Bertram Solutions LLC
1525 4th Street
Kirkland, WA 98033
(425) 616-2755
http://www.bertram.solutions
info@bertram.solutions

Travis Cook

RIDGELINE ASSET MANAGEMENT
5 Cowboys Way, Suite 300
Frisco, TX 75034

tcook@ridgelineam.com

Kirkland, April 1st, 2022

Hello Travis,

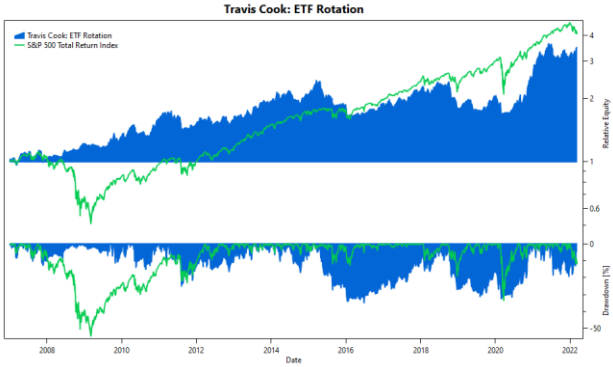
Please find some thoughts and observations regarding momentum strategies.

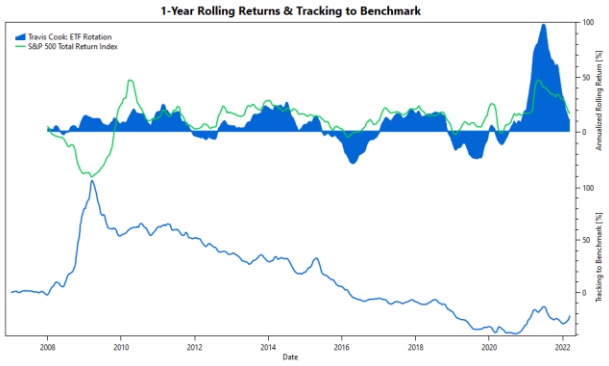
Thank you,
Best regards.

Felix Bertram

Recap

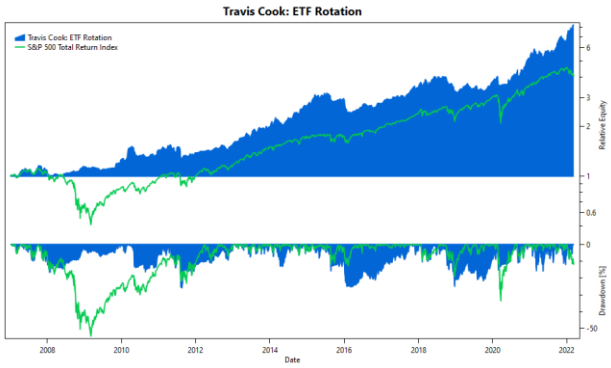
The performance of the original ETF Rotation strategy was unsatisfactory.

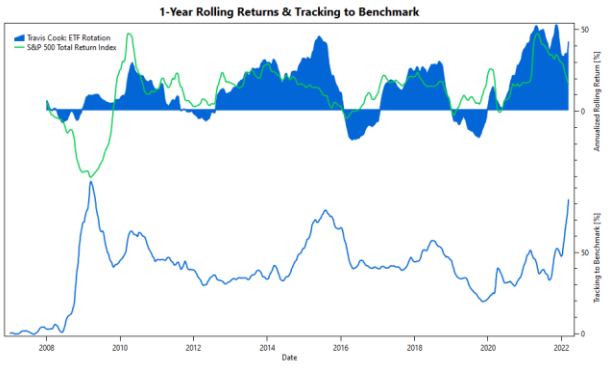




Metric		Travis Cook: ETF Rotation	S&P 500 Total Return Index
Simulation Start	01/03/2007	$1,000.00	$1,000.00
Simulation End	03/10/2022	$3,497.94	$4,098.55
Simulation Period	15.2 years		
Compound Annual Growth Rate		8.60%	9.74%
Stdev of Returns (Monthly, Annualized)		17.38%	18.24%
Maximum Drawdown (Daily)		35.19%	55.25%
Maximum Flat Days		2087.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualizec		0.42	0.47
Beta (To Benchmark, Monthly)		0.38	- benchmark -
Ulcer Index		15.09%	13.87%
Ulcer Performance Index (Martin Ratio)		0.57	0.70

