BIOINFO Financial Management

BIOINFO Financial Management
Volume 1, Issue 1, 2011, pp-09-20
Available online at http://www.bioinfo.in/contents.php?id=195

OPTION GREEKS AND SENSITIVITY OF OPTION PREMIUM: AN INDIAN CASE STUDY

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Received: July 24, 2011; Accepted: September 09, 2011

Abstract- Financal Risk Management forms a vital segment of Fiancial Markets in the current times.It is very beneficial for the investors to take correct decisions. Derivatives form a vital part of Financial Market. Options are one such derivative. Paper mainly concerns with the option as derivative and the measures of factors influencing Option Procies, However it is more of a managerial affair and managers should have correct knowledge about these risks involves- factors affecting prices and the sensitivity.

There are Five measures of sensitivity of option premium- delta, gamma, theta, rho and vega. The knowledge of these measures and sensitivity- their trend and behavior is very useful for the purpose of hedging the risks by the portfolio managers. Prtfolio insurance or dynamic hedging is the process of reducing losses by buying put options on the stocjk in addition to the underlying stock or by creating put options synthetically – which requires an understanding of this sensitivity.

Key words – Derivatives, Options, premium, Sensitivity, Measures, Greeks, SEBI

PREFACE

A well research project work should include a deep understanding and exhaustive research on the topic. In my research project on "Options and Sensitivity of Option Premium" I have tried to include each and every necessary and relevant detail.

I have included the basic underlying concept on the subject from the perspective of a layman and a law leaner, concept and meaning of Options –its significance and kinds, Current Trend in the derivative market and position of Options in that- a brief summary of how does option trading takes place, option premium and factors effecting option premium- major part of the paper deals with the measures of the sensitivity of the option premium- i.e Option Greeks and their analysis- its relation with Option pricing models and finally the regulation part of the Options which consist primarily of various SEBI circulars.

In spite of my efforts errors might creep in it. Anyone bringing them into my notice is welcome.

RESEARCH METHODOLOGY

Research will be more of descriptive and doctrinal research for the first part dealing with options in general and analytical for the second part dealing with option Greeks. The purpose behind the research is to bring an overview of options as derivative and measures of various factors influencing option premium- help of algebraic methods –mathematical deductions and graphical analysis has been taken.

The Information collection as such is divided into

i. ***Primary data collection*** - Data collected through brain storming, discussion, direct interviews and information gathering.
ii. ***Secondary data collection***- Data collected through literature survey, journals, Internet search, company records/bulletin, CD-ROM search etc.

Primary reliance has been based on internet sources like SEBI official website. Further various News pieces available were of great help

CHAPTER 1
AN INTRODUCTION TO OPTIONS
DERIVATIVES

Derivatives constitute one of the fastest growing markets in recent history and their importance today for companies and financial institutions is difficult to

overestimate. Hence, the valuation of derivatives is an important field of financial research.

Derivativesis the collective name used for a broad class of financial instruments that *derive* their value from other financial instruments. A derivative is an instrument whose value is dependent on another security (called the underlying security). The derivative value is therefore a function of the value of the underlying security. The two most commonly traded derivatives are futures and options. A futures contract is an agreement between two parties to buy or sell an asset (the underlying security) at a certain time in the future for a certain price. They are traded on exchanges.

OPTIONS

The idea of options is certainly not new. Ancient Romans, Grecians, and Phoenicians traded options against outgoing cargoes from their local seaports. Options are the result of unrelating search for better financial instruments. They belong to a class of instruments referred to as 'Derivatives' because they derive their value from an underlying commodity or a financial asset. The underlying commodities and financial assets can range from mundane products like wheat and cotton to precious items like gold, silver, petroleum and financial assets like stocks, bonds and currencies.

An option means a choice. an option in a financial market is created through a financial contract. This financial contract gives a right to its holder to enter into a trade at or before a future specified date. The underlying assets on options include stocks, stock indices, foreign currencies and debt instruments, commodities and future contracts. These are called stock options, index options, commoditiy options, currency options and future options. An option is different from other derivatives in that it provides a downside protection against risk and also an upside benefit from favorable movements in the underlying asset prices.

Meaning

An option is a contract in which the seller of the contract grants the buyer, the right to purchase from the seller a designated instrument or an asset at a specific price which is agreed upon at the time of entering into the contract. It is important to note that the option buyer has the right but not an obligation to buy or sell. But, if the buyer decides to exercise his right the seller of the option has an obligation to deliver or take delivery of the underlying asset at the price agreed upon.

The power of options lies in their versatility. They enable you to adapt or adjust your position according to any situation that arises. Options can be as speculative or as conservative as you want. This means you can do everything from protecting a position from a decline to outright betting on the movement of a market or index. This versatility, however, does not come without its costs. Options are complex securities and can be extremely risky. Despite what anybody tells you, option trading involves risk, especially if you don't know what you are doing. Because of this, many people suggest you steer clear of options and forget their existence.

