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Building a Better Core Equity Portfolio

A New Paradigm for Core Equity Investing

Picking stocks is hard, picking managers to pick stocks is hard, and picking the right manager at the right time to pick the right stocks is even harder. There is an alternative. While the traditional approach to active management focuses on the thousands of stocks to choose from, a new paradigm focuses on separating the forest from the trees, and finds only a handful of investment themes – or styles – that have systematically generated positive excess returns over the long term. These include value, momentum, and profitability.

In this paper, we provide background and economic intuition behind value, momentum and profitability-based investing. We examine their performance and show that while each has outperformed a core benchmark over the long term, each has also suffered multiyear periods of underperformance. However, we find the underperformance in these styles does not happen at the same time, meaning a portfolio that combines styles may provide more consistent outperformance. In short, we present a new paradigm for core equity investors that we believe should more reliably beat core benchmarks.

Note: Throughout this paper, references to returns, risks, outperformance, etc. are based on a hypothetical analysis and not an actual portfolio or account. Any statements about returns are also subject to the caveat that past performance is not a guarantee of future returns. Please see below for additional details on this analysis and important disclosures at the end of this paper.

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This paper was updated in November 2015 to use the term "multistyle" when describing the hypothetical strategy that seeks to outperform a core benchmark.

Introduction

Investors have pursued different investment styles, or strategies, for decades. Many of these styles have been identified and documented, and academics and practitioners are continually combing markets for evidence of new ones that work well. Such combing can be dangerous as strategies that have worked well in the past are far from guaranteed to do so in the future. We believe that successful styles, likely to do well going forward, share certain attributes; they are:

- Intuitive — have a logical, economic rationale why they work and will likely persist
- Persistent — have long-term empirical evidence of excess returns
- Pervasive — shown to work across stocks, industries and geographies
- Systematic — can be reliably captured using a well-defined process

Exhibit 1 lists three styles that are particularly useful in long-only core equity portfolios: **value**, **momentum** and **profitability**.¹ Ample evidence shows that each of these styles can generate long-term excess returns on its own – and go a long way toward explaining why some portfolio managers excel. AQR has created a hypothetical multistyle equity strategy, one designed to add value to industry-standard long-only equity benchmarks, to capture the cumulative benefits of combining these three styles.² First, though, let’s describe and explain each:

1. Value:

Description: Over the last 30 years, academics have repeatedly shown the successful performance of value strategies. There are many ways to measure a stock’s “value,” but most focus on comparing a stock’s price to some measure of its fundamental worth. For example, take a set of stocks and rank them by book equity-to-price. On average, the stocks with higher book equity-to-price values significantly outperform the market. Importantly, this effect is not limited just to U.S. equity markets, as the outperformance of value strategies has been well documented in other equity markets and in other asset classes.³

Explanation: Academics debate the explanation for why value works (Exhibit 2 provides a summary of some of the main explanations for why these styles provide long-term outperformance). The efficient-markets view is that the outperformance is compensation for bearing greater risk, as value stocks may be distressed and suffer more than growth stocks during times of macroeconomic stress. Under this framework, value stocks are “cheap for a reason” – their risks are higher, and thus must rationally compensate investors for bearing this additional risk. An alternative view is a behavioral one, in that value-based investing is simply a way to take advantage of irrational investor behavior. That is, value stocks are cheap because investors neglect them while focusing on more glamorous “growth” stocks, thus overpaying for them

Exhibit 1: Three Major Styles for Core Equity Investing

Value	The tendency for relatively cheap assets to outperform relatively expensive ones
Momentum	The tendency for a stock’s recent relative performance to continue in the future
Profitability	The tendency for more profitable stocks to generate higher returns

Source: AQR. Past performance is not a guarantee of future performance.

¹ Other well-known styles include the “size” and “low-beta” effects. In this paper, we focus on value, momentum and profitability, since we believe these styles are the most applicable for long-only investors seeking to outperform core benchmarks.

