TRADING VIX DERIVATIVES

TRADING AND HEDGING STRATEGIES USING VIX FUTURES, OPTIONS, AND EXCHANGE TRADED NOTES

RUSSELL RHOADS

Trading VIX Derivatives

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Dedicated to Merribeth, who holds down the fort.

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Preface

The current level of the CBOE Volatility Index, or VIX, is part of the litany of information thrown out at a rapid pace on morning business programs. In times of extreme market moves, the VIX gets a bit more attention and possibly a little explanation. That explanation is often that it is a "fear index." Needless to say, the VIX is much more than an index of fear in the stock market.

The VIX emerged from academic work in the early 1990s as a method of determining a consistent level of implied volatility of option contracts trading on the S&P 100 (OEX) Index at the Chicago Board Options Exchange. For almost a decade, this measure was a side note of market activity.

Then, in the early part of the 2000s, the formula was updated to encompass more option contracts and the focus shifted from the S&P 100 to the S&P 500 index. This update, to include more contracts and focus on the S&P 500, was in preparation to offer derivative contracts on volatility.

Futures and then option contracts were developed by the CBOE to allow investors the ability to capitalize on an outlook for market volatility. These contracts witnessed steady growth until the second half of 2008, when, with an explosion in implied volatility, the marketplace realized the benefits of volatility as a diversification tool.

Other exchanges have taken notice of the success of VIX futures and options and have developed their own volatility indexes and derivative products. Volatility indexes and derivatives on gold, oil, currencies, and even soybeans are now calculated and traded by a variety of exchanges.

This book is divided into two sections. The first half of the book is a description and overview of the variety of volatility-related indexes and products currently available. The unique features of many of the derivative contracts are based on implied volatility, and these are touched on throughout the first section. Some of the confusion that novice traders encounter when considering trading VIX products is addressed, along with instructions on how to interpret a variety of indexes.

The second half of this book is devoted to the uses of volatility-related indexes and products. Methods for speculating on the direction of the overall market or just volatility are addressed. Using volatility derivatives as a tool for hedging traditional portfolios is discussed. Also, the emergence of volatility indexes and trading products as forecasting tools is discussed.

Volatility as an asset class and trading tool is a rapidly growing area in the markets. While writing this book, dozens of new indexes and derivative products based on implied volatility were introduced. Trying to keep up with all of them is nearly impossible, and if I'd tried, this book may never have made it to your hands.

Acknowledgments

There are many people throughout my life who have allowed me to reach the point where I look forward to going to work and truly enjoy what I get to do professionally day in and day out.

The primary person is my wife, Merribeth Rhoads. Her support and patience have been a key contribution to the completion of this book in a timely manner.

My daughters, Margaret and Emerson, are a constant inspiration to work hard and accomplish as much as I can to set a proper example for them. My first friend and little pal are the driving force behind all I do.

My father, Richard Rhoads, has always been most supportive when I needed it and offered key pieces of advice at critical points in my career. Also, a special thanks to my Aunt Jean, who has been an excellent matriarch of the Rhoads clan for the past decade or so. I would also like to thank Richard Smith and Margie Johnson, who decided what was best for me well before I could decide myself.

Professionally, the staff of The Options Institute at the Chicago Board Options Exchange is probably the best group of people I have worked with in my life. Alphabetically, I want to thank Taja Beane, Laura Johnson, Barbara Kalicki, Michelle Kaufman, Debra Peters, Pam Quintero, and Felecia Tatum. The other three instructors at The Options Institute—Jim Bittman, Marty Kearney, and Peter Lusk—are the best mix of mentors I could have ever hoped for in my career. Also, Michael Mollet of the CBOE Futures Exchange was very helpful in pointing me in the right direction regarding VIX-related products. The professionals at the brokerage firms I work with on a regular basis have allowed me to maintain a constant enthusiasm for my current position. Finally, a portion of my job is focused on educating college students. Their enthusiasm for and interest in the financial markets rubs off on me.

Also, for a second time around, Meg Freeborn and Kevin Commins of Wiley have been wonderful to work with. I hope to collaborate on more projects with them in the future.

