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# The Case for Momentum Investing

*Though known to financial academics for many years, momentum is for most investors the "undiscovered style," a valuable tool in building diversified portfolios with above-average returns.*

**Definition.** Momentum is the tendency of investments to exhibit persistence in their relative performance. Investments that have performed relatively well, continue to perform relatively well; those that have performed relatively poorly, continue to perform relatively poorly. Momentum is about much more than buying a handful of hot stocks – it is a disciplined, systematic investing style that applies across asset classes.

**Intuition.** Momentum is a phenomenon driven by investor behavior: slow reaction to new information; asymmetric responses to winning and losing investments; and the "bandwagon" effect. Numerous academic and practitioner studies have confirmed momentum's existence.

**Implications.** Virtually all investors can expect higher risk-adjusted returns by adding momentum to their portfolios. Growth investors will see that momentum delivers much better performance. Value investors will find momentum to be an effective complement. Value-growth investors will want to consider momentum as an alternative to their growth allocation.

*This paper introduces a family of investable momentum indices, and in so doing, opens this powerful strategy to a broad range of investors.*

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## PART I – WHAT IS MOMENTUM?

Momentum is the tendency of investments, in every market and asset class, to exhibit persistence in their relative performance for some period of time.

When applied to stock picking, momentum (like value or growth) is about relative performance among stocks, and *not* about overall trends in the market. It works whether a market is in an upswing or downswing. Momentum can be used to identify securities likely to outperform, making it a powerful investment tool. It is also negatively correlated to value investing, making it an effective diversification component. Regardless of investment philosophy, virtually all investors can expect improved risk-adjusted returns by including momentum.

### Historical Evidence

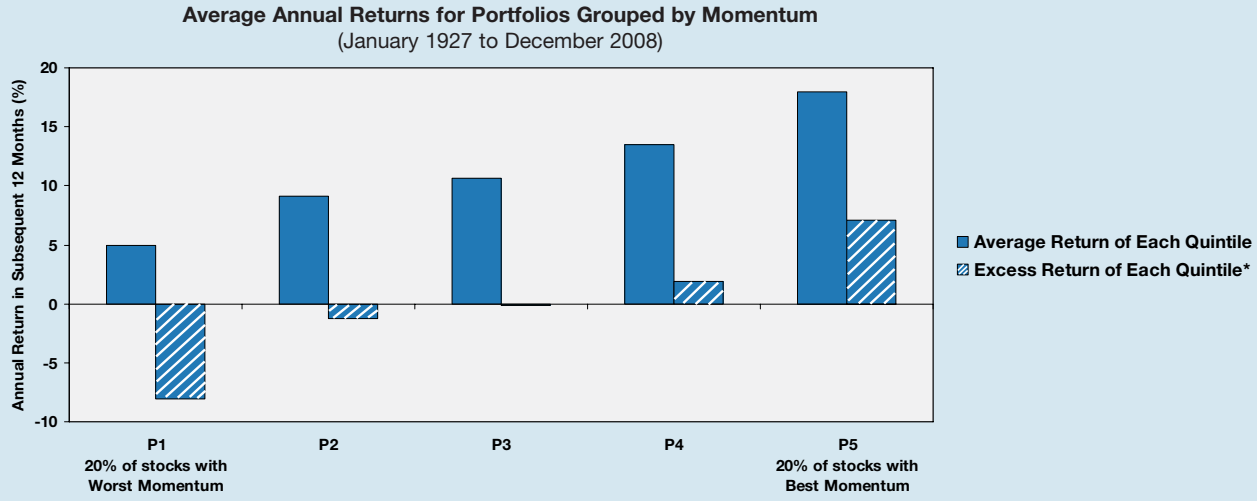
The evidence for momentum is pervasive, supported by almost two decades of academic research. The first modern studies were done in the early 1990s,[1] and more than 300 published papers have explored momentum since, including 150 in the last five years.

EXHIBIT 1 shows the performance of individual U.S. stocks broken into quintiles. Over the next year, the stocks with the best momentum (P5) outperform the ones with the worst momentum (P1), both in absolute terms and relative to the equity market as a whole.

The original momentum studies focused on the period from 1963-1990 in U.S. equities. Subsequent studies have found momentum in earlier periods[2] (as far back as the Victorian age!) and in the out-of-sample period after the original research was published.[3] Evidence supports momentum in markets outside the U.S.[4] and for assets other than individual stocks, such as industries, bonds, commodities, currencies, and global stock market indices.[5]

EXHIBIT 2 shows evidence for momentum in a range of global asset classes and markets. Since these are long-short returns, they are independent of gains from market exposure. Momentum delivers attractive Sharpe ratios (risk-adjusted returns) universally.

