The VIX Encounters Murderers' Rho

Is anyone ever happy with the level of the VIX? If it shoots higher in the midst of a market break, as it has done with regularity over the past decade, people start drawing various arbitrary lines in the digital sand, proclaiming each successively higher level to be the certain sign of a market bottom.

If it goes too low, also on an arbitrary standard, the sackcloth-and-ashes crowd emerges to proclaim impending doom upon the land. Verily, a VIX below [fill-in-the-blank] is blasphemous, and surely the wicked shall perish for their complacency and lack of fear. Please pass the pillar of salt.

Ignored in all the din has been a discussion of what will happen to option prices and volatility if and when short-term interest rates start to rise from current levels.

The Role of Rates

Volatility does not exist to be a simple and linear determinant of future market movements. The time premium contained in an option's price, the total premium less its intrinsic value, is a function of three variables, the time remaining to expiration, the risk-free rate of interest and volatility. Volatility itself is the market's price of uncertainty as determined by the ongoing auction for price insurance in the options market.

Given the roles of these three variables, we can look at options both in terms of loans and of insurance, and these two concepts are linked inextricably. Any increase in volatility - read increase in demand for insurance - increases the price of the option. The option must decline to the greater of zero or intrinsic value by expiration. This rate of decay represents a rate of borrowing to the option buyer; instead of the normal mechanics of a loan whereunder the borrower receives cash and pays it back with interest, here the option buyer pays cash and receives an asset that will decay over time. The sensitivity of option prices to interest rates is referred to with the Greek letter rho.

The September OEX settled on Friday, August 22 at 497.42. If we take the puts and calls at the 495 and 500 strikes, we can see the relationship between volatility and the time premium in each option expressed as a percentage of the index price. The 495 call settled at a higher volatility than the other options; as a result, the time premium paid as a percentage of the OEX is 1.725%.

September Expiration

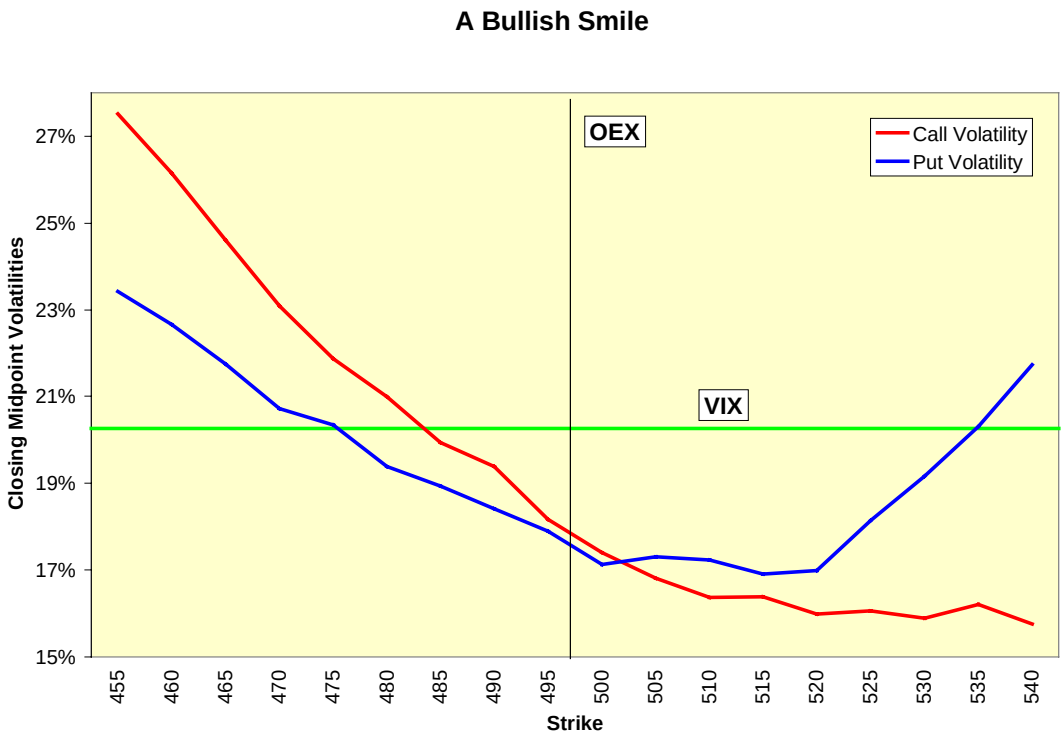
	Call			Put		
Strike	**Premium**	**Volatility**	**Time Premium**	**Premium**	**Volatility**	**Time Premium**
495	$ 11.00	18.321%	1.725%	$ 8.40	17.531%	1.689%
500	$ 8.00	17.277%	1.608%	$ 11.00	17.602%	1.693%