NATIONAL SECURITIES CLEARING CORPORATION LIMITED (FUTURES & OPTIONS) REGULATIONS

F&O Segment Regulations

F&O segment Regulations mean the National Securities Clearing Corporation (Futures & Options Segment) Regulations and includes business rules, code of conduct and such other procedures, circulars, directives and orders as issued by the Relevant Authority from time to time thereunder.

Option contract

Option Contract is a type of Derivatives Contract which gives the buyer/holder of the contract the right (but not the obligation) to buy and/ or sell the underlying security at a predetermined price within or at the end of a specified period. The option contract, which gives a right to buy, is called a Call Option and the option contract that gives a right to sell is called a Put Option.

Premium

Premium is the price which the buyer of the option pays to the seller of the option for the rights conveyed by the option contract.

Underlying security

Underlying Security means a security with reference to which a Derivatives Contract is permitted to be traded on the F&O segment of the Specified Exchange from time to time.

Options are defined in the following way in the RAO

"Options to acquire or dispose of –

a) a security or contractual based investment;
b) currency of the UK or any other country or territory;
c) palladium, platinum, gold or silver; or
d) an option to acquire or dispose of an investment of the kind specified by virtue of paragraphs (a), (b) or (c)"

The definition of "option" under FSMA 2000 is identical to the definition of that term under the Financial Services Act 1986 the reference to 'acquire or dispose' means that both put and call options are

caught within the definition. A “contractually based investment” is defined in the RAO to mean (aside from contracts of insurance, which are of no interest for present purposes) any contract defined as being an option, a future, a contract for differences, or a funeral plan contract: this circularity of definition means that an “option” may be an option to buy or sell a derivative. Aside from this reference to derivatives (which may be cash settled), the material caught under the definition of an “option” are physically settled rights to receive currency, precious metals etc and are not specified to be options which may be cash settled or settled either way.

ILLUSTRATION

The idea behind an option is present in many everyday situations. Say, for example, that you discover a house that you'd love to purchase. Unfortunately, you won't have the cash to buy it for another three months. You talk to the owner and negotiate a deal that gives you an option to buy the house in three months for a price of Rs 200,000. The owner agrees, but for this option, you pay a price of Rs.3,000.

Now, consider two theoretical situations that might arise:

1. It's discovered that the house is actually the true birthplace of Elvis! As a result, the market value of the house skyrockets to Rs 1 million. Because the owner sold you the option, he is obligated to sell you the house for Rs. 200,000. In the end, you stand to make a profit of Rs.797,000 Rs.1 million - Rs200,000 - Rs3,000).

2. While touring the house, you discover not only that the walls are chock-full of asbestos, but also that the ghost of Henry VII haunts the master bedroom; furthermore, a family of super-intelligent rats have built a fortress in the basement. Though you originally thought you had found the house of your dreams, you now consider it worthless. On the upside, because you bought an option, you are under no obligation to go through with the sale. Of course, you still lose the Rs.3,000 price of the option.

This example demonstrates two very important points. First, when you buy an option, you have a right but not an obligation to do something. You can always let the expiration date go by, at which point the option becomes worthless. If this happens, you lose 100% of your investment, which is the money you used to pay for the option. Second, an option is merely a contract that deals with an underlying asset. For this reason, options are called derivatives, which means an option *derives* its value from something else. In our example, the house is the underlying asset. Most of the time, the underlying asset is a stock or an index.

SIGNIFICANCE

Options are used for risk management, investing, and speculative purposes. Important institutional users are: banks, brokers, dealers, B/Ds, mutual funds, investment companies, insurers, producers, and other organizations which have financial interests and exposures.

Options are also used by some individuals for hedging portfolios or for speculative purposes. There are various issues relating to suitability for options.

Options are available for many products and derivatives. Among these are: stocks, commodities, real estate, Mortgage Backed Securities, Indices, Baskets of Securities, Currencies (forex, Euro), bonds and other credit instruments, futures, and even other options. Here, an option-on-an-option is called a compound option.

There are two main reasons why an investor would use options: to speculate and to hedge.

SPECULATION

Options can be used to acquire risk, rather than to insure or hedge against risk. Thus, some individuals and institutions will enter into a derivative contract to speculate on the value of the underlying asset, betting that the party seeking insurance will be wrong about the future value of the underlying asset. Speculators will want to be able to buy an asset in the future at a low price according to a derivative contract when the future market price is high, or to sell an asset in the future at a high price according to a derivative contract when the future market price is low.

The advantage of options is that you aren't limited to making a profit only when the market goes up. Because of the versatility of options, you can also make money when the market goes down or even sideways. Speculation is the territory in which the big money is made - and lost. The use of options in this manner is the reason options have the reputation of being risky.

Hedging

The other function of options is hedging. Hedging is a technique that attempts to reduce risk. There is no doubt that hedging strategies can be useful, especially for large institutions. Even the individual investor can benefit.

By using options, you would be able to restrict your downside while enjoying the full upside in a cost-effective way.

KINDS OF OPTIONS

There are two basic types of options that are traded in the market. A call option gives the holder the right to buy the underlying asset by a certain date for a certain price. A put option gives the holder the right to sell the underlying asset by a certain date for a certain price. This price is called the strike price and the date is called the exercise date or maturity of the contract.

