

FINANCIAL DERIVATIVES

The objective of this course is to make students efficient in the area of Financial Derivatives, giving them the knowledge of basics in Financial Derivatives, Future Markets, Option Strategies, etc.

*** Standard discounting and statistical tables to be allowed in the examinations.**

1. Introduction to Derivatives: Development and Growth of Derivative Markets, Types of Derivatives, Uses of Derivatives, Financial and Derivative markets - Fundamental linkages between spot & Derivative Markets, The Role of Derivatives Market, Uses & Misuses of derivatives.

2. Future and Forward Market: structure of forward and Future Markets, Mechanics of future markets, Hedging Strategies, Using futures. Determination of Forward and future prices - Interest rate futures, Currency futures and Forwards

3. Options: Distinguish between Options and Futures, Structure of Options Market, Principles of Option Pricing, Option Pricing Models: The Binomial Model, The Black – Scholars Merton Model.

Basic Option Strategies: Advanced Option Strategies, Trading with Options, Hedging with Options, Currency Options.

Swaps: Concept and Nature, Evolution of Swap Market, Features of Swaps, Major Types of Swaps - Interest Rate Swaps, Currency Swaps, Commodity Swaps, Equity Index Swaps, Credit Risk in Swaps, using Swaps to Manage Risk, Pricing and Valuing Swaps.

References:

- Fundamentals of Financial Derivatives, Swain.P.K, HPH
- Financial Derivatives and Risk Management, OP Agarwal, HPH
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MODULE-I

INTRODUCTION TO DERIVATIVE SECURITIES:

Introduction

The objective of an investment decision is to get required rate of return with minimum risk. To achieve this objective, various instruments, practices and strategies have been devised and developed in the recent past. With the opening of boundaries for international trade and business, the world trade gained momentum in the last decade, the world has entered into a new phase of global integration and liberalization. The integration of capital markets world-wide has given rise to increased financial risk with the frequent changes in the interest rates, currency exchange rate and stock prices. To overcome the risk arising out of these fluctuating variables and increased dependence of capital markets of one set of countries to the others, risk management practices have also been reshaped by inventing such instruments as can mitigate the risk element. These new popular instruments are known as financial derivatives which, not only reduce financial risk but also open up new opportunity for high risk takers.

Defining derivatives

Literal meaning of derivative is that something which is derived. Now question arises as to what is derived? From what it is derived? Simple one line answer is that value/price is derived from any underlying asset. 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. The Securities Contracts (Regulation) Act 1956 defines 'derivative' as under: 'Derivative' includes—2Security derived from a debt instrument, share, loan whether secured or unsecured, risk instrument or contract for differences or any other form of security. A contract which derives its value from the prices, or index of prices of underlying securities. There are two types of derivatives. Commodity derivatives and financial derivatives. Firstly derivatives originated as a tool for managing risk in commodities markets. In commodity derivatives, the underlying asset is a commodity. It can be agricultural commodity like wheat, soybeans, rapeseed, cotton etc. or precious metals like gold, silver etc. The term financial derivative denotes a variety of financial instruments including 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 new instruments rather they are merely combinations of older generation derivatives and/or standard cash market instruments.

Evolution of derivatives

It is difficult to trace out 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 futures markets were developed after the development of forward markets. It is believed that the forward trading was in existence during 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 got3 official recognition from the Tokugawa Shogunate. 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 these 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. During 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 commodity 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 4 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 trembled due to unfavorable events before the goods reached to the destination. In such cases, the producers had to sell their goods at 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 predetermined price. Later on these agreements became transferable, and during the American Civil War period, Le., 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 centered 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, but they have become a major force in financial markets 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 or 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 dividend 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 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 for 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.

The Forwards Contracts (Regulation) Act, 1952, regulates the forward/futures contracts in commodities all over India. As per this the Forward Markets Commission (FMC) continues to have jurisdiction over commodity forward/futures contracts. However when derivatives trading in securities was introduced in 2001, the term 'security' in the Securities Contracts (Regulation) Act, 1956 (SCRA), was amended to include derivative contracts in securities. Consequently, regulation

of derivatives came under the preview of Securities Exchange Board of India (SEBI). We thus have separate regulatory authorities for securities and commodity derivative markets.

Features of financial derivatives

It is a contract:

Derivative is defined as 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.⁷

Derives value from underlying asset:

Normally, the derivative instruments have the value which is 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.

Specified obligation:

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.

Direct or exchange traded

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.

Related to notional amount:

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 payoff. 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.⁸

Delivery of underlying asset not involved:

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.

May be used as deferred delivery:

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.

Secondary market instruments:

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.

Exposure to risk:

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.

Off balance sheet item:

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.

Classification of Derivatives

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 derivative, 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 matter. However,

Despite the distinction between these two from structure and functioning point of view, both are almost similar in nature. The most commonly used derivatives contracts are forwards, futures And options.

MODULE-II

Introduction:

Forwards:

A forward contract is a customized contract between two entities, where settlement takes place on a specific date in the future at today's pre-agreed price. For example, an Indian car manufacturer buys auto parts from a Japanese car maker with payment of one million yen due in 60 days. The importer in India is short of yen and supposes present price of yen is Rs. 68. Over the next 60 days, yen may rise to Rs. 70. The importer can hedge this exchange risk by negotiating a 60 days forward contract with a bank at a price of Rs. 70. According to forward contract, in 60 days the bank will give the importer one million yen and importer will give the banks 70 million rupees to bank

Futures:

A futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future at a certain price. Futures contracts are special types of forward contracts in the sense that the former are standardized exchange-traded contracts. A speculator expects an increase in price of gold from current future prices of Rs. 9000 per 10 gm. The market lot is 1 kg and he buys one lot of future gold (9000×100) Rs. 9,00,000. Assuming that there is 10% margin money requirement and 10% increase occur in price of gold. the value of transaction will also increase i.e. Rs. 9900 per 10 gm and total value will be Rs. 9,90,000. In other words, the speculator earns Rs. 90,000.

Options:

Options are of two types— calls and puts. Calls give the buyer the right but not the obligation to buy a given quantity of the underlying asset, at a given price on or before a given future date. Puts give the buyer the right, but not the obligation to sell a given quantity of the underlying asset at a given price on or before a given date.

Warrants:

Options generally have lives of upto one year, the majority of options traded on options exchanges having maximum maturity of nine11 months. Longer-dated options are called warrants and are generally traded over-the-counter.

Leaps:

The acronym LEAPS means long term equity anticipation securities. These are options having a maturity of up to three years.

Baskets:

Basket options are options on portfolios of underlying assets. The index options are a form of basket options.

Swaps:

Swaps are private agreements between two parties to exchange cash flows in the future according to a prearranged formula. They an be regarded as portfolios of forward contracts. The two commonly used

Swaps are:

- Interest rate swaps: These entail swapping only the interest related cash flows between the parties in the same currency
- Currency Swaps: These entail swapping both principal and interest on different currency than those in the opposite direction.

Swaptions

Swaptions are options to buy or sell a swap that will become operative at the expiry of the options. Thus a swaption is an option on a forward swap. Rather than have calls and puts, the swaptions market has receiver swaptions and payer swaptions. A receiver swaption is an option to receive fixed and pay floating. A payer swaption is an option to pay fixed and receive floating.

Uses and functions of derivatives

Generally derivatives are used as risk management tools. Here is the brief description of their uses and functions.

Uses of derivatives

Derivatives are supposed to provide the following services:

Risk aversion tools:

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, arbitrage, 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.

Prediction of future prices:

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.

Enhance liquidity:

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 number of traders, speculators arbitrageurs operate in such markets. So, derivatives trading enhance liquidity and reduce transaction costs in the markets for underlying assets

Assist investors:

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.

Integration of price structure:

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.

Catalyze growth of financial markets:

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.

Brings perfection in market:

Lastly, it is observed that derivatives trading develop the market towards 'complete markets'. Complete market concept refers to that situation where no particular investors can be better off 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.

Functions of derivatives markets

The following functions are performed by derivative markets:

Discovery of price:

Prices in an organized derivatives market reflect the perception of market participants about the future and lead the prices of underlying assets to the perceived future level. The prices of derivatives converge with the prices of the underlying at the expiration of the derivative contract. Thus derivatives help in discovery of future as well as current prices.

Risk transfer:

The derivatives market helps to transfer risks from those who have them but may not like them to those who have an appetite for them.

Linked to cash markets:

Derivatives, due to their inherent nature, are linked to the underlying cash markets. With the introduction of derivatives, the underlying market witnesses higher trading volumes because of participation by more players who would not otherwise participate for lack of an arrangement to transfer risk.

Check on speculation:

Speculation traders shift to a more controlled environment of the derivatives market. In the absence of an organised derivatives market, speculators trade in the underlying cash markets. Managing, monitoring and surveillance of the activities of various participants become extremely difficult in these kinds of mixed markets.

Encourages entrepreneurship:

An important incidental benefit that flows from derivatives trading is that it acts as a catalyst for new entrepreneurial activity. Derivatives have a history of attracting many bright, creative, well-educated people with an entrepreneurial attitude. They often energize others to create new businesses, new products and new employment opportunities, the benefit of which are immense.

Increases savings and investments:

Derivatives markets help increase savings and investment in the long run. The transfer of risk enables market participants to expand their volume of activity.

Futures contracts

Suppose a farmer produces rice and he expects to have an excellent yield on rice; but he is worried about the future price fall of that commodity. How can he protect himself from falling price of rice in future? He may enter into a contract on today with some party who wants to buy rice at a specified future date on a price determined today itself. In the whole process the Farmer will deliver rice to the party and receive the agreed price and the other party will take delivery of rice and pay to the farmer. In this illustration there is no exchange of money and the contract is binding on both the parties.

Hence future contracts are forward contracts traded only on organized exchanges and are in standardized contract-size. The farmer has protected himself against the risk by selling rice futures and this action is called short hedge while on the other hand, the other party also protects against-risk by buying rice futures is called long hedge.

