Momentum: What Do We Know About This Investment Strategy

Morning Investments Consulting

What Is Momentum?

Simply put, momentum is the rate of increase in a stock's price over a given period of time. Stocks that have "gone up a lot" in the last year are said to have substantial positive momentum, while stocks that have declined, have negative momentum.

In a series of seminal papers in 1993, 1995 and 2001, economists Jegadeesh and Titman show that stocks with high levels of positive momentum also have higher future returns over the next year. Put differently, stocks that did well over the last year, on average continue to do well in the next year. This later came to be referred to as price momentum. An investment strategy to capitalize on this finding is to go long stocks with high levels of momentum, while shorting stocks with low levels of momentum (or with negative momentum). This strategy produces returns that are positive and substantial over time while also being market neutral (limiting exposure to market risk). This result is now well accepted and has been empirically reproduced in numerous additional studies over the last twenty years including work done by Cliff Asness and colleagues at AQR (see Asness, Moskowitz, and Pederson, 2013). Thus for all but the most dogmatic opponents, it is well accepted that momentum in stocks is associated with higher future returns over the near term.

The evidence is consistent that stocks with higher levels of momentum over the last twelve months outperform over the subsequent twelve months, but underperform over the subsequent twenty-four to sixty month period. This result is referred to as "short-term momentum, long-term reversal". Hence momentum necessarily requires periodic rebalancing in a portfolio. This has led some critics of the idea of momentum to assert that higher trading costs associated with the strategy fully offset any profitability from the strategy.

Why Does Momentum Generate Better Returns?

While size and value have some intuitive appeal as risk factors, it is less clear why momentum is a priced risk factor (i.e. why investing in high momentum stocks generates larger positive returns). Financial economists have spent the last twenty years arguing about what causes higher returns to higher momentum stocks, and no single explanation has been agreed on. There are a number of theories though. These theories fall into two categories; risk-based theories suggesting higher momentum stocks also carry higher risk, and behavioral theories suggesting momentum investing relies on some sort of behavioral bias.

Regardless of the source of momentum returns, the most important issue is that momentum is a good predictor of future returns. Griffin, Ji, and Martin (2003) show convincingly that momentum is robust to controls for a variety of different possible explanatory factors, while Hogan et al. (2004) show that momentum is a statistically significant generator of excess returns under a variety of conditions.

Risk Based Explanations:

Chan, Jegadeesh, and Lakonishak (1996) suggest that momentum is a result of informational asymmetries in financial markets. Follow-up research by the same authors in 1999 reached the same conclusion. The issue with this theory is that, if this were true, as markets incorporate information faster, then momentum returns should fall. No one has found evidence of this so far.

Chorida and Shivakumar (2002) suggest that while momentum might not present an obvious market risk, perhaps it was simply a correlated proxy with some unobserved factor that is a clear risk. They look at macroeconomic factors and find that many of these factors are correlated with momentum and help to explain the returns generated by momentum strategies.

One of the more convincing explanations of momentum profits comes from Guo (2006) who suggests momentum is a proxy that captures inter-temporal fluctuations in the business cycle which can be explained by a time-varying CAPM measure. This explanation would fit both the time varying nature of the momentum loading, the persistence of the factor to a variety of different time periods and markets, and the inclusion of a substantial number of additional control variables. Liu and Zhang (2008) offer support for this view of momentum. Perhaps because of its complexity however, the inter-temporal CAPM (ICAPM) has not become a standard within the field. Importantly, whether momentum is a proxy of an unobserved factor or is the direct price risk factor, the results are consistent; momentum returns are real and substantial.

Behavioral Explanations:

Behavioral explanations that have been advanced to explain momentum include investor irrationality, failure to account for lagged macroeconomic effects, excess covariance between individual stocks, and market frictions. The most common behavioral stories to explain momentum are (1) that investors are slow to respond to new information, (2) investors tend to herd in a bandwagon effect, and (3) that investors sell "winning" stocks to early and hold "losing" stocks too long. Research by Frazzini (2006) and Berger, Israel, Moskowitz, (2009) among others support these stories.

Boyer (2011) shows that momentum may be a by-product of its own success. That is, stocks may exhibit momentum because the market expects them to based on past research. This

intriguing proposition does not diminish the value of momentum investing, but it is useful to bear in mind as it regards the limitations on the strategy. Wahal and Yavuz (2013) offer evidence in support of this explanation for momentum showing that the use of style investing (growth versus value) is a partial driver of momentum returns.

Can Momentum Be Traded?

Trading Costs:

One of the early criticisms of momentum strategies was that the higher turnover necessitated by the strategy meant that trading costs for momentum would overwhelm any excess returns generated. Lesmond, Schill, and Zhou (2004) and Korajczyk and Sadka (2004) both advanced this argument saying essentially that trading costs were too high to effectively capture momentum.

