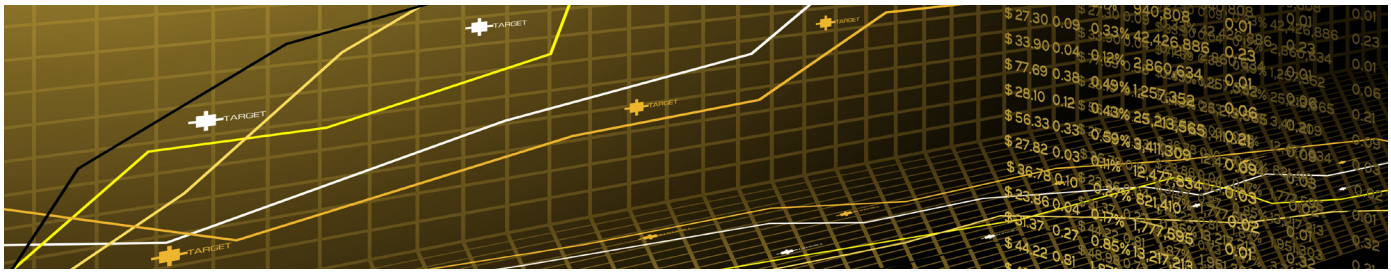


TIME AND VOLATILITY IN E-MINI S&P 500 FUTURES OPTIONS: PART I

BY LAWRENCE MORGAN

I. INTRODUCTION

Options are a standard piece of hardware in the "tool-box" of derivatives traders – whether they specialize in derivatives operations or manage funds more comprehensively as investors, speculators, or traders. This applies to options on futures as well as to options on underlying equity, fixed-income, currency, or commodity markets. Most retail options participation is to buy options based on how the trader expects prices to move – to buy calls if the underlying price is expected to rise, to buy puts if it is expected to fall. The major attraction in this basic sort of option activity is the limited risk of loss in options – an option buyer cannot lose more than the initial premium paid – in comparison to the outright symmetrical risk of long or short positions. This use of options is well understood.

The first article in this series – this article – deals with time: its influence on the pricing of E-mini S&P 500 Index Futures options, and its effects on trading strategies. In particular, it will show some of the possibilities time itself presents for trading among options of different expiration dates, such as standard quarterly cycle options, serial options, end-of-month (EOM) options, and the very short-term weekly options.

The second article will concentrate in the same way on volatility. Primarily this means the implied volatility's which is derived from the option premium, but also is related to historical volatility of the underlying S&P 500 Index and the futures price. This aspect of option valuation also brings unique opportunities to options trading.

Among the appealing qualities of the E-mini S&P 500 market is the fact that it represents one of the major benchmarks of the U.S. equity market and the great market depth of the underlying futures contract around the clock. The options market is likewise broad and deep, particularly during early American trading hours which correspond to Asian evening trading.

Traders in E-mini S&P 500 options should keep in mind the variety of expiration dates available (for more detail please refer to Advantages of Weekly and End-of-Month Options, by John Nyhoff and Tom Boggs, CME Group, 2012):

- **American-style options:** these can be exercised at any time before expiration:
  1. Standard quarterly cycle month expirations on the third Friday of each quarterly cycle delivery month (March, June, September, December).
  2. Three serial month expirations listed concurrently with the four quarterly cycle months, on the third Friday of the month.
- **European-style options:** these can be exercised only at the option expiration:
  1. End-of-Month (EOM) expirations which expire on the last trading day of each month, based on the next quarterly futures delivery month.
  2. Weekly options which expire on the first, second, and fourth Friday of each month, based on the next quarterly futures delivery month.

So there are five option expirations most months: Week 1, Week 2, and Week 4 weekly (European-style), serial month or cycle month (American-style), and End-of-Month (European style). (Occasionally an EOM option expiration would coincide with a Week 4 weekly expiration; both are European-style) – in that case, of course, the Week 4 weekly is not listed, and there are only four option expirations that month.)

This variety of option expirations is important to both time and volatility strategies.

II. TIME VALUE

Both elementary and advanced descriptions of option pricing divide the value of an option – the option premium – into two broad elements. Intrinsic value is the amount by which an option is "in the money" – when the price of the underlying instrument is on the advantageous side of the option's exercise price (strike price). For a call, this means the underlying futures price is higher than the option's exercise price; for a put, when the underlying price is lower than the exercise price.

Time value is that part of the option premium incremental to intrinsic value. Time value can be an enormous portion of the total premium for long-dated options which will not expire for a long time. In fact, if the option is "out-of-the-money" – when there is no intrinsic value – the entire option premium represents time value.

