

***Testing the Efficacy of A Momentum-Based, Long-Short Equity Hedge Fund:***

***Do past prices create alpha-generating trading opportunities?***

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## **Abstract**

In this paper I tested whether or not it is possible to generate alpha against a benchmark of common stocks by using a long-short momentum strategy composed of industry-segmented stock returns. I formed these portfolios on a rolling-basis, whereby the highest performing industry over the prior time horizon (ranging from one month to six months) represented the portion of my long portfolio, and the weakest performing sector was the short portion of the portfolio. This long-short approach to formulating an equity hedge fund was ultimately tested over multiple time horizons, and compared to several different widely used stock benchmarks.

## **Introduction**

Within the investment community there exist two broad, yet definable ideologies: active management and passive strategies. Proponents of passive investments include mutual fund managers, most retirees, and the noted “buy and hold” strategy of Warren Buffett who is quoted as saying that his favorite holding period is forever. Simply put, these investors believe that trading in and out of securities is not only costly, but hurts returns as it is challenging, if not impossible, to outperform the stock market by “timing the market.” Diametrically opposed to the passive investment community are active fund managers and traders, a group that includes proprietary traders, quantitative funds (also known as algorithmic traders), and hedge funds broadly speaking. Although each of these three aforementioned groups of investors pursue vastly differing strategies, they are united in their belief that it is possible to generate alpha, as defined as excess returns above the stock market. The latter group of investors, those who pursue active investment management, do not believe in the core tenets of the Efficient Market Hypothesis (EMH) developed by Eugene Fama and his colleagues in the 1960s. The three degrees of EMH are as follows:

- Weak Form Efficiency – makes the claim that prices on all publicly traded assets reflect all past publicly available price information.
- Semi-Strong Form Efficiency – claims that prices reflect all publicly available information and that prices immediately adjust to new information.
- Strong Form Efficiency – in addition to the claims of the prior two forms of EMH, this final form states that no information, including privately held (“insider information”), can be used to gain an investment advantage.

Therefore, given these definitions of EMH, my paper most directly tested the weak form of the hypothesis. This is due to the fact that the weak form implicitly makes clear that past prices are of no use in generating excess investment results, as past prices are obviously available to all investors, regardless of sophistication or type of strategy employed in the investment process. Should any of the time-varying momentum strategies that I composed produce alpha, these results would cast doubt on some elements of the weak form of the Efficient Market Hypothesis.

In order to construct and test the efficacy in using a momentum-based investment strategy, I used monthly industry-segmented stock return data from Kenneth R. French's website. Various research has demonstrated that a majority of an individual stock's return can be tied directly to changes in the industry in which it operates, providing credence to my decision to use industry-level return data as opposed to individual stocks. Thus, by looking at the aggregated industries in the datasets I used, it eliminated the idiosyncratic factors at play for each of the firms that compose the industry-segmented index. Additionally, it removed any potential issues regarding situations when a stock is delisted, firms merge, or other unique scenarios that would complicate the data set if I were to use individual stocks.

The basis of this investment strategy relies on how events over time will cause fluctuations in stock prices, particularly in respect to momentum and significant events such as earnings releases and other announcements from firms. Momentum has previously been demonstrated to persist for time horizons less than one year. In the investment context, momentum can be defined as the existence of a positive autocorrelation in the time series returns for stocks, whereby past prices are able to weakly predict short-term returns in the future. This implies that stocks that have been trending higher will have a higher likelihood of continuing their upwards ascent, whereas stocks that have been declining in the recent past tend to keep falling. Seen in this light, momentum-based portfolios can be seen as a "trend-following" strategy, whereby investors seek to identify long and short-biased trends and latch on to them, abiding by the trading proverb that "the trend is your friend until it ends." It is important to note that purely momentum-based considerations for asset selection, as this paper seeks to investigate, make no inclusion of fundamental data.

Fundamentals refer to the operating performance of individual firms or whole sectors, and include such metrics as revenue, net income, profit margin analysis, health of the balance sheet, amongst others. The semi-strong form of the Efficient Market Hypothesis claims that fundamental analysis is also useless, since all of these pieces of financial data are also publicly available.

I constructed a portfolio by purchasing shares in the best performing industry over different horizons and shorting the worst performing industry.<sup>1</sup> First I present a literature review on the subject of financial momentum in markets by presenting evidence that appears to support as well as refute its existence.