Features of financial futures contract

Financial futures, like commodity futures are contracts to buy or sell financial aspects at a future date at a specified price. The following features are there for future contracts:

- Future contracts are traded on organized future exchanges. These are forward contracts traded on organized futures exchanges
- Future contracts are standardized contracts in terms of quantity, quality and amount
- Margin money is required to be deposited by the buyer or sellers in form of cash or securities. This practice ensures honor of the deal.
- In case of future contracts, there is a dairy of opening and closing of position, known as marked to market. The price differences every day are settled through the exchange clearing house. The clearing house pays to the buyer if the price of a futures contract increases on a particular day and similarly seller pays the money to the clearing house. The reverse may happen in case of decrease in price.

Types of financial future contracts

Financial futures contracts can be categorized into following types:

Interest rate futures:

In this type the futures securities traded are interest bearing instruments like T-bills, bonds, debentures, euro dollar deposits and municipal bonds, notional gilt-contracts, short term deposit futures and Treasury note futures. **Stock index futures:** Here in this type contracts are based on stock market indices. For example in US, Dow Jones Industrial Average, Standard and poor's 500 New York Stock Exchange Index. Other futures of this type include Japanese Nikkei index, TOPIX etc.

Foreign currency futures:

These future contracts trade in foreign currency generating used by exporters, importers, bankers, FIs and large companies.

Bond index futures: These contracts are based on particular bond indices i.e. indices of bond prices. Municipal Bond Index futures based on Municipal Bonds are traded on CBOT (Chicago Board of Trade).

Cost of living index future:

These are based on inflation measured by CPI and WPI etc. These can be used to hedge against unanticipated inflationary pressure.

Forward contract

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 one of its clients. 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 customized to its owner's specifications.

Features of forward contract

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

Bilateral:

Forward contracts are bilateral contracts, and hence, they are exposed to counter-party risk.

More risky than futures:

There is risk of non-performance of obligation by either of the parties, so these are riskier than futures contracts.

Customized contracts:

Each contract is custom designed, and hence, is unique in terms of contract size, expiration date, the asset type, quality, etc.

Long and short positions:

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.

Delivery price:

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.

Synthetic assets:

In the forward contract, derivative assets can often be contracted from the combination of underlying assets, such assets are often known as synthetic assets in the forward market. The forward 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 compulsorily go to the same counter party, which may dominate and command the price it wants as being in a monopoly situation.

Pricing of arbitrage based forward prices:

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.

Popular in forex market:

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.

Different types of forward:

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 specific delivery (NTSD) contracts. Hedge contracts are freely transferable and do not specify, 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.

Distinction between futures and forwards contracts

Forward contracts are often confused with futures contracts. The confusion is primarily because both serve essentially the same economic functions of allocating risk in the presence of future price uncertainty.

However futures are a significant improvement over the forward contracts as they eliminate counterparty risk and offer more liquidity. Table 1.1 lists the distinction between the two.

Futures Forwards

Trade on an organized exchange	OTC in nature	Standardized contract terms	Customized contract terms
hence more liquid	Hence less liquid	Requires margin payments	No margin payment
Follows daily settlement	Settlement happens at end of period		

FUTURES AND FORWARDS: TRADING MECHANISM AND PRICING STRUCTURE:

Introduction

In the previous lesson, you have gained conceptual understanding of derivative securities including futures and forward markets. Here we will discuss the trading mechanism pricing strategies of futures and forwards. To become an efficient investor, one must have the knowledge of functioning and pricing mechanism of the futures market. The future prices are affected by so many factors, which are relevant in pricing of future products. There are various theoretical models to determine the prices of the futures, which are discussed in this lesson.

Futures markets

Futures markets refer to the relationship among participants and mechanism of trading in futures. The futures may be of commodity or any other underlying assets. Futures contracts are standardized contracts, where only price is negotiated, while in forward contracts all elements are negotiated and they are customized contracts. Since futures market have become an important ingredient of economic activity and the prices of future depend upon so many factors, that is why there is a need to understand the mechanism of futures market and the pricing aspects of the same.

Functions of futures markets

Initially futures were devised as instruments to fight against the risk of future price movements and volatility. 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. The important functions of futures market are described as follows:

Hedging function:

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 crop 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 500 tons of cotton in next six months, he could set a price for that quantity (harvest) by selling 5 cotton futures contracts, each being of 100 tons. In this way, by selling these futures contracts, the farmer tends 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 cotton price, which might occur between present and futures period. Here two prices come into picture: future price and spot price. The difference between the two is the profit or loss for the farmer.

Price discovery function:

Another important function of futures market is the price discovery which reveals information about futures cash market prices through the futures market. 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 price discovery function can be explained by an example. Supposing, a copper miner is trying to take a decision whether to reopen a marginally profitable copper mine or not.

Assuming that the copper 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 mining and refining of copper and the price of the copper to be obtained in futures. Hence, the crucial element in this decision is the futures price of copper. The miner can analyze the copper prices quoted in the futures market today for determining the estimate of the futures price of copper at a specified futures period. In this calculation, the miner has used the futures market as a vehicle of price discovery.

Financing function:

Another function of a futures market is to raise finance against the stock of assets or commodities. Since futures contracts are standardized contracts, so, it is easier for the lenders to ensure quantity, quality and liquidity of the underlying asset.

Liquidity function: It is obvious that the main function of the futures market deals with such transactions which are matured on a future date. They are operated on the basis of margins. Under this the buyer and the seller have to deposit only a fraction of the contract value, say 5 percent or percent, known as margins.

This practice ensures honouring of the future deals and hence maintains liquidity. When there is a futures contract between two parties, future exchanges required some money to be deposited by these parties called margins. Each futures exchange is responsible for setting minimum initial margin requirements for all futures contracts. The trader has to deposit and maintain this initial margin into an account as trading Account.

Price stabilization function:

Another 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. There is less default risk in case of future contract because the change in the value of a future contract results in a cash flow every day. The daily change in the value of a futures contract must be exchanged, so that if one party (the losing party) defaults, the maximum loss that will be realized is just one day's change in value. Thuthe incentive for default in futures is greater than in forwards.

Disseminating information:

Aside from the above mentioned 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. Since in futures market, futures traders' positions are marked to market on daily basis, which is known as daily resettlements. It means that every day the trader's account is added to if (profit occurs) and deducted in case the losses occur. All the profits that increase the margin account balance above the initial balance margin can be withdrawn and vice-versa. If the future price falls, trader accounts equity rises and vice-versa. Futures markets disseminate information quickly, effectively and inexpensively, and, as a result, reducing the monopolistic tendency in the market. Thus investors are aware of

Evolution of futures market in India

The sequential and chronological detail of futures market development in India is as follows:

- Organized futures market evolved in India by the setting up of Bombay Cotton Trade Association Ltd in 1875. In 1893, a separate association called "The Bombay Cotton Exchange Ltd." was constituted, following conflicts between mill owners and merchants.
- In 1900, futures trading in oilseeds were started with the setting up of Gujarati Vyapari Mandali. In 1913, a future exchange for wheat was set up in Hapur. A second exchange, the Seeds Traders' Association Ltd., trading oilseeds such as castor and groundnuts, was set up 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 1919, Calcutta Hussein Exchange Ltd., was established for trading in raw jute and jute goods.
- In 1927, East India Jute Association was set up for organized trade in jute. In 1940s, trading in forwards and futures was made difficult through price controls till 1952
- Forward contracts (Regulation) Act was enacted in 1952, while in 1953 Forwards Market Commission (FMC) was established.
- During the 1960s and 70s, the Central Government suspended trading in several commodities like cotton, jute, edible oilseeds, etc. as it was felt that these markets helped increase prices for commodities.
- Two committees that were appointed–Datawala Committee in 1966, and Khusro Committee in 1980 recommended the reintroduction of futures trading in major commodities, but without much result.

Recent development in futures market:

One more committee on Forwards market, the Kabra Committee was appointed in 1993, which recommended futures trading in wide range of commodities and also upgradation of futures market. The Kabra Committee recommended the Following:

- Strengthening of FMC and Forward Contracts (Regulation) Act, 1952
- Networking of future exchange for better and efficient functioning.
- Stringent vigilance and surveying norms.
- FMC to act as watch dog to monitor the activities of commodity exchanges
- Some of commodity exchanges need to be upgraded to international levels.

Participants of futures markets

Usually financial derivatives attract three types of traders which are discussed here as under:

Hedgers:

Generally there is a tendency to transfer the risk from one party to another in investment decisions. Put differently, 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. Hedgers are exposed to risk of a price change. They may be initiating long or short position for a good and would therefore experience losses in case of unfavorable prices.

Suppose an oil company in Britain purchases oil to export to India but during transportation period, oil prices fall thereby creating risk of lower prices. To avoid this loss, this firm can sell oil futures contracts to hedge. If the oil price declines, the trading company will lose money on the inventory of oil (spot position) but will make money in the futures contracts that were sold. This is an example of short hedge. Another company may enter into a contract fearing rise in prices which is known as long hedge. Another example of hedging can be illustrated by taking two parties: one is manufacturer of gold ornaments and the other one is retailer. In this case supposing the manufacturer of ornaments signs a deal in June 2006 agreeing to deliver gold

ornaments in November 2006 at a fixed price. It is interesting to note that the manufacturer does not have enough store or cash to buy gold today and does not wish to buy gold till Sept. 2006. The manufacturer is exposed to risk that the gold prices will rise between June to Sept. Hence to counter this risk, he should hedge by buying gold futures contracts. 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 favorable price movements.

Speculators:

A speculator is a person who is willing to take a risk by taking a futures position with the expectation to earn profits. Speculators aim to profit from price fluctuations. 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 forecasts that the price of silver will be Rs 3000 per 100 grams after one month. If the current silver price is Rs 900 per 100 grams, he can take a long position in silver and expects to make a profit of Rs 2100 per 100 grams.

This expected profit is associated with risk because the silver price after one 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 price movements in the price of an asset, whereas the speculators wish to take position in the market based upon such expected 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 initial cash payment equal to the total value of the asset purchased whereas in forward market, initial cash payment is the margin money, if any, is made to enter into forward market.

