CME Group

INTEREST RATES

Speculative Strategies with Treasury Options

NOVEMBER 11, 2013

John W. Labuszewski
Managing Director
Research & Product Development
312-466-7469
jlab@cmegroup.com

Michael Kamradt
Executive Director
International Development
312-466-7473
Michael.kamradt@cmegroup.com

David Reif
Senior Director
Interest Rate Products
312-648-3839
David.reif@cmegroup.com

Options offer tremendous flexibility to pursue speculative strategies on a finely designed basis. In particular, CME Group lists options exercisable for 2-year, 5-year and 10-year Treasury note futures; as well as options exercisable for "classic" and "Ultra" T-bond futures.

These option contracts generally offer a high degree of liquidity, transparency, price discovery and are accessible through the CME Globex® electronic trading platform.

This document is intended to provide a review of the fundamentals of CME Group Treasury options; and, a discussion of the ways in which these options may be utilized to pursue well defined speculative strategies in a wide range of market environments.

While our examples focus on the use of options exercisable for 10-year Treasury note futures, the principles illustrate are generalizable to all our options on Treasury futures and options exercisable for other instruments as well.

What is an Option?

Options provide a very flexible structure that may be tailored to meet the risk management or "alpha" seeking needs of a portfolio manager. Cash and futures markets offer portfolio managers the opportunity to manage risk and opportunity based upon an assessment of price (or yield) movements. But options offer further opportunities to conform the characteristics of a fixed income investment portfolio to take advantage of additional factors including convexity, the passage of time and volatility.

As a first step, let's get the option basics out of the way. There are two basic types of options – call and put options – with two distinct risk/reward scenarios.

Call option buyers pay a price (in the form of a "premium") for the right, but not the obligation, to buy the instrument underlying the option (in the case of our discussion, a Treasury futures contract) at a particular strike or exercise price on or before an expiration date. Call option sellers (*aka,* option "writers" or "grantors") receive a premium and have an obligation to sell futures at the exercise price if the buyer decides to exercise their right.

Put option buyers pay a price for the right, but not the obligation, to sell a Treasury futures contract at a particular strike or exercise price on or before an expiration date. [1] The seller of a put option receives a premium for taking on the obligation to buy futures at the exercise price if the put buyer decides to sell the underlying futures at the exercise price.

Options may be configured as European or American style options. A European style option may only be exercised on its expiration date while an American style option may be exercised at any time up to and including the expiration date. CME Group offers options on Treasury futures configured in the American style as well as flexible or "flex" options which allow the user to specify non-standardized expirations or strike prices and which may be European style.

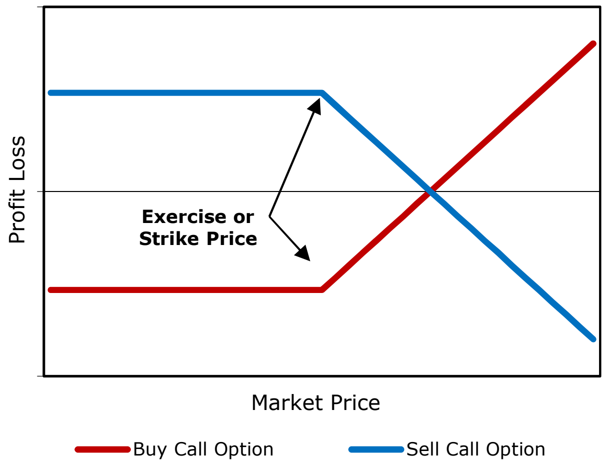
The purchase of a call option is an essentially bullish transaction with limited downside risk. If the market should advance above the strike price, the call is considered "in-the-money" and one may exercise the call by purchasing a Treasury futures contract at the exercise price even when the market rate exceeds the exercise price.

This implies a profit that is diminished only by the premium paid up front to secure the option. If the market should decline below the strike price, the option is considered "out-of-the-money" and may expire, leaving the buyer with a loss limited to the premium.

[1] One must exercise some caution when referring to options on U.S. Treasury futures insofar as these options terminate trading and expire during the month preceding the named month. Specifically, options on Treasury futures terminate trading on the last Friday which precedes by at least 2 business days the last business day of the month preceding the option month. Thus, a "March option" expires in February; a "June option" expires in May; a "September option" expires in August; a "December option" expires in November. The named month is a reference to the delivery period of the futures contract and not to the option expiration month. Note that Treasury futures permit the delivery of Treasury securities on any business day during the contract month at the discretion of the short. By terminating the option prior to the named month, traders are afforded the opportunity to liquidate futures established through an option exercise and avoid the possibility of becoming involved in a delivery of Treasury securities against the futures contract.

The risks and potential rewards which accrue to the call seller or writer are opposite that of the call buyer. If the option should expire out-of-the-money, the writer retains the premium and counts it as profit. If, the market should advance, the call writer is faced with the prospect of being forced to sell Treasury futures at the fixed strike price when prices may be much higher, such losses cushioned to the extent of the premium received upon option sale.

Profit/Loss for Call Option



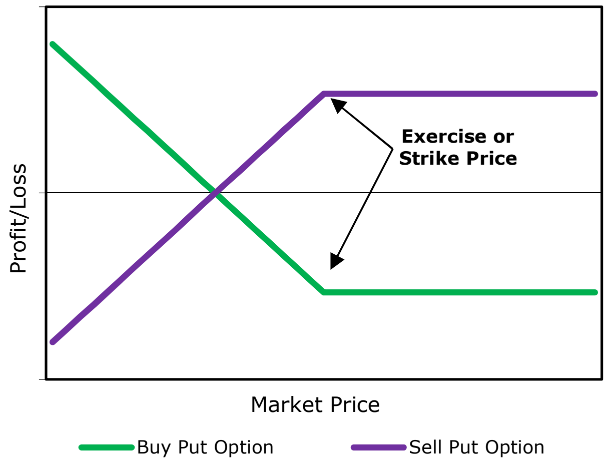
The purchase of a put option is essentially a bearish transaction with limited downside risk. If the market should decline below the strike price, the put is in-the-money and one may exercise the put by selling a Treasury futures contract at the exercise price even when the market price is less the exercise price. If the market should advance above the strike price, the option is out-of-the-money, implying a loss equal to the premium.

The risks and potential rewards which accrue to the put writer are opposite that of the put buyer. If the option should expire out-of-the-money, the writer retains the premium and counts it as profit. If the market should decline, the put writer is faced with the prospect of being forced to buy Treasury futures at the fixed strike price when prices are much lower, such losses cushioned to the extent of the premium received upon option sale.

While one may dispose of an option through an exercise or abandonment (expiration *sans* exercise), there is also the possibility that one may liquidate a long/short option through a subsequent sale/purchase.

Because of the variety of options which are offered, including puts and calls with varying exercise prices and expiration dates, one may create an almost infinite variety of strategies which may be tailored to suit one's unique needs. Further, one may deploy a combination of options to achieve particular risk management requirements.

Profit/Loss for Put Option



Option Pricing

Option pricing is at once one of the most complicated, but perhaps the most significant, topic which a prospective option trader can consider. The importance of being able to identify the "fair value" of an option is evident when you consider the meaning of the term fair value in the context of this subject.

A fair market value for an option is such that the buyer and seller expect to break even in a statistical sense, *i.e.,* over a large number of trials (without considering the effect of transaction costs, commissions, etc.). Thus, if a trader consistently buys over-priced or sells underpriced options, he can expect, over the long term, to incur a loss. By the same token, an astute trader who consistently buys underpriced and sells over-priced options might expect to realize a profit.

But how can a trader recognize over- or underpriced options? What variables impact upon this assessment? There are a number of mathematical models which may be used to calculate these figures, notably including models introduced by Black-Scholes, Cox-Ross-Rubinstein and Whaley amongst others. Several factors including the relationship between market and exercise price, term until expiration, market volatility and interest rates impact the formula. Frequently, options are quoted in terms of volatility and converted into monetary terms with use of these formulae.

The purpose of this section, however, is not to describe these models but to introduce some of the fundamental variables which impact an option premium and their effect. Fundamentally, an option premium reflects two components: "intrinsic value" and "time value."

Premium = Intrinsic Value + Time Value

The intrinsic value of an option is equal to its in-the- money amount. If the option is out-of-the-money, it has no intrinsic or in-the-money value. The intrinsic value is equivalent, and may be explained, by reference to the option's "terminal value." The terminal value of an option is the price the option would command just as it is about to expire.

When an option is about to expire, an option holder has two available alternatives. On one hand, the holder may elect to exercise the option or, on the other hand, may allow it to expire unexercised. Because the holder cannot continue to hold the option in the hopes that the premium will appreciate and the option may be sold for a profit, the option's value is limited to whatever profit it may generate upon exercise.

As such, the issue revolves entirely on whether the option lies in-the-money or out-of-the-money as expiration draws nigh. If the option is out-of-the-money then, of course, it will be unprofitable to exercise and the holder will allow it to expire unexercised or "abandon" the option.

An abandoned option is worthless and, therefore, the terminal value of an out-of-the- money option is zero. If the option is in-the-money, the holder will profit upon exercise by the in-the-money amount and, therefore, the terminal value of an in-the-money option equals the in-the-money amount.

An option should (theoretically) never trade below its intrinsic value. If it did, then arbitrageurs would immediately buy all the options they could for less than the in-the-money amount, exercise the option and realize a profit equal to the difference between the in-the-money amount and the premium paid for the option.

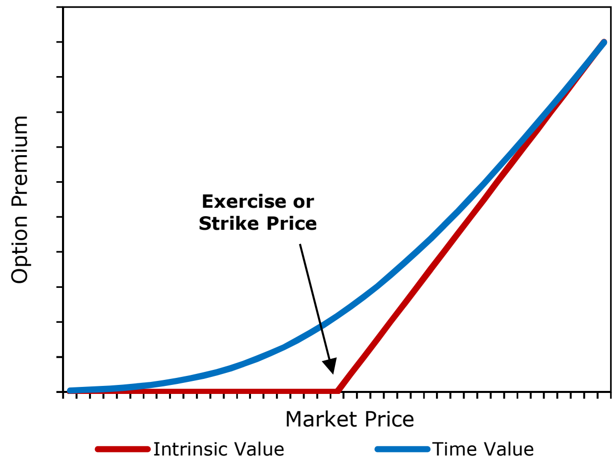
Time Value

An option contract often trades at a level in excess of its intrinsic value. This excess is referred to as the option's "time value" or sometimes as its "extrinsic value." When an option is about to expire, its premium is reflective solely of intrinsic value.

But when there is some time until option expiration, there exists some probability that market conditions will change such that the option may become profitable (or more profitable) to exercise. Thus, time value reflects the probability of a favorable development in terms of prevailing market conditions which might permit a profitable exercise.

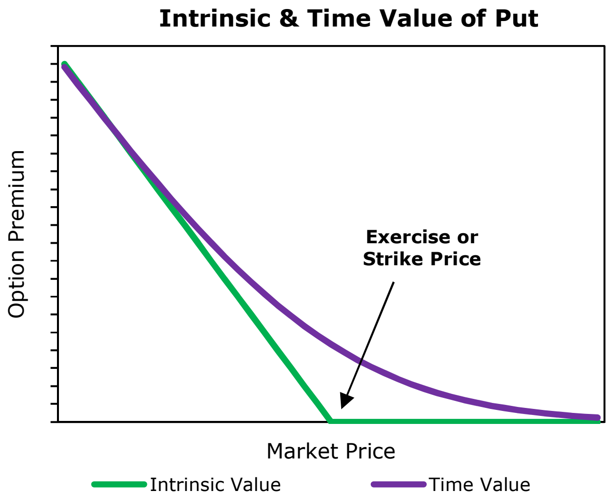
Generally, an option's time value will be greatest when the option is at-the-money. In order to understand this point, consider options which are deep in- or out-of-the-money. When an option is deep out-of-the-money, the probability that the option will ever trade in-the-money becomes remote. Thus, the option's time value becomes negligible or even zero.

Intrinsic & Time Value of Call



When an option trends deep in-the-money, the leverage associated with the option declines. Leverage is the ability to control a large amount of resources with a relatively modest investment.

Consider the extraordinary case where a call option has a strike price of zero. Under these circumstances, the option's intrinsic value equals the outright purchase price of the instrument. There is no leverage associated with this option and, therefore, the option trader might as well simply buy the underlying instrument outright. Thus, there is no time value associated with the option.

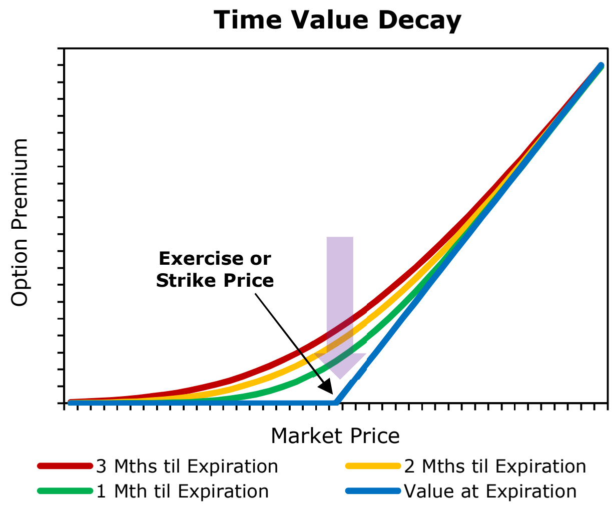


A number of different factors impact on an option on futures' time value in addition to the in- or out-of-the-money amount. These include - (i) term until option expiration; (ii) market volatility; and (iii) short-term interest rates. Options exercisable for actual commodities or actual financial instruments (*i.e.,* not futures or forwards) are also affected by any other cash flows such as dividends (in the case of stock), coupon payments (bonds), etc.

Term until Expiration

An option's extrinsic value is most often referred to as time value for the simple reason that the term until option expiration has perhaps the most significant and dramatic effect upon the option premium. All other things being equal, premiums will always diminish over time until option expiration. In order to understand this phenomenon, consider that options perform two basic functions - (i) they permit commercial interests to hedge or offset the risk of adverse price movement; and (ii) they permit traders to speculate on anticipated price movements.

The first function suggests that options represent a form of price insurance. The longer the term of any insurance policy, the more it costs. The probability that adverse events may occur is increased as a function of the term of the option. Hence, the value of this insurance is greater. Likewise, when there is more time left until expiration, there is more time during which the option could potentially move in-the-money. Therefore, speculators will pay more for an option with a longer life.



Not only will the time value of an option decline over time, but that time value "decay" or "erosion" may accelerate as the option approaches expiration. But be aware that accelerating time value decay is a phenomenon that is characteristic of at- or near-the-money options only. Deep in- or out-of-the-money options tend to exhibit a linear pattern of time value decay.

Volatility

Option holders can profit when options trend into-the-money. If market prices have a chance, or probability, to move upwards by 10%, option traders may become inclined to buy call options. Moreover, if market prices were expected to advance by 20% over the same time period, traders would become even more anxious to buy calls, bidding the premium up in the process.

It is not always easy to predict the direction in which prices will move, but it may nonetheless be possible to measure volatility. Market volatility is often thought of as price movement in either direction, either up or down. In this sense, it is the magnitude, not the direction, of the movement that counts.

Standard deviation is a statistic that is often employed to measure volatility. These standard deviations are typically expressed on an annualized basis. *E.g.,* you may see a volatility quoted at 10%, 15%, 20%, etc. The use of this statistic implies that underlying futures price movements may be modeled by the "normal price distribution."

The popular Black Scholes and Black option pricing models are, in fact, based on the assumption that movements in the instrument underlying an option may be described by reference to the normal pricing distribution. The normal distribution is represented by the familiar "bell shaped curve."