² For a more in-depth study of these styles, combining them into a portfolio, and implementation, please see our companion piece “A New Core Equity Paradigm” (2013)

³ Asness, Moskowitz, Pedersen (2013)

Exhibit 2: Behavioral and Risk-Based Explanations for Value, Momentum, and Profitability

	Value	Momentum	Profitability
Behavioral Explanations (inefficient markets)	“Glamour” stocks are over-priced by investors willing to pay for growth, offering excess returns for contrarians	Slow adjustment to news Investor herding and positive feedback	Investors may assume that profitable firms will revert to average levels of profitability too soon
Risk-based Explanations (efficient markets)	Value firms may be distressed and more likely to suffer in weak markets	Momentum stocks tend to move together, which may denote a common risk	Like Value and Momentum stocks, profitable stocks tend to move together, suggesting exposure to a common risk

Source: AQR.

and receiving lower portfolio returns as a result.

The truth may be a combination of these theories, but the evidence is irrefutable: value investing has rewarded investors over the long term.

2. Momentum:

Description: Momentum investing is supported by evidence that is equally robust and pervasive. Momentum is the tendency of stocks to exhibit persistence in their relative performance – in other words, stocks that have outperformed tend to continue to outperform. Since academics initially documented the phenomenon among U.S. equities in the early 1990s, momentum has been studied extensively and shown to be pervasive across markets and asset classes.⁴ The typical approach to momentum investing is to buy winners, i.e., to hold stocks that have outperformed their peers over the last year. These winners have, on average, significantly outperformed the market going forward. Like value, momentum tends to reward investors not just in U.S. stocks, but in a range of world equity markets and asset classes.

Explanation: like value, there are a range of theories for the “momentum premium,” most of which rely on irrational investor behavior rather than rational compensation for risk. Many of these behavioral explanations can be categorized as initial underreaction followed by delayed overreaction. Underreaction posits that markets are slow to incorporate news into prices. That is, when news comes out that justifies a new fair value for a security, prices adjust gradually. This could be for a variety of reasons, notably the anchoring bias,

which causes investors to “anchor” to prior views and information and adjust slowly to new information. Such anchoring causes prices to trend toward fair value slowly rather than to adjust to fair value quickly. In addition to underreaction, delayed overreaction may explain the continuation of the trend, as investors may, for example, exhibit the bandwagon effect (performance chasing), further pushing up (or down) a security that has been trending in price over the past few months.

3. Profitability:

Description: More recent research has emerged that strategies based on a stock’s profitability are just as successful as those based on traditional value measures.⁵ Stocks of profitable, stable and growing companies, on average, tend to significantly outperform the market.⁶ In fact, studies show that the performance of the publically-traded companies held by Berkshire Hathaway, the primary investment vehicle of Warren Buffett, can largely be explained by his commitment to buying stocks of high-quality, profitable companies.⁷ As with value and momentum, profitability can be straightforward to measure. Take, for example, the ratio of a company’s gross profits to its assets. Those with a higher ratio are more profitable, and have historically rewarded investors more than less-profitable companies have. As with value and momentum, profitability is pervasive across equity markets over the long term.

⁵ Novy-Marx (2012a, 2012b) and Asness, Frazzini and Pedersen (2013).

⁶ While new evidence is being uncovered to support profitability-based investing, the idea is not new; see for example, Graham (1973).

⁷ Frazzini, Kabiller and Pedersen (2012).

⁴ Early studies include Jegadeesh and Titman (1993) and Asness (1994)

Explanation: Under an efficient markets framework, the tendency for profitable firms to rise and fall together may point to an exposure to a common risk premium. Because of this underlying structure, these firms might have to rationally compensate investors for accepting this risk. In contrast, market inefficiency may be the cause, as investors may irrationally believe that profitable firms will revert to average levels of profitability too soon, thus not bidding their prices high enough to fair value.

While there is a healthy debate over the “correct” explanation for value, momentum and profitability, the evidence for these styles is unquestioned – strong returns exist over a range of markets, asset classes and time periods.