Therefore, speculative trading provides 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 are of two types: day traders and position traders. Position speculator uses fundamental analysis of economic conditions of the market and is known as fundamental analyst, whereas the one who predicts 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 overnight. 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. Day traders speculate only about price movements during one trading day.

Arbitrageurs:

Arbitrageurs are other important group participants in futures markets. They take advantage of price differential of two markets. An arbitrageur is a trader who attempts to make profits by locking in a riskless 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 Rs 9200 per 10 grams, but the spot price is Rs 9000 per 10 grams.

In this situation, an arbitrageur could purchase the gold for Rs 9000 and go short a futures contract that expires immediately, and in this way making a profit of Rs 200 per 10 grams by delivering the gold for Rs 9200 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.

Future pricing

There are several theories to explain the relationship between spot and futures prices. Before going through various factors affecting futures prices and spot prices, it is pertinent to note that how futures prices are read from a newspaper. Therefore, let us understand how to read futures prices the following data has been taken from “The Business Standard” dated 20.09.2006 containing future prices of some underlying assets.

Future price and the expected future spot prices:

Future prices keep on changing continuously. Thus future price can be an estimate of the expected future spot price.

Theories of futures pricing

There are several theories which have made efforts to explain the relationship between spot and futures prices. A few important of them are as follows:

The cost-of-carry approach

Some 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 reflect 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. Cost of carry which includes storage cost plus the interest paid to finance the asset less the income earned on assets. For more understanding of the concept, let's take

The expectation approach

The advocates of this approach J.M. Keynes, J.R. Hicks and N. Kalidor argued the futures price as the market expectation of the price at the futures date. Many traders and investors, especially those using futures market to hedge, will be interested 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 Oct 1, 2006 will be Rs. 7000 per 10grams. The futures price today for Jan 1, 2007 must somewhat reflect this expectation. If today's futures price is Rs. 6800 of gold, going long futures will yield an expected profit of Expected futures profit = Expected futures price – Initial futures prices. $200 = \text{Rs. } 7000 - \text{Rs. } 6800$.

Differences of the futures prices from the expected price will be corrected by speculation. Profit seeking speculators will trade as long as the futures price is sufficient far away 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 opportunity. Future prices are influenced by expectations prevailing currently.¹⁷ This is also known as hypothesis of unbiased futures pricing because it advocates that the futures price is an unbiased estimate of the futures spot price, and on an average, the futures price will forecast the futures spot price correctly.

The theory of normal backwardation

In general, backwardation is the market in which the futures price is less than the cash (spot price). In other words, the basis is positive, i.e., difference between cash price and future price is positive. 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. Second way of describing the can tango and backwardation market is that the former (cantango) 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. Futures prices are 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 speculators 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 $F = E - r$ ¹⁸ Where, F is futures price for a futures date,

E is expected price at that date and r is risk premium. The theory of normal backwardation states that futures prices should rise overtime because hedgers tend to be net-short and pay speculators to assume risk by holding long positions. Patterns of futures prices illustrate 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 labeled normal back warding It is to be noted that this line will terminate at the expected futures spot price.

Forward markets and trading mechanism

The growth of futures markets followed the growth of forward market. In early years, there were no so much transporting facilities available, and hence, a lot of time was consumed to reach at their destination. Sometimes, it took so much time that the prices drastically changed, and even the producers of the goods had to sell at loss. Producers, therefore, thought to avoid this price risk and they started selling their goods forward even at the prices lower than their expectations. For example, a farmer could sell the produce forward to another party. And by the time the actual goods reached the market, he could have protected himself against the future unfavorable price movements. This is known as short selling.

On the other hand, the long position holder agrees to buy the grain at a pre-specified price and at a particular date. For this trading, a middleman is needed who knows the expectations of buyers and sellers and he charges a fees for this purpose known as commission.²³ Another important point arises, in above said forward arrangements, who would-be willing to take the other side of the contract. Who would be the purchaser (or long) be? One such possibility is that the speculator or arbitrageur may come forward and take the short position. Second, a miller, for example, might need to purchase grain in six months to fulfill a future commitment of delivering flour at an already agreed upon price. So to protect his profit margin, the miller could purchase grain forward, booking both the fixed price at some price per quintal, as well as a source of supply. In this way, he could achieve by taking the long side of the producer's forward contract.

Forward prices determination

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 illustration to explain the forward contract. As discussed earlier, forward contracts are generally easier to analyze than futures contracts because in forward contracts there are no daily settlement and only a single payment is made at maturity. Both futures prices and forward prices are closely related.

It is important 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 as under:

USE OF FUTURES FOR HEDGING STRUCTURE

Introduction

In the previous lesson you have got an idea to calculate price of future contracts. Now in this lesson there is a detailed discussion on how the futures can be used for hedging, what are the hedging strategies and how to manage hedge position. Business outcomes are surprising and have risk and uncertainty elements. To avoid the risk arising out of price fluctuations in future, various strategies are devised keeping in view the timing and pricing dimensions of the instruments.

Suppose a farmer anticipates fall in prices of his crop three months hence. He will try to cover his future risk by entering into a future contract at a price set on today's date. Similarly suppose textile manufacturer anticipates future losses due to government policy, he will lock his future position by entering into two simultaneous contracts of buying raw material from one country and to export the finished product to another country. These are examples of hedging where an investor in anticipation of some price change (adverse or favorable) enters into a future contract/s and lock in the position. Before going deep into the strategies involving hedging, it is pertinent to know basic features and types of hedging.

Concept and types of hedging

The beauty of derivative market lies in the fact that an investor can protect his risk by entering into a contract. In broader sense, a hedging is an act of protecting one from future losses due to some reason. In a future market, the use of future contracts/instrument in such a way that risk is either avoided or minimized is called hedging. The anticipated future losses may occur due to fluctuations in the price, foreign exchange or interest rate. In case of unfavorable price movement the hedgers enter into future at different time periods. This concept considers that hedging activity is based on price risk. Why investors hedge? According to Hollbrook, hedging has following purposes:

Carrying charge hedging:

In this case, if the spread (Difference between futures and spot price) covers the carry cost too, then stocks should be bought

.Operational hedging:

According to this approach, future markets are supposed to be more liquid and investors (hedger) use futures as a substitute for cash market.

Selection or discretionary hedging:

This hedging is done only on selected occasions or when there may be some adverse price movements in future.

Anticipatory hedging:

This is done in anticipation of buying or selling price of an asset in future. If an investor uses future contract in a fashion that it eliminates the risk completely is known as perfect hedging model. The factors which may affect perfect hedging are:

- Profits are affected by change in commodity, security, interstate or exchange rate.
- Knowledge of the firm giving the impact of these factors on profit.
- Quantity which affects the firm.

Types of hedge:

There are two categories of hedging- short hedge and long hedge.

Short hedge:

Having a short position (selling futures) in futures is known as a short hedge. It happens when an investor plans to buy or produce cash commodity sells futures to hedge the cash position. It is appropriate when hedger owns an asset and expects to sell in future on a particular date. Thus selling some asset without having the same is known as short-selling. For example suppose a US exporter expects to receive Euros in three months. He will gain if the euro increases in value relative to the US dollar and will sustain loss if the euro decreases in value relative to US dollar. Another illustration can be understood with the help of the following example: 4

Supposing an oil producer made a contract on 10 Oct, 2006 to sell 1 million barrel crude oil on a market price as on 10 Jan 2007. The oil producer supposing that spot price on 10 Oct, 2006 is \$ 50 per barrel and Jan crude future price on NYMEX is \$ 48.50 per barrel. Each future contract on NYMEX is for delivery of 1,000 barrels. The company can hedge its position by short selling October futures. If the oil borrower closed his position on 10Jan 2007 the effect of the strategy should be to lock in a price close to \$ 48.50per barrel. Suppose the spot price on 10 Jan 2007 be \$ 47.50 per barrel. The company realizes the gain:\$ 48.50 – \$ 47.50 = \$ 1.00or \$ 1 million in total from the short future position. Suppose the oil prices go up by \$ 50.50 per barrel. The company realized \$ 0.50 per barrel.i.e. \$ 50.50 – \$ 50.0 = \$ 0.50

Long hedge:

A long hedge is taking long position in futures contract. A long hedge is done in anticipation of future price increases and when the company knows that it will have to buy ascertain asset in the future at anticipated higher price and wants to lock in a price now. The objective of along hedge is to protect the company against a price increase in the underlying asset prior to buy the same either in spot or future market. A net bought position is actually holding an asset which is known as inventory hedge. Suppose an investment banker anticipates receiving Rs. 1 million on June 20 and intends to buy a portfolio of Indian equities. Assuming that he has a risk factor of increase in the sensex before money is received. He can go in futures and buy today futures contract at 11000 (today's sensex 11000). He can close his position by selling 10 August stock futures.

Cross hedging:

A cross hedge is a hedge where characteristics of futures and spot prices do not match perfectly which is known as mismatch, may occur due to following reasons:

- The quantity to be hedged may not be equal to the quantity of futures contract.
- Features of assets to be hedged are different from the future contract asset.
- Same futures period (maturity) on a particular asset is not available.

Suppose a wire manufacturer requires copper in the month of June but in exchange the copper futures trade in long delivery in Jan, March, July, Sept. in this case hedging horizon does not match with the futures delivery date. Suppose that the copper required by the manufacturer is substandard quality but the available trading is of pure 100% copper and in quantity aspect too, copper may be traded in different multiples than required actually. These are examples of cross hedging.

Basis and price risk

The difference between the spot price and future price is known as basis. Basis is said to be positive if the spot price is higher than the future price and negative in case of reverse. $\text{Basis} = \text{Cash (spot price)} - \text{Future price}$ In case of difference in future price and spot price, basis risk is bound to occur. Strengthening of the basis occurs when change in the spot price is more than the change in the future price. If the change in spot price is less than the change in futures price, the basis is known as weakening of basis. The following Table 3.1 gives the clear picture of the price changes.

