also can be designated as passive or active strategies. A passive strategy is independent of cash market price/interest rate expectations. Passive strategies depend on the risk attitude of the hedger and the volatility of the cash markets. Active strategies require a forecast of future cash price/interest rates for implementation. The

forecast helps the money manager decide when and how much of the cash position to hedge. Thus, an active hedging strategy readjusts the hedging position over time.

The “reduction of risk” strategy listed above is a passive strategy. “Selective hedging” and “speculating on the basis” are active strategies. The “optimal risk-return” strategy can be either a passive or active strategy depending on whether the risk attitude of the hedger or the forecasts of the cash market determine the size of the hedge position.

Avoiding Losses: Sell or Hedge?

A typical question concerning hedging is, “Why should I hedge when I can sell the cash asset if I expect prices to decline?” In fact, selling the cash asset is preferable in some circumstances. The principal rule for deciding whether to make a transaction in the cash market or to hedge in the futures market is

If you can accomplish your goal “effectively” in the cash market, then complete your transaction in that market.

The key to this rule is the word “effectively.” In many situations one or more of the following factors cause difficulties if the transaction is completed in the cash market:

- ▶ Liquidity: the cash market for a given asset often is not liquid for large trades. Thus, the portfolio hedger who sells or buys the cash asset, or the dealer who shorts the asset, causes a significant price change in that security when liquidity does not exist. There is no liquidity problems for trades in most (near-term) financial futures contracts.
- ▶ Cost: the commissions and size of the bid-ask spread in the cash market often cause the cash transaction to be expensive relative to the same transaction in the futures market. For example, trades in a stock portfolio cost ten times the equivalent trade in futures.
- ▶ Execution: a futures transaction is initiated much quicker than a cash transaction due to liquidity reasons.
- ▶ Short selling: a short sale in the cash market typically is expensive.
- ▶ Internal policy or government-regulations: these factors can prevent the desired cash market transaction. For example, a portfolio manager often is required to have a given minimum percentage of assets in bonds rather than in cash or short-term securities, or a financial institution may be prevented from shorting a cash security to obtain an effective cash market hedge.

- Credit risk: creating a forward or short sale in the cash market often involves an implicit credit risk on the part of the participants. Futures transactions are completed with the cleaning house, virtually eliminating the credit risk problem.

So far we have examined some basic principles underlying the practice of hedging. The next step is to illustrate how these hedges are executed. We shall look at some examples developed from a variety of economic and financial environments that illustrate several hedging principles.

Summary

This chapter has introduced the concept of hedging, tools for hedging and how to devise a hedging Strategy. Hedging, in broadest sense, is the act of protecting oneself against futures loss. More specifically hedging is regarded as the use of futures transactions to avoid or reduce price risks in the spot market. Hedging is used in multipurpose concept like (a) carrying charge hedging, according to this approach, the stockists watch the price spread between the spot and futures price, and if the spread is such which covers even carrying cost, then the stockist buy ready stocks, (b) operational hedging which says that hedges use the futures market for their operations and see the same as substitute for cash or forward transactions and (c) anticipatory hedging, which is done in anticipation of subsequent sales or purchases. For example, a farmer might hedge by selling in anticipation of his crop while a miller might hedge by buying futures in anticipation of subsequent raw material needs. Perfect hedging is referred to that position which eliminates the total risk. In other words, the use of futures or forward position to reduce completely the business risk is called perfect hedge.

The chapter further elaborates the basics of long and short hedges. A short hedge is a hedge that involves short position in futures contract. In other words, it occurs when a firm/trader plans to purchase or produce a cash commodity sells futures to hedge the cash position. In general sense, it means 'being short' having a net sold position. On the other hand, a long hedge (or a buying hedge) involves where a long position is taken in futures contract. The basic objective here is to protect itself against a price increase in the underlying asset prior to purchasing it in either the spot or forward market. Another concept, 'cross hedging' arises when hedging horizon (maturity) may not match with the futures expiration date, quantity to be hedged may not match with the quantity of futures contract, physical features of the asset to be hedged may differ from the futures contract itself.

The chapter in next section explains the basis risk and price risk. Basis is the difference between the cash price and the futures price. When changes in the futures and cash price

are not equal, which is normal in practice, then there will be basis risk. Basis risk is defined as the variance of the basis. The chapter further explains how to devise a hedging strategy and how to manage the hedging strategy. Devising a hedging strategy involves deciding on the futures contract, hedge ratio concept, estimating the hedge ratio and deciding about the hedging objectives.

The last section of the chapter discusses the management of hedge position which includes (a) monitoring the hedge, (b) adjustments to the hedge and hedge evaluation and monitoring the hedge which includes, information of the current size of the cash position being hedged, changes in its magnitude since the inception of hedge, the information regarding the size of futures position and so on.

This chapter on stock index futures has highlighted in general the concept of stock index futures. A stock index or stock market index is a portfolio consisting of a collection of different stocks. In other words, a stock index is just like a portfolio of different securities proportion traded on a particular stock exchange like NIFTY S & P CNX traded on NSE. The S&P 500 index traded on NYSE, New York etc. A stock index represents the change in the value of set of stocks which constitutes the index.

A stock index futures contract in simple terms is futures contract to buy or sell the face value of a stock index. The most actively traded index is the American Standard & Poor's 500 index FTSE100, Dow & Jones 30 Index. Further various specifications of stock index futures contracts which include contract specification, exchange, quantity, delivery months, delivery specifications and minimum price movements have been stated.

In Section 8.3.2, the chapter explains the settlement procedure or delivery mechanism of stock index futures. Stock index futures are normally settled for cash delivery in contrast to most futures contracts where physical delivery of an underlying asset is called for. Then, in stock index futures contract, no physical delivery (shares or securities certificates) are delivered by the seller.

The chapter also explains the pricing of stock index futures which also like other most financial futures trade in full carry market. It means that cost-of-carry model provides virtually complete understanding of the stock index futures pricing. As per this, futures price must be equal to the spot price plus other of carrying charges, and if the conditions of this model are not fulfilled then arbitrage opportunities will arise.

A trader or investor would buy the stocks that underlie the futures contract and sell the futures and will carry the same until the futures expiration. When the stocks are priced very low relative to the futures, the cash-and carry-strategy is attractive. Theoretical value

or fair price/value for stock index futures is where the entire cost of buying the stock and carrying them to expiration is covered. It means fair value will be price of the stock plus interest less the futures value of the dividends.

There are various observations between actual and theoretical futures prices of stock index futures which may be due to error in estimating theoretical futures valued with assumed variables, like dividend yield, interest rate, etc. Further cash index value may have been either wrong or not up-to-date. Second is that trading in the stock markets incurs transaction cost. This involves commission to the brokers, execution costs and others.

The chapter further discuss about the fair or theoretical price and no-arbitrage bands. The futures price should be such that there is no arbitrage profit from buying stock and simultaneously selling futures.

However, an arbitrage's net gain will occur only if it covers the transaction costs too. The actual futures price can deviate from the fair arbitrage pressure that tends to prevent deviations of actual futures prices within a range, rather than ensuring equality with the theoretical price.

Stock index futures can be used as a portfolio management tool by the funds managers or the money managers basically for three purposes: (i) hedging (ii) asset allocation, and (iii) for yield enhancement. Stock index as hedging tool can be used by fund managers, who has a pool of public funds, like pension funds, mutual funds, insurance companies, investment and finance companies to reduce their funds exposure to a fall in stock values caused due to uncertainties about future market developments. This can be done by selling the shares and repurchasing them at a later time. Before taking a position, one needs to understand the types of risk associated with holding a security, namely, systematic risk and unsystematic risk.

