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Hello Travis,

Please find some thoughts and observations regarding momentum strategies.

Thank you,
Best regards.

Felix Bertram

ETF Rotation

The first strategy we are looking at is the ETF Rotation strategy. We interpret its rules as follows:

- Trade a universe of ETFs representing industry sectors, sub-sectors, and bonds
- Rebalance on a monthly schedule, ignore all inter-month data and signals
- Only hold positions while the S&P 500 closes above its 200-day (9.5 months) moving average
- Rank assets by their momentum, calculated as the average of the asset's 1, 3, 6, and 12-months rate of change
- Pick the top two assets and allocate 50% of the available capital to each

It is not entirely clear to us, how the exit using the *rankExit* constant works. For now, we assume that there is no functionality that keeps positions longer than for the time they are within the top-2.

Our backtest with Amibroker led to the following results:

	All trades	Long trades	Short trades	Buy&Hold ($SPXTR)
Initial capital	100000.00	100000.00	100000.00	100000.00
Ending capital	551145.03	551145.03	100000.00	401649.35
Net Profit	451145.03	451145.03	0.00	301649.35
Net Profit %	451.15%	451.15%	0.00%	301.65%
Exposure %	66.93%	66.93%	0.00%	100.00%
Net Risk Adjusted Return %	674.01%	674.01%	N/A	301.65%
Annual Return %	11.88%	11.88%	0.00%	9.58%
Risk Adjusted Return %	17.75%	17.75%	N/A	9.58%
Total transaction costs	2333.32	2333.32	0.00	0.92
Max. trade drawdown	-71840.40	-71840.40	0.00	-106549.67
Max. trade % drawdown	-26.74	-26.74	0.00	-55.25
Max. system drawdown	-76332.89	-76332.89	0.00	-106549.67
Max. system % drawdown	-25.19%	-25.19%	0.00%	-55.25%
Recovery Factor	5.91	5.91	N/A	2.83
CAR/MaxDD	0.47	0.47	N/A	0.17
RAR/MaxDD	0.70	0.70	N/A	0.17
Profit Factor	8.24	8.24	N/A	N/A
Payoff Ratio	4.94	4.94	N/A	N/A
Standard Error	33805.87	33805.87	0.00	38311.36
Risk-Reward Ratio	0.70	0.70	N/A	0.53
Ulcer Index	7.19	7.19	0.00	13.87
Ulcer Performance Index	0.90	0.90	N/A	0.30
Sharpe Ratio of trades	0.42	0.42	0.00	N/A
K-Ratio	0.05	0.05	N/A	0.04

The equity chart shows that the strategy has outperformed the S&P500-TR, but not by much. The underwater chart shows how the strategy has reduced drawdowns in 2008, 2016, 2018, 2020, and 2022. However, outside of major drawdown events, the strategy does not reduce the downside.