Consider that a hedger takes a short futures position at time t_1 and knows that the asset will be sold at time t_2 . The price for the asset will be $F_1 - F_2$. The effective price will be: $S_2 + (F_1 - F_2) = F_2 + b_1$. Basic risk = Spot price of asset to be hedged – Futures price of contract used. To illustrate the concept further suppose that a hedge is put in place at time t_1 and closed out at time t_2 . Let's assume that the spot price is Rs. 3.50 and future price is Rs. 3.20 at the initiation of the contract and at the time the hedge is close out these are Rs. 3.00 and Rs. 2.90 respectively. Hence in this case

$$S_1 = 3.00, F_1 = 3.20, S_2 = 3.00, F_2 = 2.90.$$

The basis will be

$$b_1 = S_1 - F_1 \quad b_1 = 0.30$$

$$b_2 = S_2 - F_2 \quad b_2 = 0.10$$

Supposing that a hedger who knows that the asset will be sold at time t_2 and takes a short position at time t_1 . The price realized for the asset is S_2 and the profit on the futures position is $F_2 - F_1$. The effective price for the asset with hedging will be:

$$S_2 + F_2 - F_1 = F_1 + b_2$$

Consider another case in which a company knows it will buy the asset at time t_2 and initiates a long hedge at time t_1 . The price paid for the asset is S_2 and the loss on the hedge is $F_1 - F_2$. The effective price is paid with hedging will be:

$$S_2 + F_1 - F_2 = F_1 + b_2$$

In both the cases, the value is same.

Choice of asset underlying the futures contract and the choice of the delivery month affect the basis risk. It is necessary to analyze that which of the available futures contracts has future price that are mostly correlated with the price of the asset being hedged. Further, basis risk increases as

the time difference between the hedge expiration and the delivery month increases. For example, if the delivery months are March, June, September and December for a particular contract. For hedge expirations in December, January and February, the March contract will be chosen. This practice is adopted in order to meet the hedger's liquidity requirements. Therefore, in practice, short maturity futures contracts have more liquidity.

Illustration

Suppose today is 1 March. An American company anticipates to receive 50 million Yens at the end of July, Yens futures contract have delivery months of March, June, September and December. One contract is for the delivery of 12.5 million Yens. The company, therefore, shorts four September dollar futures contracts on March 1. When the Yens are received at the end of July, the Company closed out position. Let us assume that futures price on March 1 in cents per Yens is 0.80 and that the spot and futures price when the contract is closed out are 0.7500 and 0.7550 respectively. The gain on the futures contract is $0.8000 - 0.7550 = -0.0450$ cents per yen. The basis is $0.7500 - 0.7550 = -0.005$ cents per yen when the contract is closed out.⁹

The effective price obtained in cents per yen is the final spot price plus the gain on the futures. $0.7500 + 0.005 = 0.7550$. This can also be written as the initial futures price plus the final basis $0.8000 - 0.0050 = 0.7950$

The total amount received by the company for the 50 million yens is 50×0.00795 million dollars or \$ 397500.

Illustration

Today is June 10. Suppose a company needs 10,000kg of soya bean in the month of either October or November. The soya future contracts are currently traded for delivery every month on NCDEX and the contract size is 100 kg. The company decides to use the December contract for hedging and takes a long position in 20 December contracts. The futures price on June 10 is Rs. 50 per kg. The company is ready to purchase soya on November 20. It, therefore, closes out its future contract on that date. Suppose the spot price and futures price on November 20 are Rs. 55 per kg and Rs. 53.50 per kg.

Solution:

The gain on the future contract is $53.50 - 50.00 = \text{Rs. } 3.50$ per kg. The basis at the closing out of the contract is $55 - 53.50 = \text{Rs. } 2.50$ per kg. The effective price paid (in Rs. per kg) is the final spot price less the gain on the futures, or $55 - 3.50 = \text{Rs. } 52.50$ per kg. If we take the difference between the initial future price plus the final basis, this effective price can also be calculated $50 + 2.50 = \text{Rs. } 52.50$. Therefore, total price received = $52.50 \times 10000 = \text{Rs. } 5,25,000.10$

Hedging strategies using futures

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 for reducing risk? At this stage, we restrict our attention to what might be termed hedge-and-forget strategies. The objective is usually to take a position that neutralizes the risk as far as possible.

Consider a company that knows it will gain \$ 10,000 for each 1 cent increase in the price of a commodity over the next three months and lose \$10,000 for each 1 cent decrease in the price

during the same period. To hedge, the company's treasurer should take a short futures position that is designed to offset this risk. The futures position should lead to a loss of \$ 10,000 for Each 1 cent increase in the price of the commodity over the three months and a gain of \$ 10,000 for each 1 cent decrease in the price during this period. If the price of the commodity goes down, the gain on the futures position offsets the loss on the rest of the company's business. If the price of the commodity goes up, the loss on the futures position is offset by the gain on the rest of the company's business.

Illustration

Suppose an oil importer knows in advance on July 10, that it will need to buy 30,000 barrels of crude oil at some time in October or November and the contract size is 1000 barrel. The company therefore decides to use December futures contract for hedging and takes a long position in 15 December contracts. The future price on July 10 is \$ 50 per barrel. The company finds itself in a position to purchase crude oil on November 12 closes its futures position on that date. The spot price on November 12 is \$ 52 per barrel and \$ 51.20 per barrel. The gain on the future contract is $51.20 - 50 = \$ 1.20$ per barrel. The basis on the date when the contract is closed is $52.00 - 51.20 = \$ 0.80$ per barrel. The effective price is the final spot price less the gain on the futures or $52.00 - 1.20 = 50.80$. This can also be calculated as the initial futures price plus the final basis. $50.00 + 0.80 = 50.80$. The total price received is $50.80 \times 30000 = \$ 1,52,4000$. Optimal number of contracts

INTEREST RATE FUTURES STRUCTURE:

Introduction

In financial markets, various parties, instruments and methods are applied by investors and general public. When global financial markets have become integrated, there is a need to understand the complication involved in financial transactions of various instruments among different participants. For borrowers and lenders of finance, interest rates play important role. While low interest rate is favored by borrowers of money, enhanced rates of interest on the other hand are cause of concern for them and the vice-versa in the case with lenders. Interest rate fluctuation causes interest rate risk and default risk.

Naturally both parties want to avoid this interest rate risk. Interest rate futures are financial derivatives which reduce the interest risk. There are two types of interest rate risks: short and long-term. In this lesson an attempt has been made to let the learners acquainted with the functioning of interest rate futures market and how these can be used as instruments of hedging. On these interest rate futures, a fixed return (in terms of interest) is paid after some interval (principal) or between regular intervals (interest payments). Interest rate futures contracts are complicated in the sense that they are dependent on level of interest rates and the period of maturity of the Same.

Types of interest rates

There are two types of interest rates: short-term and long-term. In financial markets, short term interest rate futures contracts, are future contracts which have a maturity of one year or less and long term interest Rate futures are futures having obligation more than one year or more.

Short term interest rate

US Treasury Bills are examples of money market instruments which are meant for one year. The other quoted interest rate futures are: deposit rates, borrowing rates and mortgage rates

Treasury rates

Treasury rate is the rate of interest at which the government of any country borrows e.g. US treasury rate is the rate at which US government can borrow in US dollars. The risk-free nature of this interest rate is due to the little chance of default by the governments.

Repo rate

This is also known as “Repurchase Agreement”, which is a contract where the owner of the funds (securities) agrees to sell them to counterparties and buy them back at later stage on a higher interest rate. The difference between the selling price and repurchase price of the security is called interest earned by the counter party and is referred to as ‘Repo Rate’. This rate is slightly higher than the treasury rate. It has very little credit risk. In overnight repo, the agreement is renegotiated.

Zero rates

An n -year zero interest rate is the interest rate on an investment which starts on today's date and last for n -years. In this time period no intermediate payment is made. All the interest and principal payment is realized at the end of n -years. Suppose a five-year treasury zero rates with continuous compounding is quoted as 5% p.a. It means that Rs. 100 invested today will grow to $100 \times e^{0.05 \times 5} = \text{Rs. } 128.40$. If the compounding is annual then the Rs. 100 amount will become $100 \times (1 + 0.05)^5 = \text{Rs. } 127.63$ after 5-years. Now, the question arises that how the pricing of bonds is done? The price of the bond can be calculated as the present value of all the cash flows that will be received by the owner of the bond using appropriate zero rates as Discount rates.

Libor rate

LIBOR (London Interbank Offer Rate) rate is also short term interest rate at which large international banks are willing to lend money to large another international banks. There is an element of risk in LIBOR, because it is influenced by changing economic conditions, financial flows of funds etc.

Forward rates

These are the rates of interest implied by current zero rates for periods of time in the future. Suppose Table 4.2 shows zero rates which are continuously compounded. Further suppose that borrower borrows Rs. 100 at 10% for one year and then invests money at 10.5% for two years, the resultant cash flow of $100e^{0.10} = \text{Rs. } 110.52$ at the end of year 1 and an inflow of $100e^{0.105 \times 2} = \text{Rs. } 123.37$ at the end of year 2. Because $123.37 = 110.52e^{0.11}$, a return equal to the forward rate (11% Financial Management) is earned on Rs. 110.52 during the second year.

Supposing that an investor borrows Rs. 100 for four year at 11% and invests it for three years at 10.8%. The resultant cash flow of $100e^{0.108 \times 3} = \text{Rs. } 138.26$ at the end of third year and a cash outflow of $100e^{0.11 \times 4} = \text{Rs. } 155.27$ at the end of the fourth year. Where R is the zero rate for a

maturity of T. This value of forward rate is applicable to very short future time period which begins at time T.

Forward rate agreement:

FRA also called future rate agreements which refer to techniques for locking in future short-term interest rates. It is just like an over-the-counter agreement that a certain interest rate will apply to a certain principal during a specified future time period, FRA serves as an effective risk management tool by entering into a bid-offer spreads which is published in newspapers showing rates of interest for future time periods. If there is any fluctuation (deviation) of interest rates, the customer and the bank may agree to pass compensation between them.