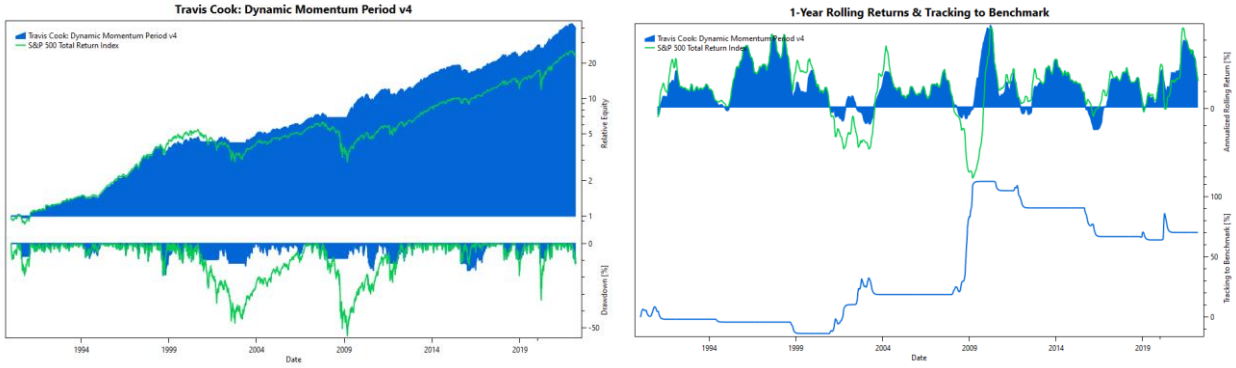
We identified the strategy's internal momentum indicator as one of the causes for poor performance. With some modifications to this indicator, we were able to improve the performance.





Metric		Travis Cook: ETF Rotation	S&P 500 Total Return Index
Simulation Start	01/03/2007	$1,000.00	$1,000.00
Simulation End	03/10/2022	$8,289.97	$4,098.55
Simulation Period	15.2 years		
Compound Annual Growth Rate		14.95%	9.74%
Stdev of Returns (Monthly, Annualized)		16.00%	18.24%
Maximum Drawdown (Daily)		26.46%	55.25%
Maximum Flat Days		816.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualizec		0.82	0.47
Beta (To Benchmark, Monthly)		0.34	- benchmark -
Ulcer Index		9.81%	13.87%
Ulcer Performance Index (Martin Ratio)		1.52	0.70

While this is a substantial improvement, there is still little incentive to trade this strategy. We researched multiple methods to measure momentum and came up with a variant that dynamically adjusts the momentum period. We tested this strategy with a simple risk-on/ risk-off strategy holding the S&P 500 or cash.



We like the low drawdowns and the fast reaction time of this momentum signal. In the next step, we wanted to integrate this momentum signal with an asset rotation strategy.

New Asset Rotation

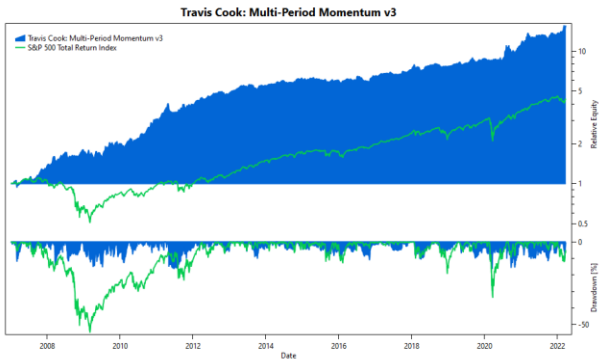
We implemented a new asset rotation strategy with the following simple rules:

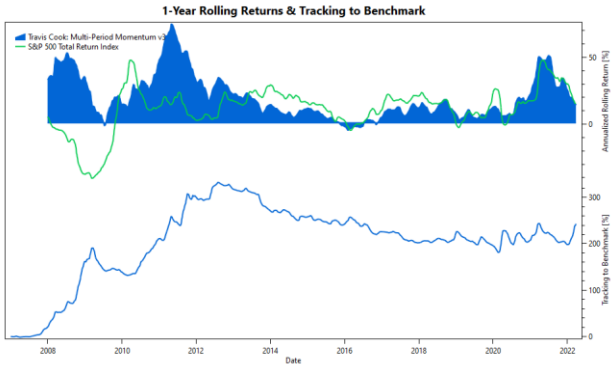
- Trade a universe of various stock sectors, stock market factor ETFs, bond and treasury ETFs, and precious metals and commodities.
- For each asset, measure the momentum based on an indicator with dynamically adjusted lookback period
- Disqualify all assets with negative momentum
- Hold the two assets with the highest momentum

