Long-only multi-asset momentum: searching for absolute returns

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Abstract

The forward perspectives for the 60/40 portfolio have deteriorated since secular tailwinds (that have benefited equities) are fading and stock-bond correlation may become positive. For this reason, allocating to uncorrelated strategies seems rational. In this paper we develop a long-only multi-asset momentum strategy that shows attractive risk-adjusted returns and the ability to generate positive returns on a rolling basis, while having low correlation with traditional portfolios. The strategy is based on a robust approach that considers several momentum measures and formation periods. It can be used in a standalone basis or combined with a 60/40 portfolio, generating higher returns with lower volatility and a fraction of the drawdowns.

Keywords: absolute returns, multi-asset momentum, trend-following, 60/40 portfolio, tactical asset allocation.

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1. Introduction

The 60-40 portfolio has performed exceptionally well over the last decades. Stocks have been the principal return generator of this portfolio, while bonds have played an important role reducing equity risk. Furthermore, bonds have served as an important diversifier for stocks, given the low (and even negative) correlation between these two assets observed during the last couple of decades[1]. However, recent developments call into question the forward returns of the 60-40 portfolio. First, high stock valuations and the withdrawal of years of accommodative monetary policies cloud the perspective for equity investments, or at least for passive investing. Second, stock-bond correlation has not always been negative, as we have experienced during the present year[2]. In this sense, the current environment favors drifting away from the 60-40 portfolio and allocating to uncorrelated strategies.

Alternative asset strategies have been widely studied in the literature and used by practitioners. Hedge funds and commodity trading advisors (CTAs) have used systematic macro and managed futures strategies for many decades. These strategies often consider several approaches, including price momentum, trend-following, macro momentum, relative value and carry. The attractiveness of these strategies relies on the potential for uncorrelated returns with traditional asset classes.

Under this wide range of alternatives, momentum and trend-following emerge as the most important. There is a vast amount of literature that explains the momentum effect and finds evidence of its persistence over time. Momentum have been applied to individual stocks (Jegadeesh and Titman (1993)), sectors/industries (Faber (2010)) and asset classes (Asness, Moskowitz and Pedersen (2013)). It consists of buying past winners and selling past losers; in other words, buying assets that are trending up and selling assets that are trending down. Furthermore, these studies suggest that the momentum effects persist over 3-to-18-month periods and reverses in 3 to 5 years.

In this paper we are interested in long-only momentum. In particular, the objective is to develop a multi-asset momentum strategy that fulfills two primary goals: 1) show attractive risk-adjusted returns and 2) generate absolute returns (uncorrelated with traditional asset classes). For this purpose, we evaluate several momentum signals and construct a ranking to select the top assets. We invest in the top assets if they exhibit positive momentum; otherwise, we allocate to a portfolio of risk-off assets. The strategy´s backtest shows historically attractive risk-adjusted returns and low drawdowns, with great potential for adding value to traditional portfolios.

The paper is structured as follows. In section 2, we explain the rationale for the asset universe selection. Additionally, in section 3, we walk through the different features related to momentum and describe our investment philosophy. In section 4, we show the performance metrics and evaluate the strategy, while section 5 discusses the role of the strategy within traditional portfolios. Finally, section 6 concludes.

[1] For example, see AQR (2022).

[2] In fact, AQR (2022) explains that the main drivers of the stock-bond correlation are inflation and growth uncertainties. If inflation uncertainty is high, then we should expect a positive correlation, while the opposite should be anticipated if growth uncertainty predominates. Given the current uncertainty around inflation, we should expect a positive correlation between stocks and bonds.

2. Asset universe

The main goal is to develop a strategy that generates absolute returns. For this purpose, our asset universe must be as broad as possible (minimizing overlapping assets) and should contain assets with positive ex-ante expected returns for at least one state of the economy. In principle, we can characterize economic regimes using two variables: inflation and growth. Since inflation can be rising or falling and growth can be accelerating or slowing, there are four possible combinations of these variables. In this sense, our universe must include assets that prevail in at least one of the four macroeconomic regimes: rising inflation and accelerating growth, falling inflation and accelerating growth, rising inflation and slowing growth, and falling inflation and slowing growth.

In a rising inflation/accelerating growth environment, we should expect that Commodities (Energy and Agriculture), Metals, Real Estate and Emerging Markets equities show positive performance. Alternatively, during the falling inflation/accelerating growth regime, we should anticipate that Corporate Bonds (IG and HY), Treasuries, Developed Markets equities and Real Estate exhibit positive returns. On the other hand, when growth slows and inflation is rising, assets such as Cash, Gold and Commodities should behave well. Finally, if growth is slowing and inflation falls, Treasuries should have positive returns. In this sense, our asset universe is composed of the following asset classes and ETFs:

- US Large Cap Equities (S&P 500): SPY
- US Large Cap Equities (Nasdaq 100): QQQ
- US Small Cap Equities (Russell 2000): IWM
- European Equities: VGK
- Japanese Equities: EWJ
- Emerging Markets Equities: EEM
- US Real Estate: VNQ
- Commodities: DBC
- Commodities (agriculture): DBA
- Gold: GLD
- Investment Grade US Corporate Bonds: LQD
- High Yield US Bonds: HYG
- Long-term US Treasuries: TLT
- Cash: SHV
- Medium-term US Treasuries: IEF

The asset universe is composed of equities, bonds, commodities, gold and real estate. Regarding equities, we differentiate between US Large Cap, US Small Cap, Europe, Japan and Emerging Markets. In particular, US Large Cap is divided into S&P 500 and Nasdaq 100, given that the latter is more concentrated in technology stocks. Fixed income includes US investment grade, US high yield and US treasuries. Finally, we include two commodities funds since DBC is focused on energy, while DBA is fully concentrated in agriculture.

Since our focus is a long-only dual momentum strategy, our asset universe is segmented into two components. The first group includes the assets that we will invest in when they exhibit positive momentum (Risk-On universe), and the second group contains the assets that we will hold when the risk-on assets show negative scores (Risk-Off universe). The latter is composed of cash and medium-term treasuries, while the former contains the rest of the asset universe.

Before going through the investment process, we must mention some caveats regarding our asset universe. We attempt to choose assets with positive ex-ante expected returns in at least one of the four macroeconomic regimes. However, we acknowledge that such returns could be negative, reason why we must emphasize that our strategy is not dogmatic. Although our asset universe selection is based on fundamental principles, the strategy is completely systematic and will select the best assets with positive trends and strong momentum, without regarding the state of the economy.

3. Investment process

As previously discussed, we are interested in constructing a multi-asset (systematic) momentum strategy. In general, momentum strategies consist in buying past winners (assets with highest/positive momentum) and selling past losers (assets with lowest/negative momentum). However, since our main goal is to develop a long-only strategy, we focus on selecting the best assets with positive momentum. In this process, we must answer the following questions: how do we define a "past winner"? How do we define a "winner"? What do we mean about "past"? In other words, the process of developing a momentum strategy entails selecting the momentum measure and the look-back period.

