Momentum and Market Correlation

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Abstract

This paper proposes that an important source of momentum profits is market information associated with correlation to general market movements. Empirical tests for U.S. stocks in the sample period 1965 to 2013 indicate that most momentum profits can be attributed to the correlation of big- and medium-capitalization stocks with the CRSP market index. Further results show that small loser stocks have low correlation to the market and post-formation return reversal, small losers can be added to long winner portfolios to enhance profits, and momentum crashes can be reduced by suspending portfolio formation in bear markets. We conclude that momentum profits are related to market information and therefore not entirely anomalous as commonly believed.

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1

Momentum and Market Correlation

I. Introduction

Now famous work by Jegadeesh and Titman (1993) shows that abnormal trading profits can be earned on simple, relative-strength momentum strategies that buy (sell) recent winners (losers). For example, in the period 1965 to 1989, equal-weighted returns of about 12 percent per year are produced by constructing zero-investment portfolios with long (short) positions in high (low) return stocks in the past 6 months (i.e., the formation period) and holding them for the next 6 months. Numerous studies prove that this momentum effect is persistent in stock returns.[1] As observed by Daniel (2011), momentum has been documented to exist for a wide variety of asset classes, including bonds, commodities, currencies, and exchange-traded funds. Moskowitz, Ooi, and Pedersen (2012) find that momentum profits are pervasive across almost five dozen different futures and forwards contracts that span a broad spectrum of asset classes and markets. Due to its widespread recognition among academics and practitioners, in the context of various anomalous patterns in average stock returns, Fama and French (2008) consider momentum to be the *premier* puzzle. In an attempt to better understand the momentum puzzle, a growing body of research has sought to investigate behavioral[2] as well as rational explanations[3].

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[1] See momentum studies by Conrad and Kaul (1998), Rouwenhorst (1998), Moskowitz and Grinblatt (1999), Grundy and Martin (2001), Jegadeesh and Titman (2001), Chordia and Shivakumar (2002), Lewellen (2002), Griffin, Ji, and Martin (2003), Cooper, Gutierrez, and Hameed (2004), Fama and French (2008), Gutierrez and Kelley (2008), Liu and Zhang (2008), Kim and Choi (2013), and others. Other contrarian trading strategies find evidence of short-term reversal in a week or month (e.g., Jegadeesh (1990), Lehman (1990), and Lo and MacKinlay (1990)) as well as very long-term reversals in three-to-five years (e.g., DeBondt and Thaler (1985, 1987)) that can yield significant abnormal investor returns.

[2] For example, see Barberis, Shleifer, and Vishny (1998), Daniel Hirshleifer, and Subramanyam (1998), Hong and Stein (1999), George and Hwang (2004), Grinblatt and Han (2005), and others.

[3] See Fama and French (1996), Johnson (2002), Sagi and Seasholes (2007), and others.

In this paper we propose that an important source of momentum profits is market information associated with correlation of winner and loser stocks' returns to general market movements. Weighting winner and loser stock returns based on their correlation to a general market index (e.g., the CRSP index) doubles momentum profits compared to equal-weighted stock returns. This fact explains why value-weighted returns outperform equal-weighted returns. That is, value-weighted returns place more emphasis on large market capitalization stocks that have higher correlation to the overall market than small stocks. Small stocks are more idiosyncratic with returns that have very low correlations with the overall market. Indeed, Daniel and Moskowitz (2013) have shown that large momentum crashes or drawdowns are possible due to small loser stocks recovering faster than winner stocks after a severe bear market downturn. In an effort to manage this idiosyncratic risk, Barroso and Santa-Clara (2015) have demonstrated that momentum crashes can be reduced by scaling the long-short portfolio by the realized variance of daily returns in the previous six months. This variance is higher in bear markets, which reduces the minimum one-month return from -79.0 percent to -28.4 percent. Extending their risk-managed momentum approach, we find that momentum profits can be increased by going long (rather than short) small loser stocks. Additionally, minimum one-month returns can be substantially reduced by suspending momentum portfolio formation when loser stocks have either mean past returns or cross-sectional dispersion in formation months $t = -12$ to -2 in the lowest quintile of the time series of such past returns (i.e., bear markets). For example, based on value-weighted returns for all CRSP stocks from 1965 to 2013, traditional value-weighted momentum portfolios that are rebalanced monthly yield 1.8 percent per month with a minimum return of -47.8 percent compared to a managed-risk strategy based on cross-sectional dispersion which yields 2.4 percent per month with a minimum return of -13.7 percent.

Thus, momentum profits are increased about 30 percent, and momentum crashes are decreased more than fourfold. Interestingly, excluding the smallest tercile of winners and losers yields momentum profits that are virtually the same for value-, correlation-, and equal-weighted returns and approximately equal to value-weighted results for all stocks including small stocks. These results imply that it is not size per se but correlation that helps to explain momentum profits. Also, the majority of momentum profits can be attributed to big- and medium-capitalization stocks. Based on this and other evidence, we conclude that momentum profits are related to market correlation and therefore not entirely anomalous as commonly believed.

The next section overviews the data and methodology. Section III presents the empirical findings. Section IV concludes.