I used monthly stock return data from January 1990-December 2017 (as well as the necessary initial lag period using 1989 data). All 336 months of data are segmented by industry: non-durables, durables, manufacturing, energy, high technology, telecommunications, shops, healthcare, utilities, and other. Over time, the industry in the long category was replaced with the new best performing industry over the prior period, and vice versa for the short position. Thus, the portfolio always had a long position in the best performing industry and a short position in the industry with the poorest past performance. In calculating the returns for each time period, it is simply the arithmetic sum of the change in the value of the long position plus the change in the short position, since this strategy attempts to make a positive return on both ends of the book (long and short).

In the analysis section of the paper, I calculate the returns to the momentum strategy, variance, worst annual performance, best annual performance, alpha generation (alpha will be defined as return above the S&P 500 index), correlation with the market index, amongst other statistical measures. These metrics reveal if momentum investing is a sustainable strategy, and one that is able to produce alpha in the long-run.

I conclude the paper by analyzing the quality of the returns, why I observed the results found, describe the outlook for the strategy going forward, and if I would recommend this investment strategy either to clients or to those starting a fund.

## **Literature Review**

Existing literature has modeled various trading strategies to predict stock market returns. It has been found that buying stocks that have previously performed well and selling poor performing stocks results in positive returns. Using NYSE and AMEX stocks during the period of 1965 to 1989, Jegadeesh and Titman (1993) analyzed returns by testing relative strength trading strategies using 3 to 12-month holding

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<sup>1</sup> *Kenneth R. French - Data Library*, Dartmouth Tuck School of Business, [mba.tuck.dartmouth.edu/pages/faculty/ken.french/data\\_library.html](http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html).

periods. Here, relative strength refers to how individual stocks or groupings of stocks perform relative to the overall market. The unitless measure known as RSI (“Relative Strength Index”) shows the degree of outperformance or underperformance. They found that buying winners based on 6-month returns and holding them for the same amount of time resulted in significant above market returns. Additionally, when monitoring returns after the sample period, the researchers found that a portfolio with long previous winners and short prior losers produced positive returns. Later, however, those excess returns diminished. Their research suggests a bias exists, particularly on the investor’s part, in believing that past winners will do just as well in the future, providing evidence in support of momentum in the market.

Furthermore, Chan, Jegadeesh, and Lakonishok (1996) provide information about the predictability of future stock returns based on past returns. They analyze stocks listed on the NYSE, AMEX, and Nasdaq from January 1977 to January 1993 and analyze a stock’s past compounded return through the standardized unexpected earnings variable (SUE), cumulative abnormal stock return (ABR), and changes in analyst earnings forecasts. Generally speaking, their results match those of previous studies. However, they also contribute a different perspective to momentum not previously discussed. The researchers found correlations between the various measures that they used to group stocks into portfolios. That being said, they found that the coefficients were not statistically significant and that the measures of earnings surprises were not strongly associated with each other. The strongest correlation was between unexpected earnings and abnormal returns around earnings releases. They also found information consistent with the idea that the market gradually adjusts to earning surprises, as opposed to discontinuous jumps. Though some of their findings confirm existing research, they found that a drift in future returns is meaningful for at least six months and that momentum is not entirely driven by positive feedback trading. Rather, the market responds gradually to new information. Surprises in the market, whether good or bad, will cause the market to trend in the same direction at least over the next two following announcements.

More recent studies have tried to determine the underlying risks responsible for driving momentum. Griffin, Ji, and Martin (2003) investigated whether macroeconomic risk plays a role in momentum returns on a global scale. The study used monthly stock returns of shares from both NYSE and AMEX, with data from 39 different countries. They find statistically significant momentum profits in all regions, demonstrating the validity of the strategy. In order to test for risk, they compare two models, an unconditional model of Chen et al (1986) and a conditional one by Chordia and Shivakumar (2002). Chen’s macroeconomic factors were not significant in explaining

the strategy's profits, while the forecasting model resulted in predicted high returning stocks earning similar returns as low returning. However, winning stocks did yield higher future returns over losing stocks. In conclusion, they demonstrated that momentum investing largely trends with macroeconomic factors such as GDP growth and subsequently declines over long periods of time, consistent with existing literature.