In the time I have been at the Options Institute, I have instructed several thousand individuals who are interested in options trading and strategies. Many of you have challenged me with your questions and inspired me with your interest in the derivative markets. Two chapters in this book directly emanated from discussions and questions that I had with students. To all those who watch webinars or attend classes in person, I truly appreciate the time you give me.

CHAPTER 1

Understanding Implied Volatility

In this book, we will discuss the ins and outs of a popular market indicator, or index, that is based on implied volatility. The indicator is the CBOE Volatility Index®, widely known by its ticker symbol, VIX. It should come as no surprise that a solid understanding of the index must begin with a solid understanding of what implied volatility is and how it works.

Implied volatility is ultimately determined by the price of option contracts. Since option prices are the result of market forces, or increased levels of buying or selling, implied volatility is determined by the market. An index based on implied volatility of option prices is displaying the market's estimation of volatility of the underlying security in the future.

More advanced option traders who feel they have a solid understanding of implied volatility may consider moving to Chapter 2. That chapter introduces the actual method for determining the VIX. However, as implied volatility is one of the more advanced option pricing concepts, a quick review before diving into the VIX and volatility-related trading vehicles would be worthwhile for most traders.

HISTORICAL VERSUS FORWARD-LOOKING VOLATILITY

There are two main types of volatility discussed relative to securities prices. The first is historical volatility, which may be calculated using recent trading activity for a stock or other security. The historical volatility of a stock is factual and known. Also, the historical volatility does not give any indication about the future movement of a stock. The forward-looking volatility is what is referred to as the implied volatility. This type of volatility results from the market price of options that trade on a stock.

The implied volatility component of option prices is the factor that can give all option traders, novice to expert, the most difficulty. This occurs because the implied volatility of an option may change while all other pricing factors impacting the price of an option remain unchanged. This change may occur as the order flow for options is biased more to buying or selling. A result of increased buying of options by market participants is higher implied volatility. Conversely, when there is net selling of options, the implied volatility indicated by option prices moves lower.

Basically, the nature of order flow dictates the direction of implied volatility. Again, more option buying increases the option price and the result is higher implied volatility. Going back to Economics 101, implied volatility reacts to the supply and demand of the marketplace. Buying pushes it higher, and selling pushes it lower.

The implied volatility of an option is also considered an indication of the risk associated with the underlying security. The risk may be thought of as how much movement may be expected from the underlying stock over the life of an option. This is not the potential direction of the stock price move, just the magnitude of the move. Generally, when thinking of risk, traders think of a stock losing value or the price moving lower. Using implied volatility as a risk measure results in an estimation of a price move in either direction. When the market anticipates that a stock may soon move dramatically, the price of option contracts, both puts and calls, will move higher.

A common example of a known event in the future that may dramatically influence the price of a stock is a company's quarterly earnings report. Four times a year a company will release information to the investing public in the form of its recent earnings results. This earnings release may also include statements regarding business prospects for the company. This information may have a dramatic impact on the share price. As this price move will also impact option prices, the option contracts usually react in advance. Due to the anticipation that will work into option prices, they are generally more expensive as traders and investors buy options before seeing the report.

This increased buying of options results in higher option prices. There are two ways to think about this: the higher price of the option contracts results in higher implied volatility, or because of higher implied volatility option prices are higher. After the earnings report, there is less risk of a big move in the underlying stock and the options become less expensive. This drop in price is due to lower implied volatility levels; implied volatility is now lower due to lower option prices.

A good non-option-oriented example of how implied volatility works may be summed up through this illustration. If you live in Florida, you are familiar with hurricane season. The path of hurricanes can be unpredictable, and at times homeowners have little time to prepare for a storm. Using homeowners insurance as a substitute for an option contract, consider the following situation.

You wake to find out that an evacuation is planned due to a potential hurricane. Before leaving the area, you check whether your homeowners insurance is current. You find you have allowed your coverage to lapse, and so you run down to your agent's office. As he boards up windows and prepares to evacuate inland, he informs you that you may renew, but the cost is going to be $50,000 instead of the $2,000 annual rate you have paid for years. After hearing your objections, he is steadfast. The higher price, he explains, is due to the higher risk associated with the coming storm.

