ABSTRACT

Financial Derivatives are innovative instruments in the financial market. Derivatives have a great deal of use in risk management. A judicial use of derivatives in right proportion enables a corporate manager to minimize risk and optimize return. Basically, there are four categories of derivatives i.e. Forward, Futures, Options, and Swaps. In India, futures and options are commonly used. In option derivative, the premium which is paid by the option holder to the option writer is known as option premium or option price. For determining the theoretical price of the option, the most appropriate model i.e. Black Scholes option pricing Model. This option pricing model is well accepted throughout the world. If the theoretical price of an option contract deviates significantly from its actual price, then the financial market will be seriously disturbed. This paper studies the efficacy of commonly used Greeks such as Delta, Gamma, Theta, Vega, and Rho and their significance in managing various types of risks associated with an option contract. Further these five Greeks are taken only for European Option within the Black Scholes Model framework. The scope of the study covers monthly option pricing and Greeks of ITC, HDFC and RELINFRA for the month of January 2017. Lastly, an attempt has been made to explore the implication of these Greeks for managing the risk associated with an option contract.

Keywords: Derivative, Risk Management, Option Pricing

INTRODUCTION

Corporate risk management is the management of unpredictable events that would have adverse consequences for the firms. In the financial market, the players may face financial risk exposures such as Price exposure (asset price exposure), foreign rate exposure, interest rate exposure and inflation rate exposures etc. Derivatives are a specific type of instruments that derive their value over time from the performance of underlying assets i.e. equities, bonds and commodities for hedging the financial risk.

In the world of finance, we find four types of derivatives in the name of Forwards, Futures, Options, and Swaps. Derivatives may be categorized as “Over The Counter (OTC) Derivatives” and “Exchange Traded Derivatives”. Option derivative is prevailing globally as it can be traded in OTC market as well as Exchange Traded market. Banks, Financial Institutions, Mutual Funds, Corporations, Individual Investors and Pension Administrators use option derivatives to hedge the various kinds of exposures in their financial dealings.

Through research evidence and practices, few models have been developed globally to determine the theoretical price (price of the option is determined by using certain factors as well as certain models) of the option. Essentially the difference between the theoretical price of the option and the price which is actually paid (actual premium paid by the option holder to option the writer) by the holder in real practice should not be significant. In case the difference is highly significant, then the financial market
of a country will be under stress. The factors which influence the value of an option are the current price of the underlying assets, Strike Price, Time to Maturity, Volatility of the Underlying Security Price and Risk-Free Interest.

Option trading means buying and selling option. The principle of options trading is to maximize payoff or minimizes potential risk looking at the stock market behavior. The options trader should be knowledgeable in measuring various categories of risks associated with trading. Through mathematical formulae, certain numbers are generated to measure these risks. Collectively these numbers are titled as Option Greeks. These option Greeks are named as Delta (∆), Gamma (γ), Theta (θ), Vega (ν) and Rho (ρ).

OBJECTIVE OF STUDY

1. To examine the impact of various determinants on option price.
2. To make an in-depth study of risk hedging strategies with options.
3. To suggest the risk management strategy through option contracts.

RESEARCH QUESTION

The option contract in financial derivative plays a crucial role in hedging the risk by minimising the volatility. Identifying the actual price of any contract will help to reduce the chances of risk for an individual, business firms and corporate houses. Past research states that common people are unaware about the price discovery or risk hedging technique through option contract. Hence, this paper will highlight the following research question “How to calculate the prices of option contract and hedge the risk by considering all the determinants?”

LITERATURE REVIEW

1. Ms. Shalini and Dr. Raveendra, (2014). Derivatives are tool for managing risk and the growth of derivatives in the recent years has surpassed the growth of its counterpart globally.
2. Fischer Black and Myron Scholes (1973). An empirical test made and observed option buyers pays more than that is predicted through formulas as there is larger transaction costs in option market.
3. Hemal Thakker and A.A Attarwalla (2016), the analysis is done to identify that price discovery is possible through binomial option pricing model. The result states that the market value of Nifty option pricing and Binomial option pricing model is significantly different from each other.
4. Thomas F. Coleman, Yohan Kim, Yuying Li and Arun Verma (2001), the volatility smile is derived out of the implied volatility. Though this ensures integrity of valuation, it distorts the delta and other Greeks because using the implied volatility cannot ensure integrity of Greeks. Thus there is a volatility smile adjustment to be made to the Greeks, especially Delta, because we use this Greek to spot hedge.
6. Midhula Mohan K. and A.V. Hemalatha (2016) the financial derivative in recent trend has shown a highest growth in financial market. The result states that most of the private and government sector are engaged in derivative trading rather than post office saving, FD or LIC. However, common people are not aware which can be done through the broker and exchanges.
7. Yuh-Dauh Lyuu. Huei-Wen Teng, (2011), Risk hedging through Option Greeks is observed to be less variate from the actual result this help for predicting by using various formulas numerically which are unbiased.
8. Luis H. Ederington and Wei Guan, (2007). There are other higher order derivatives can be considered. Particularly important in accounting for option price changes delta and others also has the role, but gamma has gained all kind of popularity.

