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# Our Quantitative Momentum Philosophy

## Buy Stocks with the Highest Quality Momentum

Authors:

Jack R. Vogel, Ph.D.
Managing Member

Wesley R. Gray, Ph.D.
Executive Managing Member

## Executive Summary

Our Quantitative Momentum (QMOM) system seeks to identify stocks with the highest quality "momentum." We consider the term momentum to mean a continuation of past returns—past winners tend to be future winners, while past losers tend to be future losers. How can we exploit this phenomenon? At Alpha Architect, we have designed a system to identify the "quality" of momentum by examining how the momentum is formed.

*But why might momentum be an interesting stock selection tool?*

First, Eugene Fama, the 2014 co-recipient of the Nobel Prize in Economics and father of the efficient market hypothesis, has summarized the academic research on momentum as follows:

*"The premier anomaly is momentum."*[1]

When the father of efficient markets suggests momentum is the leading anomaly, we take note.

Second, the empirical research on the momentum effect is compelling. For example, academic researchers have examined stock data going back over 200 years and identified a significant and robust historical performance record.[2] As natural skeptics, we have independently verified many of the empirical results associated with momentum. Momentum is well grounded, historically. And while we never want to invest in a strategy simply because it has great historical data, we believe that the momentum anomaly might be a valid strategy because the returns associated with momentum strategies could be 1) driven by innate human bias, and 2) following the strategy is difficult because of the enhanced volatility and career risk considerations.

We seek to minimize deeply ingrained human bias by following a systematic approach, which we believe protects us from our own behavioral errors. Our tools do not necessarily need to be complex, but they do need to be systematic. We contend with volatility and career risk by educating investors on the long-term horizon required to be a successful momentum investor. We refuse to appease those with short horizons by "diluting" our approach. Hence, our strategy is concentrated and must contend with more stock specific risks. In the end, we cannot guarantee long-term success, but our process does seek to follow a high-conviction momentum strategy that is *Built to Beat Behavioral Bias*.

PLEASE READ IMPORTANT DISCLOSURES AT THE END OF THIS DOCUMENT.

[1] Fama, E. and K. French, 2008, Dissecting Anomalies, *The Journal of Finance,* 63, pg. 1653-1678.

[2] Geczy, C. and M. Samonov, 212 Years of Price Momentum, University of Pennsylvania Working Paper, accessed 10/31/2015

# THE QUANTITATIVE MOMENTUM PHILOSOPHY

## Introduction

Quantitative Momentum (QMOM) has a straightforward mission:

- Identify the most effective way to systematically capture the momentum premium.

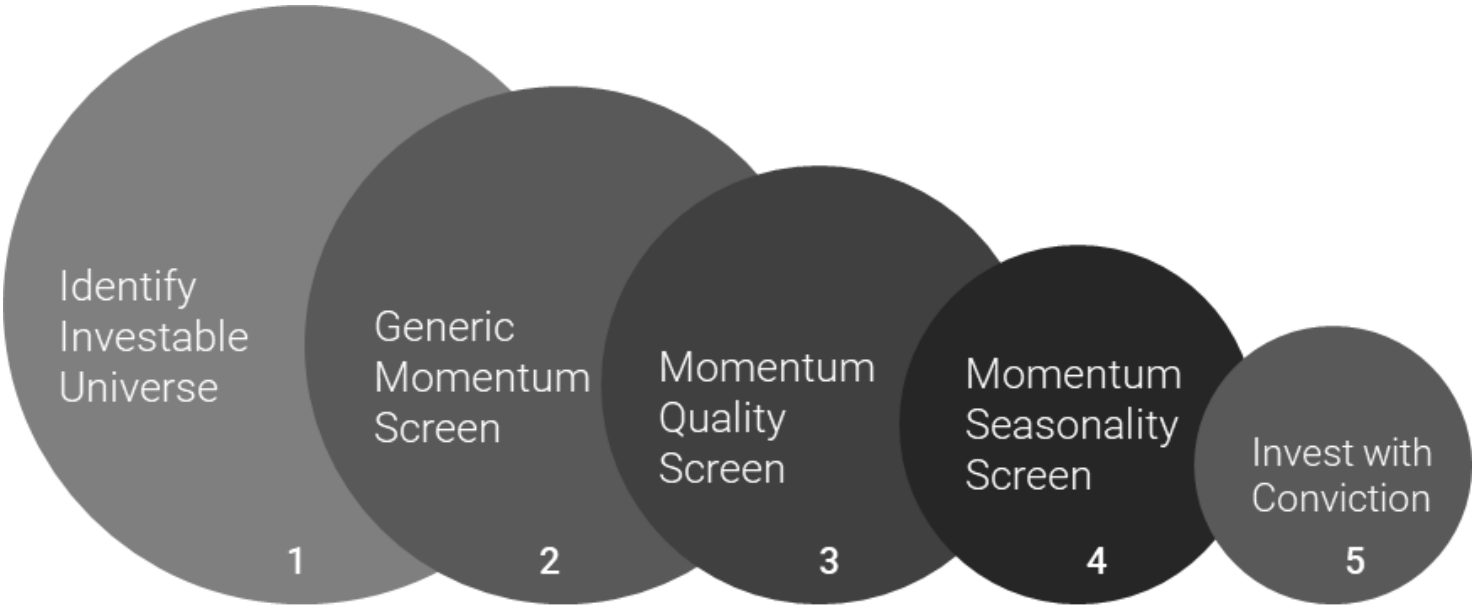
Our mission involves two core beliefs:

- Momentum investing works and is driven by a predictable *underreaction* to positive fundamentals.
- We can't control our own biases, and therefore our decision-making process must be automated.

In 2012, Alpha Architect partnered with a multi-billion dollar family office and turned our dream to deliver affordable active management into a reality. At the time, we were focused on our Quantitative Value strategy. However, in the course of our extensive research and development efforts we created a momentum strategy that complemented our value strategy. In the end, we boiled down our momentum process into five sequential steps (depicted in Figure 1):

1. Identify Investable Universe: Our universe generally consists of mid- to large-capitalization U.S. exchange-traded stocks.
2. Generic Momentum Screen: We rank stocks within our universe based on their past twelve-month returns, ignoring the first month.
3. Momentum Quality Screen: We screen high momentum stocks on the "quality" of their momentum—we focus on stocks with a "smoother" return path towards their high momentum status.
4. Momentum Seasonality Screen: We take advantage of certain seasonal aspects applicable to momentum investing, which determines the timing of our rebalance.
5. Invest with Conviction: We seek to invest in a concentrated portfolio of stocks with the highest quality momentum. This form of investing requires disciplined commitment, as well as a willingness to deviate from standard benchmarks.

Figure 1: The Quantitative Momentum (QMOM) Process




## Step 1: Identify the Investable Universe

The first step in the QMOM investing process involves setting boundaries on the universe for further screening. There are several reasons we place such limits around the stocks to consider. A critical aspect involves liquidity, which is related to the size of the stocks under consideration. In general, if we include stocks that are too small, the possibility of large price moves on small volume can lead to significantly overstated theoretical returns relative to actual returns. In other words, if we include small stocks in our universe, potential returns could be higher, but these returns may be unobtainable in the real world, even when operating with small amounts of capital.

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In order to honestly assess and reliably implement the QMOM approach, we eliminate all stocks below the 40th percentile breakpoint of the NYSE by market capitalization. As of December 31, 2014, the 40th percentile corresponded to a market capitalization of approximately $1.9 billion. Our universe also excludes ADRs, REITS, ETFs, and firms without 12 months of return data.

In summary, our investment universe contains liquid companies with at least one year of return data.

### Step 2: Generic Momentum Screen

In basketball, if a player has made a few shots in a row, the player is described as having a "hot hand;" in finance parlance, this player has "momentum." But can basketball players actually exhibit momentum? Originally, the evidence seemed to reject such a theory, as outlined in a 1985 paper by Thomas Gilovich, Robert Vallone and Amos Tversky.[3] For decades, the theory of a hot hand in sports was considered a myth. The question appeared settled. However, recent working papers by Andrew Bocskocsky, John Ezekowitz and Carolyn Stein in 2013[4], and Brett S. Green and Jeffrey Zwiebel in 2013[5], now show that the hot hand probably exists in basketball and also in baseball.

