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RelativeStrength

A Valued Investment Factor

IN BRIEF

- The effectiveness of Relative Strength has been well researched and has been persistent over long periods of time and across multiple asset classes, both internationally as well as domestically.
- Relative Strength has been shown to produce better risk-adjusted returns over time compared to its universe.
- Relative Strength is quantitative, objective, disciplined and provides easily definable entry and exit points for trades.

Clark Capital Management Group uses a Relative Strength-based methodology to manage a number of its investment portfolios. This white paper is intended to serve as a primer for anyone interested in the Relative Strength methodology. This paper will:

- Define Relative Strength.
- Provide a summary and sampling of the voluminous academic research supporting Relative Strength, including a detailed bibliography of Relative Strength research.
- Discuss the behavioral finance-based explanations for why Relative Strength is an investment factor.
- Discuss the weaknesses and limitations of the Relative Strength methodology.
- Explain why we like Relative Strength as a factor and use it to manage investments.
- Explain how our Relative Strength-based methodology is different from that of other firms.

Relative Strength

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What Is Relative Strength?

Relative Strength can be defined as the measurement of a security's performance relative to a benchmark, to another security, or to the other members of a universe. Relative Strength compares the relative performance of security "A" vs "B", measured over a period of time. For example, "A" may rise more or less than "B" in a rising market; "A" may fall more or less than "B" in a falling market. These measures are then used to find both the strongest and weakest securities or asset classes within a universe. As we will discuss later in this paper, a vast amount of research has shown that securities that display strong (or weak) Relative Strength over a given time period tend to continue to have strong (or weak) Relative Strength going forward. Relative Strength analysis can be applied to domestic or international stocks, domestic or international stock indexes (and their associated ETFs), fixed income indexes, currencies, commodities, and other asset classes.

Relative Strength is very intuitive and can be observed in markets every day. As investment professionals, we have all been aware of Relative Strength trends through casual observation. These observations can be quite varied, such as in the following examples:

- Large cap stocks are outperforming small cap stocks.
- International stocks are outperforming U.S. stocks.
- Energy stocks are underperforming the S&P 500.
- Semiconductor stocks are outperforming the Technology sector.
- Japan is outperforming both the developed markets and emerging markets.
- Thailand stocks are outperforming gold.

Research has shown that if one of these relative trends persists for an intermediate time frame (usually six to 12 months), then it is likely to persist for another three to six months.

Relative Strength is often confused with the term "price momentum" or simply "momentum." Momentum traditionally refers to the price action of a stock. Research has shown that it is difficult (in fact, nearly impossible) to predict future price/direction from past price. Relative Strength analysis instead looks at the relative relationship between multiple securities and the momentum of that relationship. Some in the investment community might compare Relative Strength or momentum-based investing to "performance chasing." This is a false comparison; Relative Strength is far from blind performance chasing. Instead, it is a systemic, objective, and disciplined process with a disciplined entry and exit in place. One notable advantage to Relative Strength analysis comes from the fact that it is by design very adaptive and adjusts to changes in market leadership over time. When Relative Strength analysis is used in a multi-asset class portfolio (as used in our Navigator Fixed Income Total Return and Navigator Global Tactical portfolios), this often means rotating into a less volatile asset class during sustained market declines.

Having defined Relative Strength, we would like to make an important note about vocabulary. A 1993 research paper by Jegadeesh and Titman spurred tremendous interest (and subsequent follow-up research) by the academic community into Relative Strength-based investing. To be clear, the academic community did not discover Relative Strength, as it had been used successfully to manage investments for many decades. However, when discussing Relative Strength, the academic community has adopted the term "momentum" to describe Relative Strength. Thus the term "momentum" is now used to describe both price momentum and Relative Strength analysis. For the purposes of this paper, the terms "Relative Strength" and the academic term "momentum" can be used interchangeably.

A Summary of Research Supporting the Validity of Relative Strength

The academic research surrounding Relative Strength/momentum has been voluminous. Fama and French have called momentum “the center stage anomaly of recent years,” and all aspects of what is called the “momentum anomaly” have been investigated, including:

- Where does momentum as an alpha generating investment factor exist, and how robust is it?
- What is the ideal measuring period and holding period for momentum screens?
- What are the benefits and correlations of a momentum strategy in a broader portfolio?
- What are the possible explanations for the existence of the momentum anomaly?

The research is so extensive that only a sampling of it can be covered here. Key findings from eight different articles on momentum will be summarized. These summaries will present the key findings of the research into momentum. There is much more worthwhile academic research to be considered and, for those who are interested, we provide a bibliography of over 50 articles on Relative Strength for further reading. The eight articles are summarized below, in chronological order of their publication. The numbers in brackets refer to items in the bibliography.

1993: Jegadeesh and Titman. *Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency* [4] This was an early study that put the spotlight on the existence and power of “momentum” as an investment factor. Monthly momentum screens were applied to the U.S. stock universe from 1965 to 1989. Back tests from 1941 to 1964 showed similar results. The strategy produced alpha of about 1% per month over the time period. The study found that the alpha generated by the momentum factor was robust across all market cap and beta levels. The lack of auto-correlation (correlation of momentum-based returns to themselves) of the momentum factor allowed momentum to stand by itself as a truly independent and robust factor. The paper’s strong

results spurred a flurry of subsequent research into momentum that followed.

2007: Fama and French. *Dissecting Anomalies* [15] Fama and French performed a very thorough study of a number of investment factors from 1927 to 2013. The study found sizeable annualized premiums for four different factors. The value factor was at 5.0%, while size was at 3.4%, beta was at 8.4%, and momentum was the largest at 9.5%. Momentum produced strong returns for all size groups in both cap-weighted and equal-weighted terms. From 1927 to 2013, a portfolio of high momentum stocks rebalanced monthly earned 16.9% annualized versus a 1.3% loss for low momentum stocks. Higher momentum stocks saw a 60% higher return versus the broader universe with only a 19% higher standard deviation, a very favorable risk-reward tradeoff. The study called momentum “the premier anomaly” stating, “The premier anomaly is momentum: stocks with low returns over the last year tend to have low returns while stocks with high past returns tend to have higher future returns.”

2007: Tibbs et al. *Using Style Index Momentum to Generate Alpha* [16] The authors performed a study that applied a momentum screen to nine Russell style box indexes and found that this methodology produced a solid alpha that was statistically significant. The study found that a strategy that owned the top two style boxes outperformed all of the Russell style boxes in terms of overall return, Sharpe ratio, Treynor measure, and alpha based on using a 12-month momentum measurement period and a one month holding period. The top ranked style box over the last 12 months proved to be an outperformer over the following 14 months. According to Fama and French’s three factor model, the style box with the strongest momentum showed strong positive alpha while the style box with the weakest momentum showed strong negative alpha. A long/short portfolio going long the strongest style box and short the weakest style box earned 9.25% per year. The momentum factor among style boxes was shown to be persistent even after controlling for the market, size, and value factors.

Relative Strength

A Valued Investment Factor

2008: Dimson et al. ABN AMRO. *Momentum in the Stock Market. Global Investment Returns Yearbook 2008* [17] ABN AMRO performed a study of U.K. equities from 1956-2007 and the winners (the top 20% gainers) outperformed losers (the bottom 20% gainers) by 10.8% per year when cap-weighted and by 12.0% per year when equal-weighted. The strategy produced a more modest but still impressive 7% per year gain when limited to only the top 100 U.K. stocks. They also studied a universe of the top 100 U.K. stocks over a 108 year period. Winners beat losers by 10.8% per year. Momentum-based returns were robust and statistically significant, even when controlling for ranking period, holding period, weighting methodology, and choice of sample. The authors asserted that the momentum effect was pervasive and persistent.