There is a further classification of options according to when they can be exercised. An European option can only be exercised at maturity while an American option can be exercised at any time up to the maturity. The value of an Asian option is dependent on the average value of the underlying security during the term of the contract while a Bermudan option can only be exercised on certain days between the present time and the maturity of the contract.

From the definition of a call option, we can see that the value of an European call option at maturity is given by

$$C = (S - K)\theta(S - K) \quad (1)$$

$S < K$

(if then the option will not be exercised and if $S > K$, the profit on the option will be $S - K$) where C is the value of the call option at maturity, S is the value of the underlying security at maturity and K is the strike price of the option. (θ represents the Heaviside function defined by $\theta(x) = 0$ if $x < 0$, $\theta(0) = 0.5$ and $\theta(x) = 1$ if $x > 0$).

We see that the payoff of a call option at maturity is either positive or zero. Hence, the call option must have a positive value before maturity, which of course is the price of the option. If we also consider the original price of the option, the profit is then given by

$$Y = (S - K)\theta(S - K) - C_0 \quad (2)$$

C_0

where Y is the profit and is the initial price of the call option. For the rest of this section (in fact for most of the rest of the thesis), we will assume that the present value of the underlying security is \$100. This does not change anything as all the prices can be rescaled by a constant factor without affecting the theory. The profit of the call option (assuming a strike price of \$100 and an initial option price of \$10) as a function of the value of the underlying security at maturity is shown in figure 1.1.

Similarly, the payoff of a put option at maturity is given by

$$Y = (K - S)\theta(K - S) - P_0 \quad (3)$$

$K < S$

(if , the option will not be exercised and if $K > S$, the profit is $K - S$) where P_0 is the initial price of the put option.

OTHER CLASSIFICATION OF OPTIONS

Equity Options – the use of derivatives to speculate on equity markets or to manage the risks associated with equity markets is a development which came later to the derivative markets than swaps and debt options.an equity based option gives the buyer the ability either to have delivered to it or to compel another party to purchase the underlying share which is the subject of the contract. This can be an option to buy or sell shares or to receive or to pay the return on the appropriate stock exchange or index.

Share options- fall into two basic catagories: those requiring cash settlement and those requiring physical settlement. The former is predicted on a requirement for the cash equivalent of an option which is the money at the expiration date. The latter entitles the purchaser of the option to receive or to sell a given quantity of the underlying share.

Currency options: are options to purchase a given quantity of a currency at a price at a date in the future. The currency option does not include an interest rate movement in its price. Rather a currency option enables the holder to benefit from a movement in the interest rate attached to the relevant currency against the interest rate that is payable on the currency.

Cash settled options: enables the investor to speculate on the movements in share prices without the need to buy shares physically on the relevant stock exchange: rather the return on that investment is paid to the buyer in cash terms if the option is in the money

CHAPTER II
OPTIONS MARKET AND TRADING

- 2.I Participants in the Options Market
There are four types of participants in options markets depending on the position they take:

1. Buyers of calls
2. Sellers of calls
3. Buyers of puts
4. Sellers of puts

People who buy options are called holders and those who sell options are called writers; furthermore, buyers are said to have long positions, and sellers are said to have short positions.

SEBI AND TRENDS IN OPTTION AS A DERIVATIVE

Exchange traded derivatives is an important segment of Indian stock markets. The derivatives markets have grown substantially over the years in India. Trading in derivatives is dominated by NSE, which has a share of more than 99 per cent of the total turnover.

During 2008-09, turnover of derivatives market was 2.86 times of the turnover in all-India equity exchanges

A clear-cut change was seen in the product composition of turnover in the derivatives market in IndiaFutures in general and single stock futures, in particular, had so far been actively traded derivatives product inIndia. But in 2008-09, the largest share in the total derivatives turnover was contributed by index options (33.9 per cent). The share of index options in the total turnover was 10.4 per cent in 2007-08. This was followed by index futures which increased from 29.2 per cent in 2007-08 to 32.4 per cent in 2008-09.