**Exhibit 1: Performance of Stocks with Good and Bad Momentum**




Source: AQR Capital Management. Data is based on monthly returns from overlapping portfolios. Momentum is calculated as the past 12-month return excluding the most recent month. *Return in excess of the beta-adjusted CRSP Value Weighted Index.

[1] Jegadeesh and Titman (1993), Asness (1994)
[2] Chabot, Ghysels, and Jagannathan (2009), Grundy and Martin (2001)
[3] Carhart (1997), Jegadeesh and Titman (2001), Asness, Moskowitz, and Pedersen (2009)
[4] Europe: Rouwenhorst (1998), Emerging markets: Rouwenhorst (1999), Asia: Chui, Titman, and Wei (2000), Globally in 40 different equity markets: Griffin, Ji, and Martin (2005)
[5] Asness, Moskowitz, and Pedersen (2009), Industries: Moskowitz and Grinblatt (1999 and 2004), Asness, Porter, Stevens (2000), Countries: Asness, Liew, and Stevens (1997)

## Possible Explanations of Momentum

There are several possible explanations for momentum. One is that momentum's higher returns are compensation for some unique risk associated with investments that have recently outperformed. As of yet, no such risk factor has been convincingly identified. If it is not compensation for risk, the existence of momentum seems to challenge the efficient market hypothesis that past price behavior provides no information about future behavior.[6] In other words, momentum is associated with some inefficiency in markets, perhaps due to investor behavior. Several possible behavioral explanations have been put forth.[7]

First, investors may be *slow to react* to new information. Efficient market theory assumes that once new information is released, it is instantly available to all investors and that prices immediately adjust to reflect the news. In practice, however, different investors (for example, a trader versus a casual investor) receive news from different sources, and react to news over different time horizons and in different ways. Also, *anchoring and adjustment* is a behavioral phenomenon in which individuals update their views only partially when faced with new information, slowly accepting its full impact. There is ample evidence supporting slow-reaction-to-information theories, ranging from market response to earnings and dividend announcements to analysts' reluctantance to update their forecasts.

Second, investors (as human beings) are prone to what behavioral economists and experimental psychologists call the *disposition effect*. Investors tend to sell winning investments prematurely to lock in gains, and hold on to losing investments too long in the hope of breaking even. The disposition effect creates an artificial headwind: when good news is announced, the price of an asset does not immediately rise to its value because of premature selling. Similarly, when bad news is announced, the price falls less because investors are reluctant to sell.[8]

Third, investors are susceptible to the *bandwagon effect* (also called *over-reaction*). Short-term traders may use recent performance as a signal to buy or sell. Longer-term investors look to recent performance to confirm their convictions. The interaction between these investors can create price run-ups or -downs that can persist for many months until an eventual correction.[9] Notable extreme examples include the technology bubble of the late 1990s and the energy rally of 2007-2008.

There continues to be a lively debate about the root causes of momentum. (A similar debate is ongoing for value investing as well). What is clear is that the overwhelming evidence from a range of markets, asset classes, and time periods supports the argument that momentum is neither a random occurrence nor an effect that disappears once the impact of transaction costs is incorporated.

**Exhibit 2: Historical Performance of Momentum Across Asset Classes**

| | Sharpe Ratio of a Long-Short Momentum Strategy | Annualized Return of a Long-Short Momentum Strategy | Time Period Studied |
|---|---|---|---|
| **In Individual Stocks** | | | |
| US | 0.7 | 10.5% | 1975-2008 |
| UK | 0.6 | 9.0% | 1985-2008 |
| Japan | 0.2 | 3.0% | 1985-2008 |
| Continental Europe | 1.1 | 16.5% | 1988-2008 |
| Stock Markets Equal-Weighted | 0.9 | 13.5% | 1988-2008 |
| **In Other Asset Classes** | | | |
| Bond Markets (Developed) | 0.3 | 4.5% | 1975-2008 |
| Currencies (Developed) | 0.5 | 7.5% | 1975-2008 |
| Commodities | 0.8 | 12.0% | 1975-2008 |
| Equity Indices (Developed) | 0.6 | 9.0% | 1975-2008 |
| Other Assets Equal-Weighted | 0.9 | 13.5% | 1975-2008 |

Source: Asness, Moskowitz, and Pedersen (2009). The above uses a long-short portfolio to isolate the returns to momentum strategies from their respective directional market returns. Hypothetical long-short back-test where each momentum portfolio is scaled to an estimated 15% annualized volatility based on either AQR or BARRA risk models; gross of transaction and financing costs. (Based on our research, adding transaction and financing costs would not have a significant effect on the results shown.)

