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Kirkland, September 12th, 2022

Hello Travis,

Please find our research regarding modifications to the momentum strategy to trade sector and factor.

Thank you,
Best regards.

Felix Bertram

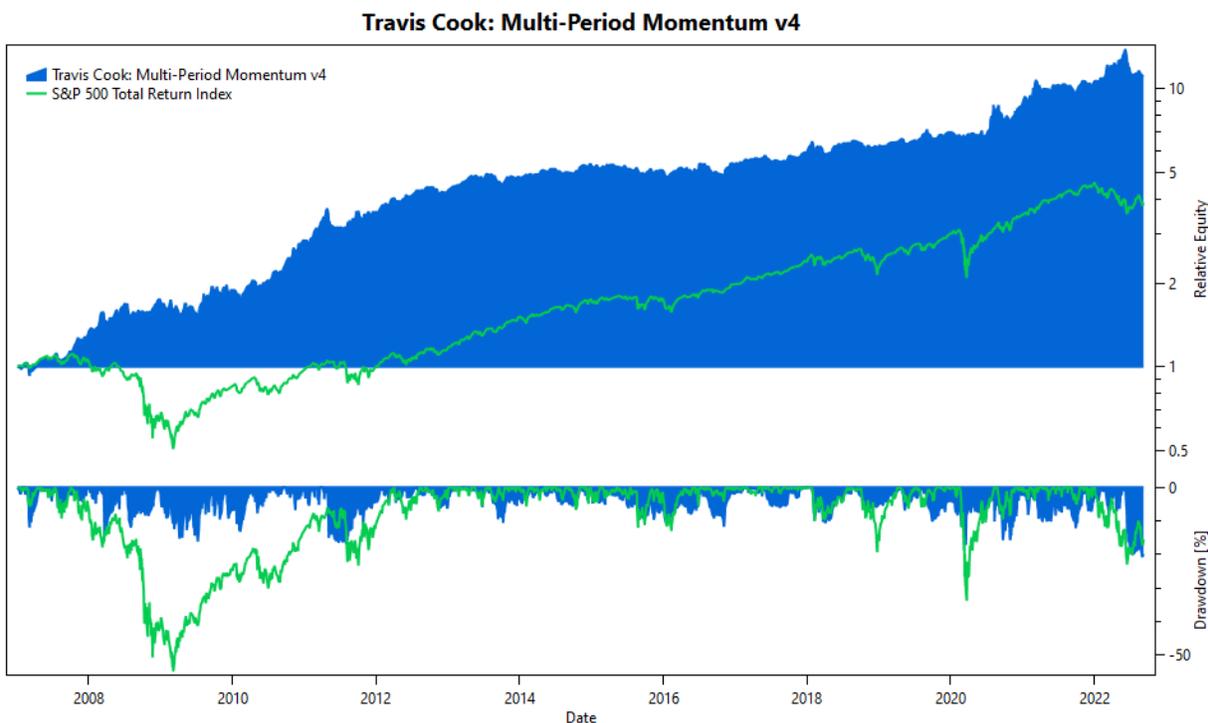
Recap

The original version of the multi-momentum strategy trades a broad universe covering various stock markets, bond markets, commodities and precious metals. In particular, the strategy trades the following ETFs:

- Sectors: XLB, XLC, XLE, XLF, XLI, XLK, XLP, XLRE, XLU, XLV, XLY
- Factors: SPY, SPYG, SPYV, MDY, MDYG, MDYV, SLY, SLYG, SLYV,
- Bonds: HYG, LQD, TLT, TLH, IEF, IEI, SHY, BIL,
- Commodities & metals: DBC, GLD, SLV,

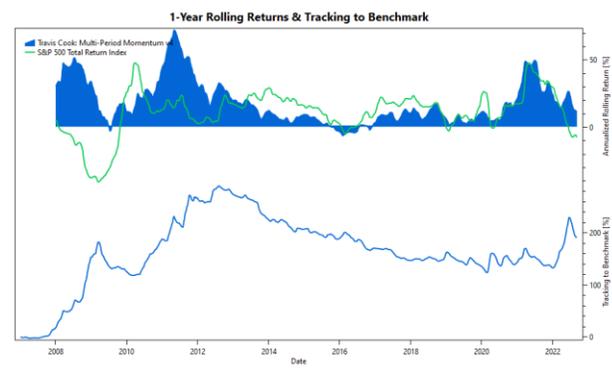
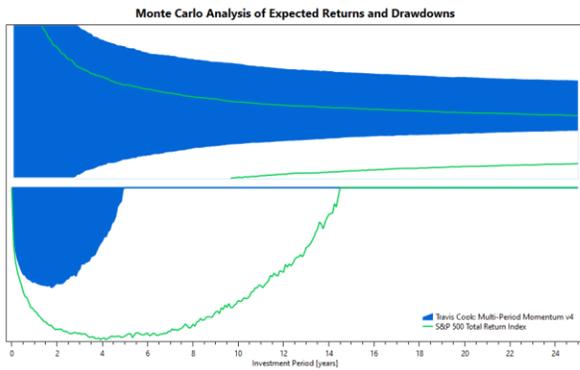
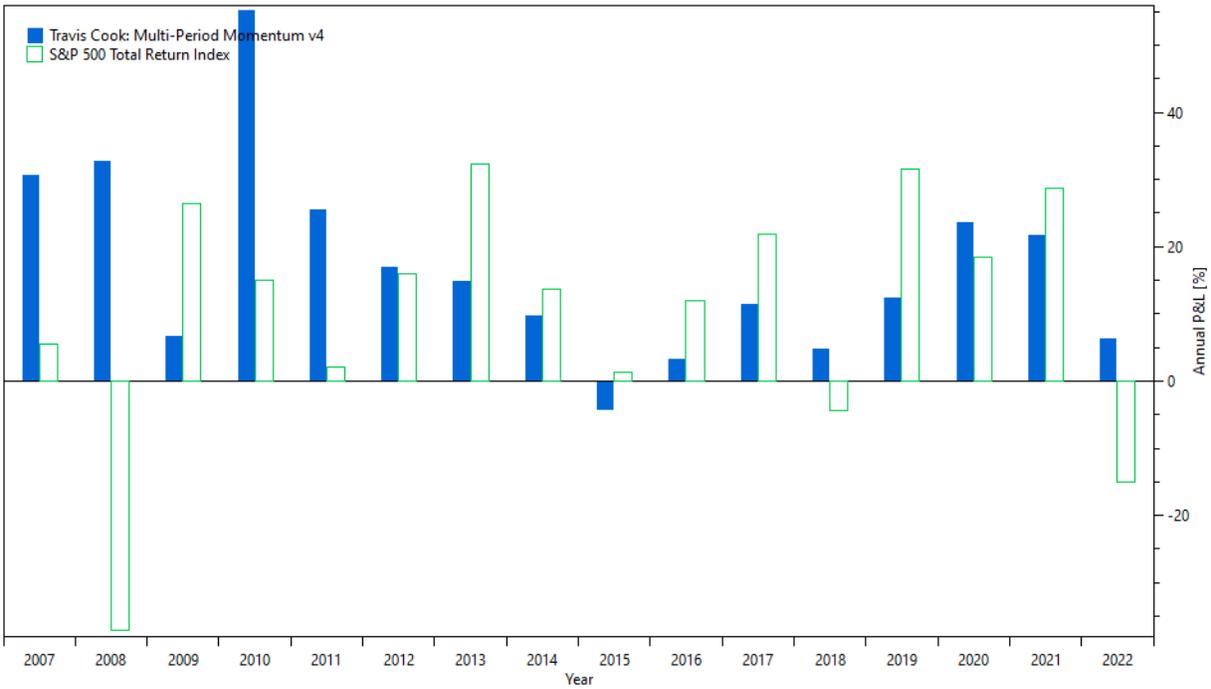
The driving force behind the development of the multi-period momentum indicator was to make such a diverse asset mix possible by not relying on the elimination of common-mode noise. And while the indicator succeeded at that, there are good reasons to break up the trading universe, create individual strategies focus similar assets, and assemble these strategies to a meta-portfolio later.

Before we get to that, we want to document the performance of the diverse universe as a baseline:



Metric		Travis Cook: Multi-Period Momentum v4	S&P 500 Total Return Index
Simulation Start	01/02/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$11,209.54	\$3,882.03
Simulation Period	15.7 years		
Compound Annual Growth Rate		16.66%	9.03%
Stdev of Returns (Monthly, Annualized)		15.33%	15.83%
Maximum Drawdown (Daily)		20.79%	55.25%
Maximum Flat Days		711.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.95	0.49
Beta (To Benchmark, Monthly)		0.31	- benchmark -
Ulcer Index		5.83%	13.87%
Ulcer Performance Index (Martin Ratio)		2.86	0.65

Annual Performance



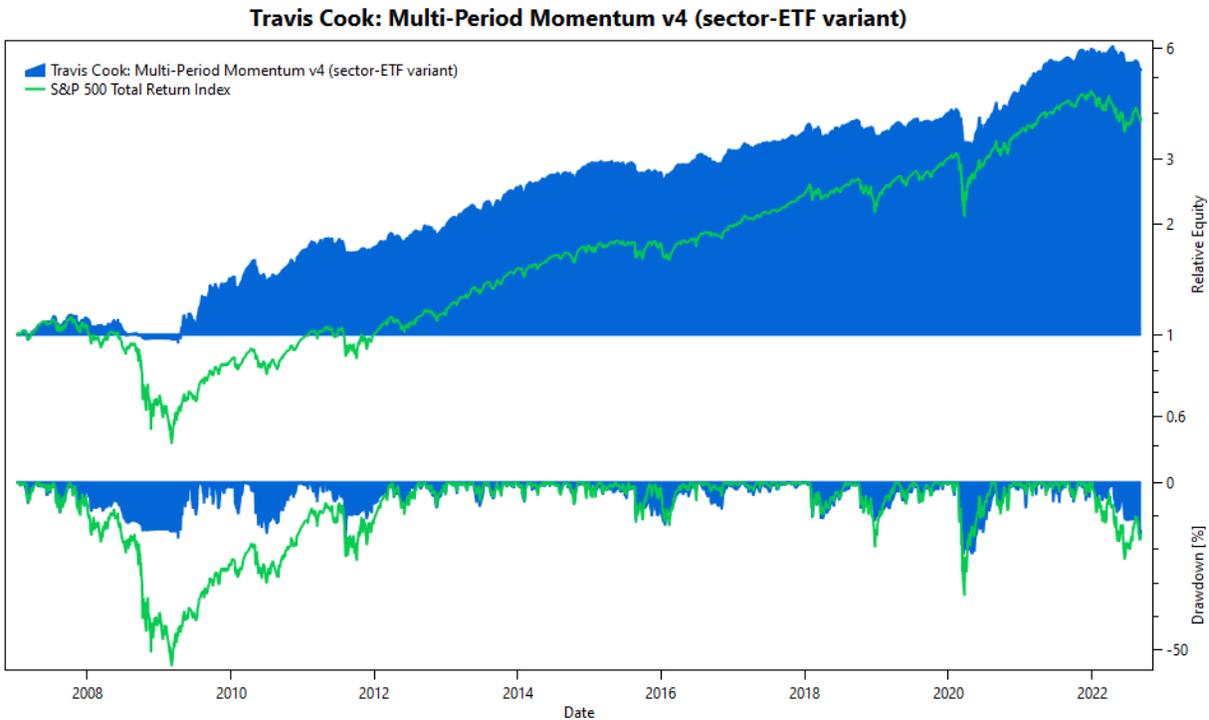
The charts show how the strategy slightly underperforms the S&P 500, but at the same time significantly reduces volatility and drawdowns.

Sectors

The first subset of the universe we are breaking apart are sector ETFs. Because we also need risk-off assets, we include treasuries with short duration and TIPS:

