

## EVO System Design

EVO is an algorithmic rule based market-timing model based on technical analysis and seasonality patterns. It was developed by Potomac Advisor's CIO in 2002. The original system took two years to develop before its implementation in May of 2002. This became the first time Potomac's CIO had created a program based on a mechanical trading system.

*EVO's design is based on the supposition, supported by academic research, that when many trading systems and combinations are aggregated, the noise and errors will tend to diversify away, while the signal remains.*

After detailed analysis and backtests of over 60 independent trading systems, Potomac Advisor's CIO was able to identify eight systems that were used in various combinations to create the original composite system in 2002. The original composite of eight systems limited the percent of time invested to only 39.9% leaving many missed opportunities on the table. Over time, the number of trading systems identified as possible candidates for selection rose to over 120. The availability of more systems from which to select, and the evolution of the system algorithms has resulted in an expansion of the number of systems utilized to 19, and coincidentally has increased the percent of time invested to over 48.5%, thereby capturing many more missed opportunities.

The individual trading systems use a myriad of quantitative indicators based on historic financial and raw stock market technical data including major and secondary market indexes, breadth, volume and volatility measures, interest rate sensitive data, sentiment, and seasonality statistics. Each system has its own unique formula, sometimes using the same data to create a variety of trend following systems, which include price, market breadth and volatility indicators, and moving average crossover systems. Countertrend indicators identifying significant overbought/oversold levels are also used.

Each of the systems is back tested separately and in various combinations with each other to optimize the risk and return performance. Systems and their combinations that give the best returns are not necessarily included in the final composite system. Those chosen have to meet strict requirements for risk and reward and have to provide a significant number of trades in the sample. The system combinations selected are further aggregated together to generate composite system buy, sell or shorting signals *when a number of unique combination of systems point one way, i.e., when the signal is strong.*

The rigorous process was designed around the concept of "filter" systems and "trigger" systems. Filter systems are generally intermediate to long-term systems that may be standalone market timing systems if used on their own. These systems function to screen trades generated by the trigger systems. Trigger systems are designed to capture shorter-term market inefficiencies or repetitive patterns that translate into very high rates of return while invested. All the individual systems in EVO have exhibited superior risk adjusted returns than the market in backtests measured from April 1987. The identification of these systems is the backbone of risk management and the excess return generated by EVO in bear markets as well as in volatile periods in bull markets.

To reduce and/or eliminate the bias effects of over-optimization during back testing, measurement of consistency of performance over rolling time periods are employed in addition to out-of-sample testing and forward performance testing, which are used to confirm the results during the in-sample data period. Sensitivity analysis is also performed to mitigate the bias by varying the parameters of potential timing systems incrementally and eliminating those parameter choices that do not lead to a smooth performance profile. That is - eliminate spike trades that distort the result.

A few trading systems have stops imbedded in them as part of the system algorithm. While an individual system's stop would result in that system cycling to a sell, it would not necessarily generate an EVO composite sell for the trade, if other systems that remained on a buy were sufficient to maintain the EVO composite on a buy.

Meanwhile, the mechanical EVO models, EVO 1 & 3, have an overall composite trade stop if the S&P 500 index declines by 7 1/2% from the entry price of the trade. This results in an 11.25% stop on a 50% (1.5x) leveraged fund. The stop may be overridden if a new composite EVO buy signal is generated on the same day, otherwise a new EVO buy signal would be required for reentry subsequent to the stop. Stops are the ultimate tool to ensure that a mechanical system does not breakdown and result in excess losses.

EVO 2 does not have a mandatory 7 1/2% trade stop, but a discretionary stop may be generated if the cumulative drawdown across multiple trades exceeds specific criteria, usually the maximum cumulative drawdown experienced in backtesting. In such a case, assets may be moved to cash and EVO trading may be suspended until an evaluation is made on how to proceed.

Stops are most susceptible to unforeseen geo-political events or a persistent failure of one or more system long or short signal combinations, indicating market conditions have changed and adjustments are necessary. However, if the system is well designed it will also be robust enough to take care of itself without frequent intervention. Black box systems may seem like voodoo to some, but in actuality they can be designed methodically using sound logic to minimize optimization biases and result in eliminating the emotions that can make discretionary trading detrimental to successful trading.

***In summary, combining the long-term filter systems with the short-term triggers that exhibit superior risk adjusted returns, and the rare use of protective stops has resulted in exceptional historic returns.***

## **EVO Investment Strategies**

Potomac Advisors has several programs that invest using EVO in a market timing strategy applied to Rydex leveraged and unleveraged market index mutual funds. In each case allocations are made 100% ("All In") into one of three funds at all times depending on whether the strategy anticipates a market advance, a market correction, or expects to profit from a market decline. No discretion is involved. All positions taken are based on mechanical signals generated by EVO.

**EVO 1 and EVO 2 Strategies:** These well-established strategies use the Rydex NOVA Fund, a leveraged (1.5X the daily change of the S&P500 index) fund for long positions, the Rydex Inverse S&P 500 Strategy Fund an unleveraged inverse S&P500 index fund for short positions and the Rydex U.S. Government Money Market fund for cash positions. The only difference between the two strategies is that EVO1 is non-discretionary, i.e. entirely mechanical, while discretion may be used in implementing the timing decisions in EVO 2. Performance for composites of these two strategies has been verified to be in compliance with GIPS (Global Investment Performance Standards) through June 30, 2014 beginning with inception of EVO 1 on May 31, 2002, and since inception of EVO 2 on February 4, 2004.

**EVO 3 Strategy:** This newly implemented mechanical strategy applies the same EVO 1 composite timing signals to the unleveraged Rydex NASDAQ 100 index fund in place of Rydex NOVA for long positions and to the same funds as used in EVO 1 for short and cash positions. This strategy was begun in December 2014. Simulation applying the actual trade dates for EVO 1 has demonstrated superb results.