[Academic Script]

[Derivatives (Part - 1)]

Subject:	Business Economics
Course:	B. A. (Hons.), 5th Semester, Undergraduate
Paper No. & Title:	Paper – 511 Macroeconomics - II
Unit No. & Title:	Unit – 5 Derivatives
Lecture No. & Title:	Lecture – 1 Derivatives (Part - 1)

DERIVATIVES (Part - I)

INTRODUCTION

Derivatives are extremely important in finance. Futures and options are actively traded on many exchanges throughout the world. Many different types of forward contracts, swaps, options and other derivatives are entered into by financial institutions, fund managers and corporate treasurers in the over counter market. A derivative can be defined as a financial instrument whose value depends on (or derives from) the values of other, more basic, underlying variables. The below discussed topics give an overview of the forward, futures and options and swaps.

FUTURES AND FORWARD CONTRACTS

FORWARD CONTRACT

A relatively simple derivative is a ***forward contract*.** It is an agreement to buy or sell an asset at a certain future time for a certain price. It can be contrasted with a spot contract, which is an agreement to buy or sell an asset today. A forward contract is traded in the over-the-counter market—usually between two financial institutions or between a financial institution and one of its clients.

One of the parties to a forward contract assumes a ***long position*** and agrees to buy the underlying asset on a certain specified future date for a certain specified price. The other party assumes a ***short position*** and agrees to sell the asset on the same date for the same price.

FUTURE CONTRACT

Like a forward contract, a futures contract is an agreement between two parties to buy or sell an asset at a certain time in the future for a certain price. Unlike forward contracts, futures contracts are normally traded on an exchange. To make trading possible, the exchange specifies certain standardized features of the contract. As the two parties to the contract do not necessarily know each other, the exchange also provides a mechanism that gives the two parties a guarantee that the contract will be honored. Most future positions are not held to take delivery of the underlying good. Instead, they are closed out or reversed prior to the settlement date.

The purchaser of a futures contract is said to have gone long or taken a **long position**, while the seller of a futures contract is said to have gone short or taken a **short position.** For each contract traded there is a buyer and a seller. The long has contracted to buy the underlying asset at the contract price at contract expiration, and the short has an obligation to sell at that price.

Example: *A farmer who sells wheat futures to reduce the uncertainty about the price of wheat at harvest time.*

CHARACTERISTICS IN A FUTURES CONTRACT

Future contract characteristics specified by the exchange include the following:

1. **Quality of the underlying asset:** When the underlying asset is a financial asset, the definition of the asset is straightforward. However, when the same is a commodity, the exchange stipulates the quality of the good that will be acceptable for settling the contract.
2. **Contract size:** It specifies the quantity of the asset that must be delivered to settle the contract to settle the futures contract.
3. **Delivery location:** Specifies the place where the delivery will take place.
4. **Delivery time:** Future contracts are referred to by the month in which the delivery takes place. Some contracts are not settled by delivery but by payment in cash, based on the difference between the future price and the market price at settlement.
5. **Price quotations and tick size:** The exchange determines how the price of the contract will be quoted as well as the minimum price fluctuation for the contract which is referred to as the tick size.
6. **Daily price limits:** The exchange sets the maximum price movement for a contract during a day.
7. **Position Limits:** The exchange sets a maximum number of cotnracts that a speculator may hold in order to prevent speculators from having an undue influence on the market.

TYPES OF FUTURE CONTRACTS

1. COMMODITY FUTURES

Commodities have characteristics such as lease rates, storage costs, and or convenience yield. Commodity and financial future contracts are similar in some regards. For example the prices of both are dependent on expected future spot price minus dividends received during the holding period. The price of the commodity is also based on their physical qualities, some commodities are storable (metals) and the associated cost depends upon the physical characteristics of the commodity.

Cash and Carry Arbitrage in Commodity Futures

A cash and carry arbitrage consists of buying the commodity, storing/holding the commodity and selling the commodity at the future price when the contract expires. The steps in cash and carry arbitrage are as follows

At the initiation of the contract:

- Borrow money for the term of the contract at the market interest rate
- Buy the underlying commodity at the spot price
- Sell a futures contract at the current future price

At the contract expiration:

- Deliver the commodity and receive the future contract price
- Repay the loan plus interest

If the future contract is overpriced, this 5 step transaction will generate a riskless profit. The future contract is overpriced if the actual market price is greater than the no-arbitrage price.