We notice a number of flat periods when the market-regime filter kicks in. This is a missed opportunity, given that the strategy's universe includes bonds.
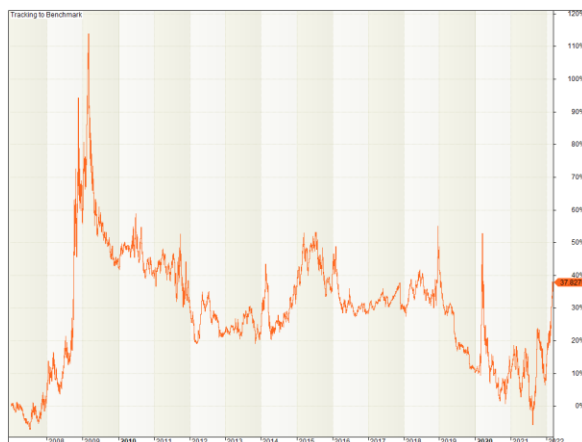
The tracking chart shows that all of the strategy's outperformance stems from the years 2008/2009. After that, the strategy's long-term performance was underperforming the benchark. Even though the strategy has been able to reduce maximum drawdowns in 2018 and 2020, it did give up all of this upside (and more) during the rebound.

```
// COMMUNICATION SERVICES
//     FDN - First Trust Dow Jones Internet ETF
//     NXTG - First Trust Indxx NextG ETF
// CONSUMER DISCRETIONARY
//     FXD - First Trust Consumer Discretionary AlphaDEX ETF
// CONSUMER STAPLES
//     FXG - First Trust Consumer Staples AlphaDEX ETF
//     FTXG - First Trust Nasdaq Food And Beverage ETF
//     FTAG - First Trust Indxx Global Agriculture ETF
// ENERGY
//     FXN - First Trust Energy AlphaDEX ETF
```

```
//   FTXN - First Trust Nasdaq Oil & Gas ETF
//   FCG - First Trust Natural Gas ETF
// FINANCIALS
//   FXO - First Trust Financials AlphaDEX ETF
//   QABA - First Trust Nasdaq ABA Community Bank Index ETF
//   FTXO - First Trust Nasdaq Bank ETF
//   LEGR - First Trust Indxx Innovative Transactn & Proc ETF
// HEALTH CARE
//   FXH - First Trust Health Care AlphaDEX ETF
//   FBT - First Trust NYSE Arca Biotechnology ETF
//   FTXH - First Trust Nasdaq Pharmaceuticals ETF
// INDUSTRIALS
//   FXR - First Trust Industrials/Producer Durables AlphaDEX ETF
//   AIRR - First Trust RBA American Industrial Renaissance ETF
//   CARZ - First Trust S-Network Future Vehicles & Technology ETF
//   FTXR - First Trust Nasdaq Transportation ETF
// INFORMATION TECHNOLOGY
//   FXL - First Trust Technology AlphaDEX ETF
//   ROBT - First Trust Nasdaq Artificial Intelligence and Robotics ETF
//   CIBR - First Trust Nasdaq Cybersecurity ETF
//   FTXL - First Trust Nasdaq Semiconductor ETF
//   TDIV - First Trust Nasdaq Technology Dividend Index ETF
//   QTEC - First Trust Nasdaq-100 Tech Sector ETF
//   SKYY - First Trust Cloud Computing ETF
// MATERIALS
//   FXZ - First Trust Materials AlphaDEX ETF
//   FTRI - First Trust Indxx Global Natural Resources Inc ETF
// REAL ESTATE
//   FFR - First Trust FTSE EPRA/NAREIT Global Developed Market Real Estate Idx ETF
//   FRI - First Trust S&P REIT Index ETF
// UTILITIES
//   FXU - First Trust Utilities AlphaDEX ETF
//   FIW - First Trust Water ETF
//   GRID - First Trust Nasdaq Clean Edge Smart Grid Infrastructure Index ETF
// BONDS
//   SHY - iShares 1-3 Year Treasury Bond ETF
//   BIL - SPDR Bloomberg 1-3 Month T-Bill ETF
```

The strategy's universe is a bit of a smorgasbord of ETFs. Because many of these ETFs are highly correlated, we are not sure that this is helpful. At the same time, it seems that some asset classes might be underrepresented, namely commodities and bonds.

Further, we notice a filter that prevents the strategy from entering positions when the traded volume is less than $250k. In our opinion, trading volume of ETFs has a very different relevance than the trading volume of stocks. Because ETFs continuously create and redeem shares (overnight, in creation units of ~50k shares), the authorized participants should have enough inventory of shares to act as a counterparty when no other buyer/seller is found on the secondary market. In our opinion, this filter should be removed.

Modification #1: Allow bonds in risk-off periods

We modified the strategy as follows:

