Momentum-Based Trading Strategy for S&P 500 ETF (SPY)

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1 Thesis

This report investigates the performance of a momentum-based trading strategy applied to the S&P 500 ETF (SPY) from 2015 to 2023. The strategy employs technical indicators—Moving Averages, RSI, and Bollinger Bands—to identify buy and sell signals. The objective is to assess whether this strategy delivers superior risk-adjusted returns compared to a simple buy-and-hold approach. While momentum trading can exploit market trends, it may also introduce risks, such as delayed reactions during rapid market reversals and vulnerability to volatile conditions.

2 Risk Concerns

Despite the potential advantages of momentum strategies, this approach involves several risks:

- **Lagging Indicators**: Moving averages and RSI are lagging indicators, meaning they respond to past price data. This delay may result in suboptimal entries or exits, especially during fast market reversals.

- **Volatility and Drawdowns**: The strategy may fail to avoid large drawdowns during severe market downturns, as seen in its maximum drawdown performance. This suggests significant downside risk similar to a buy-and-hold approach.

- **Transaction Costs**: The strategy assumes zero transaction costs. In practice, frequent trading, as triggered by signals, could significantly reduce profitability due to transaction fees and slippage.

- **Choppy Markets**: In sideways or highly volatile markets, false signals can result in frequent buying and selling, which may reduce overall performance.

3 Technical Indicators and Strategy

The strategy employs three key technical indicators to generate buy/sell signals:

- **Moving Averages**: A 50-day moving average crossing above a 200-day moving average signals an upward trend (buy), while crossing below signals a downward trend (sell).

- **RSI (Relative Strength Index)**: A 14-day RSI identifies momentum extremes. An RSI below 30 indicates oversold conditions (buy), and an RSI above 70 signals overbought conditions (sell).

- **Bollinger Bands**: These bands capture price volatility based on a 20-day moving average and 2 standard deviations. Prices below the lower band trigger buy signals, and prices above the upper band trigger sell signals.

The strategy buys when all buy signals are triggered and sells when all sell signals occur.

4 Results

The backtest is conducted with $10,000 initial capital from January 2015 to January 2023, and compared to a buy-and-hold strategy.

4.1 Sharpe Ratio

The Sharpe Ratio measures the strategy's risk-adjusted return. A higher Sharpe Ratio indicates better performance per unit of risk taken.

- **Strategy Sharpe Ratio**: 0.62
- **Buy-and-Hold Sharpe Ratio**: 0.51

4.2 Maximum Drawdown

The Maximum Drawdown captures the largest portfolio decline from a peak to a trough. Both the strategy and buy-and-hold approach experience a significant drawdown.

- **Strategy Maximum Drawdown**: -34.10%
- **Buy-and-Hold Maximum Drawdown**: -34.10%

4.3 Price with Buy/Sell Signals

Figure 1 shows the SPY price over time, overlaid with the 50-day and 200-day moving averages (MAs) to highlight long-term trends. The Bollinger Bands represent volatility, with buy signals (green triangles) appearing when the 50-day MA crosses above the 200-day MA, the RSI is below 30, and the price touches or dips below the lower Bollinger Band. Sell signals (red triangles) occur when the 50-day MA crosses below the 200-day MA, the RSI is above 70, and the price touches or exceeds the upper Bollinger Band. This plot visually captures how the strategy reacts to trends and volatility, indicating entry and exit points for trades.