Korajczyk and Sadka in particular argued that funds above $5B in size would be unable to capture momentum profits effectively. This line of argument is difficult to examine because data on trading costs are not as readily available as simple data on stock price. Grundy and Martin (2001) argue that trading costs have to be greater than 1.5% in order to fully offset momentum based profits. That level of trading costs is higher than what most studies have found. Subsequent studies such as Sagi and Seashones (2007) and Asness, Moskowitz, and Pederson (2013) find that trading costs are not large enough to subsume momentum profits.

Overall, it is fair to say that there is still disagreement among researchers regarding how large after-trading cost returns are to momentum investing strategies. However, it is unlikely that costs are so large as to completely eliminate returns to the strategy. The issue does highlight the importance of not promising specific returns to a momentum investing strategy though since trading costs vary based on the specifics of the strategy.

Tax Efficiency:

The issue of after tax returns is perhaps the second most common criticism of momentum-based trading strategies. Since momentum requires periodic portfolio rebalancing, it may result in taxes at short-term capital gains rates rather than long term capital gains rates. Israel and Moskowitz (2012) examine tax costs for trading strategies based on value and momentum. They find that value and momentum strategies have similar tax rates because while momentum involves five times more turnover than value, value strategies create exposure to dividend income (which is taxed as ordinary income under most circumstances). Momentum strategies can be altered to optimize after-tax returns which results in above market after-tax returns.

Can Momentum Strategies Be Improved Upon?

Researchers have also spent considerable energy looking for opportunities to enhance the effectiveness of basic momentum investing. Initial research focused on what has come to be termed "price momentum" – stocks whose prices have done well over the last year, continue to do well over the next year. Further research has examined earnings momentum (stocks whose earnings have been rising rapidly see their stock prices continue to rise rapidly), and residual momentum (momentum in returns specific to a given stock after accounting for other factors). Grundy and Martin (2001) show that residual momentum has value as the basis for a momentum investing strategy. A strategy built around residual momentum has produced profits that are "*remarkably stable across subperiods of the* entire *post-1926 era*". Grinblatt and Moskowitz (2004) show that controlling for stock characteristics like industry can also be used to enhance momentum returns leading to "*surprisingly large*" profits.

Research by George and Hwang (2004) showed that the length of time since a stock last hit a 52 week high is useful enhancing momentum profits, while Cooper et al. (2004) showed that momentum returns are closely correlated to the state of the market overall. Chordia and Shivkumar (2006) find that momentum profits can be enhanced by focusing on earnings momentum over price momentum. Bali et al (2006) show that liquidity factor returns are independent of momentum returns. Sagi and Seasholes (2007) show that firm level variables like revenues and costs can be used to improve on static momentum profits by as much as five percent annually.

What Can We Conclude?

Overall the conclusions in the latest major research on momentum suggest several important stylized facts:

(1) Substantial positive returns to a momentum strategy are a widespread phenomenon that persists across time, asset classes, and national markets as Hou, Karolyi, and Kho (2011) among others have shown.

(2) While momentum strategies are usually profitable, they do have asymmetric downside risk and can generate substantial losses in a short period of time as Daniel et al (2012) show. A dynamic momentum strategy can reduce this risk and substantially outperform a static momentum strategy. This is reinforced by Daniel and Moskowitz (2013).

(3) As a result of research into ways to enhance momentum, some hedge funds today use a combination of different momentum strategies built around price, earnings, and residual momentum.

(4) Momentum returns are not driven by stocks with recent price "spikes" but rather stocks that have performed well over an intermediate time horizon, specifically the past 7 to 12 months (Novy-Marx, 2012).

(5) Taxes and trading costs reduce the level of returns that can be expected from momentum trading strategies, but the overall strategy is still profitable.

(6) Long-term reversals in momentum returns to individual firms appear to result in large part from the US tax structure which taxes capital gains.

Library of Abstracts: *(Chronological Ordering)*

Chan, L. K. C., Jegadeesh, N. and Lakonishok, J. (1996):

We examine whether the predictability of future returns from past returns is due to the market's underreaction to information, in particular to past earnings news. Past return and past earnings surprise each predict large drifts in future returns after controlling for the other. Market risk, size, and book-to-market effects do not explain the drifts. There is little evidence of subsequent reversals in the returns of stocks with high price and earnings momentum. Security analysts' earnings forecasts also respond sluggishly to past news, especially in the case of stocks with the worst past performance. The results suggest a market that responds only gradually to new information.

