Research Report for Extra Marks

On

Understanding of Greeks through
Call options with underlying as 'Amazon Stock'

(Derivation of Greeks, their understanding and relevance to Amazon stock)

By

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DERIVATIVES INSTRUMENTS

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Contents

1. INTRODUCTION

As part of extra marks – research, I have decided to calculate Greeks for the call and put options with underlying as a public listed company (AMAZON here) and develop my understanding with through data analysis and connect with the theory taught in the class.

1.1 Research Scope

Following derivative been considered for calculation:-

- Call option with underlying as Amazon Stock

- Put option with underlying as Amazon Stock

Following Greeks have been computed:-

- Delta, with variation of Stock prices

- Gamma, with variation of stock prices

- Rho, with variation in stock prices

- Vega, with variation in stock prices

- Theta, with variation in stock prices

- Implied volatility for the call option.

1.2 Research Methodology

My approach was as below:-

- Data Collection – through public domain for Amazon stock prices and Amazon derivative prices along with their strike prices and expiry

- Greeks calculation

- Variation of above w.r.t. stock price and time to expiry

- Understanding

2. Risk Sensitivities - Greeks

2.1 Delta

Delta is one of the most important Greeks in term of calculation and analysis of the variation of an option price.

Contract Specification			
Call Options		Put Option	
Spot	$1629.13	Spot	$1629.13
Strike	$2105	Strike	$1560
Days to Expiry	0.366666667 4/18/2019	Days to Expiry	0.36666666 4/18/2019
Risk Free Rate	2.36%	Risk Free Rate	2.36%
Volatility	30.00%	Volatility	30.00%
Dividend yield	1.76%	Dividend yield	1.76%

Delta Variation with Stock Price

Call Option - Delta vs Stock Price

Put Option - Delta vs Stock Price
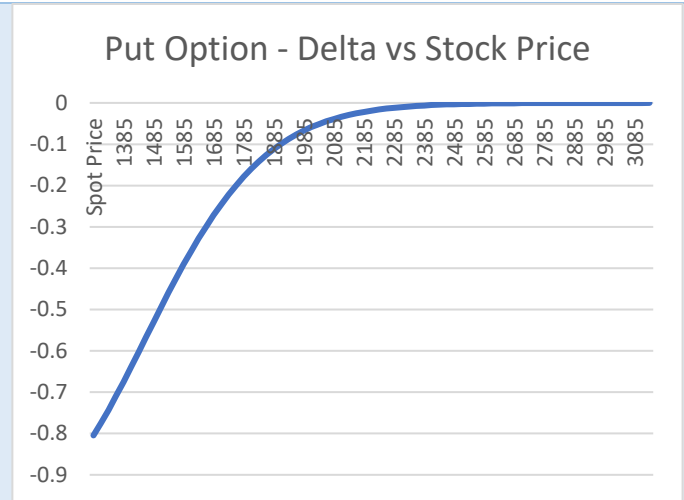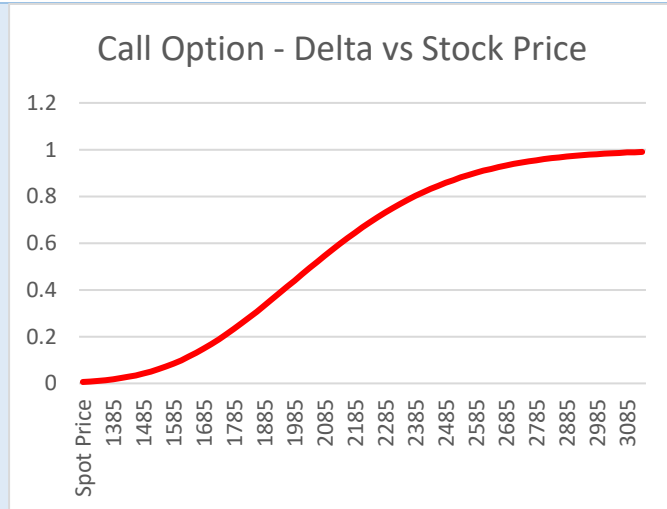
Interpretation for Above

- Below $1530, the call is out of the money as the delta of the call approaches 0.

- Between $1530 to $2110, the delta of the call increases.

- It can be observed that at stock price $2110, the delta is relatively close to 0.5 (>0.5).

- As the stock price rises to $2850 and above, the delta approaches 0.99 and gets nearer to 1. The option is clearly in the money.