The following table (from 1 April 2013) illustrates how considerable time value can be:

It is easy to see that the time value declines pretty steadily from very long-dated options to very short-dated options. In fact, it is customary to think of a "time decay curve" which plots the time value of an option against the time remaining until the option's expiration, such as this theoretical curve.

GRAPH 1

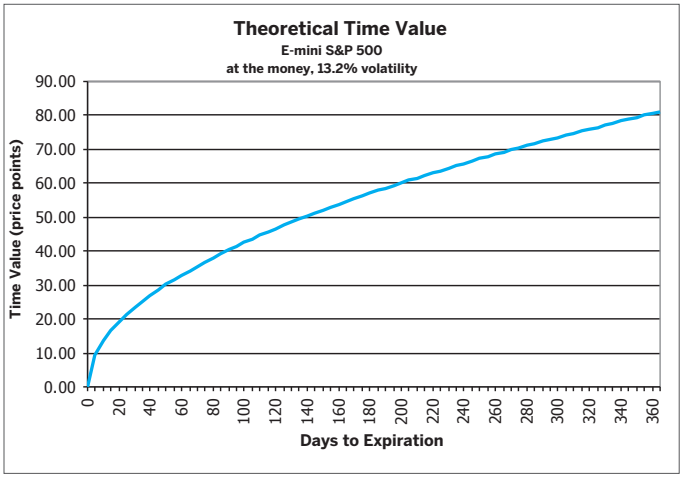


TABLE 1

OPTION EXPIRATION	EXPIRATION DATE	DAYS UNTIL EXPIRATION	STRIKE PRICE	OPTION PREMIUM	FUTURES PRICE	MONEY-NESS	TIME VALUE
WEEK 1	5 April 2012	4	1555	8.25	1556.00	+1.00	7.25
WEEK 2	12 April 2013	11	1555	13.00	1556.00	+1.00	12.00
SERIAL	19 April 2013	18	1555	16.50	1556.00	+1.00	15.50
WEEK 4	26 April 2013	25	1555	19.50	1556.00	+1.00	18.50
EOM	30 April 2013	29	1555	20.75	1556.00	+1.00	19.75
QUARTERLY	21 June 2013	81	1555	38.25	1556.00	+1.00	37.25
NEXT QUARTERLY	20 September 2013	172	1550	60.50	1549.75	-0.25	60.50

There are a couple of noteworthy features of this time decay curve:

(1) When the time-to-expiration is long the decay is gradual. In this curve the decline in time value from 80 points to 70 points requires 85 trading days (almost four calendar months) to occur.

(2) The rate of decline slowly accelerates and, although the acceleration is continual, it becomes really visible when 30 or 40 trading days remain until expiration, and extremely rapid in the final two weeks of the option's "life."

These characteristics will be key to some of the trading strategies described later in this article. There is one other point to keep in mind about time value – obvious but important. While other major factors in option valuation, such as underlying price and implied volatility are the subject of intense speculation and disagreement ["I think the S&P 500 is going up 10%". "You're crazy – it's going down!"], there is no doubt or discussion about the passage of time – it steadily goes forward.

Despite the fact that time decay is undeniable and obvious, it does have implications for trading and it offers opportunities for option positions. That's where this article turns next.

III. USING THE TIME DIMENSION

These characteristics of E-mini S&P 500 futures options provide a broad range of trading opportunities based on time value and time decay. Here is a selection of some of the most accessible possibilities.

A. Calendar Spreads

The basic structure of an option calendar spread is to sell an option expiring at one expiry date and buy an option expiring at another expiry date. Here is an example from recent market action in E-mini S&P 500 options, in which the sell-side of the calendar spread is one of the weekly options with a very short time to expiration.

TABLE 2

Theoretical Calendar Spread		
Sell 1	April 2013 1st Weekly (EW1J3) 1555 Call	at 11.75
Buy 1	May 2013 Serial (ESK3)1555 Call	at 29.50
Trade Date: 26 March 2013 April 2013 expiration date: 5 April 2013 May 2013 expiration date: 17 May 2103 Underlying Delivery Month: June 2013 Futures Price: 1557.25		