Chan, L. K., Jegadeesh, N., & Lakonishok, J. (1999):

Momentum strategies based on continuations in stock prices have attracted a wide following among money managers and investors. We evaluated the profitability of price momentum strategies based on past return and earnings momentum strategies based on standardized unexpected earnings and revisions of consensus forecasts. The strategies proved to be profitable for intermediate horizons. Chasing momentum can generate high turnover, however; hence, implementation of momentum strategies requires a focus on managing trading costs. Comparing the strategies yielded evidence that they reflect distinct phenomena and provided information about the sources of profits. The results indicate that the market is slow to incorporate the full impact of information in its valuations

Grundy, BD and Martin, JS (2001):

Buying recent winners and shorting recent losers *guarantees* time-varying factor exposures in accordance with the performance of common risk factors during the ranking period. Adjusted for this dynamic risk exposure, momentum profits are remarkably stable across subperiods of the *entire* post-1926 era. Factor models can explain 95% of winner or loser return variability, but cannot explain their mean return components are *more* profitable than those based on total returns. Neither industry effects nor cross-sectional differences in expected returns are the primary cause of the momentum phenomenon.

Jegadeesh, N. and Titman, S. (2001):

This paper evaluates various explanations for the profitability of momentum strategies documented in Jegadeesh and Titman (1993). The evidence indicates that momentum profits have continued in the 1990s, suggesting that the original results were not a product of data snooping bias. The paper also examines the predictions of recent behavioral models that propose that momentum profits are due to delayed overreactions that are eventually reversed. Our

evidence provides support for the behavioral models, but this support should be tempered with caution.

Badrinath, S.G. and Wahal, S. (2002):

We document the equity trading practices of approximately 1,200 institutions from the third quarter of 1987 through the third quarter of 1995. We decompose trading by institutions into the initiation of new positions (entry), the termination of previous positions (exit), and adjustments to ongoing holdings. Institutions act as momentum traders when they enter stocks but as contrarian traders when they exit or make adjustments to ongoing holdings. We find significant differences in trading practices among different types of institutions.

Chordia, T. and Shivakumar, L. (2002):

A growing number of researchers argue that time-series patterns in returns are due to investor irrationality and thus can be translated into abnormal profits. Continuation of short-term returns or momentum is one such pattern that has defied any rational explanation and is at odds with market efficiency. This paper shows that profits to momentum strategies can be explained by a set of lagged macroeconomic variables and payoffs to momentum strategies disappear once stock returns are adjusted for their predictability based on these macroeconomic variables. Our results provide a possible role for time-varying expected returns as an explanation for momentum payoffs.

Jegadeesh, N., & Titman, S. (2002):

Portfolio strategies that buy stocks with high returns over the previous 3–12 months and sell stocks with low returns over this same time period perform well over the following 12 months. A recent article by Conrad and Kaul (1998) presents striking evidence suggesting that the momentum profits are attributable to cross-sectional differences in expected returns rather than to any time-series dependence in returns. This article shows that Conrad and Kaul reach this conclusion because they do not take into account the small sample biases in their tests and bootstrap experiments. Our unbiased empirical tests indicate that cross-sectional differences in expected returns explain very little, if any, of the momentum profits.

Lewellen (2002):

This article studies momentum in stock returns, focusing on the role of industry, size, and book-to-market (B/M) factors. Size and B/M portfolios exhibit momentum as strong as that in individual stocks and industries. The size and B/M portfolios are well diversified, so momentum cannot be attributed to firm- or industry-specific returns. Further, industry, size, and B/M portfolios are negatively autocorrelated and cross-serially correlated over intermediate horizons.

The evidence suggests that stocks covary "too strongly" with each other. I argue that excess covariance, not underreaction, explains momentum in the portfolios.

Vuolteenaho, T. (2002):

I use a vector autoregressive model (VAR) to decompose an individual firm's stock return into two components: changes in cash-flow expectations (i.e., cash-flow news) and changes in discount rates (i.e., expected-return news). The VAR yields three main results. First, firm-level stock returns are mainly driven by cash-flow news. For a typical stock, the variance of cash-flow news is more than twice that of expected-return news. Second, shocks to expected returns and cash flows are positively correlated for a typical small stock. Third, expected-return-news series are highly correlated across firms, while cash-flow news can largely be diversified away in aggregate portfolios.

Griffin, J. M., Ji, X. and Martin, J. S. (2003):

We examine whether macroeconomic risk can explain momentum profits internationally. Neither an unconditional model based on the Chen, Roll, and Ross (1986) factors nor a conditional forecasting model based on lagged instruments provides any evidence that macroeconomic risk variables can explain momentum. In addition, momentum profits around the world are economically large and statistically reliable in both good and bad economic states. Further, these momentum profits reverse over 1- to 5-year horizons, an action inconsistent with existing risk-based explanations of momentum.