RESEARCH METHODOLOGY

In the study, the data covers European Option price (both call and put). This data are selected for a period of one month i.e. Jan 2017. The three companies i.e. HDFC (financial sector), ITC (FMCG sector) and RELINFRA (Power generation sector) have been selected from convenience sampling.

OPTION DERIVATIVE – A CONCEPTUAL FRAMEWORK

Options are contracts which provide the holder the right to sell or buy a specified quantity of an underlying asset at a fixed price on or before some point of time in future. The options can be classified into call option and put option. “The call option is one where the option buyer has a right to buy (call) the asset while a put option is one where the option buyer has right to sell(put) the asset before the writer”. The option holder has to pay a premium to the option writer for availing the right.

Style of Exercise of Option

In Derivative finance, the style of an option denotes the date on which the option may be exercised by the holder. Depending on when an option can be exercised it can be classified into following categories:

1. American style Option or American option: in this style, the option can be exercised by the option holder at any time during the life of the contract, i.e., on or before the expiration date. Thus, in an American style, the option holder has right to exercise his right to buy/sell any time before the expiry date.

2. European Style Option or European Option: In this style, the option may be exercised only on the expiry date of the option, i.e., at a single pre-defined point in time.

In options trading CA represents Call option American style, CE represents Call Option European Style, PA represents Put option American style and PE represents Put Option European Style. Besides the common term Long means to buy while short means to sell.

The position of an option trader

The position of an options trader may be the buyer of the call, the buyer of the put, the seller of a call or seller of a put. When we analyze any financial transaction through option contract (European Style) we find the following results:

<table>
<thead>
<tr>
<th>Option Position</th>
<th>On the date of option contract</th>
<th>At Expiration of the option contract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buyer (Holder) of a call: (Long call) --&gt; Right to buy</td>
<td>The option holder pays a premium and acquires the right to buy the underlying asset at the strike price on the expiration date.</td>
<td>Let X = Strike Price, ST = Market Price of the underlying asset</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If ST &gt; X, the option holder exercises the option. Then Gross pay-off = ST - X and Net Profit = ST – X – Premium.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If ST &lt; X, the option holder does not exercise the option, then Net Profit = Zero – Premium.</td>
</tr>
<tr>
<td>Buyer (Holder) of a put: (Long put) ---&gt; Right to sell</td>
<td>The option holder pays the premium and acquires the right to sell the underlying asset at the strike price on the expiration date.</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If ST &lt; X, the option holder exercises the option. Then Gross pay-off = X – ST and Net Profit = X – ST - Premium.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>• If ST &gt; X, the option holder does not exercise the option, then Net Profit = Zero – Premium.</td>
</tr>
</tbody>
</table>
The seller (Writer) of a call: (Short call) --- > Obliged to sell

The option writer receives the premium and commits to deliver the underlying asset at the strike price on the expiry date if the holder exercises the option and demands the delivery.

• If ST > X, the option holder exercises the option, then Net Loss = (X – ST) + Premium.
• If ST < X, the holder does not exercise the option. Then, Net Profit = Premium.

The seller (Writer) of a put: (Short put) --> Obliged to buy

The option writer receives the premium and commits to buy and take delivery of the underlying assets at the exercise price on the expiration date if the holder exercises the option and give delivery of the underlying.

• If ST < X, the option holder exercises the option. Then Net Loss = (ST – X) + Premium.
• If ST > X, the holder does not exercise the option. Then, Net Profit = Premium.

