Over the last few years, the US listed options market has experienced dramatic growth in volume and liquidity. This growth has led to a greater degree of transparency and pricing efficiency and has reduced opportunities for arbitrage among market participants. Coupled with a persistently low volatility environment, the increased efficiency has forced investors to find creative ways to utilise options in expressing their views on a particular security. One strategy that has enjoyed rapid growth is 'event-driven trading'. These trades isolate a known catalyst deemed important to the economic prospects of a particular equity. The very nature of options – with specific strike prices and expiration dates – facilitates the isolation of these catalysts and enables investors to express specific views on how they will impact an equity price.

The event-driven space includes a variety of catalysts that span across sectors and subject matters. For the purposes of this discussion, we 'bucket' them into four general categories.

- **Company performance** – earnings announcements, same-store sales data releases, mid-quarter updates.
- **Corporate actions** – mergers and acquisitions, leveraged buyouts (LBOs), tenders and Dutch auctions, special dividends, spin-offs.
- **Healthcare events** – Food & Drug Administration (FDA) panel recommendations and rulings, FDA Prescription Drug User Fee Act dates, trial data releases.
- **Litigation outcomes** – patent disputes, anti-trust cases, class-action lawsuits.

Investors can build strategies around these events in a number of ways. In the discussion that follows, we provide the general building blocks for these strategies and then illustrate by example how an investor can use these tools to implement option positions that optimise his view.

### Building block 1: Calculating the implied move

In seeking to identify trading opportunities, investors can use option prices to gauge the market's expectation of the volatility arising from company-specific events. When an event is anticipated, option buyers will push implied volatility (and, subsequently, option prices) higher in the month the event falls under. There are a number of ways one can analyse the implied volatility of a given option to determine just how volatile the market is anticipating an event to be.

One such way is to compute the one-day implied move, also called the 'event vol', by analysing the relative levels of implied volatility for options of two different maturities. To derive the one-day implied move, we start with known implied volatilities provided by the options market and decompose them in order to isolate the one-day event interval. This can be done by plugging in the implied volatilities and days to maturity for two same-strike options with different maturities (usually the front two months) into the following equation:

$$\sigma_{EVENT} = \left(\frac{(T_2 - 1)(T_1 - 1)}{T_1 - T_2} \right)^{1/2} \left( \frac{T_1}{T_2} \sigma_2^2 - \frac{T_2}{T_1} \sigma_1^2 \right)$$

The resulting event volatility, $\sigma_{EVENT}$, is an annualised number that can be divided by an annualisation factor, $\sqrt{252}$, to find the implied one-day move.

Table A illustrates how the market priced the volatility anticipated from the release of second-quarter earnings for several large-cap tech stocks. It is the stocks for which front-month implied volatility commands a significant premium to second-month volatility that have the highest one-day implied move.

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1 The inputs of this formula include: $T_1 =$ time to expiration for option 1; $T_2 =$ time to expiration for option 2; $\sigma_1 =$ implied volatility of option 1; $\sigma_2 =$ implied volatility of option 2. For a more complete derivation of this formula, please contact the authors of this article.
A. Large-cap tech implied earnings moves

| Ticker | July 17, 2006 closing price | Earnings announce date | Front month ATM implied volatility | Second month ATM implied volatility | % event | Implied one-day move (%)
|--------|-----------------------------|------------------------|-----------------------------------|------------------------------------|---------|------------------------
| Stock 1 | 26.56                      | July 19, 2006          | 93.2                              | 51.3                               | 171.6   | 10.8                   
| Stock 2 | 52.37                      | July 19, 2006          | 83.8                              | 51.7                               | 148.0   | 9.3                    
| Stock 3 | 31.84                      | July 18, 2006          | 74.9                              | 41.8                               | 137.2   | 8.6                    
| Stock 4 | 19.08                      | July 19, 2006          | 72.6                              | 39.5                               | 134.0   | 8.4                    
| Stock 5 | 407.89                     | July 20, 2006          | 66.5                              | 40.3                               | 118.4   | 7.5                    

Building block 2: Calculating the implied distribution

A second building block for event-driven option trading is the implied distribution. This distribution provides meaningful insight into the market’s expectation for the range of future stock price outcomes. The shape of the distribution can be inferred from the relationship among option prices of a specific expiration for a particular stock. As investors buy and sell options in front of an event, they generate a volatility surface across strikes and maturities. When overlaid against an event-driven investor’s proprietary distribution, the shape of the market’s implied distribution may provide trading opportunities.

Without using a complex options-pricing model, one can use intuition to translate option prices into implied probabilities. For instance, the value of the call or put butterfly can be thought of as being directly proportional to the likelihood of the stock finishing at the middle strike where the potential maximum payout occurs at expiration. The put fly has the structure of long one put with strike (K-X), short two puts with strike (K) and long one put with strike price (K+X). Thinking of this structure as long a (K+X, K) put spread and short a (K, K-X) put spread illustrates the capped payout of the structure. The long and short put spreads each yield a maximum payout when the stock finishes exactly at the strike price, K at expiration.

