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Greek Lessons: Rho Explained

Measuring the Impact of Interest Rate Changes on Option Pricing

Chris Hausman, CMT® | April 27, 2017 | Swan Blog

Rho, Rho, Rho your boat!

An option's sensitivity to changes in interest rates is known as "rho," which is one of the Greeks used to determine how an option's value can change.

P The Greek letter "P," pronounced 'rōw'.

One of the more hotly debated topics is exactly when and how much the Federal Reserve will be raising interest rates in the near future. It finally appears a credible plan of systematic interest rate raises is in place.

However, market conditions can still have an impact on whether or not the Federal Reserve ultimately acts or remains "data dependent." After many years of essentially zero rates, it was inevitable that rates should finally move higher.

This is a good opportunity to review how option prices are affected by changes in interest rates (Rho) and what that means.

Federal Reserve Interest Rate Probability

Meeting	Prob Of Hike	Prob of Cut	0.75-1	1-1.25	1.25-1.5	1.5-1.75	1.75-2	2-2.25	2.25-2.5
05/03/2017	13.3%	0.0%	86.7%	13.3%	0.0%	0.0%	0.0%	0.0%	0.0%
06/14/2017	63.2%	0.0%	36.8%	55.6%	7.7%	0.0%	0.0%	0.0%	0.0%
07/26/2017	64.4%	0.0%	35.6%	55.0%	9.1%	0.2%	0.0%	0.0%	0.0%
09/20/2017	81.5%	0.0%	18.5%	45.7%	31.2%	4.5%	0.1%	0.0%	0.0%
11/01/2017	82.2%	0.0%	17.8%	44.6%	31.8%	5.6%	0.3%	0.0%	0.0%
12/13/2017	86.5%	0.0%	13.5%	38.2%	34.8%	11.9%	1.6%	0.1%	0.0%
01/31/2018	87.3%	0.0%	12.7%	36.7%	35.0%	13.2%	2.2%	0.2%	0.0%

Source: Bloomberg

In general, of the five basic inputs used to price options (Delta, Theta, Vega, Gamma, and Rho), interest rates are of the least concern. This is because most option strategies are short-term in nature, and changes in interest rates will have very little impact.

In contrast, option strategies that have longer maturities, such as Long-Term Equity Anticipation Securities (LEAPS), can have a significant impact on option pricing. Once again, Rho risk gets little respect since most traders employ short term strategies; thus there is little impact on option prices with changes in interest rates. However, there can be material changes to premiums with longer-dated options, so Rho risk should not be ignored.

There are cash flows involved in trading options that can result in either credits or debits. These cash flows will either earn interest or be charged a borrowing fee. Therefore, interest rates must be considered as one of the basic inputs that go into the generally accepted Black-Scholes option pricing model.

Interest rates affect the forward price of a given underlying.

For our example, we will use stock-type settlement.

- If interest rates increase, that increases the forward price of the underlying, and call prices will rise and put prices will decline.
- If interest rates decrease, that decreases the forward price of the underlying and now put prices will rise and call prices will decline.

Option pricing models assume delta neutrality.

Let's explain this by using put-call parity, which assumes identical pay-off structures can be replicated various ways with options.

Under the assumption of parity, there are no arbitrage opportunities.

1. A long stock position can be hedged by shorting a call and purchasing a put.
2. Conversely, a short stock position can be hedged by purchasing a call and selling a put.

   If interest rates decline, the holder of long stock will be paying less in borrowing costs and should be willing to sell the call at a cheaper price and purchase the put at a higher price to hedge the position.

   If short stock is held and interest rates rise, then the short stock rebate collected will increase and the short stock holder should be willing to purchase the call at a higher price and sell the put at a lower price to hedge the position.

In other words, if one does not account for Rho, a clever trader would be able to earn a riskless, arbitrage profit.