2010: Hancock, GMO. *Momentum — A Contrarian Case for Following the Herd* [21] Jeremy Grantham's well known value-oriented firm, studied the U.S. stock universe and found that the returns from the top quartile of momentum stocks peaked at an 11 month momentum period. A momentum strategy outperformed the broader U.S. market by nearly 4% per year from 1927 to 2009. The study also had what to us is one of the most important and powerful findings about momentum: When momentum's 12-month trailing returns were strongly negative (-10% or worse), the outperformance of momentum over the next five years was strongest. We found this GMO piece particularly persuasive because GMO is a well known and respected value investing firms. They strongly believe in buying when valuations are cheap and then patiently waiting for prices to revert to the mean. GMO's belief in momentum and finding that its returns are strongest after periods of underperformance serve as an example of the potential power and long-term viability of momentum as a factor.

2010: Faber, Cambria Asset Management. *Relative Strength Strategies for Investing* [22] Cambria looked at a Relative Strength-based screening method for U.S. equity sectors over eight decades from December 1928 to December 2009. Buying the top one, two, or three sectors out of 10

produced stronger returns and a stronger Sharpe ratio than the equal weighted S&P 500. Outperformance was consistent when using a one, three, six, nine or 12 month screening period. Cambria estimated that the future outperformance of the system could range from 300 to 600 basis points. Outperformance was consistent over every decade. They also examined a Relative Strength-based screening method for five asset classes (U.S. stocks, foreign stocks, bonds, REITs, and commodities). Owning the top one, two, or three asset classes outperformed an equal weighted buy and hold index. Owning the top one through four asset classes — and simply avoiding the worst asset class — also produced consistent outperformance. Cambria concluded the following regarding Relative Strength as an investment factor: “The persistence of the momentum strategy by decade goes to show that this was not simply a property of markets 80 years ago, but continues to work today.”

2010: Moskowitz. *Momentum Investing, Finally Accessible for Individual Investors* [23] The author finds that momentum as an investment factor can produce abnormal returns that are greater than those of value or size. Momentum was found to work well among different asset classes, market capitalizations, countries, and sectors, and momentum as a factor is not captured by either a value or growth style. The author studied momentum of the stocks in the Russell Indexes and found that momentum outperformed the value factor by 1.5% per year and growth factor by 3% per year from December 31, 1979 to December 31, 2009. Momentum as a strategy tended to move with growth stocks but with higher returns and a higher Sharpe ratio. Momentum screens were most effective over a six to 12 month time frame. Momentum screens beyond a 12 month time frame become ineffective, and over a longer three to five year period, the factor sees a reversal. One important finding was that stocks that were long-term underperformers but have high six to 12 month returns ended up outperforming by an even higher margin.

2014: Asness et al. *Fact, Fiction, and Momentum Investing. AQR Capital* [50] One of the most prominent money managers that employs momentum, AQR investigated momen-

tum as a factor over the very long term and compared it to the value and size factors. They looked at Fama and French's data universe for U.S. equity over an 86 year time period and found that momentum-based screens produced gross returns and Sharpe ratios that were higher than those for both value and size. This was true for both in- and out-of-sample time periods. Using over 86 years of data for U.S. equity and over 40 years of data for five other asset classes, momentum as a methodology was equally profitable whether taking the long or short side for each of the asset classes. Momentum as a factor existed across the market cap spectrum but was particularly strong in small caps. In contrast, the value factor was small or virtually nonexistent when applied to large caps. Momentum did not see degradation of its alpha during out-of-sample periods, while value and size did see some degradation. AQR posited that this was proof of momentum's robustness. Within the U.S. equity universe, momentum measured over a seven to 12 month time period produced the strongest results. For international markets both a six and 12 month time period produced equal amounts of alpha. AQR asserted that the different results for U.S. and international markets are indications of momentum's robustness, not its weakness.

These selected studies and the more than 50 Relative Strength studies listed in the bibliography provide powerful evidence of Relative Strength as a factor. Here are some of the key conclusions from this research:

- Relative Strength has been recognized to be a strong investment factor. Across many different studies that use many different investment vehicles, a Relative Strength methodology has produced strong excess returns and improved Sharpe ratios.
- Relative Strength-based returns in the above studies were robust and statistically significant, even when controlling for screening methodology, holding period, value and size factors, and beta.
- Relative Strength was found to be effective when working with U.S. stocks, U.S. style boxes, U.S. sectors and industries, international stocks, bonds, commodities, and REITs.

- Research gives evidence that Relative Strength works particularly well among multiple asset classes, as the methodology is able to rotate towards less volatile asset classes during market turbulence.
- Relative Strength works well for long only investors, as it can both own relatively stronger sectors and avoid the weakest ones.
- Relative Strength has been particularly effective among small cap stocks.
- Measurement of Relative Strength was best done over an intermediate-term time frame, usually a six to 12 month time frame.
- Relative Strength has the ability to reassert itself and has its strongest performance after periods of relatively weaker performance.

Why We Believe Relative Strength Works

As we have demonstrated, Relative Strength analysis has been thoroughly researched and its value demonstrated. One explanation of the Relative Strength phenomenon is risk-based: it is posited that momentum stocks have greater volatility with respect to their prospects (both growth and cash flow prospects), and thus these stocks are accorded a premium. The behavioral finance field has done considerable research on Relative Strength. Many academics claim that Relative Strength persists due to a “delayed reaction to firm specific information.” Behavioral finance theory calls this the “anchoring effect” and it occurs when investors react too slowly (and only partially update their views) when encountering new information (either good or bad). Over time, as investors update their views in accordance with the information, we see price continuation. A second behavioral manifestation is the “disposition effect” — investors sell winners too soon and hold onto losers (hoping to break even). These investors' actions are contrary to the longer-lasting trend and thus make the Relative Strength phenomenon persist.

The third effect is simpler, and the one that we believe most: the “herd instinct,” also called the “bandwagon effect.” If a security starts to relatively outperform, it will at first be un-

Relative Strength

A Valued Investment Factor

recognized, then dismissed, then noticed by more participants. Then it will gradually attract more and more assets as more and more investors pile on. Psychologically, investors appear to be most comfortable following the majority of other investors. This trend may be supported and extended by the inertia of the underlying fundamental/economic factors; however, it may be merely supported by speculative fever. We have seen that one security often outperforms another until it becomes over-owned. Buying power then dries up, and the cycle reverses in the opposite direction. The period of weaker Relative Strength is the mirror image of the time of stronger Relative Strength.

At Clark Capital we believe Relative Strength works because it matches human behavioral biases and thus the nature of the majority of investors. Most importantly, we believe that these biases and human nature are unlikely to change, and therefore Relative Strength in the long run should continue to add value as an investment factor.

Weaknesses and Limitations of Relative Strength Analysis

Relative Strength uses performance data that is most often measured over intermediate time periods (six to 12 months). Therefore, the models are time based and have an associated inertia built in. During most of the time we find this to be a great advantage, as the methodology does not react to daily or even weekly gyrations. However, because of this built-in inertia, Relative Strength tends to not work well at violent turning points in the markets, either violent price movement alone or when there are rapid changes in the market's theme. This underperformance has the most magnitude at a major market bottom, when the market reverses course and prior losers often become new market leaders. At Clark Capital, we view the underperformance of Relative Strength at these times as the methodology's major weakness. An encouraging aspect of research around these periods comes from the GMO study that we previously mentioned. The study found that when Relative Strength had periods of dramatic under-

performance, the methodology's outperformance over the ensuing five years has been the strongest. At Clark Capital we believe that studies like this confirm the long-term viability of Relative Strength as a factor.

The fact that Relative Strength underperforms around major market turns makes intuitive sense, as Relative Strength is a trend following strategy, and it needs time to adjust when a new, changed trend has begun. To the methodology's benefit, however, we have observed it should not get on the wrong side of the market for very long. The models should adjust to a new trend as that trend builds strength over time. This adaptable quality of Relative Strength is in sharp contrast to the "value trap" which plagues value-oriented investors.

We'd like to address an additional weaknesses or criticisms of Relative Strength. Relative Strength by its very nature is a higher turnover strategy, and many concerns have been raised about the costs of this trading. We would address this criticism in two ways. First, firms such as Clark Capital trade institutionally and with size. Thus, while trading costs certainly do reduce performance, the tremendous competition among financial firms and the institutionalization of trading have made a Relative Strength strategy much less costly. Second, we believe Relative Strength is a strong factor and has produced sufficient alpha that it can bear the costs of trading and still add value over time.