3.1. Measuring momentum

There are several ways to measure momentum. For instance, momentum can be assessed by calculating past price returns or total returns (Antonacci, 2016), price minus moving averages (Bruder et al., 2011) and moving average crossovers (Levine and Pedersen, 2015), among others. As Hoffstein (2018) explains, these measures are ~~strongly related~~. On the other hand, some practitioners are interested in risk-adjusted momentum (ReSolve, n.d.). Moreover, authors such as Keller and Butler (2014) modify the traditional total return momentum to adjust for the correlation of the specific asset with the rest of the universe.

In this paper we explore three measures of momentum. First, we consider traditional total return momentum. Second, we use the price minus moving average measure. Third, we consider a risk-adjusted measure that corrects the total return score by the sum of absolute daily movements, thus penalizing assets with "inefficient" trends. The calculation for each of these momentum indicators is shown below.

$$Total\ return\ momentum\text{:}\quad r_{t,n}^{i} = \frac{P_t - P_{t-n}}{P_{t-n}}$$

$$Price\ minus\ moving\ average\text{:}\quad r_{t,n}^{i} = \frac{P_t}{SMA_{t,t-n}} - 1$$

$$Risk\ adjusted\ momentum:\ r_{t,n}^{i} = \frac{\ln \frac{P_t}{P_{t-n}}}{\sum_{i=t-n}^{t-1} \left| \ln \frac{P_{i+1}}{P_i} \right|}$$

Where $r_{t,n}^{i}$ is the respective momentum measure for asset i at time t with look-back period n (in days or months), P_t is the asset´s total return index at time t, and $SMA_{t,t-n}$ is the total return index simple moving average a time t with look-back period n.

The total return momentum calculation simply measures the past returns. Assets with high past returns are assets with strong momentum, and therefore should have high returns in the following periods. On the other hand, the price minus moving average calculation measures the distance between the price and the trend. A higher (and positive) distance means that the trend will accelerate, which implies that the asset has higher momentum. Finally, the risk adjusted momentum measure corrects the total return measure by the dispersion of the daily movements, penalizing assets with high dispersion. The rationale for this metric is that, although we favor assets with strong momentum, we would also like to consider the path towards such returns. In other words, comparing two assets with the same total return, we have preference for the one with the smoother path, i.e. we prefer assets with "efficient" trends.

These three measures are related and should produce a similar momentum ranking. However, each one of them approaches momentum from (slightly) different angles, reason why results can differ. In this sense, we must decide which measure to use, topic that is discussed in subsequent sections.

3.2. Look-back period

The second feature that we must consider in our momentum strategy is the look-back period. This is by no means a trivial choice since it could have significant impact on the strategy´s results. Practitioners and academics often consider formation periods that span between 1 and 18 months. In particular, the most common are 1, 3, 6 and 12 months. From a daily perspective, the most used moving averages are 20, 50, 100 and 200 days.

The selection of the look-back period is often related to the strategy´s objectives and desired trading frequency. More frequent strategies often consider smaller look-back periods. These strategies offer the advantage of capturing rapid changes in momentum and trend, at the expense of acting on noise. Alternatively, strategies with less turnover often use longer formation periods. They aim to capture long term trends and cancel out noise, with the drawback of slowly reacting to changes in momentum.

In this paper, we are interested in medium- and long-term momentum. In other words, we want to ride long-term trends and minimize noise, attempting to capture changes in momentum as fast as possible. For this reason, we discard short look-back periods (less than 3 months / 50 days) and very long look-back periods (greater than 12 months / 200 days). However, this still leaves us with multiple time frames to consider, topic that is discussed in following sections.

3.3. Adjusting for correlation

Before discussing the selection of the measure and look-back period, it is necessary to introduce an additional element for our momentum score. Since our goal is to generate absolute returns, our strategy should consider the correlation between each asset and the rest of the portfolio. In other words, in addition to preferring high momentum assets, we also want to favor assets with low correlations. By placing emphasis on the assets with low correlations, we maximize the likelihood that our strategy selects assets that have positive trends while the rest of the universe shows negative momentum. This approach has been used by Keller and Keuning (2016).

The general idea is to adjust the momentum score by the correlation between the asset and a portfolio composed of the asset universe (equally weighted). If the correlation is positive, the momentum score should be penalized, with the magnitude of the correction depending on the size of the coefficient. On the other hand, if the correlation is negative, the score should be enhanced. In this paper, we follow Keuning´s (n.d.) approach and propose the following adjustments for the momentum score.

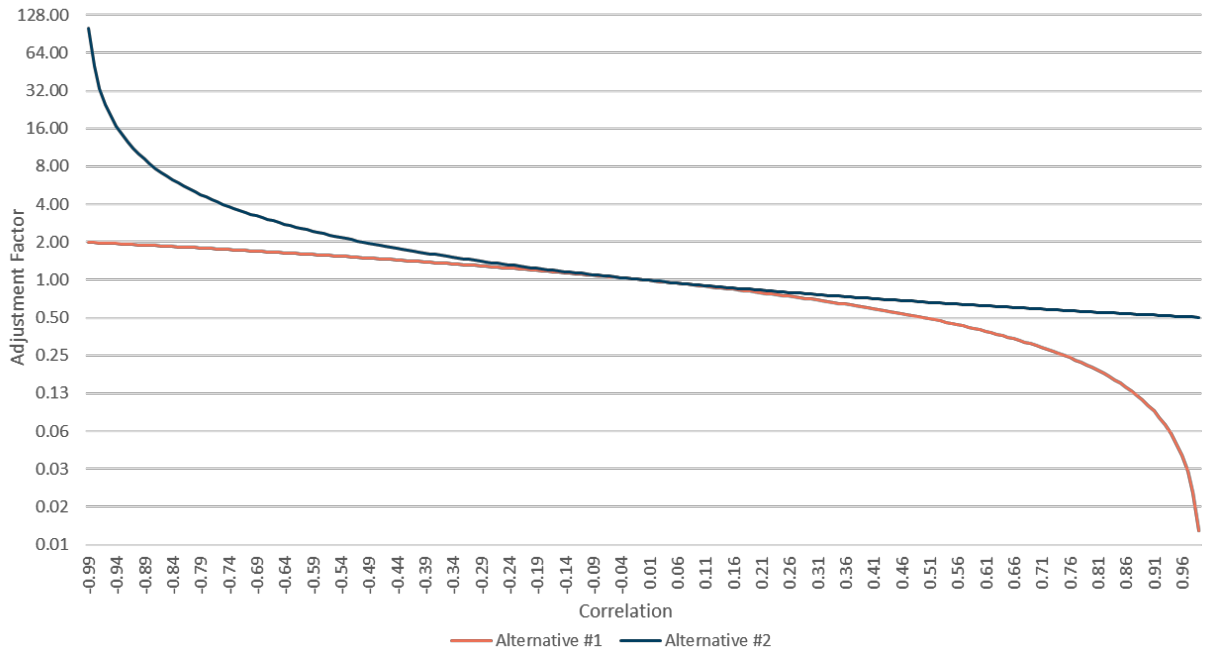
$$Correlation\ adjustment\ \#1: \quad \varphi_{t,n}^{i} = r_{t,n}^{i}\,(1-\rho)$$

$$Correlation\ adjustment\ \#2: \quad \varphi_{t,n}^{i} = \frac{r_{t,n}^{i}}{(1+\rho)}$$

where $\varphi_{t,n}^{i}$ is the correlation-adjusted score and ρ is the asset´s correlation with the asset universe portfolio (equally weighted).