To interpret a volatility of 6%, for example, you can say with an approximate 68% degree of confidence that the price of the underlying instrument will be within plus or minus 6% (=1 standard deviation) of where it is now at the conclusion of one year. Or, with a 95% degree of confidence that the price of the underlying instrument will be within plus or minus 12% (=2 x 6% or 2 standard deviations) of where the price lies now at the conclusion of a year. A good rule of thumb is that the greater the price volatility, the more the option will be worth.

One may readily calculate an historic or realized volatility by taking the standard deviation of day-to-day returns in the market of interest. One may sample these returns over the past 30, 60, 90, 180 days or some other period of interest and express the resulting number of an annualized basis. The implicit assumption is that movements over the past X number of days may be reflective of future market movements.

But the aggregate expectations of market participants with respect to future volatility may be at odds with past volatility. Thus, traders often reference "implied volatilities" or the volatility that is implicit in the level of an option premium as traded in the market.

As suggested above, there are various mathematical pricing models available which may be used to calculate the fair value of the option premium as a function of the underlying futures price (U), strike price (S), term until expiration (t), volatility (v) and short-term interest rates (r).

$$Premium = f(U, S, t, v, r)$$

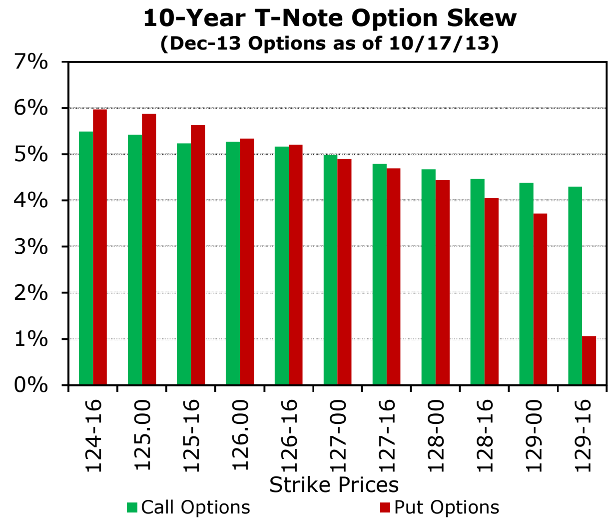
The underlying market price, strike price, term and short-term rates are readily observable. Further, the option premium trading in the marketplace may also be readily observable. This leaves volatility as the least readily observable and most abstract of the necessary variables. But one may solve the mathematical pricing model to find volatility or "implied volatility" as a function of the observed premium and the other variables.

$$v = f(Premium, U, S, t, r)$$

Referring to the table in the appendix below, we note that the implied volatilities (IVs) may be quite different amongst options that share a common underlying instrument and expire on the same date. *E.g.,* the near-the-money 127 December 2013 put had an IV=4.89% while the out-of-the-money 126 put had an IV=5.34%.

Traders frequently impute different values to options based on their subtly different investment attributes. Options on Treasury futures are heavily utilized by institutional traders who often deploy these options for risk management purposes. They tend to value less expensive out-of-the-money puts as a means of buying price protection. Thus, they may bid up the value of less expensive out-of-the-money puts, particularly where they perceive a high risk of rising rates and falling Treasury prices.

This may create a pattern known as the option skew or "smile" by reference to the fact that the graphic display of this information sometimes resembles a smile.



Treasury rates had been generally drifting higher as of October 2013 with much anticipation that the Treasury might begin to "taper" its quantitative easing programs, leading to higher rates and lower prices. This is reflected in the skew such that low-struck puts were generally bid up, resulting in higher implied volatilities. Calls with the same strike likewise displayed progressively higher IVs as a result of "put-call parity" phenomenon. [2]

Short-Term Rates

When someone invests in a business venture of any sort, some positive return typically is expected. Accordingly, when an option exercisable for a futures contract is purchased there is an investment equal to the premium. To the extent that the option is paid for up front and in cash, a return is expected on the investment.

This implies that premiums must be discounted to reflect the lost opportunity represented by an investment in options. When the opportunity cost rises, as reflected in the rate at which funds may alternately be invested on a short-term basis, the price of an option is discounted accordingly. When the opportunity cost decreases, the premium appreciates.

These remarks must be qualified by the following considerations. First, the effect described is applicable only to options on futures and not to options exercisable for actual instruments. In fact, rising short-term rates will tend to increase call premiums and decrease put premiums for options exercisable for actual instruments.

Secondly, these remarks apply holding all other considerations equal. But of course, we know that all else is never held equal. For example, if short-term rates are rising or falling, this suggests that bond futures prices will be affected. Of course, this consideration will also have an impact, often much greater in magnitude, than the impact of fluctuating short- term rates.

Delta

When the price of the underlying instrument rises, call premiums rise and put premiums fall. But by how much? The change in the premium relative to the change in the underlying commodity price is measured by a common option statistic known as "delta."

Delta is generally expressed as a number from zero to 1.0. Deep in-the-money deltas will approach 1.0. Deep out-of-the- money deltas will approach zero. Finally at- or near-the-money deltas will run at about 0.50.

It is easy to understand why a deep in- or out-of-the-money option may have a delta equal to 1.0 or zero, respectively. A deep in-the-money premium is reflective solely of intrinsic or in-the-money value. If the option moves slightly more or less in-the-money, its time value may be unaffected. Its intrinsic value, however, reflects the relationship between the market price and the fixed strike price. Hence, a delta of 1.0.

Delta
Deep In-the-Money → 1.00
At-the-Money → 0.50
Deep Out-of-the-Money → 0.00

At the other extreme, a deep out-of-the-money option has no value and is completely unaffected by slightly fluctuating market prices. Hence, a delta of zero.

A call delta of 0.50 suggests that if the value of the underlying instrument advances by $1, the premium will advance by 50 cents. A put delta of 0.50 suggests that if the value of the underlying

[2] Put-call parity suggests that if puts and calls of the same strike did not trade with approximately equal IVs, an arbitrage opportunity would arise. The execution of such an arbitrage would cause these IVs to align in equilibrium. Specifically, if a call were to trade significantly "richer" than a put with identical strikes, as measured by their respective IVs, one might pursue a "conversion" strategy. This entails the sale of the call and purchase of the put, creating a "synthetic short futures" position. This is hedged by the simultaneous purchase of futures, effectively locking in an arbitrage profit. A "reverse conversion" or "reversal may be pursued if the put were trading richer than the call with the same strike. This entails the sale of the put and purchase of the call, creating a "synthetic long futures" position. One hedges with the simultaneous sale of futures, locking in an arbitrage profit. Trader will continue to execute these traders until they have restored a market equilibrium and it becomes unprofitable to continue placing these strategies, after considering the attendant transaction costs.

instrument advances by $1, the premium will fall by 50 cents.

Note that the delta of a bullish option, *i.e.*, a long call or short put, is often assigned a positive value. On the other hand, an essentially bearish option, *i.e.*, a long put or short call, is often assigned a negative value. This convention facilitates summation of the deltas of all options in a complex position (based upon the same or similar underlying instrument) to identify the net risk exposure to price or yield fluctuations.

Delta is a dynamic concept. It will change as the market price moves upwards or downwards. Hence, if an at-the-money call starts trending into-the-money, its delta will start to climb. Or, if the market starts falling, the call delta will likewise fall.

The table in our appendix below provides the delta as well as other statistics for a wide variety of options exercisable for 10-Year U.S. Treasury note futures contracts. This data represents intra-day values sampled as of October 17, 2013 in the December 2013 options. [3]

E.g., the at- or nearest-to-the-money December 2013 call option was struck at 127-00/32nds while December 2013 futures was quoted at 126-26+/32nds. It was bid at a premium of 0-45/64ths with a delta of 0.47. This suggests that if the market were to advance (decline) by one point (*i.e.,* 1 percent of par) the premium would be expected to advance (decline) by approximately one-half of a point (holding all else constant).

Thus, delta advances as the option moves in-the-money and declines as the option moves out-of-the-money. This underscores the dynamic nature of delta.

"Greek" Statistics

In addition to movement in the underlying market price (as measured by delta), other factors impact significantly upon the option premium, notably including time until expiration and marketplace volatility.

A number of exotic "Greek" statistics including delta, gamma, vega and theta are often referenced to measure the impact of these factors upon the option premium. Underlying price movement stands out as perhaps the most obvious factor impact option premiums and we have already discussed delta as the measure of such impact. Let's consider other statistics including gamma, vega and theta.

Gamma may be thought of as the "delta of the delta." Gamma measures the expected change in the delta given a change in the underlying market price. Gamma is said to measure a phenomenon known as "convexity." Convexity refers to the shape of the curve which depicts the total value of an option premium over a range in possible underlying market values. The curvature of that line is said to be convex, hence the term convexity.

"Greek" Option Statistics

Delta	Measures expected change in premium given change in PRICE of instrument underlying option
Gamma	Measures change in DELTA given change in PRICE of instrument underlying option, *i.e.,* "delta of the delta" measuring CONVEXITY
Vega	Measures expected change in option premium given change in VOLATILITY of instrument underlying option
Theta	Measures expected change in option premium given the passage of TIME

Convexity is a concept which promises to benefit traders who purchase options to the detriment of those who sell or write options. Consider that as the market rallies, the premium advances at an ever increasing rate as the delta itself advances. Thus, the holder of a call is making money at an increasing or accelerating rate. But if the market should fall, the call holder is losing money but at a decelerating rate.

[3] Note that 10-year Treasury note futures contracts are based upon a $100,000 face value contract size. They are quoted in percent of par and 32nds of 1% of par with a minimum price increment or "tick" of 1/64th or $15.625 (=1/64th of 1% of $100,000). Thus, a quote of 128-16 represents 128 + 16/32nds or 128.50% of par. A futures quote of 128-165 means 128 + 16/32nds + ½ of 1/32nd. This equates to 128.515625% or par. Options on 10-year Treasury note futures contracts call for the delivery upon exercise of one $100,000 face value 10-year T-note futures contract. They are quoted in percent of par in increments of 1/64th of 1% of par or $15.625 (=1/64th of 1% of $100,000). Thus, one might see a quote of 1-61/64ths which equates to 1.953125% of par.

E.g., on October 17, 2013, the delta for a December 2013 call option on 10-Year T-note futures, struck at 127-00/32nds (essentially at-the-money with December futures trading at 126-26+/32nds) was 0.47. It had a gamma of 0.2535 suggesting that if the underlying futures price were to move upwards (downwards) by 1 percent of par, the value of delta would move upwards (downwards) by about 0.2535.

If the call buyer is making money at an accelerating rate and losing money at a decelerating rate, the call writer is experiencing the opposite results. Gamma tends to be highest when an option is at- or near-to-the-money. But gamma declines as an option trends in- or out-of-the-money.

Theta and vega are likewise greatest when the market is at or reasonably near to the money. These values decline when the option goes in- or out-of-the-money as discussed below. Thus, convexity as measured by gamma works to the maximum benefit of the holder of at-the-money options.

Theta measures time value decay or the expected decline in the option premium given the passage of time towards the ultimate expiration date of the option, holding all other variables (such as price, volatility, short-term rates) constant. Time value decay and the degree to which this decay or erosion might accelerate as the option approaches expiration may be identified by examining the change in the theta.

E.g., our December 2013 127-00 call had a theta of -0.0107. This suggests that over the course of one (1) day, holding all else equal, the value of this call option may fall 0.0107 percent of par. This equates to 0.685/64ths (=0.0107 x 64) or about $10.70 per $100,000 face value unit. Thus, the premium is expected to decline from the current value of 0-45/64ths to approximately 44/64ths over the course of a single day, rounding quotes to the nearest integral multiple of the tick size.

Note that we are quoting a theta in percent of par over the course of 1 calendar day. It is also common to quote a theta over the course of seven (7) calendar days. One must be cognizant of the references that are being made in this regard.

Theta is a dynamic concept and may change dramatically as option expiration draws nigh. At- or near-to-the-money options experience rapidly accelerating time value decay when expiration is close. Away-from-the-money options experience less time value decay as in-and out-of-the-money options have less time value than do comparable at- or near-the-money options.

Thetas associated with moderately in- or out-of-the-money options may be relatively constant as expiration approaches signifying linear decay characteristics. Deep in- or out-of-the-money options will have very little or perhaps no time value. Thus, the theta associated with an option whose strike is very much away from the money may "bottom-out" or reach zero well before expiration.

Time value decay works to the benefit of the short but to the detriment of the long. The same options which have high thetas also have high gammas. Convexity as measured by gamma works to the detriment of the short and to the benefit of the long. Near-the-money options will have high thetas and high gammas. As expiration approaches, both theta (measuring time value decay) and gamma (measuring convexity) increase.

Thus, it becomes apparent that you "can't have your cake and eat it too." In other words, it is difficult, if not impossible, to benefit from both time value decay and convexity simultaneously.

Vega measures the expected change in the premium given a change in marketplace volatility. Normally, vega is expressed as the change in the premium given a one percent (1.0%) movement in volatility.

E.g., our December 2013 127 call had a vega of 0.1579. This suggests that its premium of 45/64ths might fluctuate by approximately 10/64ths (=0.1579 x 64) or about $157.90 per $100,000 face value unit, if volatility were to move by 1% from the current implied volatility of 4.99% (*i.e.,* to 3.99% or 5.99%).

Vega tends to be greatest when the option is at- or reasonably near-to-the-money. In- and out-of-the-money options have generally lower vegas. However, this effect is not terribly great. Note that vega tends to fall, rather than rise, as a near-to-the-money option approaches expiration. This is unlike the movement of theta and gamma which rise as expiration draws near.

Volatility and convexity are highly related properties. This can be understood when one considers that it is only when the market is moving, or when the market is volatile, that the effects of convexity are observed. Remember that when you buy an option, convexity works to your benefit no matter whether underlying price movements are favorable or not. If the market moves against you, you lose money at a decelerating rate. If the market moves with you, you make money at an accelerating rate. Thus, the prospect of rising volatility is generally accompanied by beneficial effects from convexity (at least from the long's standpoint).

Earlier we suggested that it is generally impossible to enter an option strategy in which both time value decay and convexity worked to your benefit simultaneously. Paradoxically, it may be possible to find option strategies where the prospect of rising volatility and time value decay work for you simultaneously (although convexity will work against you).

This is possible because vega falls as expiration approaches while theta and gamma rise. *E.g.,* one might buy a long-term option experiencing the ill effects of time value decay while selling a shorter-term option which benefits from time value decay. The benefits associated with the short-term option will outweigh the disadvantages associated with the longer-term option. And, the strategy will generally benefit from the prospect of rising volatility as the long-term option will have a higher vega than will the short-term option.

Putting It All Together

Options are strongly affected by the forces of price, time and volatility/convexity. (We often consider convexity and volatility to be one in the same property for reasons discussed above.) "Exotic" option statistics such as delta, gamma, theta and vega are quite useful in measuring the effects of these variables.

As a general rule, when you buy an option or enter into a strategy using multiple options where you generally buy more than you sell, convexity and the prospect of rising volatility work to your benefit. Time value decay generally works against you in those situations. When you sell options or enter into strategies where you are generally selling more options than you buy, convexity and the prospect of rising volatility will work against you although time value decay will work to your benefit.

Earlier we had suggested that essentially bullish options including long calls and short puts are frequently assigned positive deltas. Essentially bearish options including long puts and short calls are likewise often assigned negative values. This facilitates summation of the "net delta" associated with a complex option position (based upon the same or similar underlying instruments).

Likewise, we often attach positive or negative values to gamma, theta and vega. To the extent that rising gammas and vegas benefit long option holders, we assign positive gammas and vegas to long calls and puts; and, negative gammas and vegas to short calls and puts. On the other hand, rising thetas benefit shorts to the detriment of longs. Thus, long puts and calls are frequently assigned negative thetas while shorts are assigned positive thetas.

The key point is that these variables - price, time and volatility - do not operate independently one from the other. Price may generally be considered the most important of these variables and will tend to dictate whether time value decay is more or less important than convexity and rising volatility. One can use this information to good effect when formulating a hedging strategy using options.