The impact of determinants on option price- A practical approach

Option strategy is a zero-sum game, so the option premium paid (transaction value of the option) should not significantly differ from the theoretical value of the option. To determine the theoretical value of the option six factors are to be considered. These determinants are the Spot price of the underlying asset (S), Strike Price (X), Time till Expiration (T), Expected Volatility (σ), Risk-Free Interest Rate (r) and Expected Income/Dividend (D).

The following table shows the effect of the price of an option when one of the determinants increases keeping other five determinants as constant.

<table>
<thead>
<tr>
<th>Determinant of Option Price</th>
<th>Increase</th>
<th>Call Price</th>
<th>Option Price</th>
<th>Put Price</th>
<th>Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spot price of underlying asset (S)</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strike Price (X)</td>
<td>↑</td>
<td>↓</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Time tillExpiration (T)</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Expected Volatility (σ)</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Risk-Free Interest Rate (r)</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td>↑</td>
<td></td>
</tr>
<tr>
<td>Expected Income/ dividend (D)</td>
<td>↑</td>
<td>↑</td>
<td>↓</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The above-stated determinants of option pricing and their respective implications can be put in the following model:

**Option Moneyness: At-the-Money (ATM), In-the-Money (ITM), Out-of-the-Money (OTM)**

A call option gives the holder the right to buy at the exercise price while a put option gives the holder the right to sell at the exercise price. At a particular time, the underlying may be greater, equal or lesser than the Exercise Price. In such situations, the options are said to be at-the-money (ATM) or in-the-money (ITM) or out-of-the-money (OTM). These situations are as shown below:

<table>
<thead>
<tr>
<th>Call Option</th>
<th>Option is said to be</th>
<th>Put Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exercise Price= Market Price</td>
<td><strong>At-the-Money</strong></td>
<td>Exercise Price= Market Price</td>
</tr>
<tr>
<td>Exercise Price&lt; Market Price</td>
<td><strong>In-the-Money</strong></td>
<td>Exercise Price&gt;Market Price</td>
</tr>
<tr>
<td>Exercise Price&gt; Market Price</td>
<td><strong>Out-of-the-Money</strong></td>
<td>Exercise Price&lt; Market Price</td>
</tr>
</tbody>
</table>
Risk Hedging strategies by using option Greeks

Price of a call option or put option on non-dividend paying asset is a function of five variables namely the Spot price of the underlying asset (S), Strike Price (X), Time Till Expiration (T), Expected Volatility (σ), Risk-Free Interest Rate (r). If there is any change in any variable or determinant during the option contract, its effect will be on option price. In case the effect is negative, then the options trader will be at risk. Through mathematical formulae, certain numbers are generated to estimate these risks. Collectively, these numbers are known as “Greeks”. In this paper, we have discussed five Greeks namely Delta (Δ), Gamma (γ), Theta (θ), Vega (ν), Rho (ρ). Each Greek letter of an option measures the sensitivity of an option price with respect to change in the value of a given underlying parameter such as underlying asset price.

Efficacy of Greeks in option trading

1. Option Delta- it helps to analyze that how sensible is option price towards the change in underlying assets.

2. Option Gamma- it response to the change in option delta that leads to change in the value of stock price. Gamma tends to rise if underlying assets is close to expiration.

3. Option Vega- It considers the implied volatility that affects the price of the stock. Implied volatility refers to market’s estimation which is calculated by the standard deviation. So higher the volatility higher will be the sensitivity of option.

4. Option Theta- It considers the time of expiry i.e. lesser the time of expiry lesser will be the option pricing. In such case to earn a good amount of profit the option needs to be sold at right time.

5. Option Rho- It considers the interest rate that is available in the market. As the rate of interest is usually fixed for a long period of time so the use of Rho is very less. But Rho is very useful for the underlying assets that are meant for long term.