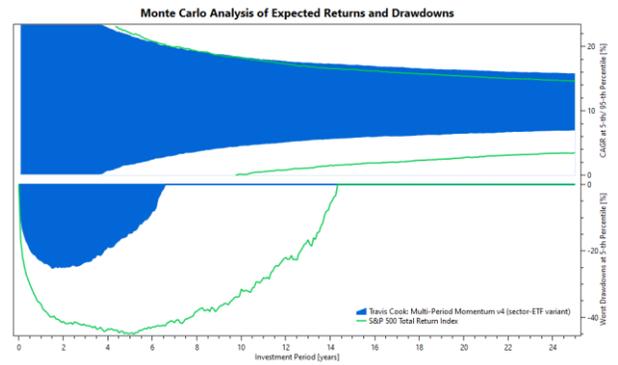
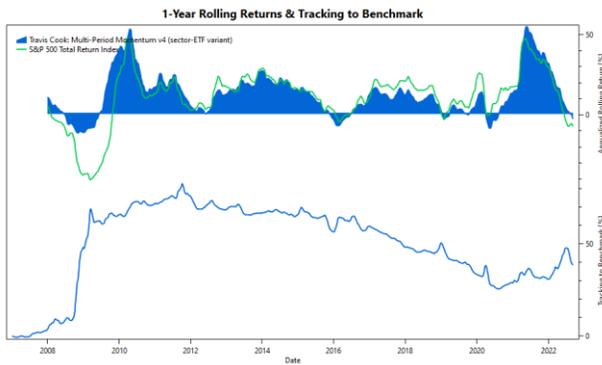
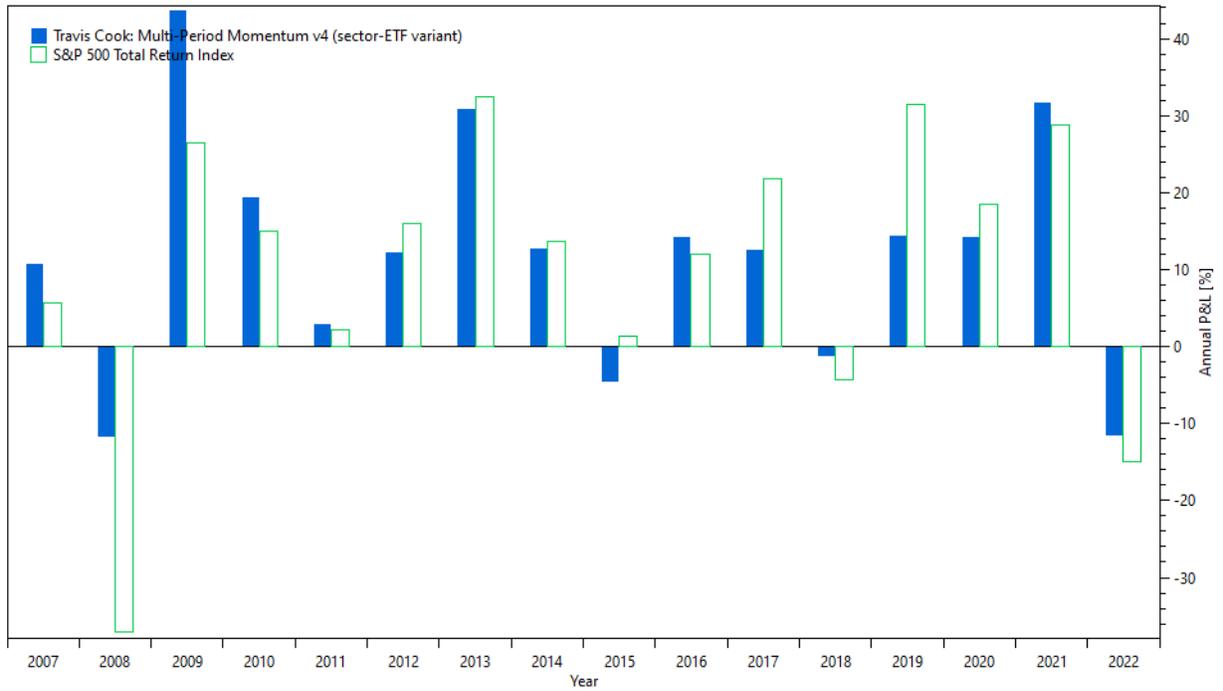
- Sectors: XLB, XLC, XLE, XLF, XLI, XLK, XLP, XLRE, XLU, XLV, XLY
- Risk-off assets: SHY, BIL, TIP

We optimized the strategy's parameters for this universe.



Metric		Travis Cook: Multi-Period Momentum v4 (se	S&P 500 Total Return Index
Simulation Start	01/03/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$5,287.72	\$3,885.96
Simulation Period	15.7 years		
Compound Annual Growth Rate		11.21%	9.04%
Stdev of Returns (Monthly, Annualized)		12.10%	15.83%
Maximum Drawdown (Daily)		21.44%	55.25%
Maximum Flat Days		598.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.81	0.49
Beta (To Benchmark, Monthly)		0.58	- benchmark -
Ulcer Index		5.89%	13.89%
Ulcer Performance Index (Martin Ratio)		1.90	0.65

Annual Performance



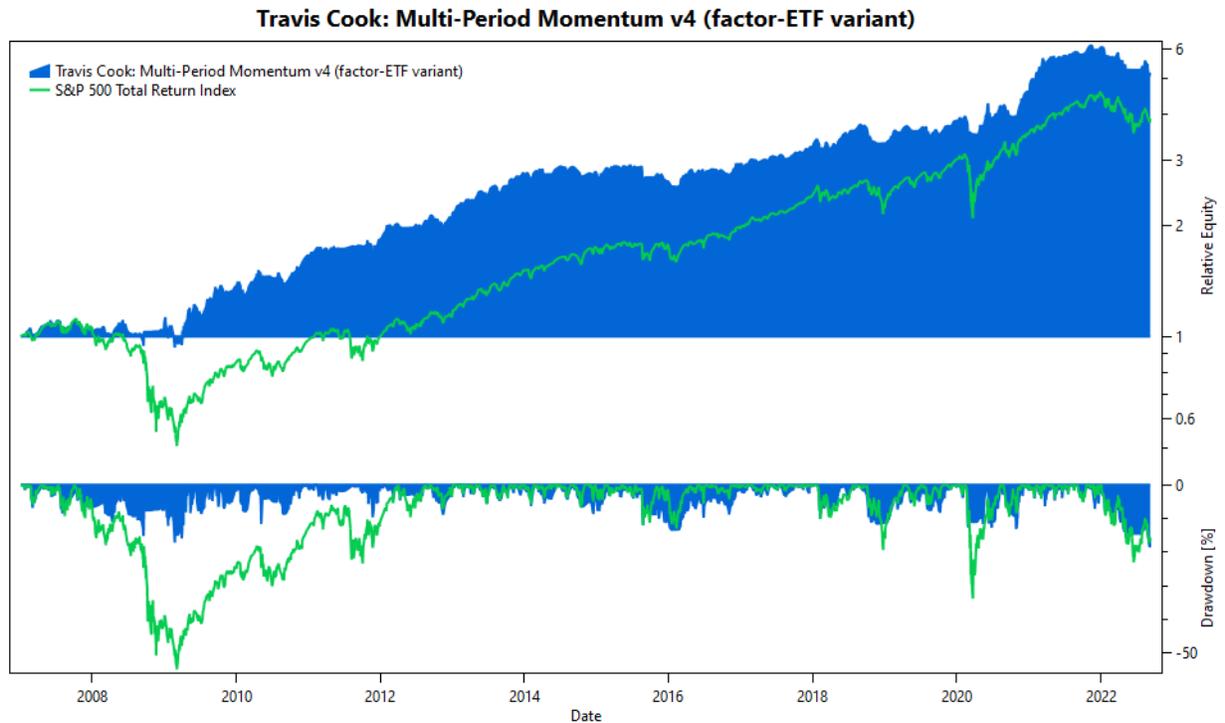
This strategy seems to perform a little better in the years between 2013 and 2018, and overall be capable of reducing volatility and drawdowns. It is worth pointing out that trading sector ETFs with momentum is finicky, and under these circumstances, the strategy is doing a great job.

Factors

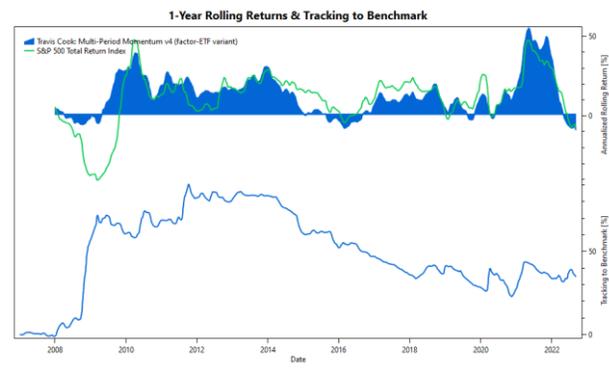
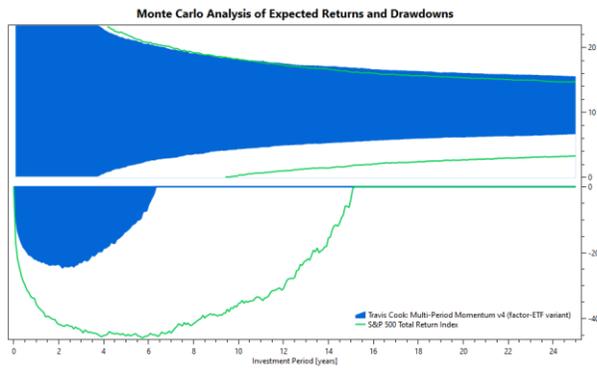
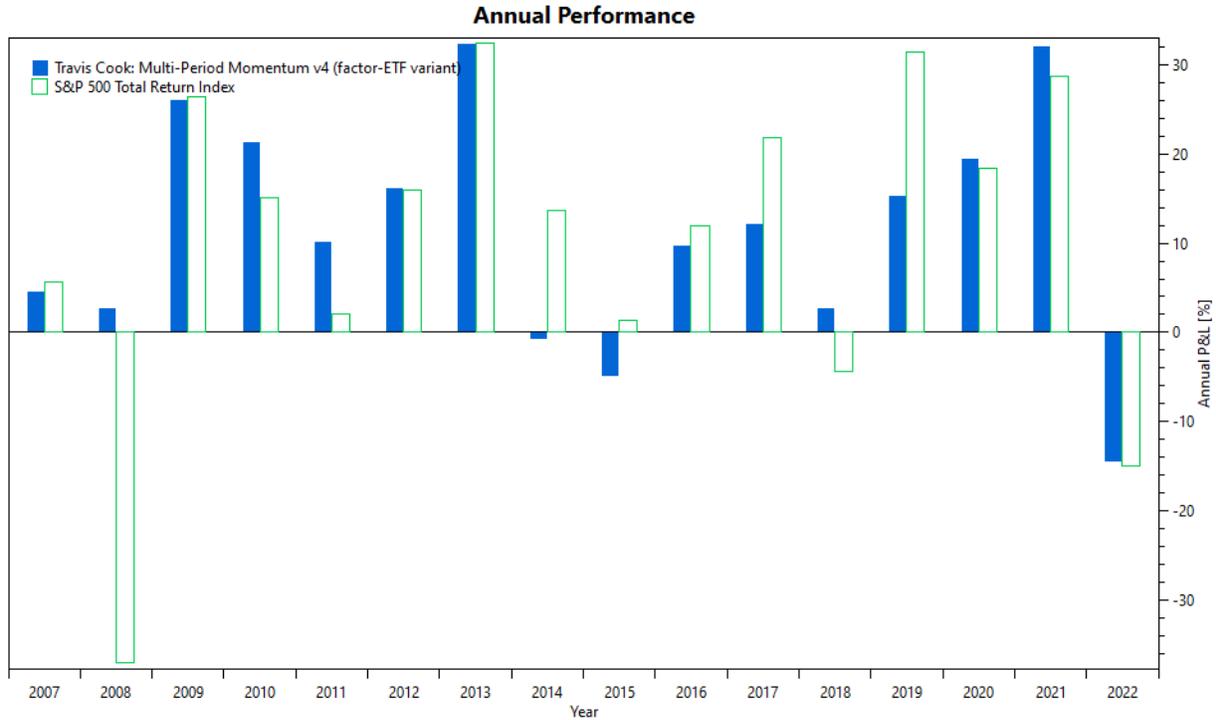
The next sub-universe we break off are factor ETFs. Again, we use treasuries with short durations as risk-off assets:

- Factors: SPY, SPYG, SPYV, MDY, MDYG, MDYV, SLY, SLYG, SLYV,
- Risk-off assets: SHY, BIL, TIP,

Again, we optimized the strategy's parameters for this universe.



Metric		Travis Cook: Multi-Period Momentum v4 (fa	S&P 500 Total Return Index
Simulation Start	01/03/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$5,165.60	\$3,885.96
Simulation Period	15.7 years		
Compound Annual Growth Rate		11.04%	9.04%
Stdev of Returns (Monthly, Annualized)		12.07%	15.83%
Maximum Drawdown (Daily)		18.52%	55.25%
Maximum Flat Days		543.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.79	0.49
Beta (To Benchmark, Monthly)		0.51	- benchmark -
Ulcer Index		5.39%	13.89%
Ulcer Performance Index (Martin Ratio)		2.05	0.65

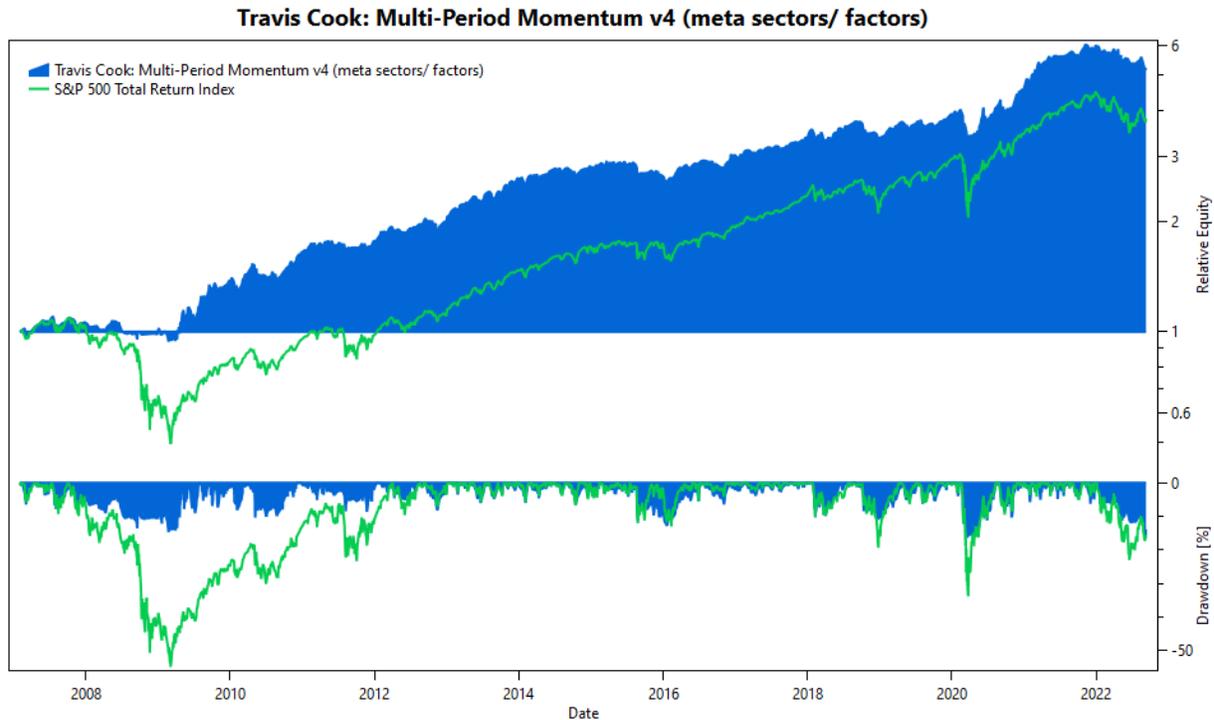


We notice similar characteristics as with the sector ETFs. The strategy did extremely well in 2008, and showed some underperformance between 2014 and 2019. However, its performance was about on-par with the S&P 500 in 2020 and beyond.