If Future price is too low, the opposite step should be executed to earn a riskless profit.

This is **reverse cash and carry arbitrage**. The steps are as follows:

At the initiation of the contract

- Sell commodity short
- Lend short sale proceeds at market interest rate
- Buy futures contract at market price

At the contract expiration:

- Collect loan proceeds
- Take delivery of the commodity for the future price and cover the short sale commitment

2. INTEREST RATE FUTURES

Treasury bonds and **Eurodollar futures** contracts are two of the most popular interest rate future contracts.

Eurodollar futures are futures contracts tied to a forward LIBOR rate. Since their creation on the Chicago Mercantile Exchange, Eurodollar futures have spread to equivalent contracts such as Euribor futures (denominated in euros)1 Euro yen futures (denominated in Japanese yen), and so on. These contracts are akin to FRAs involving three-month forward rates starting on a wide range of dates, up to 10 years into the future. The formula for calculating the value of one contract is

$$Pt = 10{,}000 \times [100 - 0.25(100 - \text{FQ}t)] = 10{,}000 \times [100 - 0.25Ft]$$

where FQt is the quoted Eurodollar futures price. This is quoted as 100.00 minus the interest rate Ft , expressed in percent; that is, FQt = 100 − Ft . The 0.25 factor represents the three-month maturity, or 0.25 years.

ILLUSTRATION:

For instance, if the market quotes FQt = 94.47, we have Ft = 100 − 94.47 = 5.53, and the contract value is P = 10,000[100 − (0.25 × 5.53)] = $986,175. At expiration, the contract value settles to

$$PT = 10{,}000 \times [100 - 0.25ST]$$

where ST is the three-month Eurodollar spot rate prevailing at T. Payments are cash settled.

As a result, Ft can be viewed as a three-month forward rate that starts at the maturity of the futures contract.

Interest rate futures contracts are designed to move like a bond—that is, to lose value when interest rates increase. The correlation is negative. This implies that when interest rates rise, the futures co tract loses value and in addition funds have to be provided precisely when the borrowing cost or reinvestment rate is higher.

T-Bond Futures are futures contracts tied to a pool of Treasury bonds that consists of all bonds with a remaining maturity greater than 15 years **(and non-callable within 15 years).** Similar contracts exist on shorter rates, including 2-, 5-, and 10-year Treasury

notes. Government bond futures also exist in other markets, including Canada, the United Kingdom, the Eurozone, and Japan. Futures contracts are quoted as with T-bonds—for example, 97-02, in percent plus thirty-seconds, with a notional of $100,000. Thus, the price of the contract is P = \$100,000 × (97 + 2/32)/100 = \$97,062.50. The next day, if yields go up and the quoted price falls to 96-0, the new price is \$96,000, and the loss on the long position is $P2 - P1 = -\$1,062.50$.

3. STOCK FUTURES

In late 2000, the United States passed legislation authorizing trading in **single stock futures**, which are futures contracts on individual stocks. Such contracts were already trading in Europe and els where. In the United States, electronic trading started in November 2002 and now takes place on "One Chicago", a joint venture of Chicago exchanges.

Each contract gives the obligation to buy or sell 100 shares of the underlying stock. Settlement usually involves physical delivery, that is, the exchange of the underlying stock. Relative to trading in the underlying stocks, single stock futures have many advantages. Positions can be established more efficiently due to their low margin requirements, which are generally 20% of the cash value. In contrast, margin for stocks are higher. Also, short selling eliminates the costs and inefficiencies associated with the stock loan process. Other than physical settlement, these contracts trade like stock index futures.

To obtain finer coverage of equity risks, hedgers could use futures contracts on industrial sectors, or exchange-traded funds (ETFs), or single stock futures.

HEDGING THROUGH FUTURES

Future contracts are used extensively for implementing hedging strategies. Many of the participants in futures markets are hedgers. Their aim is to use futures markets to reduce a particular risk that they face. This risk might relate to fluctuations in the price of oil, a foreign exchange rate, the level of the stock market, or some other variable. A perfect hedge is one that completely eliminates the risk. Perfect hedges are rare.