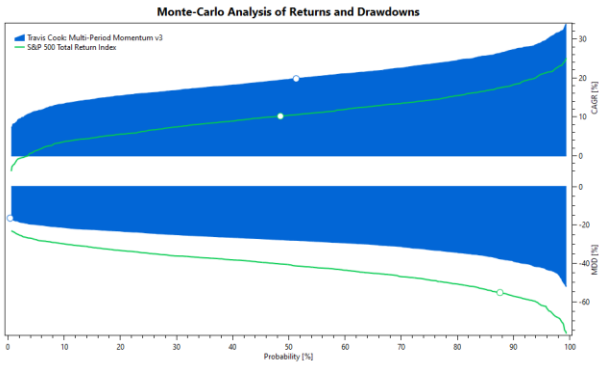
We ran experiments with different implementations for these momentum signal. Even with our dynamically adjusted lookback period, the signal's lag seemed to be too high. After at least 50 experiments with code variations, we settled on the following method with an adjustable DEMA filter:

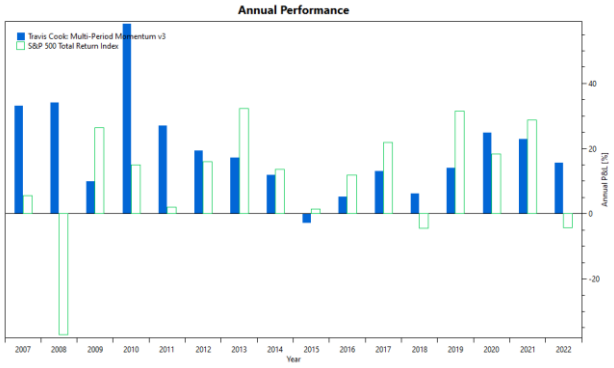
```
var assetFlt = instrument.TypicalPrice().KAMA();
var rng = assetFlt.Range(RNG_PER).Highest(RNG_PK_PER)[0] / assetFlt[0];
var relRng = Math.Min(1.0, Math.Max(0.0, (rng - RNG_MIN / 100.0)
    / (RNG_MAX / 100.0 - RNG_MIN / 100.0)));
var period = FLT_MIN
    + Math.Pow(1.0 - relRng, RNG_POW / 100.0) * (FLT_MAX - FLT_MIN);
var sc = 2.0 / (1.0 + Math.Max(21, period));
var r = assetFlt.LogReturn()[0];
var ema = IndicatorsBasic.BufferedLambda(
    prev => sc * r + prev * (1.0 - sc),
    0.0,
    cacheId)[0];
var ema_ema = IndicatorsBasic.BufferedLambda(
    prev => sc * ema + prev * (1.0 - sc),
    0.0,
    cacheId.AddParameters(2))[0];
return 2.0 * ema - ema_ema;
```

We used brute-force optimization to tweak the parameters, trying several 100,000 iterations for best risk-adjusted properties.