These alternatives penalize high/positive correlations and favor low/negative correlations. However, the adjustments are nonlinear. For instance, the first alternative places more weight on penalizing high correlations and less weight favoring negative correlations, while the second alternative prefers favoring negative correlations over penalizing positive coefficients. Both alternatives show similar behavior when the correlations are around zero. These features are shown in the following chart.

Chart 1. Correlation Adjustments



Source: own calculations.

To get a better understanding of each alternative, we present a table with the 12-month average correlation between each asset and the rest of the universe.

Table 1. Historical correlations with the 13-asset portfolio

SPY	0.86
QQQ	0.79
IWM	0.83
VGK	0.85
EWJ	0.74
EEM	0.85
VNQ	0.71
DBC	0.54
DBA	0.42
GLD	0.34
LQD	0.24
HYG	0.67
TLT	-0.13
SHV	-0.01
IEF	-0.10

Source: own calculations based on data retrieved from Bloomberg.

Equities tend to have higher correlations with the equally weighted portfolio[3], while bonds usually show near zero or negative correlations. In this sense, alternative #1 penalizes equities greatly, while alternative #2 generates a much smaller penalization. A strategy based on the first alternative would probably have less exposure to equities in comparison to a strategy that follows the second alternative, reason why the results could show important differences. We explore these differences in subsequent sections.

3.4. Parameter selection – our philosophy

The selection of the measure and look-back period is often at the core of momentum strategies. The natural decision is perhaps selecting the measure and look-back period that exhibits the best past performance (absolute or risk-adjusted), i.e. running an optimization. For example, if we determine that the total return measure and the 6-month look-back period shows the highest returns in the backtest, we would be inclined to choose this combination. Many investors would feel tempted to select the parameters with best past performance; however, we think this reasoning is flawed.

The fact that a specification has delivered the best performance in the past doesn´t necessarily mean that it will be the best combination in the future. A single specification may have just been lucky, while others may have been unfortunate. For example, let´s suppose that a specific asset has shown positive 6-month total return momentum for the past months, and assume that in the next month it will exhibit positive returns. If the most recent print shows a slightly positive score (0.5%), it would suggest maintaining that asset, thus benefiting from the forward returns. However, if the score is slightly negative (-0.5%), the asset would be withdrawn from the portfolio, missing the next month´s returns. Both prints are extremely close, but the results differ greatly. The question is whether the difference between scores justifies the difference in returns. In other words, is the first scenario a representation of the "skill" of the signal? Or is the second scenario a realization of "bad luck"?

This example highlights the fragility of a single model. The differences between specifications may be related to realizations of "luck" (or "bad luck") rather than evidence of "skill". Since luck is intrinsically random, past luck does not imply that the model will have fortune going forward. In fact, any single specification can suffer of "bad luck" in the future, which could be catastrophic for the portfolio. In more formal terms, any single model suffers of what Hoffstein (2019) has labeled as "model specification risk".

The general idea is to minimize the model specification risk, i.e. reduce the impact of luck in our strategy. For this purpose, we believe that the appropriate path is to consider all available information rather than running optimizations. If we believe that momentum works, then all signals should provide information for our decision. In other words, there should be no superior specification; all signals should be contemplated. By considering all the available information, we believe that model specification risk can be minimized. This results in a more robust framework, which has higher odds of capturing momentum and has less exposure to fortune shocks. Although the framework would probably underperform some specifications in a given time period, we believe that it enhances the prospects for the long run.

[3] This should not come as a surprise since half of the asset universe is composed by stocks, which usually share the same risk drivers.

3.5. The strategy

The final elements of our strategy are related to portfolio construction and signal aggregation process. The next step is to figure out how to aggregate all signals. Since we have three measures (total return, price minus moving average and risk-adjusted) and three look-back periods (3, 6 and 12 months / 50, 100 and 200 days), there are nine possible combinations. We propose two alternatives that take advantage of all the information embedded in these nine signals. The first alternative is to use an ensemble approach. We can consider each combination as a sub-strategy that will inform us on a specific asset allocation. If we run all sub-strategies and average out the allocations for each asset, then we would have the total portfolio allocation. The second alternative is to construct a score that aggregates all signals. For instance, we could rank the assets in each specification, assign a score to each place, and add the scores across all the signals. This will create a final score, allowing us to select the assets in the top positions. The score assignment doesn't need to be linear, it could favor assets in the top part of each ranking or penalize assets with negative momentum. We label this alternative as the "scores approach".

Finally, the portfolio construction process is as follows. At the end of each month, we rank the 13 risk-on assets according to their momentum (aggregating all signals). We select the top N assets and assign each asset an equal weight (1/N). If any of the assets exhibit negative momentum[4], it is substituted by the risk-off asset with highest score. We hold the portfolio for one month and repeat the process.

4. Historical Performance

In this section, we explore the strategy´s results. We first show the performance for the regular strategy and then discuss a slight variation more suitable for conservative investors.

4.1. Backtest

We perform the backtest using daily observations from 12/31/2003 to 05/31/2022. The data was retrieved from Bloomberg. The time series are based on total return indexes constructed from each ETF in the asset universe. However, since some ETFs have a more recent inception date, we complete the backtest using the total return of the respective underlying index. At each evaluation date, we select the top 5 assets according to their momentum scores.

We focus on several performance metrics. First, we show the total return during the whole period and the compounded annual growth rate (CAGR)[5]. Second, we present the annualized standard deviation, the return/risk ratio, and the maximum drawdown observed during the period. Finally, since we focus on absolute returns, we display the probability of the 1 year rolling returns being positive or higher than -5%.

[4] With the ensemble approach, assessing whether an asset exhibits negative momentum is straightforward. However, with the aggregate score approach, we must define how to determine if the asset has negative momentum. One alternative is to count the number of signals and compare with a specified threshold. The natural threshold is perhaps using half of the signals (however, we also use one third as a threshold, for a more conservative approach). In this sense, if more than half (or more than a third) of the signals show negative momentum, we categorize such asset as an asset with negative momentum.

[5] We also present the performance for specific periods in appendix 1.

We present the results for the momentum measures adjusted for correlation (using both alternatives discussed in section 3.3) and without adjustments (pure momentum). We show the scores approach (using both thresholds), the ensemble approach and each single specification for all the three adjusted measures. The results are displayed in the following tables.

