SPIKES® Options

Factsheet

SPIKES® Volatility Index

The SPIKES Volatility Index (index symbol: SPIKE) is a measure of the expected 30-day volatility in the SPDR S&P 500 ETF (SPY). SPY is the largest exchange traded fund in the world and tracks the most watched stock index in the United States.

SPIKES is built using the popular variance swap methodology and uses live SPY option prices to calculate volatility. This is consistent with the way the trading community is used to modelling risk and hedging exposure.

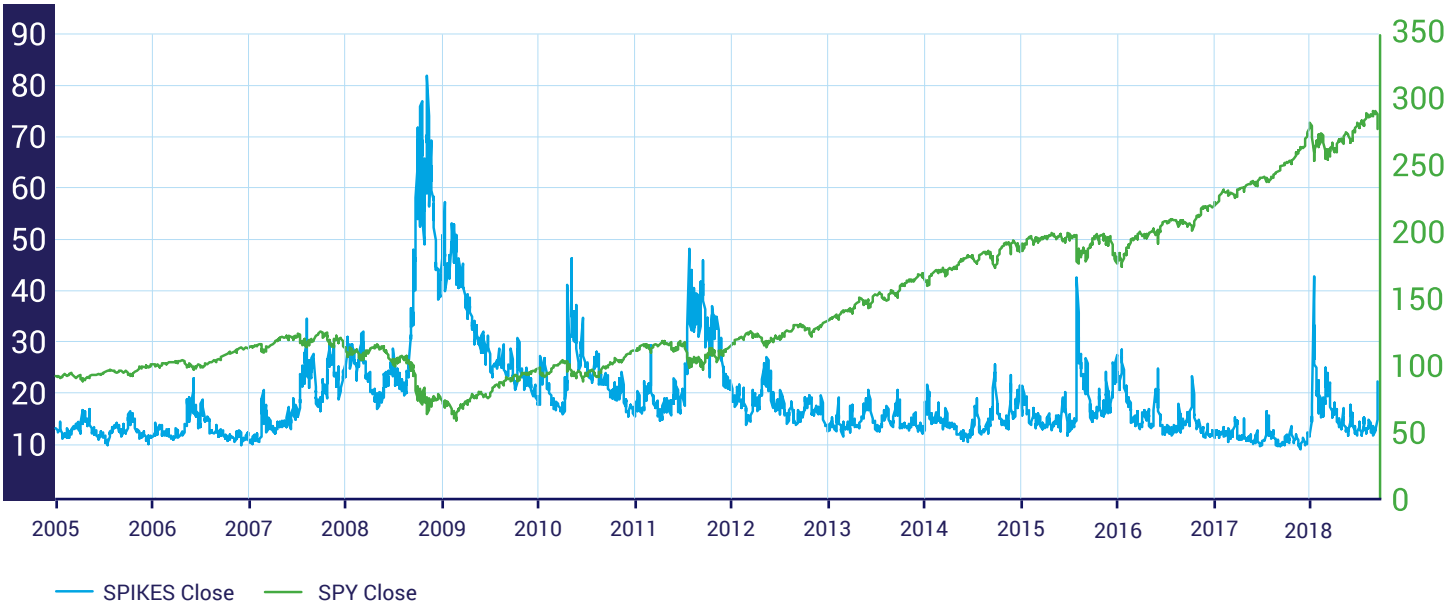
SPIKES Options

SPIKES Options are trading on MIAX - one of the fastest and most efficient options platforms in the world, offering fully electronic execution.

The SPIKES Index and volatility products offer a number of unique features designed to produce highly accurate, robust data and create a transparent and open auction settlement process.

MIAX Options is proud to partner with T3 Index to offer SPIKES Volatility products - for more confident volatility trading.

SPIKES and SPY Levels



The SPIKES Formula

SPIKES has a defined rules-based approach to selecting components—a series of options on the SPY—and weighting them to derive a single price for the index. The general formula for the SPIKES Index is as follows:

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$$SPIKES = 100 \times \sqrt{\left(\frac{t_1}{t_M}\frac{t_2 - t_M}{t_2 - t_1}\sigma_1^2 + \frac{t_2}{t_M}\frac{t_M - t_1}{t_2 - t_1}\sigma_2^2\right)}$$

- t_1 Time (in seconds) to near-term expiration
- σ_1 Estimated volatility computed by variance swap formula, near-term
- t_2 Time (in seconds) to next-term expiration
- σ_2 Estimated volatility computed by variance swap formula, next-term
- t_M Number of seconds in 30 days (30 x 86,400 = 2,592,000)

The formula for expected T-term variance is as follows:

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$$\sigma^2 = \frac{1}{T}\left[2e^{RT}\Sigma i\ \frac{\Delta K_i p_i}{K_i^2} - \left(\frac{e^{RT}(p^c_{ATM} - p^p_{ATM})}{K_{ATM}}\right)^2\right]$$

- p^c_{ATM} Price of the at-the-money (ATM) SPY call option
- p^p_{ATM} Price of the ATM SPY put option
- K_{ATM} Strike closest to the point where linearly interpolated SPY call and put prices intersect
- T Time to options expiration (in years, with 1-second precision)
- K_i, p_i A list of unique SPY options strikes, ordered from lowest to highest, and corresponding SPY options prices; of a call if $K_i > K_{ATM}$; and of a put if $K_i < K_{ATM}$; if $K_i = K_{ATM}$ then an average between the ATM SPY put and call prices
- ΔK_i Half the difference between the strikes on either side of K_i;

$$\Delta K_i = \frac{(K_{i+1} - K_{i-1})}{2}$$

For the last (highest and lowest) selected strikes, ΔK_i is simply the absolute difference between K_i and the nearest selected option's strike

- R Risk-free interest rate to option's expiration

Calculation Process

SPIKES is calculated using only standard options on the SPY that expire on the third Friday of each calendar month. Although weekly options on SPY are available, these are **not** used in the calculation of SPIKES.