The chapter further discusses about the speculation and stock index futures. The basic objective of speculators is to earn super profit by going bullish or bearish in the market. Index futures permit them an ideal instrument where the vagaries of individual stocks and settlement as they do on specific stock. The speculators select a strategy where they can have a bullish view and go long on futures. Similarly, they can have a bearish view and go short on futures.

Stock index futures trading in Indian stock market started on BSE (Index) at Bombay Stock Exchange and NSE (National Stock Exchange) with their various specifications like expiry date, price stop, position limits, trading hours and so on.

Solved Problems

1. It is February 15 and a company expects to borrow ₹ 20 crore for 3 month on April 15. The spot three-month interest rates is 12 p.a., the June three-month rupee futures price is 88, the coefficient of correlation between three-months interest rate changes and changes in the prices of futures maturing 2 months later is 0.95, the standard deviation of spot 3-month interest rate changes is 2, whereas the standard deviation of 3-month interest rate futures prices is 2.5 (for futures maturing in 2 months' time).

Design a hedge. What sources of possible hedge imperfections are present?

Solution

The basic hedge would involve dividing the exposure by the size by the size of the futures contract and selling the resulting number of futures contracts:

$$\text{₹ 20 crore} / \text{₹ 0.5 crore} = 40 \text{ contracts}$$

This number needs to be adjusted for relative volatility:

$$40 \times \text{correlation coefficient} \times \frac{\text{S.D of spot rate}}{\text{S.D of spot prices}}$$

$$40 \times 0.95 \times (2/5) = 30.4 \text{ contracts.}$$

This number should either be tailed or adjusted for variation margin leverage. If the latter approach is taken, then the previous number of contracts is reduced to

$$30.4 \times (1/1.03) \times (1.01)$$

Where 1/1.03 offsets interest on variation margin for the 3 month beginning 15 April and 1/1.01 offsets interest on variation margin prior to April 15 (making the simplifying assumption of a constant rate of receipt or payment of variation margin). The hedge would initially sell either future contract.

Source of hedge imperfections include basis risk, the possible unreliability of historical statistics as guides to futures correlation and standard deviations, the inability to trade fraction of contracts, change in interest rates and the uncertainty as to the timing of variation cash flows. Tailing is more accurate than using variation margin leverage.

2. (a) A finance manager needs to borrow ₹ 10 crore for 3 months. It is May 20 and the money is to be borrowed on August 1. How can the finance manager hedge against a rise in interest rates using futures? (Assume ₹ 25 per index point).
- (b) If euro dollar interest rates rise from 6 p.a. to 7% p.a. between May 20 and August 1, what is the loss? If futures prices fell from 93.80 to 92.90 during the same period, how much futures profit would there be from the hedging strategy adopted in part (a)?
- (c) How would the answers to (a) and (b) change if the money was to be borrowed for a year?

Solution

- (a) Sell September 10 euro dollar interest rate futures contracts.
- (b) (i) 1% on ₹ 10 crore over 3 months $0.01 \times ₹ 10 \text{ crore} \times 0.25 = ₹ 2,50,000$
- (ii) 90 ticks profit on each of 10 futures contracts at ₹ 25 per tick
 $90 \times 10 \times ₹ 25 = ₹ 22,500$
- (c) The best hedge would be a strip hedge involving September 10, December 10, March 10 and June 10 futures contracts. The loss due to the interest rate rise would be 4 times as much, i.e. ₹ 10,00,000. If all futures prices fell by 90 ticks, then the total profit from the futures would be ₹ 22,500 x 4 = ₹ 90,000.
3. An investor has the following portfolio:

	Number of Shares	Share Price (₹)	Share Beta
Andhra Auto	10,000	30	0.9
Bombay Cement	15,000	12	1.2
Calcutta Cotton	12,000	25	1.5
Delhi Tax	20,000	40	0.6

It is 15th February and the March ABC 100 future price is ₹ 300.

- (a) How can the investor hedge the portfolio, with futures? (Assume ₹ 25 per index point).
- (b) What factors might reduce the effectiveness of the measure' taken in (a)? Ans:

Solution

Calculate the market exposure of the portfolio by summing the market exposures of in dividend stocks (market exposure = number of shares x share price x beta):

$$10,000 \times ₹ 30 \times 0.9 = ₹ 2,70,000$$

$$15,000 \times ₹ 12 \times 1.2 = ₹ 2,16,000$$

$$12,000 \times ₹ 25 \times 1.5 = ₹ 4,50,000$$

$$20,000 \times ₹ 40 \times 0.6 = ₹ 4,80,000$$

$$₹ 14,16,000$$

The Total market exposure in ₹ 14,16,000. The market exposure provided by one future contract is:

$$300 \times ₹ 25 = ₹ 7,500$$

Hedging the portfolio with futures would involve selling:

$$₹ 14,16,000 / ₹ 7,500$$

$$= 18.88 \text{ contracts.}$$

Since futures contracts are indivisible, this would indicate 18 contracts.

- (b) Factors that could reduce hedge effectiveness include basis risk, the indivisibility of contracts, instability of beta and the presence of firm - or sector - specific risk (i.e. non-systematic risk).
4. (a) A finance manager needs to borrow ₹ 4 Crore for 3 month. It is May 20 and the money is to be borrowed on August 1. How can the finance manager hedge against a rise in interest rates using futures?
- (b) If euro-dollar interest rates rise from 6% p.a. to 7% p.a. between May 20 and August, what is the loss? If futures prices fell from 93.80 to 92.90 during the same period, how much futures profit would there be from the hedging strategy adopted in part (a)? (Assume ₹ 25 per index point).

Solution

(a) Sell September 10 euro-dollar interest rate futures contracts.

(b) (i) 1% on ₹ 4 crore over 3 months.

$$0.01 \times ₹ 4,00,00,000 \times 0.25 = ₹ 1,00,000.$$

(ii) 90 ticks profit on each of 10 futures contracts at ₹ 25 per tick:

$$90 \times 10 \times ₹ 25 = ₹ 22,500.$$

Self Assessment Questions

1. Explain what is meant by basis risk and price risk when futures contracts are used for hedging.
2. What do you understand by hedging? Discuss with suitable examples.
3. Discuss various concepts of hedging, with suitable examples.
4. What do you understand by perfect hedging model? Discuss various conditions that must be fulfilled before a perfect hedge is possible. Also explain how a perfect hedge works.
5. What do you understand by long hedge? Discuss with suitable example. Also discuss the situations which make a hedge to cross hedge.
6. Write a detailed note on devising a hedging strategy.
7. Write note on the following with the help of suitable data
 - a. Basis risk
 - b. Price risk
8. What is asset-liability hedge? Explain with suitable example.
9. Explain the various steps taken in devising a hedging strategy. Also explain the effect of hedging objectives in this respect.
10. Write short notes on:
 - a. Hedging objectives
 - b. Management of hedging
 - c. Hedging effectiveness
11. Critically examine the relationship between basis risk and hedging.