4.4 Strategy vs. Buy-and-Hold Portfolio Value

Figure 2 compares the portfolio value of the momentum-based strategy against a simple buy-and-hold approach. Both portfolios start with the same initial capital of $10,000. The momentum-based strategy uses buy/sell signals to time entries and exits, while the buy-and-hold portfolio passively holds SPY throughout the period. The performance
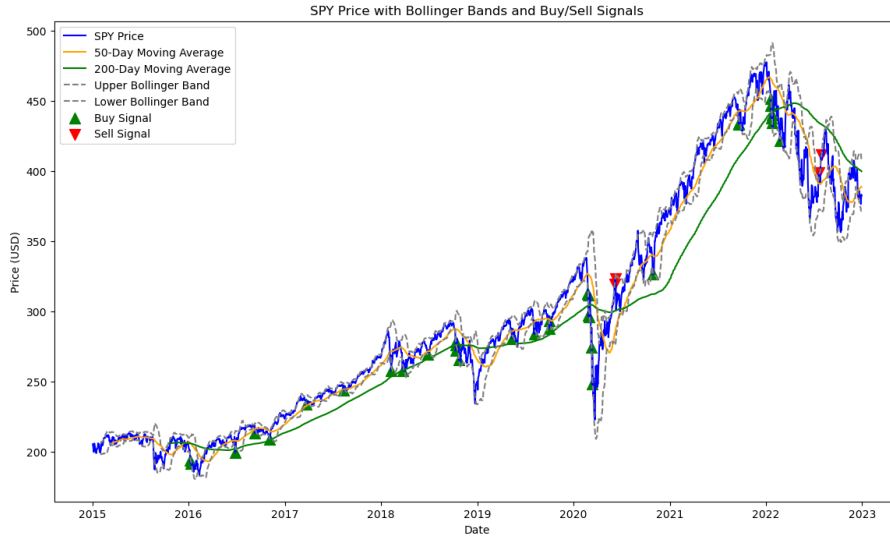
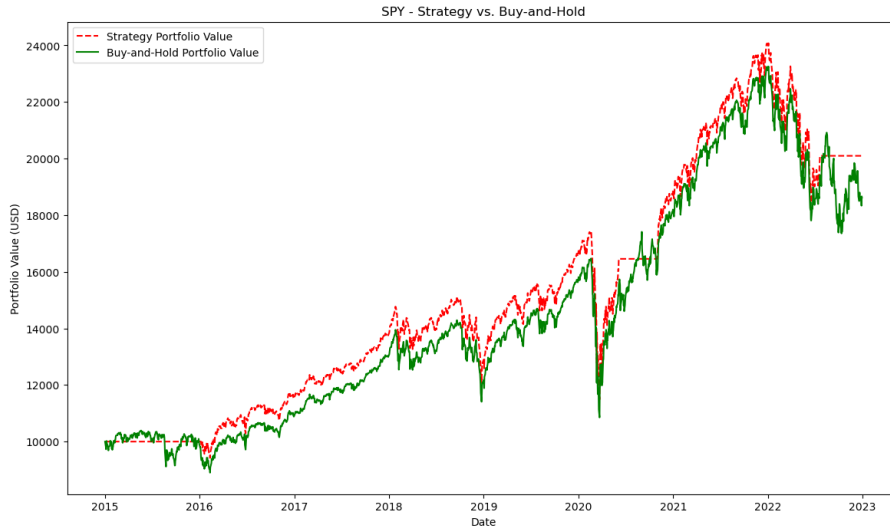Figure 1: SPY Price with Buy/Sell Signals, Moving Averages, and Bollinger Bands

Figure 2: Strategy vs. Buy-and-Hold Portfolio Value

differences between the two portfolios are evident, with the strategy showing periods of outperformance during trending markets, but underperforming in choppy markets where false signals result in frequent trades.

4.5 RSI with Buy/Sell Signals

Figure 3 displays the RSI (Relative Strength Index) over time, with buy and sell signals indicated. Buy signals (green triangles) occur when the RSI drops below 30, signaling that the asset is potentially oversold and presents a buying opportunity. Sell signals (red triangles) occur when the RSI exceeds 70, signaling that the asset is overbought and presents an opportunity to sell.
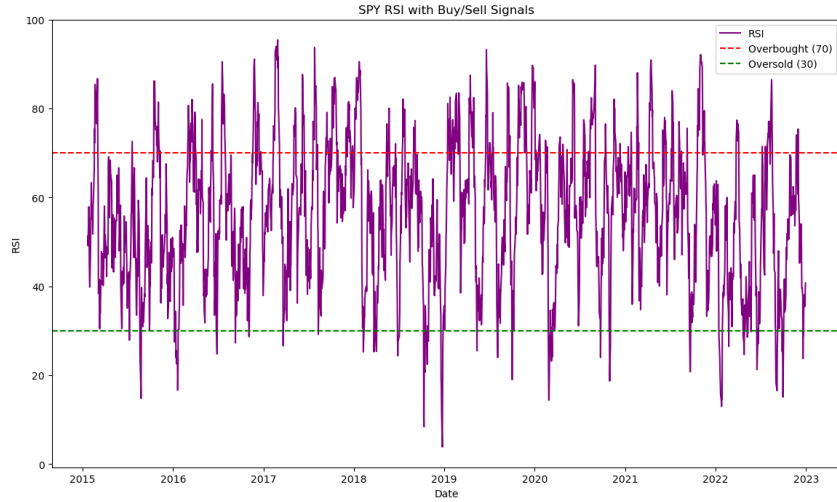
Figure 3: RSI with Buy/Sell Signals

5 Explanation of the Results

5.1 Sharpe Ratio Analysis

The Sharpe Ratio of 0.62 for the momentum-based strategy suggests that it provided slightly better risk-adjusted returns compared to the buy-and-hold approach, which had a Sharpe Ratio of 0.51. The higher Sharpe Ratio for the strategy can be attributed to its ability to avoid large losses by selling during overbought conditions (high RSI and price above the upper Bollinger Band).

5.2 Maximum Drawdown Discussion

Both the strategy and the buy-and-hold approach experienced a maximum drawdown of -34.10%. This similarity shows that the strategy was unable to fully mitigate losses during extreme market downturns. The reliance on lagging indicators, such as moving averages, likely contributed to delayed reactions during sudden market declines.

6 Extensions

To enhance this strategy, the following extensions could be considered:

- **Stop-Loss Orders**: Implementing a stop-loss mechanism would help limit downside risk during sharp market drops.

- **Adaptive Parameters**: Dynamically adjusting the length of moving averages or RSI thresholds based on market conditions could improve performance during volatile periods.

- **Multi-Asset Portfolio**: Expanding the strategy to a diversified portfolio of assets (e.g., commodities, bonds) could provide additional returns and reduce risk.

- **Transaction Costs**: Factoring in transaction costs and slippage to get a more realistic view of performance.