Nonetheless, the strategy adds value by reducing volatility and drawdowns. This not only worked in 2008, but also in 2018, 2020, and 2022.

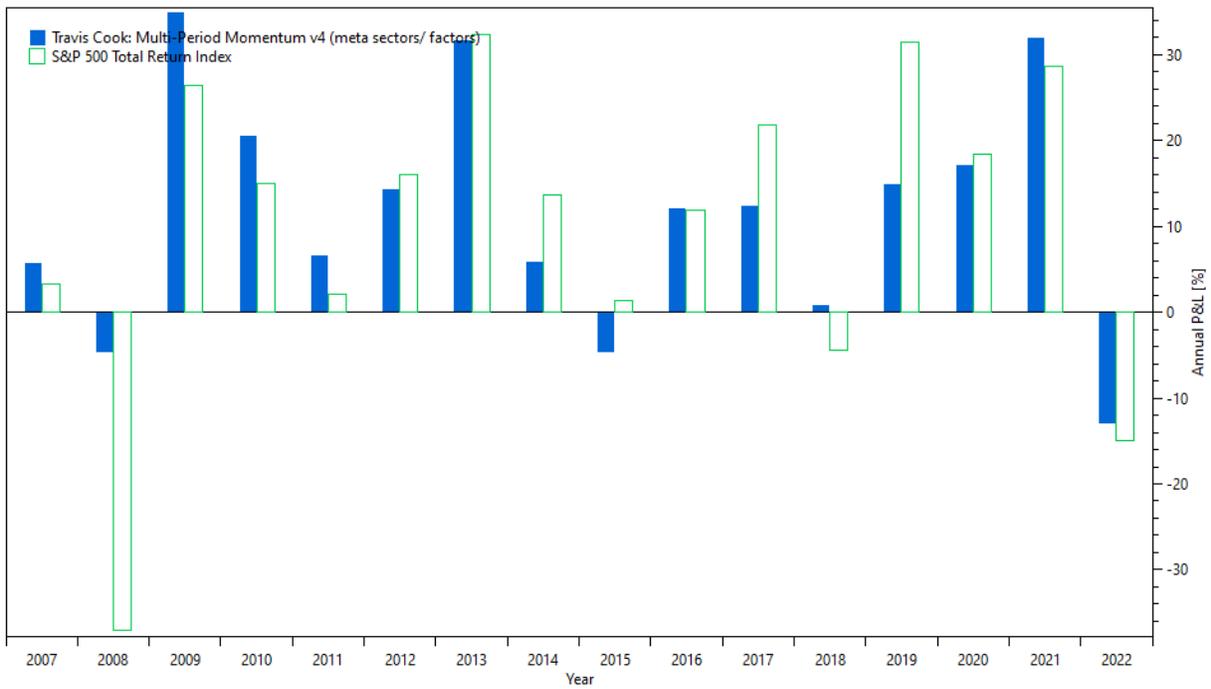
Sectors and Factors

To combine the sub-strategies trading sectors and factors, we decided not to simply expand the universe. Instead, we combined the two as a lazy portfolio by running each strategy in its separate tranche and allocating equal capital to both.

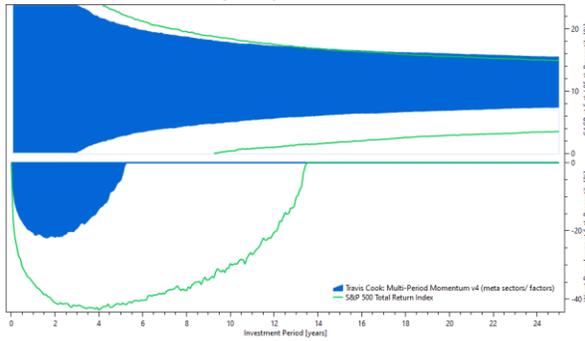


Metric		Travis Cook: Multi-Period Momentum v4 (m	S&P 500 Total Return Index
Simulation Start	02/01/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$5,224.16	\$3,802.92
Simulation Period	15.6 years		
Compound Annual Growth Rate		11.18%	8.94%
Stdev of Returns (Monthly, Annualized)		11.15%	15.86%
Maximum Drawdown (Daily)		16.31%	55.25%
Maximum Flat Days		655.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.89	0.50
Beta (To Benchmark, Monthly)		0.54	- benchmark -
Ulcer Index		5.10%	13.92%
Ulcer Performance Index (Martin Ratio)		2.19	0.64

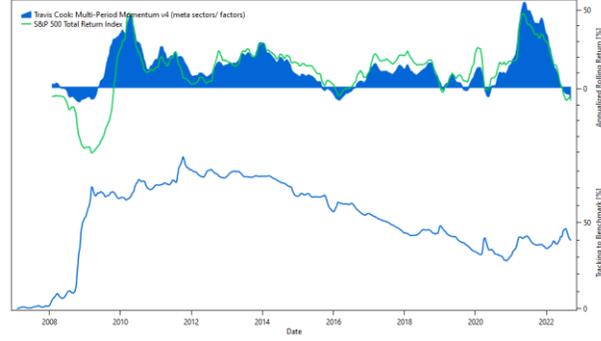
Annual Performance



Monte Carlo Analysis of Expected Returns and Drawdowns



1-Year Rolling Returns & Tracking to Benchmark



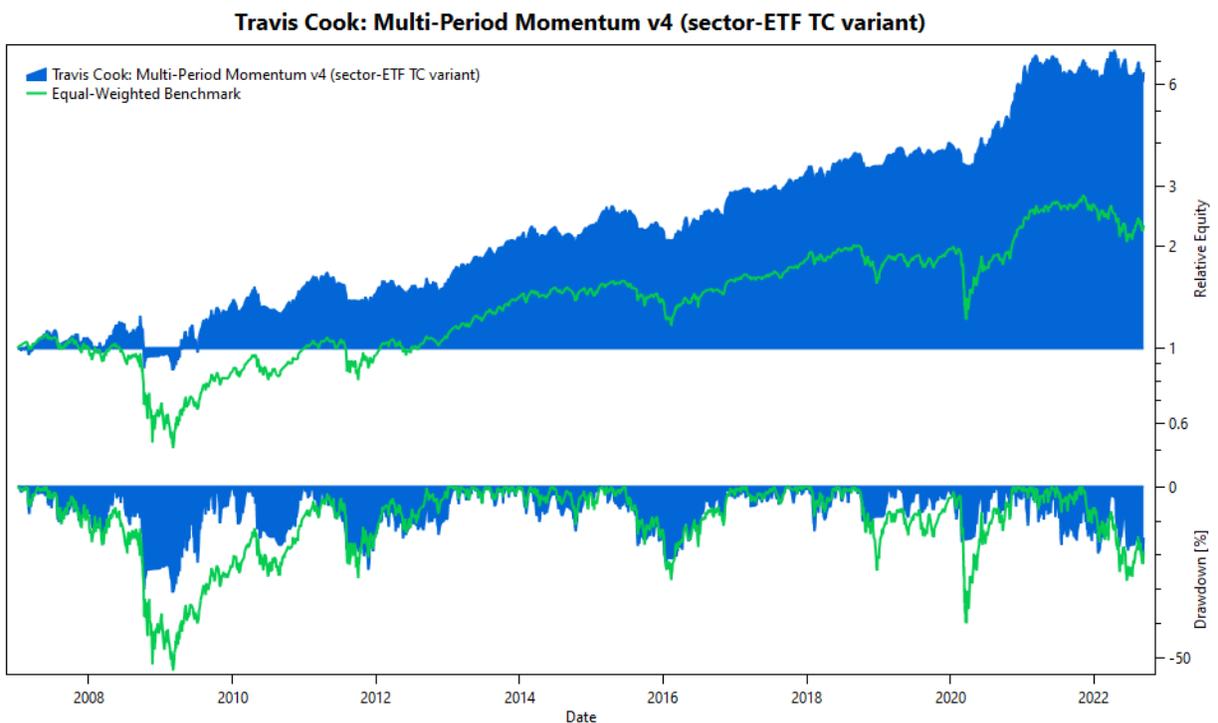
The resulting meta-strategy shows the benefits of diversification. The strategy manages to further reduce volatility and downside risk, while at the same time keeping the long-term returns up.

Industry Momentum ETFs

Based on Mr. Cook’s request, we tried the following universe:

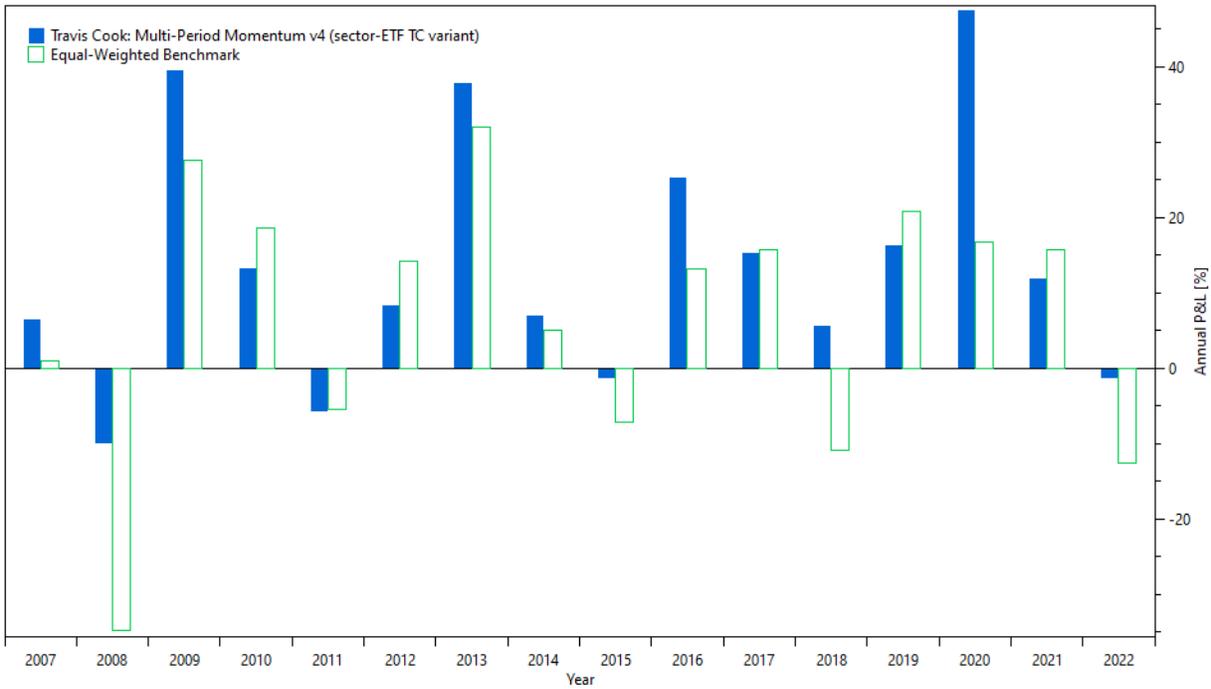
- Sectors: **XITK** Innovative Tech, **XAR** Aerospace & Defense, **KBE** Banking, **XBI** Biotech, **KCE** Capital Markets, **XHE** Health Care Equipment, **XHS** Health Care Services, **XHB** Homebuilders, **KIE** Insurance, **XWEB** Internet, **XME** Metals & Mining, **XES** Oil & Gas Equipment, **XOP** Oil & Gas Exploration, **XPH** Pharmaceuticals, **KRE** Regional Banking, **XRT** Retail, **XSD** Semiconductors, **XSW** Software & Services, **XTN** Transportation.
- Risk-off assets: SHY, BIL, TIP

We notice that this universe is very different from the traditional S&P-500 sector ETFs. It focuses on more modern themes and services, and omits some of the traditional sectors including industrials, and consumer staples. The results of this are not obvious. While combining the traditional S&P-500 sectors should add up to the overall index, we don’t know what this universe might add up to. To reflect this, we equal-weight the universe to create the strategy’s benchmark.

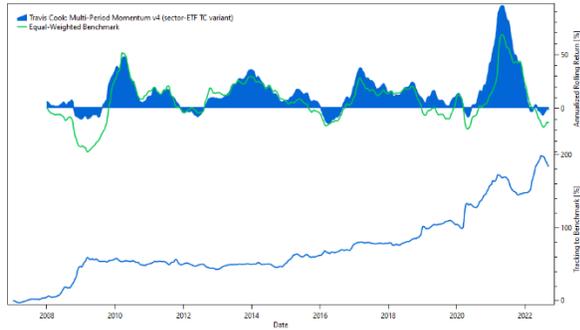


Metric		Travis Cook: Multi-Period Momentum v4 (se	Equal-Weighted Benchmark
Simulation Start	01/03/2007	\$1,000.00	\$1,000.00
Simulation End	09/09/2022	\$6,499.69	\$2,303.54
Simulation Period	15.7 years		
Compound Annual Growth Rate		12.68%	5.47%
Stdev of Returns (Monthly, Annualized)		17.15%	18.28%
Maximum Drawdown (Daily)		31.03%	54.26%
Maximum Flat Days		637.00 days	2039.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.64	0.23
Beta (To Benchmark, Monthly)		0.67	- benchmark -
Ulcer Index		9.46%	14.51%
Ulcer Performance Index (Martin Ratio)		1.34	0.38

Annual Performance



1-Year Rolling Returns & Tracking to Benchmark



Due to an issue w/ TuringTrader we have not been able to create the Monte Carlo chart here. Most likely, this is related to the benchmark's high volatility.