UNIT - V

Unit Structure

Lesson 5.1 - Financial Derivatives Markets in India

Lesson 5.2 - Benefits of Derivatives in India

Learning Objectives

After reading this chapter, students should

- Understand the meaning of financial derivatives.
- Understand the need of derivatives.
- Know about how financial derivatives evolved in India.
- Know about major recommendations of Dr. L.C. Gupta Committee on derivatives.
- Understand the various concepts involved in the various recommendations made by Dr. L.C. Gupta Committee on derivatives.
- Understand trading mechanism at National Stock Exchange (NSE) and Bombay Stock Exchange (BSE).
- Be aware about the eligibility of the stocks for derivatives trading in India.
- Understand the emerging structure of derivatives market in India.
- Know about the problems and prospects of financial derivatives in India.
- Know about the weaknesses of Indian stock market

Lesson 5.1 - Financial Derivatives Markets in India

Introduction

The individuals and the corporate sector units are freely using derivatives, also popularly known as future market instruments, in most of the developed countries of the world to manage different risks by the individuals and the corporate sector units. Emerged in 1970s, the derivatives markets have seen exponential growth and trading volumes have

nearly doubled in every three years, making it a multi- trillion dollar business market. The future markets in various segments have developed so much that now one cannot think of the existence of financial markets without the derivatives instruments. In other words, the derivatives markets whether belonging to commodities or financials have become, today, an integral part of the financial system of a country.

The Indian financial markets indeed waited for too long for derivatives trading to emerge. The phase of waiting is over. The statutory hurdles have been cleared. Regulatory issues have been sorted out. Stock exchanges are gearing up for derivatives. Mutual funds, foreign institutional investors, financial institutions, banks, insurance companies, investment companies, pension funds and other investors who are deprived of hedging opportunities now find the derivatives market to bank on. They would find very soon all other important derivatives instruments in the Indian financial markets to manage their portfolios and associated risks.

Need for Derivatives

Since 1991, due to liberalization of economic policy, the Indian economy has entered an era in which Indian companies cannot ignore global markets. Before the nineties, prices of many commodities, metals and other assets were controlled. Others, which were not controlled, were largely based on regulated prices of inputs. As such there was limited uncertainty, and hence, limited volatility of prices. But after 1991, starting the process of deregulation, prices of most commodities is decontrolled. It has also resulted in partly deregulating the exchange rates, removing the trade controls, reducing the interest rates, making major changes for the capital market entry of foreign institutional investors, introducing market based pricing of government securities, etc. All these measures have increased the volatility of prices of various goods and services in India to producers and consumers alike. Further, market determined exchange rates and interest rates also created volatility and instability in portfolio values and securities prices. Hence, hedging activities through various derivatives emerged to different risks.

Futures' trading offers a risk-reduction mechanism to the farmers, producers, exporters, importers, investors, bankers, trader, etc. which are essential for any country. In the words of Alan Greenspan, Chairman of the US Federal Reserve Board, "The array of derivative products that has been developed in recent years has enhanced economic efficiency. The economic function of these contracts is to allow risks that formerly had been combined to be unbundled and transferred to those most willing to assume and manage each risk components." Development of futures markets in many countries has contributed significantly in terms of invisible earnings in the balance of payments, through the fees and

other charges paid by the foreigners for using the markets. Further, economic progress of any country, today, much depends upon the service sector as on agriculture or industry. Services are now backbone of the economy of the future. India has already crossed the roads of revolution in industry and agriculture sector and has allowed the same now in services like financial futures. India has all the infrastructure facilities and potential exists for the whole spectrum of financial futures trading in various financial derivatives like stock market indices, treasury bills, gilt-edged securities, foreign currencies, cost of living index, stock market index, etc. For all these reasons, there is a major potential for the growth of financial derivatives markets in India.

Evolution of Derivatives in India

Commodities futures' trading in India was initiated long back in 1950s; however, the 1960s marked a period of great decline in futures trading. Market after market was closed usually because different commodities' prices increases were attributed to speculation on these markets. Accordingly, the Central Government imposed the ban on trading in derivatives in 1969 under a notification issue. The late 1990s shows this signs of opposite trends—a large scale revival of futures markets in India, and hence, the Central Government revoked the ban on futures trading in October, 1995, The Civil Supplies Ministry agreed in principle for starting of futures trading in Basmati rice, further, in 1996 the Government granted permission to the Indian Pepper and Spice Trade Association to convert its Pepper Futures Exchange into an International Pepper Exchange. As such, on November 17, 1997, India's first international futures exchange at Kochi, known as the India Pepper and Spice Trade Association—International Commodity Exchange (IPSTA-ICE) was established.

Similarly, the Cochin Oil Millers Association, in June 1996, demanded the introduction of futures trading in coconut oils. The Central Minister for Agriculture announced in June 1996 that he was in favour of introduction of futures trading both domestic and international. Further, a new coffee futures exchange (The Coffee Futures Exchange of India) is being started at Bangalore. In August, 1997, the Central Government proposed that Indian companies with commodity price exposures should be allowed to use foreign futures and option markets. The trend is not confined to the commodity markets alone, it has initiated in financial futures too.

The Reserve Bank of India set up the Sodhani Expert Group which recommended major liberalization of the forward exchange market and had urged the setting up of rupee-based derivatives in financial instruments. The RBI accepted several of its recommendations in August, 1996. A landmark step taken in this regard when the Securities and Exchange Board of India (SEBI) appointed a Committee named the Dr. L.C. Gupta Committee (LCGC

) by its resolution, dated November 18, 1996 in order to develop appropriate regulatory framework for derivatives trading in India. While the Committee's focus was on equity derivatives but it had maintained a broad perspective of derivatives in general.

The Board of SEBI, on May 11, 1998, accepted the recommendations of the Dr. L.C. Gupta Committee and approved introduction of derivatives trading in India in the phased manner. The recommendation sequence is stock index futures, index options and options on stocks. The Board also approved the 'Suggestive Bye-Laws' recommended by the Committee for regulation and control of trading and settlement of derivatives contracts in India. Subsequently, the SEBI appointed J.R. Verma Committee to look into the operational aspects of derivatives markets. To remove the road-block of non-recognition of derivatives as securities under Securities Contract Regulation Act, the Securities Law (Amendment) Bill, 1999 was introduced to bring about the much needed changes. Accordingly, in December, 1999, the new framework has been approved and 'Derivatives' have been accorded the status of 'Securities'. However, due to certain completion of formalities, the launch of the Index Futures was delayed by more than two years. In June, 2000, the National Stock Exchange and the Bombay Stock Exchange started stock index based futures trading in India. Further, the growth of this market did not take off as anticipated. This is mainly attributed to the low awareness about the product and mechanism among the market players and investors. The volumes, however, are gradually picking up due to active interest of the institutional investors.

Major Recommendations of Dr. L.C. Gupta Committee

Before discussing the emerging structure of derivatives markets in India, let us have a brief view of the important recommendations made by the Dr. L.C. Gupta Committee on the introduction of derivatives markets in India. These are as under:

1. The Committee is strongly of the view that there is urgent need of introducing of financial derivatives to facilitate market development and hedging in a most cost-efficient way against market risk by the participants such as mutual funds and other investment institutions.
2. There is need for equity derivatives, interest rate derivatives and currency derivatives.
3. Futures trading through derivatives should be introduced in phased manner starting with stock index futures, which will be followed by options on index and later options on stocks. It will enhance the efficiency and liquidity of cash markets in equities through arbitrage process.