You decide that $50,000 is too much to pay, and you return home to ride out the storm. Fortunately, the storm takes a left turn and misses your neighborhood altogether. Realizing that you have experienced a near miss, you run down to your agent's office with a $50,000 check in hand. Being an honest guy, he tells you the rate is back down to $2,000. Why is this?

The imminent risk level for replacing your home has decreased as there is no known threat bearing down on your property. As the immediate risk of loss or damage has decreased tremendously, so has the cost of protection against loss. When applying this to the option market, risk is actually risk of movement of the underlying security, either higher or lower. This risk is the magnitude of expected movement of the underlying security over the life of an option.

When market participants are expecting a big price move to the upside in the underlying security, there will be net buying of call options in anticipation of this move. As this buying occurs, the price of the call options will increase. This price rise in the options is associated with an increase risk of a large price move, and this increase in risk translates to higher implied volatility.

Also, if there is an expectation of a lower price move, the marketplace may see an increase in put buying. With higher demand for put contracts, the price of puts may increase resulting in higher implied volatility for those options. Finally, if put prices increase, the result is corresponding call prices rising due to a concept known as put-call parity, which will be discussed in the next section.

PUT-CALL PARITY

Put and call prices are linked to each other through the price of the underlying stock through put-call parity. This link exists because combining a stock and put position can result in the same payoff as a position in a call option with the same strike price as the put. If this relationship gets out of line or not in parity, an arbitrage opportunity exits. When one of these opportunities arises, there are trading firms that will quickly buy and sell the securities to attempt to take advantage of this mispricing. This market activity will push the put and call prices back in line with each other.

Put and call prices should remain within a certain price range of each other or arbitragers will enter the market, which results in the prices coming back into parity. Parity between the two also results in a similar implied volatility output resulting from using these prices in a model to determine the implied volatility of the market.

Stated differently, increased demand for a call option will raise the price of that call. As the price of the call moves higher, the corresponding put price should also rise, or the result will be an arbitrage trade that will push the options into line. As the pricing of the option contracts are tied to each other, they will share similar implied volatility levels also.

For a quick and very simple example of how put-call parity works, consider the options and stock in Table 1.1.

Using the XYZ 50 Put combined with XYZ stock, a payout that replicates being long the XYZ 50 Call may be created. The combination of owning stock and owning a put has the same payout structure as a long call option position. With the XYZ 50 Call trading at 1.00 and the XYZ 50 Put priced at 2.00, there may be a mispricing scenario. Table 1.2 compares a long XYZ 50 Call trade with a combined position of long XYZ stock and long a XYZ 50 Put.

The final two columns compare a payout of owning XYZ stock from 50.00 and buying the XYZ 50 Put at 2.00 versus buying an XYZ 50 Call for 1.00. Note that at any price at expiration, the long call position is worth 1.00 more than the combined stock and put position. With this pricing

TABLE 1.1 Put, Call, and Stock Pricing to Illustrate Put-Call Parity

Stock/Option	Price
XYZ Stock	$50.00
XYZ 50 Call	$1.00
XYZ 50 Put	$2.00

TABLE 1.2 Payout Comparison for Long Call and Long Stock + Long Put trade

XYZ at Expiration	Long XYZ Stock	Long XYZ 50 Put	Long Stock + Long Put	Long XYZ 50 Call
45.00	−5.00	3.00	−2.00	−1.00
50.00	0.00	−2.00	−2.00	−1.00
55.00	5.00	−2.00	3.00	4.00

difference, there is the ability to take a short position in the strategy that will be worth less and buy the strategy that will be worth more at expiration. The payout diagram in Figure 1.1 shows how the two positions compare at a variety of prices at expiration.

The lines are parallel throughout this diagram. The higher line represents the profit or loss based on buying the 50 call. The lower line represents the payout for the spread combining a long stock position and a long 50 put position. At any price at expiration, the combined position has less value than the long 50 call. Knowing this outcome, it is possible to benefit from the 1.00 spread, which will exist at any price at expiration for two positions that are basically the same.