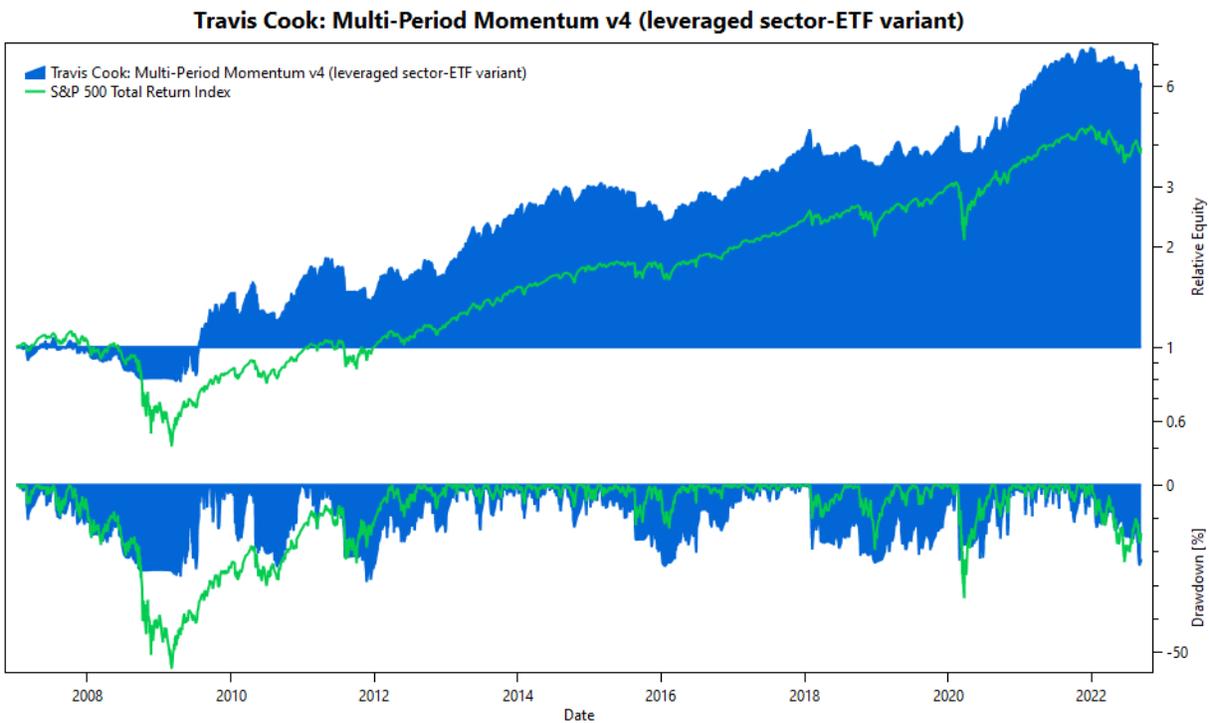
Overall, we can see that the strategy does something useful and beats its benchmark fairly consistently. The returns are higher than those of the S&P-500 industry sectors, however volatility has also increased substantially. The strategy has done fairly well in 2008, 2015, 2018, and 2022.

Leveraged Sector/Industry Momentum ETF

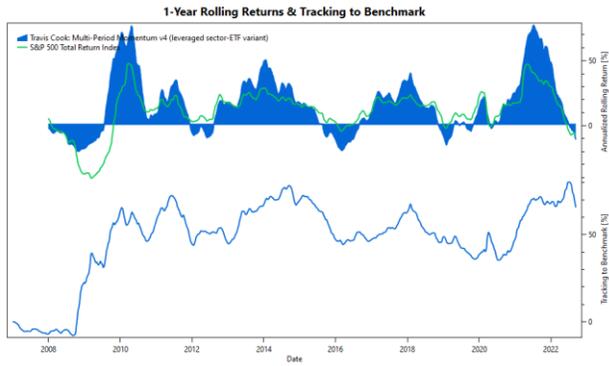
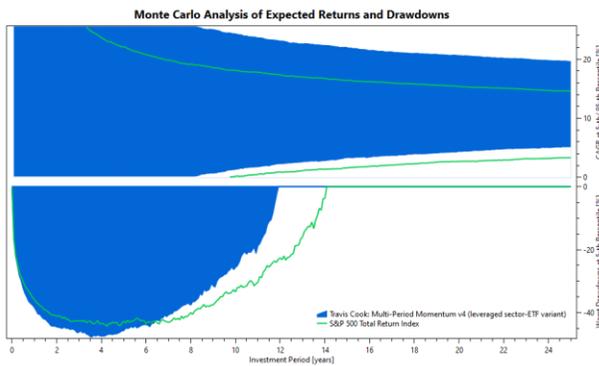
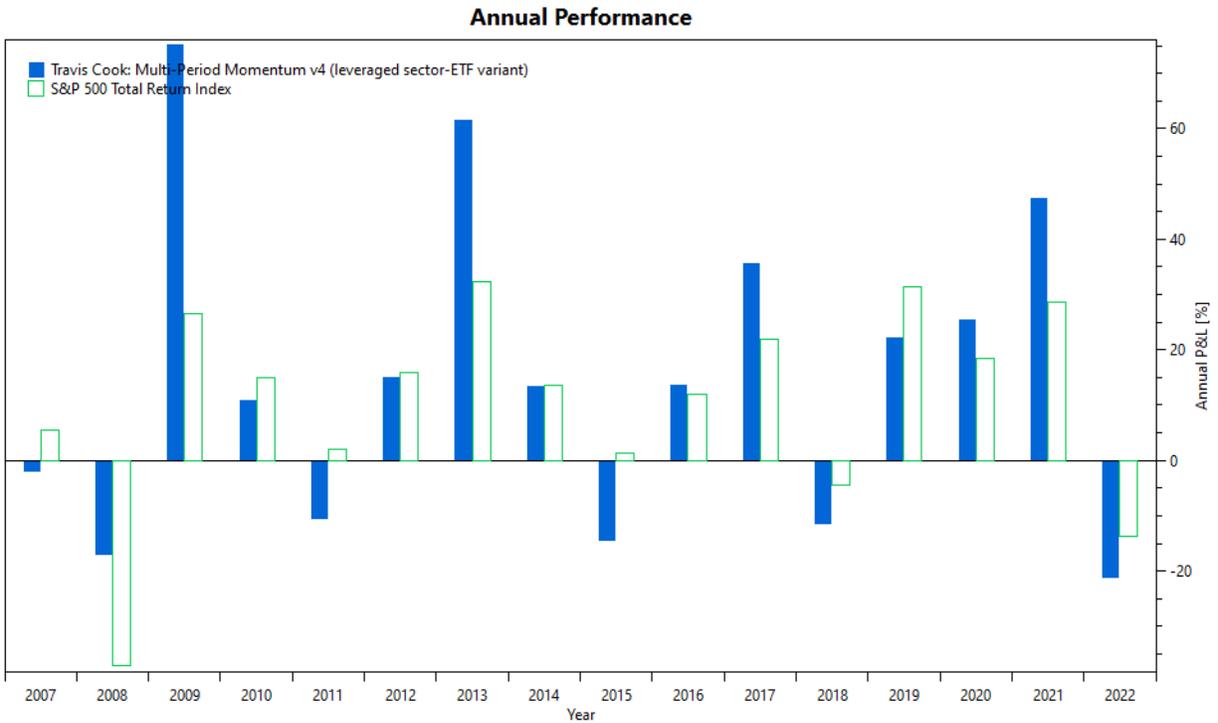
Upon Mr. Cook's request, we tried the following universe:

- Sectors: **BIB** Biotech, **DIG** Oil & Gas, **LTL** Telecom, **ROM** Technology, **RXL** Healthcare, **UCC** Consumer Services, **UGE** Consumer Goods, **UPW** Utilities, **URE** Real Estate, **USD** Semiconductors, **UXI** Industrials, **UYG** Financials, **UYM** Basic Materials.
- Risk-off assets: SHY, BIL, TIP

After optimizing the parameters, we achieved the following performance:



Metric		Travis Cook: Multi-Period Momentum v4 (le	S&P 500 Total Return Index
Simulation Start	01/03/2007	\$1,000.00	\$1,000.00
Simulation End	09/09/2022	\$6,159.64	\$3,945.65
Simulation Period	15.7 years		
Compound Annual Growth Rate		12.29%	9.15%
Stdev of Returns (Monthly, Annualized)		19.69%	15.83%
Maximum Drawdown (Daily)		29.43%	55.25%
Maximum Flat Days		746.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.54	0.49
Beta (To Benchmark, Monthly)		0.85	- benchmark -
Ulcer Index		12.40%	13.89%
Ulcer Performance Index (Martin Ratio)		0.99	0.66



The charts and metrics above seem disappointing. Given that the strategy has a 2x tail risk, there is a serious lack in performance. Further, we needed to invest in up to 10 assets simultaneously, which shows that the strategy had difficulties ranking the assets.

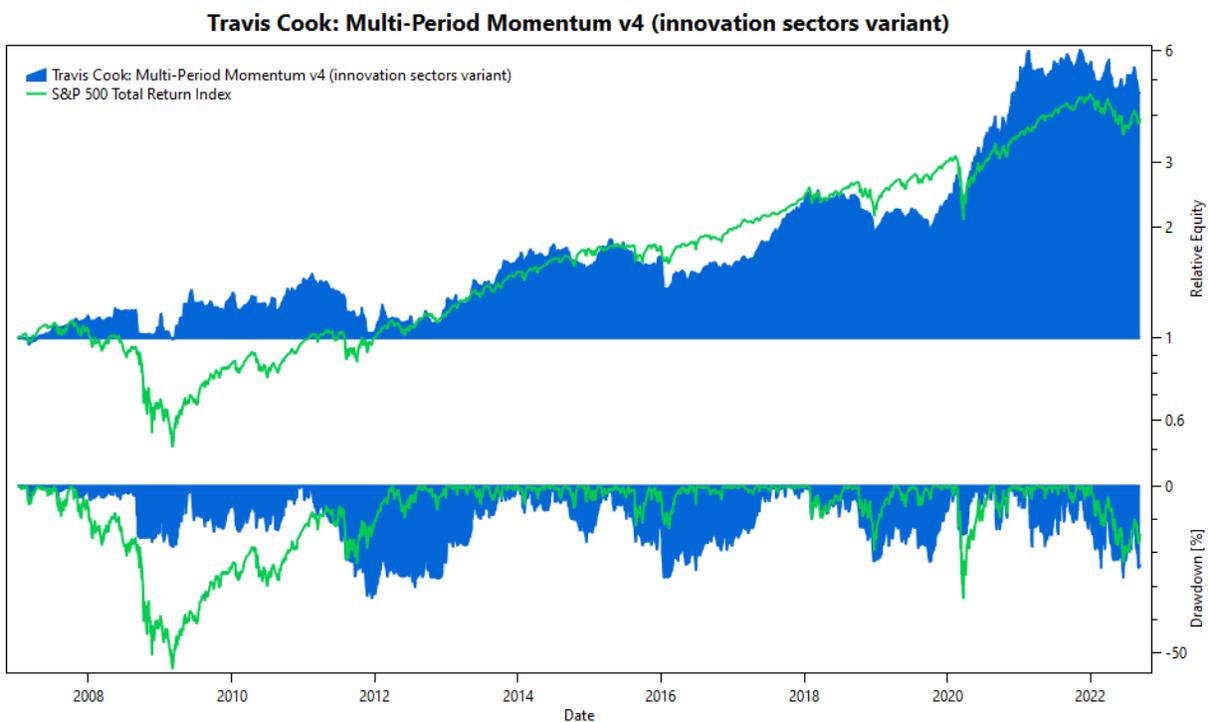
It seems that industry sectors are not a good universe to use for leveraged ETFs. We will revisit leveraged ETFs at a later stage with indices representing broader markets and/ or a different trading approach.

