

INTRODUCTION TO DERIVATIVES

The derivatives market has existed for centuries as a result of the need for both users and producers of natural resources to hedge against price fluctuations in the underlying commodities. Although trading in agricultural and other commodities has been the driving force behind the development of derivatives exchanges, the demand for products based on financial instruments—such as bond, currencies, stocks and stock indices—have now far outstripped that for the commodities contracts.

Trading derivative contracts in an organized market was legal before Morarji Desai's government banned forward contracts. Derivatives on stock were traded in the form of *Teji* and *Mandi* in unorganized markets. Recently, futures contract in various commodities have been allowed to trade on exchanges. In June 2000, National Stock Exchange and Bombay Stock Exchange started trading in futures on Nifty and Sensex respectively. Options trading in Sensex and Nifty commenced in June 2001. Thereafter, trading began in options and futures of 31 prominent stocks in the month of July and November respectively. NSE accounts for 99% of stock and index futures and options trading activity.

What are Derivatives?

Derivatives are financial contracts whose value/price is dependent on the behavior of the price of one or more basic underlying assets (often simply known as the underlying). These contracts are legally binding agreements, made on the trading screen of exchanges, to buy or sell an asset in the future. The asset can be a share, index, interest rate, bond, rupee-dollar exchange rate, or even commodities like gold, sugar, crude oil, soybean, cotton, coffee.

Example: An example of a derivative is curd, which is a derivative of milk. The price of curd depends upon the price of milk which in turn depends upon the demand and supply of milk. Another example would be: The price of Reliance Triple Option Convertible Debentures (Reliance TOCD) varies with the price of Reliance shares. And the price of Telco warrants depends upon the price of Telco shares.

Need for Derivatives Market

- The derivatives market helps to mitigate risks associated with price volatility of stocks and commodities.
- Price Discovery: Price discovery is a method of determining the price of a specific commodity or security through basic supply and demand factors related to the market. For example, if the demand for a particular commodity is higher than its supply, the price will typically increase (and vice versa).
- Increased integration of national financial markets with the international markets.
- Derivative market helps to increase savings and investment in the long run.

Types of Derivatives

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.

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 they are standardized exchange-traded contracts and can not be customized.

Options: An option contract gives the buyer of the contract the right, but not the obligation, to buy (for a call option) or sell (for a put option) a specific amount of a given stock, commodity, currency, index, or debt, at a specified price (the strike price) during a specified period of time.

Warrants: Longer-dated options are called warrants and are generally traded over-the-counter.

Swaps: Swaps are private agreements between two parties to exchange cash flows in the future according to a prearranged formula. They can 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 between the parties, with the cash flows in one direction being in a different currency than those in the opposite direction.

Types of Market

- **Cash:** Payment is made as soon as the deal is struck
- **Spot:** Price is decided today but the transaction is settled after two (or more) business days.
- **Forward/Future:** Price is decided today but the transaction takes place on a future date.

Distinguish Between Exchange Traded and OTC Derivatives

OTC Derivatives	Exchange Traded Derivatives
Traded in an unorganized/over the counter market. Customized contract terms hence Less liquid No secondary market No margin payment Settlement happens at end of period	Traded in an organized exchange Standardized contract terms hence More liquid Secondary market Requires margin payment Follows daily settlement

Trading Mechanism

- The futures and options trading system of NSE, called NEAT-F&O trading system, provides a fully automated screen based trading for index futures & options and stock futures & options.
- It supports an anonymous order driven market which provides complete transparency of trading operations and operates on a strict price–time priority. It is similar to that of trading of equities in the Cash Market (CM) segment.

Clearing

- The first step in clearing process is working out open positions or obligations of members.
- Positions are calculated on net basis (buy-sell) for each contract. Clients' positions are arrived at by summing together net (buy-sell) positions of each individual.

Settlement

- All stock and index futures and options contracts are cash settled, i.e. through exchange of cash. The underlying for index futures/options cannot be delivered.
- Futures and options on individual securities can be delivered as in the spot market. However, it has been currently mandated that stock options and futures would also be cash settled.
- NSCCL undertakes clearing and settlement of all deals executed on the NSEs F&O segment. It acts as legal counterparty to all deals on the F&O segment and guarantees settlement

Participants in derivative contracts

Hedgers

They are in the position where they face risk associated with the price of an asset. They use derivatives to reduce or eliminate risk. For example, a farmer may use futures or options to establish the price for his crop long before he harvests it. Various factors affect the supply and demand for that crop, causing prices to rise and fall over the growing season. The farmer can watch prices discovered in trading at the commodity exchange and when they reflect the price he wants, he can sell futures contracts which would assure him of a fixed price for his crop.