Exhibit 3 summarizes the long-term evidence across U.S. equity markets. Here, stocks are sorted each month into quintiles based on their attractiveness along value, momentum, or profitability themes. The subsequent annual returns are computed and plotted for each quintile. As shown, for each style, stocks with the most attractive rankings have significantly outperformed stocks with the least attractive rankings. Strikingly, this tendency is “monotonic” – within each style, the top quintile outperformed the second-best quintile; the second-best outperformed the third-best, and so on. While there are multiple enhancements that can be made to each style (and that we incorporate into our multistyle equity strategies research⁸), these straightforward measures illustrate the potential rewards from style-based investing.

Differences in Styles

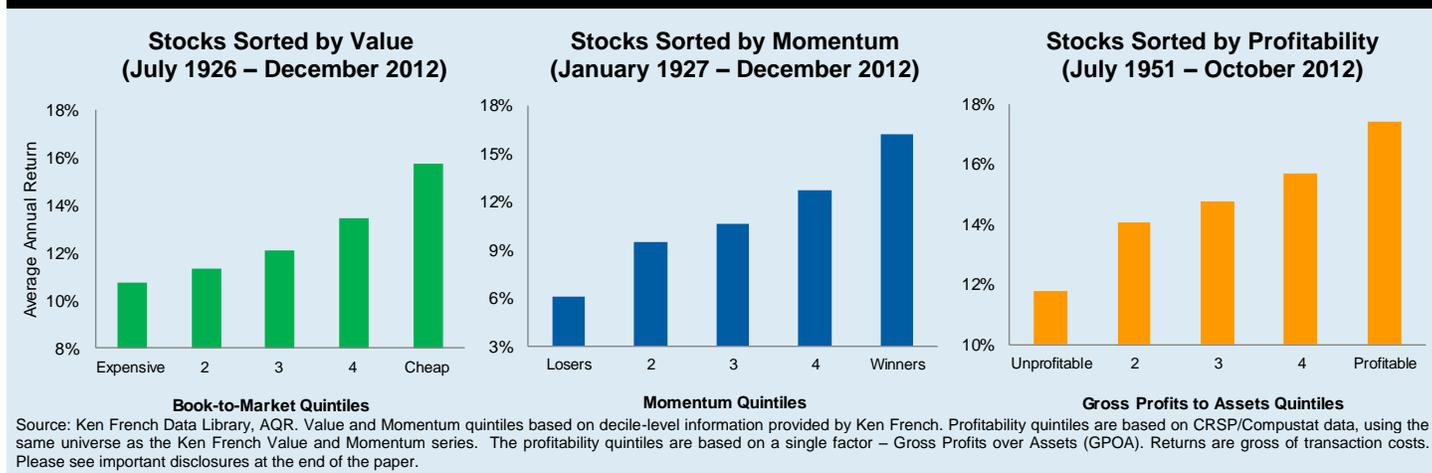
Each of the styles described above has rewarded investors over the long term, but over shorter periods each has had multiyear periods of underperformance. In fact, any reasonably good strategy will have periods – often prolonged periods – of underperformance. For example, cheap “value” stocks can get even cheaper, as shown in the tech bubble. However, while value strategies suffered in the tech bubble, momentum-based strategies generally did well.

In general, value, momentum and profitability have provided diversification to each other, as a bad period for one style is often a good period for the others. Exhibit 4 illustrates this point, showing that the worst 3 years for one style tend to be favorable for the others. There are some intuitive reasons for this.

Take, for example, value and momentum. Value seeks to buy stocks that are cheap, or “beaten up,” those whose prices have likely fallen relative to their peers. In contrast, momentum seeks to buy securities that are improving, whose prices have been increasing relative to peers. Clearly these two styles will tend to pick different stocks – one looks for stocks whose prices are low relative to peers, the other for stocks that have risen relative to peers. Consistent with the intuition, the correlation of these styles tends to be negative – when one style stumbles, the other picks up the slack.⁹