The intellectual journey to identify momentum in sports is similar to the attempts to identify momentum in stocks. Initially, stock momentum was deemed a myth because the efficient market hypothesis considered this approach to be impossible. Academics laughed at the idea. But contravening evidence began to mount…and mount…and mount. Today, no one is laughing. Serious evidence-based investors and academic researchers can no longer consider momentum heresy.

But how does one calculate momentum? When testing momentum in stock returns, we need to first identify the time period over which we will calculate the momentum variable. Below we summarize the main academic research findings for three different look-back momentum calculation periods:

- Short-Term Momentum (1-month) – exhibits a ***reversal*** in returns[6]
- Long-Term Momentum (3 to 5 years) – exhibits a ***reversal*** in returns[7]
- Intermediate-Term Momentum (6-12 months) – exhibits a ***continuation*** in returns[8]

In short, both short-term and long-term momentum signal a future ***reversal*** in returns, in other words, one can expect these stocks to underperform. However, intermediate-term momentum provides a ***continuation*** of returns–the so-called "hot-hand"–and these stocks have tended to outperform. We focus on this momentum measurement for Step 2.

### Step 3: Quality of Momentum Screen

Step 1 helps us identify a universe that is expected to be reasonably liquid, and Step 2 examines the results for our first screen–the generic momentum screen. In Step 3 we seek to identify the quality of momentum associated with the stocks from Step 2.

The details for calculating momentum quality are complex, but the intuition is simple. Consider two hypothetical momentum stocks: Stock A is a biotechnology company, Stock B is a Big Box Store, and both companies have a 200% return over the past 12 months. However, assume A and B have vastly different paths to 200 percent returns.

- Buzzing Biotech: Stock A's returns were 0% for 11 months, but just recently Stock A was granted an FDA approval for a new drug and the stock shot up 200%.

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[3] Gilovich, E., R. Vallone, and A. Tversky, 1985, The Hot Hand in Basketball: On the Misperception of Random Sequences, *Cognitive Psychology,* 17, pg. 295-314.

[4] Bocskocsky, A., J. Ezekowitz, and C. Stein, 2014, The Hot Hand: A New Approach to an Old "Fallacy", *working paper*, accessed 11/15/15

[5] Green, B. S., and J. Zwiebel, 2015, The Hot-Hand Fallacy: Cognitive Mistakes or Equilibrium Adjustments? Evidence from Major League Baseball, *working paper*, accessed 11/15/15

[6] Lehman, B. N., 1990, Fads, Martingales, and Market Efficiency, *The Quarterly Journal of Economics,* 105, pp. 1-28 and Jegadeesh, N., 1990, Evidence of Predictable Behavior of Security Returns, *The Journal of Finance,* 45, pp. 881-898.

[7] DeBondt, W. F., and R. Thaler, 1985, Does the Stock Market Overreact?, *The Journal of Finance,* 40, pp. 793-805.

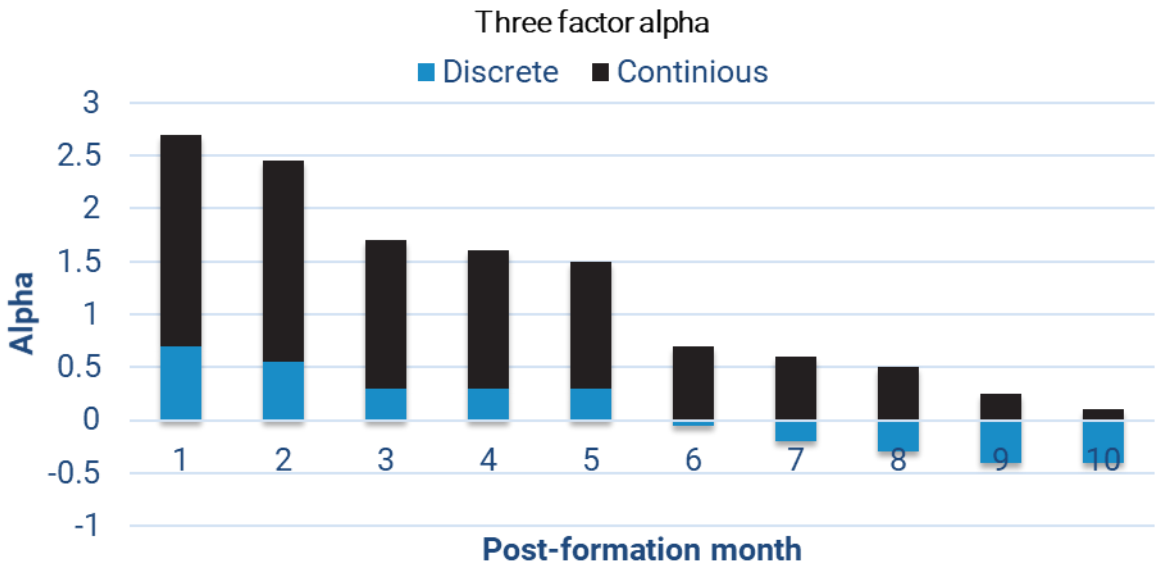
[8] Jegadeesh, N., and S. Titman, 1993, Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency, *The Journal of Finance*, 48, pp. 65-91.