Table 2. Results with pure momentum measure

	Total Return	Annual Return	Volatility	Ret/Vol	Max DD	P(1Y RR > 0%)	P(1Y RR > -5%)
Score approach, 1/2 signals threshold	536.16%	10.58%	12.17%	0.87	-23.20%	80.93%	91.33%
Score approach, 1/3 signals threshold	584.76%	11.02%	11.79%	0.93	-16.51%	83.01%	95.64%
Ensemble	446.91%	9.68%	11.23%	0.86	-18.99%	84.01%	92.11%
TR Momentum, 3 months	538.41%	10.60%	12.87%	0.82	-24.35%	82.78%	89.19%
TR Momentum, 6 months	562.91%	10.83%	12.91%	0.84	-16.97%	88.14%	95.32%
TR Momentum, 12 months	388.66%	9.01%	13.47%	0.67	-23.59%	78.79%	87.75%
Price minus MA, 50 days	302.19%	7.86%	12.58%	0.62	-23.43%	78.44%	88.71%
Price minus MA, 100 days	550.12%	10.71%	12.46%	0.86	-23.50%	79.95%	91.42%
Price minus MA, 200 days	497.11%	10.20%	12.61%	0.81	-19.76%	82.64%	93.34%
Risk-adjusted momentum, 3 months	477.22%	10.00%	11.09%	0.90	-23.46%	83.60%	90.21%
Risk-adjusted momentum, 6 months	469.98%	9.92%	11.15%	0.89	-18.09%	87.73%	95.10%
Risk-adjusted momentum, 12 months	233.94%	6.77%	11.39%	0.59	-23.41%	76.55%	85.26%

Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Table 3. Results with multiplicative correlation-adjusted measure (alternative #1)

	Total Return	Annual Return	Volatility	Ret/Vol	Max DD	P(1Y RR > 0%)	P(1Y RR > -5%)
Score approach, 1/2 signals threshold	352.71%	8.55%	10.34%	0.83	-23.32%	85.77%	93.29%
Score approach, 1/3 signals threshold	406.10%	9.21%	9.94%	0.93	-13.40%	89.17%	97.15%
Ensemble	335.79%	8.33%	9.23%	0.90	-17.55%	85.99%	92.79%
TR Momentum, 3 months	335.60%	8.33%	10.74%	0.78	-24.74%	83.42%	89.42%
TR Momentum, 6 months	398.25%	9.12%	10.55%	0.86	-15.28%	88.12%	95.85%
TR Momentum, 12 months	329.42%	8.24%	10.53%	0.78	-20.15%	84.44%	93.36%
Price minus MA, 50 days	258.46%	7.19%	10.35%	0.69	-23.21%	79.38%	88.39%
Price minus MA, 100 days	396.23%	9.10%	10.43%	0.87	-21.96%	82.19%	91.86%
Price minus MA, 200 days	485.56%	10.08%	10.76%	0.94	-20.29%	88.23%	94.27%
Risk-adjusted momentum, 3 months	265.71%	7.30%	9.60%	0.76	-22.33%	82.41%	89.94%
Risk-adjusted momentum, 6 months	325.85%	8.19%	9.48%	0.86	-15.47%	88.96%	96.19%
Risk-adjusted momentum, 12 months	221.14%	6.55%	9.20%	0.71	-20.02%	83.26%	91.56%

Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Table 4. Results with divisive correlation-adjusted measure (alternative #2)

	Total Return	Annual Return	Volatility	Ret/Vol	Max DD	P(1Y RR > 0%)	P(1Y RR > -5%)
Score approach, 1/2 signals threshold	590.66%	11.08%	11.60%	0.95	-22.30%	84.72%	92.86%
Score approach, 1/3 signals threshold	705.31%	12.01%	11.22%	1.07	-14.47%	89.32%	96.44%
Ensemble	453.87%	9.75%	10.55%	0.92	-17.74%	85.12%	92.77%
TR Momentum, 3 months	532.28%	10.54%	12.29%	0.86	-24.31%	83.71%	89.44%
TR Momentum, 6 months	605.20%	11.20%	12.36%	0.91	-16.17%	89.12%	95.69%
TR Momentum, 12 months	386.01%	8.97%	12.65%	0.71	-20.15%	80.20%	89.85%
Price minus MA, 50 days	322.36%	8.15%	11.85%	0.69	-23.15%	79.81%	89.26%
Price minus MA, 100 days	509.19%	10.32%	11.84%	0.87	-23.04%	81.64%	91.58%
Price minus MA, 200 days	561.47%	10.82%	12.19%	0.89	-20.08%	85.74%	93.66%
Risk-adjusted momentum, 3 months	395.91%	9.09%	10.45%	0.87	-23.51%	83.51%	90.12%
Risk-adjusted momentum, 6 months	537.21%	10.59%	10.56%	1.00	-15.47%	89.14%	95.94%
Risk-adjusted momentum, 12 months	244.93%	6.96%	10.27%	0.68	-20.02%	77.35%	89.21%

Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Some comments are in order. First, comparing between the three tables, we can appreciate that, in general, table 3 shows the best returns (absolute and risk-adjusted), while table 2 exhibits the lowest volatility and drawdowns. This must not come as a surprise since the first alternative for the correlation-adjusted measure penalizes equities greatly (and thus favors bonds), whereas the second alternative does not penalize equities as much (favoring equities on a relative basis). We discussed this point in previous sections. More importantly, both correlation-adjusted measures tend to show better metrics that the non-adjusted measure. This leads us to believe that there is value added by adjusting the momentum measure with the asset's correlation, although we acknowledge that more formal statistical tests should be applied.

Comparing all three tables, we prefer the second alternative for the correlation adjustment, reason why we will focus our analysis on table 3 (although a similar analysis applies for the other tables). In the first place, both approaches (ensemble and scores approach) tend to show better risk-adjusted performance and smaller drawdowns than most of the single specifications. For instance, only the risk-adjusted 6-month momentum exhibits better return/risk measure than the ensemble approach and the score approach with a 1/2 threshold. This highlights one of the most attractive characteristics of our model: the process is not only more robust and thus reduces model specification risk, but also generates better results than most of the single specifications.

On the other hand, it is worth noticing that the best results are shown by the scores approach with a 1/3 threshold. It seems that by being more conservative (categorizing an asset as "negative momentum" if more than a third of the signals are negative), it avoids important drawdowns and thus shows higher compounded returns in the long run. Although the 1/3 threshold sounds somewhat arbitrary (compared to the 1/2 threshold), it appears reasonable to take a more conservative approach by defining that an asset has negative momentum if just a few signals are negative. However, we will use both versions (in addition to ensemble approach) for the remainder of the paper.

In general, the return, volatility and drawdown metrics appear to be attractive. Nonetheless, with the purpose of gaining more insight, we add the statistics for the 60/40 portfolio[6], S&P 500 (ETF: SPY) and the 13-asset equally weighted portfolio. We must highlight that these portfolios do not constitute an appropriate benchmark for our strategy, we just show them to give a general reference.