- Allow bonds in risk-off periods
- Add IEF to the universe

	All trades	Long trades	Short trades	Buy&Hold ($SPXTR)
Initial capital	100000.00	100000.00	100000.00	100000.00
Ending capital	601438.45	601438.45	100000.00	401649.35
Net Profit	501438.45	501438.45	0.00	301649.35
Net Profit %	501.44%	501.44%	0.00%	301.65%
Exposure %	84.70%	84.70%	0.00%	100.00%
Net Risk Adjusted Return %	591.99%	591.99%	N/A	301.65%
Annual Return %	12.53%	12.53%	0.00%	9.58%
Risk Adjusted Return %	14.79%	14.79%	N/A	9.58%
Total transaction costs	3296.26	3296.26	0.00	0.92
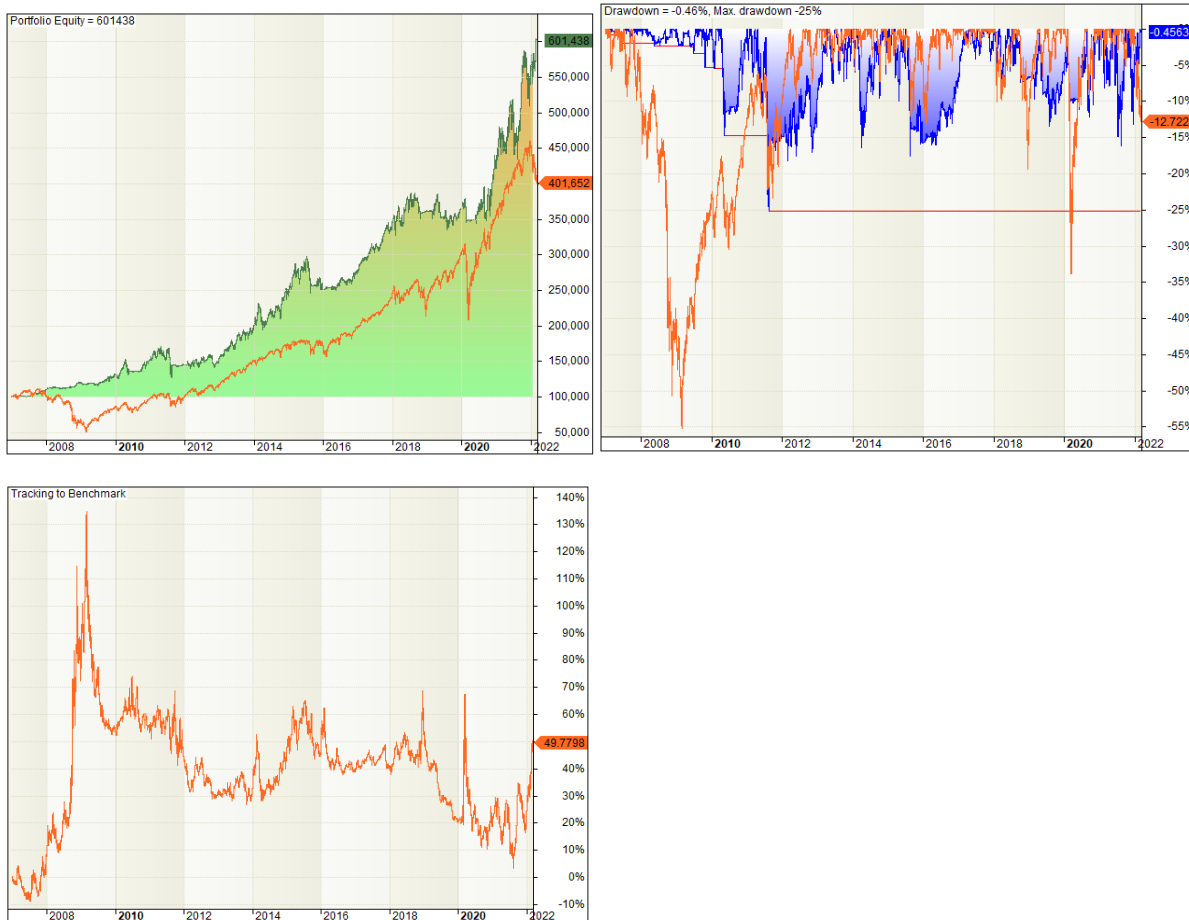
While we notice a slight improvement in performance, the results otherwise showed only very little change.

Modification #2: Remove Trade Volume Filter

We modified the strategy as follows:

- Remove the trade-volume filter

	All trades	Long trades	Short trades	Buy&Hold ($SPXTR)
Initial capital	100000.00	100000.00	100000.00	100000.00
Ending capital	350360.35	350360.35	100000.00	401649.35
Net Profit	250360.35	250360.35	0.00	301649.35
Net Profit %	250.36%	250.36%	0.00%	301.65%
Exposure %	80.78%	80.78%	0.00%	100.00%
Net Risk Adjusted Return %	309.93%	309.93%	N/A	301.65%
Annual Return %	8.60%	8.60%	0.00%	9.58%
Risk Adjusted Return %	10.64%	10.64%	N/A	9.58%
Total transaction costs	2662.02	2662.02	0.00	0.92

This change has much larger than expected implications. We expected that the strategy might even behave better with the filter removed, but the results are significantly worse. This shows that there are fundamental issues with asset ranking that should be solved. If a trade volume filter is required, it should be added back as a final step of strategy development.

