Finding Consistent Trends with Strong Momentum

RSI for Trend-Following and Momentum Strategies

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Abstract

Investors and traders typically use the Relative Strength Index (RSI) to identify turning points in security prices. This strategy, however, discounts the true nature of the indicator and limits its potential. An RSI breakdown reveals that its power lies in its ability to identify consistent uptrends with strong momentum. Some practitioners use RSI ranges to identify existing trends and RSI extremes to signal momentum shifts. These approaches, however, do not quantify how long RSI should hold its range, how regularly RSI should reach a momentum milestone and, most importantly, if RSI range and momentum indications have predictive value.

The goal of this paper is to systematically test RSI range and momentum signals using stocks in the S&P 500. Moreover, this paper will show that the RSI range alone is inadequate because it does not always capture upside momentum. The RSI range measures trend consistency well, but a momentum component is needed to uncover the strongest uptrends. After quantifying and testing, this paper will show that signals combining RSI range and momentum can foreshadow sizable advances with good success rates. As such, these signals can be part of a successful investing strategy that combines trend-following and momentum.

Trend Theory and RSI

J. Welles Wilder Jr. developed the Relative Strength Index (RSI) and introduced it in his classic book, *New Concepts in Technical Trading.*[1] Wilder used RSI as a momentum oscillator to identify turning points or reversals in security prices. While it is possible to time reversals using RSI, reversal strategies do not utilize the inherent strengths of the indicator.

Despite its label as a momentum oscillator, RSI is a natural trend indicator. RSI is bound between 0 and 100 with 50 as the mid-point. As the RSI formula reveals, RSI is above 50 when the Average Gain is greater than the Average Loss.[2] Conversely, RSI is below 50 when the Average Gain is less than the Average Loss. Thus, prices are generally rising when RSI remains above 50 and generally falling when RSI remains below 50. The further above 50, the larger the Average Gain relative to the Average Loss, and the stronger the uptrend. Conversely, the further below 50, the larger the Average Loss relative to the Average Gain, and the stronger the downtrend.

Chart 1 shows Comcast (CMCSA) and 14-day RSI to illustrate a shift in RSI and price direction. Comcast moved lower from late February to early May and RSI remained below 50 for the most part (red). A shift occurred in early June as

[1] See Wilder
[2] See Appendix 1 - Sample RSI Calculation

prices moved higher and RSI crossed above 50. Prices moved higher from early June to September and RSI remained largely above 50 (green).

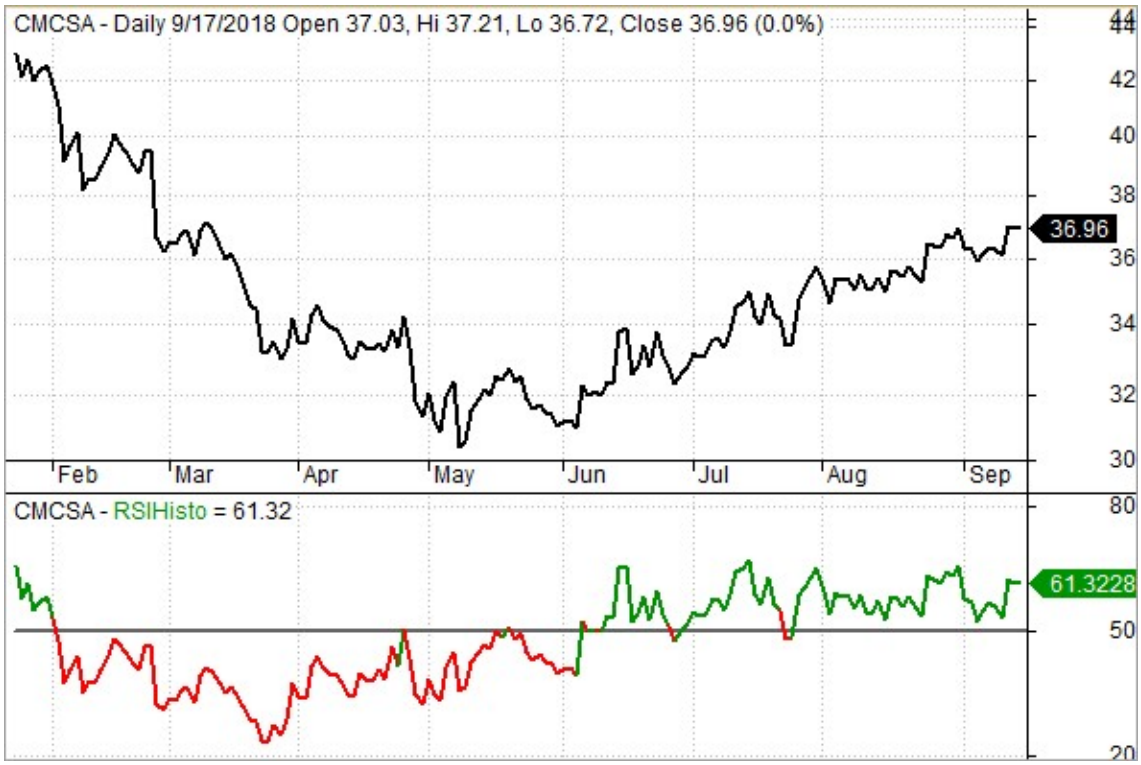

Chart 1: CMCSA - RSI Directional Shift

The zone around 50 defines the battle for trend consistency. For an uptrend to be truly consistent, pullbacks should be limited and the trend should stay in motion.[3] This is where the RSI range comes into play, especially the lower end of the range. Adding a cushion to the midpoint, declines are considered normal pullbacks within a larger uptrend as long as RSI holds above 40. Note that a buffer is needed to allow for normal pullbacks and reduce whipsaws. A price decline that

[3] See Treacy

pushes RSI below 40 indicates that the uptrend is losing consistency. Thus, RSI can be a good fit for trend-following strategies.

Research shows that time-series momentum, a form of trend-following, works in the U.S. stock market.[4] Stocks showing positive returns over a twelve-month period are more likely to have positive returns in the future. As with trend-following, time-series momentum assumes that a trend in motion will stay in motion. In other words, the chances of further gains are higher when a security is already in an uptrend. D'Souza et al. found that "the existence of time-series stock momentum has been a persistent phenomenon in the U.S. equity markets throughout the 88-year period since 1927".[5]

Some practitioners use RSI ranges to identify the price trend. Andrew Cardwell of Cardwell RSI Edge uses bullish and bearish ranges to define price trends.[6] According to Cardwell, RSI typically ranges from 40 to 80 during an uptrend and 20 to 60 during a downtrend. RSI finds support and reverses in the 40-50 zone during a normal pullback. A move to 30 suggests something more than just a pullback. A break below the bullish range indicates a downtrend is starting, and it is time to apply the bearish-range rule.