Thus, hedging using futures is a primarily ways in which hedges can be constructed so that they perform as close to perfect as possible. Initially we treat the future contracts as forward contracts, and later an adjustment popularly known as 'tailing the hedge' will take into account the difference between futures and forwards.

When an individual or company chooses to use futures markets to hedge a risk, the objective is usually to take a position that neutralizes the risk as far as possible.

A **short hedge** occurs when the hedgers shorts (sells) a futures contract to hedge against a price decrease in the existing long position. When the price of the hedged asset decreases, the short futures position realizes a positive return, offsetting the decline in asset value. Therefore, a short hedge is appropriate when you have long position and expect prices to decline.

A short hedge can also be used when an asset is not owned right now but will be owned at some time in the future.

A **long hedge** occurs when the hedger buys a future contract to hedge buys a futures contract to hedge against an increase in the value of the asset that underlies a short position. In this case, an increase in the value of the shorted asset will result in a loss to the short seller. The objective of the long hedge is to offset the loss in the short position. A long hedge is therefore appropriate when you have a short position and expect prices to rise.

BASIS RISK

Source of Basis Risk and How the risk arises when hedging with futures

Perfect hedges are not very common. The two major reasons why this is so is

1. The asset in the existing position is often not the same as that underlying the futures and
2. The hedging horizon may not match perfectly with the maturity of the futures contract.

The existence of either one of these conditions leads to what is called basis risk.

The basis in a hedge is defined as the difference between the spot price on a hedged asset and the futures price of the hedging instrument (e.g., futures contract). Basis is calculated as

Basis = Spot price of asset being hedged – Future price of contract used in hedge

When the hedged asset and the asset underlying the hedging instrument are the same, the basis will be zero at maturity.

SOURCES OF BASIS RISK

There are three sources of basis risk i.e.

1. **Interruption in the convergence of the futures and spot prices:** Normally, the spot prices and future prices will converge as the time to maturity decreases and basis reduces to zero at maturity. However, if the position is unwound prior to maturity, the return to the futures position could be different from the return to the cash position. An interruption in the convergence could result in payments from the seller to the buyer. All of these effects are types of basis risk
2. **Changes in the cost of carry:** The cost of carry includes storage and safekeeping, interest, insurance and related cost. Perhaps the most volatile of these is interest cost. An increase in the interest rate increases the opportunity cost of holing the asset, so the cost of carry and hence, the basis of the contract rises.
3. **Imperfect matching between the cash asset and the hedge asset:** Sometimes it may be more efficient to cross hedge or hedge cash position with a hedge asset that is closely related but different from the cash asset.

FORWARD CONTRACT Vs FUTURE CONTRACT

The main differences between forward and futures contracts are summarized as below. Both contracts are agreements to buy or sell an asset for a certain price at a certain future time.

A forward contract is traded in the over-the-counter market and there is no standard contract size or standard delivery arrangements. A single delivery date is usually specified and the contract is usually held to the end of its life and then settled.

A futures contract is a standardized contract traded on an exchange. A range of delivery dates is usually specified. It is settled daily and usually closed out prior to maturity.

SWAPS

A swap is an over-the-counter agreement between two companies to exchange cash flows in the future. The agreement defines the dates when the cash flows are to be paid and the way in which they are to be calculated. Usually the calculation of the cash flows involves the future value of an interest rate, an exchange rate, or other market variable. A forward contract can be viewed as a simple example of a swap.

For example, Companies X and Y enter into a 2 year plain vanilla interest swap. The swap cash flows are exchanged semiannually, and the reference rate is 6 month LIBOR. The LIBOR rates are as below. The fixed rate of the swap is 3.784%, and the notional principal is $100 million. The below is the computation of cash flows of X, the fixed payer of the swap.