Innovation Sectors

Upon Mr. Cook’s request, we tried the following universe:

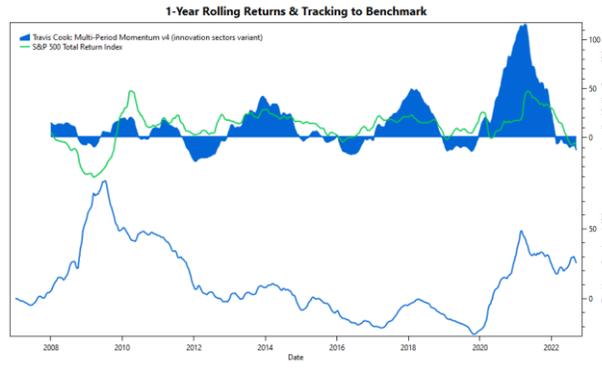
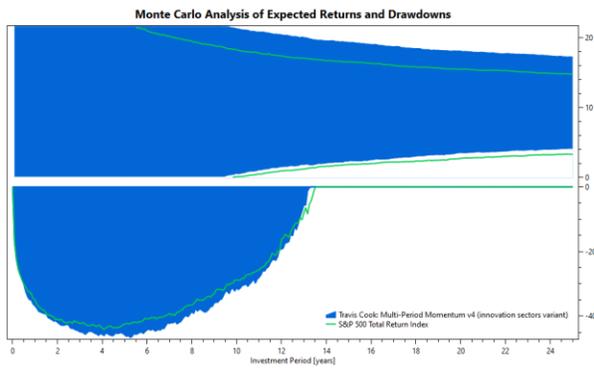
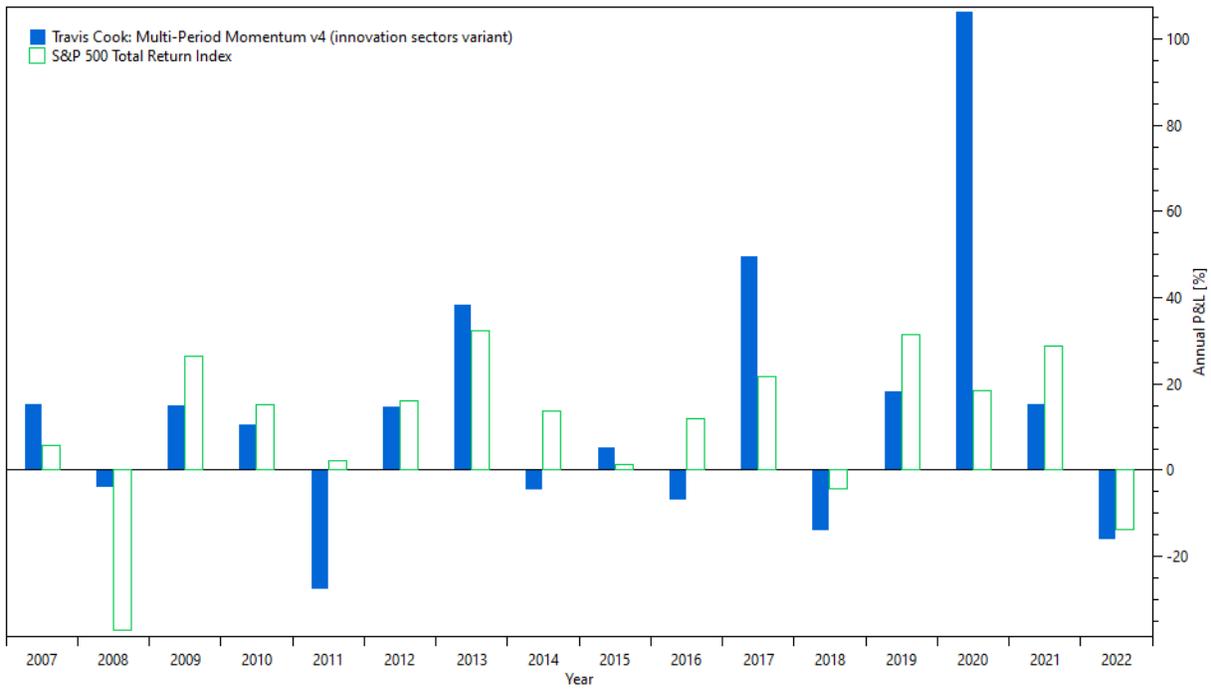
- Sectors: **LIT** – Lithium & Battery, **WCLD** – Cloud Computing, **CIBR** – Cybersecurity, **ARKW** – Next Gen Internet, **IPAY** – Mobil Payments, **BOTZ** – Robotics & AI, **QCLN** – Green Energy, **TAN** – Solar, **FAN** – Wind Energy, **DRIV** – Autonomous & EV, **PRNT** – 3D Printing, **REMX** – Rare Earth Metals, **SOCL** – Social Media, **IDNA** – Genomics & Immunology, **ARKG** – Genomic Revolution, **BBP** – Biotech Products, **GRID** – Smart Grid Infrastructure, **EVX** – Environmental Services, **BLOK** – Transformational Data Sharing.
- Risk-off assets: SHY, BIL, TIP

After optimizing the parameters, we achieved the following performance:

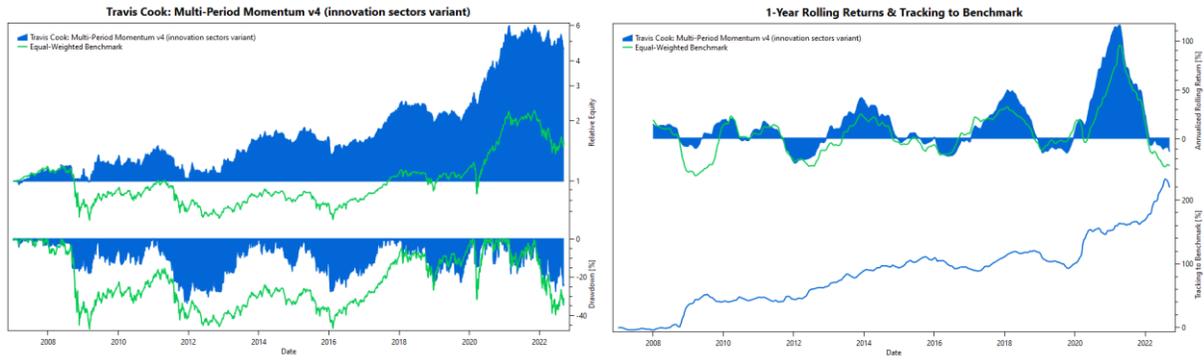


Metric		Travis Cook: Multi-Period Momentum v4 (in	S&P 500 Total Return Index
Simulation Start	01/03/2007	\$1,000.00	\$1,000.00
Simulation End	09/09/2022	\$4,655.00	\$3,945.65
Simulation Period	15.7 years		
Compound Annual Growth Rate		10.30%	9.15%
Stdev of Returns (Monthly, Annualized)		18.17%	15.83%
Maximum Drawdown (Daily)		33.76%	55.25%
Maximum Flat Days		957.00 days	1637.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.50	0.49
Beta (To Benchmark, Monthly)		0.75	- benchmark -
Ulcer Index		13.13%	13.89%
Ulcer Performance Index (Martin Ratio)		0.78	0.66

Annual Performance



Benchmarked against the S&P 500, there is no way to be satisfied with the strategy's performance. However, the universe's focus on innovative sectors skews the results significantly. Therefore, we also charted the strategy against an equal-weighted benchmark (including safe assets):

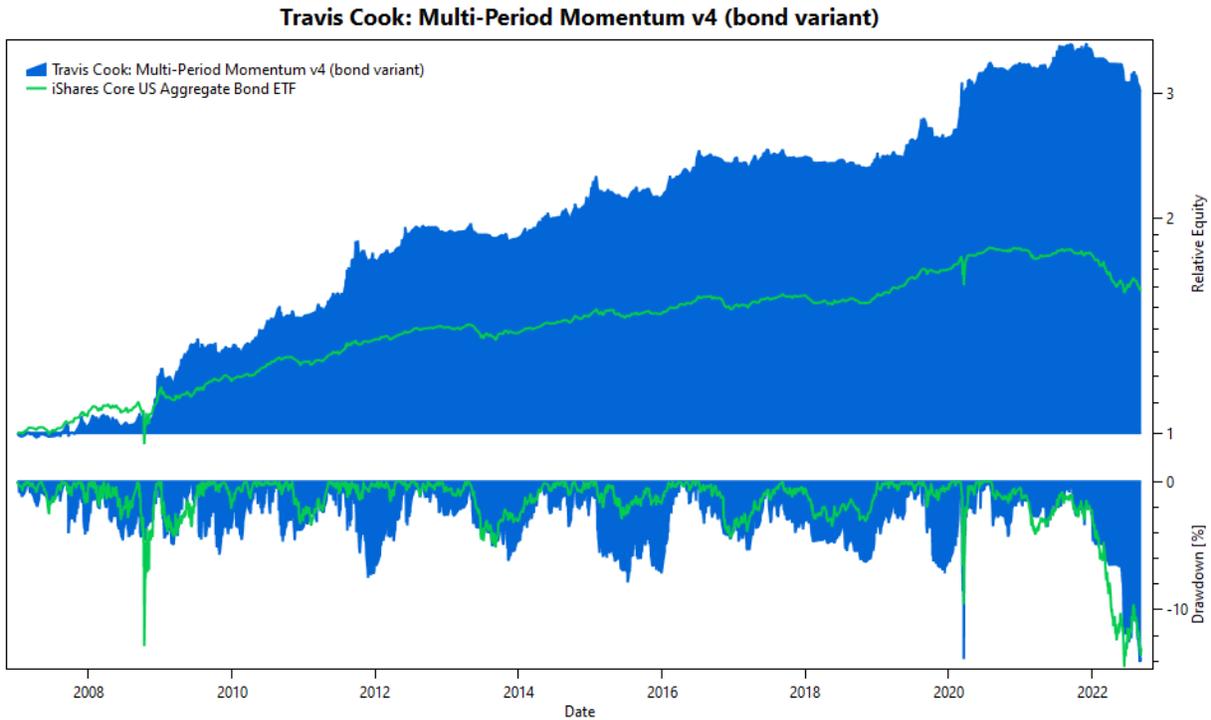


These charts suggest that the innovation sectors did not perform well in the past 15 years. Compared to this benchmark, the strategy did add significant value, even though that is not enough to rival the S&P 500.

Bonds

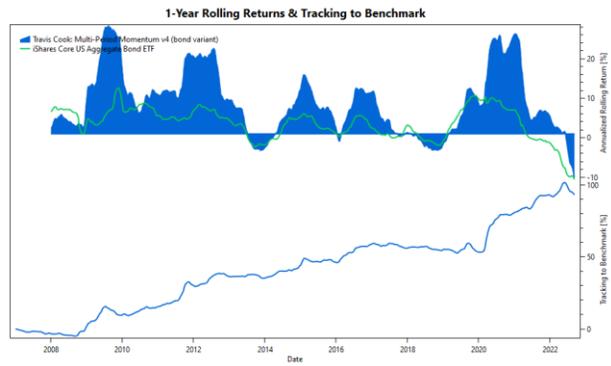
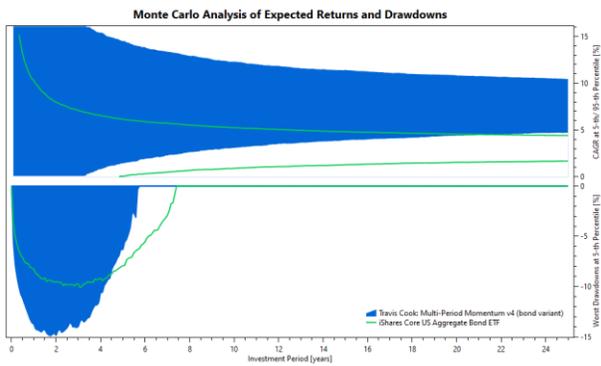
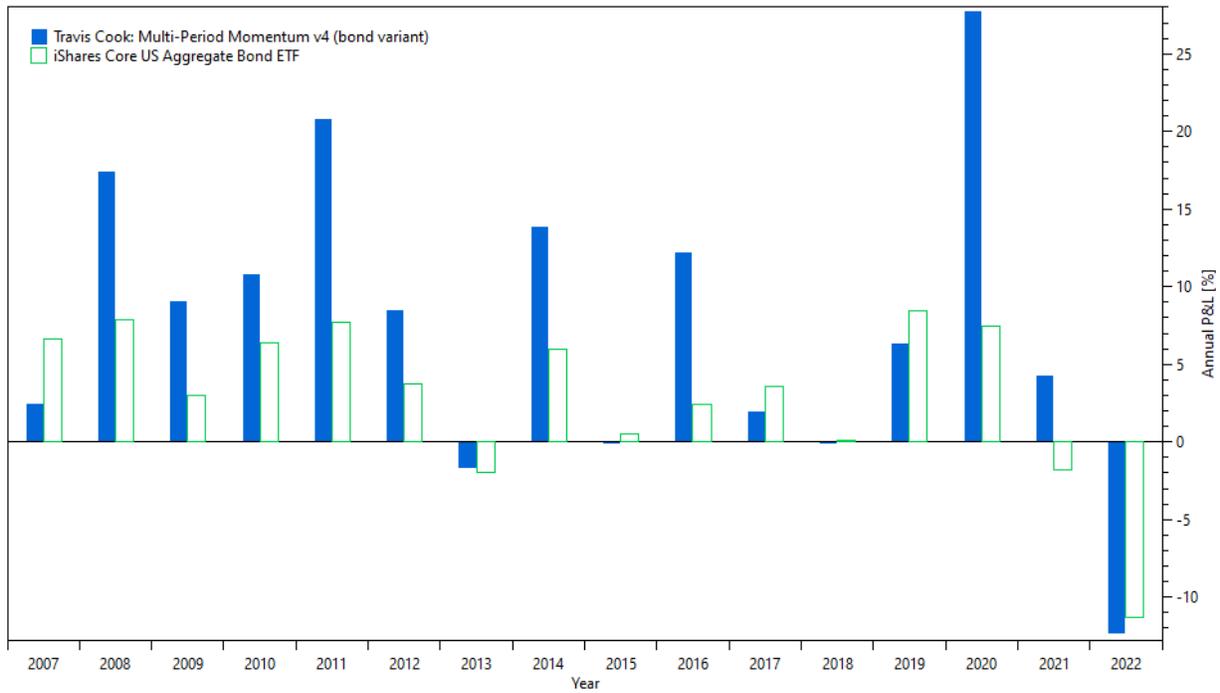
Encouraged by the previous results, we decided to spin off further sub-universes, beginning with bonds:

- HYG, LQD, TLT, TLH, IEF, IEI,
- SHY, BIL, TIP,



Metric		Travis Cook: Multi-Period Momentum v4 (b	iShares Core US Aggregate Bond ETF
Simulation Start	01/02/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$3,028.00	\$1,584.24
Simulation Period	15.7 years		
Compound Annual Growth Rate		7.32%	2.98%
Stdev of Returns (Monthly, Annualized)		8.15%	4.03%
Maximum Drawdown (Daily)		14.08%	14.43%
Maximum Flat Days		703.00 days	483.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.78	0.55
Beta (To Benchmark, Monthly)		1.41	- benchmark -
Ulcer Index		3.59%	2.61%
Ulcer Performance Index (Martin Ratio)		2.04	1.14