In their 1999 study Moskowitz and Grinblatt focus on intermediate investment horizons and the associated momentum of the trading profits. The study confirms previous research conducted by Jegadeesh and Titman (1993) in which the researchers analyzed stock momentum in relation to investor underreaction to information. Moskowitz and Grinblatt's study uses 20 value-weighted industry portfolios from July 1963 to July 1995. They find that there is little cross-sectional variation in the data they observed and that there is little evidence that unconditional abnormal industry returns exist (Moskowitz & Grinblatt 1999). Their findings are consistent with existing literature in that stocks which outperformed the average in the previous period will outperform in the next period as well. They find momentum is in fact correlated with size and the BE/ME, as seen in Fama and French (1996), as well as past returns.

## **Methodology**

Drawing on previously conducted momentum studies, I examined the efficacy of several time horizons, starting with a month-by-month industry-segmented long/short portfolio. This was in addition to 3x3 month and semi-annual time horizons. The data set was produced from Ken French's website with each of the ten industries monthly performance figures included, as well as the market (S&P 500) return over the interval from 1990-2017. For the 3x3 strategy, it used a 3 month lag period prior to the official start date of the fund (1990 is the hypothetical inception date) in order to obtain the highest performing industry over the past three months (that is, from October 1989-December 1989) to go long, and to short the worst performing industry over the same time horizon. The holding period corresponds to the length of the lagged tracking period, whereby the best performing industry of the past month, three months, or six months was held for an equal duration. The same duration equation applies to the shorted portion of the portfolio.

The portfolio tracking began on January 1st 1990, and included the best performing industry over the preceding three months as the portfolio's long position and the worst performing as the short position. This process was continued until reaching the end of the data set in December 2017. The primary rationale for looking into a three month

cycle is that firms report quarterly financial data (10Q filings), which could lead to shifts in momentum around the time earnings season unfolds. By capturing this, it might be possible to gain long exposure to recent leaders following their upbeat quarterly reports and to short firms in industries that on average have a poor quarter.

In summary, this strategy's ranking procedure selected the top and bottom performing industries over the prior three months, and then received the next three months of performance for the selected industries, with our long-short portfolio's return being equal to the absolute difference between the percentage return on our long position minus the percentage return on the short position. At any given time the portfolio held exactly 2 of the 10 industries (one short, one long).

In addition to the 3x3 strategy, I compared the results to a longer-term momentum strategy, that being 6x6, as well as a much shorter duration month-by-month portfolio. The structure is identical, with the only difference being that instead of using a 3-month prior performance indicator in determining which industries to buy and which to sell short, the formulation now used a six month lagged time horizon for the 6x6 strategy, and a single month for the month-by-month portfolio. The remaining elements of the portfolio construction and analysis were identical. The primary reason for looking into these different time periods in analyzing the effectiveness in a momentum-based portfolio is to determine at which point does serial correlation continue to persist and over which time horizons does momentum give way to mean-reverting characteristics. Academic literature has often focused on long-term mean reversion, but has not looked much into time horizons shorter than one year. Therefore, the results could potentially provide a more indicative measure over which time horizons each phenomena (momentum vs mean reversion) in question often holds.

## **Data**

The data set used contains 336 months of returns for each of the ten industries, in addition to the market index (S&P 500, excluding dividends). These industries are divided into: non-durables, durables, manufacturing, energy, high technology, telecommunications, shops, healthcare, utilities, and other. The period of stock market returns from 1990-2017 is an interesting case study for several reasons. For one, it contains multiple complete economic and market cycles, from trough to peak to another trough. In terms of market history, it starts at the beginning of the 1990s when the United States was focused on the first Gulf War and the country was emerging from a brief recession. What would follow in the last decade of the twentieth century was one

of the greatest bull markets in history dominated by the emergence of new technology firms that transformed a variety of end markets. By the year 2000 U.S. stocks were trading at extremely rich valuations, especially the much adored technology sector. After peaking in early 2000, stocks began a multi-year slide, exacerbated by exogenous shocks, notably 9/11.

After the markets bottomed in the early 2000s a new sector emerged that would lead the next bull run -- real estate, homebuilders, and the financial institutions that provided all of the capital for the growth. Similar to the early 2000s, this speculative bubble in housing and commercial real estate blew up spectacularly with the collapse of several of the leading investment banks, insurance companies, and other institutions, including Bear Stearns, Lehman Brothers, Merrill Lynch, Countrywide, amongst numerous others. In the aftermath of this meltdown of the entire financial system, the U.S. plunged into recession, the deepest contraction since the Great Depression eight decades earlier.