Speculators

Speculators wish to bet on the futures movement in the price of an asset. They use derivatives to get extra leverage. A speculator will buy and sell in anticipation of future price movements, but has no desire to actually own the physical commodity.

Arbitragers

They are in the business to take advantage of a discrepancy between prices in two different markets. Arbitragers are interested in locking in a minimum risk profit by simultaneously entering into transactions in two or more markets. If, for example, they see the future prices of an asset getting out of line with the cash price, they will take offsetting positions in the two markets to lock in a profit.

Functions of Derivative Markets

- Prices in an organized derivatives market reflect the perception of market participants about the future and lead the prices of underlying to the perceived future level. The prices of derivatives converge with prices of the underlying at the expiration of the derivative contract. Thus derivatives help in discovery of future as well as current prices
- 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
- Speculative traders shift to a more controlled environment of the derivatives market. In the absence of an organized derivatives market, speculators trade in the underlying cash markets.
- Derivatives markets help increase savings and investment in the long-run. The transfer of risk enables market participants to expand their volume of activity.

Introduction to 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. Unlike forward contracts, futures contracts are standardized and exchange traded. To facilitate liquidity in the futures contracts, the exchange specifies certain standard features of the contract. It is a standardized contract with a standard underlying instrument, a standard quantity and quality of the underlying instrument that can be delivered, (or which can be used for reference purposes in settlement) and a standard timing of such settlement. A futures contract may be offset prior to maturity by entering into an equal and opposite transaction which is called squaring off. More than 99% of futures transactions are offset this way.

The standardized items in a futures contract are:

- Quantity of the underlying instrument
- Quality of the underlying instrument
- The date and the month of delivery
- The units of price quotation and minimum price change
- Location of settlement

Terminologies used in a futures contract

Spot Price: The current market price of the scrip/index

Future Price: The price at which the futures contract trades in the futures market.

Tenure: The period for which the future is traded.

Expiry Date: The date on which the futures contract will be settled.

Basis: The difference between the spot price and the future price.

Tick Size: The minimum change in price up or down. It's the smallest increment of price movement possible in trading a given contract.

Lot Size: Lot size is the unit of trading, established by an exchange to which official price quotations apply.

The **advantage** of trading in futures contract is that it eliminates counter party risk. Since there is an exchange involved in between, and the exchange guarantees each trade; hence, the buyer or seller does not get affected if the opposite party defaults.

Differences between futures and forwards

Futures	Forwards
Futures are traded on an exchange	Forwards are non-tradable, negotiated instruments
Futures are contracts having standard terms and conditions	Forwards are contracts customized by the buyer and seller
No default risk as the exchange provides a counter guarantee	High risk of default by either party
Exit route is provided because of high liquidity on the exchange	No exit route for these contracts
Highly regulated with strong margining and surveillance systems	No such systems are present in a forward market

Difference between going short and going long

Taking a short futures position means committing yourself to deliver shares (or their value) on a certain future date. In comparison, taking a long futures position means committing yourself to take delivery of the shares (or their value) on a future date.

Taking a short position means you think the value of the future will drop. You sell futures then close out by buying futures at a lower price and taking a profit. However, if you close out the position at a higher price, you take a loss. Conversely, taking a long futures position means you think the value of the future will rise. You buy futures then close out by selling futures at a higher price and taking a profit.

Methods of Arriving at the Future Price

Future price is nothing but the current price plus the interest cost for the tenure of the future. This interest cost of the future is called Cost of Carry. If F is the future price; S is the spot price and C is the cost of carry or opportunity cost, then $F=S+C$

$$F = S (1 + r)^T$$

Where r is rate of interest and T is the tenure of the futures contract. The rate of interest is the risk-free market rate.

Example 1

The spot price of Reliance is Rs. 300. The bank rate prevailing is 10%. What will be the price of a one month future?

The price of a future is $F = S (1 + r)^T$

The one month Reliance future would be the spot price plus the cost of carry. Since the bank rate is 10%; that can be taken as the market rate. This rate is an annualized rate and hence can be recalculated on a monthly basis.

$$F = 300 (1 + 0.10)^{(1/12)}$$

$$F = \text{Rs. } 302.39$$

Example 2

The shares of Infosys are trading at Rs. 3000. The one month future of Infosys is Rs. 3100. The return expected from the G-Sec funds for the same period is 10%. Is the futures contract of Infosys over-priced or under-priced?