Cooper, M. J., Gutierrez, R. C. and Hameed, A. (2004):

We test overreaction theories of short-run momentum and long-run reversal in the cross section of stock returns. Momentum profits depend on the state of the market, as predicted. From 1929 to 1995, the mean monthly momentum profit following positive market returns is 0.93%, whereas the mean profit following negative market returns is −0.37%. The up-market momentum reverses in the long-run. Our results are robust to the conditioning information in macroeconomic factors. Moreover, we find that macroeconomic factors are unable to explain momentum profits after simple methodological adjustments to take account of microstructure concerns.

George, T. J. and Hwang, C.-Y. (2004)

When coupled with a stock's current price, a readily available piece of information—the 52-week high price–explains a large portion of the profits from momentum investing. Nearness to the 52-week high dominates and improves upon the forecasting power of past returns (both individual and industry returns) for future returns. Future returns forecast using the 52-week high do not reverse in the long run. These results indicate that short-term momentum and long-term reversals

are largely separate phenomena, which presents a challenge to current theory that models these aspects of security returns as integrated components of the market's response to news.

Grinblatt, M., & Moskowitz, T. J. (2004):

The consistency of positive past returns and tax-loss selling significantly affects the relation between past returns and the cross-section of expected returns. Analysis of these additional effects across stock characteristics, seasons, and tax regimes provides clues about the sources of temporal relations in stock returns, pointing to potential explanations for this relation. A parsimonious trading rule generates surprisingly large economic returns despite controls for confounding sources of return premia, microstructure effects, and data snooping biases.

Hogan, S., Jarrow, R., Teo, M., & Warachka, M. (2004):

This paper introduces the concept of statistical arbitrage, a long horizon trading opportunity that generates a riskless profit and is designed to exploit persistent anomalies. Statistical arbitrage circumvents the joint hypothesis dilemma of traditional market efficiency tests because its definition is independent of any equilibrium model and its existence is incompatible with market efficiency. We provide a methodology to test for statistical arbitrage and then empirically investigate whether momentum and value trading strategies constitute statistical arbitrage opportunities. Despite adjusting for transaction costs, the influence of small stocks, margin requirements, liquidity buffers for the marking-to-market of short-sales, and higher borrowing rates, we find evidence that these strategies generate statistical arbitrage.

Korajczyk, R. A. and Sadka, R. (2004):

We test whether momentum strategies remain profitable after considering market frictions induced by trading. Intraday data are used to estimate alternative measures of proportional and non-proportional (price impact) trading costs. The price impact models imply that abnormal returns to portfolio strategies decline with portfolio size. We calculate break-even fund sizes that lead to zero abnormal returns. In addition to equal- and value-weighted momentum strategies, we derive a liquidity-weighted strategy designed to reduce the cost of trades. Equal-weighted strategies perform the best before trading costs and the worst after trading costs. Liquidity-weighted and hybrid liquidity/value-weighted strategies have the largest break-even fund sizes: $5 billion or more (relative to December 1999 market capitalization) may be invested in these momentum strategies before the apparent profit opportunities vanish.

Sapp, T. and Tiwari, A. (2004):

Does the “smart money” effect documented by Gruber (1996) and Zheng (1999) reflect fund selection ability of mutual fund investors? We examine the finding that investors are able to predict mutual fund performance and invest accordingly. We show that the smart money effect is

explained by the stock return momentum phenomenon documented by Jegadeesh and Titman (1993). Further evidence suggests investors do not select funds based on a momentum investing style, but rather simply chase funds that were recent winners. Our finding that a common factor in stock returns explains the smart money effect offers no affirmation of investor fund selection ability.

Bali, T. G., Cakici, N., Yan, X. and Zhang, Z. (2005):

Goyal and Santa-Clara (2003) find a significantly positive relation between the equal-weighted average stock volatility and the value-weighted portfolio returns on the NYSE/AMEX/Nasdaq stocks for the period of 1963:08 to 1999:12. We show that this result is driven by small stocks traded on the Nasdaq, and is in part due to a liquidity premium. In addition, their result does not hold for the extended sample of 1963:08 to 2001:12 and for the NYSE/AMEX and NYSE stocks. More importantly, we find no evidence of a significant link between the value-weighted portfolio returns and the median and value-weighted average stock volatility.

Hanna, J. D., & Ready, M. J. (2005):

Haugen and Baker (1996) report that a long-short stock selection strategy based on more than 50 measures of accounting information and past return behavior would have generated excess returns of approximately 3% per month. We find that the Haugen and Baker strategies do not provide attractive returns after transaction costs if an investor already has access to strategy portfolios based on book-to-market and momentum. We also provide an extensive analysis of transaction costs over a long sample and we report results of independent interest to researchers in market microstructure.