- Boring BigBox: Stock B has returned 0.80% each day, on average, for the past 250 days, and has generated a 200% return.

Stock A and Stock B are both considered momentum stocks, but Buzzing Biotech's path is much different from Boring BigBox's path. So-called "path dependency" matters, if momentum is driven by an investor bias referred to as "limited attention." For example, Buzzing Biotech's FDA approval will likely be covered by the media and be highly available to investors, thus rapidly driving the company's price to efficient levels. However, Boring BigBox is delivering news that is consistently better than market expectations, but over a longer period, and because the attention to Boring BigBox is limited, this good news is slow to be incorporated into market prices.

Although testing the "limited attention" hypothesis in the context of momentum is challenging, we're lucky that finance professors have been hard at work. In a 2014 paper titled, "Frog-in-the-Pan: Continuous Information and Momentum," Zhi Da, Umit Gurun, and Mith Awarachka find that high momentum firms with smooth, or "high-quality" momentum, have historically tended to do better than those firms with choppy low-quality momentum. The results are summarized in Figure 3, which shows three-factor alpha estimates for long/short high-quality ("continuous") and low-quality ("discrete") momentum portfolios over various rebalance frequencies. [9]

Figure 3: Three-Factor Alpha from Da, Gurun and Warachka 2014 paper.[10]




Recall that the proverbial frog-in-the-pan sits in a pool of water whose temperature is gradually increasing. Because the change in temperature is so slow, the frog has limited attention to the rising heat and he slowly boils to death. Similarly, investors have limited attention to the ongoing flow of uneventful, but reliable information, arriving continuously in small amounts regarding a stock.

To calculate "frog-in-the-pan" momentum, the authors classify each daily return as either positive or negative (or zero in some cases). In general, a high-quality momentum stock should have a higher percentage of positive return days compared to a choppier stock.[11] We conduct our own analysis of the frog-in-the-pan variable and incorporate this variable into our Quantitative Momentum system. In our context, we use the frog-in-the-pan measure to identify stocks from Step 2 that have high-quality momentum. We split the portfolio of high generic momentum stocks into high-quality momentum and low-quality momentum. The portfolio is equal-weighted.

### Step 4: Seasonality Screen

Steps 1 through 3 focus on momentum stocks with quality momentum. Step 4 further enhances our Quantitative Momentum system by incorporating seasonality effects that have been documented in momentum strategy research.[12] Some of the most compelling research

[9] Figure 3 also highlights that the alpha for a long/short momentum strategy decreases as the holding period increases (less rebalances). A similar result is found for long-only portfolios in many academic papers.

[10] Da, Z., U. G. Gurun, and M. Warachka, 2014, Frog in the Pan: Continuous Information and Momentum, *Review of Financial Studies*, pp. 1-48.