[6] The past performance of different investments is not a secret. If markets are efficient, this information should be fully incorporated into market prices, and no one should be able to profit by investing in stocks or other investments that have done well recently. The existence of momentum implies that stocks do not (as widely believed) move in a "random walk."
[7] Many of these explanations are based on the Nobel-prize winning work of Daniel Kahneman and the late Amos Tversky. See, for example, Kahneman and Tversky (1979).
[8] Research in behavioral finance shows a strong tendency for retail investors and even mutual fund managers to exhibit the disposition effect. See Odean (1998) and Grinblatt and Han (2005) for retail investors and Frazzini (2006) for managers.
[9] Although these corrections can lead to short-term losses for momentum, our research suggests that equity momentum strategies do not have larger or more frequent drawdowns than other equity styles (value, growth, and core).

### Time Horizons

Readers may note that momentum may be caused by both an under-reaction to information (slow assimilation of news) and an over-reaction (the bandwagon effect), which would perhaps seem to cancel each other out. In fact, the under-reaction and over-reaction may reinforce one another since they typically operate over different time horizons. Momentum may be initiated by slow reaction to information, caused or sustained by behavioral biases like the disposition effect, then reinforced by the bandwagon effect over several months. The net result is that momentum will persist for a period of time (6-12 months) before ultimately leading to reversals as too many investors pile on and prices become detached from fundamentals.

Consistent with this intuition, investments do not exhibit momentum over just any time horizon. For instance, we cannot say that the stocks that have performed best over the last five years will do so over the next five years. Indeed, on a five-year horizon we find the opposite effect in the data. Stocks that outperform for a long period of time will generally become expensive, and expensive stocks tend to under-perform less expensive stocks. This is the value effect, and long-run past performance is a good (backwards!) value indicator.[10] However, the evidence does show that assets that have performed well over the last 12 months tend to do better over the next 3-12 months than assets that have performed poorly over that same period. This is the time horizon in which momentum works best.

## PART II – INTRODUCING THE AQR MOMENTUM INDICES

For an idea with so much support from academic research and historical evidence, momentum has made surprisingly modest inroads into investors' portfolios. Contrast this with value and size (large cap vs. small cap). There are hundreds of investment funds focused on each of these styles, but hardly any based purely on momentum.

One contributing factor is the lack of a momentum index. Academic research on value and size spawned a number of value and market capitalization indices, such as the S&P and Frank Russell indices. But there are no comparable equity momentum indices. At the time of Fama and French's original work on value and size, momentum research was in its infancy.[11] Today, over a decade later, momentum is part of virtually every academic model and empirical study related to asset pricing.[12]

We feel momentum is at a point in its history not unlike value and growth two decades ago: backed by overwhelming evidence, but with no real benchmark or index to follow. Now is the time to provide such an index, to give widespread access to this important investment style.

### AQR Momentum Indices: Methodology

AQR has developed an index methodology that captures momentum in an intuitive and transparent way, making it accessible to all investors. For the U.S. market, we have created two momentum indices:[13]

- The AQR Momentum Index
  (*Large Cap and Mid Cap U.S. Equities*)
- The AQR Small Cap Momentum Index
  (*Small Cap U.S. Equities*)

*Determining the Universes.* The AQR indices are built from two distinct universes. For the large and mid cap U.S. index, we examine the 1,000 largest stocks by market capitalization. For the small cap U.S. index, we look at the next 2,000 largest stocks. The universes are screened using certain liquidity and other criteria.

[10] Stocks that have performed relatively well over a 5-year period tend to have poor value and therefore perform relative poorly going forward, as shown by DeBondt and Thaler (1985) and Fama and French (1996).
[11] In their subsequent study on value and size, Fama and French acknowledged that the "main embarrassment of the three-factor model [is] its failure to capture the continuation of short-term returns of Jegadeesh and Titman (1993) and Asness (1994) [later to be known as the momentum effect]" (Fama and French, 1996).
[12] This includes the recent study of Fama and French (2008), who start by noting that "the anomalous returns associated with... momentum are pervasive."
[13] There is also an AQR International Momentum Index (Non-U.S. Equities). This paper focuses on the U.S. indices for ease of exposition, but the international evidence is similar.

*Identifying Momentum.* We determine momentum by looking at the total return of every stock in each universe over the past year.[14] As previously discussed, momentum is based on relative rather than absolute performance. In a sharply falling market, virtually all stocks may have lost money in the last year; in this instance, the stocks with the strongest momentum will be those that fell the least.

*Setting the Constituents.* Once we have ranked the stocks, we construct the index from the one-third with the strongest momentum. Within each index, we weight the stocks according to their market capitalization.

*Rebalancing.* Because momentum is based on recent performance, we need to adjust our indices fairly frequently (compared to a value index, for example). Rebalancing on a quarterly basis maintains the momentum characteristic but does not erode returns through excessive trading.