Leslie Boni and Kent L. Womack (2006):

This paper examines the value of analysts as industry specialists. We show analysts create value in their recommendations mainly through their ability to rank stocks within industries. An industry-based recommendation strategy substantially improves the return to risk ratio and reduces price momentum tilt relative to portfolios that ignore industry information. An examination of the links among analyst information, aggregated at the industry level, and industry returns and industry momentum shows that industry returns precede industry-aggregated analyst upgrades and downgrades, and the short-term industry price momentum phenomenon is partly explained by returns of firms with more analyst coverage leading those with less in that industry. Recommendation information is not valuable for predicting future relative industry returns, however.

Chordia, T. and Shivakumar, L. (2006)

This paper examines whether earnings momentum and price momentum are related. Both in time-series as well as in cross-sectional asset pricing tests, we find that price momentum is captured by the systematic component of earnings momentum. The predictive power of past returns is subsumed by a zero-investment portfolio that is long on stocks with high earnings surprises and short on stocks with low earnings surprises. Further, returns to the earnings-based zero-investment portfolio are significantly related to future macroeconomic activities, including growth in GDP, industrial production, consumption, labor income, inflation, and T-bill returns.

Frazzini (2006):

This paper tests whether the "disposition effect," that is the tendency of investors to ride losses and realize gains, induces "underreaction" to news, leading to return predictability. I use data on mutual fund holdings to construct a new measure of reference purchasing prices for individual stocks, and I show that post-announcement price drift is most severe whenever capital gains and the news event have the same sign. The magnitude of the drift depends on the capital gains (losses) experienced by the stock holders on the event date. An event-driven strategy based on this effect yields monthly alphas of over 200 basis points.

Guo, H. (2006):

This paper develops and estimates a heteroskedastic variant of Campbell's [Campbell, J., 1993. Intertemporal asset pricing without consumption data. American Economic Review 83, 487–512] ICAPM, in which risk factors include a stock market return and variables forecasting stock market returns or variance. Our main innovation is the use of a new set of predictive variables, which not only have superior forecasting abilities for stock returns and variance, but also are theoretically motivated. In contrast with the early authors, we find that Campbell's ICAPM performs significantly better than the CAPM. That is, the additional factors account for a substantial portion of the two CAPM-related anomalies, namely, the value premium and the momentum profit.

Sadka (2006):

This paper investigates the components of liquidity risk that are important for understanding asset-pricing anomalies. Firm-level liquidity is decomposed into variable and fixed price effects and estimated using intraday data for the period 1983–2001. Unexpected systematic (market-wide) variations of the variable component rather than the fixed component of liquidity are shown to be priced within the context of momentum and post-earnings-announcement drift (PEAD) portfolio returns. As the variable component is typically associated with private information [e.g., Kyle, 1985. Econometrica 53, 1315–1335], the results suggest that a substantial part of momentum and PEAD returns can be viewed as compensation for the unexpected variations in the aggregate ratio of informed traders to noise traders.

George, T. J. and Hwang, C.-Y. (2007):

Long-term reversals in U.S. stock returns are better explained as the rational reactions of investors to locked-in capital gains than an irrational overreaction to news. Predictors of returns based on the overreaction hypothesis have no power, while those that measure locked-in capital gains do, completely subsuming past returns measures that are traditionally used to predict long-term returns. In data from Hong Kong, where investment income is not taxed, reversals are nonexistent, and returns are not forecastable either by traditional measures or by measures based on the capital gains lock-in hypothesis that successfully predict U.S. returns.

Sagi, J. S., & Seasholes, M. S. (2007):

This paper identifies observable firm-specific attributes that drive momentum. We find that a firm's revenues, costs, and growth options combine to determine the dynamics of its return autocorrelation. We use these insights to implement momentum strategies (buying winners and selling losers) with both numerically simulated returns and CRSP/Compustat data. In both sets of data, momentum strategies that use firms with high revenue growth volatility, low costs, or valuable growth options outperform traditional momentum strategies by approximately 5% per year.

Agarwal, V. and Taffler, R. (2008):

This paper brings together the evidence on two asset pricing anomalies—continuation of prior returns (momentum) and the market mispricing of distressed firms—using UK data. Our analysis demonstrates both these effects are driven by market underreaction to financial distress risk. In particular, we find momentum is proxying for distress risk, and is largely subsumed by our distress risk factor. We also find, as with US studies, no evidence that size and book-to-market (B/M) effects in stock returns are linked to financial distress.

Li, X., Miffre, J., Brooks, C., & O'Sullivan, N. (2008):

This study assesses whether the widely documented momentum profits can be attributed to time-varying risk as described by a GJR-GARCH(1,1)-M model. We reveal that momentum profits are a compensation for time-varying unsystematic risks, which are common to the winner and loser stocks but affect the former more than the latter. In addition, we find that, perhaps because losers have a higher propensity than winners to disclose bad news, negative return shocks increase their volatility more than they increase those of the winners. The volatility of the losers is also found to respond to news more slowly, but eventually to a greater extent, than that of the winners.