Option Greeks: Concept, Derivation and Modelling Approach

<table>
<thead>
<tr>
<th>Greeks</th>
<th>Call Option</th>
<th>Put Option</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>Option Delta (Δ)</td>
<td>( \frac{\partial C}{\partial S} )</td>
<td>( \frac{\partial P}{\partial S} )</td>
<td>Where, ( \partial ) = Partial Derivative, C= Call option Price, S= price of the underlying asset, P= Put option price</td>
</tr>
<tr>
<td>Option Gamma (γ)</td>
<td>( \frac{\partial \Delta}{\partial S} = \frac{\partial^2 C}{\partial S^2} )</td>
<td>( \frac{\partial \Delta}{\partial S} = \frac{\partial^2 P}{\partial S^2} )</td>
<td>Where, ( \gamma ) = Gamma, ( \Delta ) = Option Delta, S= Stock Price, C= Call option Price, P= Put option price</td>
</tr>
<tr>
<td>Option Theta (θ)</td>
<td>( \frac{\partial C}{\partial t} )</td>
<td>( \frac{\partial P}{\partial t} )</td>
<td>Where, ( \partial ) = Partial Derivative, C= Call option Price, t= time till expiration, P= Put option price</td>
</tr>
<tr>
<td>Option Vega (ν)</td>
<td>( \frac{\partial C}{\partial \sigma} )</td>
<td>( \frac{\partial P}{\partial \sigma} )</td>
<td>Where, ( \partial ) = Partial derivative, P= Put option price, C= Call price, ( \sigma ) = volatility</td>
</tr>
<tr>
<td>Option Rho (ρ)</td>
<td>( \frac{\partial C}{\partial r} )</td>
<td>( \frac{\partial P}{\partial r} )</td>
<td>Where, ( \partial ) = Partial derivative, P= Put option price, C= Call price, r = Risk-free interest rate</td>
</tr>
</tbody>
</table>
OPTION GREEKS COMPUTATIONAL PROCEDURE: EXAMPLES

1. Call Option Greeks- A Numerical Example

<table>
<thead>
<tr>
<th>Inputs</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strike Price (Rs)</td>
<td>175</td>
</tr>
<tr>
<td>Spot Price (Rs)</td>
<td>170</td>
</tr>
<tr>
<td>Time (Days)</td>
<td>34</td>
</tr>
<tr>
<td>Volatility (%)</td>
<td>25</td>
</tr>
<tr>
<td>Interest (%)</td>
<td>10</td>
</tr>
<tr>
<td>Type</td>
<td>Call Option</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Price (Rs)</td>
<td>3.74</td>
</tr>
<tr>
<td>Delta</td>
<td>0.4130</td>
</tr>
<tr>
<td>Gamma</td>
<td>0.0300</td>
</tr>
<tr>
<td>Theta</td>
<td>-33.7560</td>
</tr>
<tr>
<td>Vega</td>
<td>20.2016</td>
</tr>
<tr>
<td>Rho</td>
<td>6.1920</td>
</tr>
</tbody>
</table>

Option Value = 3.74

This is the theoretical price of the option or the option premium in Rs.

**Delta = 0.4130**

If the share price or the underlying changes by a small amount, then the option price should change by 0.41 times of that amount. A negative sign would indicate a decrease in option price, whereas positive sign would indicate an increase in the option price. In this case if the underlying changes by Rs 1 or 1 point the option price should change by 0.41 times of the change. Therefore, the premium should change by $0.41 \times 1 = 0.41$ Rs.

**Gamma = 0.0300**

If the share price changes by a small amount, then the delta should change by 0.0300 times that amount. If the underlying share price or index is increased by 1, then the delta should change by 0.0300

**Theta = -33.7560**

If the time to maturity changes by a small amount, then the option value should change by $-33.7560$ times that amount. As we have 365 days in the year. A decrease of one day would mean a change of $0.2739\%$ of a year, therefore, the option value should change by $0.002739 \times -33.7560 = -0.0925$. The negative sign indicates a decrease in option price.

**Vega = 20.2016**

If the volatility changes by a small amount, then the option value should change by 20.2016 times that amount.

If the volatility increased by 0.01 (1%), then the option value should change by $0.01 \times 20.2016 = 0.0003$

**Rho = 6.1920**

If the interest rate changes by a small amount, then the option value should change by 6.1920 times that amount. A negative sign would indicate a decrease in the option price. If the interest rate is increased by 0.01 (1%), then the option value should change by $0.01 \times 6.1920 = 0.0619$. 

2. Put Option Greeks- A Numerical Example

<table>
<thead>
<tr>
<th>Inputs</th>
<th>Strike Price (Rs) 175</th>
<th>Spot Price (Rs) 170</th>
<th>Time (Days) 34</th>
<th>Volatility (%) 25</th>
<th>Interest (%) 10</th>
<th>Type Put Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Results</td>
<td>Price (Rs) 7.12</td>
<td>Delta -0.5870</td>
<td>Gamma 0.0300</td>
<td>Theta -16.4183</td>
<td>Vega 20.2016</td>
<td>Rho -9.9582</td>
</tr>
</tbody>
</table>

Option Value = 7.12

This is the theoretical price of the option or the option premium in Rs.