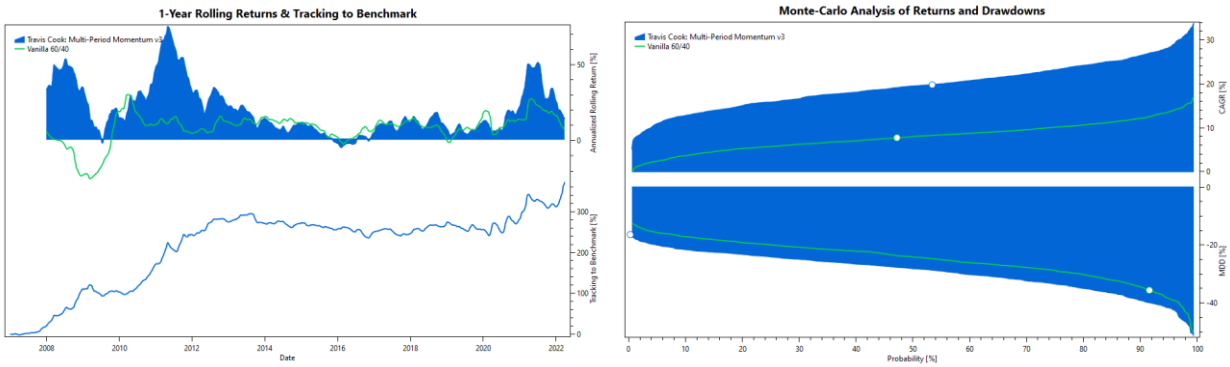




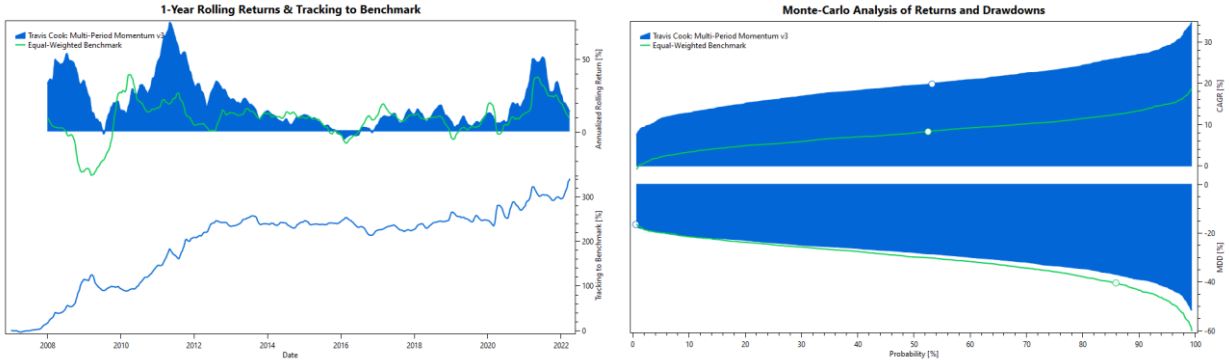


Metric		Travis Cook: Multi-Period Momentum v3	S&P 500 Total Return Index
Simulation Start	01/02/2007	$1,000.00	$1,000.00
Simulation End	03/25/2022	$15,621.95	$4,369.55
Simulation Period	15.2 years		
Compound Annual Growth Rate		19.79%	10.17%
Stdev of Returns (Monthly, Annualized)		15.10%	18.32%
Maximum Drawdown (Daily)		16.39%	55.25%
Maximum Flat Days		434.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualizec		1.12	0.46
Beta (To Benchmark, Monthly)		0.19	- benchmark -
Ulcer Index		5.13%	13.84%
Ulcer Performance Index (Martin Ratio)		3.85	0.73

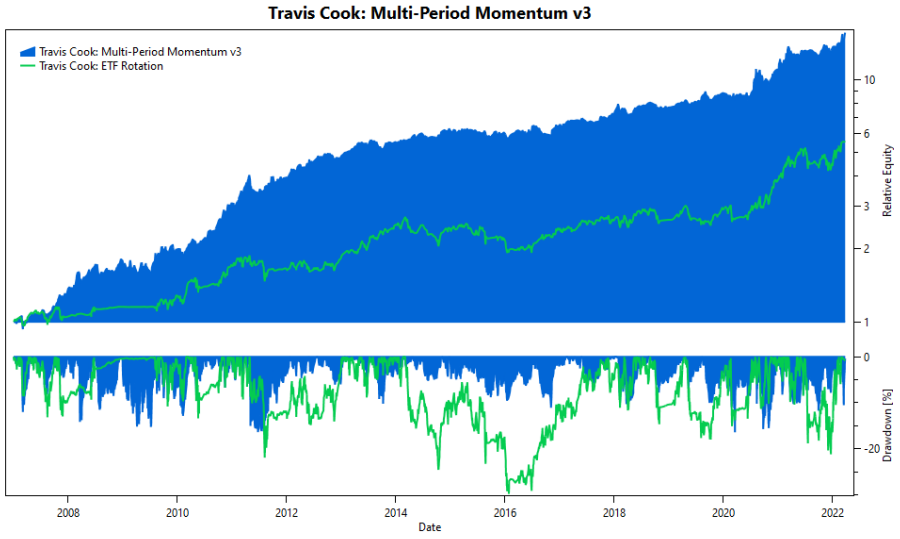
The strategy now handily outperforms the S&P 500 (in the long term) while at the same time substantially reducing risk. We notice fast reactions to market sell-offs, including 2018, 2020, and 2022. Also, we notice that the strategy had positive returns in very year but 2015. With these properties, periods of relative underperformance, e.g. between 2012 and 2018, are probably tolerable, as the strategy adds value nonetheless.