Liu, L. X., & Zhang, L. (2008):

Recent winners have temporarily higher loadings than recent losers on the growth rate of industrial production. The loading spread derives mostly from the positive loadings of winners. The growth rate of industrial production is a priced risk factor in standard asset pricing tests. In many specifications, this macroeconomic risk factor explains more than half of momentum profits. We conclude that risk plays an important role in driving momentum profits.

Chui, A. C.W., Titman, S. and Wei, K.C. J. (2010):

This paper examines how cultural differences influence the returns of momentum strategies. Cross-country cultural differences are measured with an individualism index developed by Hofstede (2001), which is related to overconfidence and self-attribution bias. We find that individualism is positively associated with trading volume and volatility, as well as to the magnitude of momentum profits. Momentum profits are also positively related to analyst forecast dispersion, transaction costs, and the familiarity of the market to foreigners, and negatively related to firm size and volatility. However, the addition of these and other variables does not dampen the relation between individualism and momentum profits.

Boyer, B. H. (2011):

I find that economically meaningless index labels cause stock returns to covary in excess of fundamentals. S&P/Barra follow a simple mechanical procedure to define their Value and Growth indices. In doing so, they reclassify some stocks from Value to Growth even after their book-to-market ratios have risen, and vice versa. Such stocks begin to covary more with the index they join and less with the index they leave. Backdated constituent data from Barra reveal no such label-related shifts in comovement during the 10 years prior to the actual introduction of the indices in 1992.

Hou, K., Karolyi, G. A., & Kho, B. C. (2011):

Using monthly returns for over 27,000 stocks from 49 countries over a three-decade period, we show that a multifactor model that includes factor-mimicking portfolios based on momentum and cash flow-to-price captures significant time-series variation in global stock returns, and has lower pricing errors and fewer model rejections than the global CAPM or a popular model that uses size and book-to-market factors. We find reliable evidence that the global cash flow-to-price factor is related to a covariance risk model. In contrast, we reject the covariance risk model in favor of a characteristic model for size and book-to-market factors.

Li, D. (2011):

Through the interaction between financial constraints and R&D, I study two asset-pricing puzzles: mixed evidence on the financial constraints–return relation and the positive R&D-return relation. Unlike capital investment, R&D is more inflexible. A financially constrained R&D-

intensive firm is more likely to suspend/discontinue R&D projects. Therefore, R&D-intensive firms' risk increases with their financial constraints. Conversely, constrained firms' risk increases with their R&D intensity. I find a robust empirical relation between financial constraints and stock returns, primarily among R&D-intensive firms. Moreover, R&D predicts returns only among financially constrained firms. This evidence suggests that financial constraints potentially drive the positive R&D-return relation.

Daniel, K., Jagannathan, R., & Kim, S. (2012):

Price momentum strategies have historically generated high positive returns with little systematic risk. However, these strategies also experience infrequent but severe losses. During 13 of the 978 months in our 1929-2010 sample, losses to a US-equity momentum strategy exceed 20 percent per month. We demonstrate that a hidden Markov model in which the market moves between latent "turbulent" and "calm" states in a systematic stochastic manner captures these high-loss episodes. The turbulent state is infrequent in our sample: the probability that the hidden state is turbulent is greater than one-half in only 20% of the months. Yet in each of the 13 severe loss months, the ex-ante probability that the hidden state is turbulent exceeds 70 percent. This strong forecastability accentuates the price momentum puzzle; a conditional momentum strategy that moves to the risk-free asset when the ex-ante probability of the turbulent state is high exhibits dramatically better performance than the unconditional momentum strategy.

Israel, R. and Moskowtiz, T. (2012):

We examine the after-tax returns and tax efficiency of Size, Value, Growth, and Momentum equity styles. Examining portfolios commonly used in the literature and practice we find that Value and Momentum have the highest tax exposures, but continue to outperform the market on an after-tax basis. Momentum and Value face similar tax rates, despite Momentum having five times the turnover of Value, because Value is exposed to high dividend income, while Momentum’s exposure is primarily capital gains. We then construct tax optimized portfolios to assess how taxes can be improved within each style. We find that managing capital gains incurs less tracking error than avoiding dividend income. Hence, optimal tax trading improves capital gain-heavy styles such as Momentum without incurring significant style drift, while income-heavy styles such as Value are more difficult to improve. Tax optimization, therefore, further increases the after-tax outperformance of Momentum relative to Value and Growth.

Novy-Marx, R. (2012):

Momentum is primarily driven by firms' performance 12 to seven months prior to portfolio formation, not by a tendency of rising and falling stocks to keep rising and falling. Strategies based on recent past performance generate positive returns but are less profitable than those based on intermediate horizon past performance, especially among the largest, most liquid stocks. These facts are not particular to the momentum observed in the cross section of US

equities. Similar results hold for momentum strategies trading international equity indices, commodities, and currencies.