Now that we have established a foundation for understanding the pricing of options, let's explore how options may be used in pursuit of profit in the context of a wide range of market conditions.

Option Spreads

An option spread may be described as a strategy which requires you to buy and sell options of the same type, *i.e.,* to buy a call and sell a call; or, to buy a put and sell a put. While the components of an option spread may be of the same type, these options may differ with respect to strike price, expiration date or both.

Option spreads are really quite flexible trading strategies. They may be used to take advantage of strongly bull or strongly bear markets. But option spreads may also be used to capitalize on mildly trending markets or even neutral markets.

Let us consider the fundamentals and some of the finer points of trading specific types of option spreads. But before reviewing the specific strategies, let's discuss the tradeoffs that may be implicit in the pursuit of option spreads.

Option Trade-offs

The pursuit of any specific option strategy is presumably driven by a market forecast. That forecast may incorporate various elements including price direction (of the underlying instrument for which the option may be exercised). But that forecast may also reference other variables which impact upon an option premium. Notable among these variables is time or term to expiration.

Thus, options are affected by (at least) two factors including price and time. A rational trader would, of course, prefer to make all the variables which impact upon an option premium (and consequently, upon an option strategy) work to his benefit. But that may be difficult or impossible and one must therefore consider the tradeoffs implicit in an option strategy.

Consider that options with different characteristics experience differential rates of time value decay. This is a function of the extent to which an option is in- or out-of-the-money. It is further a function of the term or time remaining until option expiration.

Near-the-money options experience more decay and accelerated decay relative to in- or out-of-the-money options. Consider that at- or near-the-money options have more time value to decay from the start. Longer-term options will typically have more time value than shorter-term options. But those long-term options may continue to hold on to their time value until option expiration begins to approach.

Near-money, near-term options will exhibit a pattern of accelerating time value decay. But the time value associated with an away-from-the-money, near-term option may "bottom out" and, therefore experience little or no time value decays. This is intuitive to the extent that time value fundamentally reflects the possibility that market trends may push an option into-the-money or deeper into the money if it is already in the money. The extent to which this may occur is limited when options are well out-of-the-money, when there is a short period until expiration or if volatility is very low.

Longer-term, near-the-money options will experience slight time value decay but not on the same highly accelerated pace as their shorter-term counterparts. Finally, longer-term, away-from-the-money options may experience linear pattern of time value decay.
Of course, an option trader may consider the impact of decay when pursuing a spread that involves both the purchase and sale of options. Obviously, time value decay benefits the short option holder but works adversely from the perspective of the long option holder. Time (or time value decay) may be on your side or may work against you on a net basis when putting on a spread depending on the characteristics of the particular options that comprise the spread.

Differential Rates of Time Value Decay

	Near-Term	**Long-Term**
At- or Near-the-Money	Rapid Acceleration	Slight Acceleration
In- or Out-of-the-Money	Time Value May Bottom Out	Linear Decay

Thus, option traders may be advised carefully to study the risk/reward profile associated with an option strategy. In particular, one may calculate the "greeks" (or the delta, gamma, theta, vega, etc.) associated with each leg of the option strategy. Assign each greek statistic a positive (+) or negative (-) value by reference to whether the attribute represents a positive or negative force on the strategy.

For example, when buying an option, time value decay represented by theta is a negative force over time – assign the theta for that leg a negative value. When selling an option, time value decay represented by theta is a positive force – assign that theta a positive value. Add up the thetas associated with each leg in the strategy to determine the net effect of that factor on the strategy as a whole.

Of course, most option spreads allow you to limit your risk to formulaically known parameters. Many of these strategies further entail strictly limited reward potential. Option traders may consider the ratio between potential reward and risk (maximum reward/maximum risk).

But, one must be cognizant of the probability of achieving any particular profit or loss. In general, these probabilities will balance out any asymmetry between risk and reward. Thus, a strategy with a high reward/risk ratio generally means that you have a low probability of large profit and a relatively high probability of a relatively small loss. A strategy with a low reward/risk ratio generally means that you have a high probability of small profit and a relatively low probability of large loss.

When trying to take advantage of time value decay, you generally pursue strategies of the latter nature: strategies where you have a high probability of small profit, low probability of large loss. Fortunately, an astute option trader can often trade out of a situation where a large loss is imminent - to limit the loss. There is very little an option trader can do, however, to stop the passing of time.

An option trader should think about when to hold and when to liquidate a position. By familiarizing oneself with the "dynamics" of an option strategy, you can tell when it is best advised to hold or fold an option strategy. The "dynamics" of an option strategy reflect the possible movements of the option strategy in response to the various dimensions including underlying market price and time that affect individual legs of a strategy as well as the strategy taken as a whole.

The "high-probability" strategy discussed above relies more on one's judgment regarding when to hold and when to liquidate than does the "low-probability" strategy. This is because the latter strategy usually requires more active management than the former strategy. The option trader who pursues the former strategy must be prepared to trade the position frequently.

Finally, it is well to note that option spreads entail (at least) two positions relative to a single outright option position with the implication that one's trading costs including slippage and commissions are typically greater than the costs incurred in an outright strategy involving a single instrument. Find strategies with sufficient payoff probabilities to assure that commissions are wisely spent.

Vertical Option Spreads

A vertical option spread entails the purchase and sale of two options of the same type (*i.e.,* purchase and sale of two call options; or, purchase and sale of two put options) with the same expiration but different strike prices. You can (generally speaking) scan option quotes in the pages of financial reports or on electronic quotation devices vertically to identify options which comprise vertical spreads. (Noting that option months are often displayed horizontally along the tops of columns with strikes shown vertically along rows.)

	Low Struck Option	**High Struck Option**
Bull Vertical Spread	Buy	Sell
Bear Vertical Spread	Sell	Buy

One may categorize vertical spreads along two dimensions - (i) whether they are essentially bullish or bearish; and (ii) whether it results in an initial net payment of premium - a debit - or whether it results in the initial net receipt of premium - a credit.

Bull Vertical Call Spread

As a general rule, one creates a bullish vertical spread by buying the option with the low strike price and selling the option with the high strike. This rule of thumb is valid regardless of whether you are using call or put options to construct the spread. Bearish vertical spreads are created by selling the option with the low strike price and buying the option with the high strike. Again, this applies regardless of whether you are working with call or put options.

	Debit Spread	**Credit Spread**
Bull Vertical Spread	Call	Put
Bear Vertical Spread	Put	Call

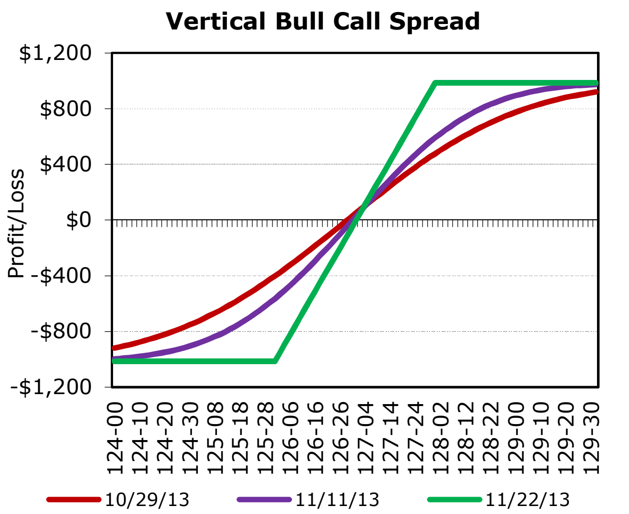
E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have constructed a vertical bull call spread by buying a 126 December call at 1-20/64ths and selling a 128 December call at 19/64ths for an initial net debit of $1,015.625.

	Premium	IV	Delta
Buy 126 Dec-13 Call	(1-20/64)	5.27%	+0.66
Sell 128 Dec-13 Call	19/64	4.67%	-0.26
	($1,015.625)		**+0.39**

	Gamma	Theta	Vega
Buy 126 Dec-13 Call	+0.2222	-0.0108	+0.1461
Sell 128 Dec-13 Call	-0.2234	+0.0084	-0.1304
	-0.0012	**-0.0024**	**+0.0157**

One may confirm that the position is essentially bullish by examining the net delta. We assign a positive delta to the long call (bullish position) and a negative delta to the short call (bearish position). Our net delta of +0.39 suggests that if the market were to advance by one percent of par, the net premium might advance by 0.39 percent of par.

Likewise, we assign positive or negative signatures to gamma, theta and vega to identify the net effect that the convexity, time value decay and (rising) volatility may exert on the spread. We assign a positive gamma and positive vega to the long call to the extent that convexity and (rising) volatility benefit the long. We assign a negative gamma and negative vega to the short call to the extent that convexity and (rising) volatility detracts from short positions. Again, convexity and rising volatility tend to work together.



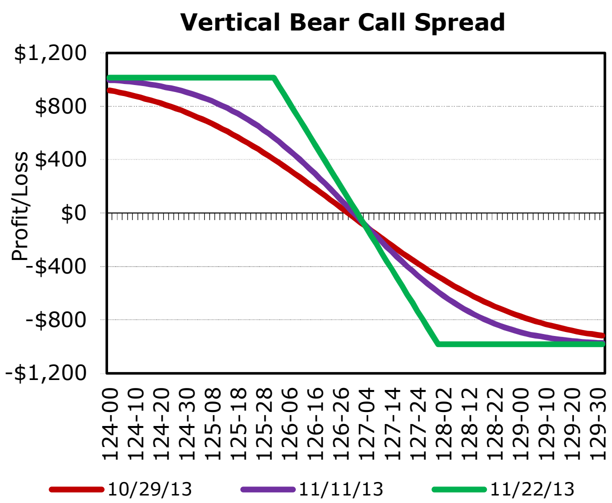
Finally, we assign a negative theta to the long call to the extent that time value decay will erode the value of long positions. A positive theta is assigned to the short call to the extent that time value decay will benefit a short position.

Note that the position has a net negative theta which implies that time value will work against the spread. This typically implies that convexity, as measured by gamma, and rising volatility, as measured by vega, will be net positive factors. The net vega is indeed a positive factor but the net gamma is negative.

This unexpected result may be attributed to the volatility skew in the market where the long call is purchased at a relatively high implied volatility (5.27%) while the short call is sold at a relatively low implied volatility (4.67%). In this case, the volatility skew is distorting what might be considered more normal pricing patterns, generating this apparent anomaly.

Our graphic illustrates the profit or loss that would accrue if this position were disposed of at varying times approaching the expiration date on November 22nd. Assuming that the market trades below the lower of the two strikes by expiration, both calls expire out-of-the-money and worthless. Thus, the trader is left with a loss equal to the initial net debit of $1,015.625.

If, however, the market rallies above the upper of the two strikes, both options are in-the-money and exercised. Thus, you buy futures at 126 and sell at 128 for a net profit of 2 full points or $2,000, less the initial net debit of $1,015.625, for a net gain of $984.375. If the market trades between the two strikes by expiration, the long call is in-the-money and exercised for some gain while the short call falls out-of-the-money and expires worthless.



Bear Vertical Call Spread

Note that the spread depicted above resulted in the initial net payment of premium or an initial net debit. This is referred to as a "debit spread." If one were to execute a trade that was exactly opposite to the bull call spread with an initial net debit, the result would be a bear call spread with an initial net credit. The risks and rewards would be defined in opposite terms.

The risk and reward parameters of bull and bear vertical call spreads, held until expiration, may be defined as below.

	Bull Vertical Call Spread	Bear Vertical Call Spread
Results in	Initial Net Debit	Initial Net Credit
Maximum Loss	Initial Net Debit	Difference in Strikes less Net Credit
Maximum Profit	Difference in Strikes less Net Debit	Initial Net Credit
Breakeven (B/E) Point	Low Strike plus Maximum Loss	Low Strike plus Maximum Profit

Bear Vertical Put Spread

One may create bull and bear spreads with call options. Or, one may create similar risk exposures using put options. Like the call spreads, put spreads may result in an initial net debit or an initial net credit.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have constructed a vertical bear put spread by selling a 126 December put at 32/64ths and buying a 128 December put at 1-29/64ths for an initial net debit of $953.125

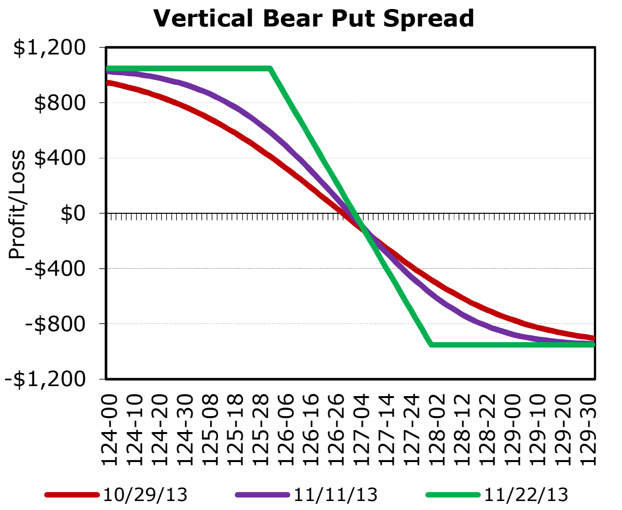
	Premium	IV	Delta
Sell 126 Dec-13 Put	32/64	5.34%	+0.35
Buy 128 Dec-13 Put	(1-29/64)	4.43%	-0.75
	($953.125)		**-0.40**

	Gamma	Theta	Vega
Sell 126 Dec-13 Put	-0.2205	+0.0110	-0.1475
Buy 128 Dec-13 Put	+0.2302	-0.0080	+0.1275
	+0.0097	**+0.0030**	**-0.0200**

This position is essentially bearish as confirmed by the negative net delta of -0.40. This suggests that if the market price were to decline by one percent of par, the net premium on the bear put spread would advance by 0.44 percent of par.

This position has a net positive theta, suggesting that time value decay on balance works to the benefit of this spread. Normally one would expect that vega and gamma would be negative to compensate for the positive theta. In other words, one would expect that the prospect of rising volatilities and convexity would benefit the spread. While the net vega is indeed negative, the net gamma is positive.

This result may be explained by the significant volatility skew, noting that the short put had a high implied volatility of 5.34% while the long put had a much lower implied volatility of 4.43%. This skew is distorting normal pricing patterns and the net risks associated with this spread.



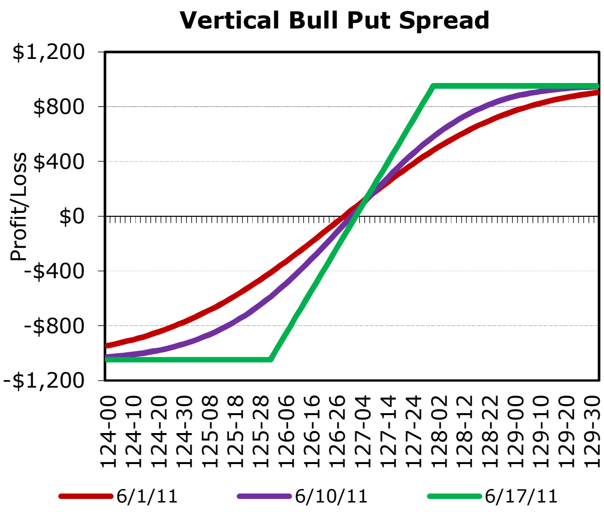
If the market should advance above the upper of the two strike prices, held until expiration, both puts expire out-of-the-money and worthless. This leaves the trader with a loss equal to the initial net debit or $953.125 in this example.

If the market should decline below the lower of the two strike prices, held until expiration, both options fall in-the-money and are exercised. This implies that one will exercise the long put by selling futures at 128 while exercise of the short put compels one to buy futures at 126. This generates a profit of 2 percent of par ($2,000), less the initial net debit of $953.125, for a net gain of $1,046.875. This result is very similar to that associated with the vertical bear call spread.