Similarly, a profitable firm can look very different from a

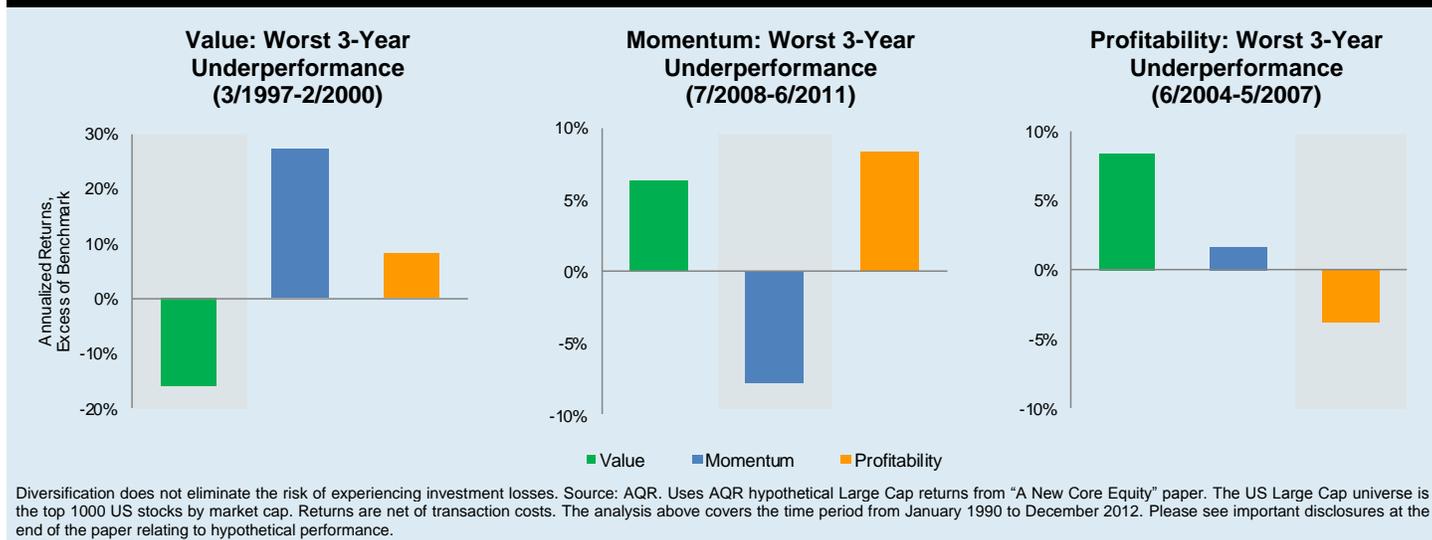
Exhibit 3: Capturing Excess Returns with Style



⁸ Please refer to AQR whitepaper “A New Core Equity Paradigm” for more details, and Israel and Moskowitz (2012) for enhancements for taxable investors.

⁹ As discussed later, style don’t always work in opposite directions – for example, a cheap and improving stock may be attractively-positioned from both a value and a momentum perspective.

Exhibit 4: Underperformance in One Style Has Been Offset by Others



cheap firm. Firms that have higher profitability are likely to be more stable than stocks that are cheap for a reason, when based solely on price. The correlations in Exhibit 5 quantify the relationships between these styles and support the intuition that value, momentum and profitability seek to capture unique sources of returns.

Because of these low correlations across sources of positive returns, a combination of these styles offers a more reliable source of positive excess returns.

Exhibit 5: Styles are Diversifying

Hypothetical Correlations of Excess Returns (US Large Cap, 1980-2012)

	Value	Momentum	Profitability
Value	1.00		
Momentum	-0.48	1.00	
Profitability	-0.39	0.38	1.00

Source: AQR. See important disclosures about hypothetical results at the end of this paper.

Building a Better Core

Combining value, momentum, and profitability allows investors to potentially take advantage of three different sources of returns, but how they are combined matters. There are two fundamental ways to combine themes in a portfolio. The first can be thought of as the “a la carte” approach, where

the investor combines individual funds that focus on each style. The second is the “integrated” approach, where a single fund invests in securities that exhibit value, momentum and profitability characteristics.