Why Does Clark Capital Prefer to Use Relative Strength?

Having explored the research surrounding Relative Strength, its behavioral explanations, and its strengths and weaknesses, we now move on to a simple but essential question. Why does Clark Capital like to use Relative Strength analysis? The main reasons that we like a Relative Strength methodology are:

- The concept is easy to measure, intuitive, and relatively simple.

- Relative Strength uses only historical data and does not involve forecasting.
- A Relative Strength system is quantitative, objective, disciplined, and provides easily definable entry and exit points for trades. The methodology has been recognized and used by money managers for a very long time, since at least the 1920s.
- The methodology has worked well over multiple measurement periods, from intermediate to long-term. Our internal research confirms that the intermediate to long-term is the optimal measure of Relative Strength.
- Relative Strength has the potential to produce strong excess returns and improved Sharpe ratios across the entire spectrum of investable assets, and these results have been found to be robust and statistically significant.
- Relative Strength has been very successful in the past at avoiding the painful losses of worst performing sectors. The methodology has avoided sectors such as Energy or Financials when they are under severe stress and shied away from countries that show financial stress such as emerging markets or even the entire Eurozone.
- Relative Strength is flexible and adaptive and has been seen to quickly adjust to the realities of a new investment regime as it develops.
- Relative Strength has been proven to work across all market cap sizes including large, mid, and small cap.
- Relative Strength can be used to analyze U.S. style boxes, U.S. sectors and industries, foreign countries and regions, bonds, commodities, currencies, and REITs.
- Relative Strength has worked better in a universe with a large dispersion of returns, worked well with uncorrelated assets, and worked well with multiple asset classes. In fact, we believe Relative Strength is at its most powerful when used among multiple asset classes (a universe with uncorrelated assets and a large dispersion of returns), as it can preserve capital by owning less volatile asset classes during sustained market declines.
- The excess returns of Relative Strength have been consistent over rolling 10 year periods.
- We believe that Relative Strength's persistence as a factor is owed to human behavioral biases, such as the herding instinct, that are unlikely to go away in the future.
- Historically, Relative Strength has had its strongest performance after periods of relatively weak performance.
- It is "the premium anomaly" among investment factors, according to Fama and French.

How Is Our Implementation of Relative Strength Unique?

Most studies and implementation of Relative Strength involve the evaluation of a large number of individual stocks. The models are simplistic in that they evaluate relative performance over a fixed period (studies show the most effective period is six to 12 months) and then indicate that the securities be held for a fixed period (often three to six months). Some studies create rules for buying (example: buy when security "A" reaches the top quartile of the universe) and rules for selling (example: sell when security "A" drops out of the top half of the universe). We believe all of these methodologies are valid and can produce positive results as demonstrated by most of the research on Relative Strength.

At Clark Capital, we have greatly expanded upon these relatively simplistic methods and have built quantitative systems that can implement a variety of portfolios with any combination of nine asset classes: U.S. equity style, U.S. equity sectors, international equity, U.S. Treasury bonds, U.S. corporate bonds, commodities, gold (which we treat as a separate asset class), currencies, and cash. Relative Strength acts as the principal tool for selecting investments within the following universes: U.S. equity style (Style Opportunity), U.S. equity sector (Sector Opportunity), international equity (International Opportunity), U.S. Treasury and corporate bond (Fixed Income Total Return), and all nine asset classes combined (Global Tactical). We also use a universe of all of the securities among the nine asset classes as a broader guide for the Investment Committee that greatly informs our top-down outlook on the markets.

The portfolios are implemented using ETFs which, in the case of equities and corporate bonds, are themselves diversified because they use broad tracking indexes. Using ETFs as the preferred vehicle limits stock specific risk. The downside of using ETFs is that they reduce concentration and limit the chance of a "home run" in security selection. We gladly accept this tradeoff, as risk reduction and reducing the chances of a portfolio "blowing up" have been a focus and a key tenet

RelativeStrength

A Valued Investment Factor

of Clark Capital since its founding.

As an enhancement, we have implemented a “matrix” approach, creating a Relative Strength model of every security vs. every other security.

If the model of “A” vs. “B” is positive, then our methodology predicts that A is likely to outperform B over the next three to six months. We create a model of A/B, A/C, A/D, A/E, ... then B/C, B/D, B/E, ... C/D, D/E, etc.

This analysis results in an immense amount of Relative Strength models. We are currently tracking the Relative Strength relationships of over 200 ETFs. Given 200 ETFs requires creating and analyzing over 19,900 models. Each model is individualized to that particular Relative Strength relationship. The process is customized and quantitative and takes up a considerable amount of computer power and time. In addition, our models take into account whether Relative Strength is accelerating or decelerating and use that as a secondary factor in the rankings. Further, the methodology is refined again by suggesting model weightings.

Portfolio candidates are thus determined quantitatively, primarily according to ranking, but also by taking into account acceleration and weighting. Other important factors such as monitoring portfolio concentration, ETF liquidity, ETF expense ratios, and limiting turnover are also taken into account.

Conclusion

Relative Strength, as a portfolio management technique, is well researched in academia, well-implemented and well documented by pragmatic portfolio managers. It is quantitative but not overly complex. It utilizes historical data and does not involve forecasting. To use a baseball analogy, we think of it as not a home run hitter but rather a good singles hitter, providing incremental performance over time. In an equity only portfolio, it can provide this added value by rising faster in rising markets and falling less severely in falling markets. One of its noteworthy strengths is that it can be effective at avoiding the big losers. When incorporated into a multi-asset portfolio, it can provide even greater downside protection when used with uncorrelated or even negatively correlated assets, such as bonds, commodities, gold and currencies.

Relative Strength has been one of the most persistent anomalies in the investment universe during the last one hundred years and, in our opinion, is likely to persist well into the future. Although Relative Strength has not added value every year, it has been seen to be remarkably consistent over ten-year rolling periods. We believe it has proven to be an effective risk-management tool. A Relative Strength driven portfolio should be used by investors with a long time horizon and realistic expectations of its benefits.

Appendix – Key Research Points

This Appendix summarizes what we believe to be the key conclusions made in a selection of noteworthy research reports. As the summaries are intended to provide direction to those interested in further research, descriptions of source material and information such as the construction of universes, time periods and indexes employed in the studies summarized are not included. For additional information, the original studies should be consulted. Numbers in brackets refer to the Bibliography. Views expressed are those of the individual authors.

Jegadeesh and Titman. *Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency.* The Journal of Finance, March 1993 [4]