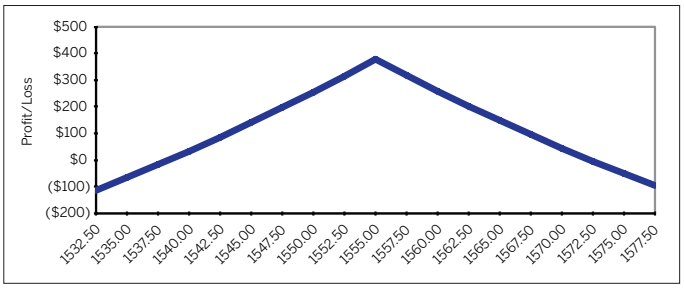
Here the same strike price is used for both options in the calendar spread, and both are based on the June 2013 E-mini S&P 500 (ESM3) futures. Both are only slightly in-the-money. The plan, of course, is to exploit the rapid decline in time value of the April 2013, 1st Weekly call with little more than one week to expiration compared to the slower time decay of the May serial call which will exist for almost two months. Since both options are calls and both have the same 1555 exercise price, the overall spread position is fairly insensitive to changes in the level of the underlying future price (the delta of the weekly call was +0.54, that of the serial call +0.52, for a negligible net spread delta of +0.02).

It is important to analyze before establishing a position how this spread would perform under various scenarios. The most profitable price evolution would be for the underlying futures price to be exactly at the exercise price 1555.00 at the expiration of the weekly call on 5 April. Then the time value of the weekly call would completely disappear: it would fall from 11.75 to 0.00. This would mean a profit of USD $587.50 (the notional value of the index is USD $50.00 per price point, so 11.75-times-USD $50.00 is USD $587.50). The May serial call would decline from 29.50 to 25.25 (a loss of USD $212.50), for a net profit of USD $375.00. This is illustrated in Graph 2 which shows the theoretical profit or loss as of the 5 April expiration of the weekly call. Also, take note of the fact that this profit declines as the ESM3 price either rises or declines from 1555.00. The position would result in a net loss if ESM3 were to be lower than 1538.50 or higher than 1572.25 at that time. That provides a margin of safety, but naturally not a guarantee of profit.

GRAPH 2

Option Strategy Profit/Loss Profile

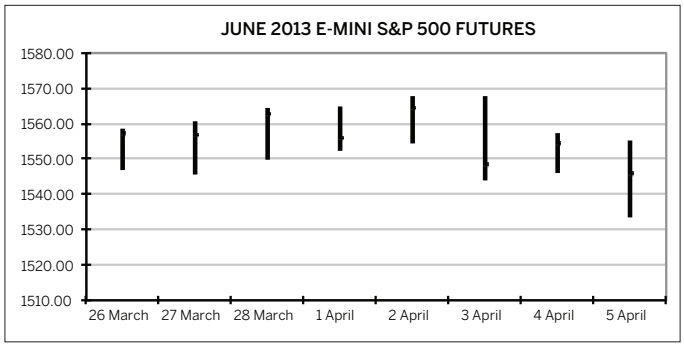
Buy 1 ESK3 1555 call @ 29.50 / Sell 1 ES1J3 1st April weekly 1555 call @ 11.75
As of 3/26/13 ESM3 futures 1557.25, evaluated for 4/5/13



This analysis was a theoretical preview of how the strategy should perform as prices move until expiration of the 1st April weekly option. In fact, over the holding period of this position the underlying ESM3 price moved as shown in Graph 3 – it ended at 1547.50 at 3:00 p.m. on 5 April, below the maximum-profit level 1555, but well within the breakeven range.

The ultimate result was . . .

GRAPH 3



This was obviously not as profitable as if ESM3 had ended at 1555.00 but it fit exactly what the initial profit/loss profile indicated for an ending futures price of 1547.50.

The important point to note in this example is that the rapid decline in the time value of the weekly options – 11.75 points within 8 trading days – gave the position a "running start" on profitability since the entire time value of that option would disappear inevitably over the term of the trade no matter how the underlying price moved.

B. Delta Variations with Time Spreads

The vertical spread is a standard option combination – for market bulls, buy a call of one strike price while selling a call of a higher strike price. For market bears, buy a put of one strike price while selling a put of a lower strike price. Both legs of a vertical spread use the same expiration date. As is well known, this strategy has a strictly limited downside risk like a simple long option position, but also has a limited profit potential so its textbook profit/loss profile at expiration takes these forms:

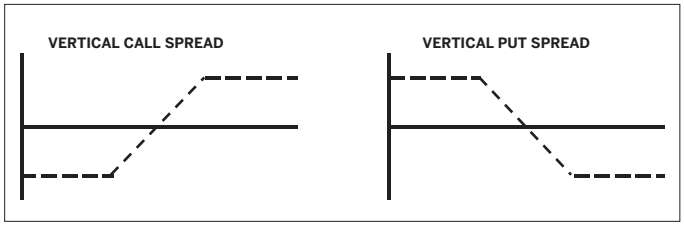


TABLE 3

Theoretical Results Trade Date: 26 March 2013. Expiration Date: 5 April 2013			
	Initial	**End**	**Profit (Loss)**
	Premium	Premium	
Sold EW1J3 1555 Call	11.75	0.00	USD $587.50 (= 11.75 x $50.00)
Bought ESK3 1555 Call	29.50	21.75	(USD $387.50) (= -7.75 x $50.00)
Net Profit (Loss)			USD $200.00