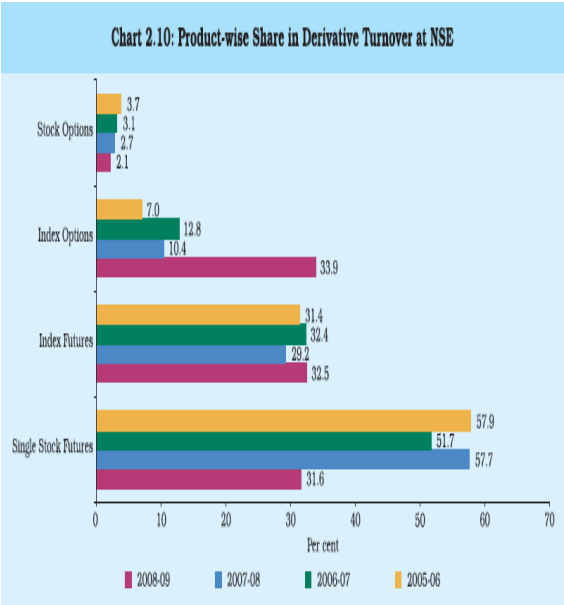


Fig. 1- Share in Derivative turnover

CHAPTER III

OPTION PREMIUM

The amount per share that an option buyer pays to the seller. The option premium is primarily affected by the difference between the stock price and the strike price, the time remaining for the option to be exercised, and the volatility of the underlying stock. Affecting the premium to a lesser degree are factors such as interest rates, market conditions, and the dividend rate of the underlying stock. Because the value of an option decreases as its expiration date approaches and becomes worthless after that date, options are called wasting assets. The total value of an option consists of intrinsic value, which is simply how far in-the-money an option is, and time value, which is the difference between the price paid and the intrinsic value. Understandably, time value approaches zero as the expiration date nears. also called option price.

Options are priced according to the Black-Scholes formula. This formula takes into account price of the underlying, the strike price, the time to expiration, and the volatility of the underlying to calculate an appropriate price for the option premium. From the Black-Scholes formula, the option "greeks" for a particular option position are derived.

FACTORS INFLUENCING OPTION PRICE

The value of an option depends on six factors:

1. the spot price or current price of the underlying asset.
2. The exercise price or strike price of the option.
3. The time to maturity or time to expiration
4. Volatility of the underlying asset or volatility in the price of underlying asset.
5. The risk free rate of interest.
6. Dividends expected during the life of the option, in case of option paying stocks.

In symbolic terms it can be expressed as:

$P = f(S, E, t, r, d)$

OPTION PRICING MODELS

There are many options pricing models. A brief listing includes: Black, Black-Scholes, Binomial, and CIR. Different models may take into account different probability functions, dividends (yes or no), continuous or discrete times, stochastics, and so on. However, it should be remembered that whatever the model chosen and the level of complexity all these models

should produce the same result at the end or expiry. If not, then there is a bias which may be exploitable in an arbitrage sense. As you move away from expiration, then the models tend to indicate different valuations for in, at, and out-of-the-money strikes.
Modern option pricing techniques, with roots in stochastic calculus, are often considered among the most mathematically complex of all applied areas of finance. These modern techniques derive their impetus from a formal history dating back to 1877, when Charles Castelli wrote a book entitled The Theory of Options in Stocks and Shares. Fischer Black and Myron Scholes, who in 1973 introduced their landmark option pricing model.

Black–Scholes model
The Black–Scholes model is a mathematical description of financial markets and derivative investment instruments. It is a model used to calculate the value of an option, by considering the stock price, strike price and expiration date, risk-free return, and the standard deviation of the stock's return. The model develops partial differential equations whose solution, the Black–Scholes formula, is widely used in the pricing of European-style options. their model is actually an improved version of a previous model developed by A. James Boness in his Ph.D. dissertation at the University of Chicago. Black and Scholes' improvements on the Boness model come in the form of a proof that the risk-free interest rate is the correct discount factor, and with the absence of assumptions regarding investor's risk preferences. The original formula for calculating the theoretical option price (OP) is as follows:

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

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:

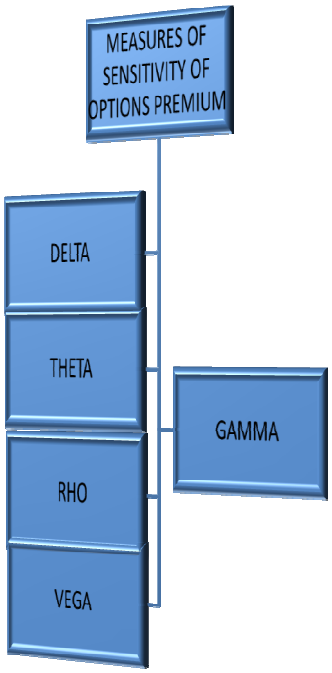
S = stock price
X = strike price
t = time remaining until expiration, expressed as a percent of a year
r = current continuously compounded risk-free interest rate
v = annual volatility of stock price (the standard deviation of the short-term returns over one year). ln = natural logarithm
N(x) = standard normal cumulative distribution function
e = the exponential function

ANALYSIS OF THE MODEL
The main advantage of the Black-Scholes model is speed[1] -- it lets you calculate a very large number of option prices in a very short time. It tells the user what is important. In other words, it includes the very factors that market analysts look for. Secondly it does not promise to produce the exact prices that show up in the market, but it does a remarkable job of pricing options that meet all of the assumptions of the model. In fact it is safe to say that virtually all option pricing models, even the xtremely complex ones, have much in common wth the Black and Scholes model.
The Black-Scholes model has one major limitation: it cannot be used to accurately price options with an American-style exercise as it only calculates the option price at one point in time -- at expiration. It does not consider the steps along the way where there could be the possibility of early exercise of an American option. Various adjustments are sometimes made to the Black-Scholes price to enable it to approximate American option prices (eg the Fischer Black Pseudo-American method) but these only work well within certain limits and they don't really work well for puts. Secondly ite other visible flaw osf the model is its inability to compute complex derivative products. The model's lack of functionality in this aspect leads to many analusts to the use of the Binomial and Monte Carlo models for more complex derivatives products. Another shortcoming of the model is the fact that all data resulting from the use of the model is based on past data. The model does not prepare for future events which can be crucial in the fast pace world of finance.