- Value Line rankings are based largely on Relative Strength and studies have affirmed their predictive power.
- Anecdotal evidence says Relative Strength managers use rules based on price movements over the past 3 to 12 months.
- This paper provides an analysis of prices movements over the 3 to 12 month time horizon; evidence of the paper is consistent with Relative Strength adding value and not due to a beta effect. The evidence points to a delayed reaction to firm specific information.
- The 3 to 12 month calculations and Relative Strength screening produces strong gains in the following 12 months, but many of those gains are lost in the next 2 years.
- Most successful strategy was selecting stocks based on their returns over past 12 months and holding this for 3 months.
- The returns are slightly higher when there is a 1 week lag between formations period and holding period.
- Relative Strength is not as high beta as one might think. For this study, the beta of the Relative Strength winners portfolio is lower than the higher beta Relative Strength losers portfolio.
- Serial covariance of Relative Strength based returns – or the auto-correlation of Relative Strength based returns – (the correlation of Relative Strength based returns with themselves) is negative per the study of a broad portfolio. Thus Relative Strength is not auto-correlated and stands more strongly as a truly independent investing factor.
- Serial covariance or auto-correlation of individual stocks screened for Relative Strength is positive. This suggests that Relative Strength profits arise from under-reaction to firm specific news.
- Relative Strength is not cross correlated with a value-based screening over time. Thus what they call the lead-lag effect is not an important source of alpha. Again the study points to market under-reaction to firm specific information.
- Relative Strength as an indicator was tested across various levels of market capitalization and beta. Relative Strength proved robust and added value over all cross sections of both market cap and beta. Thus they say Relative Strength is robust across many segments of the market, again pointing to firm specific components of return as the source of its alpha.
- Roll (1983 – page 78 of paper) says Relative Strength might not be successful in January, due to the January effect. Relative Strength loses about 7% per month in January during the study but has positive outsized returns in all other time periods.
- Relative Strength returns are fairly high in April (tax season) and November/December (tax loss selling). Relative Strength provided positive returns in 96% of Aprils. Speculation was that corporate pension funding being required by April 15th was the cause. However the April 15th (tax payments) phenomenon is a more likely cause to Clark Capital, along with general seasonality and trends peaking in April/May. Speculation about November/December outsized returns is about the selling of losers for tax purposes. Again I'd say seasonality is also strong this time of year.
- After formation of a Relative Strength portfolio, they look at how outsized returns are in a given number of months out. Relative Strength based returns are negative after 1 month, indicating the Relative Strength effect is indeed overdone over the short term historically (subject to mean reversion effect). However, after month one, the Relative Strength returns are positive in each month during the first year.
- In year 2 and the first half of year 3, the Relative Strength returns are negative, but not statistically significant.

Relative Strength

A Valued Investment Factor

- Relative Strength was back tested from 1927-1940 (markets were volatile and subject to mean reversion over this period). In this environment, month one returns were very negative on average. Months 2 to 10 are neutral.
- Key point: Relative Strength tends to select high beta or low beta stocks, depending on the market trend. When that trend undergoes a major reversal, Relative Strength will see its peak underperformance. Because bottoms are sharp and quick, Relative Strength's performance around a market bottom should be expected to struggle.
- Relative Strength was back tested from 1941 to 1964 (a period similar to the original testing period of 1965 to 1989) and results were accordingly similar. Average return is slightly negative in month 1, but returns are significantly positive in months 2 to 8. Returns are negative 12 months and beyond.
- Stocks that beat earnings expectations are stronger performers in the following 6 month period by 0.7% on average, and this outperformance is statistically significant.
- The authors conclude that the returns around earnings announcements represent about 25% of the returns over the holding period.
- Most successful long-short strategies select stocks based on 12 month returns and hold for 3 to 12 months. For a 12 month screen and 12 month hold strategy, the portfolio earns 43 basis points of alpha.
- The style momentum profits are strong over intermediate time horizons (3 to 12 months) but are statistically insignificant and near zero after 12 months.
- Trading costs of an individual equity style rotation strategy are significant; thus authors state that asset allocators will benefit most from this knowledge (this may be questionable now due to use of ETFs).
- Price and industry-adjusted momentum arbitrage profits are of similar magnitude to raw profits before adjustment. Over one year, the style momentum portfolio studied earned 65 bp per month, it earned 54 basis points after adjusting for price momentum and 56 basis points after adjusting for industry momentum. The profits do not persist when holding the positions for over one year.
- Price and industry momentum is more powerful over shorter time frames; however, over a 12 month screening period, style momentum performs best. Industry momentum, in particular, loses value over a 12 month time frame.

Chen and De Bondt. *Style momentum within the S&P-500 index*. Journal of Empirical Finance. 2004 [9]

- From abstract: "Style momentum in equity returns is an empirical phenomenon that is distinct from price and industry momentum."
- The study addresses the question of whether equity style cycles actually exist. It asks if a style is in or out of favor, does that fact help predict future returns for individual securities?
- 10 style based portfolios are ranked by returns over 3 to 12 months. Securities with in-favor characteristics outperform securities with out-of-favor characteristics. The return differential is significant – 20 to 60 bp per month. The drift lasts up to 12 months.
- The results challenge behavioral and rational explanations. They appear to be inconsistent with under-reaction to firm specific news and with research on earnings momentum.
- The authors again find that the value and no-dividend stocks earn exceptional returns in January.
- They end up going long past winner stocks (top 1 or 2 styles) and short past loser stocks (bottom 1 or 2 styles). Subsequent test periods range from 3 months to 3 years.
- The tests leave little doubt that style momentum is a determinant of S&P 500 equity returns that survives the inclusion of price and industry momentum indicator variables. The explanatory power of style momentum extends to 2 year test returns; that is not the case for price momentum. Industry momentum also does not last past 1 year and is negative after 12 months.
- Other studies (Chordia and Shivakumar) show that price momentum strategies do not earn profits during recessions. Jensen finds that size and value premia are higher during times of expansionary monetary policy.
- Accordingly, style momentum strategies break down in bear markets, just as momentum as a strategy often does.
- Behavioral finance theory of asset pricing offers grounds to support style momentum – it may be the case that there are waves of optimism and pessimism in how investors interpret macroeconomic data.

Fama and French. *Dissecting Anomalies*, Second Draft. University of Chicago, June 2007 [15]

- In summary the authors reported that anomalies associated with net stock issues, accruals, and momentum are pervasive; they show up in all size groups (large, small, micro) in cross section regressions and are strong in sorts.

- Asset growth and profitability are anomalies but are less robust. Profitability is a factor, but only high profitability leads to higher returns. Low profitability does not portend low returns. Asset growth as a factor works in micro and small caps, but it is absent in large caps.
- The authors state: “The premier anomaly is momentum: stocks with low returns over the last year tend to have low returns for the next few months and stocks with high past returns tend to have high future returns.”
- Definition from *Quantpedia*: “The accrual anomaly is related to the negative association between accounting accruals (the non-cash component of earnings) and future stock returns. The logic of this anomaly is based on the reasoning that it is important to measure if company’s earnings (as reported by company management) are based on real cash inflow or based on revenue recognition from questionable accounting practices. Companies which have low levels of accruals have more certain real earnings and therefore should earn higher market returns. This anomaly could be exploited by acquiring a long position in low accruals companies and a short position in high accruals companies.”
- Momentum is left unexplained by Fama and French’s 3 factor model explaining stock price movements from 1993 and is not explained by CAPM. (However see Fama and French. *A five-factor asset pricing model*. Journal of Financial Economics. Jan 2010 [45]) The authors state: “The two clear winners, in terms of strong average regression slopes for all size groups, are net stock issues and momentum.”
- They skip the returns for momentum over a 1 month period because of evidence of negative correlation (reversal rather than continuation) of month to month (1 month) returns.
- Net issues (i.e., buybacks – net new issues are negatively correlated to the market). Buybacks produce negative long-short returns due to negative returns for extreme new issues and positive abnormal returns for large buybacks.
- Momentum produces strong cap weighted and equal weighted returns for all size groups. Average monthly returns for micro are 1.37%, small 1.16%, and large cap 0.66% when cap weighting. Returns for equal weighted for micro are 0.73%, small 1.08%, and large cap 0.72%.
- Momentum strategies when equal weighted appear to have unique positive alpha for small-mid caps (3rd, 4th, and 5th decile of market cap).
- Key conclusion: “Since stock issues, accruals, and momentum produce large average equal weighted and value weighted hedge returns in all size groups, at least in terms of hedge returns, these three anomalies are pervasive.”
- Momentum produces positive returns in all of the size groups studied, and the returns vary from the high to low end of sorts.
- When cap weighted, returns for momentum are smallest in micro caps and weakest for big stocks but are positive across all capitalizations.
- For both equal and cap weighted, momentum returns increase systematically from strongly negative for extreme losers to strongly positive for extreme winners.
- For stock repurchases, all size groups studied show that strong stock buybacks result in strong positive equal weighted returns. Positive returns for any company that does any size buyback is seen by Fama and French as surprising.
- Only buybacks and momentum show strong explanatory power in all studied size groups in regressions.
- As with sorts on size and other factors, regressions show that the positive relation between average returns and momentum is strong for all size groups studied.
- In contrast, the relation between momentum (the center stage anomaly of recent years) and average returns is similar for small and big stocks but only about half as strong among micro caps. Micro caps and momentum effect are less strong.
- It seems reasonable that high returns over the last year signal high expected cash flows, so the positive relation between momentum and average returns is consistent with the value equation.