Bull Vertical Put Spread

Like the bull call spread, the bear put spread results in the initial net payment of premium or an initial net debit - a "debit spread." If one were to execute a trade that were exactly opposite to the bear put spread with an initial net debit … the result would be a bull put spread with an initial net credit. The risks and rewards would be defined in opposite terms.

As is the case with call spreads, put spreads may result in an initial net debit or an initial net credit. As a rule, the bull call spread and bear put spreads are debit spreads; the bear call spread and the bull put spread result in initial net credits.



The risk/reward parameters of the bear and bull vertical put spreads, held until expiration, may be defined as follows.

	Bear Vertical Put Spread	Bull Vertical Put Spread
Results in	Initial Net Debit	Initial Net Credit
Maximum Loss	Initial Net Debit	Difference in Strikes less Net Credit
Maximum Profit	Difference in Strikes less Net Debit	Initial Net Credit
Breakeven (B/E) Point	High Strike less Maximum Loss	High Strike less Maximum Profit

Selecting Vertical Spreads

Is it preferable to take advantage of a bullish market forecast using a bull (debit) call spread or a bull (credit) put spread? Consider the risks and rewards associated with bull call and bull put spreads as described in our examples above.

Examining the potential magnitude of profit and loss with both these spreads we find, not unexpectedly, that they turn in very similar performance. The maximum loss with the bull call spread is calculated as $1,015.625 while the maximum loss associated with the bull put spread is $1,046.875. Similarly, the maximum possible profits are $984.375 and $953.125, respectively. The breakeven points are also very similar at 127-01/64ths and 127-03/64ths.

Do the (slight) differences in the risk/reward parameters suggest that there are market inefficiencies at play? Actually, the differences might, at least partially, explained by the fact that option spreaders must be compensated to post a debit and effectively charged to take a credit from the marketplace.

Strikes	Max Loss	B/E Point	Max Profit
Bull Call Spreads			
126/126-16	-$328.125	126-21	$171.875
126/127	-$609.375	126-39	$390.625
126/127-16	-$843.750	126-54	$656.250
126/128	**-$1,015.625**	**127-01**	**$984.375**
126/128-16	-$1,140.625	127-09	$1,359.375
126/129	**-$1,218.750**	**127-14**	**$1,781.250**
Bull Put Spreads			
126/126-16	-$328.125	126-21	$171.875
126/127	-$625.000	126-40	$375.000
126/127-16	-$859.375	126-55	$640.625
126/128	**-$1,046.875**	**127-03**	**$953.125**
126/128-16	-$1,187.500	127-12	$1,312.500
126/129	-$1,265.625	127-17	$1,734.375

Note that the maximum loss associated with the debit bull call spread is 1/32nd (or $31.25) less than the maximum loss associated with the credit bull put spread. Likewise, the maximum profit associated with the debit bull call spread is 1/32nd more than the maximum profit associated with the bull put spread.

This 1/32nd advantage compensates the holder of the bull call spread for the fact that the spread is placed at an initial net debit of $1,015.625 while the bull put spread is placed at a credit of $953.125. Theoretically, this advantage should reflect the time value of money. At the very low short-term interest rates prevailing at the time, this may have overcompensated the bull call spread holder, suggesting that other factors were similarly at play.

Another factor may be described as "control." If the market is trading between the two strike prices, the credit spread entails a short in-the-money option and a long out-of-the-money option. By contrast, the debit spread entails a long in-the-money and a short out-of-the-money option.

Because the short gives up control regarding the timing of a possible exercise, the credit spreader may find his strategy disrupted prematurely by exercise of the short option at a time when the long option is out-of-the-money. This may be particularly true when the short is trading near its intrinsic value, *i.e.,* when term to expiration is short, volatility is low, or the option is relatively deep in-the-money. By contrast, the debit spread provides more control of the situation, which may have some value.

In addition to choosing between debit and credit spreads, option traders may also select amongst a variety of strike prices. Assume, for example, that you maintain a bearish outlook and wish to place a bear call spread. But which strike prices should you select?

Let's compare the 126/128 bull call spread to the 126/129 bull call spread. The 126/128 spread offers a reward/risk ratio of 0.97 (=maximum profit of $984.375 / maximum loss of $1,015.625). The 126/129 spread offers a more attractive reward/risk ratio of 1.46 (= $1,781.25/$1,218.75). The one effectively pays for the superior reward/risk ratio by pushing the breakeven point higher from 127-01 to 127-14.

The 126/129 spread offers a superior reward/risk ratio but a reduced probability of actually realizing a profit. This underscores the point that risks and rewards are balanced by the probability of achieving any particular outcome. Theory suggests that if all options were priced at their "fair value," then risks and rewards would be completely balanced by the probability of attaining those outcomes. Under those conditions one might, theoretically, become indifferent to entering into any option or option strategy.

Horizontal Spreads

A horizontal spread entails the purchase of a put and the sale of a put; or, the purchase of a call and the sale of a call. The two options which comprise a horizontal spread share a common strike price but are distinguished with respect to their expiration dates.

You can generally scan option quotes in the pages of financial reports or on electronic quotation devices horizontally to identify options which comprise horizontal spreads. Option months are usually quoted horizontally along columns, with prices shown vertically along the rows. Because the options which comprise horizontal spreads have different terms to expiration, these spreads are also be referred to as "time" or "calendar spreads."

	Near-Term	**Longer-Term**
Horizontal Call Spread	Sell	Buy
Horizontal Put Spread	Sell	Buy

We are interested primarily in debit horizontal spreads. These spreads are characterized by the sale of a short-term option (nearby month) and the purchase of a long-term option (deferred month).

Horizontal Call Spread

This spread typically results in an initial net debit to the extent that long-term options command greater premiums than do short-term options with the same strike. However, this rule may not work in the context of options on futures. This may be explained by the fact that the options on futures are exercisable for futures in two different months with implications that are explored later. The idea is simply to take advantage of the tendency for shorter-term options to exhibit more time value decay than longer-term options.

E.g., December 2013 10-Year Treasury note futures are at 126-26+/32nds while March 2014 futures are at 125-16+/32nds on October 17, 2013. One may have constructed a debit horizontal call spread by selling a 127 December 2013 call at 45/64ths and buying a 125-16/32nds March 2014 call at 1-33/64ths. This results in an initial net debit of $812.50.

	Premium	IV	Delta
Sell 127 Dec-13 Call	45/64	4.99%	-0.47
Buy 125-16 Mar-14 Call	(1-33/64)	5.08%	+0.51
	($812.50)		**+0.04**

	Gamma	Theta	Vega
Sell 127 Dec-13 Call	-0.2524	+0.0107	-0.1579
Buy 125-16 Mar-14 Call	+0.1330	-0.0051	+0.2951
	-0.1205	**+0.0056**	**+0.1372**

Actually, this does not quite conform to a textbook definition of a horizontal spread because the two strike prices are a bit different. Technically, it is a diagonal spread as described below. But noting that December futures were at 126-26+ and March futures at 125-16+, the 127 December call and the 125-16 March call represented the nearest-to-the-money options.

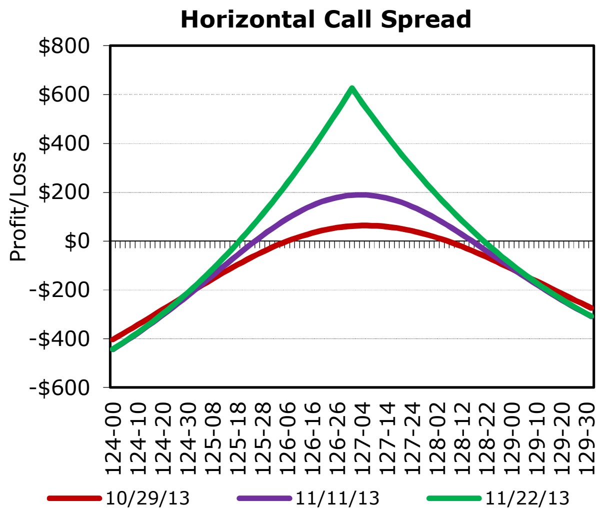
The Dec/Mar futures spread may be quoted at 1-10/32nds (=126-26+ less 125-16+). Assuming that the underlying futures spread is stable, it may be more important to select options by reference to the relationship between the strike and market price than by the outright strike price alone. *I.e.,* select two options that are equivalently in-, out- or near-to-the-money. Thus, we may have stretched our definition of a horizontal spread.

This spread is essentially price neutral as indicated by the near-zero net delta. It also offers a positive net theta and a negative net gamma. Thus, time value decay works to the spread's benefit while convexity represents a negative factor, as one would expect. But the spread further entails a positive net vega, suggesting that rising volatility may exert a positive impact. This is a relatively rare case of a strategy which offers a counterintuitive package of risks and rewards, even in the absence of significant volatility skews or pricing distortions.

What would happen if the strategy were held until expiration of the December short call? The horizontal scale of our graphic depicts the value of December futures contract with the implicit assumption that the Dec/Mar spread remains stable. Likewise, for purposes of our simulated returns, we assume that the implied volatilities of the two options that comprise the spread remain stable.

Profit is maximized in a horizontal spread when the market is reasonably stable and the near-term leg of the spread is trading at or near its strike price by expiration. Because the profit is contingent upon the sale price of the long deferred call at expiration of the nearby call, there is no convenient formula you can use to estimate the maximum profit. Rather, the profit must be approximated by simulation as shown above. In this example, the maximum profit is approximated at $600.

Because profit is maximized in a stable environment when the nearby leg goes out at its strike price, it is advisable to use strikes which are near to where you believe the market may be trading at expiration of the nearby option. If you are mildly bearish, set strikes somewhat below the market. If you are mildly bullish, set the strikes a bit above the market. But don't set strikes too far from the money.



This spread is intended to capitalize on the differential time value decay associated with short-term and long-term near-the-money options. It likely won't work if you use options which are too far from the money and which do not experience the patter of time decay normally associated with near-the-money options.

Just as the maximum profit cannot be calculated in a straightforward manner, the breakeven points can likewise only be approximated through the process of simulation.

If the market declines significantly by expiration of the December contract, the short Dec call will become worthless. Likewise, the long March call is driven deep out-of-the-money and becomes worthless.

Thus, the spread results in the loss of the initial net debit.

	Horizontal Call Spread	Horizontal Put Spread
Results in	Initial Net Debit	
Maximum Loss	Approximated by Initial Net Debit *	
Maximum Profit	Must be simulated but realized near strike price of short option	
Breakeven (B/E) Points	Must be Simulated	

* This only applies where one places a "true" horizontal spread where both strike prices are equivalent. It is further qualified where there is movement in the underlying futures spread.

If the market advances significantly, losses accruing on the short near-term call equal the in-the-money amount. As the market advances, the long long-term call likewise moves deep in-the-money. At some point, a deep in-the-money option is worth nothing more than its intrinsic value. Thus, the loss on the short option is offset by profit on exercise of the long option and the spreader is left with a loss equal to the initial net debit.

However, this assumes that this is a true horizontal spread where both options are struck at equivalent levels. It also assumes that the spread between the two underlying legs is stable. We discuss these qualifications in more detail below.

Horizontal Put Spread

Just as one may place a horizontal spread using call options, one may likewise put on a horizontal spread with the use of put options. In either case, the results are quite similar.

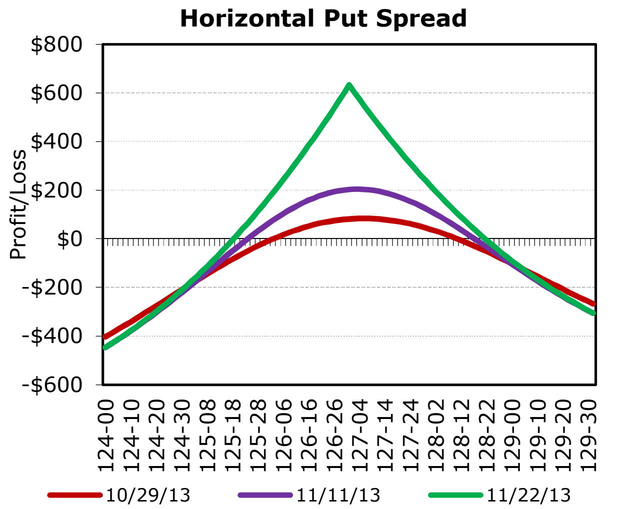
E.g., December 2013 10-Year Treasury note futures are at 126-26+/32nds while March 2014 futures are at 125-16+/32nds on October 17, 2013. One may have constructed a debit horizontal put spread by selling a 127 December 2013 call at 45/64ths and buying a 125-16/32nds March 2014 put at 1-33/64ths. This results in an initial net debit of $812.50.

	Premium	**IV**	**Delta**
Sell 127 Dec-13 Put	56/64	4.89%	+0.54
Buy 125-16 Mar-14 Put	(1-33/64)	5.16%	-0.49
	($640.625)		**-0.05**

	Gamma	**Theta**	**Vega**
Sell 127 Dec-13 Put	-0.2586	+0.0104	-0.1587
Buy 125-16 Mar-14 Put	+0.1309	-0.0058	+0.2944
	-0.1277	**+0.0046**	**+0.1357**

What happens if the strategy is held until expiration of the nearby December option? Our simulation assumes that the December long put is liquidated at prevailing market prices; that the Dec/Mar spread is held constant; and, that the options trade at constant volatilities into the future.

Again, the maximum profit and breakeven points may be approximated through simulation. Your estimate is dependent on what you estimate the long-term put will be worth at expiration of the near-term put.
The maximum (upside) risk may be approximated as the initial net debit. If the market rallies sharply, both options fall deep out-of-the-money and become worthless. If the market declines sharply both options fall deep in-the-money. A loss equal to the in-the-money amount of the short put upon exercise is offset by the profit on exercise of the long put.



This assumes that the long put will be worth only its in-the-money amount, which is typical for deep in-the-money options. Again, this is qualified by the assumption that you are placing a true horizontal spread with identical strikes and where the underlying futures spread is stable.

Underlying Futures Spread

We have indicated that the maximum risk associated with horizontal spreads may only be approximated by reference to the initial net debit. Why is this only an approximation?

Evaluating calendar spreads becomes complicated in the context of task for options on futures relative to stock options. The reason is that the two legs of a horizontal spread using options on futures are exercisable for two different contracts. Of course, a 100-share lot of stock is the same regardless of whether the stock option expires in December or March. But a December futures contract is not the same as a March futures contract.

In our example above, December futures were at 126-26+ while March futures were at 125-16+ for a spread of 1-10/32nds. But if that futures spread should rally or decline, the option spread will be affected. If the Dec/Mar futures spread declines (*i.e.,* December futures decline relative to March futures), the call spread may generate an enhanced profit. If the Dec/Mar spread advances (*i.e.,* December rallies relative to March), the value of the call spread declines.

	Horizontal Call Spread	**Horizontal Put Spread**
Futures spread rallies	Negative Effect	Positive Effect
Futures spread declines	Positive Effect	Negative Effect

Note that our calendar call spread entails a nearby short call (a bearish position) and a deferred long call (a bullish position). Thus, if nearby futures should decline relative to deferred futures (if the futures spread should decline), this benefits the call spread. But if nearby futures rally relative to deferred futures (the futures spread rallies), this adversely impacts the calendar call spread.

The same logic applies in reverse with respect to a put calendar spread. A put spread entails a nearby short put (bullish) and a deferred long put (bearish). Thus, the put spread benefits when the spread between nearby and deferred futures rallies and is adversely impacted when the underlying futures spread declines.

Diagonal Spread

A diagonal spread entails the purchase of a put and the sale of a put; or, the purchase of a call and the sale of a call. The two options which comprise a diagonal spread differ with respect to both strike price and expiration date. Because this spread involves options which differ with respect to both strike and expiration, it incorporates elements of both the vertical and horizontal spread.