[11] The exact variable used is ID = sign(momentum over past 12 months ignoring last month)*(%negative-% positive)

[12] Sias, R., 2007, Causes and Seasonality of Momentum Profits, *Financial Analyst Journal*, 63, pp. 48-54.

on this subject is found in a 2007 paper titled, "Causes and Seasonality of Momentum Profits," published in the *Financial Analyst Journal* by Rishard Sias. Professor Sias shows that window-dressing (i.e., when institutions buy stocks that have performed well so they can report ownership of "winning" stocks at quarter-ends) and tax incentives at year end drive momentum seasonality effects. Professor Sias summarizes his results:

> "…the average monthly return to a momentum strategy for U.S. stocks was found to be 59 bps for non-quarter-ending months but 310 bps for quarter-ending months…investors using a momentum strategy should focus on quarter-ending months…"

Sias's paper focuses on long/short momentum portfolios, but the conclusions regarding momentum seasonality can be incorporated into our long-only Quantitative Momentum system.[13]

### Step 5: Invest with Conviction

Steps 1 through 4 systematically identify stocks with the highest quality momentum and seek to take advantage of momentum seasonality. We believe we have identified a form of momentum investing that intelligently incorporates the best research on the subject into a coherent and pragmatic investment approach. But we can easily destroy the benefits of a reasonable investment process by mismanaging portfolio construction and "diworsifying" our active momentum exposure. Charlie Munger, at the 2004 Berkshire Hathaway Annual Meeting, is quoted as saying, "The idea of excessive diversification is madness…almost all good investments will involve relatively low diversification." Charlie Munger is right: to the extent you believe you have a reliable method of constructing a high alpha "active" portfolio, less diversification is desirable.

In the spirit of aspiring to high conviction, we construct our portfolios to hold around 60 securities, on average.

Consider our typical process:

1. **Identify Investable Universe:** We typically generate 1,200 names in this step of the process.
2. **Generic Momentum Screen:** Select the top decile of firms on their past momentum, or 120 stocks.
3. **Quality of Momentum Screen:** Select high-momentum firms with smoothest momentum, 60 stocks or 50%.
4. **Seasonality Screen:** Rebalance the portfolio near the beginning of quarter-end months.
5. **Invest with Conviction:** We invest in our basket of 60 stocks with the highest quality momentum.

We believe each element of our Quantitative Momentum process increases the system's overall effectiveness in expectation. However, regardless of how we build our momentum process, we must acknowledge that concentrated momentum strategies have the potential to generate higher volatility than generic passive market indexes. That is the nature of the beast. Yet while our Quantitative Momentum strategy is no different from a risk standpoint, for each unit of additional risk associated with our QMOM strategy, we seek to be compensated via higher expected returns--a desirable quid pro quo.

### Why Isn't Everyone Doing This?

We believe our Quantitative Momentum process has a chance to outperform the market over the long-haul on a risk-adjusted basis. But while all of this may sound promising, one must consider a simple question:

**Why aren't all investors doing it?**

We believe there are two key reasons (there are others), which we explain below:

1. Momentum investing attracts less capital than traditional Value or Growth investing.
2. High-conviction momentum investing is loaded with career risk for asset managers.

Why might momentum attract less capital? One reason is that momentum investing doesn't easily fit in the standard "style" chart. Consider your typical chart from Morningstar, as depicted below in Figure 7.

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[13] While the January finding in the paper is interesting (low momentum has outperformed high momentum in January), attempting to trade on this can be difficult to implement. As such, we do not include this in our Quantitative Momentum screening methodology.

Figure 7: Typical Style Investment Chart

| | Value | Blend | Growth |
|---|---|---|---|
| Large-cap | | | |
| Mid-cap | | | |
| Small-cap | | | |

Figure 7 highlights an important issue regarding momentum investing—it doesn't fit into the standard classification table. It is a round peg people want to put into a square hole. Also, some simply misconstrue it. For instance, a common knee-jerk reaction is that momentum investing is just growth investing—but not so fast. From 1974-2014 we examine the overlap between the top decile of firms formed on their generic momentum (simple 12/2 momentum) and firms in the bottom decile when ranked on enterprise multiples (e.g., growth firms). Surprisingly, there is only a 29% overlap between the top decile of high momentum firms and growth firms (top decile) from 1963-2014.[14] So while related to growth, momentum investing is ***decidedly not the same as*** growth investing—A momentum stock can be a value stock, a growth stock, or anything in between.

