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Equity Options

MONTRÉAL EXCHANGE

Interest rates regimes and option prices

The financial crisis of 2008, was followed by an exceptional period of (very) low interest rates. With rates at extremely low levels by historical measures, option price sensitivity to interest rates has been anything but irrelevant in practice over the last decade. However, 2018 has marked the definite end of the ZIRP (Zero Interest Rate Policy) in North America. The US Federal Reserve has raised the overnight rates 4 times so far this year and both short-term and longer dated rates are on the rise. It is therefore the right time for option users to take a closer look at the relationship between option prices and interest rates and how it might affect their investment and trading decisions.

The forgotten Greek:

The most widely used method by market participants to price options is the well-known Black & Scholes model (B&S 1973). Option traders use a number of different versions of this pricing formula in order to try and match more closely the reality of the world we live in. For instance, by considering things such as sudden jump and discontinuity of stock prices, which the original B&S formula does not incorporate. For the purposes of this note, we will rely on the original B&S formula. Nonetheless, most of our observations and comments hold true in general and are model-independent.

For a stock or an equity index, the price of an option depends on a number of parameters (called variables): the price of the underlying stock (index), the option's strike price, the time left before the option expires (i.e. time to maturity), the implied volatility (one can think of this as a measure of the market's estimate of future volatility), the dividend yield of the stock (index) and finally the prevailing interest rate (the one that matches the period left to the maturity of the option: i.e. a 6 month interest rate for a 6 month option).

When one of these variables changes, it naturally causes the price of the option to change along with it. For instance, if the stock price moves higher – all else equal - the price of a call option increases, or as time elapses – all else equal – the price of an option decreases, the infamous "time decay".

In derivatives' jargon, the sensitivity of an option price to each one of these variables is designated by a specific Greek letter. Options traders monitor closely these sensitivities as they allow them to estimate how their portfolios will perform under different market scenarios. More specifically:

- Δ (Delta) is the change in option price due to the change in the underlying price (here the stock or index)
- ν (Vega) is the change in option price due to changes in the implied volatility (i.e. perception of future risk)
- θ (Theta) is the change in option price due to the passage of time
- and ρ (Rho) is the change in the price of the option due to the change in interest rate

Out of these 4 Greeks, as you might have noticed, ρ (Rho) is the one that is least talked about in the media or among traders. Why? The main reason is that options prices are quite more sensitive to the other 3 Greeks than to ρ (Rho). Traditionally, the effects of interest rate changes on options prices are much less important than those resulting from the move in the stock (index) price or the effects of a jump in implied volatility. Yet, in a low interest rate environment or a changing interest rate environment, Rho becomes relevant and deserves some level of attention and recognition.

Getting to know Rho:

Rather than diving into a technical review to how interest rates affect options prices, we will focus on acquiring some intuition on the interplay of rates and options prices. Here are three rules of thumbs that are quite useful in practice.

a) Interest rates matter most for longer dated options

In a risk neutral world, an investor should receive the same return on capital whether he/she holds a stock (index) or cash. The following relation (1) describes the expected price of a stock (index) in such a world:

Stock (index) price today + Interest (holding period) – Dividend (holding period) = Interest on Cash (1)

The fair price of a stock (index) at a given time in the future (called Forward price) is the price of the stock today plus the interest one would receive over the period from today to that date (assuming no dividends). This is because in a risk-neutral world all assets "grow" at the risk-free rate and one is indifferent to holding one asset or the other.

As a result, one can readily see that whether rates decline or increase; the longer the holding period of the stock (index), the more its future value will be affected by the prevailing interest rate. That is why longer dated options are more sensitive to changes in interest rates.

Table 1 below shows option prices for an at-the-money call on a $50 stock for maturities ranging from 3 months to 2 years, the stock has a 2.5% dividend yield and we assume a 25% implied volatility.

We have valued these options for an interest rate of 1% and 3% respectively. As expected longer dated option prices are more sensitive both on an absolute and a relative basis to change in interest rate.

A 2-year option's price increases by 13% if rates go from 1% to 3% whereas a 6 months option's price only raises by 7% for the same increase in rates.

TABLE 1

Price of an $50 call option

(stock at $50, implied volatility 25%, dividend yield 2.5% per year)

Time to maturity	3 months	6 months	9 months	1 year	1.5 year	2 year
Interest rate = 1%	$2.39	$3.31	$3.98	$4.53	$5.39	$6.08
Interest rate = 3%	$2.51	$3.54	$4.31	$4.96	$6.02	$6.88
Price difference ($)	$0.12	$0.23	$0.33	$0.43	$0.63	$0.80
Price difference (relative)	4.9%	6.9%	8.3%	9.6%	11.6%	13.2%

Relative difference = (Option price 3% / Option price 1%) -1

For a portfolio containing longer-dated options (for example LEAPS), it is important to monitor the sensitivity to interest rates.

b) Changes in interest rates have more effect on options on low volatility stocks (indices)

As we mentioned, a main reason for the lack of focus on interest rates when it comes to option pricing is that the effect of other variables on pricing is quite more important. Usually, changes in stock (index price) and in implied volatility dominate by far those of interest rates.