Annual Performance

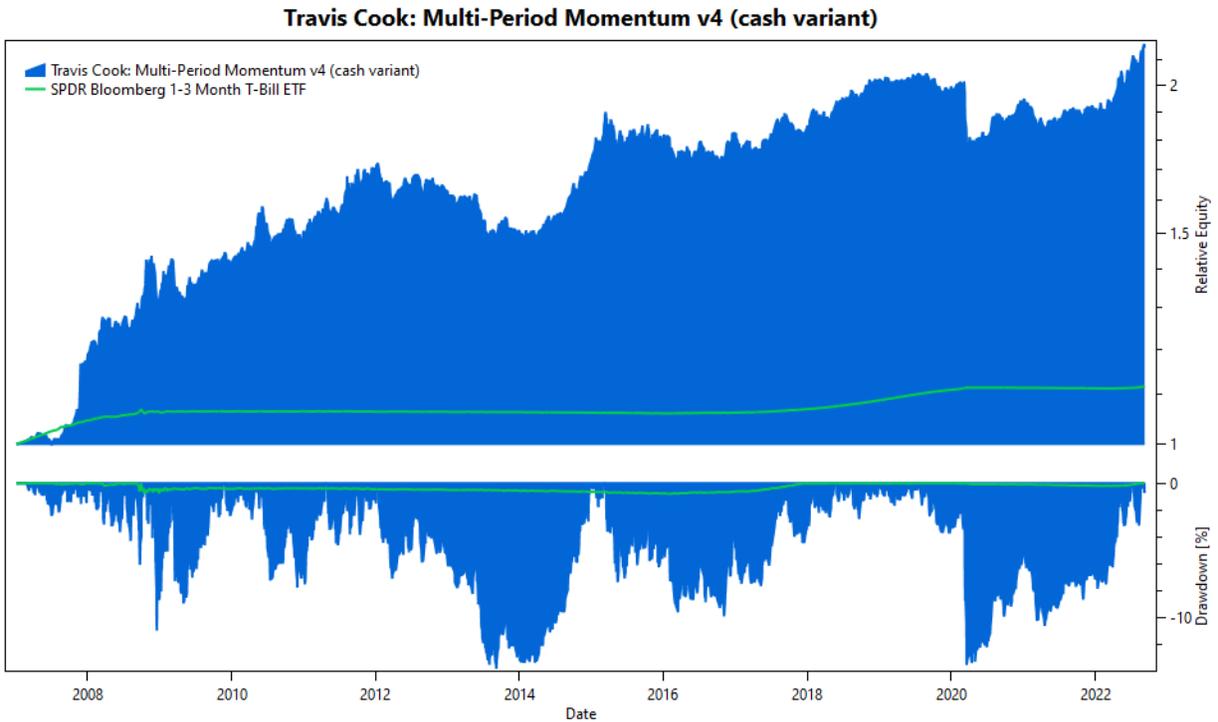


For a bond strategy, this strategy is very aggressive. It significantly boosts returns when benchmarked against the aggregate bond market, but also increases volatility. We are not overly concerned about this increase in volatility, as we expect the bonds to have a rather low correlation to the stock market.

Cash

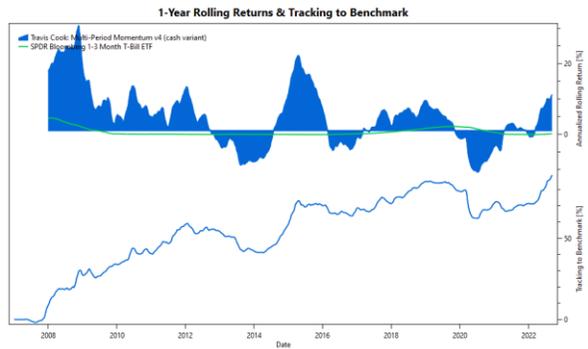
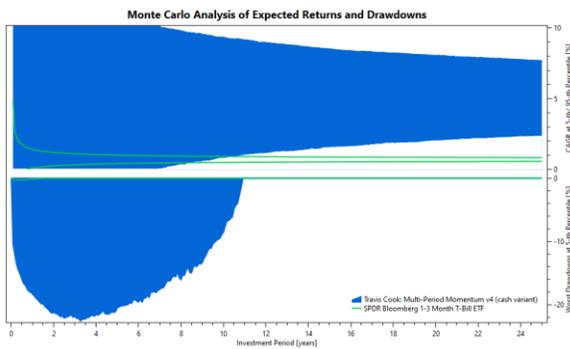
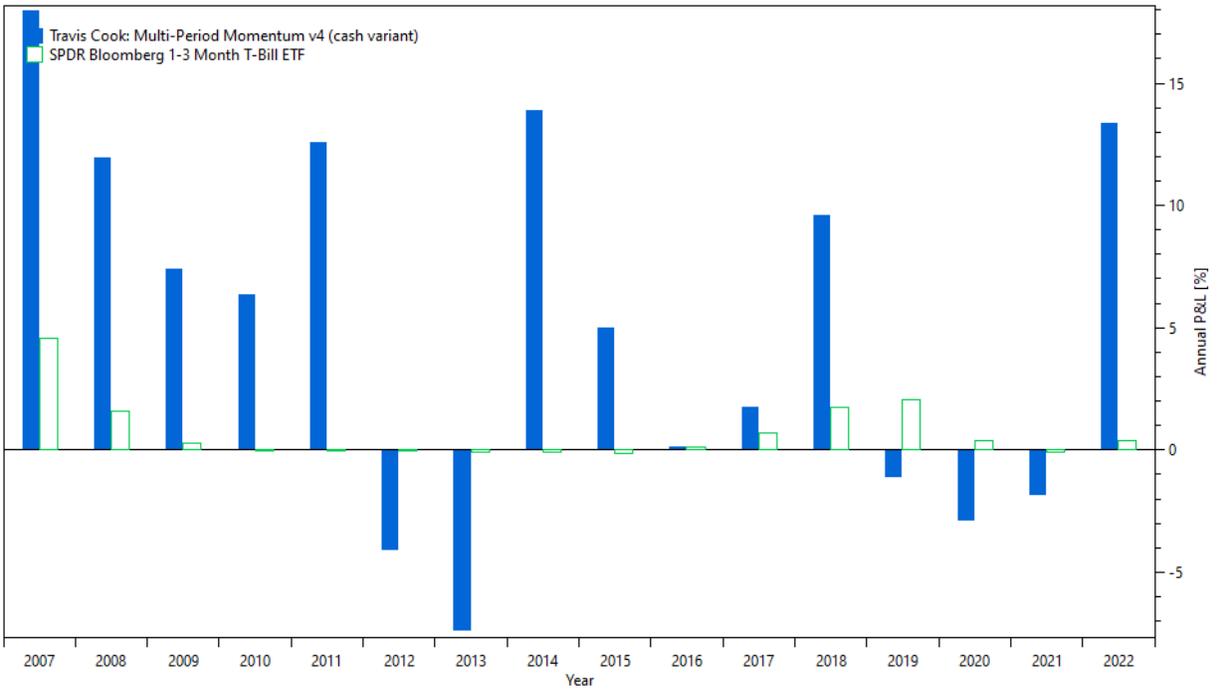
To further complement the strategies above, we decided to add a strategy focused on cash. We chose the following universe, which not only holds short-term treasuries, but also includes some FOREX component:

- UDN, UUP, BIL, SHY, TIP



Metric		Travis Cook: Multi-Period Momentum v4 (ca	SPDR Bloomberg 1-3 Month T-Bill ETF
Simulation Start	01/03/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$2,154.12	\$1,117.71
Simulation Period	15.7 years		
Compound Annual Growth Rate		5.02%	0.71%
Stdev of Returns (Monthly, Annualized)		7.88%	0.40%
Maximum Drawdown (Daily)		13.76%	0.78%
Maximum Flat Days		1085.00 days	3364.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.52	-0.48
Beta (To Benchmark, Monthly)		1.37	- benchmark -
Ulcer Index		5.75%	0.40%
Ulcer Performance Index (Martin Ratio)		0.87	1.78

Annual Performance

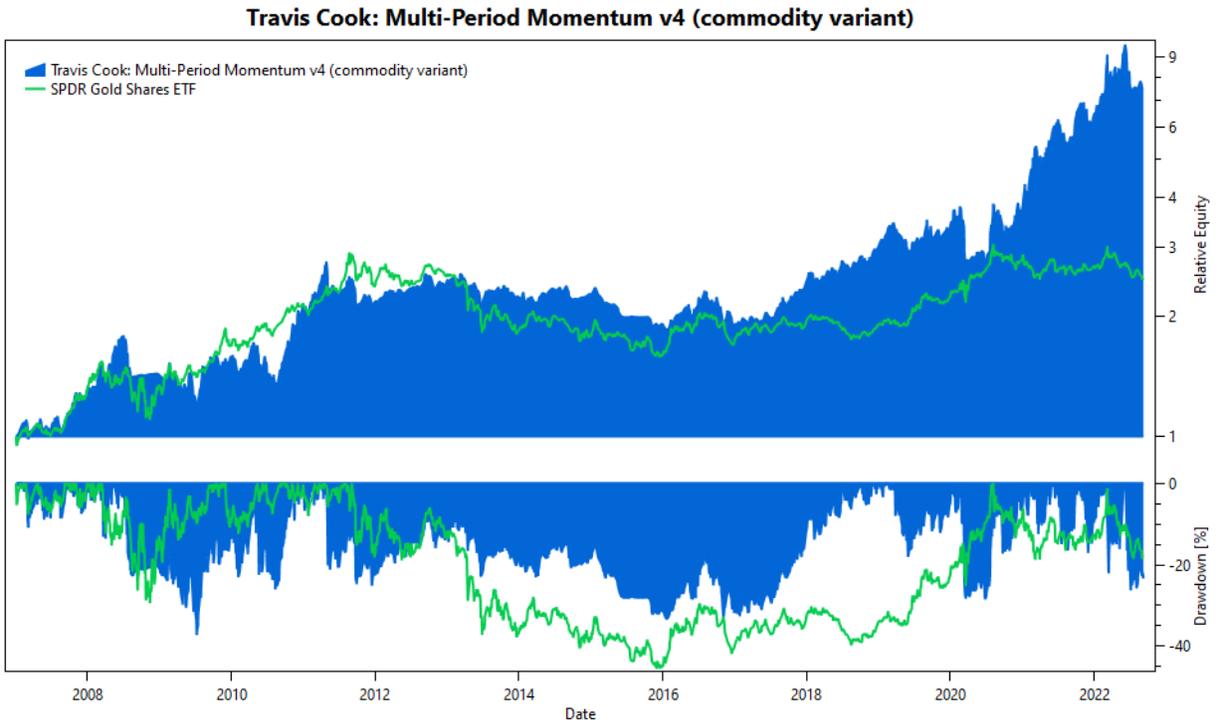


While including significantly higher risks, this strategy also dwarfs the returns from holding T-bills. In particular, this strategy delivers positive returns in 2022, where no other asset class did so far.

Commodities and Hard Assets

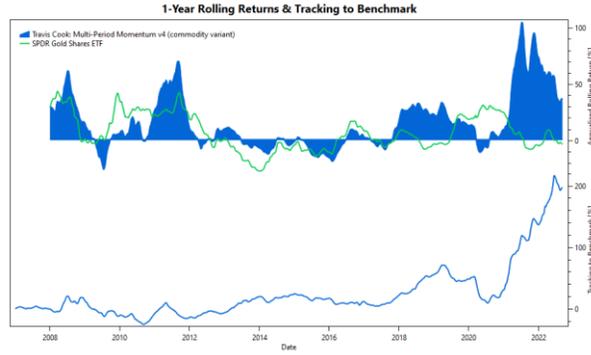
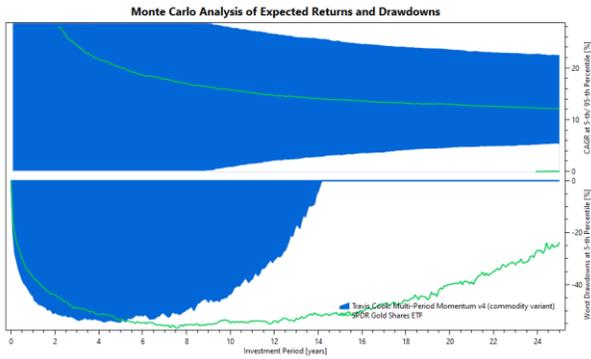
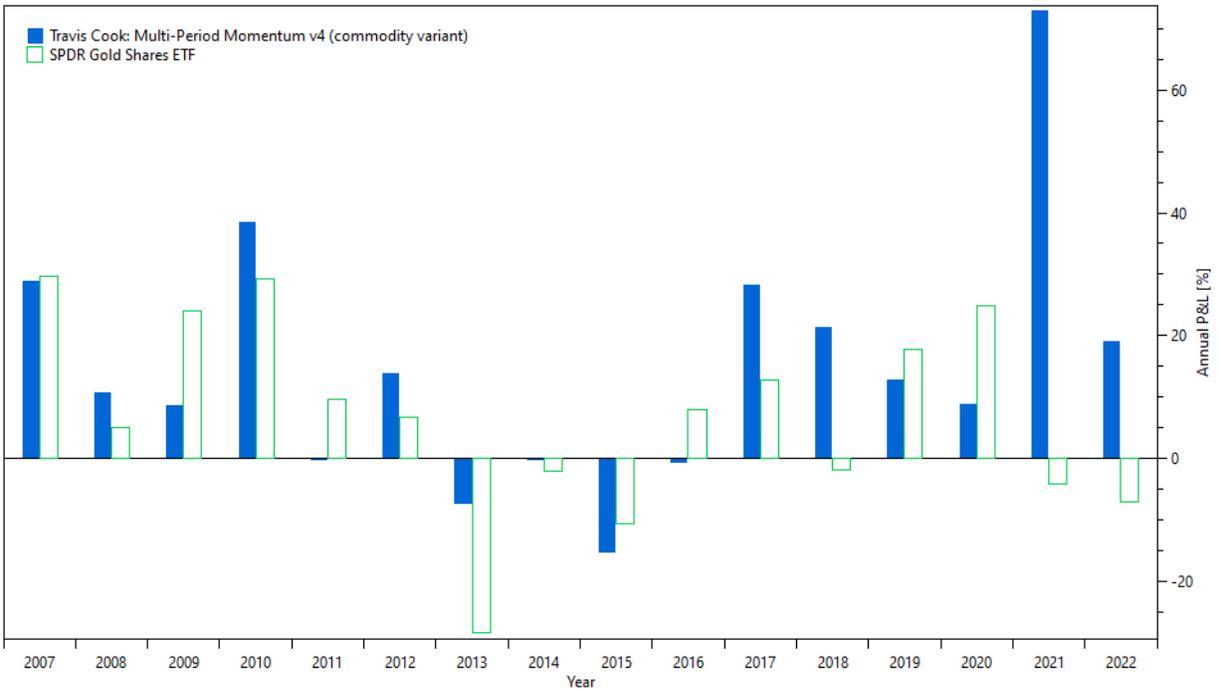
To round off the sub-universes, we added one final category: commodities and hard assets. In particular, we use the following ETFs:

- Hard assets: GLD, SLV, PPLT, PALL, DBB, DBP, USO, FCG, IYR
- Risk-off assets: BIL, SHY, TIP



Metric		Travis Cook: Multi-Period Momentum v4 (cc	SPDR Gold Shares ETF
Simulation Start	01/02/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$7,495.77	\$2,501.47
Simulation Period	15.7 years		
Compound Annual Growth Rate		13.71%	6.02%
Stdev of Returns (Monthly, Annualized)		22.83%	17.14%
Maximum Drawdown (Daily)		37.24%	45.57%
Maximum Flat Days		2625.00 days	3250.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		0.52	0.29
Beta (To Benchmark, Monthly)		0.52	- benchmark -
Ulcer Index		17.15%	24.05%
Ulcer Performance Index (Martin Ratio)		0.80	0.25

Annual Performance



Compared to gold, the strategy significantly outperforms, while at the same time substantially reducing the downside risk.