The “a la carte” approach:

Here the investor seeks to capture each theme *individually* in building the portfolio – for example, by buying a value fund, a momentum fund, and a profitability fund. Although the “a la carte” approach is an intuitive way to seek returns from each style individually, the resulting portfolio may be not very efficient. This is because a stock that is attractive along one theme is not necessarily attractive on the other themes – in fact, because of the low correlations across these styles, we would expect this to happen more often than not. This matters because in the process of building a value portfolio, the investor might also inadvertently be betting against momentum or profitability, potentially creating a significant drag on excess returns. The result: a stock that is overweighted in one portfolio is likely to be underweighted in another, *diminishing the value-added from each style*, and the investor ends up paying transaction and management costs for off-setting positions. As an aside we find that when investors invest in these ideas separately, they view risk at a product level, and because these risks are diversifying or offsetting end up with a combination that is too close to the benchmark (benchmark hugging).

The “integrated” approach:

The integrated approach is where each stock is evaluated across *all* themes. In other words, the integrated approach seeks to invest in stocks that show attractive value and momentum and profitability characteristics. This approach considers the interactions of the themes before investing. Rather than picking the “best” value stock, this approach focuses on the best “combined” stock.

Exhibit 6: Benefits of an Integrated Approach

**Two Approaches to Combining Styles
(US Large Cap, 1980-2012)**

	"A la carte"	Integrated
Average Return	15.7%	17.3%
Volatility	17.2%	16.6%
Sharpe Ratio	0.62	0.74

Source: AQR. For illustrative purposes only, not representative of an actual portfolio. Please read important disclosures at the end of this paper.

Intuitively, one would expect the “integrated” approach to work better: A stock that is both cheap and profitable and exhibiting signs of positive momentum is a better bet than one showing signs of negative momentum. Conversely, a hot momentum stock with high profitability that is selling cheap is a better buy than one with low profitability that looks expensive. The combination of all three styles simultaneously has the potential to provide a fuller measure of the best stocks to purchase or avoid, providing a more efficient strategy.

The integrated approach can also be more efficient when it comes to trading and taxes. This is because instead of making buy or sell decisions based on a subset of styles (the “a la carte” approach), the integrated approach delays buying or selling until after a stock is evaluated across all styles. This

reduces the number of trades required to maintain desired exposures to the underlying styles, adding further efficiency to the integrated approach.

Exhibit 6 compares the “a la carte” and integrated approaches. Here, value, momentum, and profitability are measured the same way; the only difference is in how the styles are combined. By accounting for the interactions between the styles, the integrated approach is able to add “alpha” or value through portfolio construction. Unlike the traditional form of “alpha”, which relies on a unique investment thesis, the integrated approach is able to add value systematically and more reliably.

While there are various implementation requirements for efficiently and cost-effectively pursuing returns from styles, the historical performance of value, momentum, and profitability has exceeded implementation costs.¹⁰ Still, additional value can be added through a manager’s “craftsmanship” in implementation, including through proprietary algorithmic trading systems and risk-management.¹¹

Exhibit 7 is a hypothetical performance summary of our approach to multistyle equity investing, based on value, momentum, and profitability. The exhibit shows that this approach has historically worked across markets, generating excess returns in U.S. Large Cap, U.S. Small Cap, and International equities. Importantly, the last three rows highlight the complementary nature of these styles – even though each style has had periods of underperformance, the combination has provided more consistent historical excess returns.