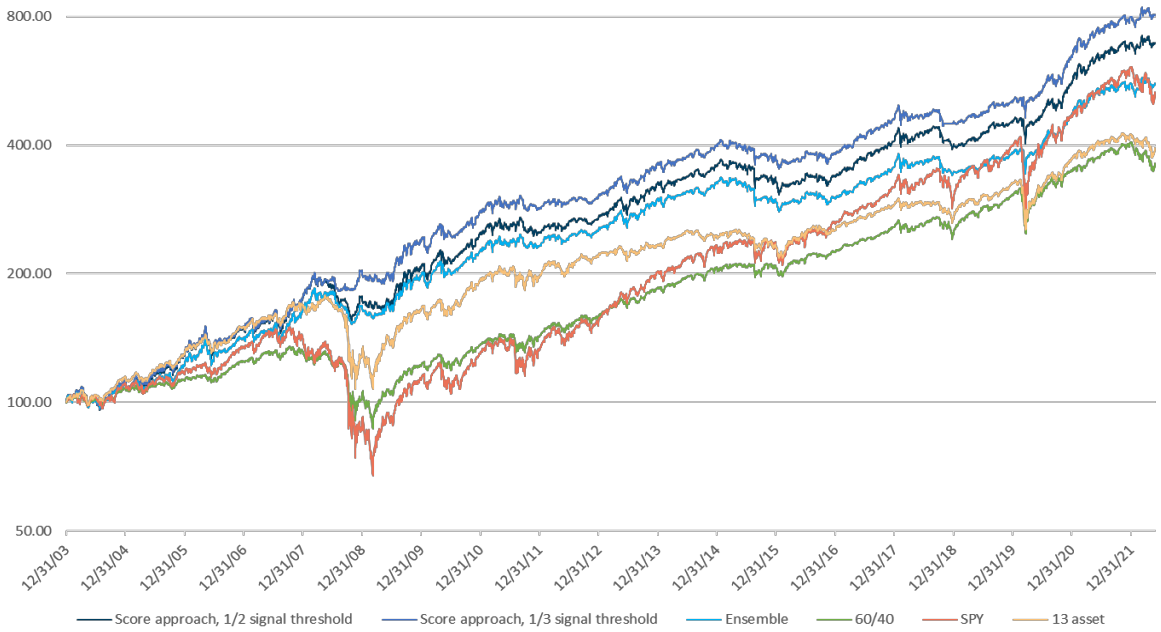
Table 5. The strategy and some reference portfolios

	Total Return	Annual Return	Volatility	Ret/Vol	Max DD	P(1Y RR > 0%)	P(1Y RR > -5%)
Score approach, 1/2 signals threshold	590.66%	11.08%	11.60%	0.95	-22.30%	84.72%	92.86%
Score approach, 1/3 signals threshold	705.31%	12.01%	11.22%	1.07	-14.47%	89.32%	96.44%
Ensemble	453.87%	9.75%	10.55%	0.92	-17.74%	85.12%	92.77%
60/40 Portfolio	260.46%	7.22%	11.32%	0.64	-35.78%	88.48%	93.25%
SPY	429.26%	9.48%	19.09%	0.50	-55.20%	85.97%	90.26%
13 asset portfolio	290.22%	7.68%	13.34%	0.58	-39.58%	84.05%	91.40%

Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

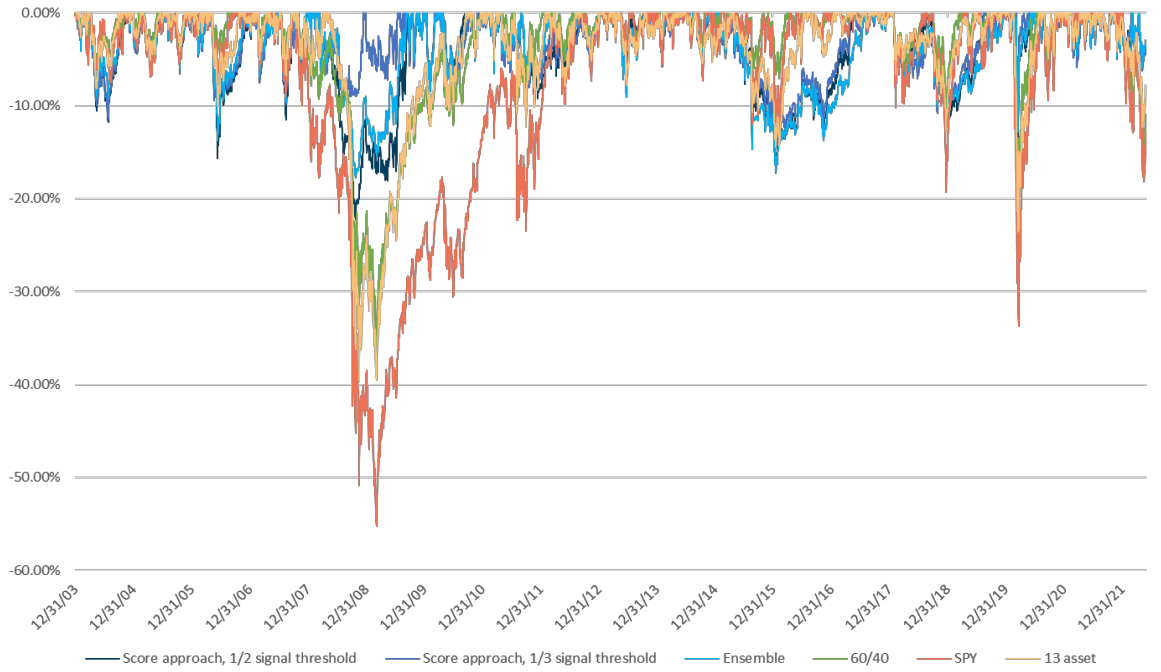
[6] The 60-40 portfolio is composed by 60% SPY and 40% AGG (US Aggregate), rebalanced monthly at the end of each month. The performance metrics include the reinvestment of dividends (total return).

Chart 2. Growth of a $100



Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Chart 3. Drawdowns



Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

The strategy shows similar volatility to the 60/40 portfolio, with higher total returns than the S&P 500. Moreover, maximum drawdowns are cut by approximately half of those experienced by the 60/40 portfolio. In this sense, the strategy has the benefit of low volatility given by the 60/40 portfolio, shows potential for equity-like returns, and dramatically reduces drawdowns. All in all, the strategy appears to be very attractive from a risk-adjusted basis.

However, we must mention some caveats regarding our strategy. The probability of 1-year rolling returns being positive or higher than -5% is not significantly different than those seen in the reference portfolios. Additionally, these probabilities seem rather small to achieve the absolute return goal. Following Keller and Keuning (2016), we should expect that an absolute return strategy exhibits a probability of positive 1-year rolling returns higher than 95%, and a 99% probability of rolling returns better than -5%[7]. In this sense, although the strategy appears to accomplish the risk-adjusted goal, it fails to generate absolute returns on a rolling basis. For this reason, we discuss a simple modification of the strategy that could help us succeed towards the absolute return goal.