## AQR Momentum Indices: Performance

EXHIBITS 3 and 4 show the performance of the AQR Momentum Index and the AQR Small Cap Momentum Index relative to a variety of other indices for comparison purposes. A few key results stand out:

*Performance.* The AQR Momentum Indices each outperform a comparable core index over the period studied. They also outperform other investment styles such as value and growth.

*Volatility.* The AQR Momentum Indices are somewhat more volatile than the comparable core and value indices, but are similar to growth indices.

*Sharpe Ratio.* The Sharpe ratios of the AQR Momentum Indices are higher than their comparable core and growth indices, and similar to those of value indices. Relative to a comparable core equity index, the information ratios

**Exhibit 3: Performance of the AQR Momentum Indices**

| January 1980 - April 2009 | AQR Momentum Index | Russell 1000 Value Index | Russell 1000 Growth Index | Russell 1000 Index |
|---|---|---|---|---|
| **Annual Return** | **13.7%** | **11.7%** | **10.6%** | **11.2%** |
| Annualized Volatility | 18.6% | 14.9% | 18.0% | 15.7% |
| Sharpe Ratio | 0.38 | 0.35 | 0.23 | 0.30 |
| | | | | |
| Excess Return over Russell 1000 | 2.5% | 0.5% | -0.6% | |
| Tracking Error to Russell 1000 | 8.1% | 5.1% | 4.9% | |
| Information Ratio | 0.30 | 0.10 | -0.13 | |
| Correlation to Momentum Index | 1.00 | -0.50 | 0.43 | |
| | | | | |
| Estimated Transactions Costs | 0.7% | | | |

| | AQR Small Cap Momentum Index | Russell 2000 Value Index | Russell 2000 Growth Index | Russell 2000 Index |
|---|---|---|---|---|
| **Annual Return** | **15.4%** | **12.8%** | **9.6%** | **11.2%** |
| Annualized Volatility | 22.2% | 17.1% | 23.0% | 19.5% |
| Sharpe Ratio | 0.40 | 0.36 | 0.13 | 0.24 |
| | | | | |
| Excess Return over Russell 2000 | 4.2% | 1.6% | -1.6% | |
| Tracking Error to Russell 2000 | 7.0% | 6.2% | 5.7% | |
| Information Ratio | 0.60 | 0.25 | -0.29 | |
| Correlation to Momentum Index | 1.00 | -0.58 | 0.51 | |
| | | | | |
| Estimated Transactions Costs | 1.5% | | | |

Source: AQR Capital Management. Given that the core research on momentum was published in the early 1990s, a large portion of the results shown here are out-of-sample. AQR Momentum Indices are historical indices and not the returns to actual portfolios.

[14] Note, in calculating the return, we exclude the most recent month to avoid situations in which a stock that has moved sharply in the very short term may be due for a correction. There is evidence across a range of asset classes that sharp, short-term changes in price may be caused by liquidity effects and tend to reverse themselves. Jegadeesh (1990), Lo and MacKinlay (1990), and Lehmann (1990) find strong short-term (one-day to one-month) reversals among stocks. Most academic studies of momentum also exclude the most recent month (see Asness (1994) and Fama and French (1996) for early examples). Excluding the most recent month also lowers the turnover of the index.

