Understanding Leveraged ETFs Through the Lens of Optimized RSI Parameters and Position Sizing with Genetic Optimization

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Context: Retail trading is at an all-time high, yet challenges like risk assessment, psychological biases, and the pursuit of maximized returns remain. While margin borrowing and options are the dominant tools retail investors use for leverage, they come with risks such as margin calls, borrowing costs, and time decay. Leveraged ETFs (LETFs) provide an alternative that removes some of these frictions, yet their use among retail traders remains limited.

Problem: The mainstream consensus views leveraged products, such as margin, options, and LETFs alike, as suitable for short-term trades but suboptimal for long-term investing due to their various qualities. However, compared to margin and options, LETFs have received far less empirical study beyond their structural design and theoretical decay models. In particular, there is little research into their actual performance under different investment horizons and strategies. More evidence is needed to determine if there exists a market regime scenario where the often-criticized long-term buy-and-hold approach is competitive with short-term active strategies.

Method: This study examines leveraged S&P 500 ETFs through a genetic-optimization lens for RSI-based mean-reversion and position sizing. By simulating pre-inception LETF performance anchored to SSO/UPRO NAVs, popular 2x and 3x SPX ETFs, with an extrapolation to a hypothetical 4× ETF under the same constraints, allowing for more rigorous backtesting beyond the 21st-century bull market. To combat overfitting in the backtesting pipeline, risk-adjusted alpha and Sharpe were excluded from the multi-objective fitness function, as early testing showed that directly optimizing for these metrics systematically favored fragile strategies that failed out-of-sample. Walk-forward re-calibration and strategy ensembles were used to improve structural and temporal robustness, while shortening the training window and increasing retraining frequency further helped "forget" stale signals as market dynamics changed. Finally, Principal Component Analysis (PCA) was used to verify that each fitness metric contributed unique signal content, reducing redundancy and improving backtest efficiency

Findings: Using such an optimization approach and holding all other training parameters constant, 3x leverage ETFs produced stronger and less noisy results, capitalizing on rebounds more effectively while mitigating holding cost. The vast majority of pareto-optimal strategies held little to no base position regardless of selected metrics (**median base position of 0%** and mean being 6%), supporting the notion that LETFs are indeed more fitting for a short-term trading approach rather than a buy-and-hold approach. Selecting for Sortino ratio, maximum drawdown, value-at-risk, and annual return led to stable outperformance throughout seeds, achieving an average of **1.97% risk-adjusted alpha (t=10.49, p=1.91*E-10)**during the 1989-2025 backtests at an average **beta of .87**. A detail to note is that median entry and exit RSI thresholds were 34 and 74 respectively, converging onto the widely accepted 30-70 levels with an upwards skew, likely to account for the overall bullish nature of the US market. These tests suggest that buy-and-hold on leveraged ETFs will almost always be less risk-efficient compared to trading around some sort of strategy, despite the fact that such a strategy remains to be found.

Caveats: Although the results are reasonable and statistically significant, it is still noisy, with a standard deviation of .92% for alpha and .04 for beta. Furthermore, note that these optimized strategies produce short term capital gains, and thus if the calculations for tax liabilities of realized short term capital gains were to be integrated into the pipeline, investors utilizing such a trading strategy would be left with worse-than-market results.