	Near-Term	**Longer-Term**
Diagonal Call Spread	Sell	Buy
Diagonal Put Spread	Sell	Buy

Of course, our discussion centered about the use of options exercisable for futures contracts. To the extent that the two futures contracts may be trading at very different prices, we might modify our definitions here by focusing on the extent to which the two options that comprise a diagonal spread are in-, near-, or out-of-the-money.

A diagonal option spread is often constructed using the following formula: (i) sell the nearby and buy the deferred option to capitalize on the accelerated time value decay associated with near-term options; (ii) sell an at- or near-the-money option and buy a low struck option to enter a mildly bullish position; and (iii) sell an at- or near-the-money option and buy a high struck option to enter a mildly bearish position.

Diagonal Call Spread

Vertical bull call spreads may be pursued given an expectation that the market may rise to a particular breakeven point by expiration, *i.e.,* a bullish position. The horizontal call spread might be pursued in anticipation that market prices will trade in a neutral range. The diagonal call spread is generally practiced in anticipation of a mildly bullish market scenario.

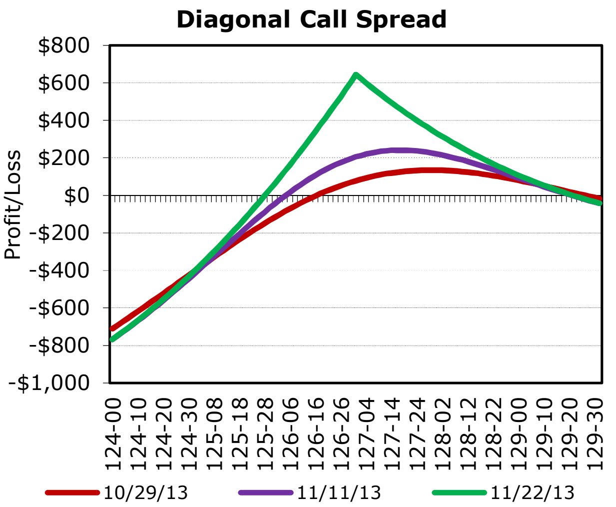
E.g., December 2013 10-Year Treasury note futures are at 126-26+/32nds while March 2014 futures are at 125-16+/32nds on October 17, 2013. One may have constructed a diagonal call spread by selling a 127 December 2013 call at 45/64ths and buying a 124-16/32nds March 2014 call at 2-09/64ths. This results in an initial net debit of $1,437.50.

	Premium	**IV**	**Delta**
Sell 127 Dec-13 Call	45-64ths	4.99%	-0.47
Buy 124-16 Mar-14 Call	(2-09/64ths)	5.35%	+0.61
	($1,437.50)		**+0.14**

	Gamma	Theta	Vega
Sell 127 Dec-13 Call	-0.2535	+0.0107	-0.1579
Buy 124-16 Mar-14 Call	+0.1216	-0.0055	+0.2837
	-0.1319	**+0.0052**	**+0.1258**

The maximum possible profit and the breakeven points must be identified through the process of simulation and the application of assumptions regarding volatility and the performance of the underlying futures spread. Specifically, one must simulate the possible sale price of the long low-struck deferred call in order to assess possible outcomes.

Like the horizontal spread, you can approximate the maximum potential loss by reference to the initial net debit. In our example, this is approximately $1,437.50. This may be understood by considering that if the market should fall sharply, both options fall out-of- the-money and become worthless. Thus, the spread trader is left with the initial net debit.



If the market should rally sharply, both options are driven into-the-money. The short option will generate a loss equal to its in-the-money amount at expiration. Likewise, the deep in-the-money long call will be worth its intrinsic value.

But the long call may have more intrinsic value than the short to the extent that it is struck at a lower level. Of course, this is contingent upon the possible performance of the underlying futures calendar spread. Thus, the returns associated with the spread in the event of a substantial rally may be expressed as the difference in strike prices less the initial debit. In this example, that translates to a $1,062.50 profit.

Because "downside" returns, *i.e.,* returns in the event of a market decline, are worse than "upside" returns, *i.e.,* returns in the event of a market advance, this strategy is clearly somewhat bullish.

	Diagonal Call Spread	Diagonal Put Spread
Results in	Initial Net Debit	
Maximum Profit	Must be simulated but realized near strike price of short option	
Maximum Downside Loss	Approximated by Initial Net Debit *	Approximated by Difference in Strikes Less Initial Net Debit *
Maximum Upside Loss	Approximated by Difference in Strikes Less Initial Net Debit *	Approximated by Initial Net Debit *
Breakeven (B/E) Points	Must be Simulated	

* This assumes that the "underlying futures spread" is at zero and does not fluctuate. If the underlying futures spread should depart from zero or fluctuate, however, this will affect the returns on these spreads constructed using options on futures.

Maximum profits, however, are still realized at the short strike price of the nearby option. This is attributed to the accelerated time value decay associated with near- or at- the-money options. As expiration approaches, holding December futures constant at 127, it is clear that the value of the spread appreciates at an accelerated pace.

Diagonal Put Spread

The combination of a short nearby, near-the-money call and a long deferred, in-the-money call constitutes a diagonal call spread as discussed above. What if you used puts instead of calls?

E.g., December 2013 10-Year Treasury note futures are at 126-26+/32nds while March 2014 futures are at 125-16+/32nds on October 17, 2013. One may have constructed a diagonal put spread by selling a 127 December 2013 put at 56/64ths and buying a 126-16/32nds March 2014 put at 2-01/64ths. This results in an initial net debit of $1,140.625.

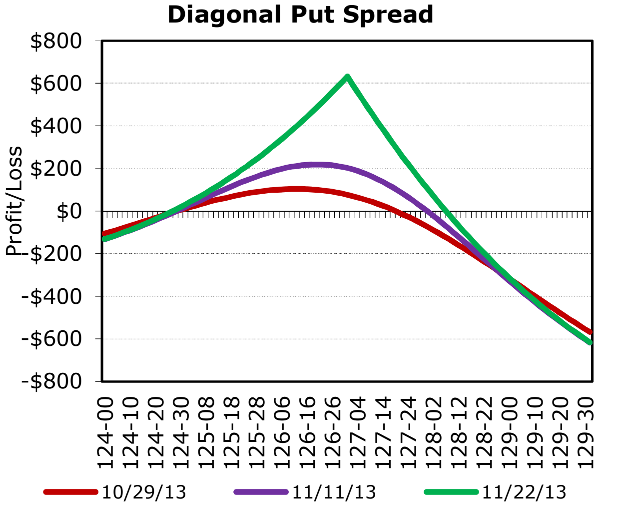
	Premium	IV	Delta
Sell 127 Dec-13 Put	56/64ths	4.89%	+0.54
Buy 126-16 Mar-14 Put	(2-01/64ths)	5.00%	-0.60
	($1,140.625)		**-0.06**

	Gamma	Theta	Vega
Sell 127 Dec-13 Put	-0.2586	+0.0104	-0.1587
Buy 126-16 Mar-14 Put	+0.1325	-0.0054	+0.2925
	-0.1261	**+0.0050**	**+0.1338**

You can approximate the maximum "upside" loss by reference to the initial net debit. If the market rallies and both options run deep out-of-the-money, they might both become worthless leaving the spreader with a loss equal to the initial net debit of $1,140.625.

If the market should decline sharply, both options are driven deep in-the-money. The short put generates a loss equal to its in-the-money amount by expiration. Likewise, the deep in-the-money long put will be worth little more than its intrinsic or in-the-money value.

If the underlying futures spread or the spread between September and December futures is at zero, the difference between the intrinsic values of the two puts will be indicated by the difference in option strike prices. Thus, the maximum "downside" loss may be approximated by the difference in strike prices less the initial net debit.



In our example, however, the long put was struck 16/32nds or $500 less than the short put. Thus, the downside loss may be estimated at $640.625 or the initial net debit of $1,140.625 less that $500 difference in strikes.

Because the return on the upside, in the event of a market advance, is much worse than the return on the downside, in the event of a market advance, this strategy may be considered somewhat bearish.

Profits tend to be maximized at the short strike price. This is attributed to the accelerated time value decay associated with near- or at- the-money options. As expiration approaches, holding December futures constant at the 127 strike, the value of the option spread will appreciate at an accelerated pace. The maximum profit simulated in our example is approximately $600.

Futures Spread Movement

Diagonal and horizontal spreads are very closely related and sometimes almost indistinguishable as we consider the nominal strike price vs. in- or out-of-the-money values. Thus, just as the performance of the underlying futures spread may strongly impact the diagonal spread, it may likewise impact upon the value of the horizontal spread.

Our simulated returns are based upon the assumption of a stable underlying futures spread. Of course, if that spread should fluctuate, the effect on a diagonal spread is similar to the effect upon a horizontal spread.

Specifically, if the futures spread should decline (March futures rally relative to December), this will exert a positive impact on horizontal and diagonal call spreads; and, a negative impact on horizontal and diagonal put spreads. If the spread should rally (March futures fall relative to December), this has a negative impact on both horizontal and diagonal call spreads; and, a positive impact on both horizontal and diagonal put spreads.

Weighted Spreads

Weighted spreads may be thought of as variations on the simple vertical spread. Vertical spread entail the purchase of one call and sale of one call; or, the purchase of one put and sale of one put, *i.e.,* a balanced 1-for-1 ratio. A "ratio" spread is a vertical spread except that you sell more options that you buy. A "backspread" is a vertical spread where you buy more options that you sell.

As a general rule, ratio spreads are thought of as tools which allow you to take advantage of time value decay. Backspreads are just the opposite and are generally thought of as trading strategies dependent upon a large market movement or volatility to succeed.

2-for-1 Ratio Call Spread

The "2-for-1" is the most common of ratio spreads. This strategy calls for the purchase of one option (put or call) and the sale of two options (puts or calls). Like the vertical spread, the long and short legs of the spread share a common expiration but differ with respect to strike prices.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have constructed a 2-for-1 ratio call spread by buying a one 126 December call at 1-20/64ths and selling two 128 December calls at 19/64ths for an initial net debit of $718.75.

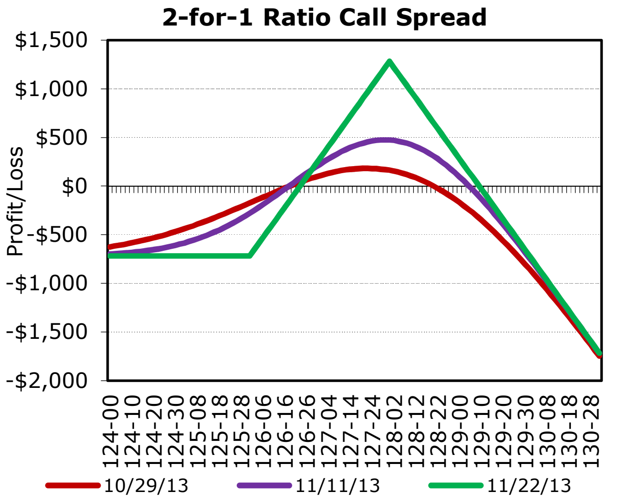
	Premium	**IV**	**Delta**
Buy 1 126 Dec-13 Call	(1-20/64ths)	5.27%	+0.66
Sell 2 128 Dec-13 Calls	0-19/64ths	4.67%	-0.26
	($718.75)		**+0.14**

	Gamma	**Theta**	**Vega**
Buy 1 126 Dec-13 Call	+0.2222	-0.0108	+0.1461
Sell 2 128 Dec-13 Calls	-0.2234	+0.0084	-0.1304
	-0.2246	**+0.0060**	**-0.1147**

In our example, the 2-for-1 spread resulted in an initial net debit. Sometimes these spreads may result in a debit and sometimes in a credit. We typically think of strategies that result in the initial receipt of premium (net credit) as strategies to be pursued in an essentially neutral or reasonably calm market environment. Note that the net gamma is negative while the net theta is positive. Thus, the initial net debit appears to be inconsistent with the implications associated with the positive net theta and negative net gamma and vega.

The initial net delta of +0.14 suggests that this is a slightly bullish strategy. But we would more aptly characterize this spread as slightly bullish to the extent that profits are maximized if the market rallies from 126-26+ to the 128 strike price by option expiration.

Let's summarize the risks and rewards associated with the strategy. Should the market fluctuate to the lower strike or below by expiration, both calls fall out-of-the-money. Thus, the trader is left with a loss of the original net debit or, in this case, $718.75.



Profit is maximized at the upper of the two strike prices or 128 in our example. If the market is at precisely 128, the single long call is 2 percent of par in-the-money and worth $2,000. The two short higher struck calls are at-the-money and worthless. This implies a profit equal to the in-the-money amount of the long call which may be expressed as the difference in strikes less any net debit or plus any net credit. In our example, the maximum profit equals $1,281.25 (= $2,000 – $718.75).

If the futures rally above the upper of the two strike prices, the two short calls fall in-the-money. At some point, the losses which accrue from the exercise of the short options offset the profit from the single in-the-money long option. This is the breakeven point identified as the upper strike price plus the maximum profit. In our example, that equals 128 plus 1-18/64ths, or 129-18/64ths.

	2-for-1 Ratio Call Spread
Downside Risk	Initial net debit or credit
Maximum Profit	Difference in strikes plus or minus initial net debit or credit
Upper Breakeven (B/E) Point	Upper strike price + Maximum profit

We think of this spread as one that might be placed when the market is near or perhaps under the lower of the two strikes. The idea is to find a situation where the market may be expected to gradually trade toward the short strike price by expiration. But if the market price fails to rally, loss is limited to any initial net credit or debit. While the spread illustrated in our example entailed an initial net debit and a loss in the event of a market downturn, the more distressing loss occurs if the market rallies well past the upper strike price and breakeven point.

2-for-1 Ratio Put Spread

Just as you can place a 2-for-1 ratio call spread in anticipation of a mildly bullish market, you can place a 2-for-1 ratio put spread in anticipation of a mildly bearish market.

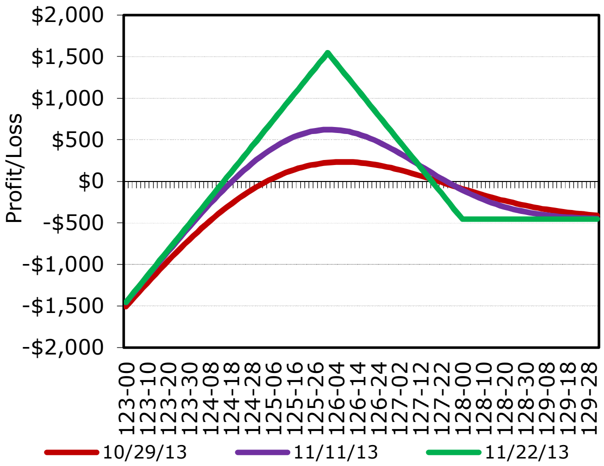
E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have constructed a 2-for-1 ration put spread by selling two 126 December puts at 32/64ths and buying one 128 December put at 1-29/64ths for an initial net debit of $453.125.

	Premium	IV	Delta
Sell 2 126 Dec-13 Puts	0-32/64ths	5.34%	+0.35
Buy 1 128 Dec-13 Put	(1-29/64ths)	4.43%	-0.75
	($453.125)		**-0.05**

	Gamma	Theta	Vega
Sell 2 126 Dec-13 Puts	-0.2205	+0.0110	-0.1475
Buy 1 128 Dec-13 Put	+0.2302	-0.0080	+0.1275
	-0.2108	**+0.0014**	**-0.1675**

If the market price is at or above the upper of the two strikes at expiration, both puts fall out-of-the-money and become worthless. Thus, the trader is left with a loss of the original net debit. In our example, that implies a loss equal to the initial net debit of $453.125.