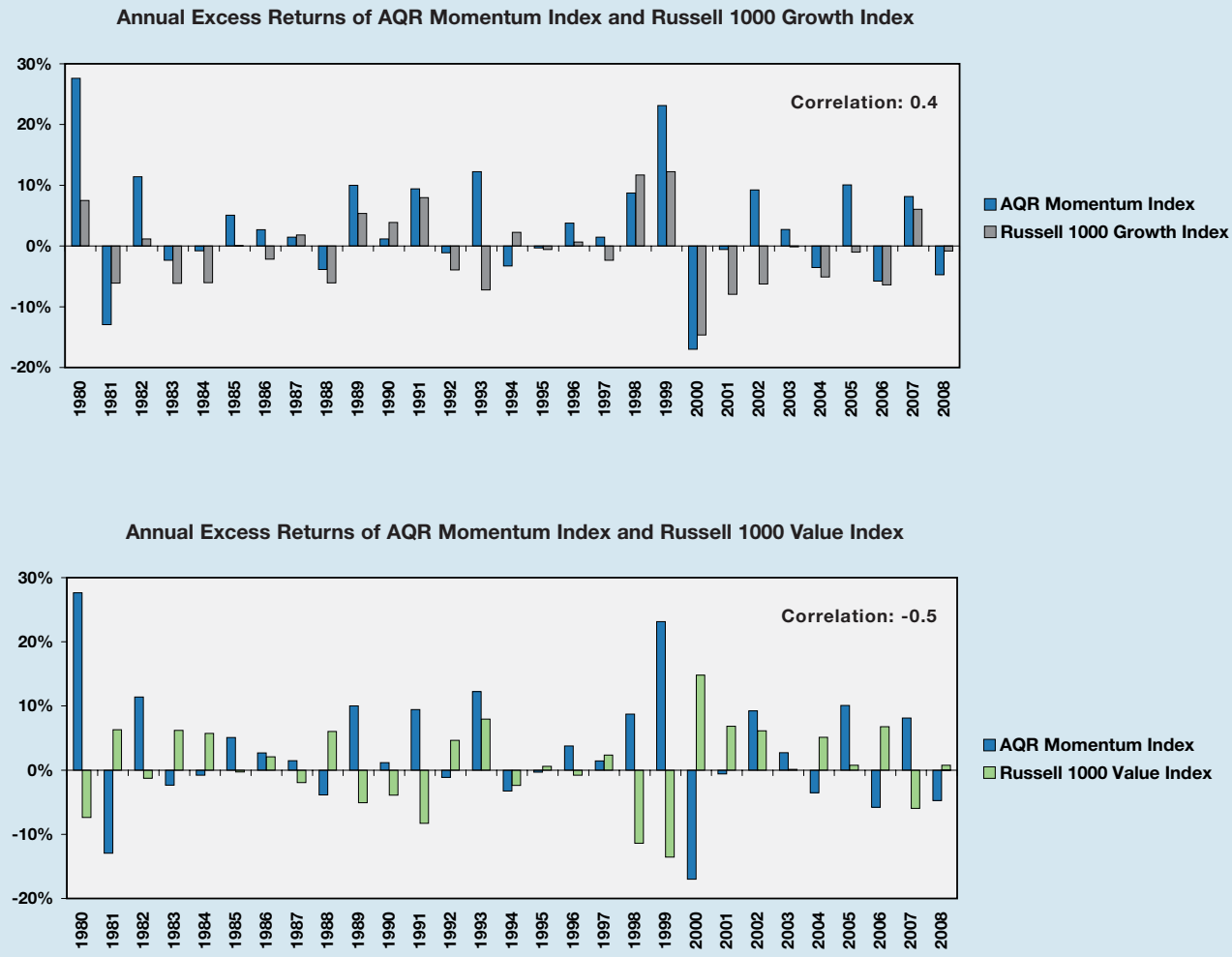
of the AQR Momentum Indices are higher than those of growth and value indices.

*Correlation.* The excess returns of the AQR Momentum Indices (over a core equity index) are positively correlated to the excess returns of a comparable growth index, and negatively correlated to the excess returns of a comparable value index (see EXHIBIT 4). As we will show in the next section, these correlations make momentum a better alternative to growth and an attractive complement to value.

*Transaction Costs.* In EXHIBIT 3, neither the AQR Momentum Indices nor the comparison indices reflect any transaction costs. However, transaction costs are important, and we have included an estimate of these costs for the AQR Momentum Indices. The costs are not insignificant (0.7% annually for large cap and 1.5% for small cap), but they are not high enough to materially change the attractiveness of momentum, both in absolute terms and relative to value and growth.

Backtests do have inherent limitations. However, based on the historical evidence from academia, the wealth of out-of-sample evidence from other time periods and asset classes, along with AQR's experience with momentum-based strategies for over a decade, we are confident that our indices capture the characteristics of momentum investing.

**Exhibit 4: Comparing Momentum to Growth and Value**




Source: AQR Capital Management. January 1980 to December 2008. Returns are excess to Russell 1000 Index. AQR Momentum Index is a historical index and does not represent the returns to actual portfolios.

## PART III – INVESTING IN MOMENTUM

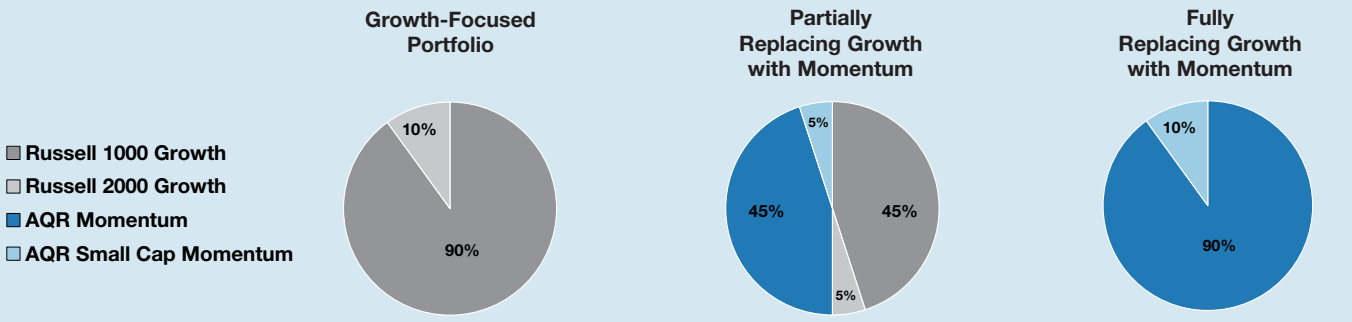
Many investors already think about style exposures as part of the asset allocation process (i.e., large cap vs. small cap, value vs. growth). Momentum is a powerful style that can improve any asset allocation strategy. It offers better returns than growth and is a better complement to value. For a typical investor, shifting assets from growth equity to momentum equity results in a more efficient portfolio with a higher expected return.