The VIX is constructed by taking the weighted average of the implied volatilities of eight different options on the OEX, the nearest in- and out-of-the-money (ITM and OTM) put and call options of from the first and second month expirations. This construction exposes the VIX to interest rates in several different ways above and beyond the rate of decay mentioned above. Only one, the shape of the option "smile" curve, will be discussed here. The intermonth spread between September and October is the other principal interest rate trade.

Smiling With The Box

We expect volatility to be lowest at the at-the-money (ATM) strikes and to rise for both ITM and OTM strikes, producing a smile on the chart. In an ideal world with symmetric risks higher and lower and frictionless arbitrage, the smile would be symmetric and equal, or unskewed, for the puts and the calls.

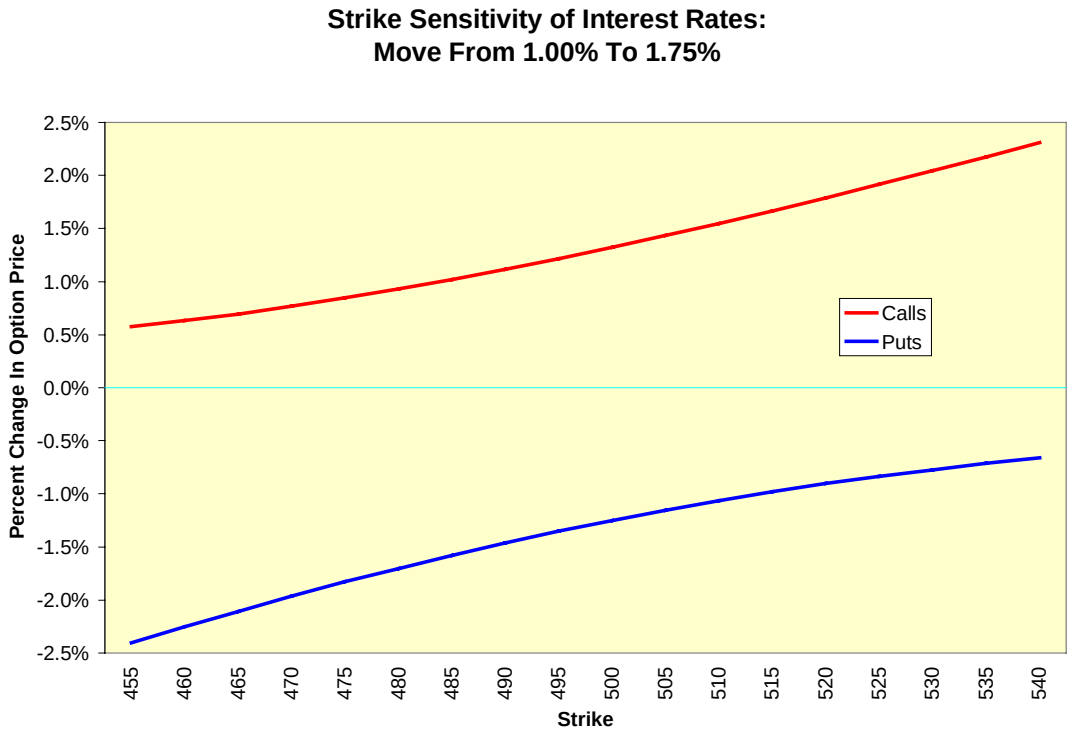
The closing midpoints of the bid and ask prices for last Friday to not depict a textbook smile, however. Volatility is higher, as is typical for an "investor skew" market such as stocks with greater downside anxiety, but the low volatility for OTM calls indicates option traders are betting against a substantial move higher in the near-term. That bet is bullish in a contrarian sense; these traders will need to cover their short bets quickly in sharp move higher.