4.2. Seeking absolute returns

We believe that a more defensive approach in our asset allocation is necessary to achieve the absolute returns goal. In this sense, we propose a slight variation of our model that considers the number of assets with negative momentum in the determination of the exposure to risk-on assets. Once this exposure is assessed, we follow the previous rules for the portfolio construction.

Based on Keller and Keuning (2016), we suggest the following formulae to define the exposure to risk-on assets.

$$\%\ Risk\ On\ Exposure = \max\left(1 - \frac{n}{N - q * \frac{N}{4}}, 0\%\right)$$

where n is the number of assets with negative momentum, N is the number of assets in the risk-on universe, and q depends on the desired level of protection ($q = 0,1,2$).

The rationale for this additional layer of protection relies on the fact that, when the market crashes, correlations between risky assets tend to approach unity. In this regard, too many assets with negative momentum may perhaps indicate that the remaining assets will fall. In previous sections, we explained our logic for the asset universe selection, considering four possible macroeconomic regimes. In three of the regimes, we argued that some risk assets should thrive. However, in the falling inflation/slowing growth scenario, only the risk off assets were expected to show positive returns. In this sense, a large

[7] The rationale for this metric is that we should expect that no matter when the investor enters the strategy, he should have very high chances of exhibiting positive returns in one year.

number of assets with negative momentum could indicate that the economy is or will enter into such regime, signaling that the remaining assets will probably exhibit negative performance.

The selection of the parameter q depends on the desired level of protection. We can achieve a low level of protection setting the parameter to 0, which would mean that the risk-on exposure is equal to the proportion of assets with positive momentum. On the other hand, a medium level of protection ($q = 1$) indicates that if three quarters of the risk-on universe shows negative momentum, then the portfolio should be invested entirely in risk-off assets. Finally, $q = 2$ (high level of protection) means that if half of the assets exhibit negative momentum, then the portfolio would be completely protected. In this paper, we explore the low and medium levels of protection.

Table 6. The strategy with additional protection layer

	Total Return	Annual Return	Volatility	Ret/Vol	Max DD	P(1Y RR > 0%)	P(1Y RR > -5%)
Score approach, 1/2 signals threshold, low protection	431.87%	9.51%	8.81%	1.08	-11.66%	92.34%	98.43%
Score approach, 1/3 signals threshold, low protection	377.98%	8.88%	8.00%	1.11	-9.21%	94.96%	99.29%
Ensemble, low protection	312.97%	8.02%	7.61%	1.05	-9.69%	92.61%	99.18%
Score approach, 1/2 signals threshold, mid protection	383.71%	8.95%	8.27%	1.08	-10.29%	94.73%	99.54%
Score approach, 1/3 signals threshold, mid protection	304.17%	7.89%	7.37%	1.07	-8.46%	95.87%	99.98%
Ensemble, mid protection	273.86%	7.43%	6.91%	1.08	-8.39%	95.64%	100.00%
60/40 Portfolio	260.46%	7.22%	11.32%	0.64	-35.78%	88.48%	93.25%
SPY	429.26%	9.48%	19.09%	0.50	-55.20%	85.97%	90.26%
13 asset portfolio	290.22%	7.68%	13.34%	0.58	-39.58%	84.05%	91.40%

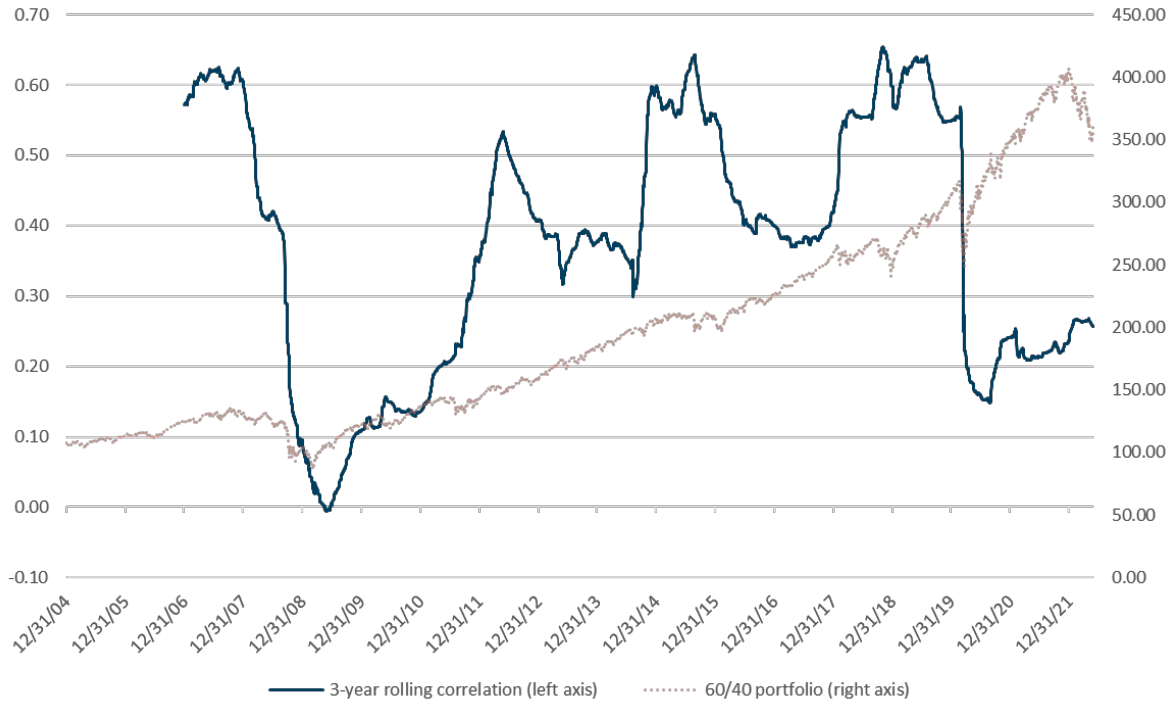
Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Adding the layer of protection improves the risk-adjusted returns. The more protective stance generates lower returns but also significantly reduces the volatility and drawdowns. More importantly, in most variations the probability of rolling returns being positive or greater than -5% is higher than 95% and 99%, respectively. Additionally, the strategy has slightly higher returns than the 60/40 portfolio (and in some instances, similar returns to the S&P 500), but reducing considerably the volatility and cutting the maximum drawdown to more than a third of the movement observed in the 60/40. In this sense, we believe that this variation of the strategy is both capable of delivering attractive risk-adjusted returns and showing positive returns on a rolling basis.

5. The role of the strategy in a traditional portfolio

The case for investing in the strategy on a standalone basis has already been discussed. However, the effects of the strategy within a traditional portfolio are not clear. Since the strategy has a multi-asset investment universe, we should expect a low correlation (on average) with the 60/40 portfolio. In this sense, allocating a percentage of the portfolio to the strategy would probably reduce the volatility and drawdowns of the overall portfolio, while enhancing returns. In the following chart we explore the 3-year rolling correlations (daily observations) between the strategy and the 60/40 portfolio. As an example, we use the variation defined by the scores approach with 1/2 signals threshold and medium protection.