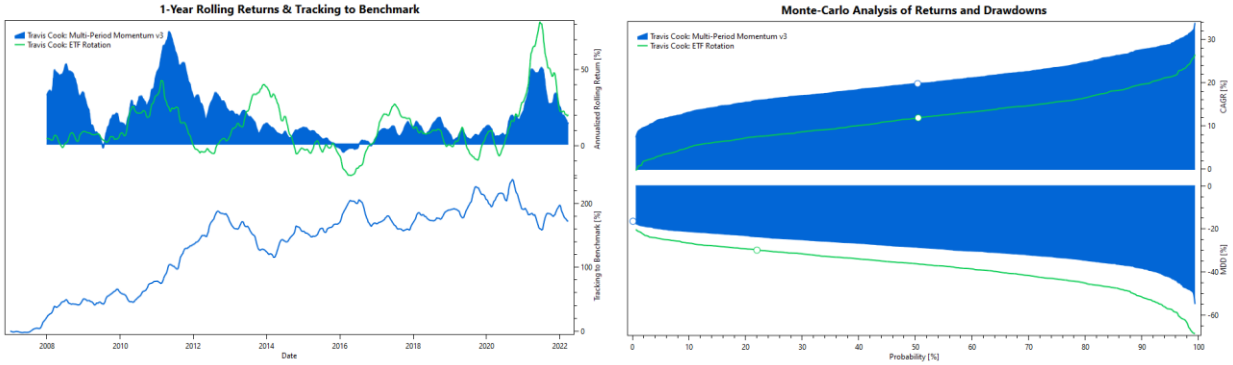


Compared to a passive 60/40 portfolio, we see that the strategy does not underperforme its benchmark. Its risk profile is slightly taller than the buy-and-hold portfolio, but given the long-term outperformance, this should be acceptable.



Compared to the equal-weighted benchmark we notice a slight reduction in risk, and the same substantial outperformance.



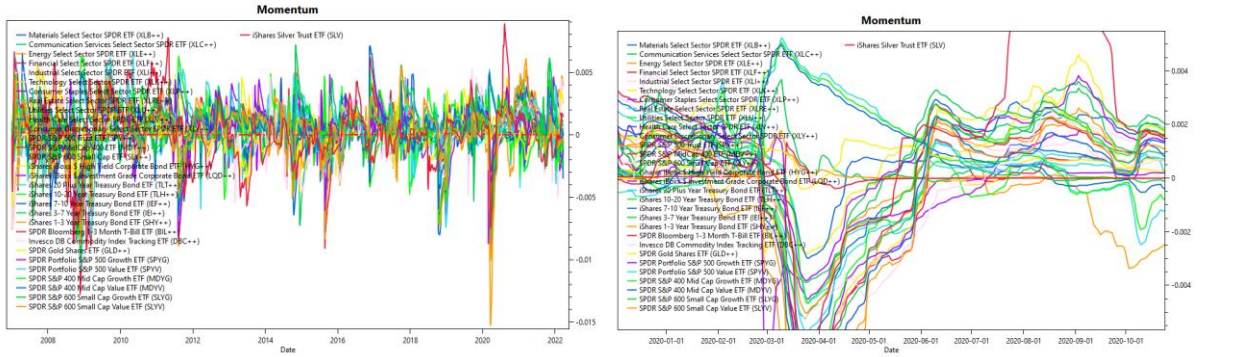


Compared to the original strategy (with our improvements), we see strong outperformance and a meaningful reduction in risk.

It is important to recognize that this strategy is new and unique. From a 10,000ft perspective, it resembles the most-naïve approach to investing. However, this is only made possible through the work done on improved momentum indicators. We like to summarize the strategy as follows:

- Simple structure, based on a single concept (momentum)
- No need for additional market-regime filters
- Ability to freely mix asset classes
- Streamlined universe

As we spent most of the previous report looking at momentum filters, it is worth looking at the new strategy's internal signals.



We notice that the momentum signals generally carry low noise, while at the same time being able to react swiftly to market changes. However, we see further improvement potential. It seems that an improved control mechanism could do a better job to keep the momentum steady, while at the same time allowing for fast transitions.

Next Steps

We suggest the following next steps:

- Port the strategy to AmiBroker. This seems to be a top priority, because of the strategy's favorable characteristics over the current ETF Rotation strategy.
- Continue research. We would like to reach our goal of continuously beating the S&P 500. To do so, we see two main avenues:
    - Further work on momentum indicators. In particular, we might want to experiment with other filter architectures. Ehler's book Rocket Science for Traders might be a good starting point for additional ideas.
    - Add dynamic position sizing. We see the following possibilities:
        - Position sizing inverse to volatility, see Stocks on the Move
        - Position sizing through mean-variance optimization, see https://logical-invest.com/universal-investment-strategy/