### Momentum vs. Growth

Growth equity is a large part of many portfolios. Growth investors typically seek to reap gains from owning shares of successful companies that are expanding their businesses and profits. However, at the index level, the fact is that growth equity has underperformed core equity investing.[15] This is not to say that some active growth managers may not be able to outperform the overall market benchmark, but the historical performance of growth indices suggests that they do start with a handicap.

The evidence shows that growth style investors would do better to shift some or all of their exposure to momentum strategies. Since 1980, the AQR Momentum Index has outperformed the Russell 1000 Growth Index by an average of 3% per year. Over this period growth and momentum are also strongly positively correlated (shown in EXHIBITS 3 and 4), implying that momentum may be an appealing substitute for growth. EXHIBIT 5 shows the impact of moving from a growth-focused portfolio to one built around momentum. The momentum portfolio has better performance, both in absolute terms and relative to a core index.

**Exhibit 5: Adding Momentum to a Growth-Focused Portfolio**




| | Growth-Focused Portfolio | Partially Replacing Growth with Momentum | Fully Replacing Growth with Momentum |
|---|---|---|---|
| **Portfolio Return** | **10.5%** | **12.2%** | **13.8%** |
| Volatility | 18.2% | 18.1% | 18.7% |
| Sharpe Ratio | 0.22 | 0.31 | 0.39 |
| Excess Return over Russell 3000 | -0.7% | 1.0% | 2.7% |
| Tracking Error to Russell 3000 | 4.9% | 5.5% | 7.9% |
| Information Ratio | -0.14 | 0.18 | 0.34 |

Source: AQR Capital Management. January 1980 to April 2009. We assume a 90/10 split between large cap and small cap. The returns shown are gross of transaction costs. Based on our research, adding transaction costs for the various strategies would not have a significant effect on the improvements shown.

[15] The historical underperformance of growth investing is documented extensively by Fama and French (1992) and Lakonishok, Shleifer, and Vishny (1994). In our analysis, we use the Frank Russell U.S. style indices to illustrate the performance of growth (and value).

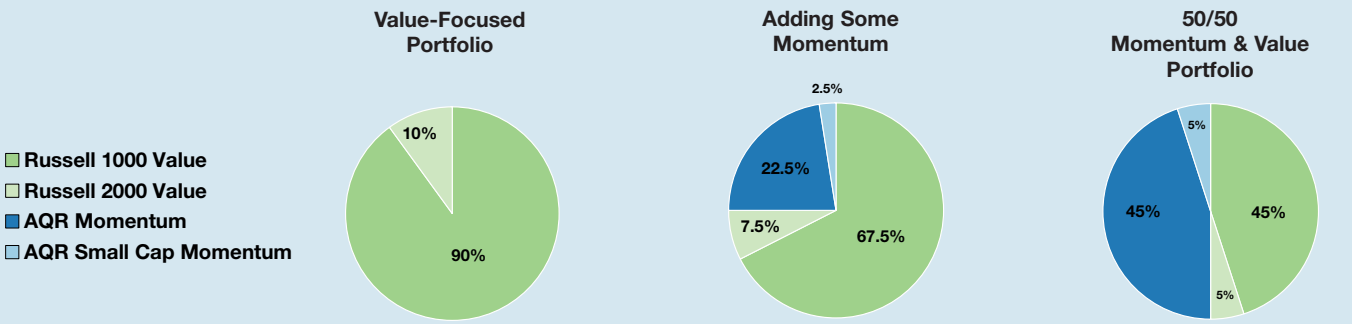
## Momentum vs. Value

While value stocks have historically outperformed growth stocks, focusing exclusively on value also has its drawbacks. A value-focused strategy has substantial tracking error relative to core equity benchmarks. Value periodically falls out of favor and the returns suffer dramatic reversals,[16] costing investors in the short term and often leading them to give up on value strategies at exactly the wrong time. Value investors who make poor timing decisions may end up faring worse than investors who hold core index portfolios.

Like value, momentum has historically outperformed core equity benchmarks. Moreover, value and momentum are negatively correlated[17] (shown in EXHIBITS 3 and 4), which offers a big advantage. Investors in value may see losing streaks, as may investors in momentum. But investors who combine value and momentum are better protected, since the strategies rarely move together. This is the true power of diversification.