[4] See Gray
[5] See D'Souza
[6] See Cardwell

Chart 2 shows Illumina (ILMN) trending higher as RSI ranged between 40 and 80 (green shading). The October break below 40 ended this bull range. Chart 3 shows BorgWarner (BWA) trending lower as RSI ranged between 20 and 60 (red shading).

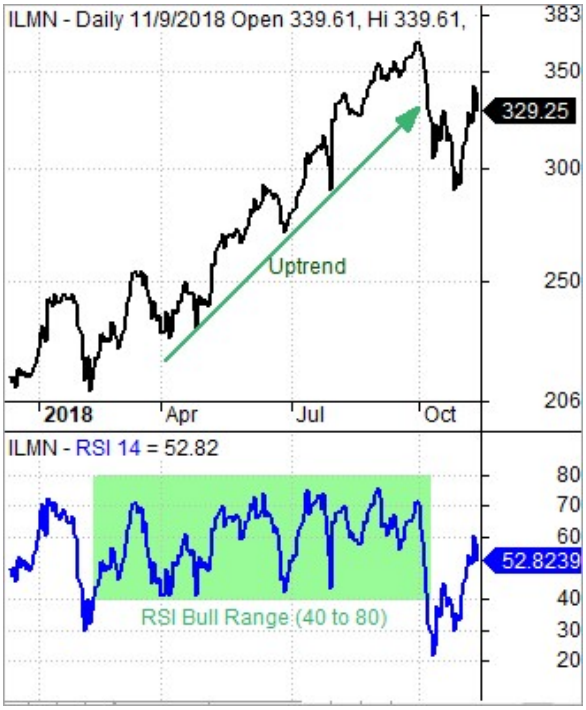

Chart 2: ILMN - RSI Bull Range (40 to 80)

Chart 3: BWA - RSI Bear Range (20 to 60)

Constance Brown asserts that momentum oscillators such as RSI and the Stochastic Oscillator do not "travel between 0 and 100".[7] Brown argues that RSI finds support in the 40-50 zone during an uptrend and resistance in the 80-90 zone. Conversely, RSI meets resistance in the 55-65 zone during a downtrend and finds

[7] See Brown

support in the 20-30 zone. Brown suggests wider ranges than Cardwell: 40 to 90 for a bullish range and 20 to 65 for a bearish range.

Momentum Theory and RSI

RSI also has a clear momentum component. When analyzing past winners, it is easy to find stocks with strong momentum that outperformed for extended periods. More often than not, these stocks became overbought numerous times as their uptrends persisted. "Overbought" readings occur when RSI moves above 70. Stocks like Apple, Best Buy, Boeing, Mastercard, Nvidia, Tiffany and Valero more than doubled from June 2016 to June 2018, a mere two years. This diverse group of stocks had one thing in common: RSI became "overbought" by moving above 70 on a regular basis.

Chart 4 shows Boeing (BA) with 14-day RSI moving above 70 regularly from October 2016 to January 2018. The stock was indeed overbought by the traditional definition, but these overbought readings reflected strong upside momentum and the stock subsequently outperformed for an extended period.

Chart 4: BA - RSI Strong Momentum (above 70)

What exactly does overbought mean? Greg Morris notes that overbought and oversold are "the most overused and misunderstood terms when talking about the markets".[8] Indeed, overbought conditions present traders and investors with a paradox. Consider when RSI moves above 70. One investor might use an overbought signal to prepare for a reversal, while another could view strong upside momentum as a prerequisite for further gains.

RSI moves above 70 and becomes "overbought" when prices move higher, usually sharply higher. Such an advance signals strong upside price momentum

[8] See Morris

and RSI quantifies this momentum by moving into the upper end of its range. Moreover, RSI values above 70 are relatively rare and show exceptional strength.

The distribution of RSI values confirms the 20 year uptrend in stocks and the uniqueness of values above 70. Threshold testing reveals that the majority of RSI values exceeded 50 for stocks in the S&P 500 from 7/1/1998 to 7/2/2018. In fact, Chart 5 shows that 56.7% of RSI values exceeded 50 during this twenty-year test period, while 43.3% were below 50.[9] These numbers make sense because the S&P 500 Total Return Index advanced 247%, generating a 6.4% compound annual return, over this same period. The S&P 500 was also above its 200-day simple moving average 70% of the time.

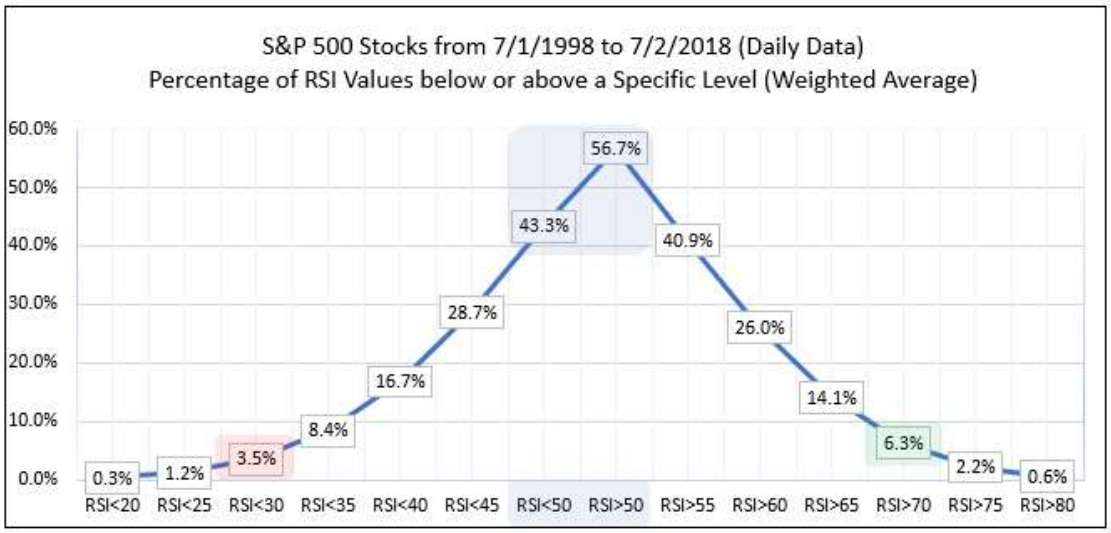

Chart 5: Distribution of RSI Values between 0 and 100

[9] See Appendix 2 - Weighted Average Calculation

Chart 5 also reveals that RSI values below 30 and above 70 are exceptional. RSI fell below 30 just 3.5% of the time, and exceeded 70 just over 6% of the time. Stocks with RSI values above 70 are in an elite group and they can be considered momentum leaders. Accordingly, RSI values above 70 can be used in momentum strategies that focus on the strongest stocks. On the flip side, stocks with RSI values below 30 can be viewed as serious underperformers.