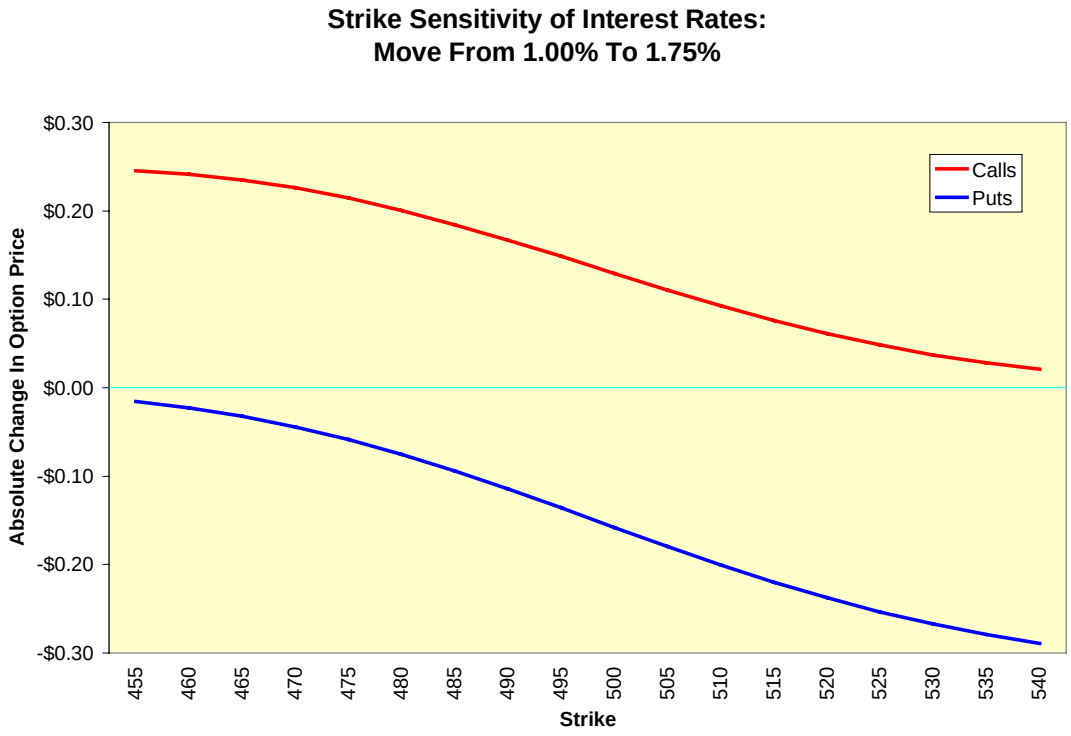
The slope of this smile should reflect interest rates via the mechanics of "box spreading." In the example above, a trader could buy the bull call spread, paying ($11-8, or $3), and the bear put spread, paying ($11-8.4, or $2.6). This trader just paid $5.60 for something that must be worth $5.00, the difference between the strikes, at expiration. That $0.60 in time premium will disappear at expiration and represents an interest rate. The lender here, the seller of the two ITM options, the 495 call and the 500 put, is said to be buying the box.

Impact of Rising Rates

If Harry Truman pleaded for an one-armed economist so he wouldn't have to hear "on the other hand," he would have been apoplectic around option traders, with their partial derivatives requiring that everything else be held equal. Let's illustrate one effect in a partial sense, holding the world constant except for an increase in the risk-free rate from 1.00% to 1.75%. The percentage price changes in the whole series of September OEX options are depicted in the chart below; the calls become more expensive, while the puts become cheaper, with the effects being exaggerated the further out-of-the-money we go.



If we restate the data above not as percentage changes but rather as absolute changes, a different conclusion starts to emerge. It is the ITM options that now change more in price. This would imply that the seller of the box, the trader who buys the ITM options and is borrowing money, would be paying a greater premium for the options.



Given the importance of the ATM options in the calculation of the VIX, we should expect that - all else held equal, of course - volatility to rise as a function of rising interest rates. Once again, the question will not be "is the VIX too high or low?" but "is the VIX appropriately valued given the technical state of the market and the level of interest rates?"