4. There should be two-level regulation (regulatory framework for derivatives trading), i.e., exchange level and SEBI level. Further, there must be considerable emphasis on self regulatory competence of derivative exchanges under the overall supervision and guidance of SEBI.
5. The derivative trading should be initiated on a separate segment of existing stock exchanges having an independent governing council. The number of the trading members will be limited to 40 percent of the total number. The Chairman of the governing council will not be permitted to trade on any of the stock exchanges.
6. The settlement of derivatives will be through an independent clearing Corporation/ Clearing house, which will become counter-party for all trades or alternatively guarantees the settlement of all trades. The clearing corporation will have adequate risk containment measures and will collect margins through EFT.
7. The derivatives exchange will have on-line-trading and adequate surveillance systems. It will disseminate trade and price information on real time basis through two information vending networks. It should inspect 100 percent of members every year.
8. There will be complete segregation of client money at the level of trading/clearing member and even at the level of clearing corporation.
9. The trading and clearing member will have stringent eligibility conditions. At least two persons should have passed the certification programme approved by the SEBI.
10. The clearing members should deposit minimum ₹ 50 lakh with clearing corporation and should have a net worth of ₹ 3 crore.
11. Removal of the regulatory prohibition on the use of derivatives by mutual funds while making the trustees responsible to restrict the use of derivatives by mutual funds only to hedging and portfolio balancing and not for speculation.
12. The operations of the cash market on which the derivatives market will be based, needed improvement in many respects.
13. Creation of a Derivation Cell, a Derivative Advisory Committee, and Economic Research Wing by SEBI.
14. Declaration of derivatives as 'securities' under Section 2 (h) of the SCRA and suitable amendments in the notification issued by the Central Government in June, 1969 under Section 16 of the SCRA.

The SEBI Board approved the suggested Bye-Laws recommended by the L.C. Gupta Committee for regulation and control of trading and settlement of derivatives contracts.

Explanation of Some Important Terms Used in the Committee's Recommendations

Derivatives Concept

A derivative product, or simply 'derivative', is to be sharply distinguished from the underlying cash asset. Cash asset is the asset which is bought or sold in the cash market on normal delivery terms. Thus, the term 'derivative' indicates that it has no independent value. It means that its value is entirely 'derived' from the value of the cash asset. The main point is that derivatives are forward or futures contracts, i.e., contracts for delivery and payment on a specified future date. They are essentially to facilitate hedging of price risk of the cash asset. In the market term, they are called as 'Risk Management Tools'.

Financial Derivatives – Types

Though the Committee was mainly concerned with equity based derivatives but it has tried to examine the need for derivatives in a broad perspective for creating a better understanding and showing inter-relationship.

Broadly, there are three kinds of price risk exposed to a financial transaction, viz.

1. Exchange rate risk, a position arisen in a foreign currency transaction like import, export, foreign loans, foreign investment, rendering foreign services, etc.
2. Interest rate risk, as in the case of fixed-income securities, like treasury bond holdings whose market price could fall heavily if interest rates shot up
3. Equities', 'market risk', also called 'systematic risk'—a risk which cannot be diversified away cause the stock market as a whole may go up or down from time to time

The above said classification indicates towards the emergence of three types of financial derivatives namely currency futures, interest rate futures and equity futures. As both forward contracts and futures contracts can be used for hedging, but the Committee favours the introduction of futures wherever possible.

Forward contracts are presently being used in India to provide forward cover against exchange rate risk. Currency and interest rate futures lie in the sphere of Reserve Bank of India (RBI).

The Dr. L.C. Gupta Committee recognizes that the basic principles underlying the organization, control and regulation of markets of all kinds of financial futures are the more or less same and that the trading infrastructure may be common or separate, partially or

wholly. The Committee is of further opinion that there must be a formal mechanism for coordination between SEBI and RBI in respect of financial derivatives markets so that all kinds of overlapping of jurisdiction in respect of trading mechanism, be removed.

Financial derivatives markets in India have been developed so far in three important instruments like equity, interest and currency. First one is regulated by the SEBI, whereas other two are controlled by the RBI. The markets of these instruments are in their preliminary stage.

Equity Derivatives

Dr. L.C. Gupta Committee considered in its study both types of equity like stock index derivatives and individual stocks derivatives. At the international level, stock index derivative is more popular than the individual stock. The Committee found in its survey that index futures are more preferable than individual stock from the respondents. The order of over-all preference in India as per the survey of the Committee, was as follows: (i) Stock index futures, (ii) Stock index options, (iii) Individual stock options and (iv) Individual stock futures.

Basic Reasons for the Preference of Stock Index Futures

Not only in India, in other countries too, is stock index futures most popular financial derivatives due to the following reasons:

1. Institutional investors and other large equity holders prefer the most this instrument in terms of portfolio hedging purpose.
2. Stock index futures are the most cost-efficient hedging device whereas hedging through individual stock futures is costlier as observed in other countries.
3. Stock index futures cannot be easily manipulated whereas individual stock price can be exploited more easily in India it is rather easier to play this game as witnessed in the past scams.
4. This is in fact that due to a limited supply of an individual stock, supply can easily be cornered even in large companies in India like Reliance Industries, State Bank of India, etc. The Management of these companies has complained many times about their share prices being manipulated by some interested parties. On the other hand, the supply of stock index futures is unlimited, and hence, the possibility of cornering is ruled out. In fact, the manipulation of stock index futures can be possible only of the cash prices of each component securities in the index be influenced, which is rare and not so high.

5. It is observed from the experiences of other countries that stock index futures are more liquid, more popular and favourable than individual stock futures. The same is also witnessed by the L.C. Gupta Committee in its survey from the responses of the respondents.
6. Since, stock index futures consists of many securities, so being an average stock, is much less volatile than individual stock price. Further, it implies much lower capital adequacy and margin requirements in comparison of individual stock futures.
7. In case of stock index futures trading, there is always clearing house guarantee, so the chances of the clearing house going to be bankrupt is very rare, and hence, it is less risky.
8. Another important reason is that in case of individual stocks, the outstanding positions are settled normally against physical delivery of the shares. Hence, it is necessary that futures and cash prices remained firmly tied to each other. However, in case of stock index futures, the physical delivery is almost impractical, and they are settled in cash all over the world on the premise that index value, as independently derived from the cash market, is safely accepted as the settlement price.
9. Lastly, it is also seen that regulatory complexity is much less in the case of stock index futures in comparison to other kinds of equity derivatives.

In brief, it is observed that the stock index futures are more safer, popular and attractive derivative instrument than the individuals stock. Even in the US market, the regulatory framework does not allow use of futures on the individual stocks. Further only very few countries of world, say one or two, have futures trading on individual stock.

Strengthening of Cash Market

The Dr. L.C. Gupta Committee observed that for successful introduction of futures market in any country, there must be a strong cash market because derivatives extract their value from the cash asset. The constant feedback between these two markets through arbitrage will keep these markets in alignment with each other. The Committee noted certain weaknesses of the Indian equities markets which should be taken care for success of the futures trading in India. A few important weaknesses observed are as under:

Mixing of Cash and Forward Transactions

1. There is queer mixture of cash and future transactions in the Indian stock markets. For example, cash transactions (involving delivery), in most active scripts, deliveries

are just around 5 per cent of the trading volume whereas in many others, it is just, 20-30 percent. In fact, the dominant cash transactions are the non-delivery which are the equivalent of futures/forward transactions.

2. It is further noted that the above said mixed system (cash-cum-carry forward) is not very sound for futures trading because (i) no transparency in the carry forward system, (ii) the influence of fundamental factors is not so strong due to dominance of short term speculation and (iii) creating a future market on such basis may have the effect of compounding the existing weaknesses.
3. The Committee is of the view that there must be separation between cash market and futures market. It will promote the markets economic efficiency. This has led to the adoption of the rolling settlement system because in this way, cash market will function as genuine cash markets but no carry forward. Even futures market does not permit carry forward from one settlement to another in the way practiced in India.
4. The trading in Indian stock market was shifted to rolling settlement recently where always empha sized for settlement by delivery. But in India, 'squaring up or closing' business (i.e. offsetting of buying and selling transactions within the settlement) is accounted for in bulk which is not appropriate for futures trading.