EXHIBIT 6 compares the historical performance of a value-focused portfolio to two different value-plus-momentum portfolios. Adding momentum to a value portfolio leads to higher returns with less tracking error relative to a core equity portfolio.

**Exhibit 6: Adding Momentum to a Value-Focused Portfolio**

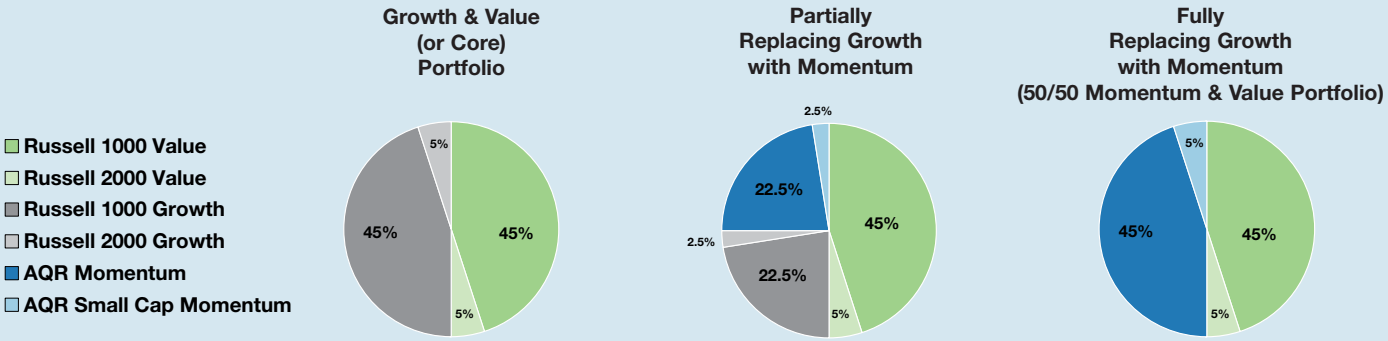



| | Value-Focused Portfolio | Adding Some Momentum | 50/50 Momentum & Value Portfolio |
|---|---|---|---|
| **Portfolio Return** | **11.8%** | **12.3%** | **12.8%** |
| Volatility | 14.9% | 15.1% | 15.9% |
| Sharpe Ratio | 0.36 | 0.38 | 0.40 |
| Excess Return over Russell 3000 | 0.7% | 1.2% | 1.7% |
| Tracking Error to Russell 3000 | 5.1% | 3.3% | 3.4% |
| Information Ratio | 0.13 | 0.36 | 0.49 |

Source: AQR Capital Management. January 1980 to April 2009. We assume a 90/10 split between large cap and small cap. The returns shown are gross of transaction costs. Based on our research, adding transaction costs for the various strategies would not have a significant effect on the improvements shown.

[16] For example, for the two years ending in March 2000, the Russell 1000 Value Index underperformed the core Russell 1000 by 30%.
[17] The negative correlation between value and momentum has an intuitive explanation. Stocks with good momentum tend to have risen in price and offer less value, while stocks with good value have often fallen in price and have poor momentum.

**Exhibit 7: Adding Momentum to a Value & Growth Portfolio**




| | Growth & Value (or Core) Portfolio | Partially Replacing Growth with Momentum | Fully Replacing Growth with Momentum (50/50 Momentum & Value Portfolio) |
|---|---|---|---|
| **Portfolio Return** | **11.1%** | **12.0%** | **12.8%** |
| Volatility | 15.8% | 15.8% | 15.9% |
| Sharpe Ratio | 0.29 | 0.35 | 0.40 |
| Excess Return over Russell 3000 | — | 0.8% | 1.7% |
| Tracking Error to Russell 3000 | — | 1.7% | 3.4% |
| Information Ratio | — | 0.51 | 0.49 |

Source: AQR Capital Management. January 1980 to April 2009. We assume a 90/10 split between large cap and small cap. The returns shown are gross of transaction costs. Based on our research, adding transaction costs for the various strategies would not have a significant effect on the improvements shown.

## Momentum in a Portfolio

Portfolios rarely consist exclusively of value stocks or growth stocks. Most investors allocate to both styles, and often include active management. Value is a natural allocation because of its attractive return characteristics. Growth, on the other hand, has historically underperformed a core equity index. We believe that value-growth index investors should consider substituting momentum for some – arguably all – of their growth index exposure. An assessment of this substitution is shown in EXHIBIT 7. The improvement in both the Sharpe ratio and information ratio is substantial when substituting momentum for growth in the portfolio.