Due to unprecedented intervention from the Federal Reserve and central banks around the globe in the form of Quantitative Easing, ZIRP (Zero Interest Rate Policy), and buying distressed mortgage backed securities, the economy began to pick up and stocks began ripping higher, leading to the current bull market that has been in place since March 2009. Therefore, this data set is remarkable for the sheer volatility incorporated within it, which will certainly put our various momentum strategies to the test.

## **Analysis**

After processing the stock return data and constructing the relevant 3x3 long-short portfolios, it is evident that the cumulative returns from 1990 to 2017 are very underwhelming. During this 28-year period, a single dollar invested into a fund that implemented this strategy only grew to \$1.51. This translates to a compounded annual growth rate (CAGR) of only 1.49%. The 3x3 Long-Only portfolio (created by buying the prior three months best performing industry) only produced a total return of 610%, which is equivalent to a CAGR of 7.25% over the sample period.

During the period from January 1990–December 2017 the S&P 500 produced a cumulative return (excluding dividends) of 994%, which translates to a CAGR of 8.87%. Thus it is quite evident that a 3x3 strategy lags far behind the market benchmark. The following data table presents some of the sample statistics for the



performance of the 3x3 strategy compared to the market, the clear takeaway from which is that this strategy is strictly dominated by simply holding the market index.

<i>January 1990 - December 2017</i>				
<b>Strategy</b>	<b>Avg Monthly %</b>	<b>Avg Annual %</b>	<b>CAGR</b>	<b>Alpha / Year</b>
<b>3x3 L/S</b>	-0.03%	-1.30%	-1.49%	-10.36%
<b>3x3 L Only</b>	0.73%	9.34%	7.25%	-1.62%
<b>3x3 Buy Worst</b>	0.63%	7.90%	5.27%	-3.60%
<b>Market</b>	0.74%	9.43%	8.87%	n/a

Moving from the 3x3 strategy to the 6x6 formulation, there are significant differences in the performance of these two strategies. During the sample period, the 6x6 momentum portfolio returned a mere 30%, equivalent to a 0.94% CAGR. Not only were the returns from the 6x6 L/S strategy far lower than the market, they were inferior in every regard to the 3x3 L/S strategy. However, looking at the long-only portion of the 6x6 experiment, the 6x6 L Only returns, we see that their average annual return was 12.75% and the strategy produced a CAGR of 10.25% over the 28 year interval. Thus, the 6x6 L-Only strategy outperformed the S&P 500 by 1.38% per year. However, due to the high standard deviation of the strategy, this outperformance was not statistically significant, as a matched-pair test revealed a t-statistic of only 0.144 with 28 degrees of freedom.

<i>January 1990 - December 2017</i>				
<b>Strategy</b>	<b>Avg Monthly %</b>	<b>Avg Annual %</b>	<b>CAGR</b>	<b>Alpha / Year</b>
<b>6x6 L/S</b>	0.37%	3.41%	0.94%	-7.93%
<b>6x6 L Only</b>	1.00%	12.75%	10.25%	1.38%
<b>6x6 Buy Worst</b>	0.63%	7.95%	4.84%	-4.03%
<b>Market</b>	0.74%	9.43%	8.87%	n/a

Turning to the shortest lagged period in constructing our portfolio, we see that there is a sizable difference in performance between the monthly and 3-month momentum returns. The month-by-month strategy produced a CAGR of 4.1% over the sample period, which was 2.61% higher than the 3x3 L/S strategy. The month-by-month long-only performance was better still, with a 6.94% CAGR. Despite this, the monthly strategy also underperformed the benchmark.

January 1990 - December 2017				
Strategy	Avg Monthly %	Avg Annual %	CAGR	Alpha / Year
1x1 L/S	0.54%	6.40%	4.10%	-4.77%
1x1 L Only	0.72%	9.20%	6.94%	-1.93%
1x1 Buy Worst	0.18%	2.03%	-0.09%	-8.96%
Market	0.74%	9.43%	8.87%	-

Seen below are the aggregated performance of all strategies in question, along with their associated standard deviations. The only strategy that produced an above-market return was the 6x6 Long-Only, but as previously mentioned, this outperformance was not statistically significant.