Differences in Trading Cycles Among Stock Exchanges

1. Indian stock exchanges, now, most of them, have a weekly trading cycle but the cycles are not uniform. For example, NSE has from Wednesday to Tuesday and BSE has from Monday to Friday. Due to difference in trading cycles, the brokers who have membership in both the exchanges can easily go on circulating their trades from one exchange to the other without ever having to delivery. Such situation is a complete travesty of the cash market and an abuse to the stock market system.
2. It seems that in Indian stock markets, the different trading cycles have been kept with a vested interest in order to deliberately generate arbitrage opportunities, it is seen that due to this, the prices for the same securities on two (NSE and BSE) stock exchanges differ from 0.5 to 1.5 percent even it is larger on expiration days. The Committee feels that the different cycles serving the interest of only speculators and not of genuine investors. Even it is not good for market development and futures trading.
3. It is also noted, that the prices of various securities on both exchanges (NSE and BSE), sometimes are not the same. As a result, the value of the stock indices on both

the exchanges will not be same, if computed separately from the NSE and BSE prices. This will create a problem in valuation of future market stock.

4. The Committee also noted that for a successful future trading, a coordinated but pro-competitive nationwide market system be achieved. So it is suggested that before implementing a uniform trading cycle system among all exchanges, till such time the rolling settlement system can be adopted. This system will provide 'a sound and reliable basis for futures trading in India.

Weakness of Stock Exchange Administrative Machinery

The Dr. L.C. Gupta Committee members were of the strong opinion that for successful derivatives trading on the stock exchanges, there must be stringent monitoring norms and match higher standard of discipline, than in the present, be maintained. Though the SEBI has already made a good efforts but much more still is to be done specifically in the controlling of trading members.

Inadequate Depository System

The Committee is of the view that all such securities which are composing in stock index and used for stock index futures, should necessarily be in depository mode. As observed earlier, settlement problems of the cash market may weaken the arbitrage process by making it risky and costly. Since, index based derivatives trading does not itself involve deliveries, it will increase the arbitrage trading between cash and index derivatives markets. The arbitrage process keeps the two markets in alignment. Thus, due to this reason, it is essential for successful futures trading that all the scripts of the particular stock index futures must be in the depository mode. Hence, depository scripts in India should be enhanced.

The Committee has no doubt that the creation of futures markets by introducing the financial derivatives, including equity futures, currency futures and interest rate futures would be a major step towards the further growth and development of the Indian financial markets provided that the trading must be cost-efficient and risk hedging facilities.

Lesson 5.2 - Benefits of Derivatives in India

Benefits of Derivatives in India

During December, 1995, the NSE applied to the SEBI for permission to undertake trading in stock index futures. Later SEBI appointed the Dr. L.C. Gupta Committee, which conducted a survey amongst market participants and observed an overwhelming interest in stock index futures, followed by other derivatives products. The LCGC recommended derivatives trading in the stock exchanges in a phased manner. It is in this context SEBI permitted both NSE and BSE in the year 2000 to commence trading in stock index futures. The question, therefore, becomes relevant—what are the benefits of trading in Derivatives for the country and in particular for choosing stock index futures as the first preferred product?

Following are some benefits of derivatives

1. India's financial market system will strongly benefit from smoothly functioning index derivatives markets.
2. Internationally, the launch of derivatives has been associated with substantial improvements in market quality on the underlying equity market. Liquidity and market efficiency on India's equity market will improve once the derivatives commence trading.
3. Many risks in the financial markets can be eliminated by diversification. Index derivatives are special in so far as they can be used by the investors to protect themselves from the one risk in the equity market that cannot be diversified away, i.e., a fall in the market index. Once the investors use index derivatives, they will suffer less when fluctuations in the market index take place.
4. Foreign investors coming into India would be more comfortable if the hedging vehicles routinely used by them worldwide are available to them.
5. The launch of derivatives is a logical next step in the development of human capital in India. Skills in the financial sector have grown tremendously in the last few years. Thanks to the structural changes in the market, the economy is now ripe for derivatives as the next area for addition of skills.

Categories of Derivatives Traded in India

1. Commodities futures for coffee, oil seeds, and oil, gold, silver, pepper, cotton, jute and jute goods are traded in the commodities futures. Forward Markets Commission regulates the trading of commodities futures.
2. Index futures based on Sensex and NIFTY index are also traded under the supervision of Securities and Exchange Board of India (SEBI).
3. The RBI has permitted banks, Financial Institutions (F1's) and Primary Dealers (PD's) to enter into forward rate agreement (FRAs)/interest rate swaps in order to facilitate hedging of interest rate risk and ensuring orderly development of the derivatives market.
4. The National Stock Exchange (NSE) became the first exchange to launch trading in options on individual securities. Trading in options on individual securities commenced from July, 2001.
5. Options contracts are American style and cash settled and are available in about 40 securities stipulated by the Securities and Exchange Board of India.
6. The NSE commenced trading in futures on individual securities on November 9, 2001. The futures contracts are available in about 31 securities stipulated by SEBI. The BSE also started trading in stock options and futures (both Index and Stocks) around at the same time as the NSE.
7. The National Stock Exchange commenced trading in interest rate future on June 2003. Interest rate futures contracts are available on 91-day 1-bills, 10-year bonds and 10-year zero coupon bonds as specified by the SEBI.
8. Table Calendar of Introduction of Derivatives Products in Indian Financial Markets

Calendar of Introduction of Derivatives Products in Indian Financial Markets

OTC	Exchange traded
➤ 1980s—Currency forwards	➤ June, 2000—Equity index futures
➤ 1997—Long term foreign currency- rupee swaps	➤ June, 2001—Equity index option
➤ July, 1999—Interest rate swaps and FRAs.	➤ July, 2001—Stock option
➤ July, 2003—FC-rupee options	➤ June, 2003—Interest rate futures

Source: www.derivativesportal.com

Financial Derivatives in India: A Chronology

Date	Progress
14 December, 1995	NSE asked SEBI for permission to trade futures
18 November, 1996	SEBI setup L.C. Gupta Committee to draft a policy framework for index futures
11 May, 1998	L.C. Gupta Committee submitted report
7 July, 1999	RBI gave permission for OTC forward rate agreement (FRAs) and interest rate swaps
24 May, 2000	SIMES chose NIFTY for trading futures and options on an Indian index
25 May, 2000	SEBI gave permission to NSE and BSE to do index futures trading
9 June, 2000	Trading of BSE sensex futures commenced at BSE
12 June, 2000	Trading of NIFTY futures commenced at NSE
31 August, 2000	Trading of futures and options on NIFTY to commence at SIMES
July, 2001	Trading on equity futures commenced at NSE on 31 securities
June, 2003	Trading on interest rate futures commenced at NSE
July, 2003	Trading on FC-rupee options started

Derivatives Trading at NSE/BSE

The most notable of development in the history of secondary segment of the Indian stock market is the commencement of derivatives trading in June, 2000. The SEBI approved derivatives trading based on futures contracts at National Stock Exchange (NSE) and Bombay Stock Exchange (BSE) in accordance with the rules/bye-laws and regulations of the stock exchanges. To begin with, the SEBI permitted equity derivatives named stock index futures. The BSE introduced on 9 June, 2000 stock index futures based on the sensitive Index (also called SENSEX comprising 30 scripts) named BSX, and NSE started on June 12 2000 stock index future based on its index S&P CNX NIFTY (comprised 50 scripts) in the name of N FUTIDX NIFTY. Further details of these are given in Table.