Due to put-call parity and the mispricing between the 50 Call and 50 Put, the call may be purchased combined with a short position in the stock and put option. A quick transaction using the prices in the example would result in a profit of 1.00 upon options expiration. This 1.00 profit would be realized regardless of the price of the stock at expiration. Firms would attempt to take advantage of this opportunity through buying the cheaper call option and selling the comparable more expensive put option. The market

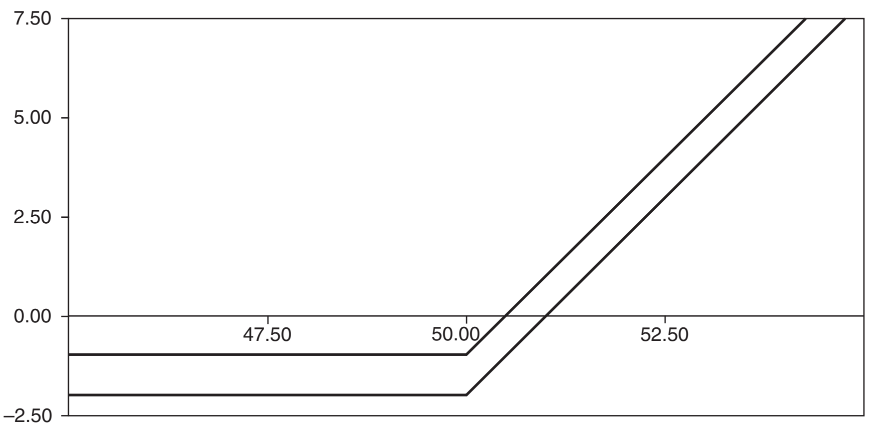

FIGURE 1.1 Payout Diagram Comparison

activity of these participants is what keeps put and call option prices in line with each other and the implied volatility of both put and call contracts at the same level.

ESTIMATING PRICE MOVEMENT

What the implied volatility of an option projects onto the underlying security is the expected range of price movement over a certain period of time. This estimation of price movement is based on statistics and the bell curve. The implied volatility of an option is the projection of an annualized one standard deviation move in the underlying stock over the life of the option. According to statistics and using implied volatility as a guide, the price of a stock should land between up and down one standard deviation at option expiration. The closing price should land in this range 68.2 percent of the time.

This 68.2 percent comes from statistics and what is referred to as a normal distribution. Statistics like this reveal that 68.2 percent of the time a stock should be between up one standard deviation and down one standard deviation a year from today. A formula may also be used to take this annualized number and narrow down the projection to a single day. The normal distribution also indicates that there is a 95.4 percent expectation of the stock landing between up two standard deviations and down two standard deviations. Finally, at three standard deviations, the probability reaches 99.7 percent.

With a stock trading at $50 and the underlying option prices indicating 20 percent implied volatility, the result is a one standard deviation price move equal to $10 (20 percent of $50). In other words, the stock is expected to close between $40 (down $10) and $60 (up $10) with 68.2 percent certainty a year from today. A two standard deviation price move would be equal to $20. This is calculated by simply multiplying 2 times a single standard deviation. Using two standard deviations, it can be projected out that the stock should land between $30 and up $70, with a confidence of 95.4 percent. At three standard deviations, there is a 99.7 percent chance of the stock closing between $20 and $80 a year from the date of the calculation.

VALUING OPTIONS: PRICING CALCULATORS AND OTHER TOOLS

An option pricing calculator is a tool that allows a user the ability to input the pricing variables that determine the value of an option with the result being a theoretical option price. Ultimately the market determines the price of an option through buying and selling forces. However when analyzing and investigating option trades, using an option pricing calculator with certain assumptions gives an idea where an option may be trading in the future. Also, using an option pricing calculator is an excellent way to become familiar with the price action of option contracts. The CBOE has a free option calculator available on its website at www.cboe.com/tradtool; it is a valuable tool for option pricing.