Standard Deviation		Summary of Return Profiles January 1990 - December 2017				
Strategy	Standard Deviation	Strategy	Avg Monthly %	Avg Annual %	CAGR	Alpha / Year
1x1 L/S	23.08%	1x1 L/S	0.54%	6.40%	4.10%	-4.77%
1x1 L Only	20.57%	1x1 L Only	0.72%	9.20%	6.94%	-1.93%
		1x1 Buy Worst	0.18%	2.03%	-0.09%	-8.96%
3x3 L/S	21.52%	3x3 L/S	-0.03%	-1.30%	-1.49%	-10.36%
3x3 L Only	20.26%	3x3 L Only	0.73%	9.34%	7.25%	-1.62%
		3x3 Buy Worst	0.63%	7.90%	5.27%	-3.60%
6x6 L/S	21.81%	6x6 L/S	0.37%	3.41%	0.94%	-7.93%
6x6 L Only	21.72%	6x6 L Only	1.00%	12.75%	10.25%	1.38%
S&P Buy & Hold	14.29%	6x6 Buy Worst	0.63%	7.95%	4.84%	-4.03%
HFRI Buy & Hold	14.65%	Market	0.74%	9.43%	8.87%	-

Despite the fact that neither the 3x3 nor the 6x6 portfolio was able to come close to beating the market, there does appear to be a silver lining for believers in momentum. Upon inspection of the data set, if one were to perform the 6x6 strategy but only go long the best performing industry over the past six months and ignore the worst performing, doing so would have produced a cumulative return of 1,437%, good for a CAGR of 10.25%. Said in a way that appeals to most institutional investors, following a long-only 6x6 strategy produced annual alpha over the S&P 500 of over 138 basis points (or 1.38% percentage points) during the 28 years of data in the sample. It is

worth noting that this figure does not include dividends, so the actual return is substantially higher, but for the purposes of capital gains from a momentum strategy, this distinction is not relevant since I also ignored the dividends from holding a market index.

The natural question to ask is why does going long momentum appear to be a good strategy? The first part to answering this question is that stocks have a positive drift in the long-run due to rising corporate profits. Additionally, by not having to pay the cost of maintaining short positions (broker fees, margin interest, paying dividends to holders of the stock) you will be exposed to lower overall transaction costs. Taking these into consideration, it makes sense that long-biased momentum could be a sustainable investment strategy that is capable of producing alpha above the market benchmark. The chart below is a graphical representation of what \$1 invested into each of the strategies would have grown into using their respective CAGRs during the period from January 1990 to December 2016.