CHAPTER IV
SENSITIVITY OF OPTION PREMIUN
Options Greeks
Greeks play a critical role in strategy behavior, most importantly in determining the prospects for success or failure. Option greeks measure the options sensitivity to various risk components inherent to the price of an option. These measure include the speed of the underlying securities price movement, interest rate movement, time decay of an option, and volatility. In mathematical finance, the Greeks are the quantities

[1] Available at www.hoadley.net/options/bs.htm (last visited on 17th march 2010)

representing the sensitivities of derivatives such as options to a change in underlying parameters on which the value of an instrument or portfolio of financial instruments is dependent.



The Greeks are vital tools in risk management. Each Greek measures the sensitivity of the value of a portfolio to a small change in a given underlying parameter, so that component risks may be treated in isolation, and the portfolio rebalanced accordingly to achieve a desired exposure.

A summary of the risk measures known as the Greeks is presented, noting how each expresses the expected changes in an option's price resulting from changes in the underlying (*Delta*), volatility (*Vega*), time value decay (*Theta*), interest rates (*Rho*) and the rate of change of *Delta* (*Gamma*). It was also shown what it means to have positive or negative position Greeks.

SENSITIVITY OF OPTION PREMIUM

DELTA

The delta of a stock option can be defined as the ratio of change in the price of an option to the change in the price of the underlying asset. Delta measures the sensitivity of the option value to changing stock prices. Delta of any option gives an idea about the number of units of a stock that should be held by any investor for creating a riskless hedge. Since the value of the call increases, when the stock price increases the delta of a call will always be positive but as the value of put decreases with the increases in the stock price, the delta of a put will always be negative.

For example, if you buy an at-the-money call or put, it will have a *Delta* of approximately 0.5, meaning that if the underlying stock price moves 1 point, the option price will change by 0.5 points (all other things remaining the same). If the price moves up, the call will increase by 0.5 points and the put will decrease by 0.5 points.

Important features

- An increase in the value of the underlying asset makes the premiums on calls to increase and the premiums on puts to decrease, given that all other factors remain constant.
- An option can never gain or loose value faster than the underlying asset. Therefore delta of a call can have an upper bound of 1
- An option cannot move in the direction opposite to the underlying asset. So its lower bound is zero.
- Puts have opposite characteristics of a call. So its range is -1 and 0.
- The investor's position remains neutral for very short time period. This happens because delta changes not only when the stock price changes but also changes when other factors like standard deviation and time change.
- For creating the delta hedge of a portfolio, we have to continuously rebalance the portfolio as the stock price changes.

Inferences

- The difference between the values of dc/ds and N(d) becomes zero when we consider very small changes in the stock price. For small changes in stock prices, dc/ds approaches N(d).
- Delta tends to approach 1.0 when the call option is deep in the money and when the call is deep out of the money delta approaches zero.
- Delta of a call will be most sensitive to change in stock prices, when the underlying stock prices, when the underlying stock price approaches the exercise price. Delta of a put option will be always negative.
- For every two options purchased, one underlying asset has to be sold to establish a neutral hedge. Since puts have negative deltas the purchase of puts will require one to purchase the underlying contract.

Mathematical Expression

- If change in the stock price is ds and corresponding change in the call price is dc,

then derivative reflecting sensitivity will be dc/ds.

- In case of portfolio of derivatives and other assets where there is a single underlying asset, that will be the weighted sum of all the derivatives of other assets forming part of the portfolio.

dp = solution of (weight of x derivative in the portfolio).(delta of x derivative)
where x = 1 to n.
Delta = (rate of change in option price) / (rate of change in underlying security price)
If you own a call option at $2 when the stock was $30 and now the stock moves up to $31 and the option does as well to $2.50. In our formula above, the delta in this situation would be ($2.5 - $2) / ($31 - $30) = .5

Relationship between call and put delta
Given a call and put option for the same underlying, strike price and time to maturity, the sum of the absolute values of the delta of each option will be 1.00
If the value of delta for an option is known, one can compute the value of the option of the same strike price, underlying and maturity but opposite right by subtracting 1 from the known value.

Delta Neutral Trading
Delta neutral trading, also known as "hedge" trading is a method of trading where the total position delta is 0. The idea is to hedge your position by slowing your position speed down. Delta neutral trading is used by many traders to make profitable adjustments on their trade as the price of the security moves up and down. For example, a popular strategy is to make adjustments to your total position to bring it back to delta neutral after the underlying security has moved 20% in either direction. This can be done by making adjustments to the profitable side of your trade.