However, for stock (indices) with low volatility, changes in option prices due to interest rates can become of the same magnitude of those due to implied volatility.

Table 2 shows the price of a two year at-the-money call for $50 stock assuming a 2.5% dividend yield for implied volatilities ranging from 10% to 35%.

While the absolute change in option price remains around 36 cents when we increase interest rates from 1% to 3%, on a relative basis the price of a call for a low-volatility stock (10% implied volatility) increases by 18% whereas that of a stock with 25% implied volatility increases only by about 5%.

TABLE 2

Price of a 2-year $50 call option

(stock at $50, dividend yield 2.5% per year)

Implied Volatility	10%	15%	20%	25%	30%	35%
Interest rate = 1%	$2.06	$3.40	$4.74	$6.08	$7.41	$8.73
Interest rate = 3%	$2.44	$3.77	$5.09	$6.41	$7.72	$9.02
Price difference	$0.38	$0.37	$0.35	$0.33	$0.31	$0.28
Relative difference	18.4%	10.9%	7.4%	5.5%	4.2%	3.3%

To get a sense of how this observation matters in practice, let's think of some stocks that exhibit a low level of volatility.

Traditionally, financial stocks such as major banks and utilities exhibit low levels of volatility. What is quite interesting is that these stocks are usually quite sensitive to changes in interest rates. Usually bank stocks benefit from rising rates (figure 1) while to the contrary, utilities stocks tend to underperform when interest rates rise (figure 2).

FIGURE 1

Financial stocks vs. 2-year rate

XFN (Financials ETF) vs. Canada 2 year rates

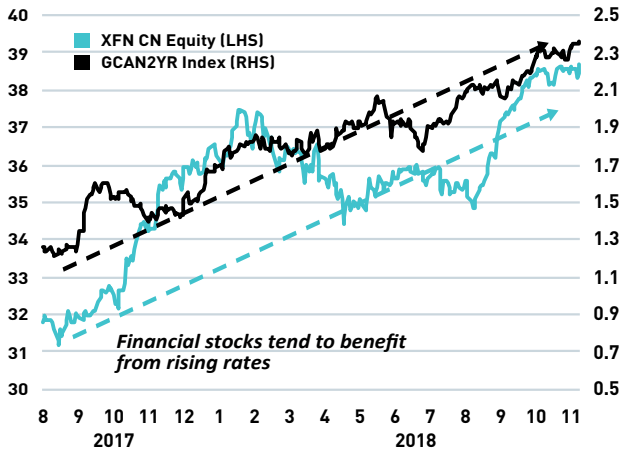
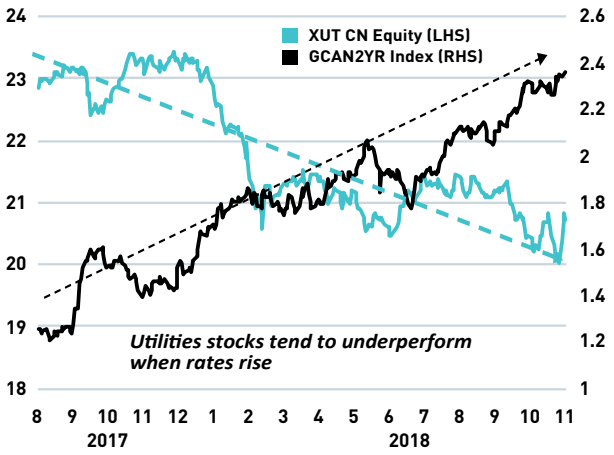


FIGURE 2

Utilities stocks vs. 2-year rate

XUT (Utilies ETF) vs. Canada 2 year rate



In practice this means that interest rates affect banks and utilities option prices through two channels:

1. the strong link (correlation) of stock prices and interest rates for these sectors, and

2. the fact that these sectors have low volatility, therefore their option prices are more sensitive to changes in interest rate changes.

What's most important to remember is that in a changing interest rate environment, special attention must be directed towards options on stocks (indices) with low volatility. The financial and utilities sectors are of particular importance given that interest rates affect them through both stocks prices and the interest rate portion of the option valuation formula.

An example of a practical conclusion of these observations for an investment portfolio is the fact that:

- If one expects higher interest rates along the way, call options on banks could capture a double effect: calls appreciating as stocks would likely rally due to higher rates and call option price appreciating as interest rates drive their pricing higher.

In other words, if a stock (or any security) is sensitive to interest rates then options on that stock are affected

c) Interest rates, call and put prices

A useful and simple rule of thumb is (all else equal):

Higher rates, higher call prices (and lower put prices)

Lower rates, lower call prices (and higher put prices)

Table 3: Rule of thumb on option prices and interest rates

(all else equal)

Interest Rates	Call price	Put Price
Up	↑	↓
Down	↓	↑

This rule is based on to the risk neutral relation we discussed previously.