Exhibit 7: Hypothetical Performance Characteristics

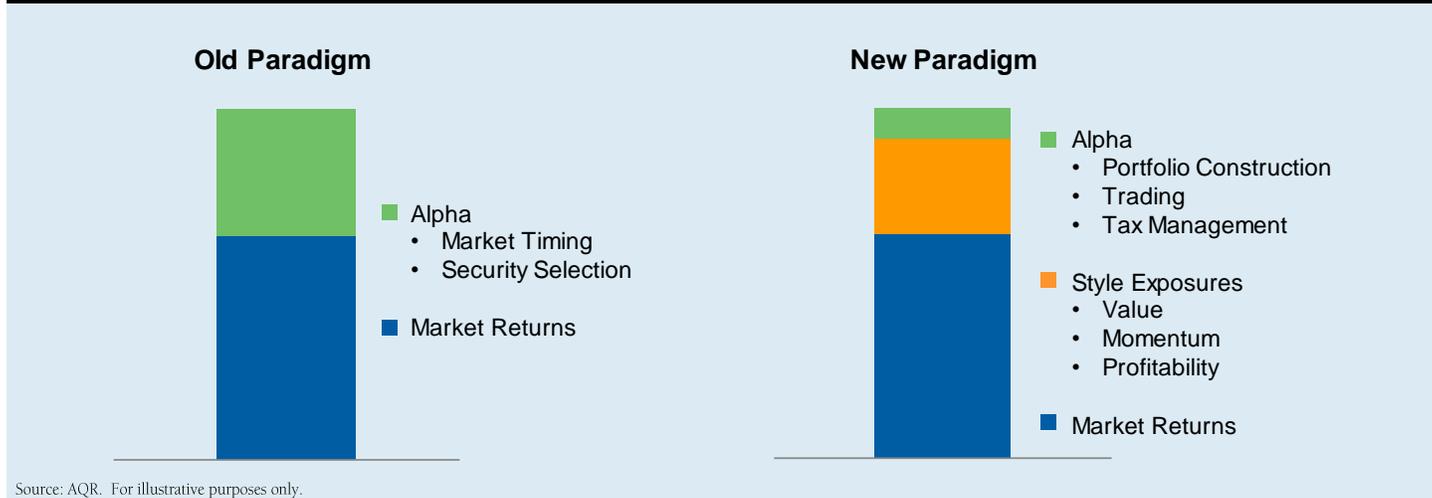
	U.S. Large Cap, 1980 - 2012	U.S. Small Cap, 1980 - 2012	International, 1990 - 2012
Return	17.3%	20.7%	11.2%
Volatility	16.6%	19.9%	15.7%
Sharpe Ratio	0.74	0.79	0.50
Excess Return	5.3%	8.6%	5.1%
Tracking Error	5.8%	5.2%	7.0%
Information Ratio	0.91	1.67	0.72
Net Returns	15.6%	18.3%	10.3%
Net Information Ratio	0.62	1.21	0.60
Total Trading Costs	1.7%	2.4%	0.9%
Turnover (1-sided)	136%	102%	125%
% of Rolling 3-year Underperformance	4.7%	4.7%	13.2%
% of Rolling 5-year Underperformance	0.0%	0.0%	2.9%
% of Rolling 10-year Underperformance	0.0%	0.0%	0.0%

Source: AQR. Uses AQR hypothetical returns based on a quarterly rebalanced strategy from “A New Core Equity Paradigm” paper. Net returns are after estimated transaction costs but gross of fees. Performance is hypothetical and is not based on an actual portfolio or account. Please see important disclosures at the end of the paper relating to hypothetical performance.

¹⁰ Frazzini, Israel and Moskowitz (2012)

¹¹ Frazzini, Israel and Moskowitz (2012), Ilmanen and Villalon (2012)

Exhibit 8: A New Paradigm for Active Management



A New Paradigm

Active management is famously a “zero-sum game” – that is, an investor who beats the market does so at the expense of somebody who loses (and worse, net of fees, the zero-sum game becomes a negative-sum game).

Even those managers who have outperformed benchmarks are rarely able to do so for sustained periods.¹² Research has uncovered limited evidence that managers who have outperformed their benchmarks in one year persist in subsequent years, further narrowing the window for long-term success for traditional active management.

Styles matter because they can provide a tailwind to investors seeking to beat a benchmark, as illustrated in Exhibit 8. Rather than narrowing in on the idiosyncrasies of each stock, styles provide a broader view of potential sources of excess returns. By focusing on major themes and seeking to add value not from stock picking or market timing but from implementation efficiency, investors may better position themselves to capture potentially larger sources of excess returns, instead of relying purely on manager stock-picking skill as a return source, which may be narrower, more idiosyncratic, and capacity-constrained in nature.