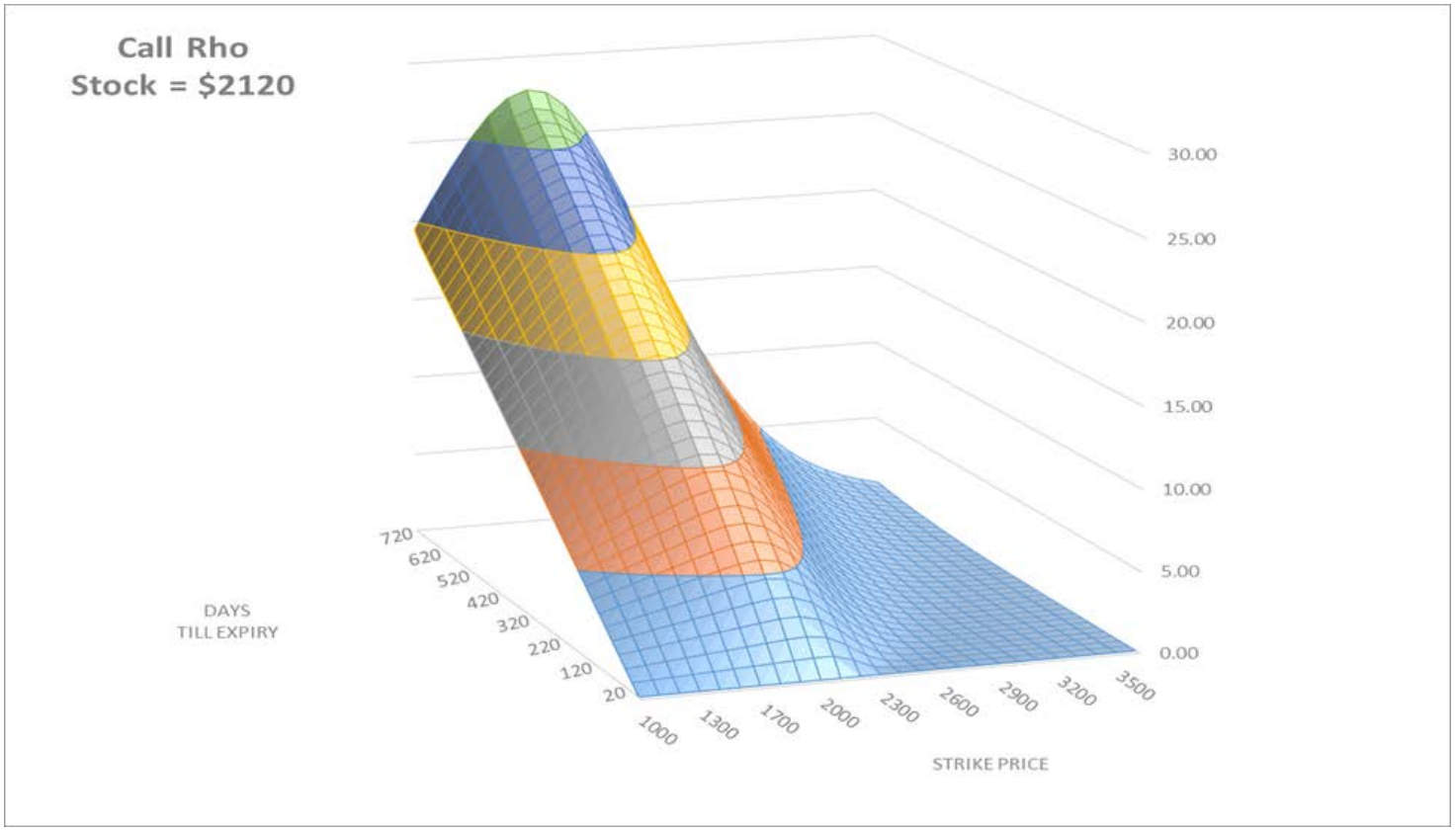
Typically, the risk-free rate is the rate used in the option pricing model to derive theoretical prices. Yields on government securities with maturities equivalent to the expiry of the option would be the appropriate input into the model. In reality, however, we cannot lend and borrow at the same government rate so a more realistic, or "tradable," rate may be the yield on Eurodollar futures, for example.

Complicating matters even more, most traders must borrow at a higher rate and lend at a lower rate, so their models might even incorporate multiple rates like required when evaluating options on foreign currencies.

In short, Rho is positive for calls and negative for puts.