Combining this rule with one's directional view on a stock (index) and depending on the level of interest rates, an investor can build option strategies to implement his/her fundamental view with a higher risk-adjusted return when compared to simply implementing that view by buying (selling) the stock or index.

Let us go over some practical examples:
In a high rate environment (all else equal), the cost of put options its relatively lower. As a result, hedging a long stock (index) portfolio is less costly when rates are higher. Interestingly, high rate environments can often coincide with the end of the economic cycle, when volatility is also low – making options relatively cheaper.

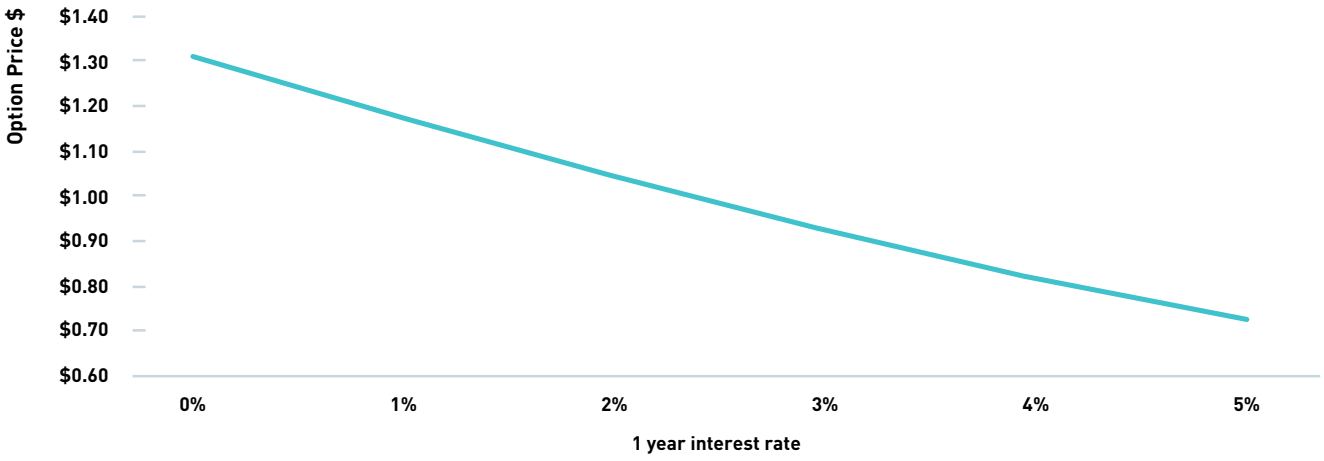
That is to say that put hedging strategies are more appropriate in a low volatility and higher rate environment (which is likely to coincide with the top of the economic cycle).

Figure 3 shows, for a $50 stock that a 1 year 10% out of money (i.e. $45 strike) put's price increases by 50% (from $0.70 to about $1.15) when rates drop from 5% to 2%. While one might point out that this kind of sudden drop in rates is not necessarily a realistic scenario – to the exception of major events like the financial crisis or Tech Bubble - for those running systematic hedge programs even a 5 or 10% difference in the cost of hedging can be significant on the long run.

FIGURE 3

Price of a 1 year $45 strike put for a $50 stock

(Implied vol = 15%, div yield = 2.5%)



Conversely, in a low rate environment the cost of puts is relatively higher. A low rate environment is also often the result of aggressive rate cuts following an economic downturn and a market sell-off where implied volatilities are elevated.

Therefore, in a high volatility and low rate environment, for instance in the aftermath of a strong economic downturn and/or equity market correction, put write strategies are more appropriate.

Where are rates likely to come into play next?

To answer this question, one should focus on markets and economies where the interest rates are volatile or the interest regime is likely to shift.

Emerging markets traditionally have higher interest rates levels than developed markets. 2-year rates in Brazil and South Africa are both above 7%, in Russia above 9% and in Turkey it exceeds 25%. Additionally, interest rates volatility in emerging markets are also more volatile. Exposure to these markets via options exhibit higher sensitive to interest rate.

In the developed world, while interest rates in US and Canada have been on the rise over the last year, rates remain still very low in Europe. If one is of the view that the end of the Quantitative Easing (QE) by the European Central Bank is likely to be a catalyst for higher rates, then a portfolio of long dated option on European stocks (indices) will see the relatively significant effects from the potential change in interest rate levels.

Lastly, if you are of the school of thought which sees the potential for rates to move quite higher from present levels in the US and Canada on the back of inflation or other catalysts – this view has gained some traction over the last year and is something we have not witnessed in over two decades - then keeping a close eye on options on US and Canadian equities, indices and ETFs is warranted.

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In addition to niche derivatives strategies, LFC also provides risk-management, hedging and overlay advisory services to family offices, institutional investor and businesses.

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