**Delta = -0.5870**

If the share price or the underlying changes by a small amount, then the option price should change by -0.59 times of that amount. A negative sign would indicate a decrease in option price, whereas positive sign would indicate an increase in the option price. In this case if the underlying changes by Rs 1 or 1 point the option price should change by -0.59 times of the change. Therefore, the premium should change by -0.59 * 1 = -0.59 Rs.

**Gamma = 0.0300**

If the share price changes by a small amount, then the delta should change by 0.0300 times that amount. If the underlying share price or index is increased by 1, then the delta should change by 0.0300

**Theta = -16.4183**

If the time to maturity changes by a small amount, then the option value should change by -16.4183 times that amount. As we have 365 days in the year. A decrease of one day would mean a change of 0.2739% of a year, therefore, the option value should change by 0.002739 * -16.4183 = -0.0450. The negative sign indicates a decrease in option price.

**Vega = 20.2016**

If the volatility changes by a small amount, then the option value should change by 20.2016 times that amount.

If the volatility increased by 0.01 (1%), then the option value should change by 0.01 * 20.2016 = 0.0003

**Rho = -9.9582**

If the interest rate changes by a small amount, then the option value should change by -9.9582 times that amount. A negative sign would indicate a decrease in the option price. If the interest rate is increased by 0.01 0 (1%), then the option value should change by 0.01 * -9.9582 = -0.0996.

1. **Option Greeks-An Empirical Analysis:**

Financial Derivative tends to fluctuate due to several factors beyond the change in prices of underlying assets. To maintain a healthy portfolio with fewer chances of risk an investor should manage the expected risk by applying Greek characters based on such the investor can take a decision that whether to buy or sell the option contract.
Information | ITC | RELINFRA | HDFC  
--- | --- | --- | ---
Today | 02/01/2017 | 02/01/2017 | 02/01/2017  
Maturity | 25/01/2017 | 25/01/2017 | 25/01/2017  
Strike Price | 265 | 500 | 1300  
Stock Price | 240.95 | 478.7 | 1217.1  
Dividend | 0 | 0 | 0  
Int Rate | 0.0619 | 0.0619 | 0.0619  
Volatility | 0.2090 | 0.1971 | 0.2161  
Calendar | 17 | 17 | 17  
Years | 0.06746 | 0.06746 | 0.06746  
Shares | 100 | 100 | 100  

From above calculations and graph, we got a clear picture that how well Greeks characters help to understand the risk and return of option contract, that an investor can take the right decision. We considered three companies namely ITC (FMCG), RELINFRA (Power and Distribution) and HDFC (Finance). HDFC and ITC show out the money i.e. the price of the stock less than the price of the strike. These stocks are a high risk that makes them less expensive. An investor if prefer to accept this stock due to less expensive then he/she is making its portfolio very risky. In contrary, the stock price is found a bit more than the strike price in case of Reliance infrastructure which makes it less risky and hence attracts many investors.

**SUGGESTIONS**

1. For any options trading, an investor must consider the sensitivity of the option
2. The investor should take the position of a call option writer or put option holder in the bearish market to hedge the financial risk.
3. In the bullish market, the investor should be a call option holder otherwise if they take the position of call option writer then you will incur more losses. Similarly in the same bullish
market, one should take the position put option writer otherwise if they take the position of put option holder, then they will suffer financial losses.

4. Regular awareness programme should be conducted by SEBI, NSE, BSE, and MCX, NCDEX (Use of Option and Future Derivatives) for the investors in India.

5. SEBI being the regulator of security market should introduce strategic measures for boosting derivative segment in India as a technique of hedging.

CONCLUSION

This article presents a simple way to understand option derivative, the determinants of option pricing models and also the concept of moneyness in options trading. The five option Greeks for European options under the Black Scholes model have been studied with respect to their individual potentiality. To make the derivative market more strong the players should have right kind of knowledge in understanding these Greeks and their judicious applicability for hedging any kind of adverse exposure.

FUTURE STUDY

The paper tries to focus on giving basic idea on Option Greeks as it is one of the complicated contracts in financial derivative. The analysis is done for one month considering three sectors as the calculation required a statistical tool to measure the vast data. However, a researcher or an investor can calculate different sector in following ways so as to identify how to hedge the risk in option contract.

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