Conclusion

Traditional active management relies on an investor’s ability to identify individual stocks that will outperform the market, or on identifying a manager to identify those stocks. However,

investor experience and economic theory have not been encouraging. Not only have managers that add value one year shown limited ability to do so in subsequent years, but investors must pick those managers ahead of time, adding another hurdle for success in active investing.

Style investing offer a new paradigm for capturing excess returns, and we believe a better alternative to active management. Style investing seeks to capture sources of returns that are supported by economic theory and by decades of evidence across stocks, sectors, and geographies. Unlike the traditional approach to active management, which relies on unique investment theses for each stock, styles focus on more pervasive, persistent, and deeper sources of excess returns.

By integrating three complementary styles – value, momentum, and profitability – we are able to create a more consistent core equity strategy. While our focus on portfolio construction and diversification shares elements with passive investing, we believe style-based investing represents a better approach to, and new paradigm for, active management.

Investors have traditionally relied on equity markets to drive their portfolios’ performance. Our multistyle approach to core equity investing seeks to provide three additional sources of returns, each of which has been shown to provide better risk/reward tradeoffs than both the broad market and traditional core strategies. For investors looking to more reliably capture excess returns, we offer a new, multistyle approach to core equity investing.

¹² Carhart (1997)

Related Studies

- Asness, Cliff, 1994, "Variables that Explain Stock Returns", Ph.D. Dissertation, University of Chicago.
- Asness, Cliff, 2011, "Momentum in Japan", *Journal of Portfolio Management*, 37, 67-75.
- Asness, C., and A. Frazzini (2012), "The Devil in HML's Details." working paper, AQR Capital Management.
- Asness, C., A. Frazzini, and L. Pedersen (2013), "Quality Investing." Forthcoming working paper, AQR Capital Management.
- Asness, C., T. Moskowitz, and L. Pedersen (2012), "Value and Momentum Everywhere." *Journal of Finance*, forthcoming.
- Berger, A., R. Israel and T. Moskowitz (2009), "The Case for Momentum Investing" White paper, AQR Capital Management.
- Bernard, V., 1992. Stock price reactions to earnings announcements In: Thaler, R. (Ed.), *Advances in Behavioral Finance*. Russell Sage Foundation, New York, pp. 303-319
- Chan, L., N. Jegadeesh, and J. Lakonishok, "Momentum strategies." *Journal of Finance*, 51 (1997), pp. 1681-1713.
- DeBondt W., and R. Thaler (1985), "Does the Stock Market Overreact?" *Journal of Finance*, Vol. 40, No. 3, 793-805.
- (1987), "Further Evidence on Investor Overreaction and Stock Market Seasonality." *The Journal of Finance*, Vol. 42, No. 3, 557-581.
- Fama, E., and K. French (1992), "The Cross-section of Expected Stock Returns." *Journal of Finance*, Vol. 47, No. 4, 427-465.
- (1993), "Common Risk Factors in the Returns on Stocks and Bonds." *Journal of Financial Economics*, 33, 3-56.
- (1996), "Multifactor Explanations of Asset Pricing Anomalies." *Journal of Finance*, Vol. 51, No 1, 55-84.
- (1998), "Value versus growth: The international evidence," *Journal of Finance*, Vol. 53, 1975-1999.
- (2006), "The Value Premium and the CAPM," *Journal of Finance*, Vol., 61, 2163-2185.
- (2007), "Disagreement, Tastes, and Asset Prices," *Journal of Financial Economics* Vol., 83, 667-689.
- (2008), "Dissecting Anomalies," *Journal of Finance*, Vol. 63, 1653-1678.
- (2012), "Size, value, and momentum in international stock returns," *Journal of Financial Economics*, forthcoming.
- Frazzini, A., R. Israel, and T. Moskowitz (2012), "Trading Costs of Asset Pricing Anomalies." Working paper, AQR Capital Management.
- Frazzini, A., D. Kabiller, and L. Pedersen (2012), "Buffett's Alpha." working paper, AQR Capital Management.
- Frazzini, A., and L. Pedersen (2011a), "Betting Against Beta." working paper, AQR Capital Management, New York University and NBER (WP 16601).
- Frazzini, A., and L. Pedersen (2011b), "Embedded Leverage." working paper, AQR Capital Management, New York University.
- Graham, B. (1973), "The Intelligent Investor (4th Rev. ed.)." Harpers & Row, New York, New York.
- Greenblatt, J. (2010), "The Little Book That Beats the Market." John Wiley & Sons, Hoboken, New Jersey
- Israel, R. and T. Moskowitz (2012), "How Tax Efficient Are Equity Styles?" Working paper, University of Chicago Booth School of Business.
- Israel, R., and T. Moskowitz (2013), "The Role of Shorting, Firm Size, and Time on Market Anomalies." *Journal of Financial Economics*, forthcoming.
- James Grant (1838), "The Great Metropolis," Vol. II, E.L. Carey and A. Hart.
- Jegadeesh, N., and S. Titman (1993), "Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency." *Journal of Finance*, Vol. 48, No. 1, 65-91.
- Keim, D. (1999), "An Analysis of Mutual Fund Design: The Case of Investing in Small-Cap Stocks, *Journal of Financial Economics* Vol. 51.
- Korajczyk, R., and R. Sadka (2004), "Are momentum profits robust to trading costs?," *Journal of Finance*, vol. 59, pp. 1039-1082.
- Lesmond, D., M. Schill, and C. Zhou (2003), "The illusory nature of momentum profits," *Journal of Financial Economics*, vol. 71, pp. 349-380.
- Michaely, R., Thaler, R. H. and Womack, K. L. (1995), "Price Reactions to Dividend Initiations and Omissions: Overreaction or Drift?" *The Journal of Finance*, 50: 573-608.
- Moskowitz, T. and M. Grinblatt (1999), "Do Industries Explain Momentum?" *Journal of Finance*, Vol. 54, No. 1, 1249-90.
- Novy-Marx, R. (2012a), "The Other Side of Value: The Gross Profitability Premium." *Journal of Financial Economics*, forthcoming.
- Novy-Marx, R. (2012b), "The Quality Dimension of Value Investing." Working paper.