2-for-1 Ratio Put Spread



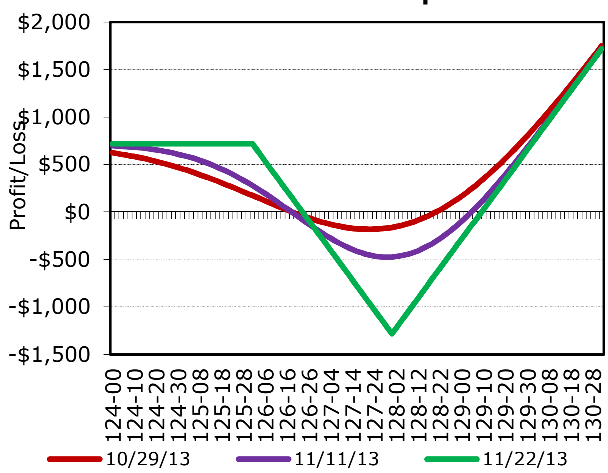
Profits are maximized at the lower of the two strike prices. Here, the single long put falls 2 percent of par or $2,000 in-the-money. The two short lower struck puts are at-the-money and worthless. Thus, the profit equals the in-the-money amount of the long put plus any initial net credit or minus any initial net debit. In our example, that equals $1,546.875 (= $2,000 - $453.125).

	2-for-1 Ratio Put Spread
Downside Risk	Initial net debit or credit
Maximum Profit	Difference in strikes plus or minus initial net debit or credit
Lower Breakeven (B/E) Point	Lower strike price - Maximum profit

If the market price should trend below the lower of the two strikes, 2 short puts fall in-the-money. At some point, losses which accrue from the exercise of the short options offset the profit from the single in-the-money long option. The loss associated with one of the two short puts offsets the profit from the single long put.

Under the lower of the two strikes, it is as if you long one futures contract in a falling market. The lower breakeven point is identified as the lower strike price less the maximum profit. In our example, that equals 126 less 1-35/64ths or 124-29/64ths.

2-for-1 Call Backspread



Analogous to the ratio call spread, the ratio put spread is normally placed when the market is around or above the upper of the two strikes. Hopefully, the market will gradually trade toward the short strike price by expiration. The risk is that the market will decline rapidly down to or below the lower breakeven point.

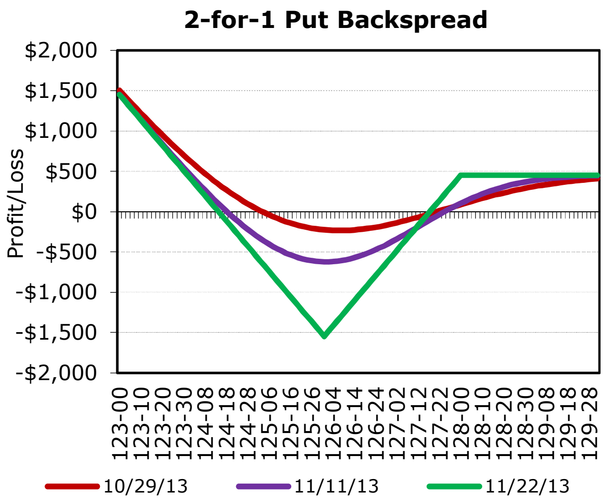
Backspreads

A "backspread" is created by taking a vertical spread but by buying more options than are sold, or the opposite of a ratio spread. As one might expect, the risks and rewards associated with these strategies are precisely opposite those associated with similarly weighted ratio spreads.

In fact, one may simply rotate a ratio spread diagram along a horizontal axis to create a diagram illustrating a backspread. Similarly, you may rotate these graphics along a vertical axis and change the orientation from a put to a call; or, a call to a put.

Volatility Driven Strategies

One of the several factors that drive option prices is marketplace volatility. Of course, there are other factors notably including the relationship of the market price to the option strike or exercise price; and, the term or time remaining until option expiration. All of these variables impact upon the option premium to one degree or another and, therefore, impact upon the outcome of one's option trading strategy.



Let's focus on a series of option strategies that are sometimes referred to as "volatility trades." But while these trades may be called volatility trades, it is important to recognize the impact that price time and volatility wield upon the particular strategy. Further, it is important to understand that these three variables are not independent but rather act in concert to off the option trader a number of trade-offs. Thus, one's strategy tends to be driven by a judgment regarding which of these factors is most likely to exert a heavy impact upon the market.

The specific strategies we intend to highlight include straddles, strangles, guts, butterflies and condors. All of these strategies are significantly affected by rising or falling volatilities. But, as a practical matter, it may be difficult to isolate the impact of volatility on the strategy apart from the concerted impact of market price movement and the significance of time value decay. This is apparent when one considers that volatility is essentially defined by the degree of price movement over time.

As a general rule, short options are thought of as instruments that permit you to capitalize on stable prices, the onset of time value decay and falling volatility. Long options permit you to capitalize on heavily trending prices over short time periods and rising volatility.

Long Straddle

The terms "straddle" and "spread" are sometimes employed interchangeably in the context of futures but this is not true when we speak of options. As discussed above, an option spread involves the purchase and sale of two calls; or the purchase and sale of two puts. In other words two options of the same type. A straddle is distinguished from an option spread in the sense that it utilizes both types of options, *i.e.,* calls and puts. Specifically, a straddle entails the purchase of a call and a put; or, the sale of both a call and a put.

The calls and puts that constitute an option straddle share a common strike or exercise price and a common expiration date. A "long straddle" entails the purchase of a call and a put; while a "short straddle" entails the sale of both a call and a put.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have entered a long straddle by buying a 127 December 2013 call for 45/64ths and buying a 127 December 2013 put at 56/64ths for an initial net debit of $1,578.125.

	Premium	IV	Delta
Buy 127 Dec-13 Call	(45/64ths)	4.99%	+0.47
Buy 127 Dec-13 Put	(56/64ths)	4.89%	-0.54
	($1,578.125)		**-0.07**

	Gamma	Theta	Vega
Buy 127 Dec-13 Call	+0.2535	-0.0107	+0.1579
Buy 127 Dec-13 Put	+0.2586	-0.0104	+0.1587
	+0.5121	**-0.0211**	**+0.3166**

The maximum loss associated with a long straddle may be identified as the initial net debit. If the market trades to the common strike price by expiration, both options are at-the-money and expire with zero in-the-money or intrinsic value. Thus, the options might be abandoned leaving the trader with a loss equal to the initial debit. In our example, this equals $1,578.125.

The maximum potential profit might be described as open-ended. It is limited only by the extent to which the market might trend away from the common strike price over the life of the trade. An upper and a lower breakeven point may be identified as the common strikes price plus and minus the initial net debit, respectively.

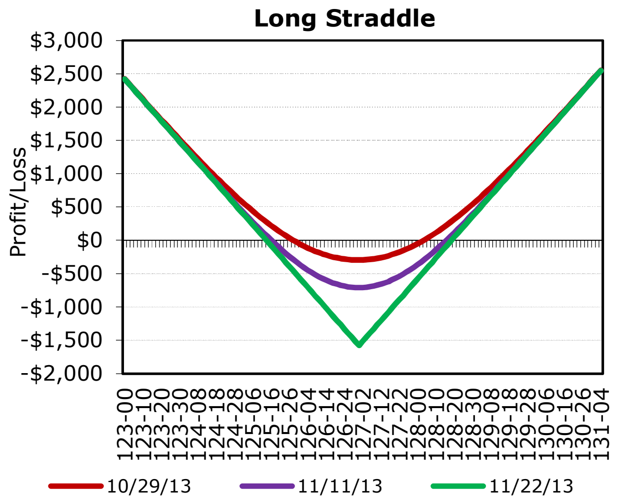
If the market rises to the strike price plus the initial net debit, the long call is in-the-money by an amount equal to the debit while the long put is out-of-the-money and worthless, resulting in breakeven. Similarly, if the market declines to the strike price less the debit, the long put is in-the-money by an amount equal to the debit while the long call is out-of-the-money, resulting in breakeven again.

In our example, the breakeven points may be calculated as 126-27/64ths and 128-37/64ths. These values are calculated as 127 plus 1-37/64ths; and, 127 minus 1-37/64ths.

	Long Straddle
Maximum Loss	Initial net debit
Upper B/E	Strike price + Initial net debit
Lower B/E	Strike price - Initial net debit

The long straddle may be characterized as a non-directional trade in the sense that it can generate profits regardless of which direction the market moves. The initial net delta in our example is -0.07 and close to zero.

But more telling are the positive net gamma and negative net theta. Thus, the trade will benefit from convexity in a volatile market environment but will experience time value decay resulting in loss in a neutral market. Finally, the net vega is also quite positive suggesting that the long straddle will benefit from rising volatility.



If you are slightly more bullish than bearish or bearish than bullish, you may wish to enter the straddle using options struck below the market (an in-the-money call and an out-of-the-money put) or struck above the market (an out-of-the-money call and an in-the-money put).

Short Straddle

Just as you can buy a put and a call to create a long straddle, you can sell both a put and a call to create a short straddle. A short straddle allows you to take advantage of the possibility that the market will trade in a range between the breakeven points or that volatility will decline.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have entered a short straddle by selling a 127 December 2013 call for 45/64ths and selling a 127 December 2013 put at 56/64ths for an initial net credit of $1,578.125.

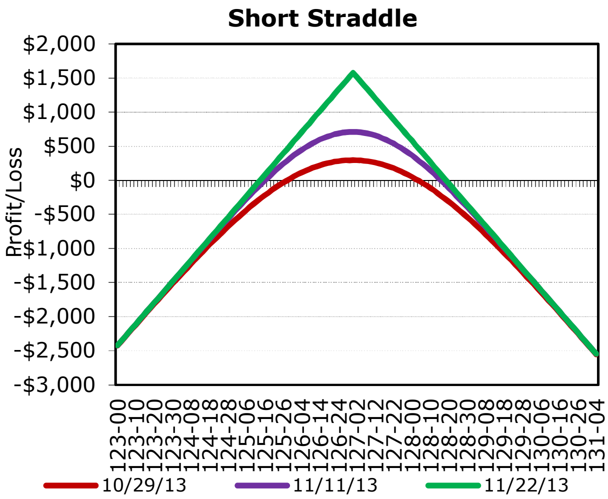
	Premium	IV	Delta
Sell 127 Dec-13 Call	45/64ths	4.99%	-0.47
Sell 127 Dec-13 Put	56/64ths	4.89%	+0.54
	$1,578.125		**+0.07**

	Gamma	Theta	Vega
Sell 127 Dec-13 Call	-0.2535	+0.0107	-0.1579
Sell 127 Dec-13 Put	-0.2586	+0.0104	-0.1587
	-0.5121	**+0.0211**	**-0.3166**

The risk/reward parameters of the short straddle are exactly the opposite of those of the long straddle. Unlike the long straddle that requires the payment of premium or an initial net debit, the short straddle implies the receipt of premium for an initial net credit.

This initial net credit represents the maximum possible profit presuming that the market trades to the common strike price by expiration. Under these circumstances, both options are at-the-money and worthless at expiration. Thus, you are left with the initial net credit which, in our example, is equal to $1,578.125

If the market rallies, the call runs into-the-money and will presumably be exercised at some point. Losses accruing from the exercise of the call will offset the initial receipt of the net credit, resulting in a breakeven situation. Thus, an upper breakeven point is found at the common strike plus the net credit. The lower breakeven point is found where the in-the-money value of the short put offsets the initial receipt of the net credit or at the common strike price less the net credit.



In our example, the breakeven points may be calculated as 126-27/64ths and 128-37/64ths. These values are calculated as 127 plus 1-37/64ths; and, 127 minus 1-37/64ths. Of course, these match the B/E points of the long straddle precisely

	Short Straddle
Maximum Profit	Initial net credit
Upper B/E	Strike price + Initial net credit
Lower B/E	Strike price - Initial net credit

Short straddles tend to be placed using strike prices that are at- or near-the-money just like long straddles. If, however, you were slightly bullish or bearish, you might consider the sale of straddles that are struck a bit above or a bit below the prevailing market price. But you likely would not use options struck very far from the money to the extent that the intent is to take advantage of time value decay. Options struck far-from–the-money tend not to exhibit much time value decay.

Long Strangle

Strangles are very similar to straddles in the sense that they entail the purchase of a call and put; or, the sale of both a call and a put option. Unlike a straddle that entails the use of two options with the same strike price, a strangle entails use of a high-struck call and a relatively low-struck put. While the two options differ with respect to strike prices, they nonetheless share a common expiration date.

A "long strangle" entails the purchase of a high-struck call with the purchase of a relatively low-struck put. A "short strangle" entails the sale of a high-struck call with the sale of a relatively low-struck put. These trades are generally, although not necessarily, placed when the market is trading between the two strike prices. As such, this implies that strangles are generally constructed using out-of-the-money options.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have entered a long strangle by buying a 128 December 2013 call for 19/64ths and buying a 126 December 2013 put at 32/64ths for an initial net debit of $796.875.

	Premium	IV	Delta
Buy 128 Dec-13 Call	(19/64ths)	4.67%	+0.26
Buy 126 Dec-13 Put	(32/64ths)	5.34%	-0.35
	($796.875)		**-0.09**

	Gamma	Theta	Vega
Buy 128 Dec-13 Call	+0.2234	-0.0084	+0.1304
Buy 126 Dec-13 Put	+0.2205	-0.0110	+0.1475
	+0.4439	**-0.0194**	**+0.2779**

The long strangle performs much like a long straddle insofar as it permits you to take advantage of a market breaking sharply up or sharply down. But if the underlying futures price should remain between the two strikes prices, both options are at-the-money and worthless if held until expiration. Thus, the trader realizes a net loss equal to the initial net debit. In our example, that equates to a loss of $796.875.

If the market should rally over the upper of the two strike prices, the call runs into-the-money. At some point, the profit on exercise of the call offset payment of the initial net debit. This is the upper breakeven point.

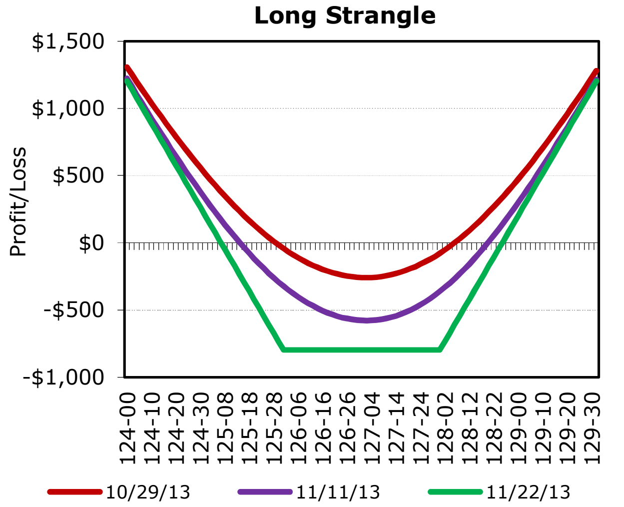
If the market should breaks under the lower of the two strike prices, the put runs into-the-money and profits on exercise offset the initial net debit. This is the lower breakeven point.

	Long Strangle
Maximum Loss	Initial net debit
Upper B/E	Call strike price + Initial net debit
Lower B/E	Put strike price - Initial net debit

The upper and lower breakeven points may be defined as the call strike plus the net debit and the put strike less the net debit, respectively. In our example, these B/E points equal 128-51/64ths (=128 + 51/64ths) and 126-13/64ths (=126 – 51/64ths).

The long strangle performs very much like the long straddle. It is a non-directional volatility play which benefits from sharp movement either up or down but suffers from the phenomenon of time value decay. But it might be considered a bit more conservative than the long straddle.

To explain, assume that you buy a strangle when the market is midway between the two strikes; or, buy a straddle struck exactly at-the-money. At-the-money options are more responsive to time value decay and to shifting volatilities than are out-of-the-money options. Further, out-of-the-money options will cost less than an at-the-money option. This suggests that long strangles will generally entail a smaller initial net debit and less maximum risk than long straddles. Thus, the long strangle is the more conservative of strategy.