Unfortunately, style block mentality, which identifies a manager's benchmark also affects the incentives of asset managers. Managers tend to create products that closely follow benchmark portfolios associated with the boxes above and avoid direct exploitation of the momentum anomaly documented in the academic literature.

Another related reason why many professionals shy away from momentum investing is the return path itself—the volatility and deviations from standard benchmarks are extreme. That added volatility is hazardous to an asset manager's employment. For those who follow an index, the Quantitative Momentum strategy comes with increased tracking error. In other words, investors must prepare for major deviations from standard benchmarks and multiple opportunities to get fired as an asset manager.

The ability to withstand short-term pain is required to pursue a high-conviction momentum strategy, but we believe this provides an opportunity for a disciplined investor to potentially achieve outsized upside expected returns.

## Conclusion

In the short-run, most of us simply cannot endure the pain that momentum investing strategies impose on our portfolios and our psyches. It is simply too difficult. Furthermore, for those in the investment advisory business, providing a strategy with the potential for multi-year underperformance is akin to career suicide. And yet, at Alpha Architect, we explicitly focus on a momentum investing philosophy because the historical evidence is so striking and robust. Why would we risk such career suicide? Our hope is that we can educate investors with the appropriate temperament on what it takes to achieve long-term investment success as a momentum-investor. It is not easy, and it is not for everyone, but for those rare souls who understand the discipline required, our systematic momentum investment process allows investors to simply "follow the model" and avoid behavioral biases that can poison even the most professional and independent fundamental momentum investors.

Our enhanced process can be distilled into the following phrase:

We Seek to Buy Stocks
with the Highest Quality Momentum

[14] Gray, W., J. Vogel, D. Foulke, 2015, DIY Financial Advisor, John Wiley & Sons, pg. 145.

# THE QUANTITATIVE MOMENTUM PHILOSOPHY

## Disclosures

Past performance does not guarantee future results.

The fund's investment objectives, risks, charges and expenses must be considered carefully before investing. The statutory and summary prospectus contains this and other important information about the investment company, and it may be obtained once available by calling 215-882-9983 or visiting www.MomentumShares.com. Read it carefully before investing.

Investments involve risk. Principal loss is possible. Redemptions are limited and often commissions are charged on each trade. Because the Fund is non-diversified, it may be more sensitive to economic, business, political or other changes affecting individual issuers or investments than a diversified fund, which may result in greater fluctuation in the value of the Fund's Shares and greater risk of loss. Unlike mutual funds, ETFs may trade at a premium or discount to their net asset value.

Investing in or having exposure to securities with positive momentum entails investing in securities that have had above-average recent returns. These securities may be more volatile than a broad cross-section of securities. Returns on securities that have previously exhibited momentum may be less than returns on other styles of investing or the overall stock market. Momentum can turn quickly and cause significant variation from other types of investments, and stocks that previously exhibited high momentum may not experience continued positive momentum. In addition, there may be periods when the momentum style is out of favor, and during which the investment performance of the Fund using a momentum strategy may suffer.

*Diversification does not assure a profit or protect against a loss in a declining market.*

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Definitions:

Alpha is defined as the excess return of the fund relative to the return of the benchmark index.

Three factor alpha is defined as the average return of the fund after controlling for exposures to the benchmark index, a portfolio of value stocks, and a portfolio of small capitalization stocks.

Continuous portfolios are portfolios of high momentum stocks that tend to have daily returns that have lower volatility than discrete portfolios. Detailed calculations metrics are described in the academic paper, "Frog-in-the-Pan: Continuous Information and Momentum," by Zhi Da, Umit Gurun, and Mith Awarachka.

Discrete portfolios are portfolios of high momentum stocks that tend to have daily returns that have higher volatility than continuous portfolios. Detailed calculations metrics are described in the academic paper, "Frog-in-the-Pan: Continuous Information and Momentum," by Zhi Da, Umit Gurun, and Mith Awarachka.

Bps (basis points) represent one hundredth of one percent.

12/2 momentum is a strategy that sorts stocks based on their cumulative 12 month past returns (ignoring the first month).