Research shows that momentum strategies generate positive returns and consistently outperform. The momentum anomaly indicates that stocks that have outperformed tend to continue outperforming, while stocks that have underperformed tend to continue underperforming.[10] Research from Jegadeesh and Titman showed that stocks that outperformed over three- to twelve-month time horizons continued to outperform.[11] An updated paper by Jegadeesh and Titman showed that this momentum strategy still worked on U.S. stocks overall, though it suffered a setback in 2009.[12]

Practitioners have also found that high RSI levels can be bullish and lead to further price gains. In a presentation to the CMT Association, David Cox, CMT, CFA, showed how a surge above 70 can signal the start of a new uptrend.[13] After an extended downtrend and RSI values below 30, an RSI surge above 70 reflects a

[10] See Fama and French
[11] See Jegadeesh and Titman (1993)
[12] See Jegadeesh and Titman (2011)
[13] See Cox

clear shift in price dynamics. Using Apple (AAPL) as an example, Cox showed RSI moving from a deeply oversold condition to an overbought condition. Chart 6 shows this downtrend reversing to an uptrend when RSI surged above 70, which showed strong upside momentum. Chart 7 shows Eversource Energy (ES) becoming "oversold" as RSI dipped below 30 in February and June 2018. The sharp move from below 30 to above 70 signaled a clear shift in momentum and further gains followed.

Chart 6: AAPL - RSI Surge and Trend Reversal

Chart 7: ES - RSI Surge and Trend Reversal

Testing, Methodology and Data

Wilder suggested 14 days when calculating RSI and this setting will be used throughout the paper.[14] With 14-day RSI as the base indicator, this paper will test five signal groups: bull range, bear range, bull momentum, bear momentum and bull range-momentum.

1. RSI Bull Range: RSI fluctuates between 40 and 100 over N days.
2. RSI Bear Range: RSI fluctuates between 0 and 60 over N days
3. RSI Bull Momentum: highest high value of RSI is greater than 70 over N days
4. RSI Bear Momentum: lowest low value of RSI is less than 30 over N days
5. RSI Bull Range-Momentum: combination of 1 and 3 over N days

Each test group covers five lookback periods (N days): 25, 50, 75, 100 and 125 (trading days). For example, the 25-day RSI Bull Range test triggers a signal when 14-day RSI has fluctuated between 40 and 100 for at least 25 days; the signal ends when RSI moves below 40, breaking the range. The next test, 50-day RSI Bull Range, triggers a signal when 14-day RSI has fluctuated between 40 and 100 for at least 50 days; the signal ends when RSI moves below 40.

Tests used historical constituents in the S&P 500 to prevent survivorship bias. That is, the study used components in the index at the time of testing. For

[14] See Wilder

example, testing before 12/23/2013 did not include Facebook (FB) because it was not yet part of the S&P 500. Similarly, testing after 12/20/2013 did not include Teradyne (TER) because it was removed from the S&P 500 (replaced by Facebook). This also means signals ended when a stock was removed from the S&P 500. Stock data were adjusted for capital reconstructions, special dividends and ordinary dividends.

The testing period used daily price data extending from 7/1/1998 to 7/2/2018, encompassing twenty years and four market cycles. This period includes the bear markets in 2001-2002 and 2008-2009, and the bull markets of 2003-2007 and 2009-2018. The latter bull run also includes the flash-crash in May 2011, high volatility from July to October 2011 and an extended correction from July 2015 to February 2016.

For testing purposes, the system measures the percentage change in the stock price for the duration of the signal. Signals are generated on the close, while entries and exits are based on the next open. Commissions and slippage are not considered. The price change is simply the open price at entry less the open price at exit. This difference is then divided by the open price at entry to calculate the percentage change.

The performance metrics focus on the Success Rate, the Average Advance, the Average Decline and the Profit/Loss Ratio. A successful signal occurs when

there is an advance after a bullish signal and a decline after a bearish signal. A failed signal occurs when there is a decline after a bullish signal and an advance after a bearish signal. The Success Rate is the percentage of successful signals (out of total signals).

The size of the subsequent advance or decline captures the magnitude of the success or failure, while the Profit/Loss Ratio measures the degree of success. An advance after a bullish signal is deemed a profit, while a decline is deemed a loss. Similarly, a decline after a bearish signal is deemed a profit, while an advance is deemed a loss. Thus, the Profit/Loss Ratio compares the magnitude of the successful signals to the magnitude of the failed signals.

The Success Rate and Profit/Loss Ratio should be considered together, not separately. The Success Rate shows how often the signals worked, while the Profit/Loss Ratio reflects the degree of success. Together, these two indicators provide insight on the true potential of the signals. Signals with relatively low Success Rates (below 35%) and low Profit/Loss Ratios (below 1.2) do not show potential, while signals with relatively high Success Rates (above 50%) and high Profit/Loss Ratios (above 2) show potential.

Testing RSI Bull and Bear Ranges

The first test analyzes the RSI Bull Range, which extends from 40 to 100. Though Cardwell and Brown set upper limits from 80 to 90, the true maximum is 100. The ability to fluctuate between 40 and 100 keeps RSI in the top 60% of its theoretical range.

Chart 8 shows F5 Networks (FFIV) with the 75-day RSI Bull Range indicator (red/green) and RSI (blue) with a gray line at 40. The RSI Bull Range indicator moves to +1 (green) when RSI fluctuates between 40 and 100 for at least 75 days. The indicator moves to -1 (red) when RSI moves below 40 and breaks the range. The green arrow shows the beginning signal and the red arrow shows the ending signal. FFIV advanced 29.9% after the bullish signal for a success (profit). In contrast, Chart 9 shows a failed bullish signal (loss) for TripAdvisor (TRIP), which fell 11.1% between signals.