Chart 4. 3-year rolling correlations between the strategy and the 60/40 portfolio



Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

The 3-year rolling correlation ranges between 0 a 0.60, with a concentration inside the 0.2-0.6 interval. The average correlation in the whole period is 0.37. Moreover, the correlation dynamics are quite interesting. The value tanked to zero during the 2008 financial crisis and became small during 2020 pandemic; in other words, the strategy switched to assets uncorrelated with the 60/40 portfolio and avoided those big drawdowns. Additionally, the correlation coefficient remained somewhat elevated between 2010 and 2020, capitalizing on the rising trend of the 60/40 portfolio. In this sense, the overall correlation is small and dynamically adapts to the movements in the 60/40. For this reason, adding the

strategy to the traditional portfolio would provide diversification benefits and enhance returns. We explore these effects in the following table[8].

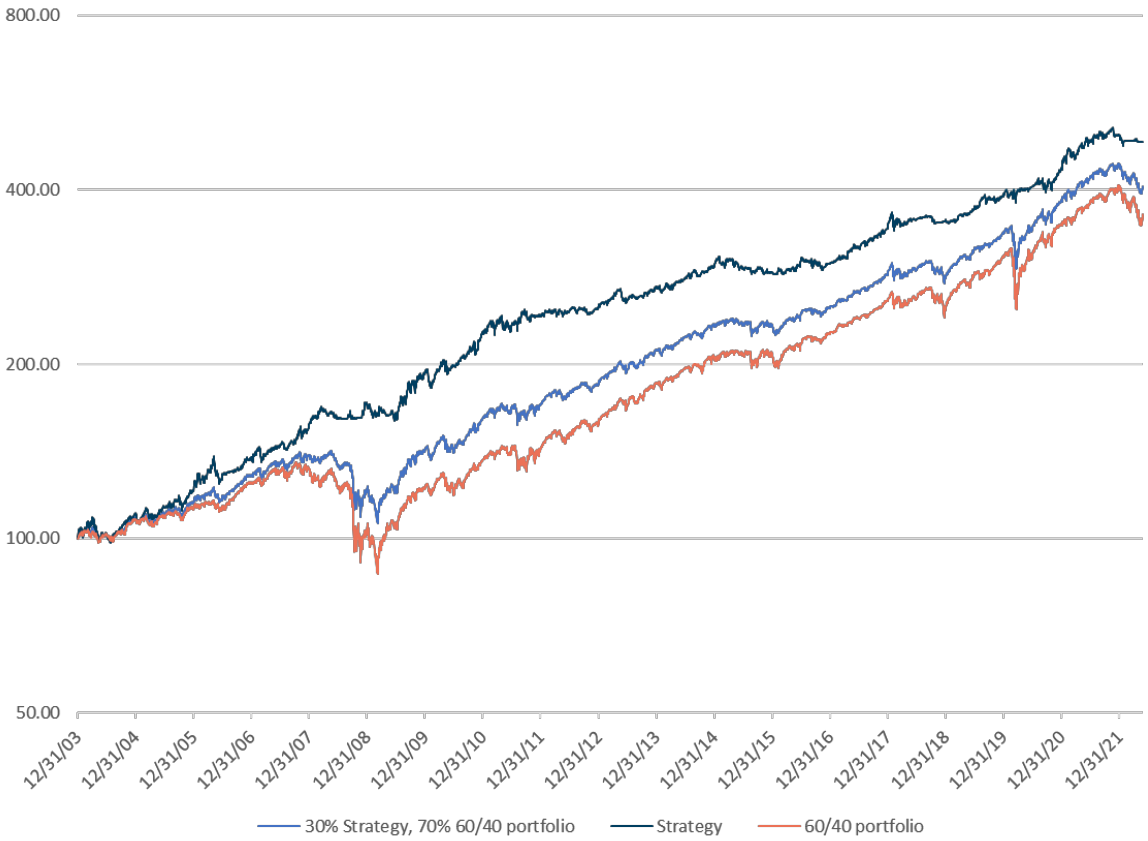
Table 7. Combining the strategy with the 60/40 portfolio

	Total Return	Annual Return	Volatility	Ret/Vol	Max DD	P(1Y RR > 0%)	P(1Y RR > -5%)
10% strategy, 90% 60/40 portfolio	275.51%	7.46%	10.47%	0.71	-32.03%	89.73%	93.91%
20% strategy, 80% 60/40 portfolio	290.18%	7.68%	9.69%	0.79	-28.32%	89.98%	94.68%
30% strategy, 70% 60/40 portfolio	304.40%	7.89%	9.00%	0.88	-24.94%	90.53%	95.32%
40% strategy, 60% 60/40 portfolio	318.07%	8.09%	8.42%	0.96	-21.71%	90.62%	95.51%
50% strategy, 50% 60/40 portfolio	331.09%	8.27%	7.97%	1.04	-18.40%	91.22%	95.67%
Strategy	383.71%	8.95%	8.27%	1.08	-10.29%	94.73%	99.54%
60/40 Portfolio	260.46%	7.22%	11.32%	0.64	-35.78%	88.48%	93.25%

Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

[8] Once again, we use as an example the scores approach with 1/2 threshold and medium level of protection.

Chart 5. Combining the strategy with the 60/40 portfolio: Growth of $100



Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Combining the 60/40 portfolio with the strategy dramatically improves the performance of the 60/40 standalone portfolio. For instance, investing 30% of the capital in the strategy and 70% in the traditional portfolio lowers the overall volatility by more than 20%, while annual returns increase by 10%. Moreover, a balanced 50% strategy and 50% 60/40 portfolio results in a volatility below 8%, while returns remain above such level and drawdowns are cut to a more manageable -18%. In fact, the return-risk ratio for this combination is very similar to the one observed in the original strategy. In this sense, the strategy appears to add value to the traditional portfolios by increasing returns and reducing volatility and drawdowns.

6. Concluding remarks

The 60/40 portfolio has delivered great returns over the last couple of decades. However, many features that favored the performance of traditional portfolios have changed recently. For instance, stock valuations are historically high and years of accommodative monetary policy are being reversed, while stock-bond correlation appears to have turned positive due to the high uncertainty around inflation. In this context of low expected returns for the 60/40 portfolio, allocating to uncorrelated strategies seems reasonable.

For this purpose, we developed a long-only multi-asset momentum strategy that shows attractive risk-adjusted returns and the ability to generate positive returns on a rolling basis, while having low correlation with traditional portfolios. The strategy exhibits higher returns than the 60/40 portfolio, with an important reduction in volatility and experiencing a fraction of the worst drawdown. Furthermore, the strategy appears to have very high chances of showing positive performance in a one-year period, i.e. it seems as a plausible strategy for generating absolute returns. It can be used in a standalone basis or combined with a 60/40 portfolio. In the latter case, it improves considerably the performance metrics of the traditional portfolio by increasing returns and reducing volatility and drawdowns.