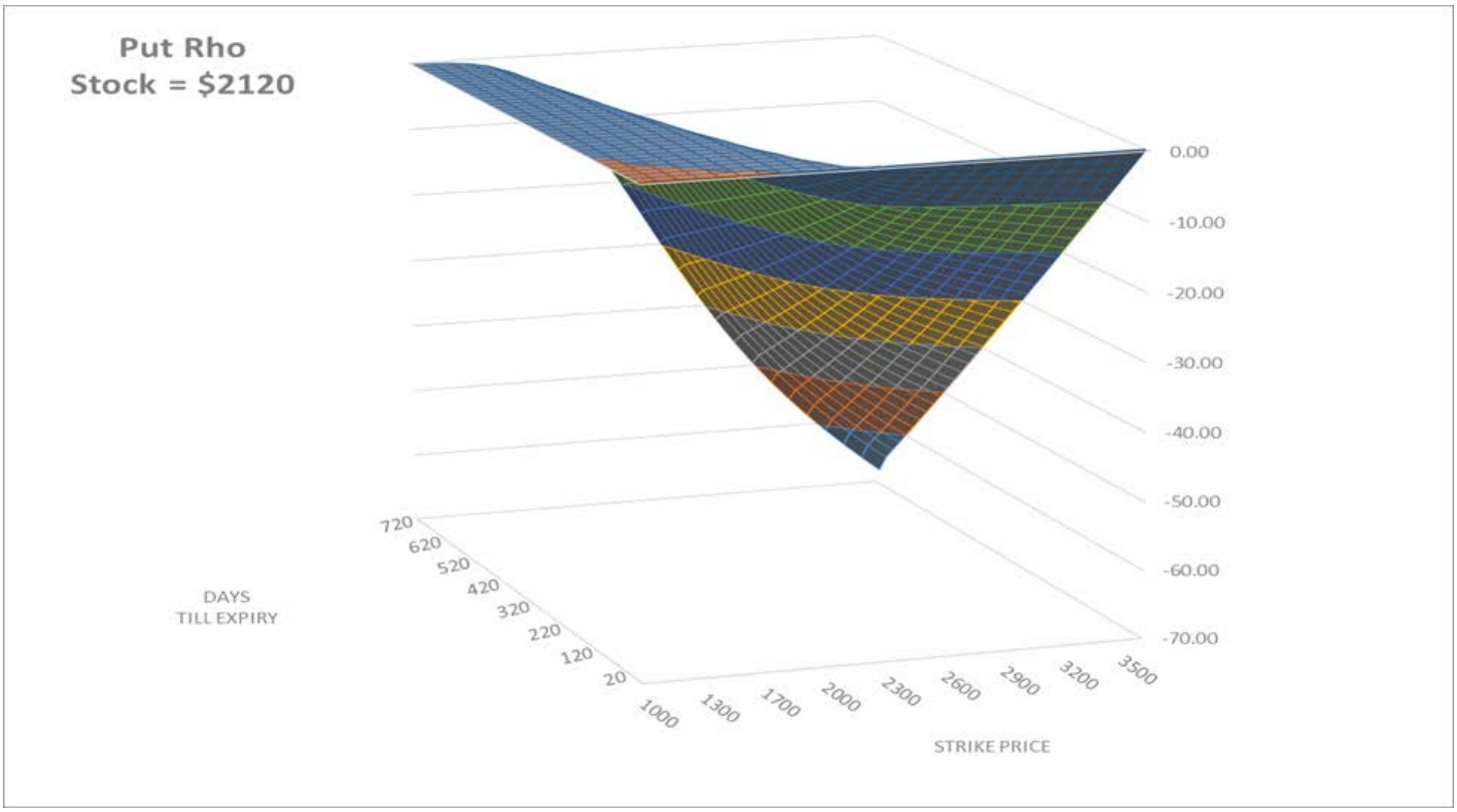
As discussed, the Rho is much greater for longer term options. Rho increases as calls go further in the money and decreases (gets more negative) as puts go further in the money.

Below are two graphs demonstrating the Rho characteristics for calls and puts. In the call example, the stock price is at $2120. Strikes range from 1000 up to 3500 and the time until expiration ranges from 0 out to 720 days. The graph clearly shows that deeper in the money calls (strikes less than the current stock price and with more time to maturity) have the most sensitivity to changes in interest rates.



Source: Swan Global Investments

The same can be said for puts, except now higher strikes with more time until expiration will have the most sensitivity to changes in interest rates.



Source: Swan Global Investments

Those who utilize option strategies must always be cognizant of all the potential risks.

Over the last few years with short-term rates held close to zero, Rho risk has essentially been a non-issue. This will likely change moving forward as we are about to begin a new interest rate cycle that many have not witnessed or simply forgot what it felt like.

Consequently, adhering to sound risk management principles and proper assessment of all risks will help navigate you in merrily achieving your financial goals.

Check out the rest of the Greek Lessons blog series:

- Delta Explained
- Theta Explained
- Vega Explained

Feel free to review more information on the Defined Risk Strategy performance, or its components, or call 970.382.8901.

About the author:

Chris Hausman, CMT®, Director of Risk Management and Chief Technical Strategist, focuses on risk assessment and management for the Defined Risk Strategy investments and positions. He monitors risk across all of Swan's portfolios and prepares stress tests, risk assessment reports and contributes to strategic decision making for the investment management team, as well as serving as an additional layer of oversight for the trading team. As a Chartered Market Technician, he also acts as Chief Technical Strategist at Swan Global Investments.

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