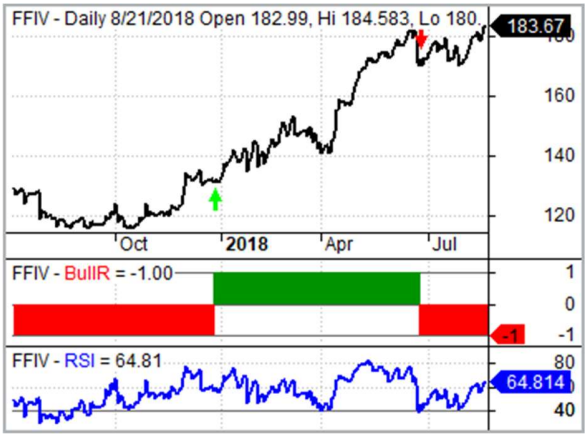

Chart 8: FFIV - RSI Bull Range

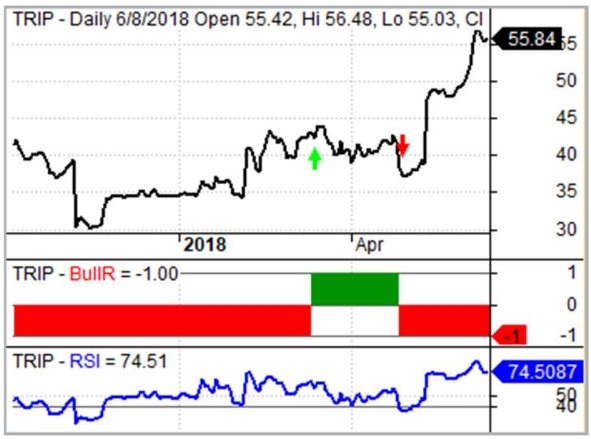

Chart 9: TRIP - RSI Bull Range

Source: AmiBroker and PremiumData

Table 1 shows results when applying RSI Bull Range signals to stocks in the S&P 500 over the test period. The Success Rate ranged from 34% to 37%, which means less than 40% of stocks advanced after triggering bullish signals. Despite these low Success Rates, the Profit/Loss Ratios ranged from 2.35 to 2.52, which are quite high. This means the average profit from a signal was more than twice the average loss. Thus, the RSI Bull Range signals show promise with high Profit/Loss Ratios, but merit caution because of Success Rates below 40%.

RSI Bull Range Test	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day RSI Bull Range	26002	37%	+13.58%	-5.51%	2.46
50-day RSI Bull Range	14606	36%	+12.65%	-5.38%	2.35
75-day RSI Bull Range	7939	36%	+11.87%	-4.81%	2.47
100-day RSI Bull Range	4353	36%	+11.72%	-4.65%	2.52
125-day RSI Bull Range	2375	34%	+11.36%	-4.77%	2.38

Table 1: Performance Metrics for RSI Bull Range Test

The second test analyzes the RSI Bear Range, which extends from 0 to 60. Again, this test uses the theoretical lower limit. RSI remains in the lower 60% of its range when it fluctuates between 0 and 60.

Chart 10 shows Dish Network (DISH) with the 75-day RSI Bear Range indicator and RSI with a horizontal line at 60. The RSI Bear Range indicator moves to -1 (red) when RSI does not move above 60 for a least 75 days. This bearish signal (red arrow) remains in play as long as RSI fails to break above 60.

The indicator moves to +1 (green) when RSI moves above 60 and breaks the range (green arrow). DISH declined 30.4% for a successful bearish signal (profit). Chart 11 shows a failed bearish signal (loss) for Cerner (CERN), which subsequently advanced 17.7%.

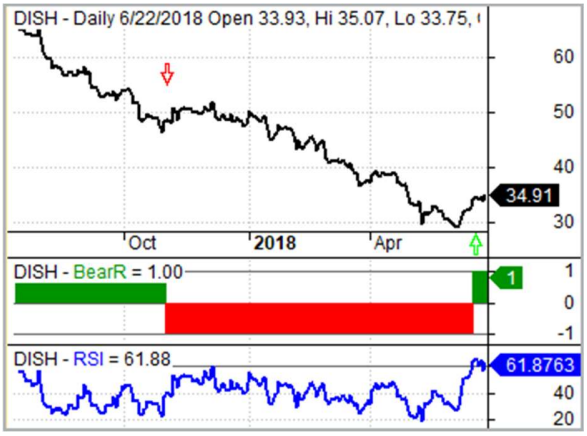

Chart 10: DISH - RSI Bear Range

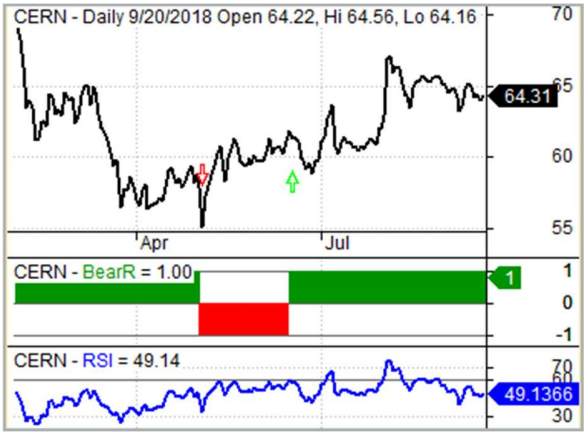

Chart 11: CERN - RSI Bear Range

Source: AmiBroker and PremiumData

Table 2 shows results when applying RSI Bear Range signals to all stocks in the S&P 500 over the test period. The Success Rates ranged from 25% to 28%, which means less than 30% of stocks declined after the bearish indicator triggered a signal. The Profit/Loss Ratios were all above 1.2 as prices tended to fall after the RSI Bear Range signals, but the Profit/Loss Ratios fell from 2.11 to 1.28 as the lookback period extended. Thus, performance deteriorated significantly as time extended. Overall, the Profit/Loss Ratios are not high enough to justify the extremely low Success Rates.