Suppose an FRA in which a financial institution agrees to earn an interest rate of R_k for the period of time between T_1 and T_2 on a principal amount of L . Let R_F is the forward LIBOR interest rate for the period between T_1 and T_2 . R is the actual LIBOR interest rate observed at time T_1 for a maturity T_2 .

When FRA is firstly initiated, R_k is set equal to R_F . In other words, the financial institution earns the forward rate for the time period between years 2 and 3 by borrowing a certain amount of money for two year and investing it for three years. To further illustrate the concept, let's consider the illustration

Illustration

Suppose a 3-months LIBOR is 5% and the six-months LIBOR is 5.5% with continuous compounding. Consider an FRA where a financial institution will receive 7% measured with quarterly compounding on a principal of Rs. 1 million between the end of month 3 and end of month 6. In this case, the forward rate is 6% with continuous compounding or 6.0452% with quarterly compounding.

Hence, applying the formula:

$$V = L (R_k - R_F) (T_2 - T_1) e^{-R_F T_2}$$

$$V = 1,00,000 (0.07 - 0.060452) \times 0.25 \times e^{-0.055 \times 0.5} = \text{Rs. } 2,322.8$$

MODULE-III

OPTION MARKETS STRUCTURE

Introduction

The options are important financial derivatives where the instruments have additional features of exercising an option which is a right and not the obligation. Hence, options provide better scope for risk coverage and making profit at any time within the expiration date. The price of the underlying is derived from the underlying asset. Options are of different types. Some are related to stock index, some with currency and interest rates. During the last three decades the option trading gained momentum though the first option in commodity was launched in 1860 in USA. Based on the sale and purchase there are two types of options: put and call. The exercise-time of adoption makes it in American or European. The other category of option includes- over the counter (OTC) or exchange traded. Options can be valued either with the help of intrinsic value or with time value. There are two positions in option trading- long and short position.

Option may be defined as a contract between two parties where one gives the other the right (not the obligation) to buy or sell an underlying asset at a specified price within or on a specific time. The underlying may be commodity, index, currency or any other asset. As an example, party has 1000 shares of Satyam Computer whose current price is Rs. 4000 per share and other party agrees to buy these 1000 shares on or before a fixed date (i.e. suppose after 4 months) at a particular price say it is become Rs. 4100 per share. In future within that specific time period he will definitely purchase the shares because by exercising the option, he gets Rs. 100 profit from purchase of a single share.

In the reverse case suppose that the price goes below Rs. 4000 and declines to Rs. 3900 per share, he will not exercise at all the option to purchase a share already available at a lower rate. Thus option gives the holder the right to exercise or not to exercise a particular deal. In present time options are of different varieties like- foreign exchange, bank term deposits, treasury securities, stock indices, commodity, metal etc. Similarly the example can be explained in case of selling right of an underlying asset.

Features of options

The following features are common in all types of options.

- **Contract:**

Option is an agreement to buy or sell an asset obligatory on the parties.

- **Premium:**

In case of option a premium in cash is to be paid by one party (buyer) to the other party (seller).

- **Pay off:**

From an option in case of buyer is the loss in option price and the maximum profit a seller can have in the options price.

- **Holder and writer**

Holder of an option is the buyer while the writer is known as seller of the option. The writer grants the holder a right to buy or sell a particular underlying asset in exchange for a certain money for the obligation taken by him in the option contract.

- **Exercise price**

There is call strike price or exercise price at which the option holder buys (call) or sells (put) an underlying asset.

- **Variety of underlying asset**

The underlying asset traded as option may be variety of instruments such as commodities, metals, stocks, stock indices, currencies etc.

- **Tool for risk management**

Options are a versatile and flexible risk management tools which can mitigate the risk arising from interest rate, hedging of commodity price risk. Hence options provide custom-tailored strategies to fight against risks.

Types of options

There are various types of options depending upon the time, nature and exchange of trading. The following is a brief description of different types of options:

- Put and call option
- American and European option
- Exchange traded and OTC options.

Put option

It is an option which confers the buyer the right to sell an underlying asset against another underlying at a specified time on or before predetermined date. The writer of a put must take delivery if this option is exercised. In other words put is an option contract where the buyer has the right to sell the underlying to the writer of the option at a specified time on or before the option's maturity date.

Call option

It is an option which grants the buyer (holder) the right to buy an underlying asset at a specific date from the writer (seller) a particular quantity of underlying asset on a specified price within a specified expiration/maturity date. The call option holder pays premium to the writer for the right taken in the option.

American option provides the holder or writer to buy or sell an expiry of the option. On the other hand a **European option** can be exercised only on the date of expiry or maturity. It is clear that American options are more popular because there is timing flexibility to exercise the same. But in India, European options are prevalent and permitted.

Exchange traded options can be traded on recognized exchanges like the futures contracts. Over the counter options are custom tailored agreement traded directly by the dealer without the

involvement of any organized exchange. Generally large commercial bankers and investment banks trade in OTC options. Exchange traded options have specific expiration date, quantity of underlying asset but in OTC traded option trading there is no such parties. Hence OTC traded options are not bound by strict expiration date, specific limited strike price and uniform underlying asset. Since exchange traded options are guaranteed by the exchanges, hence they have less risk of default because the deals are cleared by clearing houses.

On the other side **OTC options** have higher risk element of default due to non-involvement of any third party like clearing houses. Offsetting the position by buyer or seller in exchange traded option is quite possible because the buyer sells or the seller buys another option with identical terms and conditions., the rights are transferred to another option holder. But due to unstandardized money is required by the writer of option but there are no such requirement formargin funds in OTC optioning. In exchange traded option contracts, there is low cost of transactions because the creditworthiness of the buyer of options is influencing factor in OTC-traded options.

Distinction between futures and options

Though both futures and options are contracts or agreements between two parties, yet the relies some point of difference between the two. Futures contracts are obligatory in nature where both parties have to oblige the performance of the contracts, but in options, the parties have the right and not the obligation to perform the contract. In option one party has to pay a cash premium (option price) to the other party (seller) and this amount is not returned to the buyer whether no insists for actual performance of the contract or not.

In future contract no such cash premium is transferred by either of the two parties. In futures contract the buyer of contract realizes the gains/profit if price increases and incurs losses if the price falls and the opposite in case of vice-versa. But the risk/rewards relationship in options is different. Option price (premium) is the maximum price that seller of adoption realizes. There is a process of closing out a position causing causation of contracts but the option contract maybe any number in existence.

Valuing an option

The value of option can be determined by taking the difference between two or if it is not exercised then the value is zero. The valuation of option contract has two components: intrinsic value and time value of options.

Intrinsic value of option

Let's understand the cases when to exercise an option and when not exercise it. In case of a call option the buyer of call will exercise the option if the strike/exercise price (x) is less than the current market (spot price) while do differently. Similar case is with writer of an option. The seller writer) will exercise the option if the strike price (X) is higher than the current (spot) price.

Suppose X is exercise price and S is spot current market price.6.1, the option holder will exercise the option if the exercise price is less than the current market price i.e. if $S > X$ or $X < S$. The difference between S and X will be positive and this is known a positive intrinsic value and in case if $s = X$ then the intrinsic value is zero. In any case it cannot be negative because then the

holder will not exercise the option. Similarly the intrinsic value of a put option is the difference as shown: $\max[(X-S), 0]$. If $X > S$ or $S > X$ then the writer will exercise the option. In case of equal values of X and S the intrinsic value will be zero. There is no negative value of a put because the writer will not exercise his right to sell an underlying if the exercise price is less than the market price. Further an option is said to be in-the-money if the holder (writer) gets the profit if the option is immediately exercised. The option is said to be out of the money if it gives loss when exercised immediately. If the current/spot is equal to the strike price the option becomes at-the-money.

Time value of an option

As you know that an American option can be exercised any time before the expiration date, there lies a probability that the stock price will fluctuate during this period. It is the time at which the option holder should exercise the option. Suppose an option holder wants to exercise his option right at a particular time t , because at that time he thinks that it is profitable to exercise the option.

Hence, the difference between the value of option at time suppose ' t ' and the intrinsic value of the option is known as time value of the option. Now there are various factors which affect the time value as follows:

- Stock price volatility
- The time remaining to the expiration date
- The degree to which the option is in-the-money or out of the money.

In other words, the time value of an option is the difference between its premium and its intrinsic value. The maximum time value exists when the is At the Money (ATM). The longer the time to expiry, the greater is adoption's time value. At expiration date of an option, it has no (zero) time value.

For better understanding let's assume that X is the exercise price and S is the stock current price. Suppose this is a case of a call, where the holder Time value of a call = $C_t - \{\max[0, S-X]\}$. C_t is the premium of a call. Similarly, for a put the time value will be Time value of put = $P_t - \{\max[0, X-S]\}$ is the premium of a put option.

Pay-off for options

The optionality characteristic of options results in a non-linear payoff for options. In simple words, it means that the losses for the buyer of an option are limited; however the profits are potentially unlimited. The write-off an option gets paid the premium. The payoff from the option writer is exactly opposite to that of the option buyer. His profits are limited to the option premium; however his losses are potentially unlimited. These nonlinear payoffs are fascinating as they lend themselves to be used for generating various complex payoffs using combinations of options and the underlying asset. We look here at the four basic payoffs.

Payoff for buyer of call options: Long call

A call option gives the buyer the right to buy the underlying asset at the strike price specified in the option. The profit/loss that the buyer makes on the option depends on the spot price of the underlying. If upon expiration, the spot price exceeds the strike price, he makes a profit. Higher

the spot price more is the profit he makes. If the spot price of the underlying is less than the strike price, he lets his option expire un-exercised. His loss in this case is the premium he paid for buying the option. Figure 6.1 gives the payoff for the buyer of a three month call option on gold (often referred to as long call) with a strike of Rs. 7000 per 10 gms, bought at a premium of Rs. 500.