The value of an option contract is derived from a variety of inputs. Inputs into an option pricing model include the price of the underlying security, the strike price of the option, the type of option, dividends, interest rates, and time to option expiration. The final input into an option pricing model is the implied volatility of the option. These inputs may be used in a model to determine the value of an option.

Table 1.3 demonstrates how an option pricing model is used to determine the value of an option. The inputs are at the top of the table, with the value of the option showing up as the only output. Option pricing models calculate a variety of pieces of useful information, such as the impact of changes in pricing factors. These outputs are known as the option Greeks. However, to keep focus on the topic at hand, implied volatility, only the necessary outputs are going to be demonstrated in this example of an option calculator.

The option price in the model is determined from a stock trading at 44.75 with implied volatility of 30 percent and a risk-free interest rate of 1.00 percent. The result is a call option value with a strike price of 45 and 30 days to expiration would be valued at 1.45 based on the inputs used in this model. Keep in mind that this is a pricing model, not the actual market trading price of the option. Again, the inputs in the model are assumptions,

TABLE 1.3 Option Pricing Calculator–Option Value Output

Factor	**Input**
Call/Put	Call
Underlying Price	44.75
Strike Price	45.00
Implied Volatility	30%
Days to Expiration	30
Interest Rate	1.00%
Dividends	0.00%
Output	**Result**
Option Value	1.45

not just the market price. Just because using these inputs results in a value of 1.45 for this 45 Call does not mean it can be traded at this level. In fact, the market price of this option will vary if the market consensus differs from the inputs used in this model.

The real value of an option at any given time is actually determined by the price that it may be bought or sold in the market. In the case of this 45 Call, even though the inputs into the model result in a 1.45 value, when checking market quotes for this option we find that the current trading price is 1.70. The reason for the difference between our model's value and the market price is the result of different implied volatility levels being used. The previous model, in Table 1.3, takes inputs and the result in a difference in option values based on the inputs.

The pricing factors in an option pricing model are for the most part set in stone. The exception of this is the implied volatility input. For the model, the assumption of 30 percent implied volatility was used. However, the market is pricing in a higher implied volatility level. This is determined before any numbers or formulas have been run just by comparing the option market price and the option value assumption that resulted from the model. The market price of the option is higher than the pricing model output. Seeing this, it is pretty certain that the implied volatility based on market prices is higher than what was entered into the model. There is a direct correlation between high and low relative option prices and higher or lower implied volatility.

Table 1.4 is an option pricing model that uses the market price as an input with the sole output being implied volatility. This implied volatility level is being indicated by the 1.70 market price of the 45 Call. The higher option price here is a higher implied volatility than what was used in the first pricing model. As the option price in this model is higher than the

TABLE 1.4 Option Pricing Calculator—Implied Volatility Output

Factor	Input
Call/Put	Call
Underlying Price	44.75
Strike Price	45.00
Option Price	1.70
Days to Expiration	30
Interest Rate	1.00%
Dividends	0.00
Output	**Result**
Implied Volatility	35%

TABLE 1.5 Impact of a 5 Percent Increase in Implied Volatility

Implied Volatility	30%	35%
Option Price	1.45	1.70

option value that resulted from a 30 percent implied volatility, the expectation would be a higher implied volatility result. Using 1.70 as the price of the option actually results in the implied volatility that is being projected by this option price to be 35 percent. Professional traders generally start with the market price of an option to calculate implied volatility as that is where the implied volatility of an option is ultimately determined.

Another method of demonstrating the impact of different implied volatility levels on option prices appears in Table 1.5. Instead of a comparison of what the model output was versus the option price based on model outputs, consider the previous option prices in a different way. Consider the two option prices and implied volatility differences as changes based on an increase in demand for the option. Both prices represent the market and the option price increases from 1.45 to 1.70. This option price rise occurs due to an increase in buying of the call option while all other factors that influence the option price stay the same.

Since the price of the option contract has increased, the resulting implied volatility output from an option model has also increased. Higher option prices, whether put or call prices, will result in a higher implied volatility output with no changes in any of the other option pricing factors.

To recap, there is a direct link between the demand for option contracts and their prices in the marketplace. This is regardless of changes occurring in the underlying stock price. With demand in the form of buying pressure pushing option prices higher or an increase in selling occurring due to market participants pushing option prices lower, the implied volatility of an option is dictated by market forces.