RSI Bear Range Test	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day RSI Bear Range	23881	25%	+5.87%	-12.38%	2.11
50-day RSI Bear Range	10590	26%	+7.30%	-13.85%	1.90
75-day RSI Bear Range	4715	26%	+7.90%	-15.65%	1.98
100-day RSI Bear Range	2142	28%	+10.04%	-15.54%	1.55
125-day RSI Bear Range	1034	25%	+11.46%	-14.67%	1.28

Table 2: Performance Metrics for RSI Bear Range Test

Testing RSI Bull and Bear Momentum

Testing now turns from range signals to momentum signals. This third test analyzes performance when RSI exceeds 70 over different lookback periods. RSI values above 70 show strong upside momentum and suggest outperformance. The signal ends when RSI fails to exceed 70 over the lookback period, which suggests waning upside momentum.

Chart 12 shows PNC Financial Services (PNC) with the RSI Bull Momentum indicator and RSI with a horizontal line at 70. The RSI Bull Momentum indicator moves to +1 (green) when RSI exceeds 70 and remains at 1 as long as the highest high of RSI is above 70 over the lookback period, which is 75 days. The indicator moves to -1 (red) when the highest high of RSI fails to exceed 70 over a 75-day period. PNC advanced 15.4% for a successful bullish signal (profit). Chart 13 shows eBay (EBAY) declining 15% for a failed bullish signal (loss).

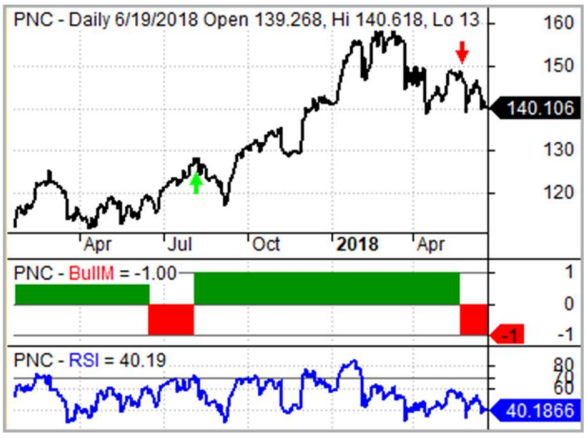

Chart 12: PNC - RSI Bull Momentum

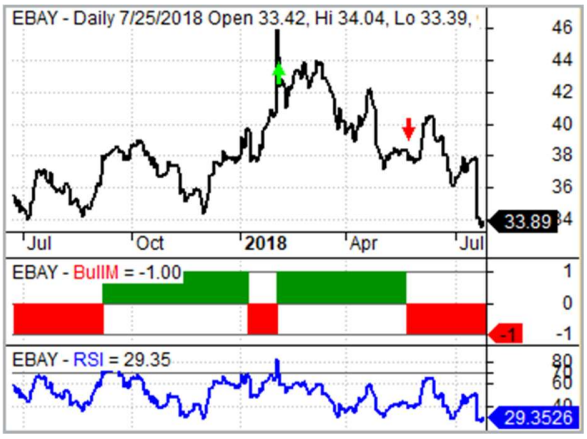

Chart 13: EBAY - RSI Bull Momentum

Source: AmiBroker and PremiumData

Table 3 applies RSI Bull Momentum signals to all stocks in the S&P 500 over the test period. The Success Rates jump out because they range from 52% to 58% and exceed 50% in every instance. Thus, more than 50% of stocks advanced after the signals. The Profit/Loss Ratios ranged from 1.37 to 2.11, and rose as the lookback period extended from 25 days to 125 days. Also, notice how the Average Advance increased as the lookback period extended. Overall, the RSI Bull Momentum signals show promise with Success Rates above 50% and sizable gains (Average Advances), but warrant caution because the Average Declines weigh on the Profit/Loss Ratios.

RSI Bull Momentum Test	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day RSI Bull Momentum	18761	52%	+9.10%	-6.66%	1.37
50-day RSI Bull Momentum	13870	55%	+15.14%	-9.96%	1.52
75-day RSI Bull Momentum	10508	56%	+22.51%	-12.75%	1.77
100-day RSI Bull Momentum	8129	57%	+29.92%	-15.80%	1.89
125-day RSI Bull Momentum	6293	58%	+39.97%	-18.96%	2.11

Table 3: Performance Metrics for RSI Bull Momentum Test

The fourth test analyzes performance when RSI moves below 30 over different lookback periods. RSI values below 30 reflect strong downside momentum and point to underperformance. The signal ends when RSI fails to move below 30 over the lookback period, which implies less downside momentum.

Chart 14 shows Henry Schein (HSIC) with the 75-day RSI Bear Momentum indicator and RSI with a horizontal line at 30. The indicator moves to -1 (red) when the lowest low of RSI is below 30 over the last 75 days. This triggers a bearish signal that lasts until RSI fails to move below 30 over a 75-day period. An ending signal occurs when the RSI Bear Momentum indicator moves to +1 (green). HSIC declined 14.3% for a successful bearish signal (profit). Chart 15 shows Occidental Petroleum (OXY) advancing 23.7% for a failed bearish signal (loss).

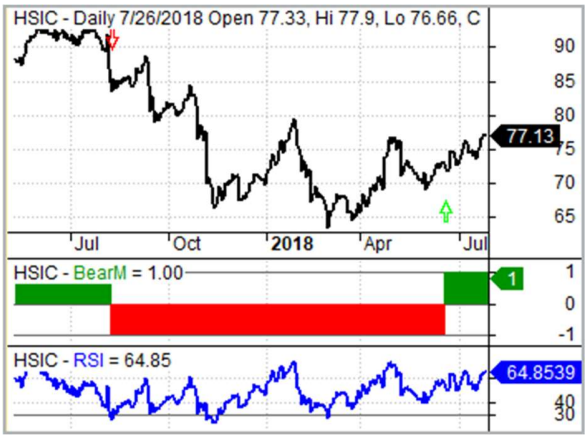

Chart 14: HSIC - RSI Bear Momentum

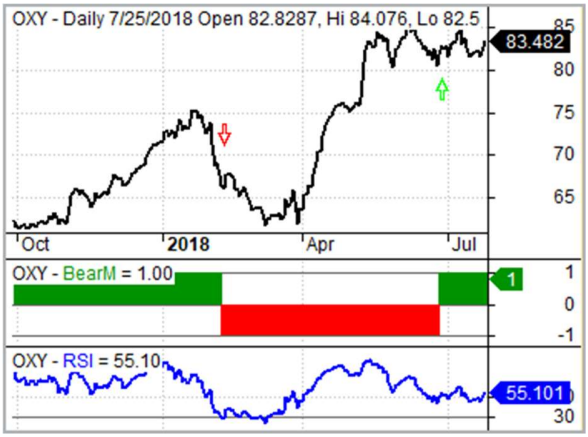

Chart 15: OXY - RSI Bear Momentum

Source: AmiBroker and PremiumData

Table 4 shows the results of applying RSI Bear Momentum signals to all stocks in the S&P 500 over the test period. The Success Rates ranged from 31% to 39%, but fell as the lookback period extended. Less than 40% of stocks declined after the bearish indicator triggered a signal. The Average Decline was larger than the Average Advance at every lookback period, but the Profit/Loss Ratios were barely above 1. The RSI Bear Momentum signals do not show potential because the Success Rates were low and the Profit/Loss Ratios were barely above 1.