Asness, C. S., Moskowitz, T. J., & Pedersen, L. H. (2013):

We find consistent value and momentum return premia across eight diverse markets and asset classes, and a strong common factor structure among their returns. Value and momentum returns correlate more strongly across asset classes than passive exposures to the asset classes, but value and momentum are negatively correlated with each other, both within and across asset classes. Our results indicate the presence of common global risks that we characterize with a three-factor model. Global funding liquidity risk is a partial source of these patterns, which are identifiable only when examining value and momentum jointly across markets. Our findings present a challenge to existing behavioral, institutional, and rational asset pricing theories that largely focus on U.S. equities.

Daniel, K. D., & Moskowitz, T. J. (2013):

Across numerous asset classes, momentum strategies have historically generated high Sharpe ratios and strong positive alphas relative to standard asset pricing models. However, the returns to momentum strategies are negatively skewed: they experience infrequent but strong and persistent strings of negative returns. These momentum crashes are partly forecastable. They occur in what we term "panic" states – following market declines and when market volatility is high, and are contemporaneous with market "rebounds." We show that the low exante expected returns in panic states result from a conditionally high premium attached to the option-like payoffs of past losers. An implementable dynamic momentum strategy based on forecasts of each momentum strategy's mean and variance generates an unconditional Sharpe ratio approximately double that of the static momentum strategy. Further, we show that momentum returns in panic states are correlated with, but not explained by, volatility risk. These results are robust across eight different markets and asset classes and multiple time periods.

Wahal, S., & Yavuz, M. D. (2013):

Barberis and Shleifer (2003) argue that style investing generates momentum and reversals in style and individual asset returns, as well as comovement between individual assets and their styles. Consistent with these predictions, in some specifications, past style returns help explain future stock returns after controlling for size, book-to-market and past stock returns. We also use comovement to identify style investing and assess its impact on momentum. High comovement momentum portfolios have significantly higher future returns than low comovement momentum portfolios. Overall, our results suggest that style investing plays a role in the predictability of asset returns.

References:

Agarwal, V. and Taffler, R. (2008), Does Financial Distress Risk Drive the Momentum Anomaly?. Financial Management, 37: 461–484. doi: 10.1111/j.1755-053X.2008.00021.x

Asness, C. S., Moskowitz, T. J., & Pedersen, L. H. (2013). Value and momentum everywhere. *The Journal of Finance*, *68*(3), 929-985.

Badrinath, S.G. and Wahal, S. (2002), Momentum Trading by Institutions. The Journal of Finance, 57: 2449–2478. doi: 10.1111/1540-6261.00502

BALI, T. G., CAKICI, N., YAN, X. and ZHANG, Z. (2005), Does Idiosyncratic Risk Really Matter?. The Journal of Finance, 60: 905–929. doi: 10.1111/j.1540-6261.2005.00750.x

Berger, Adam, Israel, Ronen and Tobias Moskowitz, 2009. The Case for Momentum Investing. AQR Capital Management Whitepaper.

Boni, L. and Kent L. Womack (2006). Analysts, Industries, and Price Momentum. Journal of Financial and Quantitative Analysis, 41, pp 85-109. doi:10.1017/S002210900000243X.

BOYER, B. H. (2011), Style-Related Comovement: Fundamentals or Labels?. The Journal of Finance, 66: 307–332. doi: 10.1111/j.1540-6261.2010.01633.x

CHAN, L. K. C., JEGADEESH, N. and LAKONISHOK, J. (1996), Momentum Strategies. The Journal of Finance, 51: 1681–1713. doi: 10.1111/j.1540-6261.1996.tb05222.x

Chan, L. K., Jegadeesh, N., & Lakonishok, J. (1999). The profitability of momentum strategies. *Financial Analysts Journal*, *55*(6), 80-90.

Chordia, T. and Shivakumar, L. (2002), Momentum, Business Cycle, and Time-varying Expected Returns. The Journal of Finance, 57: 985–1019. doi: 10.1111/1540-6261.00449

Chordia, Tarun, and Lakshmanan Shivakumar. "Earnings and price momentum." *Journal of financial economics* 80.3 (2006): 627-656.

CHUI, A. C.W., TITMAN, S. and WEI, K.C. J. (2010), Individualism and Momentum around the World. The Journal of Finance, 65: 361–392. doi: 10.1111/j.1540-6261.2009.01532.x

Cooper, M. J., Gutierrez, R. C. and Hameed, A. (2004), Market States and Momentum. The Journal of Finance, 59: 1345–1365. doi: 10.1111/j.1540-6261.2004.00665.x

Daniel, K., Jagannathan, R., & Kim, S. (2012). *Tail risk in momentum strategy returns* (No. w18169). National Bureau of Economic Research.