The following process is used to calculate SPIKES:

STEP 1 Select two SPY expirations	STEP 2 Apply "Price Dragging" technique	STEP 3 Select option inputs	STEP 4 Apply variance swap formula	STEP 5 Calculate SPIKES
Select the two SPY expiration months. The SPIKES calculation begins with the universe of regular monthly SPY options and selects the first monthly expiration with more than two full days to expiry and the next monthly expiration.	Apply "Price Dragging" technique to determine option price inputs. Price Dragging uses eligible trades, bids, and offer prices to reduce erratic movements of the index value that could result from illiquid out-of-the-money options.	Select option inputs. For each expiration, choose the at-the-money and all out-of-the-money options, limited by truncation.	Apply variance swap formula. For each expiration, the volatility is estimated using the variance swap formula, with the selected options' prices weighted according to the formula [2] above.	Calculate SPIKES. Compute the 30-day weighted average of the near- and next-expiration variances, take the square root, and multiply by 100 as illustrated in the formula [1] above.

MIAX Settlement Auction

SPIKES Special Settlement Auction (a modified Opening Process)

The SPIKES Special Settlement Auction occurs on MIAX Options in the SPY options that have 30 days to expiration on the Wednesday that is 30 days prior to the third Friday of the calendar month immediately following the month in which the contract expires. If that Wednesday or the expiration Friday that is 30 days following that Wednesday is a holiday, the final settlement date for the contract shall be on the business day immediately preceding that Wednesday.

Before and during the opening process for each relevant SPY option, MIAX Options will disseminate robust imbalance information over its AIS feed. Anyone (members and non-members) may subscribe to the AIS feed.

New liquidity types called Settlement Auction Only (SAO) orders and SAO eQuotes were created for this process.

SPIKES Combo Orders

MIAX Options now allows SPIKES Combo Orders – orders to buy or sell one or more SPIKES options series and the offsetting number of SPIKES Combinations to be delta neutral – with ratios of up to eight to one. SPIKES Combinations are the purchase (or sale) of a SPIKES call option and sale (or purchase) of a SPIKES put option with the same expiry and strike.

Trading fees

See SPIKES Options **rate card** at **www.miaxoptions.com/spikes**

Contract Specifications of SPIKES Options

Description	SPIKES measures changes in expected volatility of the SPDR S&P ETF (commonly known and referred to by its ticker symbol, SPY)
Symbol	SPIKE
CUSIP	84851L107
Multiplier	$100
Strike Interval	Minimum strike price intervals are set at $0.50 where the strike price is less than $15, $1 or greater where the strike price is between $15 and $200, and $5 or greater where the strike price is greater than $200
Minimum Trading Increment	$0.05 for series trading below $3 and $0.10 for series trading at or above $3 Complex Orders and PRIME Price Improvement Auctions are in $0.01 increments
Expiration Date	The Wednesday that is thirty days prior to the third Friday of the calendar month immediately following the expiring month
Expiration Month	Up to twelve expiration months. Short-term, quarterly and LEAPS may also be available
Exercise Style	European
Last Trading Day	Trading will ordinarily cease at 4:15 p.m. (New York Time) on the Tuesday preceding an expiration Wednesday
Settlement Type	Cash
Settlement Value Symbol	SPKCS
Settlement Value	The exercise and settlement value will be calculated on Wednesday at 9:30 a.m. (New York time) using opening prices, and if no trade has occurred, the mid-point of the opening market for the SPY options used in the calculation of the Index at that time. The exercise-settlement amount will be equal to the difference between the settlement value and the exercise price of the option, multiplied by $100. Exercise will result in the delivery of cash on the business day following expiration.
Settlement of Exercise	Next business day following expiration
Position and Exercise Limits	No position and exercise limits
Trading Hours	9:30 a.m. - 4:15 p.m. Eastern Time (New York time)

About MIH and the MIAX Exchange Group

Miami International Holdings, Inc. (MIH) is the parent holding company of Miami International Securities Exchange, LLC (MIAX®), MIAX PEARL, LLC (MIAX PEARL™) and MIAX Emerald, LLC (MIAX Emerald™ and together with MIAX and MIAX PEARL, the MIAX Exchange Group), which operates three fully electronic options trading exchanges.

MIAX, MIAX PEARL and MIAX Emerald leverage the MIAX Exchange Group's industry-leading technology and infrastructure to provide their member firms with traditional pricing and pro rata allocation (MIAX), maker-taker pricing and price-time allocation (MIAX PEARL) market structures, and a hybrid market structure with maker-taker pricing and pro rata allocation (MIAX Emerald). MIAX Options serves as the exclusive exchange venue for cash-settled options on the SPIKES® Volatility Index (Ticker: SPIKE), a measure of the expected 30-day volatility in the SPDR® S&P 500® ETF (SPY).

The MIAX Exchange Group's executive offices and National Operations Center are located in Princeton, NJ, with a Miami Operations Center and additional offices located in Miami, FL.

To learn more about MIH and the MIAX Exchange Group visit **www.miaxoptions.com**.

About T3 Index

SPIKES has been developed by T3 Index, a research-driven financial indexing firm, specializing in volatility and option benchmarking. T3 Index is dedicated to developing investible, proprietary indices that track related strategies across a range of asset classes to transform the way people invest and manage risk.

Further information on T3 Index can be found at **www.t3index.com**.

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