The main difference with other momentum strategies is the approach used to capture the signals. We make no efforts to optimize the measure and look-back period. Instead, we believe that each measure and formation period addresses the issue from a slightly different angle and thus provides useful information. For this reason, we aggregate several signals in our analysis. This process reduces the model specification risk and the exposure to "luck". Although the approach may underperform a single specification in a given time period, we believe that it enhances the prospects for future returns.

Despite our robust approach and attractive historical performance, we must highlight some limitations of our strategy. For instance, we do not address an important dimension of risk embedded in momentum and trend following strategies: the "rebalance timing luck" (Hoffstein et al., 2020)[9]. Our strategy rebalances at the end of each calendar month, which makes it vulnerable to such risk[10]. Furthermore, although we attempt to capture momentum, we would like to avoid being invested in assets that have already gone parabolic. In this sense, we could improve the model by incorporating mean reversion or counter-trend signals. These are perhaps the most important areas for improvement; however, we believe that the strategy developed in this paper has an attractive outlook for future returns.

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[9] The rebalance timing luck refers to the divergences in performance associated with different rebalancing schedules (Hoffstein et al., 2020).

[10] A possible solution for minimizing rebalance timing risk is to reduce the rebalancing frequency. For example, we could divide our strategy in four sub-strategies, each one of them addressing the same signals and rebalancing at the last day of every four weeks. In this sense, every Friday we would rebalance a quarter of the portfolio and hold that sub-strategy for the next four weeks.

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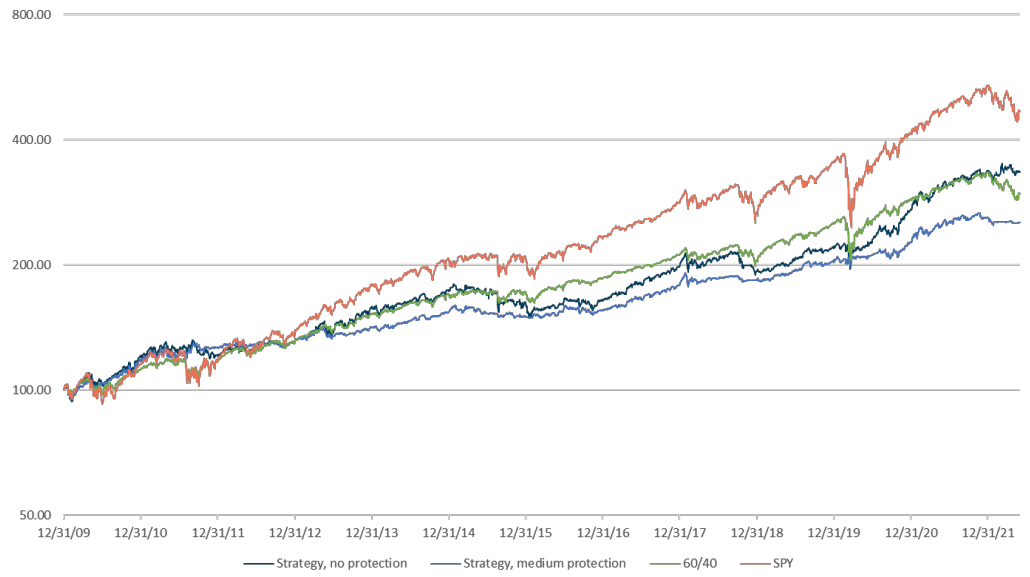
Appendix 1

The strategy shows attractive performance metrics over the entire study period. In charts 2 and 3, we can appreciate that the strategy performed well during the sharp market downturns seen in 2008-2009 and 2020. Alternatively, although the strategy showed attractive returns during the 2010 decade, it increased at a much slower pace than the equity market and 60/40 portfolio. However, a more thorough analysis of specific time periods is important for setting future expectations. In this sense, we present several charts with the performance over particular time frames.

Chart 6. Growth of $100 (12/29/2006 – 12/31/2010)

Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Chart 7. Growth of $100 (12/31/2009 – 05/31/2022)



Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Chart 8. Growth of $100 (12/31/2019 – 12/31/2020)

Source: own calculations based on data retrieved from Bloomberg. It assumes no transaction costs or management fees.

Starting with the 2008 Financial Crisis, we can appreciate that both variations of the strategy performed well. Although the strategy without protection declined during 2008, the drawdown was small and the strategy bottomed well before the traditional portfolio, recovering all losses by the end of 2009. Additionally, the protective strategy remained flat in 2008 and started increasing during the third quarter of 2009. The drawdown was almost non-existent during this period. In this sense, the behavior exhibited through the 2008 Financial Crisis highlights one key element of our strategy: during prolonged declines in markets, the strategy is expected to have small drawdowns and effectively protect capital.

The behavior observed during 2020 somewhat resembles the one experienced in previous crashes. The protective strategy barely moved during March, and started grinding up around May, closing the year with a 12% gain. The strategy without protection experienced a small drawdown, had a slow recovery the following months, and accelerated the pace during the second half, sustaining a better return than the S&P 500 at the end of the year. However, we must highlight that the strategy may have slightly benefited from rebalance timing luck. At the end of February, the strategy switched to a more defensive stance, avoiding part of the March´s crash[11].

The picture is different when equity markets exhibit prolonged uptrends. For instance, between 2010 and 2019, the strategy rose at a much slower pace than equities and traditional portfolios. Since the strategy tends to have a defensive stance, short corrections followed by rapid recoveries imply that the strategy will switch to other uncorrelated assets and will thus forego the fast rebounds in stocks. However, despite showing lower returns than equities and traditional portfolios during this period, the strategy experienced non-negligible returns: the regular strategy had a CAGR of roughly 8.2%, while the protective strategy exhibited an annual 7.4% return.

The previous analysis gives us some insights for setting future expectations. During prolonged downtrends in global assets, we should expect the strategy to have low drawdowns. When assets start to recover, the strategy should remain in a defensive stance; however, as momentum increases, the strategy should adapt and raise the exposure to risk-on assets. The result is a combination of attractive returns, low volatility, and minimum drawdowns over long periods of time. These characteristics come with a cost: during prolonged uptrends, the strategy tends to underperform traditional portfolios. In more formal terms, the cost of cutting the left tail of the distribution is the whipsaw risk embedded in momentum and trend following strategies.

[11] The strategy without protection had an allocation of 20% SPY, 20% QQQ, 20% GLD, 20% LQD and 20% TLT during February. At the rebalance, SPY went risk-off and switched to 20% IEF. Although the difference is not material, the rebalance schedule certainly favored the performance. Additionally, the protective strategy was already 20% Risk-Off in February but switched to more than 90% Risk-Off at the rebalance date. If the strategy had rebalanced before the equity declines observed in late February, the drawdown would have been worse.