RSI Bear Momentum Test	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day RSI Bear Momentum	14071	39%	+9.94%	-11.13%	1.12
50-day RSI Bear Momentum	11548	35%	+13.90%	-14.86%	1.07
75-day RSI Bear Momentum	9593	35%	+16.20%	-17.99%	1.11
100-day RSI Bear Momentum	8030	33%	+18.64%	-20.00%	1.07
125-day RSI Bear Momentum	6759	31%	+21.27%	-21.78%	1.02

Table 4: Performance Metrics for RSI Bear Momentum Test

A Combination with Predictive Value

Overall, the bullish indicators show potential, but the bearish indicators do not. The Bear Range signals suffer from low Success Rates (below 35%) and the relatively low Profit/Loss Ratios. The Bear Momentum signals have the lowest Profit/Loss Ratios and relatively low Success Rates. The Bull Range signals have high Profit/Loss Ratios (above 2.30), but low Success Rates (below 40%). In contrast, the Bull Momentum signals show high Success Rates (above 50%), but relatively low Profit/Loss Ratios.

The results suggest that RSI Bull Range and RSI Bull Momentum are complementary indicators that should be combined. The RSI Bull Range indicator places a momentum floor at 40 to contain price declines. The RSI Bull Momentum indicator, in contrast, focuses on price advances by ensuring they are strong enough to push RSI above 70 on a regular basis. The RSI Bull Range indicator takes care of trend consistency, while the RSI Bull Momentum indicator ensures strong upward momentum. It is a powerful combination.

Chart 16 shows Harris Corp (HRS) with the combined indicator and RSI with horizontal lines at 40 and 70. The RSI Bull Range-Momentum indicator moves to 1 and turns gray when either the RSI Bull Range or Bull Momentum indicators trigger a signal. The indicator moves to 2 and turns green when both indicators have triggered signals. Thus, a move to 2 means the lowest low value of RSI did not dip below 40 over the last 75 days AND the highest high value of RSI moved above 70 over the last 75 days.

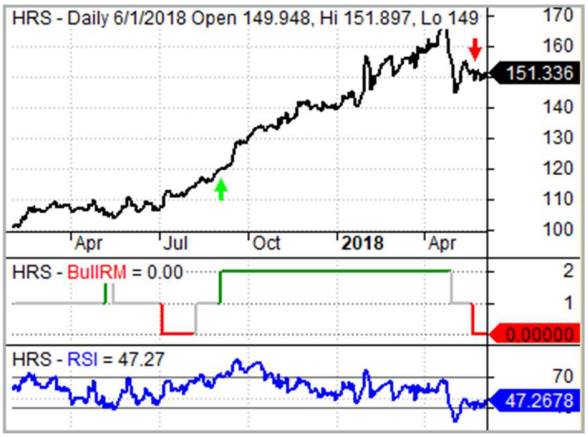

Chart 16: HRS - RSI Bull Range-Momentum

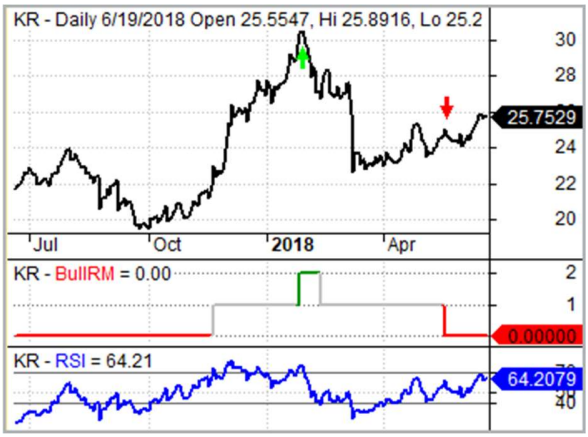

Chart 17: KR - RSI Bull Range-Momentum

Source: AmiBroker and PremiumData

A move to 2 generates an entry signal that remains in effect until BOTH indicators reverse their signals. This means the lowest low value of RSI dipped below 40 and the highest high value of RSI did not exceed 70 over the 75-day lookback period (indicator turns red). The trend lost consistency because RSI broke the bull range AND stopped showing strong upside momentum because RSI failed to exceed 70. Chart 16 shows Harris Corp (HRS) advancing +26.8% for a successful bullish signal (profit). Chart 17 shows Kroger (KR) declining 16.7% for a failed bullish signal (loss).

Table 5 shows the results when applying RSI Bull Range-Momentum signals to all stocks in the S&P 500 over the test period. The Success Rates ranged from 45% to 58% and exceeded 50% when the lookback period was 75 days or longer. The Profit/Loss Ratios ranged from 1.95 to 2.4 and exceeded 2 when the lookback period was 75 days or longer. Overall, the results steadily improved as

the lookback period extended. This suggests that longer lookback periods are better suited for trend-momentum strategies.

RSI Bull Range-Momentum	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day	14712	45%	+13.31%	-6.82%	1.95
50-day	10653	49%	+15.19%	-8.24%	1.84
75-day	6271	54%	+19.57%	-9.46%	2.07
100-day	3595	55%	+24.71%	-11.69%	2.11
125-day	2031	58%	+32.01%	-13.34%	2.40

Table 5: Performance Metrics for RSI Bull Range-Momentum Test

Chart 18 shows a scatter plot with the results for each of the five tests. The Success Rates are shown on the x-axis and the Profit/Loss Ratios are on the y-axis. A horizontal line at 50% delineates the Success Rate, while a vertical line at 2 delineates the Profit/Loss Ratio. These lines create four performance quadrants that we can use to compare the test results.

The Bear Momentum results (BearM - red circle) appear in the lower-left quadrant because they have the lowest Profit/Loss Ratios and relatively low Success Rates. The Bear Range results (BearR - triangle) are also mostly in the lower left quadrant because of the low Success Rates (below 30%) and the relatively low Profit/Loss Ratios. Only the 25-day Bear Range signal showed a Profit/Loss Ratio above 2.