Interpretation for Above

- Over $2290, the put is out of the money as the delta of the call approaches 0.

- Between $1441 to $2290, the delta of the put increases.

- It can be observed that at stock price $1535, the delta is relatively close to -0.5 .

- Below $1410, the delta approaches -0.99 and gets nearer to -1. The put option is in the money.

Exercise Point

- Call option to be exercised when stock price is greater than $2850

Exercise Point

- Put option to be exercised when stock price is lower than $1410.

2.2 Gamma

Gamma measures the rate of change in an option's delta per 1-point move in the underlying asset price.

Contract Specification			
Call Options		Put Option	
Spot	$1629.13	Spot	$1629.13
Strike	$2105	Strike	$1560
Days to Expiry	0.366666667 4/18/2019	Days to Expiry	0.36666666 4/18/2019
Risk Free Rate	2.36%	Risk Free Rate	2.36%
Volatility	30.00%	Volatility	30.00%
Dividend yield	1.76%	Dividend yield	1.76%
Gamma Variation with Stock Price			

Call Option - Gamma vs Stock Price
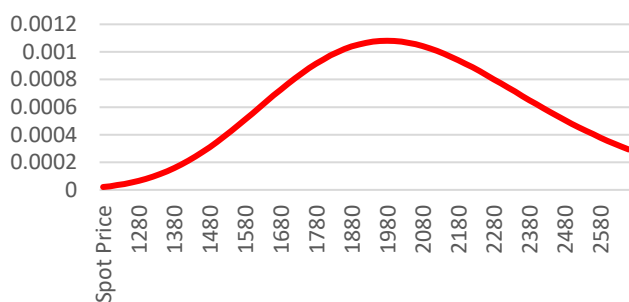
Put Option - Gamma vs Stock Price
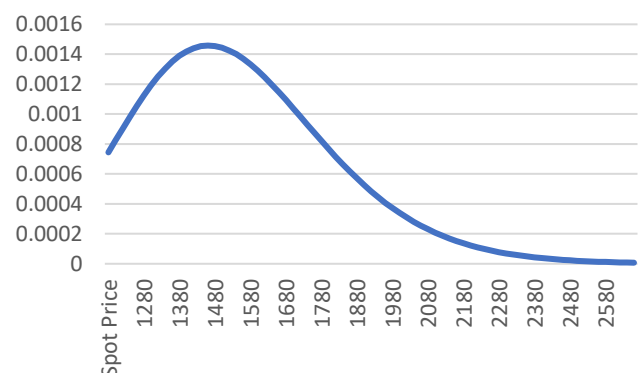
Interpretation for Above

- Below $1280, the call is out of the money as the Gamma of the call approaches 0.
- Between $1280 to $1980 the Gamma of the call increases.
- It can be observed that at stock price $1980, the Gamma is relatively close to 0.012.
- As the stock price rises to $2580, the Gamma approaches 0. The option is in the money.
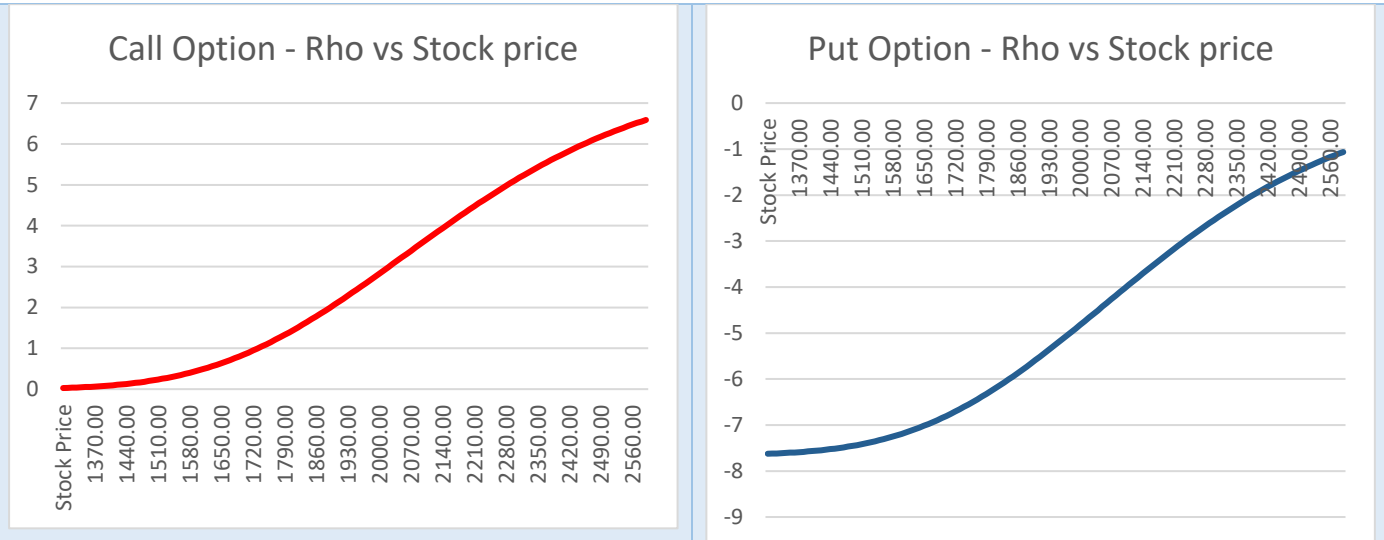
Interpretation for Above