THETA – "Time decay of an option"
Anybody who has purchased an option knows what *Theta* is, since it is one of the most difficult hurdles to surmount for buyers. As soon as you own an option (a wasting asset), the clock starts ticking, and with each tick the amount of time value remaining on the option decreases, other things remaining the same.
Theta can be defined as a measure of option or derivative sensitivity with respect to expiration time. If the stock price and other factors of the option pricing models are constant, the price of the option will change with the increase and decrease in the option life. Theta is the rate at which option loses value as time passes. Theta is expressed in terms of time.
Owners of these wasting assets take the position because they believe the underlying stock or futures will make a move quick enough to put a profit on the option position before the clock has ticked too long. In other words, *Delta* beats *Theta* and the trade can be closed profitably. When *Theta* beats *Delta*, the seller of the option would show gains. This tug of war between *Delta* and *Theta* characterizes the experience of many traders, whether long (purchasers) or short (sellers) of options.

Features

- Theta is negative of the first derivative of option price with respect to the time remaining until expiration.
- Theta of a call and a put can be greater or less than zero. Normally it is less than zero because as the time to expiration decreases, the value of the option also decreases.
- Though the time can never be negative but theta assumes negative values because the option lose value as time passes.
- A long option position will always have a negative theta and a short option position always has a positive theta.
- Theta as an asset class seems to be rather appealing, as it is capable of delivering consistent uncorrelated returns and most market environments.
- To access the time value seems to be straight forward by extracting from it written equity index options.
- An option time value strategy seems to be rather complex on the one hand but on the other hand, straight forward because most of the questions can be answered by simply applying basic option theory.
- After all, in due course, it comes down to having a disciplined approach to carefully constructing and modeling the risk you are managing. An extensive experience and deep knowledge of trading
- In option markets can only help because theory, as we all know, has its pitfalls.
- It is certainly a great advantage that time value strategies are not followed by many. It is a niche strategy which can deliver an attractive risk/return profile with low correlations to equities, bonds and even major hedge fund strategies.

Vega
When any position is taken in options, not only is there risk from changes in the underlying but there is risk from changes in implied volatility. Vega measures the sensitivity of the option premium with respect to the

volatility of the asset provided other factors determining the option premium are constant. When the underlying changes, or even if it does not in some cases, implied volatility levels may change. Whether large or small, any change in the levels of implied volatility will have an impact on unrealized profit/loss in a strategy. Some strategies are long volatility and others are short volatility, while some can be constructed to be neutral volatility.

Features

- Since volatilities change over a certain time period, the option premium of both call and put is liable to behave accordingly.
- Vega of call and put will always be identical and positive because all options gain value with rising volatility.
- Vega of all options declines as expiration approaches. A long term option will always be more sensitive to change in volatility than a short term option with similar conditions.
- For deep in the money and deep out o the money the Vega will always and tends to be zero.
- If Vega of any option is very high, the value of an option will be very sensitive to even a small change in the volatility of the underlying assets.
- When a strategy is long volatility, it has a positive position *Vega* value and when short volatility, its position *Vega* is negative. When the volatility risk has been neutralized, position *Vega* will be neither positive nor negative.

RHO

Rho is a risk measure related to changes in interest rates. Since the interest rate risk is generally of a trivial nature for most strategists

Rho can be defined as a measure of the sensitivity of option value to change in interest rates. It is the first derivative of an option premium with respect to the interest rate. Call option is positively related to the interest rate whereas put option is negatively related to the interest rate. Thus Rho of any call will be always positive and Rho of any put will always be negative.

When interest rates rise, call prices will rise and put prices will fall. Just the reverse occurs when interest rates fall. *Rho* is a risk measure that tells strategists by how much call and put prices change as a result of the rise or fall in interest rates. The *Rho* values for in-the-money options will be largest due to arbitrage activity with such options. Arbitragers are willing to pay more for call options and less for put options when interest rates rise because of the interest earnings potential on short sales made to hedge long calls and opportunity costs of not earning that interest.

Trends

Rho will be lower for deep out of the money call, while it will be higher for a deep in the money call.

Rho will be lower for a deep in the money put and it will be higher for a deep out of the money put.

Rho of a call and a put will change, with the expiration of time and it tends to approach zero as expiration approaches.

GAMMA

Delta measures the change in price of an option resulting from the change in the underlying price. However, *Delta* is not a constant. When the underlying moves so does the *Delta* value on any option. This rate of change of *Delta* resulting from movement of the underlying is known as *Gamma*

The gamma of any option is the rate of the change of the option's delta with respect to the price of the underlying stock. Gamma does not measure any sensitivity of option premium with respect to the underlying parameters deciding the option value. Gamma is a second order derivative of option premium with respect to the stock prices. Enabling him to make a quick estimate of how the delta is changing.

Gamma is a measure of how fast an option changes its directional characterstics, acting more or less like an underlying position. The gamma can help a trader maintain a delta neutral position. *Gamma* is largest for options that are at-the-money, while smallest for those options that are deepest in- and out-of-the-money.

Trends

- The gamma of a put and call option will always be equal.
- Higher gamma reflects the greater sensitivity of option's delta wrt the stock price.
- Gamma of deep out of the money options will always be lower and will be less sensitive to the change in the stock prices.
- Gamma also varies with the time remaining until expiration. The greater value of the gamma reflects the greater sensitivity of the delta wrt the stock prices, when the expiration is approaching for near the money option.