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Gross performance results do not reflect the deduction of investment advisory fees, which would reduce an investor's actual return. For example, assume that \$1 million is invested in an account with the Firm, and this account achieves a 10% compounded annualized return, gross of fees, for five years. At the end of five years that account would grow to \$1,610,510 before the deduction of management fees. Assuming management fees of 1.00% per year are deducted monthly from the account, the value of the account at the end of five years would be \$1,532,886 and the annualized rate of return would be 8.92%. For a ten-year period, the ending dollar values before and after fees would be \$2,593,742 and \$2,349,739, respectively. AQR's asset based fees may range up to 2.85% of assets under management, and are generally billed monthly or quarterly at the commencement of the calendar month or quarter during which AQR will perform the services to which the fees relate. Where applicable, performance fees are generally equal to 20% of net realized and unrealized profits each year, after restoration of any losses carried forward from prior years. In addition, AQR funds incur expenses (including start-up, legal, accounting, audit, administrative and regulatory expenses) and may have redemption or withdrawal charges up to 2% based on gross redemption or withdrawal proceeds. Please refer to AQR's ADV Part 2A for more information on fees.

Broad-based securities indices are unmanaged and are not subject to fees and expenses typically associated with managed accounts or investment funds. Investments cannot be made directly in an index.

There is a risk of substantial loss associated with trading commodities, futures, options, derivatives and other financial instruments. Before trading, investors should carefully consider their financial position and risk tolerance to determine if the proposed trading style is appropriate. Investors should realize that when trading futures, commodities, options, derivatives and other financial instruments one could lose the full balance of their account. It is also possible to lose more than the initial deposit when trading derivatives or using leverage. All funds committed to such a trading strategy should be purely risk capital.