# Modification #3: New Momentum Formula

We modified the strategy as follows:

- Change the momentum formula to
  ```
  mom = 100 * 252 * LinRegSlope(log(C), momPer);
  vol = 100 * sqrt(252) * StDev(log(C / Ref(C, -1)), stdPer);
  ps = 10000 + mom / Max(vol, 20);
  ```
  with *momPer = 210* and *stdPer = 10*

	All trades	Long trades	Short trades	Buy&Hold ($SPXTR)
Initial capital	100000.00	100000.00	100000.00	100000.00
Ending capital	563559.11	563559.11	100000.00	401649.35
Net Profit	463559.11	463559.11	0.00	301649.35
Net Profit %	463.56%	463.56%	0.00%	301.65%
Exposure %	85.74%	85.74%	0.00%	100.00%
Net Risk Adjusted Return %	540.64%	540.64%	N/A	301.65%
Annual Return %	12.05%	12.05%	0.00%	9.58%
Risk Adjusted Return %	14.05%	14.05%	N/A	9.58%
Total transaction costs	3273.28	3273.28	0.00	0.92
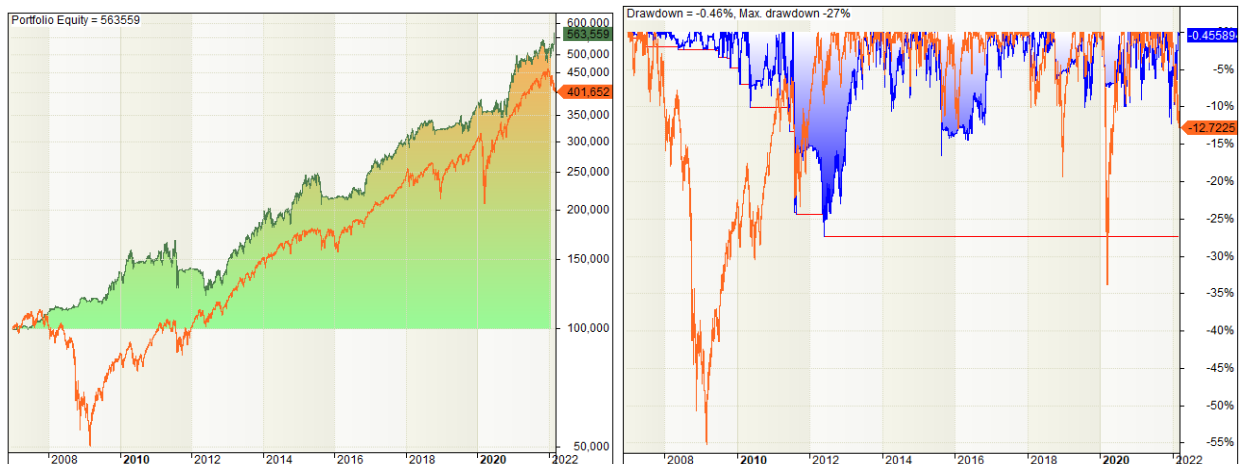
The backtest shows an improvement in performance. However, the strategy still massively underperformed between 2009 and 2021 and does not add much value in the remaining years.

Next Steps

We have reached the limit of experiments that can be quickly executed in Amibroker. Because TuringTrader is much more flexible in terms of calculating complex indicators and implementing non-trivial trading rules, it will be significantly more productive to code the strategy for TuringTrader before continuing the evaluation.

Once this effort is done, we suggest investigating the following:

- Isolate the market regime filter and implement separate strategies for bull and bear markets
- Potentially use the previously developed bond strategy for bear markets
- Experiment with more complex ranking schemes
- Experiment with dynamic position sizing
- Streamline the strategy's universe