Beginning of Period	LIBOR
1 Years	3.00%
2 Years	3.50%
3 Years	4.00%
4 Years	4.50%
5 Years	5.00%

The basic cash flow takes place at the end of period one and uses the LIBOR at the beginning of that same period. In other words, at the beginning of each period, both payments for the payments for the end of the period are known. The gross cash flows for the end of the first period for both the parties are calculated as below

Floating = $ 100 million x 0.03 x 0.5 = $1.5 million

Fixed = $ 100 million x 0.03784 x 0.5 = $1.892 million

Note: *The 0.5 is the semiannual day count. The net payment for Company X is an outflow of $0.392 million. Note that we are ignoring the many day count and business day conventions associated with swaps.*

TYPES OF SWAPS

1. **INTEREST RATE SWAPS**

Mechanics of Interest Rate Swaps

The most common type of swap is a ‘‘plain vanilla’’ interest rate swap. In this swap a company agrees to pay cash flows equal to interest at a predetermined fixed rate on a notional principal for a predetermined number of years. In return, it receives interest at a floating rate on the same notional principal for the same period of time.

LIBOR

The **floating rate** in most interest rate swap agreements is the London Interbank Offered Rate (LIBOR). It is the rate of interest at which a bank is prepared to deposit money with other banks that have a AA credit rating. One-month, three-month, six-month, and 12-month LIBOR are quoted in all major currencies.

Just as prime is often the reference rate of interest for floating-rate loans in the domestic financial market, LIBOR is a reference rate of interest for loans in international financial markets. To understand how it is used, consider a 5-year bond with a rate of interest specified as 6-month LIBOR plus 0.5% per annum. The life of the bond is divided into 10 periods, each 6 months in length. For each period, the rate of interest is set at 0.5% per annum above the 6-month LIBOR rate at the beginning of the period. Interest is paid at the end of the period.

ILLUSTRATION

Consider a hypothetical 3-year swap initiated on March 5, 2012, between Microsoft and Intel. We suppose Microsoft agrees to pay Intel an interest rate of 5% per annum on a principal of $100 million, and in return Intel agrees to pay Microsoft the 6-month LIBOR rate on the same principal. Microsoft is the fixed-rate payer; Intel is the floating ratepayer. We assume the agreement specifies that payments are to be exchanged every 6 months and that the 5% interest rate is quoted with semi-annual compounding.

2. CURRENCY SWAPS

Another popular type of swap is known as a currency swap. In its simplest form, this involves exchanging principal and interest payments in one currency for principal and interest payments in another.

A currency swap agreement requires the principal to be specified in each of the two currencies. The principal amounts are usually exchanged at the beginning and at the end of the life of the swap. Usually the principal amounts are chosen to be approximately equivalent using the exchange rate a the swap's initiation. When they are exchanged at the end of the life of the swap, their values may be quite different.

ILLUSTRATION

Consider a hypothetical 5-year currency swap agreement between IBM and British Petroleum entered into on February 1, 2011. We suppose that IBM pays a fixed rate of interest of 5%in sterling and receives a fixed rate of interest of 6%in dollars from British Petroleum. Interest rate payments are made once a year and the principal amounts are $18 million and £10 million. This is termed a fixed for-fixed currency swap because the interest rate in each currency is at a fixed rate.

Initially, the principal amounts flow in the opposite direction to the arrows. The interest payments during the life of the swap and the final principal payment flow in the same direction as the arrows. Thus, at the outset of the swap, IBM pays $18 million and receives £10 million. Each year during the life of the swap contract, IBM receives $1.08 million.

(= 6% of $18 million) and pays £0.50 million (= 5% of £10 million). At the end of the life of the swap, it pays a principal of £10 million and receives a principal of $18 million.

SUMMARY

In this session, we have discussed about various types of derivatives.

Derivatives have been a very successful innovation of the capital markets. A forward or futures contract involves an obligation to buy or sell an asset at a certain time in the future for a certain price. Specification of future contracts is an important activity for a futures exchange. The various types of future contracts depend on the underlying asset i.e. a Commodity Futures.

There are three main types of traders in a market, 1) Hedgers who use derivatives to reduce or eliminate this risk; 2) Speculators use derivatives to get extra leverage and 3) Arbitrageurs who are in business to take advantage of a discrepancy between prices in two different markets and mainly hedge their risk through futures using various strategies.

Swaps are another type of derivative, which is used to hedge risk, mainly interest rate and foreign currency fluctuation risk. The two most common types of swaps are interest rate swaps and currency swaps.