Payoff for buyer of call option on gold

the profits/losses for the buyer of a three-month call option on gold at a strike of Rs. 7000 per 10 gms. As can be seen, as the prices gold rise in the spot market, the call option becomes in-the-money. If upon expiration, gold trades above the strike of Rs. 7000, the buyer would exercise his option and profit to the extent of the difference between the spot gold close and the strike price. The profits possible on this option are potentially. However if the price of gold falls the strike of Rs. 7000, he lets the option expire. His losses are limited to the extent of the premium he paid for buying the option.

Payoff for writer or call options: short call

A call option gives the buyer the right to buy the underlying asset at the strike price specified in the option. For selling the option, the writer of the option charges a premium. The profit/loss the buyer makes on the option depends on the spot price of the underlying. Whatever is the buyer's profit is the seller's loss. If upon expiration, the spot price exceeds the strike price, the buyer will exercise the option on the writer. Hence as the spot price increases writer of the option starts making losses. Higher the spot price, more is the loss he makes. If upon expiration the spot price of the underlying is less than the strike price, the buyer lets his option expire un-exercised and the writer gets to keep the premium. Figure 6.2 gives the payoff for the writer of a three month call option on gold (often referred to as short call) with a strike of Rs. 7000 per 10 gms, sold at a premium of Rs. 500.

Payoff for buyer of put options: Long put

A put option gives the buyer the right to sell the underlying asset at the strike price specified in the option. The profit/loss that the buyer makes on the option depends on the spot price of the underlying. If upon expiration, the spot price is below the strike price, he makes a profit. Lower the spot price more is the profit he makes. If the spot price of the underlying is higher than the strike price, he lets his option expire un-exercised. His loss in this case is the premium he paid for buying the option. it gives the payoff¹¹for the buyer of a three month put option (often referred to as long put) with a strike of 2250 bought at a premium of 61.70.

Payoff profile for writer of put options: Short put

A put option gives the buyer the right to sell the underlying asset at the strike price specified in the option. For selling the option, the writer of the option charges a premium. The profit/loss that the buyer makes on the option¹²depends on the spot price of the underlying. Whatever is the buyer's profit is the seller's loss. If upon expiration, the spot price happens to be below the strike price, the buyer will exercise the option on the writer. If upon expiration the spot price of the underlying is more than the strike price, the buyer lets his option expire un-exercised and the writer gets to keep the premium. It gives the payoff for the writer of a three month put option (often referred to as short put) with a strike of 2250 sold at a premium of 61.70.

Currency options

With the opening and integration of capital markets world-wide, the free flow of foreign currency from one country to another has increased at a faster pace. Foreign currency options are used by different market participants e.g. exporters, importers, speculators, arbitrageurs, bankers traders and financial institutions. Currency options are devised to protect the investors against unfavorable movements/fluctuations in foreign exchange rates. Like other option instruments, currency options are also financial instruments which give the option holder the right not the obligation to buy or sell a particular currency at a specific exchange rate (price) on or before an expiration date. Here the underlying asset is the foreign currency.

Features of currency options

- **Right not the obligation:** The currency options give the holder to buy or sell a currency right (not obligation at a fixed price(exchange rate) for a specified time period. A call currency option gives the holder to buy a currency at a fixed rate (price at a specified time and a put currency option gives the owner the right to sell a currency at a fixed price (exchange rate) at a specified time. the buyer is known as holder and seller is called writer of currency option. The writer gets the premium from the holder for obligation undertaken in the contract.
- **Two parties:** There are two parties in the contract. The buyer(holder) and the seller (writer). In other words, a yen call option gives the holder the right to buy yen against rupee, is also a rupee put option.
- **The exercise/strike** price is the rate at which the currency is exchanged for another.
- **The premium** is the cost or price or value of the option itself.
- **Spot exchange** rate is the current rate of exchange.
- **Option premium** is paid in advance by the buyer to the seller which lapses irrespective of whether the option is exercised or not. In OTC market the premium is quoted as percentage of the transaction amount, whereas in domestic currency amount per unit of foreign currency in the exchange traded options.
- **The currency options** can be in the money (ITM), out of the money (OTM) or at the money (ATM) as explained in the earlier lessons.
- **Currency options** can be traded on over the counter (OTC) market as well as exchange traded. OTC currency options are customer tailored and have two categories: retailer and wholesale markets. The retail segment of currency option markets are influenced by participants such as-traders, financial institutions and portfolio managers who trade (purchases) from banks. The wholesale currency options market is participated by big commercial banks, financial institutions and investment banking firms for speculation or arbitrage purposes. This market has so many limitations like- relatively lower liquidity due to customer tailored nature; non standardized ,risk of non-performance by the writer (counterparty risk); mispricing due to non-competitiveness; differing exercise prices, expiration date, amount and premium. On the other hand, the currency option can also be traded through recognized exchanges worldwide. The first such exchange to

introduce currency options trading is Philadelphia Stock Exchange (PHLX) in 1982. Since then a lot of exchanges have been involved in currency option trading. The exchange traded options are cleared through clearing house, which is the counterparty to every option contract and guarantees the fulfillment of the contracts.

Types of currency options

Likewise other forms of options, currency options have also two types of pricing/values. The price/value of a currency option is the premium (amount) which is paid by the holder (buyer) of currency option to writer (seller) of currency option. There are two types of currency option prices; intrinsic value and time value of currency option. The option holder will exercise the right if he finds movement of exchange rate in favorable direction i.e. in case of higher exchange rate than the current rate of exchange, he will exercise the call. Hence intrinsic value of the currency option is the financial gain on in-the-money option.

In case of out-of-the-money, the option holder will not exercise the current option and the intrinsic value is zero. For example in at he gain will be \$ 0.04 per Franc. There lie enormous possibilities of price movement between the current date and the expiration date, hence giving option holders the profits/gains. The time value of a life of the option. As the option approaches to its expiration, the time value will tend to zero. Consider an example that the value of a call option on French Franc with a strike price of \$ 1.5/Franc. The intrinsic value will be zero at the spot exchange rate of \$ 1.50/FF but as the spot rate moves, the time value will be positive. Near expiry the time value will be zero. The total value will be equal to time value plus the intrinsic value.

Factors affecting pricing of a currency option

There are so many determinants of the valuation of a currency call option. These are discussed below:

- Fluctuations in exchange forward rate
- Fluctuations in spot exchange rate
- Time to expiration
- Interest rate changes
- Changing volatility
- Alternative option exercise prices

Fluctuations in forward exchange rate:

Change in the spot exchange rate has direct impact on the time value of currency option. Past and expected change in the spot exchange rates should be taken care of by the traders of currency options. This sensitivity is known as Delta (Δ) the value of which is given by's (Δ) = Change in stock exchange rate / Change in premium / Spot exchange rate Premium = $\Delta \Delta$

Time to expiration:

Longer the time to maturity, the higher will be the value of the currency option. This sensitivity is known as theta and is measured by ratio of relative change in premium w.r.t. timeline. $\Theta = \frac{\text{Time Premium } \Delta \Delta}{\Delta \Delta}$. The longer maturity currency options have better value, because with the time period expiring to maturity the time value of currency option deteriorates.

Interest rate changes:

The differential in the interest rates have also on valuation of currency option. The change may in the interest rate of domestic currency or in the foreign currency. There are two measures to quantify this sensitivity i.e. Rho and Phi. Rho is the ratio of change in premium paid in foreign currency option w.r.t. change in the interest rate in domestic currency. $\text{Rho } (\rho) = \frac{\Delta \text{Premium}}{\Delta \text{Interest rate}}$ On the other hand ϕ (Phi) is the ratio of changes in premium in domestic currency w.r.t. change in the interest rates. $\phi (\text{Phi}) = \frac{\Delta \text{Premium}}{\Delta \text{Interest rate}}$ When interest rates on foreign currency are higher than the interest rate on domestic currency, the foreign currency sells forward at a discount and vice-versa. When the domestic interest rate rises, the trader should buy a call option on foreign currency option to avoid loss due to increase in the value of the option.

Illustration

Assume that call currency option enable to buy of dollar for Rs. 50.00 while it is quoted at Rs. 50.70 in the spot market, and premium paid for call currency option is Rs. 1.00. Calculate the intrinsic value of the call?

Sol: Spot rate (Rs./\$) = 50.70

Strike rate (Rs/\$) = 50.00

Intrinsic value = $50.70 - 50.00 = \text{Rs. } 0.70$.

Time value of the currency call = $1.00 - 0.70 = \text{Rs. } 0.30$.

Strategies in currency option:

The strategies for the options trading have been discussed in lesson 8. To give a small view of the strategies in a currency options, the following strategies can be used: The currency option trader definitely looks for the maximum trade off (pay off) from exercising the option. If an investor buys a call, then he will buy in anticipation of rise in exchange rate of that currency in future. Suppose an Indian foreign exchange dealer anticipates rise in the exchange rate from Rs. 52/\$ then he will get a profit

Buyer of a put option:

In a currency put option the investor will exercise the option if the current spot rate is lower than the strike price. The profit in this case will be Profit = Strike price – (Spot rate + premium). Buyer of the currency put option has enormous potential to earn and the loss is limited to the amount of premium paid to the writer.

Spread strategies:

In these strategies both call or puts are purchased or sold simultaneously. There may be bull spread, bear spread, butterfly spreads, calendar spread and diagonal spreads etc.

Straddle strategies

A straddle of currency options is created by

Buying or selling a call and put with similar strike rate and expiration date.

Strangle strategies:

Like in straddle, strangle has the same strategy but for the difference in strike prices of call and the put.

Futures and options trading system

The futures and options trading system of NSE, called NEAT-F & Trading system, provides a fully automated screen-based trading for Nifty futures and options and stock futures and options on a nationwide basis as well as an online monitoring and surveillance mechanism. It supports an order driven market and provides complete transparency of trading operations. It is similar to that of trading of equities in the cash market segment. The software for the F & O market has been developed to facilitate efficient and transparent trading in futures and options instruments. Keeping in view the familiarity of trading members with the current capital market trading system, modifications have been performed in the existing capital market trading system so as to make it suitable for trading futures and options.