- Below $128, the put is out of the money as the Gamma of the put approaches 0.
- Between $1280 to $1480, the Gamma of the call increases.
- It can be observed that at stock price $1480, the Gamma is relatively close to 0.0014
- As the stock price rises to $2080, the Gamma approaches 0. The option is in the money

2.3 Rho

Rho represents the rate of change between an option's value and a 1% change in the interest rate. This measures

sensitivity to the interest rate.

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Strike	$2105	Strike	$1560
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Volatility	30.00%	Volatility	30.00%
Dividend yield	1.76%	Dividend yield	1.76%

Rho Variation with Stock Price

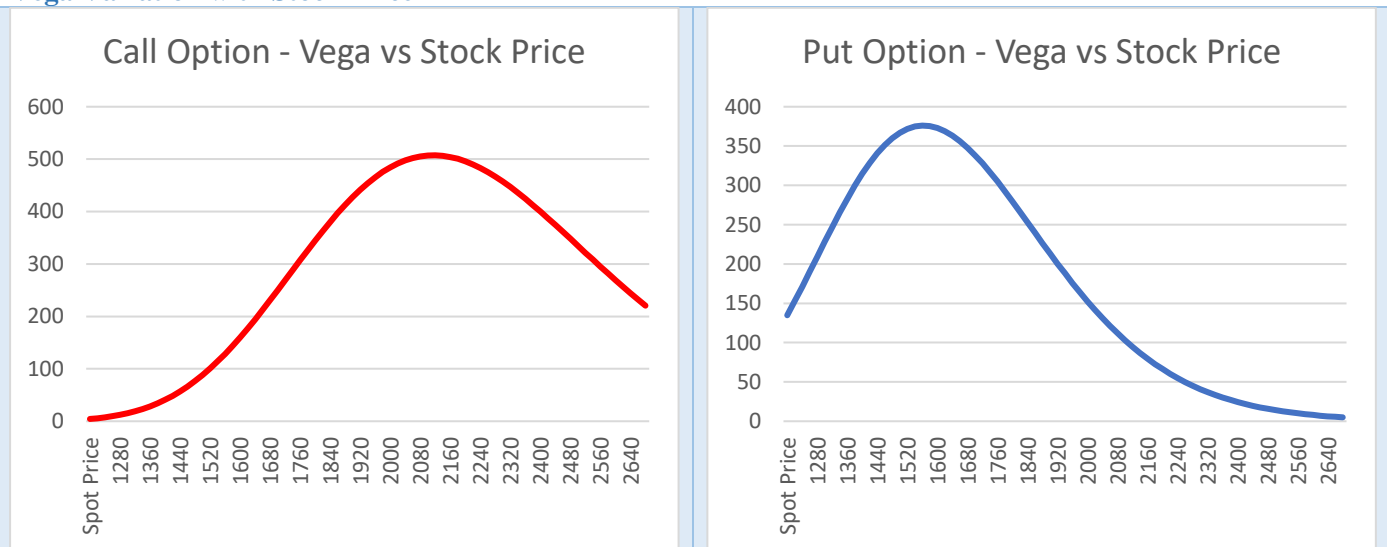**Interpretation for Above**

- For Call out of money, Rho is quite low, that is its sensitivity to the interest rate is low when out of the

    money.

- In the money, Rho is quite high meaning high sensitivities to interest rate.

- Similarly for put option.

2.4 Vega

Vega is the Greek which is directly link to the implied volatility of the underlying asset.