Tibbs et al. *Using Style Index Momentum to Generate Alpha*. East Carolina University, Dec 2007 [16]

- Using Relative Strength among 9 Russell Index style boxes, the authors find that results are generally positive and statistically significant, particularly for shorter time periods.
- Long-short periodic returns peak at a 1 month holding period, and a combination of 12 month formation/calculation period and 1 month holding period tests out best.
- The authors thus use the 12 months formation period, 1 month holding period template for the rest of the paper. Time period of study is Jan 1972 to Dec 2005.

Relative Strength

A Valued Investment Factor

- In a detailed study, the authors found the top performing strategy was always driven by medium-term momentum, using performance from the 8 to 14 months prior.
- Style box Relative Strength can be very persistent. In their study, the authors found the top ranked style box over 12 months had particularly persistent performance and outperformed all other portfolios for 14 months.
- The 12 month Relative Strength calculation, 1 month holding period style box portfolio — when using the top 2 style boxes — outperforms all Russell style indexes in return, Sharpe ratio, Treynor, and alpha.
- Testing in accordance with Fama and French's 3 factor models shows strong alpha for the top style box and strong negative alpha for the bottom style box. The results are statistically significant. The results provide evidence that momentum in style boxes exists even after controlling for the market, size, and value factors.
- Small value was the top performer 34% of the time and was thus held 34% of the time in the portfolio.
- Mid growth was the largest contributor. Small growth, large value, and small value were also solid contributors, indicating that style box momentum is spread across all of the styles and is not an isolated phenomenon.
- The long-short portfolio (long strongest style box, short weakest) averaged 9.25% per year. Even if you exclude the 2 largest return periods from 1972 to 1980, the portfolio still earned 5.08% annualized. Best year was 50% in 1999. Worst year was - 20.4% in 2000.

Dimson, et al. *Momentum in the Stock Market*. ABN-AMRO, Global Investment Returns Yearbook 2008, Feb 2008 [17]

- Across the UK equity market from 1956 to 2007, winners (top 20% gainers) outperformed losers (bottom 20%) by 10.8% per year – cap weighted.
- Equal weighted, the difference is even greater at 12.0% per year.
- With winners/losers defined as the top and bottom 10%, the differences were even greater.
- The winner minus loser (long-short) portfolio had a smaller 7% per year gain when limited to just the top 100 UK stocks. However, in this liquid group of stocks the strategy was much harder to implement.
- Authors state theirs is the longest momentum study ever done, covering the top 100 stocks for 108 years. Winners beat losers by 10.3% per year.

- Momentum returns are robust to the choice of ranking period, holding period, weighting scheme, definition of winners, definition of losers, and choice of sample. All strategies achieved statistical significance.
- The authors conclude: “The momentum effect, both in the UK and globally, has been pervasive and persistent. Though costly to implement on a stand-alone basis, all investors need to be acutely aware of momentum. Even if they do not set out to exploit it, momentum is likely to be an important determinant of their investment performance.”

Hancock. *Momentum – A Contrarian Case for Following the Herd*. GMO White Paper. Mar 2010 [21]

- The historical success of momentum has continued well after its effect was first documented. Thus the strategy has won widespread respect from investors over the years.
- When analyzing the CRSP universe, the returns from momentum quartiles (the top quartile) peak at 11 months of momentum (actually 12 months, but 11 months since the most recent month is excluded). The strategy outperformed by nearly 4% per year from 1927 to 2009.
- In 2008, momentum was battered and lost nearly ¼ of its value relative to the market. The greatest damage was done when there was a complete reversal of leadership that occurred at the March 2009 market bottom.
- For momentum stocks, P/E expansion is a predominant component in returns relative to the market. Accordingly, we can see that momentum stocks consistently outgrow the market over time.
- Momentum does badly at market turns such as 6 months after a market bottom and 6 months after a market top.
- If it is evident that the market is at a major bottom, it is clearly unwise to pursue a momentum strategy.
- However, the evidence shows that at a major turning point, a longer term move away from momentum investing is not warranted. There is no major difference in momentum's return profile following the identification of a bottom. The major turns in the market thus do not break the validity of the momentum factor.
- Many would suggest that momentum fares better in strong up markets. That would make sense as it is a growth oriented strategy. This turns out to be only a coincidental indicator. The level of market returns is thus not a useful predictor for momentum.

- Importantly, volatility is bad for momentum, since it is associated with mean reversion and not trending.
- Those who say that momentum should respond to volatility by shortening its time horizon and be more nimble in a volatile environment are proven wrong. When volatility is high, there are more short term reversals. If anything, then, momentum should expand its time horizon during volatility.
- Returns in momentum over the last decade are what might be expected given the markets in general. The factor shows no erosion in effectiveness.
- Momentum is and always will be an uncomfortable strategy to run.
- GMO uses momentum as a small diversifying element to its fundamentally oriented strategies.
- When momentum has failed and fallen out of favor (and underperformed significantly) is when momentum has subsequently done best. The number of events to measure this is small, but the results are intuitive and can be seen as proof that momentum is a viable long-term factor. While momentum involves buying the individual most popular stocks, at times the willingness to do this becomes very much contrarian. That behavioral phenomenon is necessary for momentum to work and be viable in the long term.
- Relative Strength showed consistent outperformance over every decade, when looking at the top 1, 2, and 3 sectors.
- Cambria looks at the weakness of Relative Strength – that it is long asset classes that may have higher beta.
- Solutions to Relative Strength weaknesses are to 1) hedge and 2) add non-correlated asset classes.
- The recommended hedge is to move to cash when the price of the asset being owned is below its 10-month moving average.
- By moving to cash, most portfolios preserve their returns but with the benefit of reducing volatility and drawdowns. Sharpe ratio is increased.
- It is important to note that Cambria studied Relative Strength among 5 different asset classes (U.S. stocks, foreign stocks, bonds, REITs, and commodities).
- Owning top 1, 2, 3, or top 4 asset classes beat the buy and hold index. That owning just the top 4 beats buy and hold is important, as it points to Relative Strength's key unstated benefit – it avoids owning the worst underperformers. Owning the top 1, 2, and 3 asset classes produced stronger returns and a higher Sharpe ratio. Also, the strategy resulted in lower drawdowns.
- The strategy was robust over 1, 3, 6, 9, and 12 month Relative Strength measures.

Faber, Cambria Investment Management. *Relative Strength Strategies for Investing*. The Journal of Wealth Management, Spring 2007, updated Feb 2013 [22]

- Momentum, or Relative Strength, has been one of the most widely discussed and researched investment strategies (academics call the term an anomaly).
- Cambria looks at 8 decades of sector returns (December 1928 to December 2009) using cap-weighted sector rankings.
- Buying the top 1, 2, and/or 3 sectors produces stronger returns than an equal-weighted S&P 500 sector portfolio and produces a stronger Sharpe ratio. The Relative Strength-based returns are robust for 1, 3, 6, 9, and 12 month Relative Strength comparisons, as well as combining Relative Strength based rankings for all 5 periods.
- The system outperformed buy and hold for 70% of the years.
- Cambria estimates that outperformance is 300 to 600 basis points per year.
- A key statement from the study is “the Relative Strength methodology works on all of the measurement periods from 1 month to 12 months, as well as a combination of time periods. Most interesting is that the system outperforms buy and hold in roughly 70% of all years. A rough estimate of 300 to 600 basis points of outperformance is reasonable.”
- Owning the top 1, 2, and 3 asset classes was also robust when separated out by decade.
- The author then studied the 5 asset classes but only bought those that are above their 10-month simple moving average. Results showed similar returns but marked reductions in maximum drawdown (when combining 1, 3, 6, 9, and 12 month Relative Strength rankings).
- Another key statement: “The persistence of the momentum strategy by decade shows that this was not only a property of markets 80 years ago but that it continues to work today.”
- To reduce trading frequency and possible transaction costs, the author recommends a sell filter. Assuming a universe of 10 funds, the top 3 funds are bought and sold when they drop out of the top 5.