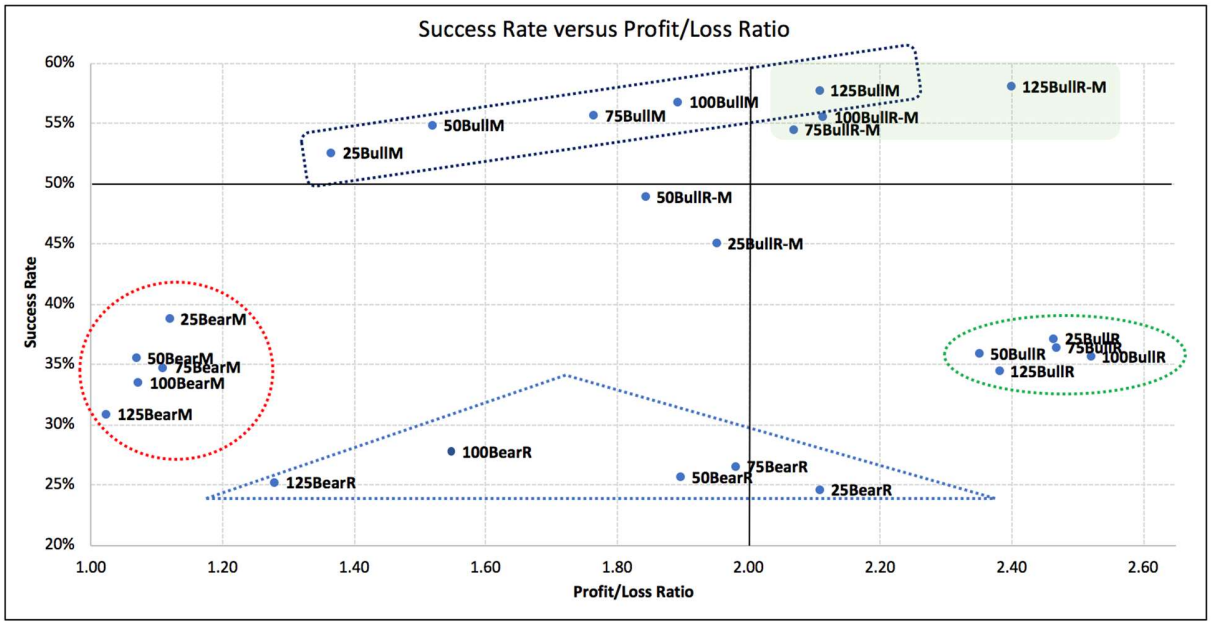

Chart 18: Scatter Plot for Success Rates and Profit/Loss Ratios

The Bull Range results (BullR - green oval) are in the lower-right quadrant because they have high Profit/Loss Ratios (above 2.30) and low Success Rates (below 40%). The Bull Momentum results (BullM - rectangle) are mostly in the upper-left quadrant because of the high Success Rates (above 50%) and low Profit/Loss Ratios. The 125-day Bull Momentum signal is the only result with a Profit/Loss Ratio above 2.

The RSI Bull Range-Momentum results with lookback periods of 75 days or more show the most predictive value. The 25-day and 50-day Bull Range-Momentum signals ended up in the left quadrant with Success Rates just below 50% and Profit/Loss Ratios just below 2. Performance greatly improved as the

lookback period increased from 75 to 125 days. These results landed in the upper right quadrant with high Success Rates and high Profit/Loss Ratios (green shading). Clearly, the longer RSI Bull Range-Momentum signals show potential for inclusion in a trend-momentum strategy. The 125-day RSI Bull Momentum results also landed in the upper right quadrant and show potential.

Conclusions

Even though RSI is widely used to signal price reversals, a the formula and signal testing reveal that this momentum oscillator is well-suited for trend-following and momentum strategies, which research shows can be profitable and outperform.[15] [16] The RSI Bull Range indicator ensures trend consistency by requiring RSI to hold above 40 on pullbacks. The RSI Bull Momentum indicator captures upside leadership by requiring RSI to regularly exceed 70. Threshold testing in S&P 500 stocks over the twenty-year testing period shows that RSI exceeded 70 just 6.3% of the time. Thus, stocks with RSI values above 70 show exceptional upside momentum.

Taken together, the evidence shows that RSI range and momentum signals can foreshadow sizable advances with a good success rate, especially when the

[15] See D'Souza
[16] See Jegadeesh and Titman (2011)

lookback period extends from 75 to 125 days.[17] The RSI Bull-Momentum signals were less successful at the 25-day and 50-day lookback periods, which suggests, perhaps, that there is some short-term mean-reversion at work. The performance metrics improved dramatically as the lookback period extended from 75 days to 125 days, which covers periods from three-and-a-half to six months. These longer lookback ranges point to a trend-momentum sweet spot that investors can use to profit and outperform.

Test results show that bullish signals work better than bearish signals. This partly due to the upward bias in the S&P 500 Index over the twenty-year testing period. Despite the upward bias, the index experienced significant declines along the way. As such, investors may also consider the broad market environment when implementing a trend-momentum strategy. Bilello and Gayed found that volatility and risk increase when the S&P 500 is below its 200-day moving average[18]. They also showed that volatility declines and conditions favor outperformance when the S&P 500 is above its 200-day moving average. Thus, adding a market timing mechanism to this RSI strategy could, in fact, reduce drawdowns during broad market declines and enhance returns during broad market advances.