The one month future of Infosys will be

$$F = 3000 (1 + 0.10)^{(1/12)}$$

$$F = \text{Rs. } 3023.90$$

But the price at which Infosys is traded is Rs. 3100, thus it is overpriced by Rs.76

The futures price gets affected by a dividend. Dividend is an income to the seller of the future. It reduces his cost of carry to that extent. If dividend is going to be declared, the same has to be deducted from the cost of carry.

Thus, the price of a futures contract in this case is:

$$F = S (1 + r - d)^T$$

Where d is the dividend rate

Example 3

The spot price of Reliance is Rs. 300. The bank rate prevailing is 10%. What will be the price of a one month future? Reliance will be paying a dividend of 50 paise per share.

Solution

Since Reliance is paying 50 paise per share and the face value of Reliance is Rs. 10, the dividend rate is 5%.

So while calculating futures,

$$F = 300 (1 + 0.10 - 0.05)^{(1/12)}$$

$$F = \text{Rs. } 301.22$$

Mark to market is a mechanism devised by the exchanges to minimize risk. In case one starts making losses in his/her position, the exchange collects money to the extent of the losses up front. For example, if one buys futures at Rs. 300 and its price fall to Rs. 295 then one has to pay a mark to market margin of Rs. 5. This is over and above the margin money that one pays to take a position in the futures contract.

Initial Margin is the money that must be deposited in a futures account before any trading takes place. Initial margin per contract is relatively low and equals about one day's maximum price fluctuation on the total value of the underlying assets. For example, if the contract value of Gold is Rs 900,000, the investor will not invest the whole 900,000. He just needs to invest in a minimum margin i.e. 4% of the contract which is 36,000.

Maintenance Margin is the amount of margin that must be maintained in the futures account. If the margin balance falls below the maintenance margin due to changes in the contract price of the underlying asset then additional funds must be deposited to bring the margin balance back up to the initial margin requirement. This is in contrast to equity margins, which requires bringing the margin percentage up to maintenance margin, not back to the initial margin level.

For example, if an investor had bought one lot i.e. 1kg of gold at 9100/10gms, the contract value of gold would be 910,000 (9100*100). He would have to invest in a minimum margin i.e. 4% of the contract value i.e. 36,400. If the market closes at 9,000 the contract value would be 900,000(9000*100) i.e. loss of Rs. 10,000. Now this 10,000 will be deducted from the initial margin. So the additional funds must be deposited to bring the margin balance back up to the initial margin.

Variation Margin is the fund that must be deposited into an account to bring it back to the initial margin amount. If account margin exceeds the initial margin requirement, funds can be withdrawn or can be used as initial margin for other trades.

Introduction to Options

Options are contracts that give buyers the right (but not the obligation) to buy or sell a specified quantity of a certain underlying asset at a specified price (strike or exercise price) on or before a specified date. On the other hand, the seller is under obligation to perform the contract (buy or sell the underlying) if the contract is exercised by the buyer. The underlying asset can be share, index, interest rate, bond, rupee-dollar exchange rate, sugar, crude oil, soybean, cotton, coffee etc. Those options that give the buyer the right to buy are called call options and those which give the buyer the right to sell are called put options.

Determinants of options pricing

1. Price of the underlying stock or index.
2. Strike price/exercise price of the option.
3. Time to expiration of the option.
4. Risk-free rate of interest.
5. Volatility of the price of underlying stock or index.

Call Option: Call options give the buyer the right to buy a specified underlying instrument at a set price on or before a particular date. For example, Satyam 260 Feb call option gives the buyer the right to buy Satyam shares at a price of Rs 260 per share on or before the last Thursday of February. The price of 260 in the above example is called the strike price or the exercise price. Call options are also called teji in the Indian markets.

Put Option: Put options give the buyer the right to sell a specified underlying instrument at a set price on or before a particular date. For example, Satyam 260 Feb put option gives the buyer the right to sell Satyam shares at a price of Rs 260 per share on or before the last Thursday of February. Put options are also called mandi in the Indian markets.

American Style Option: The holder of an American style option has the right to exercise the option any time until the expiry of the option. The writer of an American option has to be ready to meet the obligation at any time until the expiry of the option. All Indian stock option contracts are American style.

European Style Option: The holder of a European style option has the right to exercise the option only on its expiry date. The writer of a European option has to be ready to meet the obligation only on the date of expiry. All Indian Index options are European style.

Spot Price (S): The price of an asset (underlying) in the spot market.