You could also utilize strangles with wider or narrower strike price intervals if you wished to employ a more or less conservative strategy. As a general rule, the greater the strike price interval, the more conservative the strategy measured in terms of less initial cost and associated risk. You could further shade the strangle by using higher or lower strike prices in anticipation of a bit more bearish or a bit more bullish market forecast respectively.

Short Strangle

Just as you might buy a put and a call to create a long strangle, you can sell a put and a call to create a short strangle. Like a short straddle, the short strangle allows you to take advantage of a neutral market or declining volatility, *i.e.*, to capitalize on time value decay.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have entered a short strangle by selling a 128 December 2013 call for 19/64ths and selling a 126 December 2013 put at 32/64ths for an initial net credit of $796.875.

	Premium	IV	Delta
Sell 128 Dec-13 Call	19/64ths	4.67%	-0.26
Sell 126 Dec-13 Put	32/64ths	5.34%	+0.35
	$796.875		**+0.09**

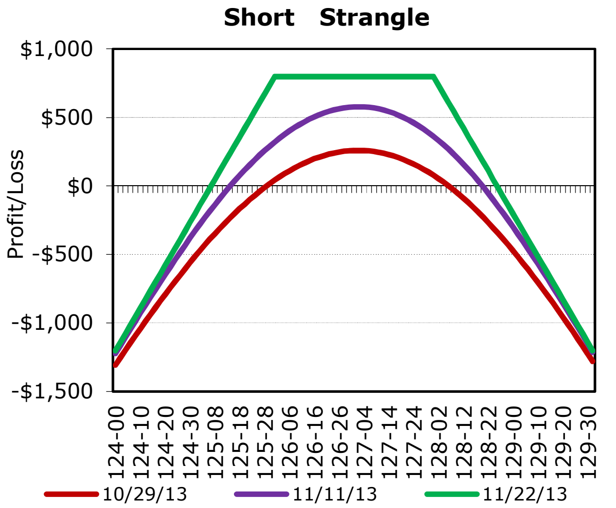
	Gamma	Theta	Vega
Sell 128 Dec-13 Call	-0.2234	+0.0084	-0.1304
Sell 126 Dec-13 Put	-0.2205	+0.0110	-0.1475
	-0.4439	**+0.0194**	**-0.2779**

Of course, the risk/reward parameters of the short strangle are the exact opposite of those of the long strangle. Like a short straddle, the short strangle allows you to receive premium equal to the initial net credit.

That initial net credit represents the maximum possible profit associated with the strategy. If the market should remain within the two strike prices, both options will become worthless held until expiration. This leaves the trader with a profit equal to the initial net credit. In our example, that initial net credit was equal to $796.875.

If the market should rally, the put is out-of-the-money and will expire worthless if held until its full term. But the call goes into-the-money and accumulates intrinsic value to the detriment of the short. The upper breakeven is found at the upper strike price plus the initial net credit.

If the market should decline below the lower of the two strike prices, the short call is out-of-the-money and may expire worthless. But the put is driven into-the-money and its intrinsic value will offset the receipt of the initial net credit at the lower breakeven point. This lower breakeven is calculated as the lower strike price less the initial net credit.



In our example, the maximum profit is represented by the initial net credit of $796.8755. The upper and lower breakeven points may be defined as the call strike plus the net credit and the put strike less the net credit, respectively. These B/E points equal 128-51/64ths (=128 + 51/64ths) and 126-13/64ths (=126 – 51/64ths), respectively.

Just as the long strangle is more conservative than the long straddle, the short strangle is likewise more conservative than the short straddle. The profitable range associated with a short strangle is a bit wider than that of a short straddle but the maximum profit is reduced by virtue of the fact that the out-of-the-money options tend to cost less than at-the-money options, resulting in a relatively modest initial net credit.

	Short Strangle
Maximum Profit	Initial net credit
Upper B/E	Call strike price + Initial net credit
Lower B/E	Put strike price - Initial net credit

Time value decay tends to be weaker for the out-of-the-money options that generally comprise a strangle than the near-to-the-money options associated with a straddle. This is counterbalanced by the reduced convexity generally associated with strangles.

Long Guts

A "guts" trade is a close cousin to a straddle or a strangle. It too involves the purchase of a call and a put; or, the sale of a call and a put. We often think of straddles as the purchase or sale of at-the-money options and strangles as the purchase or sale of out-of-the-money options. Think of guts as the purchase and sale of in-the-money options, *i.e.,* a high-struck put coupled with a relatively low-struck call. Like straddles and strangles, the two options that comprise a guts strategy share a common expiration date but differ with respect to strike price.

A "long guts" represents the purchase of a low-struck call coupled with the purchase of a high-struck put. A "short guts" is the opposite or the sale of a low-struck call along with the sale of a high-struck put. To the extent that the market may be trading between the two strike prices, a guts trade involves two in-the-money options.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have entered a long guts by buying a 126

December 2013 call for 1-20/64ths and buying a 128 December 2013 put at 1-29/64ths for an initial net debit of $2,765.625.

	Premium	IV	Delta
Buy 126 Dec-13 Call	(1-20/64ths)	5.27%	+0.66
Buy 128 Dec-13 Put	(1-29/64ths)	4.43%	-0.75
	($2,765.625)		**-0.09**

	Gamma	Theta	Vega
Buy 126 Dec-13 Call	+0.2222	-0.0108	+0.1461
Buy 128 Dec-13 Put	+0.2302	-0.0080	+0.1275
	+0.4524	**-0.0188**	**+0.2736**

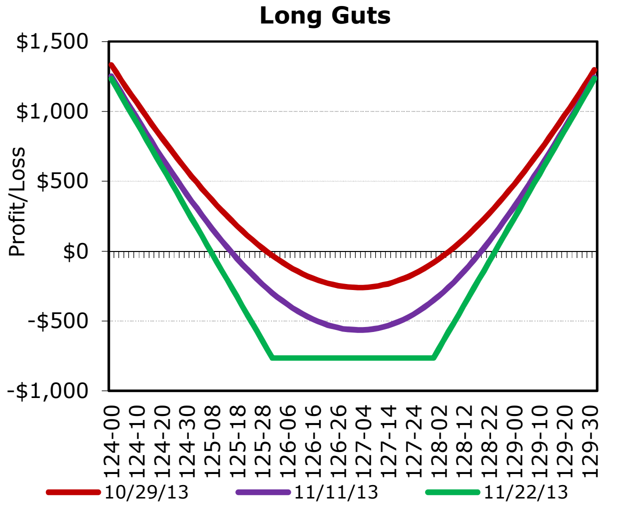
The risk/reward profile of the long guts strongly resembles that of the long strangle. A fixed loss is realized between the two strikes and profits may be realized if the market breaks in either direction. The magnitude of these profits and losses are similar.

If underlying market prices should remain within the two strikes by expiration, both options fall in-the-money and may be exercised. The total profit on exercise of the two options must equal the difference in strikes. Thus, the long guts generates a loss equal to the initial net debit less the difference in strikes as long as the market trades within the two strike prices by expiration.

To illustrate in the context of our example, assume that the underlying futures price trades to 127 by option expiration. This is exactly midway between the 126 call and the 128 put strike price. Both options are in-the-money by 1 percent of par or $1,000 each. If both are exercised, that implies an aggregate profit one exercise of $2,000. Thus, the maximum potential loss equals $765.625 or the initial net debit of $2,765.625 reduced by the difference in strikes or $2,000.

	Long Guts
Maximum Loss	Initial net debit less difference in strikes
Upper B/E	Call strike price + Initial net debit
Lower B/E	Put strike price - Initial net debit

Profits result if market prices should advance or decline sharply in either direction. If the market should advance to the lower of the two strike prices plus the initial net debit, the low-struck call is exercised for an intrinsic value that exactly offsets that debit. This is the upper breakeven point. If the market should decline to the lower of the two strike prices less the initial net debit, then the long put might be exercised for an intrinsic value that offsets that debit. This is the lower breakeven point.



In our example, the upper and lower breakeven points may be calculated as 128-49/64ths and 126-15/64ths, respectively. The upper breakeven point is calculated as the call strike of 126 plus 2-49/64ths. The lower breakeven point is calculated as the put strike of 128 less 2-49/64ths.

The long guts and long strangle are distinguished insofar as the strangle results in a reduced initial net debit. Thus, it requires less cash up-front to finance a strangle even though both positions offer a very similar risk/reward posture.

To put it another way, strangles offer enhanced leverage relative to guts. However, the market tends to compensate in the sense that the maximum loss associated with long guts tends to be slightly less than the maximum loss associated with long strangles with the same strike prices. This implies that breakeven points associated with a long guts strategy tend to be a bit narrower than that associated with a comparable long strangle.

Short Guts

Likewise, a short guts strategy is similar to a short strangle in terms of its risk/reward profile. The notable exception is that the short guts trade tends to generate a larger initial net credit. Presumably, traders will reinvest those funds at prevailing short-term rates, providing a bit more return.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. One may have entered a short guts by selling a 126 December 2013 call for 1-20/64ths and selling a 128 December 2013 put at 1-29/64ths for an initial net credit of $2,765.625.

	Premium	IV	Delta
Sell 126 Dec-13 Call	1-20/64ths	5.27%	-0.66
Sell 128 Dec-13 Put	1-29/64ths	4.43%	+0.75
	$2,765.625		**+0.09**

	Gamma	Theta	Vega
Sell 126 Dec-13 Call	-0.2222	+0.0108	-0.1461
Sell 128 Dec-13 Put	-0.2302	+0.0080	-0.1275
	-0.4524	**+0.0188**	**-0.2736**

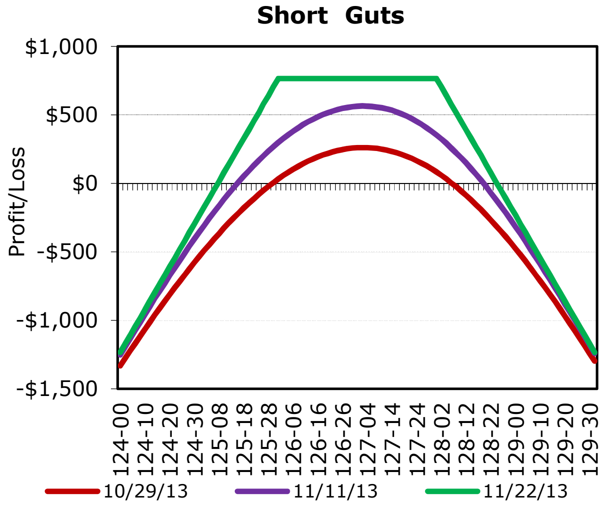
The maximum possible loss associated with the short guts equals the initial net credit adjusted by the difference in strike prices. Consider that if the market should fall anywhere between the two strike prices, the intrinsic value of the two options must aggregate to the value of the difference in strike prices.

If the market should be at 127 or midway between the 126 and 128 strike prices, the intrinsic value of both options is equal to 1 percent of par or $2,000 in the aggregate. Because you are short both of these options in a short guts, you lose that amount cushioned by the initial receipt of the initial net credit of $2,765.625. This represents a net gain of $765.625 which is the maximum possible profit.

	Short Guts
Maximum Loss	Initial net credit less difference in strikes
Upper B/E	Call strike price + Initial net credit
Lower B/E	Put strike price - Initial net credit

The upper breakeven point is defined as the call strike price plus the initial net credit. If the market should rally about the call strike price, it falls in-the-money and may be exercised against the call writer. The upper breakeven point is found at the level where the intrinsic value of the call exactly offsets the initial net credit. The lower breakeven point is defined as the put strike price less the initial net credit. This is where the intrinsic value of the put exactly offsets the initial net credit.

In our example, the upper and lower breakeven points may be calculated as 128-49/64ths and 126-15/64ths, respectively. The upper breakeven point is calculated as the call strike of 126 plus 2-49/64ths. The lower breakeven point is calculated as the put strike of 128 less 2-49/64ths.



A short guts strategy will entail a larger initial net credit relative to a short strangle with the same strike prices. But the short strangle trader is compensated with a bit higher maximum possible profit and a bit wider breakeven points.

Comparing Straddles, Strangles, Guts

Let's compare the relative merits of entering the straddle, strangle or guts trades as shown in our examples above. We restrict our consideration to long strategies although the principles are equally applicable to short strategies but in reverse.

Clearly, the straddle is the most aggressive of the three strategies. The long straddle in our example entails much more risk than do the strangle or the guts. As might be expected, the straddle also offers narrower breakeven points. Thus, the increased maximum possible loss is offset by a greater probability that the market may trend sufficiently to generate a profitable disposition of the trade.

The differences between the results associated with the strangle and the guts strategies are much more subtle. The guts trade entails slightly reduced risk and somewhat narrower breakevens relative to the strangle. But it also requires a much greater initial net debit. There is an opportunity cost associated with the payment of a larger relative to a smaller initial net debit in the sense that cash deployed in an option trade might otherwise be earning short-term interest rates.

	Risk	Low Breakeven	High Breakeven
Long Straddle	$1,137.50	95.2950	96.2050
Long Strangle	$606.25	95.2575	96.2425
Long Guts	$587.50	95.2650	96.2350

We can also tell a great deal about these trades by examining the "greeks" or the net deltas, gammas, vegas and thetas associated with the three trades. Most of these numbers are quite similar or in some cases identical from one strategy to the next. But there are some subtle differences worth noting.

For example, the straddle is the most sensitive to fluctuating volatility levels as indicated by the net vega. In fact, the straddle is most sensitive to convexity as measured by gamma as well as time value decay measured by theta. This may be understood by considering that at-the-money options tend to be more sensitive to these factors relative to the out-of-the-money options that comprise the strangle or in-the-money options that comprise that guts strategy.

All of these strategies are considered "volatility plays" and pursued in an attempt to capitalize on an expected advance or decline in volatility as measured by vega. Thus, let's consider the results that may be realized in the event that volatilities were to advance by a uniform 1% in all three cases.

We may do so through a simulation using option pricing models. In our example, the long straddle is found to be marginally more responsive to a 1% advance in volatility relative to the strangle or guts. The straddle generates a simulated return of $317 relative to $278 and $274 on the long strangle and long guts trades, respectively. Actually, this result flows directly from an examination of the net vegas of the three strategies.

	Vega	Profit	Invest-ment	Return
Long Straddle	+0.3166	~$317	$1,578.125	20.1%
Long Strangle	+0.2779	~$278	$796.875	34.9%
Long Guts	+0.2736	~$274	$2,765.625	9.9%

While the straddle produces marginally superior absolute returns, the percentage profit associated with the strangle is by far the most attractive. This underscores the superior leverage associated with out-of-the-money, as opposed to in-the-money, options. Thus, those cheap out-of-the-money options provide greater elasticity on a dollar-for-dollar basis than do relatively more expensive at- or in-the-money options.

Specialty Option Strategies

Straddles and strangles are the popular of so-called volatility plays. However, when you sell straddles and strangles in anticipation of declining volatility in an essentially neutral market, you nonetheless open yourself up for open-ended risks in the sense that there is no limit on the maximum loss in the event of a major move either up or down. Thus, some traders prefer the use of "butterflies" or "condors" that provide very similar risk/reward structures with the added benefit of limited risk should the market move sharply up or down.

Butterflies

Butterflies strongly resemble short straddles in the sense that returns are maximized at the strike price associated with the short options in the strategy. Unlike the short straddle, however, the butterfly represents a combination of four options rather than just two options. Further, all four of these options may be calls or puts. Or, one may construct a butterfly with a combination of put and call options. These options share a common expiration date but differ which respect to strike prices.

The characteristic structure of a butterfly calls for the purchase of two extreme struck options combined with the sale of two options with strike price that falls between the two extremes. The strategy may be constructed by purchasing two extreme struck calls coupled with the sale of two calls at a common intermediate strike price. Or, the purchase of two extreme struck puts coupled with the sale of two puts at an intermediate strike price.