Meta Portfolios

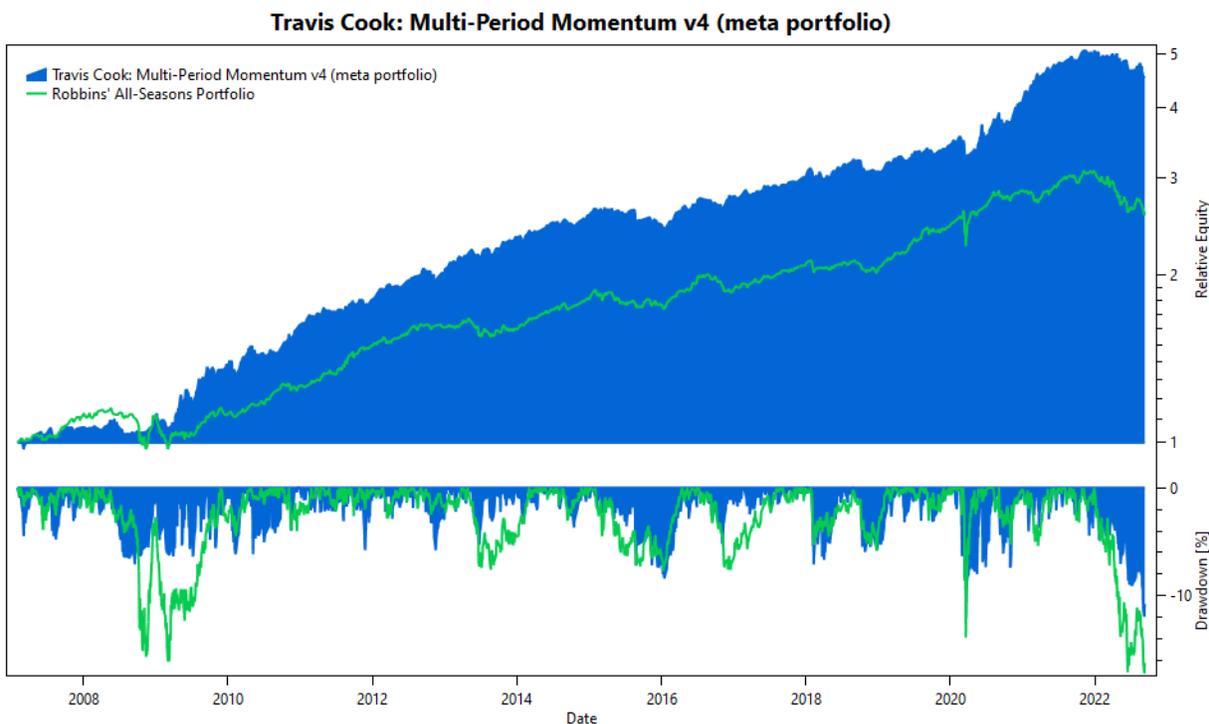
With the various sub-strategies in place we can build a wide array of semi-tactical strategies. These strategies offer the advantages of tactical asset allocation, while at the same time also benefitting from the stable and diverse asset-mix that strategic investments offer.

We believe that these portfolios are good candidates to appeal to more conservative investors, which are reluctant to invest in fully tactical portfolios.

Alternative All-Seasons Portfolio

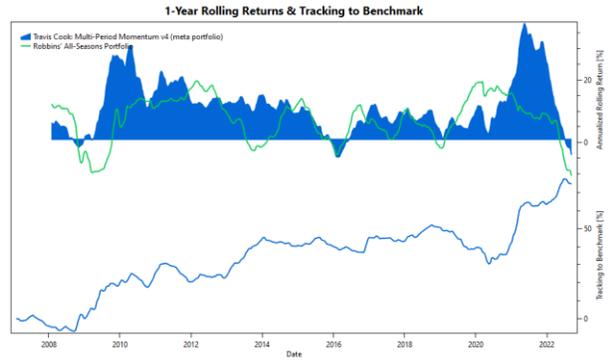
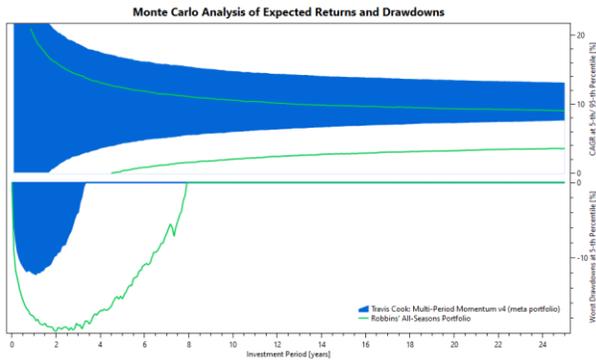
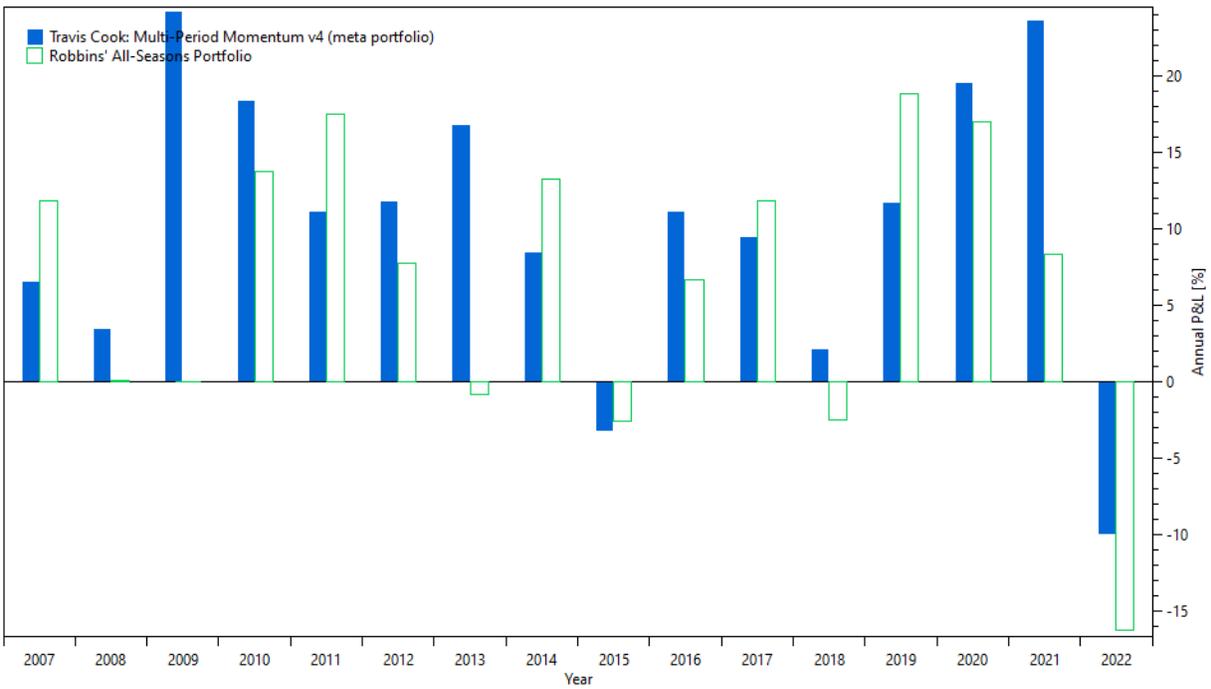
We construct a portfolio as follows and benchmark it against Tony Robbins' All-Seasons Portfolio:

- Stocks: 30%
- Bonds: 35%
- Commodities & hard assets: 15%
- Cash: 10%



Metric		Travis Cook: Multi-Period Momentum v4 (m)	Robbins' All-Seasons Portfolio
Simulation Start	02/01/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$4,562.57	\$2,587.77
Simulation Period	15.6 years		
Compound Annual Growth Rate		10.22%	6.28%
Stdev of Returns (Monthly, Annualized)		7.65%	7.74%
Maximum Drawdown (Daily)		12.07%	17.22%
Maximum Flat Days		396.00 days	554.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		1.17	0.69
Beta (To Benchmark, Monthly)		0.53	- benchmark -
Ulcer Index		2.89%	4.16%
Ulcer Performance Index (Martin Ratio)		3.54	1.51

Annual Performance



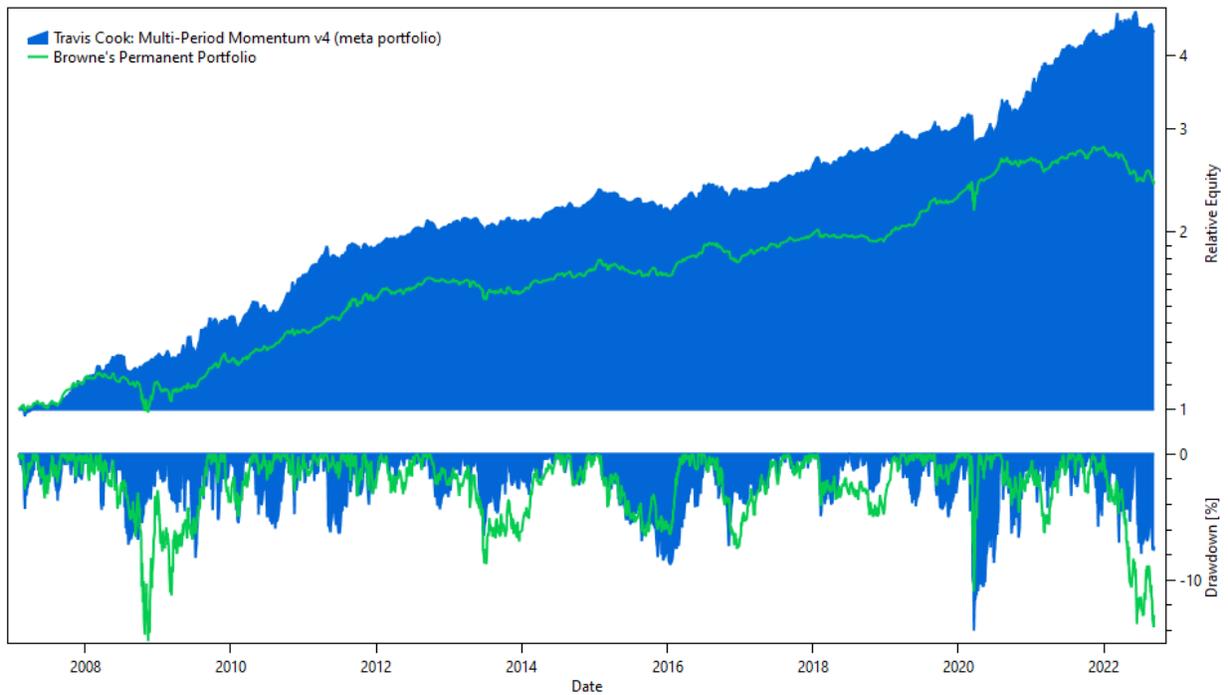
We find that the portfolio regularly outperforms its benchmark, while at the same time offering similar volatility, and significantly lower downside risk.