Relative Strength

A Valued Investment Factor

- The final conclusion is that Relative Strength showed robust performance across measurement periods but draw-downs remain high. Thus it is recommended to hedge the exposure, or to include non-correlated asset classes in your Relative Strength analysis.

Moskowitz. *Momentum Investing, Finally Accessible for Individual Investors*. Investment Management Consultants Association, 2010 [23]

- Momentum produces abnormal positive returns (alpha) even better than size or value.
- Momentum works in different asset classes, market capitalizations, countries, and sectors. Momentum is not captured by the value or growth styles.
- Momentum is particularly beneficial when combined with a value style. Both can deliver positive excess returns, but because they are negatively correlated, the combination lowers risk and improves portfolio efficiency.
- Momentum stocks as a group tend to move together, a movement that other sources cannot explain.
- Outperformance of a long only top quintile of momentum (when looking at U.S. stocks) is about the same as underperformance of the bottom quintile. An investor who could not short still can benefit from going long the winners.
- From 1979 to 2009 (using Russell Indexes and an AQR study), momentum outperformed the market or a core index. Momentum outperformed value by 1.5% per year and growth by more than 3% per year.
- The excess returns of momentum are positively correlated to growth strategies and negatively correlated to those of value, making momentum a good substitute or add-on to a growth strategy and complementary to a value allocation.
- Behavioral explanations for momentum include: Anchoring – different investors react to the same news event over different time horizons and in different ways. Individuals update their views only partially when faced with new information, slowly accepting its full impact. Also, the disposition effect – investors sell winning investments prematurely to lock in gains and hang on to losers in the hope of breaking even.
- Momentum exists over a 6 to 12 month time frame. Beyond 12 months, momentum as a factor wanes, and over 3 to 5 year periods we see a reversal.

- Assets that have performed well over the last 6 to 12 months tend to do better over the next 6 to 12 months, and vice versa for poor performers.
- A momentum strategy tends to move with growth stocks but with higher returns and higher Sharpe ratios.
- When combined with value, momentum is a terrific diversifier. The combination may raise Sharpe ratios by over 50% and information ratios by 2 to 3 times.
- Of interest: Data confirm that value stocks that have been long term losers but have recent high momentum (6 to 12 month returns) that can go on to outperform by an even higher margin.
- Momentum is more tax efficient than value because it generates many short-term losses that can be used to offset other gains in a broader portfolio. Value, on the other hand, exposes investors to more heavily taxed dividends.
- Momentum investing's beta can vary over time. In a down-trending market, the beta tends to fall below 1, but in an up-trending market, the beta can exceed 1. When the market takes an abrupt and significant turn of direction as in 2000, 2008, and 2009, these beta exposures are proven wrong, and short-term losses are the result.

Lewis. *Relative Strength and Asset Class Rotation*. Dorsey Wright & Associates, Feb 2011 [25]

- Dorsey Wright developed a Monte Carlo based system to test the Relative Strength process. The testing system selects 10 ETFs at random from the top quartile of Relative Strength rankings. Then it replaces any that fall out of the top quartile with another randomly selected ETF from the top quartile. The universe was a selection of ETFs from all asset classes.
- Even drawing securities at random from the top quartile of an asset class, an ETF universe provided outperformance in 100% of the test cases versus several asset class benchmarks. Study covered December 31, 1999 to December 31, 2010.
- In 2005 and 2006, all Relative Strength test results beat the S&P 500. In 2009 none of them did, as Relative Strength struggled after the 2009 bottom.
- Relative Strength is an intermediate term factor. Most studies have found that a 3 to 12 month measurement period is ideal. Dorsey tested 1, 3, 6, 9, 12, 18, and 24 months, and all time periods produced stronger performance than the S&P 500.

- Very short term 1 month performance was clearly not as good, and Relative Strength does not capture every wiggle in returns.
- Relative Strength rotates between themes that are in favor. In a multi-asset class portfolio, this means rotating into less volatile assets during major declines.
- The beta of a multi-asset class Relative Strength strategy varies greatly over time and increases and decreases when risk is in or out of favor.
- The adaptive nature of Relative Strength allows the process to adapt to changing leadership over time.

Moody. *Relative Strength, A Critical Portfolio Management Tool*. Investment & Wealth Monitor. Jan-Feb 2012 [28]

- Definition: Relative Strength is a measurement of the performance relative to a benchmark or relative to the rest of a given universe. Relative Strength can be used to find the strongest (and weakest) trends in a market or to identify the strongest (and weakest) asset classes in a given universe.
- Academics who belatedly discovered Relative Strength in the 1990s renamed it “momentum.” The terms Relative Strength and momentum can be used interchangeably.
- Relative Strength is not gun-slinging or super-active trading. Rather, it is a systemic, objective, and disciplined investing style that applies across asset classes.
- Relative Strength is a rate of change (relative to a benchmark or universe) and is not related to the physics concept of momentum.
- Moskowitz (from AQR) on Relative Strength/momentum: “Momentum’s effect exists in nearly all securities, sectors, international markets, and asset classes. It works in large cap, mid cap, small cap stocks, and among value and growth stocks too.”
- Key point: Relative Strength, even when adjusted for risk, using the Fama French 3 factor model, still produces alphas from a momentum strategy. Cross sectional differences in risk do not explain momentum profits.
- Jegadeesh and Titman say: “the evidence suggests that momentum profits arise because of a delayed reaction to firm specific information.”

- Value investors argue that investors over-react to negative information, leading to prices that are too low according to fundamentals. Relative Strength investing suggests that investors under-react to positive information (and conversely under-react to negative information), again leading to prices that are too low given the fundamentals (or conversely too high given fundamentals, for negative news).
- Value and Relative Strength combine well in a portfolio.
- When a universe has a very narrow performance spread between individual items – investment grade bonds as an example – Relative Strength is not as likely to work well.
- Calculating relative performance across a wide variety of asset classes is easy to do, and it is objective.
- Moody concluded Relative Strength was proven to add value across a wide swath of measurement periods. All of these many different measurement periods are capable of outperforming the market benchmark over time.
- Selecting securities based on short-term Relative Strength performance actually results in negative alpha and poor performance. To be useful, Relative Strength must be measured over the intermediate term.
- Sweet spot for Relative Strength analysis appears to be a 6 to 12 month time period.
- Common practice in the Relative Strength investment community is to form portfolios based on the top quintile or quartile of Relative Strength.
- When markets are trending steadily or adjusting course gradually, Relative Strength tends to perform quite well. However, during periods of abrupt trend change, Relative Strength will lag, often significantly. Reason: Relative Strength is a trend-following strategy and requires a period of adaptation to get synchronized with a new and changed trend.
- Psychological problem: During this period of duress a Relative Strength investor may abandon ship, just as potential smooth sailing and outperformance will follow. Thus stick with the discipline and diversify strategies.
- Relative Strength and value are not correlated and thus combine well when building a portfolio.
- Relative Strength is a growth factor, and because it tends to outperform growth over time, a more efficient portfolio with higher expected return can be built by substituting Relative Strength for growth entirely.