This approach can also be modified to exploit the opportunity offered by rapid time decay by choosing a relatively short time-to-expiration for the sell side of the position (or long time-to-expiration for the long side). In this case it is called a diagonal spread since it includes not only the vertical distance between strike prices, but also the horizontal distance between expiration dates. Let's compare the following variations of an E-mini S&P 500 call spread based on prices as of 9 April 2013 (when the June 2013 futures – ESM3 – was at 1559.25):

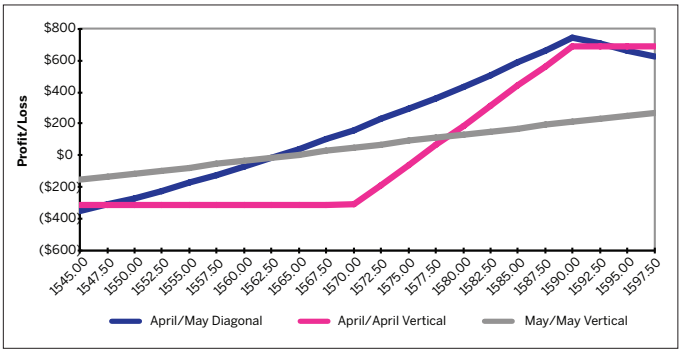
TABLE 4

Theoretical Spreads as of 9 April 2013		
		Delta
A.	April/May Diagonal Spread	
	Buy 1 May 2013 serial 1570 call at 19.00	+0.44
	Sell 1 April 2013 serial 1590 call at 1.75	- 0.13
	Net	**+0.31**
B.	April Vertical Spread	
	Buy 1 April 2013 serial 1570 call at 8.00	+0.37
	Sell 1 April 2013 serial 1590 call at 1.75	- 0.13
	Net	**+0.24**
C.	May Vertical Spread	
	Buy 1 May2013 serial 1570 call at 19.00	+0.44
	Sell 1 May 2013 serial 1590 call at 9.75	- 0.29
	Net	**+0.15**

In the prospective and theoretical profit/loss profile below (evaluated as of the April expiration on 19 April) combination A has the greatest net delta of the three variations and produces greater profit than combination B and C over a wide range of underlying futures price levels. This additional profit is the result of the rapid time decay of the April call contrasted with the slower time decay of the May call.

Option Strategy Profit/Loss Profile

(A) Buy 1 ESK 1570 call / Sell 1 ESJ3 1590 call
(B) Buy 1 ESJ3 1570 call / Sell 1 ESJ3 1590 call
(C) Buy 1 ESK3 1570 call / Sell 1 ESK3 1590 call
As of 9 April 2013; ESM3 Futures 1559.25, evaluated for 19 April 2013



This is not riskless, however. Assume the trader's estimate is that the underlying futures price will rise moderately over the period from 9 April to 19 April. If that is correct the April/May combination will be superior. If the underlying price actually falls below about 1560.00, however, the May/May combination will show a smaller loss. And if the underlying price rises much higher than 1590.00 the April/April combination would be superior.

The purpose of this explanation is not to advocate one strategy over another. Rather it is to illustrate that time and time decay affect the performance of option strategies and that the wide variety of option expirations available for E-mini S&P options provides a rich choice of strategy designs.

C. Time's Influence in Covered Option Strategies

Covered strategies – in which a futures position is balanced by a short option position – can also be modified depending on the time to expiration of the option employed.

Typically one thinks of a covered position as something like the following:

A trader has a long position in E-mini S&P 500 futures and wants to reduce the risk of the position and potentially earn additional income by selling an offsetting option. The resulting position would normally then be:

Long 1 June futures contract / Short 1 June futures call.

- The short OTM (or out-of-the-money) call position partially hedges the risk of the outright long futures position and provides additional income as the call seller receives the option premium.
- If the futures price falls, the long futures position shows a loss but that loss is potentially reduced by the call option premium. If the futures price remains exactly unchanged, the long futures position shows neither profit nor loss and the call option premium is a net gain at expiration.
- If the futures price rises above the strike price of the call, the call buyer will exercise it; the seller of the call will receive a short position which offsets the original long futures position at the option strike price, therefore showing a futures profit — but a limited profit — and augmenting that limited profit by the call premium's intrinsic value component.