Daniel, K. D., & Moskowitz, T. J. (2013). Momentum crashes. *Swiss Finance Institute Research Paper*, (13-61), 14-6.

Frazzini, A. (2006). The disposition effect and underreaction to news. *The Journal of Finance*, *61*(4), 2017-2046.

GEORGE, T. J. and HWANG, C.-Y. (2004), The 52-Week High and Momentum Investing. The Journal of Finance, 59: 2145–2176. doi: 10.1111/j.1540-6261.2004.00695.x

GEORGE, T. J. and HWANG, C.-Y. (2007), Long-Term Return Reversals: Overreaction or Taxes?. The Journal of Finance, 62: 2865–2896. doi: 10.1111/j.1540-6261.2007.01295.x

Griffin, J. M., Ji, X. and Martin, J. S. (2003), Momentum Investing and Business Cycle Risk: Evidence from Pole to Pole. The Journal of Finance, 58: 2515–2547. doi: 10.1046/j.1540-6261.2003.00614.x

Grinblatt, M., & Moskowitz, T. J. (2004). Predicting stock price movements from past returns: The role of consistency and tax-loss selling. *Journal of Financial Economics*, *71*(3), 541-579.

Grundy, B. D., & Martin, J. S. (2001). Understanding the nature of the risks and the source of the rewards to momentum investing. *Review of Financial Studies*, *14*(1), 29-78.

Guo, H. (2006). Time-varying risk premia and the cross section of stock returns. *Journal of Banking & Finance*, *30*(7), 2087-2107.

Hanna, J. D., & Ready, M. J. (2005). Profitable predictability in the cross section of stock returns. *Journal of Financial Economics*, *78*(3), 463-505.

Hogan, S., Jarrow, R., Teo, M., & Warachka, M. (2004). Testing market efficiency using statistical arbitrage with applications to momentum and value strategies. *Journal of Financial economics*, *73*(3), 525-565.

Hou, K., Karolyi, G. A., & Kho, B. C. (2011). What factors drive global stock returns?. *Review of Financial Studies*, *24*(8), 2527-2574.

Israel, R., & Moskowitz, T. J. (2012). How Tax Efficient Are Equity Styles?. *Chicago Booth Research Paper*, (12-20).

Jegadeesh, N., & Titman, S. (1993). Returns to buying winners and selling losers: Implications for stock market efficiency. *The Journal of Finance*, *48*(1), 65-91.

Jegadeesh, N., & Titman, S. (2001). Profitability of momentum strategies: An evaluation of alternative explanations. *The Journal of Finance*, *56*(2), 699-720.

Jegadeesh, N., & Titman, S. (2002). Cross-sectional and time-series determinants of momentum returns. *Review of Financial Studies*, *15*(1), 143-157.

Korajczyk, R. A. and Sadka, R. (2004), Are Momentum Profits Robust to Trading Costs?. The Journal of Finance, 59: 1039–1082. doi: 10.1111/j.1540-6261.2004.00656.x

Lesmond, David A., Michael J. Schill, and Chunsheng Zhou (2004), "The illusory nature of momentum profits," Journal of Financial Economics, vol. 71, pp. 349–380.

Lewellen, J. (2002). Momentum and autocorrelation in stock returns. *Review of Financial Studies*, *15*(2), 533-564.

Li, D. (2011). Financial constraints, R&D investment, and stock returns. *Review of Financial Studies*, hhr043.

Li, X., Miffre, J., Brooks, C., & O'Sullivan, N. (2008). Momentum profits and time-varying unsystematic risk. *Journal of Banking & Finance*, *32*(4), 541-558.

Liu, L. X., & Zhang, L. (2008). Momentum profits, factor pricing, and macroeconomic risk. *Review of Financial Studies*, *21*(6), 2417-2448.

Novy-Marx, R. (2012). Is momentum really momentum?. *Journal of Financial Economics*, *103*(3), 429-453.

Sadka, Ronnie. "Momentum and post-earnings-announcement drift anomalies: The role of liquidity risk." *Journal of Financial Economics* 80.2 (2006): 309-349.

Sagi, J. S., & Seasholes, M. S. (2007). Firm-specific attributes and the cross-section of momentum. *Journal of Financial Economics*, *84*(2), 389-434.

SAPP, T. and TIWARI, A. (2004), Does Stock Return Momentum Explain the "Smart Money" Effect?. The Journal of Finance, 59: 2605–2622. doi: 10.1111/j.1540-6261.2004.00710.x

Vuolteenaho, T. (2002), What Drives Firm-Level Stock Returns?. The Journal of Finance, 57: 233–264. doi: 10.1111/1540-6261.00421

Wahal, S., & Yavuz, M. D. (2013). Style investing, comovement and return predictability. *Journal of Financial Economics*, *107*(1), 136-154.