Alternative Permanent Portfolio

We construct a portfolio as follows and benchmark it against Harry Browne’s Permanent Portfolio:

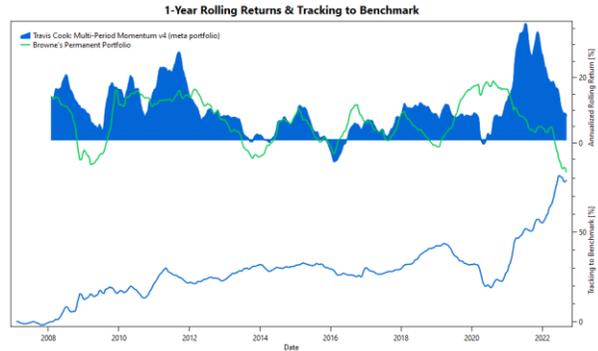
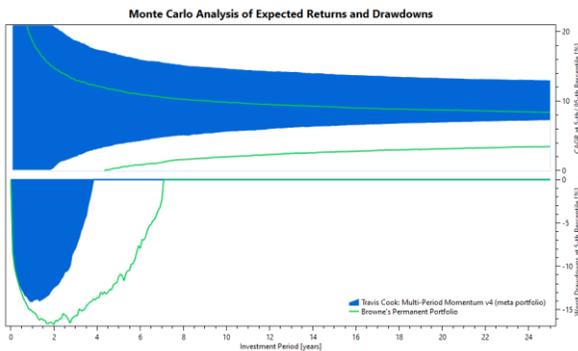
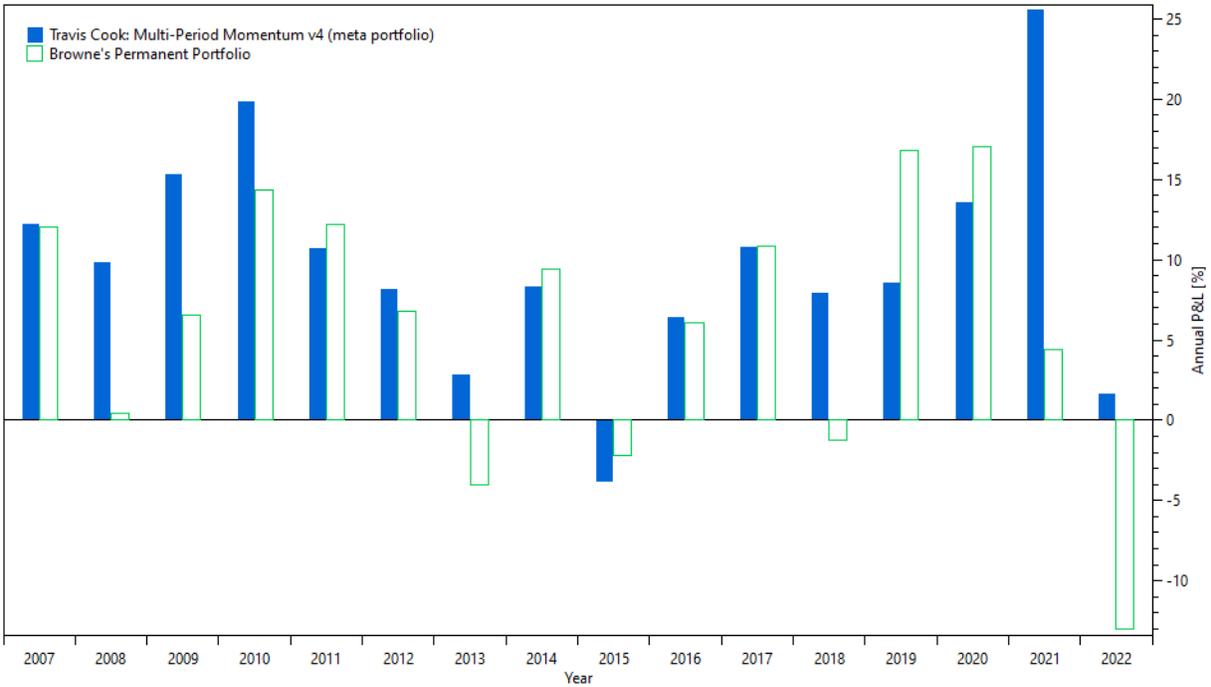
- Stocks: 25%
- Bonds: 25%
- Commodities & hard assets: 25%
- Cash: 25%

Travis Cook: Multi-Period Momentum v4 (meta portfolio)



Metric		Travis Cook: Multi-Period Momentum v4 (m)	Browne's Permanent Portfolio
Simulation Start	02/01/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$4,397.46	\$2,433.92
Simulation Period	15.6 years		
Compound Annual Growth Rate		9.96%	5.87%
Stdev of Returns (Monthly, Annualized)		7.89%	7.10%
Maximum Drawdown (Daily)		14.02%	14.83%
Maximum Flat Days		521.00 days	623.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		1.11	0.70
Beta (To Benchmark, Monthly)		0.54	- benchmark -
Ulcer Index		3.12%	3.55%
Ulcer Performance Index (Martin Ratio)		3.19	1.65

Annual Performance

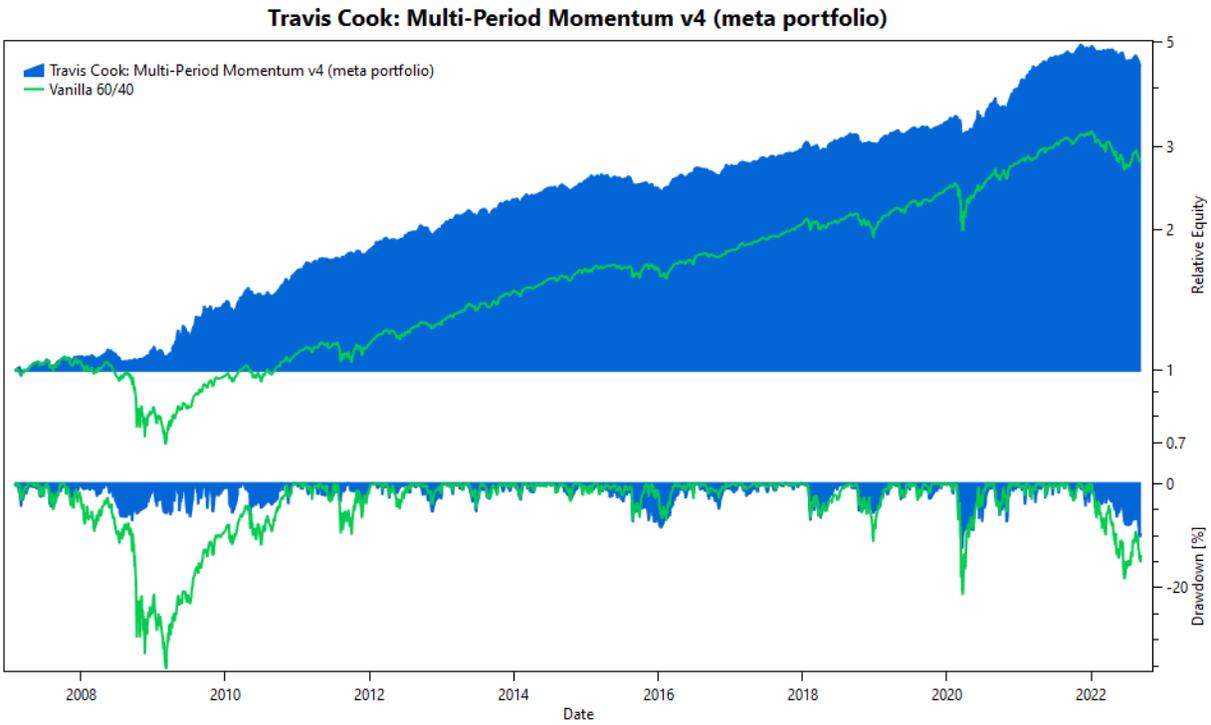


Similar as the previous example, we can see this portfolio consistently outperform its benchmark, similar volatility, and significantly lower downside risk. However, there is a notable performance slump in 2020.

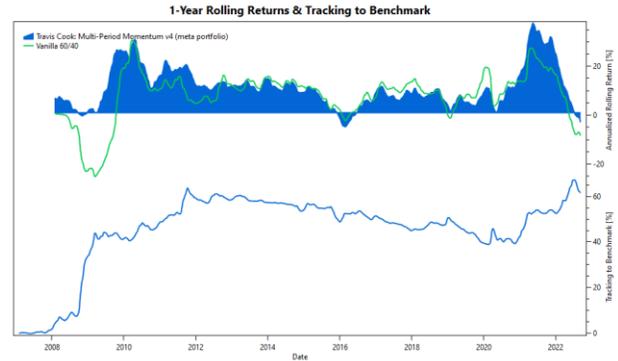
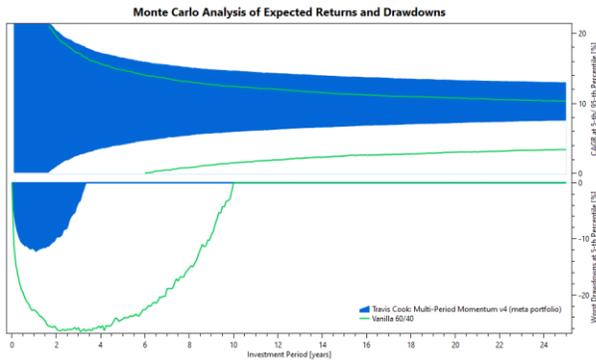
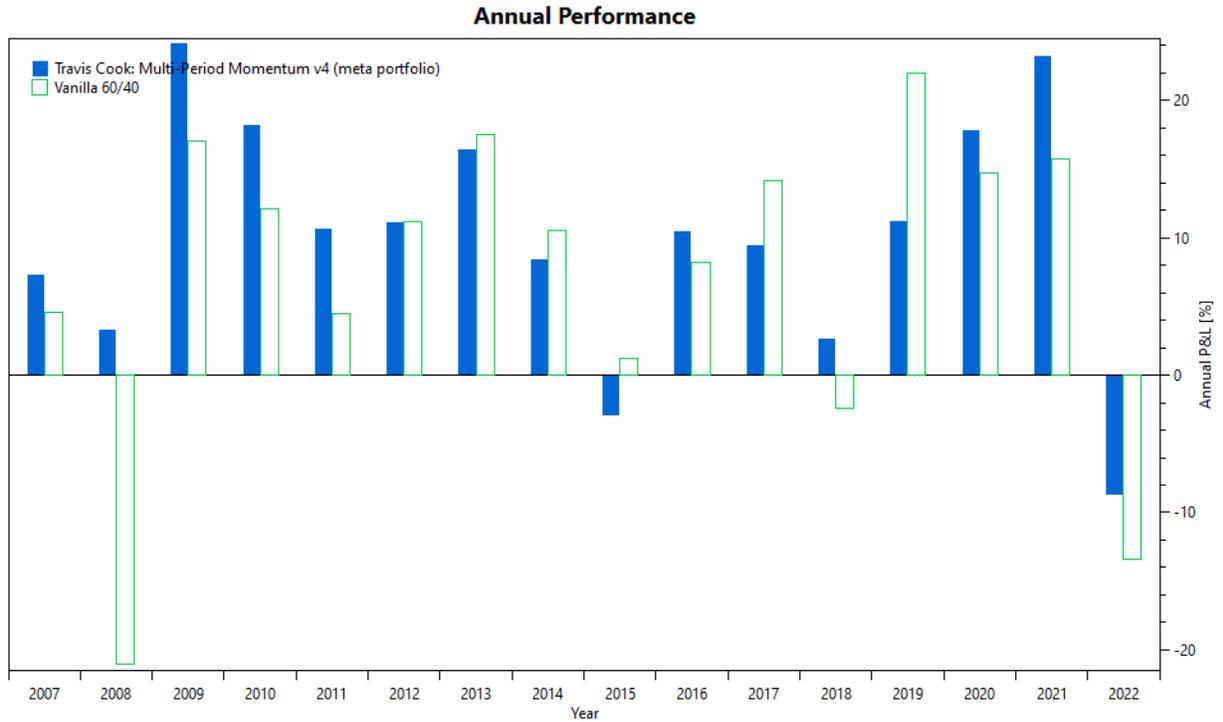
Alternative 60/40

We construct a portfolio as follows and benchmark it against a vanilla 60/40:

- 60% stocks
- 25% bonds
- 10% cash
- 5% commodities



Metric		Travis Cook: Multi-Period Momentum v4 (m)	Vanilla 60/40
Simulation Start	02/01/2007	\$1,000.00	\$1,000.00
Simulation End	09/08/2022	\$4,486.93	\$2,801.03
Simulation Period	15.6 years		
Compound Annual Growth Rate		10.10%	6.83%
Stdev of Returns (Monthly, Annualized)		7.56%	9.81%
Maximum Drawdown (Daily)		12.52%	35.62%
Maximum Flat Days		404.00 days	1165.00 days
Sharpe Ratio (Rf=T-Bill, Monthly, Annualized)		1.17	0.60
Beta (To Benchmark, Monthly)		0.55	- benchmark -
Ulcer Index		2.86%	7.39%
Ulcer Performance Index (Martin Ratio)		3.53	0.92



In most years, the strategy delivers returns on par with the 60/40. However, similar to the previous examples, we notice much improved risk-adjusted metrics, and significantly reduced downside risk.

Conclusion

Overall, it seems that the multi-period momentum strategy works about as well with the smaller universe subsets as it does with the full universe. Even though the absolute performance seems lower, this is mostly attributed to the performance in 2007/2008. In these years, some universes outperformed more than others, leading to the impression that some work significantly better than others. When looking at the rolling returns and tracking charts, it becomes clear that in the longer term, the strategies perform quite similarly when compared to their benchmarks.

However, we still notice that we have not been able to outperform the benchmark with the stock market universes. While we noticed these difficulties with other momentum approaches before, we have precedence (TuringTrader's Round Robin), that this should be possible with an adaptive momentum strategy. We started experimenting with a strategy that uses multi-winner ranked-choice to pick the winning asset across multiple time frames. We are not sure yet, if this approach offers any significant advantages.

We'd like to point out that in order to get decent results with the various subsets, the strategy's parameters had to be tweaked significantly. This hints at some limitations of the multi-period momentum indicator, which does not seem to self-adjust as well to changing environments, as we would like to see. More research might be required to further improve the method of adjusting the lookback period.

Of special interest are the universes of leveraged ETFs and innovation sectors. For both universes, the strategy failed to produce any meaningful value beyond buy and hold of the unleveraged S&P 500. However, it is worth noting that the equal-weighted universes of these ETFs also severely underperform. Consequently, the blame for these disappointing results goes more toward the universes than toward the strategy mechanism.