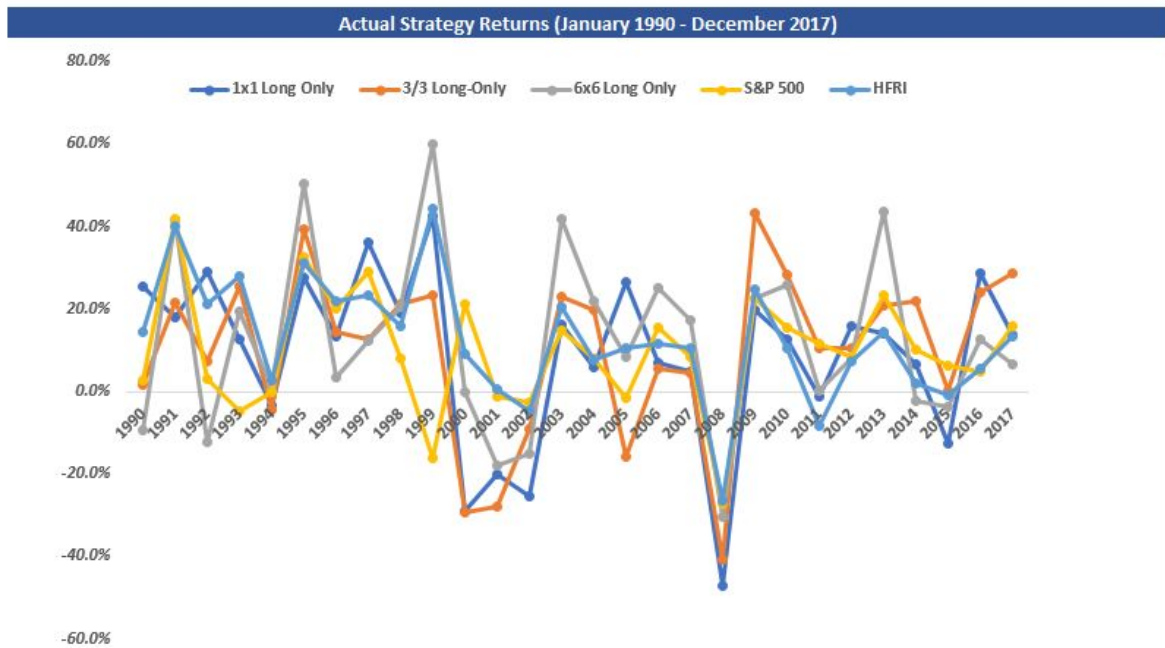


Diagram of Strategy Return Profiles (\$1 growing at respective CAGR)



Comparing returns in a vacuum is not a complete exercise. Fund managers are also expected to produce returns that are uncorrelated with the general market indexes. Thus, even if managers do not produce meaningful outperformance, or should they even underperform, if they do so with very low correlation to the S&P 500 they are often congratulated by their limited partners (i.e. their investor base). After performing the correlation calculations across these strategies, I came across some interesting findings. The correlations between all of the long-short strategies and the S&P 500 are negative, which is not too surprising since the returns on these strategies was poor despite the market (which by definition is long-only) going up by an average of 9.43% over the 28 years in sample.

This stands in marked contrast to the correlations between the long-only strategies and the Hedge Fund Return Index (HFRI). As can be seen in the diagram above, the correlations are 0.76, 0.63, and 0.75 for the 1x1 Long Only, 3x3 Long Only, and the

6x6 Long Only, respectively when compared to the HFRI. This implies that a large number of hedge funds included within the HFRI are employing strategies that are quite

Correlation Matrix		
Strategy	Correlation w/ S&P 500	Correlation w/ HFRI
1x1 L/S	-0.12	0.44
1x1 L Only	0.44	0.76
1x1 Buy Worst	0.54	0.31
3x3 L/S	-0.11	0.13
3x3 L Only	0.42	0.63
3x3 Buy Worst	0.51	0.45
6x6 L/S	-0.11	0.12
6x6 L Only	0.46	0.75
6x6 Buy Worst	0.50	0.61
S&P Buy & Hold	1.00	0.46
HFRI Buy & Hold	0.46	1.00

similar to the long-only momentum strategies outlined in my paper. So then how come the HFRI was able to produce a CAGR of 12% over the interval, outperforming the S&P 500 and each of the momentum strategies within this paper? The most likely reason is due to the fact that most hedge funds are individual stock pickers, and do not simply buy or short index funds or ETFs. This is important since the individual stocks within aggregated funds are more volatile than their overall industry average, which can lead to excess returns by employing a momentum strategy comparable to the ones I investigated. However, there exists a certain degree of survivorship bias within the HFRI, as hedge funds that close shop (either due to sustained underperformance or a spectacular blow up) are removed from the index. This has the effect of producing an upward bias in average hedge fund performance.

### Conclusion

In analyzing the effectiveness in a long-short monthly, 3x3 long-short, and 6x6 long-short momentum-based portfolio, my results indicate that both strategies trail behind market performance. However, the 6x6 Long-Only and HFRI both were able to beat the market benchmark, despite not being statistically significant. For almost all of the scenarios in question, the returns are dominated by a simple buy and hold strategy

of purchasing the market index. In the long term, shorting bad companies appears not to be a sustainable strategy. This could be explained by the positive drift in asset prices. Momentum strategies perform best in sustained periods of rising or falling markets because choppiness leads to being shaken out of trades.

The outlined momentum strategy in this paper can be improved by eliminating shorting, which removes brokerage fees on margin accounts (interest rate, paying the dividends of the stocks you short). I could also combine fundamental factors (value factors) with momentum (flow) factors and use dynamic modeling in our portfolio to ascertain whether there exist momentum-driven factors at play within the market at that point in time. Furthermore, potential areas for future research could be examination of the performance of best and worst individual stocks rather than best and worst industries. I could also look at different time horizons (weekly and yearly) and combine momentum factors using different time periods i.e. potentially long shorter-term momentum and short long-term momentum. In conclusion, portfolios composed of assets that have demonstrated long-biased momentum could be a sustainable investment strategy that is capable of producing sustainable alpha above the market benchmark.

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