Other investors focus on core equity, often employing a passive approach through the S&P 500, Russell 1000, or MSCI World indices. Because combining a value index and a growth index by definition results in a core index portfolio, EXHIBIT 7 also illustrates the advantage of shifting from a core index portfolio to a value-plus-momentum indexed portfolio. The debate about the virtues of indexing versus active management goes beyond the scope of this paper, but readers should note that momentum indices can be viewed as a low-cost "active" strategy relative to a growth index.

## Conclusion

Momentum is a powerful investment style, nearly unmatched in its predictive strength and robustness. Today, momentum is at a point similar to that of value two decades ago: fully adopted by the academic community, long used by leading institutional investors, but without an investable index and therefore largely unavailable to the broader investment community.

The introduction of the AQR Momentum Indices represents a pivotal development in momentum's emergence as a widely accepted investment strategy. Momentum will enable all investors to enhance their portfolio diversification and increase their expected risk-adjusted returns.

*For more information on the AQR Momentum Indices, please visit www.aqrindex.com.*

AQR Index (Ticker Symbol)
AQR Momentum Index (AQRMOMLC)
AQR Small Cap Momentum Index (AQRMOMSC)
AQR International Momentum Index (AQRMOMIL)

## Bibliography


Asness, C.S. "Variables that Explain Stock Returns." Ph.D. Dissertation, University of Chicago (1994).

Asness, C.S., Liew, J. and Stevens, R. "Parallels Between the Cross-sectional Predictability of Stock and Country Returns." Journal of Portfolio Management 23 (1997).

Asness, C.S., Moskowitz, T.J. and Pedersen, L.H. "Value and Momentum Everywhere." National Bureau of Economic Research Working Papers (2009).

Asness, C.S., Porter, R.B. and Stevens, R. "Predicting Stock Returns Using Industry-Relative Firm Characteristics." Working Paper (2000).

Carhart, M. "On Persistence in Mutual Fund Performance." Journal of Finance 53 (1997).

Chabot, B., Ghysels, E. and Jagannathan, R. "Price Momentum In Stocks: Insights From Victorian Age Data." National Bureau of Economic Research Working Papers 14500 (2009).

Chui, A.C.W., Titman, S. and Wei, K.C.J. "Momentum, Legal Systems and Ownership Structure: An Analysis of Asian Stock Markets." University of Texas at Austin Working Paper (2000).

DeBondt, W.F.M. and Thaler, R. "Does the Stock Market Overreact?" Journal of Finance 40 (1985).

Fama, E.F. and French, K.R. "Dissecting Anomalies." Journal of Finance 63 (2008).

Fama, E.F. and French, K.R. "Multifactor Explanations of Asset Pricing Anomalies." Journal of Finance 51 (1996).

Fama, E.F. and French, K.R. "The cross-section of expected stock returns." Journal of Finance 47 (1992).

Frazzini, A. "The Disposition Effect and Underreaction to News." Journal of Finance 61 (2006).

Griffin, J., Ji, S. and Martin, S. "Global Momentum Strategies: A Portfolio Perspective." Journal of Portfolio Management (2005).

Grinblatt, M. and Han, B. "Prospect Theory, Mental Accounting, and Momentum." Journal of Financial Economics (2005).

Grundy, B. F. and Martin, S.R. "Understanding the Nature of the Risks and the Source of the Rewards to Momentum Investing." Review of Financial Studies 14 (2001).

Jegadeesh, N. "Evidence of Predictable Behavior of Security Returns." Journal of Finance 45 (1990).

Jegadeesh, N. and Titman, S. "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency." Journal of Finance 48 (1993).

Jegadeesh, N., Titman, S. "Profitability of Momentum Strategies: An Evaluation of Alternative Explanations." Journal of Finance 56 (2001).

Kahneman, D. and Tversky, A. "Prospect Theory: An Analysis of Decision Under Risk." Econometrica 47 (1979).

Lakonishok, J., Shleifer, A. and Vishny, R.W. "Contrarian Investment, Extrapolation, and Risk." Journal of Finance 49 (1994).

Lehmann, B.N. "Fads, Martingales, and Market Efficiency." Quarterly Journal of Economics 105 (1990).

Lo, A.W. and MacKinlay, A.C. "When are Contrarian Profits Due to Market Overreaction?" Review of Financial Studies 3 (1990).

Moskowitz, T.J. and Grinblatt, M. "Predicting Stock Price Movements from Past Returns: The Role of Consistency and Tax-Loss Selling." Journal of Financial Economics 71 (2004).

Moskowitz, T.J. and Grinblatt, M. "Do Industries Explain Momentum?" Journal of Finance 54 (1999).

Odean, T. "Are Investors Reluctant to Realize Their Losses?" Journal of Finance 53 (1998).

Rouwenhorst, K.G. "Local Return Factors and Turnover in Emerging Stock Markets." Journal of Finance 54 (1999).

Rouwenhorst, K.G. "International Momentum Strategies." Journal of Finance 53 (1998).

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