Or, one may combine a bull vertical call spread with a bear vertical put spread where the short components of the two vertical spread share a common strike price. Or, the combination of a bull vertical put spread with a bear vertical call spread where the short options share a common strike price. Perhaps the easiest way of thinking about a long butterfly is that it represents the combination of a bull and a bear vertical spread and it doesn't matter whether one uses call vertical spreads, put vertical spreads or a combination of the two. In other words, there are many ways to piece together a butterfly.

Regardless of how the butterfly is constructed, the strategy is intended to capitalize on declining volatility or neutral markets. The strategy will generally result in the payment of an initial net debit. Thus, we often referred to this as a "long" butterfly.

E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. A butterfly could have been created by buying a 126 call at 1-20/64ths, selling two 127 calls at 45/64ths each and buying a 128 call at 19/64ths for an initial net debit of $203.125.

	Premium	**IV**	**Delta**
Buy 1 126 Dec-13 Call	(1-20/64ths)	5.27%	+0.66
Sell 2 127 Dec-13 Calls	45/64ths	4.99%	-0.47
Buy 1 128 Dec-13 Call	(19/64ths)	4.67%	+0.26
	($203.125)		**-0.02**

	Gamma	**Theta**	**Vega**
Buy 1 126 Dec-13 Call	+0.2222	-0.0108	+0.1461
Sell 2 127 Dec-13 Calls	-0.2535	+0.0107	-0.1579
Buy 1 128 Dec-13 Call	+0.2234	-0.0084	+0.1304
	-0.0614	**+0.0022**	**-0.0393**

If the underlying futures market should fall at or below the lowest of the three strikes by expiration, all three call options fall out-of-the-money and expire worthless. Thus, the butterfly buyer is left with a loss equal to the initial net debit. In our example, this equates to a modest loss of $203.125.

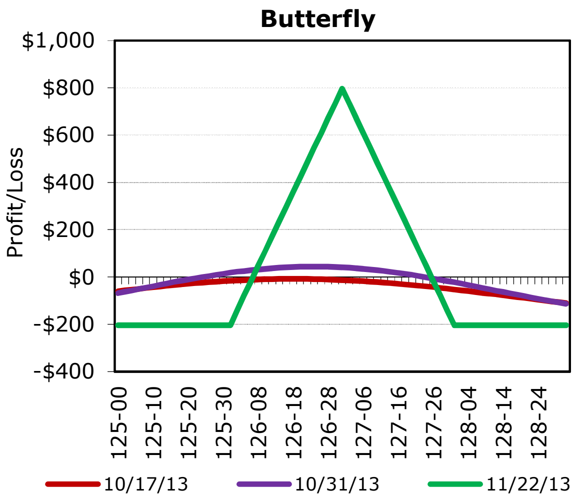
If the market trades to the intermediate strike price by expiration, the lowest struck call falls in-the-money by an amount identified as the difference in strike prices. That long call may be exercised for its intrinsic value which offsets the initial net debit. Thus, the maximum possible profit realized at the intermediate short strike price may be defined as the difference in strikes less any initial net debit. In our example, the maximum possible profit equals $796.875 ($1,000 less $203.125.

If the market should advance to the highest of the three strike prices by expiration, the lowest struck long call is in-the-money by an amount equal to the difference between the high and low strike prices. Thus, one may recover its in-the-money or intrinsic value through exercise. The two short intermediate struck options are likewise in-the-money by an amount equal to the difference between the highest strike and the intermediate strike.

	Long Butterfly
Maximum Profit	Difference in strikes – Initial net debit
Upper B/E	Intermediate strike price + Maximum profit
Lower B/E	Intermediate strike price - Maximum profit
Maximum Loss	Initial net debit

This results in a loss equal to the strike price span times two to the extent that that are two short calls. The net result is that the profit on exercise of the long low-struck call offsets the loss on exercise of the two short intermediate struck calls. This leaves on with a maximum loss equal to the initial net debit. In our example, the initial net debit or maximum possible loss equates to $203.125.

An upper and a lower breakeven point may be identified as the intermediate strike price plus and minus the maximum possible profit. In our example, the upper breakeven point is found at 127-13/64ths (=127 + 13/64ths). The lower breakeven point is found at 126-51/64ths (=127 – 13/64ths).



The risk/return graphic of our long butterfly strongly resembles a short straddle with the exception that risk is limited if the market should rally above or break below the upper or lower of the three strike prices, respectively.

Condors

If a butterfly may the thought of as akin to a short straddle with limited risk, a condor is said to resemble a short strangle with limited risk. It too may be thought of as the combination of bullish and bearish vertical spreads except that the spreads do not share any common strikes. Thus, a condor may be composed of all calls, all puts or a combination of both calls and puts. Like a long butterfly, the long condor is intended to capitalize on time value decay or a neutral market.

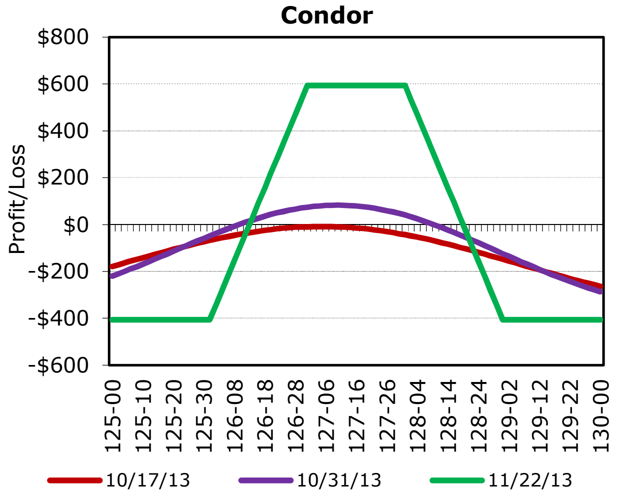
E.g., December 2013 10-Year Treasury note futures are trading at 126-26+/32nds on October 17, 2013. A condor could have been created by buying a 126 call at 1-20/64ths, selling a 127 call at 45/64ths, selling a 128 call at 19/64ths and buying a 129 call at 6/64ths for an initial net debit of $406.25.

	Premium	IV	Delta
Buy 126 Dec-13 Call	(1-20/64ths)	5.27%	+0.66
Sell 127 Dec-13 Call	45/64ths	4.99%	-0.47
Sell 128 Dec-13 Call	19/64ths	4.67%	-0.26
Buy 129 Dec-13 Call	(6/64ths)	4.38%	+0.11
	($406.25)		**+0.04**

	Gamma	Theta	Vega
Buy 126 Dec-13 Call	+0.2222	-0.0108	+0.1461
Sell 127 Dec-13 Call	-0.2535	+0.0107	-0.1579
Sell 128 Dec-13 Call	-0.2234	+0.0084	-0.1304
Buy 129 Dec-13 Call	+0.1380	-0.0042	+0.0759
	-0.1167	**+0.0041**	**-0.0663**

Provided that the underlying futures market price remains at or under the lower of the four strikes by expiration, all four options fall out-of-the- money and expire worthless. Thus, the condor buyer is left with a maximum loss equal to the initial net debit. In our example, that represents a risk of $406.25.

If the market trades to the lower intermediate strike price by expiration, the lowest struck call is in-the-money by an amount equal to the difference in strike prices and may be exercised for its intrinsic value. All other options in the condor are either at- or out-of-the-money and worthless. Thus, the maximum profit may be defined as the difference in strike prices less the initial net debit. In our example, that equals $593.75 or $1,000 less the initial net debit of $406.25.



If the market should advance to the upper of the two intermediate strike prices by expiration, the lowest struck call is in-the-money by an amount equal to the difference between the high intermediate strike and the lowest strike and may be exercised for the same amount. The short call with the lower of the two intermediate strikes is also in-the-money but by an amount equal to the difference between the high intermediate and low intermediate strike prices. It may be may be exercised against the condor trader for a loss in that amount.

On a net basis, the maximum profit is still defined as the difference between the low intermediate strike and lowest strike less the initial net debit. In our example, provided that the market remains between the two intermediate strike prices by expiration, the maximum possible profit equals $593.75 or $1,000 less the initial net debit of $406.25.

Finally, if the market should advance to or beyond the highest of all four strike prices, all four options may fall in-the-money and might be exercised. This results in a net wash and the trader is left with a maximum possible loss defined as the initial net debit. In our example, this equals $406.25.

Upper and lower breakeven points may be identified as the upper intermediate strike price plus the maximum profit; and, the lower intermediate strike price less the maximum profit. In our example, the upper breakeven equals 128-38/64ths or the upper intermediate strike price of 128 plus 38/64ths. The lower breakeven equals 126-26/64ths or the lower intermediate strike price of 127 less 38/64ths.

	Long Condor
Maximum Profit	Difference in strikes – Initial net debit
Upper B/E	Upper intermediate strike price + Maximum profit
Lower B/E	Lower intermediate strike price - Maximum profit
Maximum Loss	Initial net debit

The condor is generally thought of as a bit more conservative than the butterfly. Butterflies generally offer a bit more maximum profit and a bit less maximum return than do condors. But this is balanced by the fact that the breakeven points associated with condors are generally wider than those associated with butterflies. Thus, condors offer a greater probability of realized profit along with a bit more modest return. These points are underscored by comparing the butterfly and condor strategies shown in our examples above.

Matching Strategy and Forecast

We began by suggesting that options are remarkably flexible trading tools that provide one with the ability closely to tailor your trading strategy to a market forecast. When you trade futures, the implicit market forecast is really very straightforward. Buy futures if you anticipate a strongly bullish market or sell futures if you anticipate an essentially neutral market environment. But options provide the ability to take advantage of much more subtle forecasts that incorporate expectations regarding price, time and volatility.

If you were strongly bullish, you might simply buy futures. Or, you might consider the purchase of call options which provides unlimited participation in a bull market but with strictly limited risk in the event your forecast is in error. Sell futures if strongly bearish. Or, you may consider the purchase of put options which likewise provides one with the ability to participate fully in a bear movement but again with strictly limited risk in the event your forecast is in error.

More subtle forecasts include an expectation of a neutral to mildly bullish environment; or, a neutral to mildly bearish market scenario. In those cases, one might attempt to structure a trade that allows you to take advantage of time value decay with a bullish or bearish tilt. The sale of put options, vertical bull spreads and ratio spreads are all reasonable alternative strategies in a neutral to mildly bullish environment. Likewise, the sale of calls, vertical bear spreads or ratio spreads might be consider in a neutral to mildly bearish environment.

But options are even more flexible insofar as they allow you to take advantage of a very neutral market by selling straddles or strangles. These strategies take advantage of time value decay at the risk of accepting negative convexity and the possibility of rising volatilities in a strongly rallying or breaking market.

If your forecast was just the opposite and you anticipated that the market might rally or break strongly but were uncertain regarding the direction, consider the purchase of straddles or strangles. Some question how one might arrive at a "bullish or bearish" forecast? One possibility is that you expect the release of a significant piece of fundamental market information but are unsure about the direction in which that information may send market prices but are confident nonetheless in a strong reaction.

Forecast	Option Strategy
Strongly Bullish	Buy futures; buy calls
Neutral to mildly bullish	Sell puts; vertical bull spreads; ratio spreads
Neutral	Sell straddles or strangles
Neutral to mildly bearish	Sell calls; vertical bear spreads; ratio spreads
Strong bearish	Sell futures; buy puts
Bullish or bearish	Buy straddles or strangles
Specialty trades	Time & backspreads; butterflies & condors

Finally, we may consider a variety of specialty trades including time spread such as horizontal or diagonal option spreads; backspreads; butterflies and condors.

The point is that options are extremely flexible and allow one to take advantage of possibly very elaborate market forecasts in ways that the blunter instruments represented by futures contracts simply cannot offer.

Conclusion

While futures contracts represent rather blunt tools for pursuit of speculative opportunities in straightforward bullish or bearish market environments, options provide tremendous flexibility to tailor make a strategy based upon more subtle or elaborate market forecasts.

As such, options have become an indispensable addition to the speculative repertoires of many of the most astute and successful traders. To learn more about CME Group interest rate products, please visit our website at www.cmegroup.com/trading/interest-rates.

Appendix: Options on 10-Year Treasury Note Futures

(As of 10/17/13)

Month	Put/ Call	Strike	Futures Price	Premium	Implied Volatility	Delta	Gamma	1-Day Theta	Vega
Dec-13	Call	124-16	126-26+	2-31	5.49%	0.86	0.1287	-0.0070	0.0088
Dec-13	Call	125.00	126-26+	2-04	5.42%	0.81	0.1617	-0.0084	0.1097
Dec-13	Call	125-16	126-26+	1-42	5.24%	0.74	0.1964	-0.0096	0.1288
Dec-13	Call	126.00	126-26+	1-20	5.27%	0.66	0.2222	-0.0108	0.1461
Dec-13	Call	126-16	126-26+	0-63	5.16%	0.56	0.2430	-0.0106	0.1570
Dec-13	Call	127-00	126-26+	0-45	4.99%	0.47	0.2535	-0.0107	0.1579
Dec-13	Call	127-16	126-26+	0-30	4.79%	0.36	0.2490	-0.0095	0.1486
Dec-13	Call	128-00	126-26+	0-19	4.67%	0.26	0.2234	-0.0084	0.1304
Dec-13	Call	128-16	126-26+	0-11	4.47%	0.18	0.1866	-0.0059	0.1049
Dec-13	Call	129-00	126-26+	0-06	4.38%	0.11	0.1380	-0.0042	0.0759
Dec-13	Call	129-16	126-26+	0-03	4.30%	0.06	0.0919	-0.0030	0.0496
Dec-13	Put	124-16	126-26+	0-13	5.97%	-0.16	0.1302	-0.0077	0.0972
Dec-13	Put	125.00	126-26+	0-18	5.87%	-0.21	0.1567	-0.0097	0.1150
Dec-13	Put	125-16	126-26+	0-24	5.63%	-0.27	0.1871	-0.0106	0.1318
Dec-13	Put	126.00	126-26+	0-32	5.34%	-0.35	0.2205	-0.0110	0.1475
Dec-13	Put	126-16	126-26+	0-43	5.20%	-0.43	0.2407	-0.0106	0.1562
Dec-13	Put	127-00	126-26+	0-56	4.89%	-0.54	0.2586	-0.0104	0.1587
Dec-13	Put	127-16	126-26+	1-09	4.69%	-0.64	0.2538	-0.0092	0.1489
Dec-13	Put	128-00	126-26+	1-29	4.43%	-0.75	0.2302	-0.0080	0.1275
Dec-13	Put	128-16	126-26+	1-52	4.05%	-0.85	0.1839	-0.0049	0.0931
Dec-13	Put	129-00	126-26+	2-15	3.72%	-0.93	0.1178	-0.0028	0.0547
Dec-13	Put	129-16	126-26+	2-44	1.06%	-1.00	Na	Na	Na
Mar-14	Call	124-16	125-16+	2-09	5.35%	0.61	0.1216	-0.0055	0.2837
Mar-14	Call	125-00	125-16+	1-52	5.23%	0.56	0.1278	-0.0060	0.2915
Mar-14	Call	125-16	125-16+	1-33	5.08%	0.51	0.1330	-0.0051	0.2951
Mar-14	Call	126-00	125-16+	1-15	4.95%	0.45	0.1356	-0.0057	0.2934
Mar-14	Call	126-16	125-16+	0-63	4.78%	0.40	0.1368	-0.0052	0.2855
Mar-14	Put	124-16	125-16+	1-09	5.43%	-0.39	0.1200	-0.0055	0.2841
Mar-14	Put	125-00	125-16+	1-20	5.25%	-0.44	0.1272	-0.0061	0.2923
Mar-14	Put	125-16	125-16+	1-33	5.16%	-0.49	0.1309	-0.0058	0.2944
Mar-14	Put	126-00	125-16+	1-47	5.00%	-0.55	0.1342	-0.0057	0.2934
Mar-14	Put	126-16	125-16+	2-01	5.00%	-0.60	0.1325	-0.0054	0.2925