Strike Price (X/K): Also called the exercise price, it is the rate at which a call option buyer has a right to buy from or a put option buyer has a right to sell to the option writer (seller of the option contract).

When the strike price of a call or a put option is equal to the spot price of the underlying instrument the option is said to be **at-the-money**.

When the strike price of a call is lower than the spot price of the underlying instrument, the option is said to be **in-the-money**. An in-the-money call gives the right to buy an instrument at a price lower than the spot price, so that exercising the option would give gains. Similarly, a put option is in-the-money when the spot price is below the strike price. An in-the-money put option gives the holder a right to sell at a price higher than the spot price, so that exercising the option results in gain.

Those options, which have certain intrinsic value, are said to be in the money, by virtue of the fact that they are holding some money right now. For example, when SBI is quoting at Rs200, an SBI call option with Rs190 strike price is in the money because you have the right to buy at a price lower than the market price of the underlying. All those call options which have their strike price lower than the spot price of the underlying are in the money. Similarly when SBI is quoting at Rs200, an SBI put option with Rs210 strike price is in the money because you have the right to sell at a price higher than the spot price of the underlying. All those put options which have their strike price higher than the spot price of the underlying are in the money.

When the strike price of a call is higher than the spot price of the underlying instrument, the option is said to be **out-of-the-money**. A put option is out-of-the-money when the spot price is greater than the strike price.

Those options whose intrinsic value is zero are called out of the money, by virtue of the fact that they are not holding any money right now. For example, when SBI is quoting at Rs200, an SBI call option with Rs220 strike price is out of the money because you have the right to buy at higher price than the spot price of the underlying. All those call options which have their strike price higher than the spot price of the underlying are out of the money. Similarly when SBI is quoting at Rs200, an SBI put option with Rs180 strike price is out of the money because you have the right to sell at a price lower than the spot price of the underlying. All those put options which have their strike price lower than the spot price of the underlying are out of the money

Premium (Value of an Option): The initial price that the option buyer must pay to the option seller to acquire the right is known as premium. It is also known as the price of the option or value of an option.

Intrinsic Value

For a call option: Intrinsic value = Price of the underlying - Exercise price

For a put option: Intrinsic value = Exercise price - Price of the underlying

An option is said to have intrinsic value if and to the extent that the option is currently profitable to exercise. This is the amount by which the option is in-the-money. As mentioned earlier, if the spot price is less than the strike price, put option is in-the-money and the holder can realize a gain which will be equal to $(X - S)$. Similarly, the gain to the holder of a call option will be $(S - X)$ when the strike price is lower than the spot price. Intrinsic value refers to these gains, which are available to the holder. Intrinsic value is also referred as 'moneyness' of the option.

Option Pricing Models

Black-Scholes Model

The Black-Scholes (1973) option pricing formula prices European put or call options on a stock that does not pay a dividend or make other distributions

The Mode

$$OP = SN(d_1) - Xe^{-rt}N(d_2)$$

Where:

$$d_1 = \frac{\ln\left(\frac{S}{X}\right) + \left(r + \frac{v^2}{2}\right)t}{v\sqrt{t}}$$

$$d_2 = d_1 - v\sqrt{t}$$

The variables are:

S = stock price

X = strike price

t = time remaining until expiration, expressed as a percent of a year

r = current continuously compounded risk-free interest rate

v = annual volatility of stock price (the standard deviation of the short-term returns over one year).

ln = natural logarithm

N(x) = standard normal cumulative distribution function

e = the exponential function

Part I of the model

In order to understand the model itself, we divide it into two parts. The first part, SN (d1), derives the expected benefit from acquiring a stock outright. This is found by multiplying stock price [S] by the change in the call premium with respect to a change in the underlying stock price [N(d1)].

Part II of the model

The second part of the model, $Ke^{-rt}N(d_2)$, gives the present value of paying the exercise price on the expiration day.

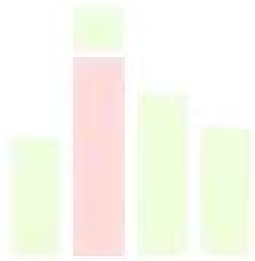
The fair market value of the call option is then calculated by taking the difference between these two parts

Assumptions of the Black and Scholes Model:

- The stock pays no dividends during the option's life
- European exercise terms are used
- Markets are efficient
- No commission is charged
- Interest rates remain constant and known
- Returns are log normally distributed

Value of Put Option:

$$P = Ke^{-rt}N(-D_2) - SN(-D_1)$$



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