Salient Features of Index Futures Contracts at BSE and NSE

Sl. No	Items	BSE	NSE
1	Date of introduction	June 9, 2000	June 12, 2000
2	Name of security	BSX	N FUTJDX NIFTY S&P
3	Underlying asset	BSE Sensitive Index (SENSEX)	CNX NIFTY

4	Contract size	Sensex value x 50	200 or multiples of 200
5	Tick size/Price step	0.1 point of Sensex (equivalent to ₹ 5)	₹ 0.05
6	Minimum price fluctuations	₹ 5	Not applicable
7	Price bands	NA	NA
8	Expiration months	3-near months	3-near months
9	Trading cycle	A maximum of 3 months; the near month (1), the next month (2) and the a month (3)	As in previous column
10	Last trading/Expiry day	Last Thursday of the month or the preceding day	As in previous column
11	Settlement	In cash on $T+1$ bas	As in previous column
12	Final settlement price	Index closing price on the last trading day (a)	Index closing price on the 1st trading day (s)
13	Daily settlement price	Closing of futures contract (a)(a)	Closing of future contract
14	Trading hours	9.30 am to 3.30 pm	-
15	Margin	Upfront margin on daily basis	As in previous column

- (a) Computed on the basis of the weighted average of last 15 minutes trading.
- (b) Computed on the basis of weighted average of the last 5 minutes, or if the no, of weighted average of last 5 trades.
- (c) Weighted average price for the last half an hour's trade.

In India, stock index futures are available for one-month, two-month and three-month maturities. All the open positions in these contracts are settled daily. Further, the buyers and sellers are required to deposit margin with the respective stock exchanges determined as per the SEBI guidelines. To facilitate the effective risk management in the derivatives segment, all the important measures like minimum net worth requirement for the broker, determination of margin based on value at risk model, position limit for various participants, mechanism for collection and enforcement of margin, etc. have been put in place. Subsequently, the derivative products range had been increased by including options and futures on the indices and on several highly traded stocks. In an estimate, the product wise turnover of derivatives on the Indian stock markets as on July 6, 2002 is stock futures

(50%), index futures (21%), stock options (25%) and index option (4%). It means stock futures are most popular derivative traded at the stock market of India.

During the last decade, to make stock market functioning effective for futures trading, the SEBI has adopted several internationally tested and accepted mechanism for implementation at the Indian stock exchanges. For this, proper surveillance and risk containment like the circuit breaker, price bands, value at risk (VaR) based margin collections, etc. have been introduced.

The SEBI set up a 'Technical Group' headed by Prof. J.R. Verma to prescribe risk containment measures for new derivative products. The group recommended the introduction of exchange traded options on Indices which is also conformity with the sequence of introduction of derivatives products recommended by Dr. L.C. Gupta Committee.

The Technical Group has recommended the risk containment measure for exchange traded options on indices. The following are the important features of the risk containment framework for the trading and settlement of both index futures and index option contracts:

1. European style index options will be permitted initially. These will be settled in cash.
2. Index option contracts will have a minimum contract size of ₹ 2 lakh, at the time of its introduction.
3. The risk containment measures described hereunder are only for premium style European option.
4. Index option contract will have a maximum maturity of 12 months and a minimum of three strikes, i.e., in the money, near the money and out of the money.
5. A portfolio based margining approach, which would take an integrated view of the risk involved in the portfolio of individual client will be adopted. It is for the first time that such an approach is introduced in the Indian stock market. It is inconsistent with the practices followed in the countries. This approach will not only cover the risk but also help in reducing the transaction costs in derivatives.
6. The initial margin requirements will be based on worst case loss of a portfolio of an individual client to cover a 99% value at risk (Va) over a one day horizon. The initial margin requirement will be netted at level of individual client and it will be on gross basis at the level of Trading/Clearing member. Further, the initial margin requirement for the proprietary position of Trading/Clearing member will also be on net basis.

7. The short option minimum margin equal to 30% of the Notional value of all short index option will be charged if sum of the worst scenario loss and the calendar spread margin is lower than the short option minimums margin.
8. Net option value will be calculated on the current market value of the option times the number of options (positive for long options and negative for short options) in the portfolio. The net option value will be added to the Liquid Net Worth of the clearing member.
9. For option positions, the premium will be paid in by the buyer in cash and paid out to the seller in cash on T+ 1 day until the buyer pays in the premium due shall he deducted from the available Liquid Net Worth on a real time basis. In case of index futures contracts, the mark-to-market gains losses for index futures position will continue to be settled.

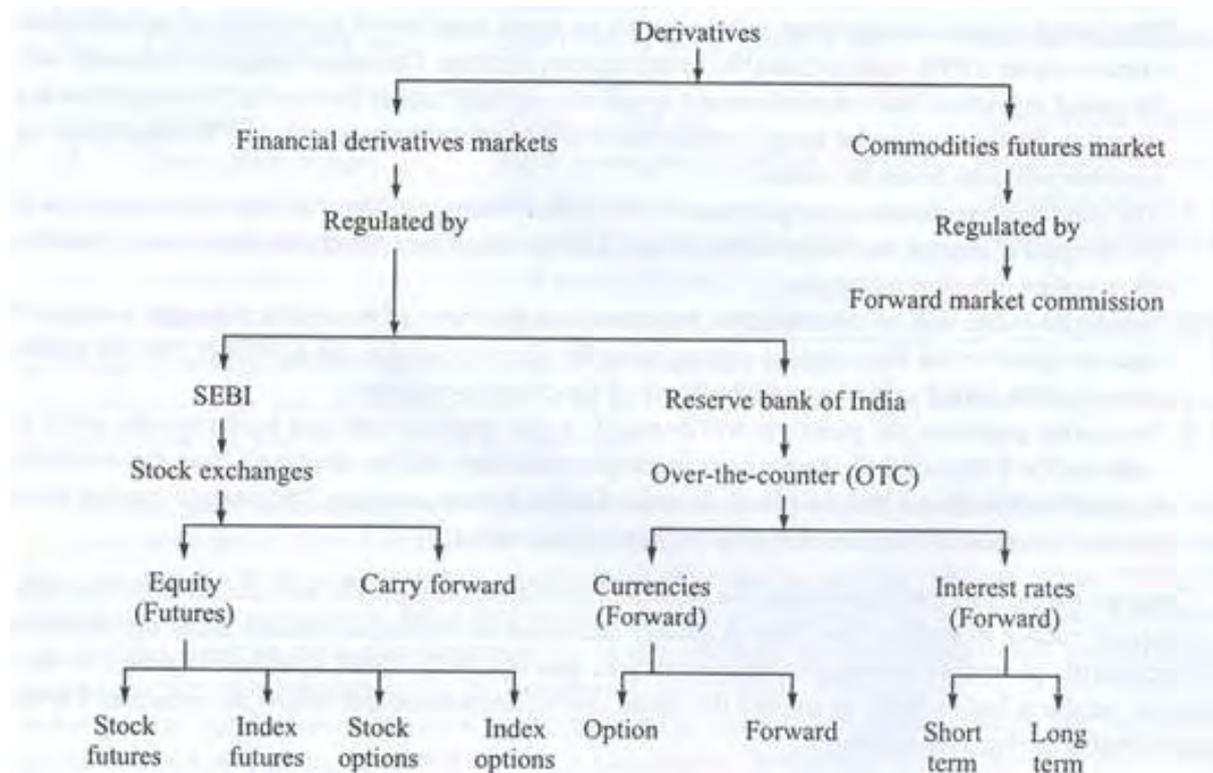
Contrary to international experience, the growth of derivatives market did not take off as anticipated. The value of trading has been low. This is mainly attributed to the low awareness about the products and mechanism of trading among the market players and investors. SEBI's technical group on new derivative products has recently examined this issue and recommended the following measures for the development of derivatives market:

1. The system of sub-brokers be used for increasing the volume of trading in this market.
2. Financial institutions and mutual funds be permitted to sell short in the cash market for facilitating the free arbitrage between cash and derivatives market. However, such short sale may be restricted to the extent of corresponding exposure in the derivative market.
3. Arbitrage between cash and derivatives markets will assist in better price discovery in both the markets.