Relative Strength

A Valued Investment Factor

Antonacci. *Risk Premia Harvesting Through Dual Momentum*. Portfolio Management Consultants, Jan 28, 2013 [34]

- Researchers have verified the existence of momentum in the following areas: U.S. stocks, industries, foreign stocks, emerging markets, equity indexes, commodities, currencies, global government bonds, corporate bonds, and residential real estate. Momentum has been shown to work in out-of-sample periods going forward and back all the way to over 100 or 200 years. Momentum works well across asset classes as well as within them.
- Momentum when used cross-sectionally works well, but it also works well on an absolute or time series basis.
- From research by Schwert: “explored all known market anomalies and declared momentum as the only one that has been persistent and survived since publication.”
- No one has a clear explanation to why momentum works. The most common explanations use behavioral factors, such as anchoring, herding, and the disposition effect. Behavioral factors of people are unlikely to disappear, and this may explain why momentum profits persist, and may continue to persist, as an anomaly.
- Other studies have shown that greater momentum profits come from assets that are more volatile and have extreme past returns.
- Research by Jostova, Niklova, and Philipov show that momentum strategies can be highly profitable among high yield bonds. High yield bonds have by far the greatest volatility in the studied bond universe. The high volatility can be seen as a proxy for credit default risk.
- In the dual momentum concept, Antonacci uses Relative Strength vs. T-bills over a 1 year period as a proxy. Thus T-bills are a hurdle rate before you can even invest in a given asset.
- Antonacci skips the most recent 1 month return because this short of a momentum time period does not work due to the short-term reversal effect (related to liquidity or microstructure issues).
- Relative Strength momentum among the studied equities (domestic and international) provided higher returns, a higher Sharpe ratio (but slightly higher standard deviation) compared to its universe. Dual momentum provides even higher returns, a higher Sharpe ratio, and lower standard deviation. Dual momentum doubles the Sharpe ratio and cuts the drawdown in half.

- Single asset class momentum shows higher returns than the broad index but also higher volatility. Dual momentum shows higher returns but with lower volatility and drawdown.
- Applying dual momentum to high yield and credit bond indexes produces a doubling of individual Sharpe ratios. Dual momentum gave the same profit as high yield bonds alone but with half the volatility and ¼ the drawdown.
- The same dual momentum approach works for REITs and, in general, dual momentum. Gold and long-term Treasuries are economic stress based and volatility based factors, and dual momentum works well with both of them.
- Momentum and dual momentum work well with high volatility asset classes. It can work with countries or regions, but the diversification benefits of using different asset classes commands attention. Momentum among asset classes thus is particularly effective.
- Combining Relative Strength and dual momentum produces higher returns, a much lower standard deviation, and a higher Sharpe ratio, with a lower maximum drawdown. The percentage of profitable months is just as high as Relative Strength or buy and hold.
- Absolute momentum, when combined with relative momentum, gives a substantially lower drawdown than Relative Strength alone. Only absolute momentum substantially reduces volatility and drawdown.
- Long only momentum works best when combining absolute and relative momentum. Trend determination with absolute momentum can mitigate downside risk and take advantage of regime persistence. Portfolio can take advantage of low correlation of dual momentum, making multi-asset momentum portfolios desirable.

Steiner. *The Skinny on Momentum Investing Strategies*. Bankrate.com, Nov 2013 [39]

- Momentum can be looked at in two broad ways. The first is comparing asset classes to other asset classes; the second compares one stock to another, and this is called cross sectional momentum.
- Momentum when used among stocks appears to be more successful and profitable when used among smaller firms, growing firms, leveraged firms, firms with higher sales volatility, and firms with lower credit quality.
- The profitable holding period for a momentum based strategy is a quarter to a few months but less than a year.

- Using momentum combined with a screen requiring that a security must be above the 200 day moving average reduces volatility and reduces drawdowns.
- Momentum should not be the only strategy in an investor's portfolio. Ideally it is combined with a value based strategy.

Deluard et al. *An Objective Look at Momentum*. Europe Strategy, Ned Davis Research, Dec 6, 2013 [40]

- Ned Davis measured over 100 momentum models in Europe and showed that it does exist and is sufficiently stable over time. Key point: The model universe was the largest 100 European stocks. Many academic studies point out that the momentum factor is strongest for small cap stocks. Ned Davis studied the algorithm on 100 of the small European stocks, and the average annualized excess gains were much more spectacular — over 10% per year since 1999. Average holding period for the study was 547 days.
- Momentum strategies in Europe were tested for up to 56 weeks lookback and a 56 week holding period. Only in the very short and very longest time periods were returns even negative. Thus momentum worked largely regardless of the time periods of the model. The average annualized excess return for the 108 momentum strategies tested was 1.7%.
- The sweetest spot for momentum was 36 weeks lookback period, holding the portfolio for 46 weeks. That confirms the sweet spot area for Relative Strength is in the 6 to 12 month time period. 30-40 weeks for lookback period and 25-50 weeks of holding period were generally the highest returning time frames.
- Over 14 weeks, the best strategy outperformed its benchmark by 100 cumulative percentage points.
- During major market turns, momentum does underperform. The strategy underperformed its benchmark by 15% in the 2000 and 2008 downturns.
- They reran the strategy from 1987 to 1998 and then used an out-of-sample period. The results are very similar, with a 41 week lookback and 31 week holding period faring best. Model produced 3.2% excess annualized return. Using the same parameters of the model from 1999 to now, the model produced virtually identical excess returns of 3.0%.

Bender et al. *Foundations of Factor Investing*. MSCI Research Insight, Dec 2013 [41]

- Definition: A factor is any characteristic relating to a group of securities that can explain their returns and risk. The market (beta) can be seen as the most important equity factor.
- Momentum as a factor reflects excess returns to stocks that have superior past performance.
- Some factors are significant in explaining returns but do not have a persistent market premium. Growth and liquidity are examples.
- Factors per MSCI's work are risk premia factors that have earned significant returns over the long run and reflect exposure to some source of systematic risk. All of the Fama French factors count as risk premia since the aim of studies was to find pricing drivers.
- MSCI's World Momentum Index produces returns of 10.4% per year, with total risk of 15.9%, versus the MSCI World Index producing 7.1% per year and a total return of 15.4%.
- MSCI's World Momentum Index produces a 330 basis point estimated premium, a number that is well in excess of an estimated 127 basis points of trading cost.

Conley. *The Case for Momentum Investing: Building Better Portfolios*. JAG Capital Management, 2014 [43]

- Unlike value strategies, momentum oriented strategies will rarely purchase securities at the bottom of a long-term period of declines. Similarly, momentum strategies will rarely if ever sell at the top of a long term increase.
- The considerable academic research on momentum provides evidence that it can work effectively with large or small cap stocks, as a stand-alone strategy, or as a potent diversifier when complemented by a value oriented strategy.
- Fama and French's data show that over 87 calendar years ending December 2013, a portfolio of high momentum stocks, rebalanced monthly, earned 16.9% annualized versus a loss of 1.3% for low momentum stocks.
- When compared to the S&P 500, the high momentum stocks saw a 60% higher return with only a 19% higher standard deviation. This is a highly favorable risk-reward tradeoff.

RelativeStrength

A Valued Investment Factor

- Momentum investing, per the AQR Large Cap Momentum Index, delivered a higher Sharpe ratio than the S&P 500 and the Russell 1000 Growth. When added to a blended portfolio, momentum is a diversifier and adds to a better Sharpe ratio.
- Higher turnover among momentum stocks does not equate to higher tax costs. Momentum strategies emphasize holding winners for as long as they remain winners and selling losers early. Thereby creating a tax efficient mix over time. Value strategies tend to get much of their earnings from dividends, which are taxed at a much higher rate.
- Momentum as a discipline has the advantage of rotating out of flat or declining stocks. Adding the strategy to a portfolio can make the portfolio more efficient.
- Academic research shows that the premium for momentum investing has generally been as large or larger than what has been earned in value stocks.
- Momentum as a concept can be seen as counterintuitive. Our human intuition leads us to think that what goes up must come down. There is ample evidence to the contrary. Evidence shows that what goes up tends to continue to go up for some measurable period of time.
- Gross returns for momentum can be large and larger than for those for value and size. This is true for an 87 year period, also from 1963 onwards, and also during the out-of-sample period.
- Momentum's advantage over other factors is somewhat smaller in Sharpe ratio terms than in raw spread returns. Even considering the higher volatility, momentum still comes out on top.
- Over an 87 year period, and from 1963 on, and the out-of-sample period, momentum was a consistent factor in providing steady alpha (more than size and value).
- It is recommended that value and momentum be used together.
- Momentum's returns can be exploited in long only fashion, particularly by avoiding losers. The long side of a momentum portfolio provides about an equal amount of alpha as the short side (almost exactly equal).
- Israel and Moskowitz show long and short momentum are equally profitable over 86 years of U.S. data and 40 years of data from 5 other asset classes.
- Momentum exists in small caps and large caps. The value premium is very strong among small caps but not as strong (or nonexistent) in large caps.
- Momentum has a .24 Sharpe ratio in large caps versus 0.45 in small caps. The value factor hardly exists in large caps. Thus momentum is much more complex and broad across market caps than value.
- Many studies show momentum is more dynamic and powerful among small caps. However, the factor is still solid and adds alpha among large caps. There is no sample period in this study that shows momentum fails among large caps.
- When institutionally managed and structured, per dollar trading costs for momentum can be quite low. Thus, despite higher turnover and higher volatility, momentum survives transaction costs.
- Momentum can work for the taxable investor. Momentum generally holds on to winners and sells losers. More importantly, generally momentum has lower dividend exposure, and the lower taxes on dividends makes it roughly equal to value in tax efficiency. Momentum also can add more alpha than value over time, and thus the after tax returns are higher.