To illustrate how the curve is formed, assume XYZ Corp. has October 128, 130 and 132 mid-market put prices of 1.20, 1.75 and 2.60, respectively. The price of the put fly (long one each of the 128 and 132 put and short two of the 130 puts) is $0.30. With a maximum payout of $2, the $0.30 premium for the fly implies a 0.3/2 = 15% probability that XYZ finishes exactly at 130 on option expiration date. Repeating this calculation for all of the strikes allows us to generate a range probability curve for XYZ for October 2006 expiration.

A case study in implied distribution

The importance of the implied distribution as a decision-making tool can be illustrated by example. In the case of a chip company that engaged in a long-term patent infringement case with a competitor, the market priced options such that out-of-the-money calls traded at an implied volatility premium to at-the-money calls. This highly unusual ‘strike skew’ reflected a unique implied distribution associated with the catalyst-driven nature of this company’s long-term prospects. Figure 1 illustrates the January 2007 probability curve for the stock as of March 2006.

To capture the uniqueness of this distribution, we overlay the lognormal distribution. Here we see that, for very large moves to the upside, the lognormal and implied distributions show very little difference. The implied distribution assumes far less probability for stock to finish near its current price when compared to the lognormal. Furthermore, the implied distribution assigns a greater chance for moves to the downside. Finally, notice how far the mode of the implied distribution lies from the mean (forward price). This shows the ‘binary’ nature of the events surrounding this stock.

One popular trading strategy around this distribution was the one-by-two call spread. In this structure, an investor buys an at-the-money call and sells two times as many upside calls. Given the extent to which the market’s distribution implied such a substantial probability that the stock could finish at such high levels (the demand for upside calls was significant), this structure provided an attractive opportunity for investors who thought the stock would rise, but not by that much. Note, however, that the investor maintains unlimited risk by being short an uncovered call. Here, by overlaying one’s own expectation of stock price outcome against that generated by the market, a trading opportunity was perceived.

LBOs and gamma versus vega exposure

Over the past few years, the market has seen a revival of the LBO, including several recent large examples. The LBO involves taking a public company private through the acquisition of all outstanding equity, typically financed through debt by using the target company’s balance sheet to borrow money. This balance sheet recapitalisation usually generates significant returns for the equity shareholder, but may have mixed results for option holders depending upon their exposures.

When an investor buys an option, he is assuming long exposure to both realised volatility (gamma) and implied volatility (vega). Shorter-term options are more affected by gamma, while vega is of greater significance to longer-term options. The effect of an
announced LBO on equity options is to benefit long-gamma and hurt long-vega positions. The considerable expected one-day move that results from a declared LBO has most beneficial impact to short-term options as they experience the most dramatic delta change. While holders of longer-term options will also profit from the gamma of this one-day move, this benefit is typically dwarfed by the loss associated with the anticipated drop in implied volatility from the cash nature of the LBO. Given the disparate impact an LBO has on gamma versus vega exposure, a common strategy implemented by investors has been the short calendar spread. Here, an investor buys short-dated calls in anticipation of the stock price move and sells longer-dated calls in order to collect time premium that vanishes due to the cash nature of the announced LBO. Note that the investor has to maintain the unlimited risk of being short an uncovered call once the short-dated long call expires.

A closer look at a recently announced LBO shows the effect that such a transaction has on the options market. Over the summer, a private consortium teamed with management to announce a $21.3 billion bid for the company, a 16% premium to its previous close, and the largest LBO to date. Figure 2 examines the effect this news had on both the stock price and the implied volatility of the January 2008 expiration 50 strike calls.

To illustrate further the behaviour of a calendar spread when an LBO transaction is announced, we look at the one-week change in the stock and options market from our example. Assume an investor buys 1,000 August 50 calls and sells 1,000 January 2008 50 calls on a delta-neutral basis to set up the short calendar spread. Using closing stock and option prices from July 19, one would have collected $3.15 for the call spread and, by trading it delta neutral, would have paid $43.29 to buy 35,000 shares to delta hedge it. One week after the deal announcement, and the subsequent gamma and vega moves in the options, the stock closed at $49.36 while the mid-market value of the call spread was reduced to $1.10. By hedging the delta at the end of each trading day and by capturing the long-gamma, short-vega profile of this calendar spread, the investor profits.

Conclusions
As investors search for creative ways to generate alpha, event-driven trading has become increasingly prominent. In this strategy, an investor seeks to capitalise on a proprietary view surrounding a stock-specific event such as a merger, earnings announcement or litigation outcome. Because of the definitive expiration characteristic of options, investors have employed them heavily to facilitate event-driven trades. Here we have outlined two useful metrics – the implied move and the implied distribution – that can serve as a spot check for investors contemplating a catalyst driven transaction. Each of these calculations can help identify trading opportunities that may arise from instances where an investor’s expectations differ from those implied by the market. Whether structuring a position around a pending merger or around a forthcoming earnings announcement, the same tools can be applied for determining the market’s implied one-day move and, further, the implied distribution at a given maturity.

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