There is a direct correlation between theta and gamma. When an options gamma is high, the theta moves higher as well. When we say higher, it means theta becomes more negative which negatively impacts the time premium for a long option holder. Some options traders will actually play the high theta by selling shorter term options and buying that same strike option with a greater term to maturity at the same time. They are banking on the fact that the longer dated option will have slower time decay than the shorter dated option.

OTHERS

Other than Gamma there are several other higher order derivatives like Charm, Color, Lambda, Vomma,

Vanna, Zomma, Ultima, Speed and DvegaDtime. Most of these measures the rate of change of a specific first order derivative with time or some other factoe.

BLACK SCHOLES MODEL AND OPTION GREEKS
DELTA:
A by-product of the Black-Scholes model is the calculation of the delta: the degree to which an option price will move given a small change in the underlying stock price. The formula for a the delta of European call on a non-dividend paying stock is:
Delta = $N(d_1)$
Gamma:

$$\text{Gamma} = \frac{d^2C}{dS^2} = \frac{e^{(-d^2/2)}}{S\sigma\sqrt{2\pi T}}$$

Gamma is a measure of the calculated delta's sensitivity to small changes in share price.
Theta:

$$\text{Theta} = \frac{dC}{dt} = \frac{\frac{S\sigma}{e^{(d^2/2)}}}{2\sqrt{2\pi T}} - \frac{rE}{e^{rT}} * N(d-\sigma\sqrt{T})$$

Theta measures the calcualted option value's sensitivity to small changes in time till maturity.
Vega:

$$\text{Vega} = \frac{S\sqrt{T}}{\frac{e^{(d^2/2)}}{\sqrt{2\pi}}}$$

Vega measures the calculated option value's sensitivity to small changes in volatility.
Rho:

$$\text{Rho} = \frac{TE}{e^{rt}} N(d-\sigma\sqrt{T})$$

CHAPTER V

REGULATIONS AND LEGAL FRAMEWORK
SMDRP/DC/CIR-15/0
This is in continuation with SEBI Circular No.SMDRP/DC/CIR-8/01 dated June 21, 2001 and SEBI Circular No.SMD/DC/Cir-10/01 dated November 2, 2001 regarding adjustment in derivative contracts at the time of corporate action.
Committee of the ACD constituted to determine the manner of adjustment in derivative contracts at the time of corporate action. The Exchanges may now determine the manner of adjustment in derivative contracts at the time of corporate actions in conformity with the following principles:-

- The basis for any adjustment for corporate action shall be such that the value of the position of the market participants on cum and ex-date for corporate action shall continue to remain the same as far as possible.
- The exchanges shall take into account best practices followed internationally.
- The exchanges shall act consistent with SEBI Circular No. SMDRP/DC/Cir-8/01 dated June 21, 2001 on adjustment for corporate actions as well as the decisions of the erstwhile sub-committee on corporate actions.
- The Exchanges shall consider the circumstances of a particular case and the general interest of investors in the market.
- The Exchanges shall ensure that the adjustment methodology for a corporate action is uniform across all exchanges

SMDRP/DC/CIR- 8/01: Adjustment of Corporate Actions for Stock Option
The 'Technical Group' headed by Prof. J.R Varma, set up to prescribe risk containment measures for new derivative products, has recommended the risk containment measure for Exchange traded Stock Option Contracts.
Certain adjustments for Corporate Actions for Stock Options would be as follows:

1. The basis for any adjustment for corporate action shall be such that the value of the position of the market participants on cum and ex-date for corporate action shall continue to remain the same as far as possible. This will facilitate in retaining the relative status of positions viz. in-the-money, at-the-money and out-of-money. This will also address issues related to exercise and assignments.

2. Any adjustment for corporate actions shall be carried out on the last day on which a security is traded on a cum basis in the underlying cash market.

3. Adjustments shall mean modifications to positions and / or contract specifications as listed below such that the basic premise of adjustment laid down under 1. above is satisfied :
    a. Strike Price
    b. Position
    c. Market Lot / Multiplier

    The adjustments shall be carried out on any or all of the above based on the nature of the corporate action. The adjustments for corporate actions shall be carried out on all open, exercised as well as assigned positions.

The methodology proposed to be followed for adjustment of various corporate actions to be carried out are as follows :

Bonus, Stock Splits and Consolidations

Strike Price : The new strike price shall be arrived at by dividing the old strike price by the adjustment factor as under.

Market Lot / Multiplier : The new market lot / multiplier shall be arrived at by multiplying the old market lot by the adjustment factor as under.

Position : The new position shall be arrived at by multiplying the old position by the adjustment factor as under.

The adjustment factor for Bonus, Stock Splits and Consolidations is arrived at as follows:

Bonus

Ratio – A : B Adjustment factor : (A+B)/B

Stock Splits and Consolidations

Ratio – A : B Adjustment factor : A/B

Right

Ratio – A : B Premium – C Face Value – D Existing Strike Price : X

New Strike Price : ((B * X) + A * (C + D))/(A+B)

Existing Market Lot / Multiplier / Position : Y

New issue size : Y * (A+B)/B

1. Dividends which are below 10% of the market value of the underlying stock, would be deemed to be ordinary dividends and no adjustment in the Strike Price would be made for ordinary dividends. For extra-ordinary dividends, above 10% of the market value of the underlying stock, the Strike Price would be adjusted.
2. The Exchange may on a case to case basis carry out adjustments for other corporate actions as decided by the group in conformity with the above guidelines.