FLUCTUATIONS BASED ON SUPPLY AND DEMAND

As mentioned in the first section of this chapter, implied volatility does fluctuate based on supply and demand for options. This leads to the question, "What exactly causes the supply and demand for options to fluctuate?" The short answer is the near-term expected price changes that may occur in the underlying stock. These moves are usually the result of information that has influenced the fundamental outlook for a stock. The best example of this type of information would be a company's quarterly earnings reports.

Every publicly traded company in the United States reports its earnings results four times a year. The date and timing (generally before the market open or after the market close) are usually known well in advance of the actual announcement. Along with the earnings results, other information is disseminated, such as the company's revenues and the source of those revenues. Many companies offer a possible outlook regarding the prospects for their business conditions, and most will hold a public conference call to answer professional investors' questions. These events often have a dramatic impact, either positive or negative, on the price of a stock.

Again, the date that these results are announced is public knowledge and often widely anticipated by analysts and traders. As the date draws near, there is usually trading in the stock and stock options that is based on the anticipated stock price reaction to the earnings announcement. The result is usually net buying of options as there is speculation regarding the potential move of the underlying stock. The net option buying results in higher option prices and an increase in the implied volatility projected by the options that trade on this stock. Usually this increase impacts only the options with the closest expiration and strike prices that are close to where the stock is trading. An excellent example of this can be seen in the option prices and resulting implied volatility levels for Amazon stock shown in Table 1.6.

These are market prices from just before the close of trading on July 22, 2010. Amazon's earnings were reported after the market close on the 22nd with weekly options that expire on the 23rd having only one trading day until expiration after the news was released. The difference in implied volatility between the options that have one trading day left and those that have just under a month left is pretty significant.

TABLE 1.6 Amazon Option Implied Volatility and Option Prices Minutes Prior to an Earnings Announcement

AMZN @ 120.07

Call Strike	July 23 Call	July 23 Call IV	Aug 21 Call	Aug 21 Call IV
115	7.00	163%	9.25	48%
120	3.92	156%	6.25	45%
125	1.82	148%	4.05	45%
Put Strike	**July 23 Put**	**July 23 Put IV**	**Aug 21 Put**	**Aug 21 Put IV**
115	1.92	159%	4.05	48%
120	3.82	155%	6.20	47%
125	6.75	148%	8.90	45%

This difference stems from the options that market participants would use as a short-term trading vehicle related to Amazon's earnings announcement. This would be the same for hedgers and speculators alike. Both would focus on the strike prices that are closest to the trading price of the stock as well as the options with the least amount of time to expiration.

Option contracts that have the closest expiration to a known event that occurs after the event are the contracts that will have the most price reaction before and after the event occurs. With Amazon reporting earnings the evening of July 22 and an option series expiring on July 23, the July 23 options are the contracts that will see the most price action based on the stock price reaction to the earnings release.

The stock price is very close to the 120 strike price when the option first listed and just before the earnings announcement. Using the 120 strike options, implied volatility for both the put and call options that expire the following day is around 155 percent. This indicates that on an annualized basis the option market is pricing in a 155 percent price move over a single day. This is much more dramatic sounding that it is in reality. Annualized implied volatility of 155 percent for an option with a single trading day left translates to a one-day move of around 9.76 percent. The math behind this is (see the following feature on calculating single day implied volatility):

$$9.76\% = 155\%/15.87$$

This single-day implied volatility can be interpreted as being a single standard deviation range of expected price movement of the stock on that day.

CALCULATING SINGLE-DAY IMPLIED VOLATILITY

Assuming there are 252 trading days in a year, the denominator of this formula turns out to be the square root of the number of trading days for the year.

1 Day Movement = Implied Volatility/Square Root of 252

Amazon did report its earnings, and the initial price reaction was pretty close to what the option market was pricing in. The NASDAQ opening price the day after the company reported earnings was down 11.76 percent from the previous day's close. The market was forecasting a 9.76 percent move based on option pricing.