[17] See Appendix 3 - Results Table
[18] See Bilello and Gayed

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End Notes

Thanks to Cesar Alvarez of AlvarezQuantTrading.com for consulting on the AmiBroker code and results. https://alvarezquanttrading.com

Performance metrics were generated with signal tests using AmiBroker 6.2 Professional Edition. https://www.amibroker.com

Data used in AmiBroker was provided by Premium Data. https://premiumdata.com

Appendix 1: Subset sample RSI Calculation for Biogen (BIIB)

	Date	BIIB Close	Change	Gain	Loss	Avg Gain*	Avg Loss*	RS	14-day RSI
1	1/16/18	338.85	+2.90	2.90		2.37	1.64	1.45	59.18
2	1/17/18	344.87	+6.02	6.02		2.63	1.52	1.73	63.41
3	1/18/18	344.44	-0.43		0.43	2.44	1.44	1.70	62.91
4	1/19/18	342.41	-2.03		2.03	2.27	1.48	1.53	60.48
5	1/22/18	347.64	+5.23	5.23		2.48	1.38	1.80	64.30
6	1/23/18	346.75	-0.89		0.89	2.30	1.34	1.72	63.18
7	1/24/18	346.50	-0.25		0.25	2.14	1.26	1.69	62.85
8	1/25/18	353.74	+7.24	7.24		2.50	1.17	2.13	68.08
9	1/26/18	367.91	+14.17	14.17		3.34	1.09	3.06	75.38
10	1/29/18	358.48	-9.43		9.43	3.10	1.69	1.84	64.76
11	1/30/18	352.59	-5.89		5.89	2.88	1.99	1.45	59.16
12	1/31/18	347.81	-4.78		4.78	2.67	2.19	1.22	55.00
13	2/1/18	346.00	-1.81		1.81	2.48	2.16	1.15	53.47
14	2/2/18	343.83	-2.17		2.17	2.30	2.16	1.07	51.61
15	2/5/18	328.31	-15.52		15.52	2.14	3.11	0.69	40.72
16	2/6/18	332.86	+4.55	4.55		2.31	2.89	0.80	44.42
17	2/7/18	326.89	-5.97		5.97	2.15	3.11	0.69	40.82
18	2/8/18	311.79	-15.10		15.10	1.99	3.97	0.50	33.43
19	2/9/18	316.78	+4.99	4.99		2.21	3.68	0.60	37.46
20	2/12/18	316.63	-0.15		0.15	2.05	3.43	0.60	37.39
21	2/13/18	316.99	+0.36	0.36		1.93	3.19	0.61	37.70
22	2/14/18	296.08	-20.91		20.91	1.79	4.45	0.40	28.68
23	2/15/18	299.38	+3.30	3.30		1.90	4.13	0.46	31.47
24	2/16/18	291.87	-7.51		7.51	1.76	4.38	0.40	28.72
25	2/20/18	287.45	-4.42		4.42	1.64	4.38	0.37	27.21
26	2/21/18	286.10	-1.35		1.35	1.52	4.16	0.37	26.75
27	2/22/18	284.81	-1.29		1.29	1.41	3.96	0.36	26.29
28	2/23/18	292.78	+7.97	7.97		1.88	3.67	0.51	33.85
29	2/26/18	290.01	-2.77		2.77	1.75	3.61	0.48	32.60
30	2/27/18	290.10	+0.09	0.09		1.63	3.35	0.49	32.68
31	2/28/18	288.99	-1.11		1.11	1.51	3.19	0.47	32.13
32	3/1/18	282.35	-6.64		6.64	1.40	3.44	0.41	28.98
33	3/2/18	286.96	+4.61	4.61		1.63	3.19	0.51	33.83
34	3/5/18	286.95	-0.01		0.01	1.52	2.97	0.51	33.82

*First 13 values use data prior to 1/16/18. Avg = Wilder EMA

Appendix 2: Sample Calculation of Weighted Average (subset)

Ticker	Total Days RSI>50	Total Trading Days	
AAL	409	826	
A	2602	4547	
AAMRQ-201312*	527	1180	
AAP	372	751	
AABA	2392	4409	
AAPL	3179	5032	
ABBV	907	1384	
ABC	2589	4234	
ABI-200811	1451	2616	
ABKFQ-201304	993	1883	
ABMD	21	22	
ABS-200606	964	1991	
ABT	3014	5032	
ABX	455	1017	
ACAS-201701	117	417	
ACKH-200712	165	602	
ACN	1178	1759	
ACS-201002	806	1472	
ACV-201105	1273	2109	
ADBE	3120	5032	
ADCT-201012	952	1990	
ADM	2786	5032	
ADI	2674	4710	
ADP	3053	5032	
ADS	572	1138	
ADSK	2903	5032	
ADT-201604	464	899	
AEP	2975	5032	
AEE	3041	5032	
AES	2702	4968	
AET	3169	5032	
AFL	2861	4804	
	54,686	**95,016**	**57.55%**
	Total Days RSI>50	Total Trading Days	Total Days RSI>50/ Total Trading Days
*Symbols removed from S&P 500 show year and month of removal.			

Appendix 3: Performance Metrics Overview

RSI Bull Range Summary	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day Bull Range	26002	37%	13.58%	-5.51%	2.46
50-day Bull Range	14606	36%	12.65%	-5.38%	2.35
75-day Bull Range	7939	36%	11.87%	-4.81%	2.47
100-day Bull Range	4353	36%	11.72%	-4.65%	2.52
125-day Bull Range	2375	34%	11.36%	-4.77%	2.38

RSI Bear Range Summary	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day Bear Range	23881	25%	5.87%	-12.38%	2.11
50-day Bear Range	10590	26%	7.30%	-13.85%	1.90
75-day Bear Range	4715	26%	7.90%	-15.65%	1.98
100-day Bear Range	2142	28%	10.04%	-15.54%	1.55
125-day Bear Range	1034	25%	11.46%	-14.67%	1.28

RSI Bull Momentum Summary	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day Bull Momentum	18761	52%	9.10%	-6.66%	1.37
50-day Bull Momentum	13870	55%	15.14%	-9.96%	1.52
75-day Bull Momentum	10508	56%	22.51%	-12.75%	1.77
100-day Bull Momentum	8129	57%	29.92%	-15.80%	1.89
125-day Bull Momentum	6293	58%	39.97%	-18.96%	2.11

RS Bear Momentum Summary	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day Bear Momentum	14071	39%	9.94%	-11.13%	1.12
50-day Bear Momentum	11548	35%	13.90%	-14.86%	1.07
75-day Bear Momentum	9593	35%	16.20%	-17.99%	1.11
100-day Bear Momentum	8030	33%	18.64%	-20.00%	1.07
125-day Bear Momentum	6759	31%	21.27%	-21.78%	1.02

RSI Bull Range-Momentum Summary	Total Signals	Success Rate	Average Advance	Average Decline	Profit/Loss Ratio
25-day Bull Range-Momentum	14712	45%	13.31%	-6.82%	1.95
50-day Bull Range-Momentum	10653	49%	15.19%	-8.24%	1.84
75-day Bull Range-Momentum	6271	54%	19.57%	-9.46%	2.07
100-day Bull Range-Momentum	3595	55%	24.71%	-11.69%	2.11
125-day Bull Range-Momentum	2031	58%	32.01%	-13.34%	2.40