Contract Specification			
Call Options		Put Option	
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Strike	$2105	Strike	$1560
Days to Expiry	0.366666667 4/18/2019	Days to Expiry	0.36666666 4/18/2019
Risk Free Rate	2.36%	Risk Free Rate	2.36%
Volatility	30.00%	Volatility	30.00%
Dividend yield	1.76%	Dividend yield	1.76%

Vega Variation with Stock Price

Call Option - Vega vs Stock Price

Put Option - Vega vs Stock Price

Interpretation for Above

- Vega is higher for the put than the call, it is because I choose longer maturity of puts.

- Also, for options too far away from being at-the-money (either Out-of-the-money or in-the-money) Vega is very small for above and option in general are not affected by the volatility.

2.5   Theta

Theta measures the rate of change in the value of the option with respect to the passage of time while all else remain the same.
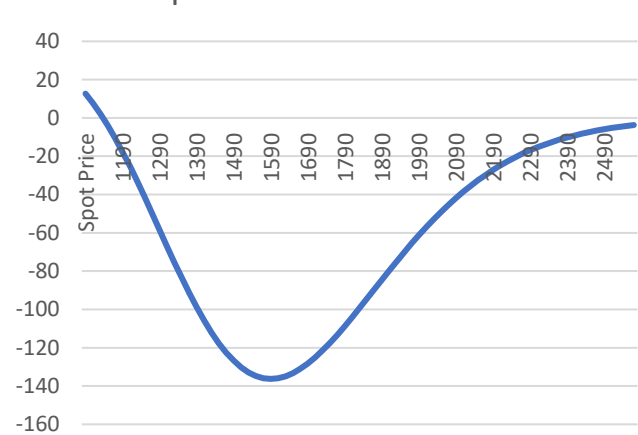
Contract Specification			
Call Options		Put Option	
Spot	$1629.13	Spot	$1629.13
Strike	$2105	Strike	$1560
Days to Expiry	0.366666667 4/18/2019	Days to Expiry	0.36666666 4/18/2019
Risk Free Rate	2.36%	Risk Free Rate	2.36%
Volatility	30.00%	Volatility	30.00%
Dividend yield	1.76%	Dividend yield	1.76%

Theta Variation with Stock Price
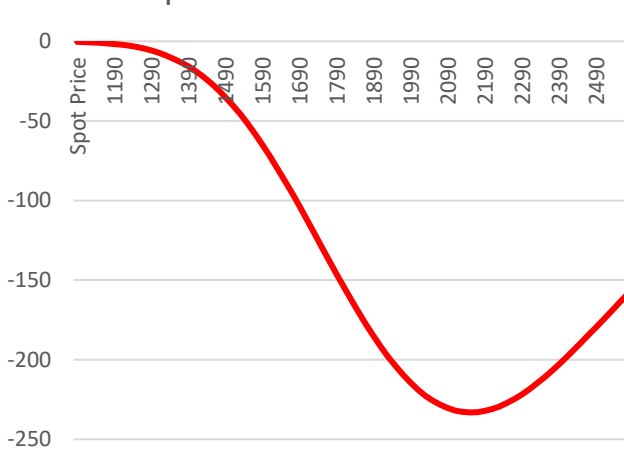
Interpretation for Above

- Theta is highest (in absolute values) when at the money and decreases when in the money or out of the money.

- At-the-money options will experience more significant dollar losses over time than in- or out-of-the-money options with the same underlying stock and expiration date.

- That's because at-the-money options have the most time value built into the premium. And the bigger the chunk of time value built into the price, the more there is to lose.

3 RESULTS

- For Delta, as the option approaches maturity, it can be observed that the delta of the call tends to 0.5. Whereas the delta of the call as time to maturity approaches, gets closer to -0.3.

- For Gamma, it was observed that as the time to expiration draws nearer, the gamma of at-the-money options increases while the gamma of in-the-money and out-of-the-money options decreases.

- Rho is quite low for Amazon Stocks, meaning that the sensitivity to the interest rate is low when out of the money. In the Money, Rho is quite high meaning that the sensitivity to the interest rate is important. At the Money, Rho reaches a middle level between low and high.

- For vega, it reaches its maximum point when the stock price approaches the strike price.

- For Theta, conclusion is call on the stock is out of money.

4 REFERENCES

- Risk Free Rate: https://www.treasury.gov/resource-center/data-chart-center/interest-rates/Pages/TextView.aspx?data=billrates

- Amazon Quotes: https://www.barchart.com/stocks/quotes/AMZN/options?moneyness=allRows