Participants in the trading system

These are four entities in the trading system. Trading members, clearing members, professional clearing members and participants.

- **Trading members:** Trading members are members of NSE. They can trade either on their own account or on behalf of their clients including participants. The exchange assigns a trading member ID to each trading member. Each trading member can have more than one user. The number of users allowed for each trading member is notified by the exchange from time to time each user of a trading member must be registered with the exchange and is assigned an unique user ID. The unique trading member ID functions as a reference for all orders/trades of different users. This ID is common for all users of a particular trading member. It is the responsibility of the trading member to maintain adequate control over persons having access to the firm's user IDs.
- **Clearing members:** Clearing members are members of NSCCL. They carry out risk management activities and confirmation/inquiry of trades through the trading system.
- **Professional clearing members:** A professional clearing member is a clearing member who is not a trading member. Typically, banks and custodians become professional clearing members and clear and settle for their trading members.
- **Participants:** A participant is a client of trading members like financial institutions. These clients may trade through multiple trading members but settle through a single clearing member.

Basis of trading

The NEAT F & O system supports an order driven market, where in orders match automatically. Order matching is essential on the basis of security, its price, time and quantity. All quantity fields are in units and price in rupees. The lot size on the futures market is for 100 Nifty. The exchange notifies the regular lot size and tick size for each of the contracts traded on this segment from time to time. When any order enters the trading system, it is an active order. It tries to find a match on the other side of the book. If it finds a match, a trade is generated. If it

does not find a match, the order becomes passive and goes and sits in the respective outstanding order book in the system.

OPTION PRICING STRUCTURE

Introduction

In the previous lesson you have got an idea of the options markets and its mechanisms. The present lesson is devoted to options pricing. Any option holder takes decision on the basis of price of the option. If he finds price favorable, then he can hedge, arbitrage or spillage. Pricing of an option involves complex mathematical calculations and treatment. In case of put and call the pricing is decided based on some factors like exercise price, time to exercise the option, hedge ratio, nature and expectations of the investors, current market price of option, variance on return on stock (σ^2), risk free rate of return etc. Two models are there to determine price of an option-

- (a) Binomial option pricing model and
- (b) Black-Scholes option pricing model.

In binomial model, it is considered that underlying stock follows binomial return generating process (i.e. the stock's value is bound to changeably one or two constant values either upside or downside within any period during life of the option. On the other hand, the Black-Scholes option pricing model is based on some assumptions that there exists no taxes, no restriction on short selling or writing of calls, constant risk-free rate of borrowing and lending, etc.

Pricing an Option

For recapitulation, you already know that an option is a legal contract, which grants its owner the right (not the obligation) to either buy or sell given stock. A call grants its owner the right to purchase stock (called underlying shares) for a specified exercise price (also known as astride price or exercise price) on or before the expiration date of the contract. Suppose, for example, that a call option with an exercise price of Rs.100 currently exists on one share of stock. The option expires in one year.

This share of stock is expected to be worth either Rs. 90 or Rs. 120 in one year, but we do not know which at the present time. If the stock were to be Worth Rs. 90 when the call expires, its owner should decline to exercise the call. It would simply not be practical to use the call to purchase stock for Rs.100 (the exercise price) when it can be purchased in the market for Rs. 90. The call would expire worthless in this case. If, instead, the stock were to be worth Rs. 120 when the call expires, its owner should exercise the call. Its owner would then be able to pay Rs. 100 for a share which has a market value of Rs. 120, representing Rs. 20 profit.

In this case, the call would be worth Rs.20 when it expires. Let T designate the options term to expiry, let ST be the stock value at option expiry, and let cT be the value of the call option at expiry. The value of this call at expiry is determined as follows:

$$cT = \text{MAX} [0, ST - X]; \text{when } ST = 90,$$

$$cT = \text{MAX} [0, 90-100] = 0. \text{When } ST = 120,$$

$$cT = \text{MAX} [0, 120-100] = 20. \dots (7.1)$$

A put grants its owner the right to sell the underlying stock at specified exercise price on or before its expiration date. A put contract is similar to an insurance contract. For example, an owner of stock may purchase a put contract ensuring that he can sell his stock for the exercise price given by the put contract. The value of the put when exercised is equal to the amount by which the put exercise price exceeds the underlying stock price (or zero if the put is never exercised). Further suppose that a put with an exercise price of Rs. 100 expires in one year. The stock is expected to be worth either Rs. 90 or Rs. 120. The value of the put will be calculated as follows:

$$PT = \text{MAX} [0, X - ST]:$$

When $ST = 90$,

$$pT = \text{MAX} [0, 100-90] = 10.$$

$$\text{When } ST = 120, pt = \text{MAX} [0, 100 - 120] = 0 \dots (7.2)$$

The owner of the option contract may exercise his right to buy or sell; however, he is not obligated to do so. Stock options are simply the contracts between two investors issued with the aid of a clearing corporation, exchange, and broker which ensures that investors should honor their obligations. For each owner of an option contract, there is a seller or 'writer' of the option who creates the contract, sells it to a buyer, and must satisfy an obligation to the owner of the option contract. The option writer sells (in the case of a call exercise) or buys (in the case of a put exercise) the stock when the option owner exercises.

The owner of a call is likely to profit if the stock underlying the option increases in value over the exercise price of the option (he can buy the stock for less than its market value); the owner of a put is likely to profit if the underlying stock declines in value below the exercise price (he can sell Stock for more than its market value). Since the option owner's right to exercise represents an obligation to the option writer, must be purchased from the option writer; the option writer receives a 'premium' from the option purchaser for assuming the risk of loss associated with enabling the option owner to exercise.

Binomial Option Pricing: Multiple Time Periods

In multi-period setting, how the price of the option is calculated? Let's discuss this in detail. Equation (7.7) is quite appropriate for evaluating a European call in a one-time-period framework. That is, in the model presented thus far, share prices can either increase or decrease once by a pre-specified percentage. Thus, there are only two potential prices that the stock can assume at the expiry of the stock. Thus, there are only two potential prices that the stock can assume at the expiration of the stock.

The binomial option pricing model can be further extended to cover as many potential outcomes and time periods as necessary for a particular situation. The next step in the development of amore realistic model is extension of the framework to two time periods. One complication is that the hedge ratio only holds for the beginning of the first time period. After this period, the hedge ratio must be adjusted to reflect price changes and movement through time. Thus, the next step in extending the model to two time periods is to substitute for the hedge ratio based one equation (7.4)

SWAP MARKETS STRUCTURE

Introduction

In the recent past, there has been integration of financial markets world-wide which have led to the emergence of some innovative financial instruments. In a complex world of variety of financial transactions being taken place every now and then, there arises a need to understand the risk factors and the mechanism to avoid the risks involved in these financial transactions. The recent trends in financial markets show increased volume and size of swaps markets.

Financial swaps are an asset liability management technique which permits a borrower to access one market and then exchange the liability for another type of liability. Thus, investors can exchange one asset to another with some return and risk features in a swap market. In this lesson an attempt has been made to get the students acquainted with the mechanism of swaps markets and the valuation of the swap instruments.

Meaning of swaps

The dictionary meaning of 'swap' is to exchange something for another. Like other financial derivatives, swap is also agreement between two parties to exchange cash flows. The cash flows may arise due to change in interest Rate or currency or equity etc. In other words, swap denotes an agreement to exchange payments of two different kinds in the future. The parties that agree to exchange cash flows are called 'counter parties'.

In case of interest rate swap, the exchange may be of cash flows arising from fixed or floating interest rates, equity swaps involve the exchange of cash flows from returns of stocks index portfolio. Currency swaps have basis cash flow exchange of foreign currencies and their fluctuating prices, because of varying rates of interest, pricing of currencies and stock return among different markets of the world.

Features of swaps

The following are features of financial swaps:

Counter parties: Financial swaps involve the agreement between two or more parties to exchange cash flows or the parties interested in exchanging the liabilities.

Facilitators: The amount of cash flow exchange between parties is huge and also the process is complex. Therefore, to facilitate the transaction, an intermediary comes into picture which brings different parties together for big deal. These may be brokers whose objective is to initiate the counterparties to finalize the swap deal. While swap dealers are themselves counter parties who bear risk and provide portfolio management service.

Cash flows: The present values of future cash flows are estimated by the counterparties before entering into a contract. Both the parties want to get assurance of exchanging same financial liabilities before the swap deal.

Less documentation: is required in case of swap deals because the deals are based on the needs of parties, therefore, fewer complexes and less risk consuming.

Transaction costs: Generating very less percentage is involved in swap agreement.

Benefit to both parties: The swap agreement will be attractive only when parties get benefits of these agreements.

Default-risk: is higher in swaps than the option and futures because the parties may default the payment.

Types of financial swaps

The swaps agreement provide a mechanism to hedge the risk of the counter parties. The risk can be- interest rate, currency or equity etc.

Interest rate swaps

It is a financial agreement to exchange interest payments or receipts for a predetermined period of time traded in the OTC market. The swap may be on the basis of fixed interest rate for floating interest rate. This is the most common swap also called 'plain vanilla coupon swap' which is simply in agreement between two parties in which one party payments agrees to the other on a particular date a fixed amount of money in the future till a specified termination date. This is a standard fixed-to-floating interest rate swap in which the party (fixed interest payer) makes fixed payments and the other (floating rate payer) will make payments which depend on the future evolution of a specified interest rate index.

The fixed payments are expressed as percentage of the notional principal according to which fixed or floating rates are calculated supposing the interest payments on a specified amount borrowed or lent. The principal is notional because the parties do not exchange this amount at any time but is used for computing the sequence of periodic payments. The rate used for computing the size of the fixed payment, which the financial institution or bank are willing to pay if they are fixed ratepayers (bid) and interested to receive if they are floating rate payers in a swap (ask) is called fixed rate.