How does the variety of option expirations available in E-mini S&P 500 affect the performance of such a strategy? Traders can compare at least two factors: (1) time value: the longer the time to expiration of the option, the greater the option premium the seller will receive; (2) time decay: the shorter the time to expiration, the more quickly the premium will decline.

Let's take a hypothetical example and consider three alternative simple structures based again on 9 April levels:

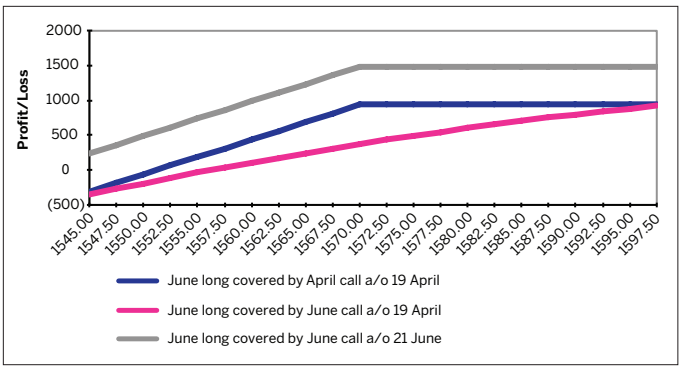
TABLE 5

A.	Buy 1 June futures contract at 1559.25 Sell 1 April serial 1570 call at 8.00 Trade Date: 9 April 2013 Evaluate it as of 19 April 2013 expiration
B.	Buy 1 June futures contract at 1559.25 Sell 1 June Quarterly 1570 call at 19.00 Trade Date: 9 April 2013 Evaluate it as of 19 April 2013.(the April expiration)
C.	Buy 1 June futures contract at 1559.25 Sell 1 June Quarterly 1570 call at 19.00 Trade Date: 9 April 2013 Evaluate it as of 21 June 2013 expiration

(Note that positions B and C are equivalent to selling a naked put – it is included in this comparison to illustrate the effects of time value). The factors of time value and time decay combine to make significant differences in the performance of the strategies, as the graph below indicates.

Option Strategy Profit/Loss Profile

(A) Buy 1 June futures / Sell 1 ESJ3 1570 call till 19 April
(B) Buy 1 June futures / Sell 1 ESM3 1570 call till 19 April
(C) Buy 1 June futures / Sell 1 ESM3 1570 call till 21 June
As of 9 April 2013; ESM3futures 1559.25



The most obvious difference is between the upper line which indicates profit/loss if one sells the June 1570 call and the middle line representing the strategy employing the April 1570 call.

(a) The June call was priced on 9 April much higher than the April call, naturally, because of the much longer time to expiration. But to receive the entire benefit of that premium one must hold the position until expiration on 21 June.

(b) If the trader's horizon is shorter, only until mid-April, the covered position using the June call shows a lower profit than the structure using the April call unless the price rises or falls very far.

Here, as in previous examples, the key point is not that one structure or another is superior but that there are many structures to choose from because of the many option expirations available for every underlying futures contract. Which is superior at any time depends on the trader's situation and purpose.

IV. CONCLUSION

As always, discussions about options quickly show the myriad of possibilities these fascinating derivatives offer to both individual and institutional market participants. This complexity requires close attention to the key pricing factors of options – time value, in this article; volatility in the next; and others besides.

Furthermore, CME's E-mini S&P 500 options provide many ways to capitalize on these possibilities. The attention and analysis required will be a worthwhile investment of time and effort because they reveal the variety of strategies available to reflect the particular market insights an investor develops. Alert traders can begin with a basic view about how E-mini S&P 500 futures will behave over their time horizon, analyze the structures the market offers them, and choose the structure that best matches their outlook how price will evolve and how quickly it will evolve.

To learn more about CME Group's Options on Futures visit cmegroup.com/options

Larry Morgan recently retired from the financial futures and options brokerage industry after a 33-year career assisting institutional clients in devising and executing hedging and trading strategies, primarily in fixed-income and currency markets. His clientele included commercial and investment banks, hedge funds, insurance firms, and corporate treasurers in North America, Europe, and East Asia.

He has incorporated derivatives analysis and training throughout his career, instructing clients and others in the theory and practice of derivatives markets, as part of the instructional staff at Dean Witter Reynolds and in courses through the Korea Banking Institute in Seoul and at the People's University of Beijing. Before entering the brokerage profession, he was Senior Staff Economist at the Chicago Board of Trade. Currently, he's Adjunct Instructor in Economics at the City Colleges of Chicago.