IES/DC/CIR- 5/00: Risk containment measures for Option on Indices.

This is in continuation of SEBI Circular No. IES/DC/CIR-4/99 dated July 28, 1999 wherein SEBI had laid down the risk containment measures for Exchange traded Index Futures Contracts. The 'Technical Group' has recommended the risk containment measure for Exchange traded Options on Indices. While SEBI would not mandate any particular risk management product, the framework shall be consistent with the risk management guidelines mandated by the L. C. Gupta Committee. The Exchanges are free to decide whether they want to adopt any of the risk management models available globally or else may like to develop their own models for risk management.

Few relevant points from the given circular:

The Index option contracts to be traded on the derivative exchange/segments shall have prior approval of SEBI. The Contract should comply with the disclosure requirements, if any, laid down by SEBI.

For the purpose of the calculation of option values the exchanges may use any of the following standard Option Pricing Models – Black-Scholes, Binomial, Merton, Adesi-Whaley.

For option positions, the premium shall be paid in by the buyers in cash and paid out to the sellers in cash on T+1 day.

Until the buyer pays in the premium, the premium due shall be deducted from the available Liquid Net Worth on a real time basis

SMD/DC/CGM/ CIR - 6/01: Reporting of option contracts to SEBI

In continuation of our circular dated June 20, 2000 on reporting of derivative contracts to SEBI, you are advised to provide the additional information, as per the attached sheet, for each derivative contract, on a daily basis. Required information should be submitted to SEBI at the end of each trading day, by 5 P.M.

- Following has to be reported:
- Product
- Series
- Type
- Volume (in number of contracts)
- Notional Value (in Rs. Crores)
- Open interest at the end of the day (in no. of contracts)
- VAR at the close of the day.

SEBI/DNPD/Cir-26/2004/07/16

Risk containment measures, position limits and the broad eligibility criteria of Stocks and Index on which futures and options could be introduced.

This circular is being issued in exercise of powers conferred by section 11 (1) of the Securities and Exchange Board of India Act, 1992, read with section 10 of the Securities Contracts(regulation) Act 1956, to protect the interests of investors in securities and to promote the development of, and to regulate the securities market.

Based on the recommendations of the Advisory Committee, considered and approved by the SEBI Board, the eligibility criteria, the position limits and the risk containment measures in the derivative markets stand modified.

SEBI/DNPD/Cir-33/2007 Introduction of mini derivative (Futures & Options) contract on Index (Sensex & Nifty)

This circular is being issued in exercise of powers conferred by sub-section (1) of Section 11 of the Securities and Exchange Board of India Act, 1992, to promote the development of the securities market. Pursuant to the recommendation of the Derivatives Market Review Committee (DMRC) headed by Professor M. Rammohan Rao, it has been decided to introduce mini derivative contract on Index (Sensex and Nifty).

The existing risk containment and other measures applicable for existing exchange traded equity Index derivative contracts shall also be extended to the mini derivative contract on Index.

SEBI/DNPD/Cir-34/2008

Introduction of Index options with longer tenure

The risk containment and other measures applicable for existing exchange traded equity Index option contracts shall be extended suitably to long term option contracts on Index. The SEBI Derivatives Market Review Committee (DMRC) headed by Professor M. Rammohan Rao, recommended the introduction of new derivative products in the Indian market, with option contracts on indices and stocks with life/tenure of up to 5 years (60 months) being one of them. The risk containment and other measures applicable for existing exchange traded equity Index option contracts shall be extended suitably to long term option contracts on Index.

CONCLUSION

Financal Risk Management forms a vital segment of Fiancial Markets in the current times.It is very beneficial for the investors to take correct decisions. Derivatives form a vital part of Financial Market. Options are one such derivative. Paper mainly concerns with the option as derivative and the measures of factors influencing Option Procies, However it is more of a managerial affair and managers should have correct knowledge about these risks involves- factors affecting prices and the sensitivity.

There are Five measures of sensitivity of option premium- delta, gamma, theta, rho and vega. The knowledge of these measures and sensitivity- their trend and behavior is very useful for the purpose of hedging the risks by the portfolio managers. Prtfolio insurance or dynamic hedging is the process of reducing losses by buying put options on the stocjk in addition to the underlying stock or by creating put options synthetically – which requires an understanding of this sensitivity.

Coming to Law part- it consists merely of the SEBI circular and that too relating to Options in general. In UK we have separate Act and laws but not in India- it infers that Options are not Expressly recognized in India- But we have certain Circulars. Sensitivity being a managerial concerns there has to be this absence. But we should come out with definite rules and regulations for each derivative including Options- and to avoid speculation guidelines relating to option premiums as well.

References

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