Trendrating. *Momentum Investing Gains Momentum*.
seekingalpha.com, April 28, 2015 [48]

- The Chicago Fed released a study that analyzes trends of over 200 years of investment data and proves that there are viable correlations in the data.
- Other studies show that factor premiums, like low volatility, value, and momentum, outperform market cap weighted indexes and possess a better risk return profile.

Asness et al. *Fact, Fiction and Momentum Investing*. Journal of Portfolio Management, Fall 2014 [50]

- The existence of momentum as a factor is an established fact, proven by over 200 years of data, data from well before the time of financial economics.
- Momentum and value when combined have a tremendous synchronous relationship.
- Momentum has been present, robust, and stable in many places for many years prior to its academic "discovery" early in the 1990s.

- Few other factors have as strong and sustained added alpha (or return premium) as momentum (200+ year track record). Momentum's premium and alpha are sustained over time. While it may have rough periods as all factors do, the authors believe the concept and its value will not go away.
- Many think momentum could go away due to its short history in academic circles and due to the strong push by many for a behavioral explanation.
- The authors believe momentum and value are a great mix together, and the prominence and existence of value investing means that there may always be a growth investor for every value investor and vice versa.
- Israel and Moskowitz look at the issue of momentum studies returns degrading after the out-of-period sample, and they did not see any degradation in the factor's alpha. The same studies also looked at value and size under the same light and did see some degradation of those factors out-of-sample.
- Momentum, even if it had zero alpha going forward, could have a solid role in a portfolio due to its strong diversification benefits with value.
- When optimizing a portfolio of the market, size, value, and momentum factors together, momentum got a strong 38% weighting. Even in an extreme case when momentum's alpha is literally zero, an optimal portfolio still places significant weight on momentum because the diversification benefits were strong.
- Value and momentum as factors have a - 0.4 correlation from 1927 to 2013 using Fama French data.
- Even if doesn't add value, momentum can be a valuable hedge to a diversified portfolio.
- When momentum has bad periods of underperformance (e.g., 2009), value almost always outperforms during the bad period for momentum and thus a combined portfolio of the two usually holds its own.
- Momentum strategies that buy winners and sell losers is long low beta stocks and short high beta stocks at the worst time, at the market bottom. When the market turns up, being short high beta stocks causes momentum to lag. Here, our methodology of not being short losers means we avoid what is the proven toughest time for momentum (right at the bottom of a major decline - 1932 and 2009 are examples).
- Combining momentum with value means you can avoid the momentum struggles at various times. The worst drawdown of a momentum strategy from 1927-2013 was 43% for value, 77% for momentum, but only 30% for a 60% value, 40% momentum strategy.
- Momentum does give different results when measured over different time periods, and while each of these measures adds incremental performance, overall the momentum effect over the long-term is very similar across different measures. Choosing a single, simple measure or an average of all viable measures adds some incremental performance.
- Novy Marx (key author of paper on profitability) says that momentum in U.S. equities is better measured by past returns 7 to 12 months ago versus most recent 6 months' returns of data.
- Another paper by Goyal and Wahal shows that in 35 of 36 countries the most recent 6 month period and the 6 to 12 month period contribute equally to momentum's alpha.
- The authors assert the fact that different measures of momentum generate substantially similar results is a sign of its robustness not a critique.
- There is behavioral theory behind momentum; like most factors, there is a risk based and behavioral approach to explaining it.
- Behavioral models explain momentum as either an under-reaction or a delayed over-reaction. Under-reaction is the information traveling more slowly (plus disposition effect - selling winners and holding losers too long). Over-reaction has investors chasing returns, creating a feedback mechanism of higher prices.
- Risk based models conceive of momentum stocks having greater risks with regard to their cash flow and growth prospects or face greater discount risk because of investment opportunities, causing them to face a higher cost of capital.
- Under behavioral explanations of momentum, as long as the biases, behaviors, and limits to arbitrage exists and are stable, momentum should remain stable as well. Historically, the momentum phenomenon and the factors behind it are not short lived.

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A Valued Investment Factor

Why Momentum Investing Works. A Wealth of Common Sense, July 7, 2015 [52]

- Value investing is easy to explain. Buy at a discount and then wait. Momentum as a factor is based on buying high and selling higher or cutting losses and letting winners run. Value investing is based on long term reversion to the mean. Momentum investing is based on the gap in time that exists before mean reversion occurs.
- Momentum certainly does chase performance but does so with a disciplined entry and exit strategy in place.
- Swedroe and Berkin point to the Fama and French studies that show the premiums for four different factors (annualized, per year, 1927-2014): value is 5.0%, size is 3.4%, beta is 8.4%, and momentum is 9.5%.
- Two explanations for momentum are that it takes more risk or takes advantage of behavioral factors. Behavioral factors might make sense because the only way for an investor to outperform is for another investor to underperform.
- Research also shows that investors hold onto losing stocks too long, hoping they will come back to their original price but sell winners too early.
- Investors also anchor to recent results, so they underreact to news and new data.
- Another behavioral effect is herding, as investors over-react when news is apparent, and overshoot occurs in both directions.
- Fear, greed, confirmation bias, and overconfidence lead investors to pile into winning areas too much and sell out of losers after they have fallen.
- Momentum attempts to benefit from irrational market participants – however, the task is not easy, as the trends momentum benefits from don't last forever and have swift reversal when they come to an end.

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Director of Research

As Director of Research David directs the ongoing research into securities selection and portfolio strategies used to enhance the Navigator investment programs. In the late 1970s, David began to develop economically based, quantitatively driven econometric models. David has also developed technical models in the effort to enhance relative returns and reduce the risks of ETF and fund based products. David is a member of the Clark Capital Investment Committee. David was formerly President and Chief Investment Officer of RTE Asset Management which merged with Clark Capital in 2005. David holds a degree in Electrical Engineering from Lehigh University.



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Mason joined Clark Capital Management Group, Inc. in 2005 as a Portfolio Manager. He is a member of the Clark Capital Investment Committee, contributing to asset allocation policy and security selection. Mason has almost two decades of experience in the investment industry. He is responsible for quantitative investment analysis, security selection, and communicating the firm's investment policy to wealth advisors and consultants. He participates in the research and product development efforts of the Portfolio Team. A graduate of Dickinson College, Mason earned an M.B.A. in International Management from the Garvin School of Management at Thunderbird (the American Graduate School of International Management). He holds the CFA designation and is a Chartered Market Technician.

The S&P 500 measures the performance of the 500 leading companies in leading industries of the U.S. economy, capturing 75% of U.S. equities. It is not possible to invest directly in an index.

The Appendix included in this white paper summarizes what we believe to be the key conclusions made in a selection of noteworthy research reports. As the summaries are intended to provide direction to those interested in further research, descriptions of source material and information such as the construction of universes, time periods and indexes employed in the studies summarized are not included. For additional information, the original studies should be consulted. Numbers in brackets refer to the Bibliography. Views expressed are those of the individual authors.

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