Countries like USA, UK and Singapore have reaped considerably economic benefit from foreign participation in their futures markets. Foreign participation in futures markets hedge the potential to act as a substantial 'invisible earner' of foreign exchange. Earlier the SEBI and the RBI both were hesitant to allow the foreign institutional investors (FITs) for trading in the futures markets. However, recently the RBI has allowed FITs to trade in derivatives market subject to the condition that the overall open position of the FIT shall not exceed 100 percent of the market value of the concerned FII's total investment. As per the recent notification of the Central Government, SEBI and RBI will jointly examine the issues concerning trading in financial derivatives by FIs and FII (s).

Eligibility of Stocks

The SEBI board has initially approved the introduction of single stock futures contract on 31 stocks on which option contracts have been introduced on BSE and NSE. A list of these has been given in Table. The Advisory Committee on Derivatives of the SEBI shall review the eligibility criteria for introduction of futures and options on any other stock from time to time. A brief structure in general relating to financial derivatives operating in India has been shown in Fig.



Structure of derivatives markets in India.

Emerging Structure of Derivatives Markets in India

Derivatives markets in India can be broadly categorized into two markets namely; financial derivatives markets and commodities futures markets. Financial derivatives markets deal with the financial futures instruments like stock futures, index futures, stock options, index options, interest rate futures, currency forwards and futures, financial swaps, etc. whereas commodity futures markets deal with commodity instruments like agricultural products; food grains, cotton and oil; metals like gold, silver, copper and steel and other assets like live stocks, vegetables and so on.

Products of the National Stock Exchange (NSE)

Products	Index / futures	Index options	Futures on individual securities	Option on individual securities
Underlying instruments	S&P CNX NIFTY	S&P CNX NIFTY	87 Securities stipulated by SEBI	87 securities stipulated by SEBI
Type	-	European style	-	American style
Trading cycle	Maximum of 3-month trading cycle. At any point in time, there will be 3 contract available: 1. Near month 2. Mid month 3. Far month duration	Maximum of 3-month trading cycle. At any point in time, there will be 3 contract available: 1. Near month 2. Mid month 3. Far month duration	Maximum of 3-month trading cycle. At any point in time, there will be 3 contract available: 1. Near month 2. Mid month 3. Far month duration	Maximum of 3-month trading cycle. At any point in time, there will be 3 contract available: 1. Near month 2. Mid month 3. Far month duration
Expiry day	Last Thursday of expiry month			
Contract size	Permitted lot size is 200 and multiple thereof	Permitted lot size is 200 and multiple thereof	As stipulated by NSE (Not less than ₹ 2 lacs)	As stipulated by NSE (Not less than ₹ 2 lacs)
Price steps	₹ 0.05	₹ 0.05	-	-
Basic price first day of trading	Previous day closing NIFTY value	Theoretical value of the option contracts arrived at based on Black scholes model	Previous days closing value of the underlying security	Theoretical value of the option contracts arrived at based on Black scholes model
Base price subsequent	Daily settlement price	Daily close price	Daily settlement	Daily close price
Price bands	Operating ranges are kept at +10%	Operating ranges are kept at 99% of the base price	Operating ranges are kept at +20%	Operating ranges are kept at 99% of the base price

Quantity freeze	20,000 units or greater	20,000 units or greater	Lower of the 1% of the market position limit stipulate for option positions or ₹ 5 crores	Lower of the 1% of the market position limit stipulate for option positions or ₹ 5 crores
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Financial derivatives markets in India are regulated and controlled by the Securities and Exchange Board of India (SEBI). The SEBI is authorized under the SEBI Act to frame rules and regulations for financial futures trading on the stock exchanges with the objective to protect the interest of the investors in the market. Further carry forward trading (Badla trading) is also regulated by the SEBI which is traded on the stock exchanges.

Some of the other financial derivatives like currency options and futures and interest rate futures are controlled by the Reserve Bank of India (RBI). These are dealt on Over-the-Counter (OTC) markets. Financial futures on interest rate include both short-term interest rate and long-term interest rate forwards. Currencies include options and forwards. Since the RBI is the apex body to regulate currencies and interest rates in India, hence, financial derivatives relating to foreign currencies and interest rates are generally come under the RBI regulation.

Major stock exchanges in India, under the regulation of the SEBI, trade in two kinds of futures products, namely equity and carry forwards. Equity futures include stock futures, index futures, stock options and index options. Currently these are traded on National Stock Exchange and Bombay Stock Exchange. Examples of such companies on which options and futures are available, e.g. ACC, SBI, CIPLA, HPCL, TELCO, GRASIM, Dr. Reddy, Lab, HLL, HDFC, Hero Honda, etc.

Commodity futures markets are regulated in India by Forward Market Commission (FMC). The Commission is entrusted with to regulate commodities futures trading in India. Products like hessian, potatoes, pepper, cotton, etc. are traded on Coimbatore Commodity Exchange and Calcutta Commodity Exchange. Recently the Central Government has allowed futures trading on 54 new commodities of different categories to be eligible for trading on exchanges.

The future of derivatives trading in India is bright and growing day by day. More new products and instruments are coming up to be traded on stock and commodity exchanges. Very soon we will have trading on interest rate futures on NSE and BSE. A brief view of this structure has been shown in Fig.

Summary

This chapter has introduced financial derivatives markets in India by briefly describing the need of derivatives markets in India. The need of derivatives in India has arisen due to economic liberalization. Since 1991 individuals and corporates were facing exchange risk, interest rate risk and other risks. The management of these risks is very important in the globalized world, and derivatives play an important role in this respect. This chapter also highlighted the various recommendations of the Dr. L.C. Gupta Committee on financial derivatives in India which emphasises the urgent need of introduction of financial derivatives and which should be in phased manner.

In addition, it has discussed the derivatives trading at NSE/BSE Derivatives trading was started in June, 2001 with the introduction of stock index futures based on Sensex name BSE on BSE and on NSE June 12, 2000 named N FUTIDX NIFTY. In India, Stock index futures are available for one-month, two- month and three-month maturities. Finally the chapter has concluded with defining the structure of derivatives market in India. Indian derivatives market can be divided in two parts: (a) commodities futures markets (b) financial derivative market. Financial derivatives market is regulated by the SEBI and RBI. SEBI regulates equity futures and carry forward through the help of exchanges and RBI regulated currencies and interest rates forward both short-term and long-term mature through OTC. Commodity futures market is regulated by forward market commission (FMC). The chapter ends with a list of showing name of securities using derivatives instruments in India.