A US dollar floating to fixed 9-year swap rate will be quoted as: 8 years Treasury (5.95%) + 55/68. It means that the dealer is willing to make fixed payments at a rate equal to the current yield on 8-years T-note plus 55 basis points (0.55%) above the current yield on T-note (i.e. $5.95 + 0.45 = 6.40\%$) and willing to receive fixed rate at 68 basis points above (i.e. $5.95 + 0.68 = 6.63\%$) the Treasury yield.

Another example to understand the concept: Suppose a bank quotes a US dollar floating to a fixed 6-years swap rate as: Treasury + 30 BP/Treasury + 60 BP vs. six months LIBOR. Here this quote indicates that the bank is willing to pay fixed amount at a rate equal to the current yield on 6-years T-note plus 30 basis point (0.30%) in return for receiving floating payments say at 9 six months LIBOR.

The bank has offered to accept at a rate equal to 6-year T-note plus 60 BP (0.60%) in return for payment of six-month LIBOR. Similarly floating rate is one of the market indices such as LIBOR, MIBOR, prime rate, T-bill rate etc. and the maturity of the underlying index equal the

time period/interval between payment dates. The fixed rate payments are normally paid semi-annually or annually

E.g. example March 1 and Sept. 1. On trade date the swap deal is concluded and the date from which the first fixed and floating payments start accruing is known as Effective Date. For example, a 5-year swap is traded on Aug 30, 2006, the effective date may be Sept 1, 2006 and ten payments dated from 2007 to Sept 1, 2011. Floating rate payments in a standard swap are October in advance paid in arrears, i.e. the floating rate applicable to any period is fixed at the start of the period but the payments occur at the end of the period.

There are three dates relevant to the swap floating payments' (s) in the setting date at which the floating rate applicable for the next payment is set. D (1) is the date from which the next floating payment starts to accrue and D (2) is the date on which payment is due. Fixed and floating rate payments are calculated as: Fixed payment = $P \times R_{fx} \times F_{fx}$ = $P \times R_{fl} \times F_{fl}$ Where P = Notional principal, R_{fx} is the fixed rate R_{fl} is the float in rate set on reset date. F_{fx} is fixed rate day count fraction" and F_{fl} is "floating day count fraction". No calculate interest, the last two time periods are. For floating payments in is $(D_2 - D_1)/360$. Hence in a swap only are exchanged and not the notional principal.

Illustration:

Suppose a financial institution gives 50 BP higher on floating interest rate (LIBOR) on its deposits and pays floating interest rate to housing society at a fixed rate of 14%. To hedge against the risk involved due to non-payment of interest to the depositor, it enters in to a swap agreement with a dealer and makes that it will receive from the dealer Floating rate (LIBOR) + 100 BP and will pay 14% fixed interest on the same notional amount. In this process the financial institution gets a profits of (0.5%) on notional amount. The dealer enters into another swap contract with a bank with whom it agrees to pay a (LIBOR + 125 BP) and receives 14% interest on notional principal. In this way, every participant gets profit due to this swap transaction which can be shown by the following diagram:

Currency swaps

In these types of swaps, currencies are exchanged at specific exchange rates and at specified intervals. The two payments streams being exchange are dominated in two different currencies. There is an exchange of principal amount at the beginning and a re-exchange at termination in a currency swap. Basic purpose of currency swaps is to lock in the rates (exchange rates). As intermediaries large banks agree to take position in currency currency suppose 'pounds' and the other party raises the funds at fixed rate in currency suppose US dollars.

The principal amount is equivalent at the spot market exchange rate. In the beginning of the swap contract, the principal amount is exchanged with the first party handing over British Pound to the second, and subsequently receives US dollars as return. The first party pays periodic dollar payment to the second and the interest is calculated on the dollar principal while it receives from the second party payment in pound again computed as interest on the pound principal. At maturity the British pound and dollar principals are re-exchanged on a fixed-to-floating currency swaps or cross-currency-coupon swaps, the following possibilities may occur:

- (a) One payment is calculated at a fixed interest rate while the other in floating rate.
- (b) Both payments on floating rates but in different currencies.
- (c) There may be contracts without and with exchange and exchange of principals.

The deals of currency swaps are structured by a bank which also routes the payments from one party to another. Currency swaps involve exchange of assets and liabilities. The structure of a currency swap agreement can be understood with the help of the following illustration. Suppose a company 'A' operating in US dollar wants to invest in EUR and the company 'B' operating in EUR wants to invest in US dollars. Since company 'A' having revenue in EUR and both have opposite investment plans. To achieve this objective, both the companies can enter into a currency swap agreement. The following structure describes the investment plans of the company A and B Operations

Fixed to fixed currency swaps:

In this swap agreement the currencies are exchanged at a fixed rate. A fixed to floating currency swap involves the combinations of a fixed-to-fixed currency swap and floating swap. One party pays to the another at a fixed rate in currency say 'A' and the other party makes the payment at a floating rate in currency say 'B'. In a floating to-floating swap the counter parties will have payment at floating rate indifferent currencies.

Valuation of swaps

The value of a swap depends upon so many factors such as the nature of swap, interest rate risks, expiry time, value at expiration, fixed and floating rates of interest, the principal amount and many more. Let's discuss the valuation aspect of an interest rate swap.

Valuation of interest rate swap

At the initiation stage the worth of an interest swap is zero or nearly zero. With the passage of time, this value may be positive or negative. The fixed rate interest swap is valued by treating the fixed rate payments as cash flows on a traditional bond and the floating rate swap value is quite equivalent to a floating rate note (FRN). If there is no default risk, the value of an interest swap can be computed either as a long position in one bond combined with a short position in another bond or as a portfolio of forward contracts.

Since in a swap agreement the principal is not exchanged. Some financial intermediaries act as market makers and they are ready to quote a bid and an offer for the fixed rate which they will exchange for floating. The is the fixed rate in a contract where the market maker will pay fixed and receive floating while the offer rate in a swap the market maker will receive fixed and pay floating. These rates are quoted for the number of maturities and number of different currencies

Valuation of a currency swap

The currency swaps can be valued as the difference between the present values of the conventional bonds. The computation of a currency swap is just equivalent to the valuation of interest rate swaps. Suppose that there is no default risk and S^* is the spot exchange rate (expressed as the number of units of domestic currency per unit of a foreign currency), the value of the currency swap will be given by: $V_{cusw} = S^*BB_f - B_d \dots (5.2)$ Where V_{cusw} is the

value of currency swap, B_f is the value of foreign currency bond (foreign currency) and B_d is the value of domestic currency bond underlying the swap. In this case the valuation of currency swap can be done based on interest rates in domestic currency, term structure of interest in foreign currency and the spot exchange rate. The value of bond equivalent to the foreign currency interest flows has the value as:
$$\Sigma = -\sum_{t=1}^n \frac{I_t}{(1+r_f)^t} + \frac{P}{(1+r_f)^n} \quad (5.3)$$
 Where I_t is the foreign currency interest flows, r_f is the foreign currency discount rate, t is the corresponding time periods to the interest payments and P is the principal sum in foreign currency. Similarly, the bond equivalent to the domestic currency cash flow be determined as follows:
$$\Sigma = -\sum_{t=1}^n \frac{I_t}{(1+r_d)^t} + \frac{P'}{(1+r_d)^n}$$
 where I_t is the fixed foreign currency interest payments, r_d is the discount rate for various periods to cash flow, t is the length of those time periods to cash flows, P' is the exchange P is the principal expressed in foreign currency converted into equivalent domestic currency principal.

Rationale behind swapping

To avoid risk of fluctuation in forex, interest rates, stock indices investors attitude etc. the swap market has merged now to explain that why firms and people want to enter into swap agreement. The rationale can be explained by the following points:

- Market in perfection and inefficiency
- Different risk preferences
- Government regulation
- Funding at low cost
- Demand supply imbalance
- To improve financial records

Imperfect market:

As you know that the swap agreements are meant for transforming financial claims to reduce risk. Since there lie different reasons for the growth in swap market and the most important to the imperfection and inefficiency in the markets. The swap agreements are required in order to investigate market imperfections, difference of attitude of investors, information asymmetry, tax and regulatory structure by the government, various kinds of financial norms and regulations etc. Had there been a uniformity of standards and norms and perfect market conditions, swaps could not have generated much enthusiasm. Hence due to imperfect capital market conditions, swaps give opportunity to the investors for hedging the risk.

Differing risk profiles:

The basis of credit rating of bonds by financial institutions, banks and individual investor is quite different. In other words, the computation of risks are different from point of view of individual, institutional and other types of investor, thereby changing the risk profile. Based on this, the investor has to take decision to hedge, speculate or arbitrage opportunity. In some markets, the company can raise funds at lower cost and can swap for a particular market. A low credit rated firm can raise funds from floating rate credit market and enjoy comparative advantage over highly rated company because it pay a smaller risk premium. The differing interest rates in different markets can be arbitrated and disbursed between the counter parties.

Regulation by govt:

The regulatory practices of government of different nations can make attractive or unattractive the swap markets. Sometimes the government restricts the funding by foreign companies to protect the interest of the domestic investors. It may also happen that to attract foreign companies the government opens the domestic markets. This phenomenon of the government rule and regulations influence the growth of swap agreements.

Funding at low cost:

In some businesses suppose export financing, there exists subsidized funding and currency swap agreements can take advantage of this situation. The company can swap the exchange risk by entering into a favorable currency swap.

Demand and supply forces:

Depending on the needs of the country and its development plans, the central bank squeezes the reserve requirements there by increasing the supply of the funds because of resultant lowering of interest rates. Definitely the borrowers will be interested in those markets where there is a sufficient supply of funds. Thus the borrowers can take arbitrage opportunity in his favor due to different economic conditions

Matches Asset-Liability: The counter parties involved in swap some times desire to make the match between asset and liability. For this purpose they take the help of swap and funds can be tapped as per the requirements of the companies. Therefore, differing rates of interests in different markets and over time changes in the same provide arbitrage opportunities which can be tapped by currency swap agreements.