Self Assessment Questions

1. Explain the term financial derivative. What are its different types of derivatives as given under SEBI guidelines? Explain them.
2. Clearly bring out the need of derivatives market in India with suitable arguments in favour and disfavour.
3. Discuss the growth of financial derivatives in India, in the light of major recommendations of Dr. L.C. Gupta Committee on derivatives trading.
4. "Derivatives are considered as most important tools used by organization to hedge their risks." Comment on this statement with suggestions.
5. Explain the important recommendations of Dr. L.C. Gupta Committee regarding derivative trading in India with suitable examples.
6. Explain the emerging structure of financial derivatives markets in India with suitable examples.

7. Write a note on evolution of derivative markets in India.
8. Discuss the recent trends of financial derivative in India with special reference to international finance.
9. Explain the risk containment measures for the financial derivatives trading in India.
10. Explain the weakness of the Indian stock market for launching of futures trading. Discuss the measures taken by the SEBI in this regards.
11. Write a detailed note on historical development of Financial derivatives in India.

CASE STUDY

I . Case Study

An insurance Company's losses of a particular type are to be reasonable approximation normally distributed with a mean of \$ 150 million and a standard deviation of \$ 50 million. (Assume no difference between losses in a risk-neutral world and losses in the real world). The 1-year risk-free rate is 5%. Estimate the cost of the following.

- (a) A contract that will pay in 1 year's time 60% of the insurance company's cost on a pro rata basis.
- (b) A contract that pays \$ 100 million in 1 year's time if losses exceed \$ 200 million.

II . Case Study

If more Tax concessions are offered to real investors that share market will move forward Do you agree? Give reasons.

III. Case Study

Do you think that the present method of settlement of share transactions is popular among common man? Give your comments.

IV. Case Study

You are back in Mumbai after a grueling day in New Delhi. You were called by the mandarins in the North Block to explain the mandarins in the North Block to explain the cause of the crash in the price of the stock of your company- a leading Indian Software MNC. The investors were aghast at the stock price crash. The main charge was simple. Your company used futures trading for speculation Instead of normal hedging.

Before you can get out of our Shining Merc (which might get auctioned soon) media-persons are already all over the place thrusting microphones in your face- waiting for a sound bite. You barely mumble 'no comments' to the gathering but promise to get back with detailed description of events, to be transmitted live on the television, in a couple of hours.

As you sit down at your office table, and call for a RT (room-temperature) glass of narial paanee (coconut water)-Since your friends tell that it is god when you have hyper-acidity; you need a strong stomach lining to digest all the vitriol being offered to you.

When you look at the documents spread in front of you, the following details emerge:

- (a) Since the exposure of your company is in USD, you chose to buy 6-month USD futures at a price that was above spot price for a long time, and you sell GBP futures for 9-months since pricing is very attractive, and you are expecting to receive payments for services rendered in about 8-months time.
- (b) As the maturity of USD futures approached, US of A attacked Iraq, leading to a jump in oil prices.
- (c) Sensing trouble you immediately bought 3-months interest rate futures which were trading below spot.
- (d) Within a week of your purchase, markets started stabilizing and returned to normal behaviour.
- (e) But your board was uncomfortable with your position, and margin calls. They ask you to settle your position and face the jury, charging ou for speculation in the markets with company money.

Questions

- (i) What additional information will you need?
- (ii) How will you defend your case ?

V. Case Study

G needs to borrow in the bond market 6 months hence: As he expects the interest rates to rise, he needs hedging. The company has the option on govt bond future.

- (a) Should the company buy a put (or) call option.
- (b) If the present future contracts trades at ₹ 300 and a 6 month put option involves, a cost of ₹ 2 1/2 % based on the strike price, during the six months, interest rates rise and the price govt bond went down to ₹ 95. What is the gain (or) loss on the option per ₹ 1,00,000 contracts.

VI. Case Study

A farmer in Punjab expects to harvest 20000 bushels of wheat in late July. On 10th June, the price of wheat is ₹ 160 per bushel. The farmer is worried as he suspects that price will fall below ₹ 160 before his July delivery date he can hedge his position by selling July wheat futures. The July wheat future price is ₹ 157 per bushel. The farmer sold the July wheat futures. When July end approached, the price had fallen to ₹ 150 per bushel.

Calculate

- (a) What is the gain of the future contract?
- (b) What is the revenue from the sale of wheat?
- (c) What is the cash flow per bushel of wheat?

VII. Case Study

Brain Vandergriff is a portfolio manager for Southside Bank and Trust Company. He currently is considering purchasing shares of Deere (maker of arm equipment) and Zenith (a producer of electronic equipment) common stock for inclusion in several portfolios he manages. As an alternative, he also is considering purchasing Deere and Zenith convertible bonds. The portfolios under consideration are mostly equity portfolios having the objective of aggressive growth. Vandergriff expects Deere to benefit from the recent growth in demand for agricultural equipment abroad. Zenith may be on the comeback trail after its earnings growth faltered in the late 1980s. He also expects interest rates to remain stable during the next year.

Convertible	DEERE	ZENTH
Coupon	5.50%	6.25%
Maturity (Years)	8	18
Rating	A-	CCC
Conversion rate (# shares)	30.53	32
Market price (% part)	222.50	66.25
Investment Value	85.43	64.95
Call price	105	106
Common Stock		
Market price	72.88	6.88
Dividend	2.00	0.00
Beta	1.05	1.45

Question

Analyze these two convertibles. Recommend the convertible debentures that, in your opinion, would be more desirable for purchase by an aggressive, growth-oriented investor. Justify your recommendation.

VIII. Case Study

Maria Gilbert is a principal in the firm of Orion Financial Management. For twenty years she was chief investment officer with Reliance Investments, the pension management arm of the Second National Bank of South Bend, Indiana. She left the bank in May 1995 in an attempt to turn her expertise into greater personal rewards

Two portfolios under management for medium-sized pension funds were on the top of her current agenda. The first portfolio was an index fund representing a cross section of the S & 500 stocks. This portfolio had been established as a core portfolio for the South Bend Firefighters, currently \$10 million. The second portfolio was an actively managed fund for the Ryan Country Public Employees Retirement Fund, which aggregated \$2.75 million.

The firefighters portfolio was put in a cross section of S & P 500 stocks on December 23, 1995, when the S & P 500 Stock Index was at 500. One year later, on December 20, 1996, the S & P 500 Index closed at 595. On the same day the S & P 500 March/1997 futures contract closed at 600. The March/600 call on the S & P 500 Index carried a premium of

18.75 points, and the March/600 put was at 8.50. The Ryan Country fund was allocated as follows: cash equivalents, 9 percent; fixed income securities, 36 percent; equities, 55 percent, Treasury-bond futures were priced at 95.

On December 20, 1996, Maria arrived at the office determined to adjust these two portfolios. However, she had mixed feelings about the stock market. On the one hand, she believed the market might continue its advance from an S & P 500 level of 595 to an index level of 640 during the next three months if corporate profits continued their upward surge. On the other hand, she worried that a downward correction could take the market to 545 if interest rates moved sharply higher as some were predicting. After pondering her options she decided to look more closely at alternative strategies for both funds, ignoring taxes and transaction costs for simplification of her task.

Question

Suppose Gilbert thought the stock market would weaken and she wanted to lighten, but not eliminate, her equity position and increase the fixed income part of the Ryan portfolio. Indicate specific actions she could take in the futures markets to shift the allocation of the Ryan portfolio to Zero cash, \$1.6 million fixed-income, and \$1.15 million equities.

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