II. Data and Methodology

Following Daniel and Moskowitz (2013), we employ monthly CRSP common stock returns (share codes 10 or 11) based on closing prices for all firms listed on the NYSE, AMEX, and NASDAQ. The formation period covers 11 months denoted $t = -12$ to -2, with no restriction that returns must be available for all months. The sample period is January 1965 to December 2013. All stocks are ranked on holding period returns in the formation period and then sorted into deciles. The top decile (winners) and bottom decile (losers) are retained. Portfolio returns for winner and loser stocks are computed in month $t = 0$ after skipping month $t = -1$.[4] We follow previous work by computing value- and equal-weighted portfolio returns.

Departing from previous studies, we hypothesize that reducing idiosyncratic volatility among stocks in winner and loser portfolios provides improved diversification, which potentially

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[4] We tested different holding period returns based on the 11-month formation period (e.g., 1-month returns without skipping one month as well as 3- and 6-month returns). To conserve space, because the return performances for these holding periods were almost always inferior to 1-month returns after skipping one month, we do not report them. Results are available upon request.

can boost momentum profits. A simply way to do this is to weight stocks in these portfolios using their market index correlations. As idiosyncratic risk increases, market correlation tends to decrease. To see this, the correlation coefficient between the returns of stock j and the market portfolio over time is defined as:

$$\rho_{jm} = \frac{\text{cov}(R_{jt}, R_{mt})}{\sigma(R_{jt})\sigma(R_{mt})}, \tag{1}$$

which can be re-written as

$$\rho_{jm} = \frac{\beta_j \sigma(R_{mt})}{\sigma(R_{jt})}. \tag{2}$$

Equation (2) shows that, holding a stock's beta and market volatility constant, stocks with higher volatility have lower correlation coefficients than lower volatility stocks. Indeed, small stocks with large idiosyncratic risk will tend to have low correlation with a chosen market index for this reason. Other alternatives are to use the squared correlation coefficient or simply the inverse of the variance of stock returns to place greater emphasis on stock volatility in computing weighted average winner and loser portfolio returns. In unreported results, we found that the results were little changed and often superior using the correlation coefficient to weight winner and losers in their respective portfolios. Hence, forthcoming results focus on correlation weights.

While reducing portfolio noise and thereby improving diversification is one way to think about correlation as a weight in winner and loser portfolios, market correlation can be viewed as a kind of market force that helps to improve the momentum profit spread. As an analogy, the gravity of the sun on two planetary bodies keeps them in separate orbits and thereby reduces the risk that they will collide with one another. Correlation with the overall market is tantamount to the sun's gravity in this paradigm. As correlation between winner and loser stocks and the

overall market increases (i.e., noise decreases), the likelihood that an existing positive spread between their co-moving returns will be maintained increases. An existing spread between winner and loser stocks' returns has momentum to the extent that market correlation forces tend to keep them in separate "orbits" over time. If there was no correlation between winner and loser stocks, their idiosyncratic (noisy) behavior over time would likely cause the spread to collapse or reverse (i.e., crash). Because market correlation is a major component of systematic risk as measured by CAPM beta (see Sharpe (1964), Lintner (1965), and Mossin (1966))[5], to the extent that market correlation does play a role in momentum profits, we can infer that momentum is related to market risk and therefore not entirely anomalous.

Correlation between the returns of individual stocks and the overall market varies with their market capitalization (size). Based on stocks' monthly return correlation with value-weighted CRSP index returns in our sample period 1965 to 2013, quintiles of winner stocks as well as loser stocks are created. Table 1 summarizes the results. As shown there, correlations range widely across the quintiles for winners (losers) from 0.005 to 0.495 (-0.044 to 0.375). Comparing the winner and loser stocks' market capitalizations, losers tend to be much smaller than winners in terms of size. The highest correlation losers in quintile 5 have an average market capitalization of $361 million, which is relatively small compared to winners with $2.6 billion on average in the high correlation quintile. Also, as correlation increases from low to high, market capitalization increases, particularly among the winner stocks (e.g., quintiles 1 and 5 have average market capitalizations of $218 million and $2.6 billion, respectively). It is noteworthy that small losers in quintiles 1 and 2 have very small market capitalizations at $33 and $35 million, respectively, as well as little or no correlation to the general market index. Thus, small

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[5] See Pollet and Wilson (2010) for discussion and references on individual stock return correlation to the overall market return and associated market risk.

loser stocks are idiosyncratic with respect to general market movements. Finally, winner stocks

have average monthly returns in a narrow range of 1.78 percent to 1.91 percent across correlation

quintiles, but loser stocks' average returns vary widely from 2.10 percent in the low correlation

quintile to only 0.20 percent in the high correlation quintile. Low correlation small losers are

striking in terms of their relatively high average returns. Only among the high correlation

quintiles 4 and 5 are returns fairly low among losers at 0.91 percent and 0.20 percent,

respectively. Most loser stocks in fact have fairly good monthly returns compared to the winner

stocks. These basic statistics will be useful in forthcoming analyses.

III. Empirical Results

Given the correlation and return differences between big- and small-capitalization stocks

discussed above, in this section we divide winner and loser stock portfolios into three groups by

market capitalization on the last day of the formation period: big, medium, and small. We begin

by exploring the post-formation period returns taking into account these size groups.

Subsequently, we explore the performance of different momentum strategies that incorporate

these size groups with different return weighting schemes and risk management approaches.

A. *Post-Formation Momentum Returns by Size*

Value-weighted returns for size groups of winner and loser stocks in post-formation

months $t = -1$ to $t = +5$ are shown in Table 2. In month t-2 at the end of the formation period,

winners (losers) have fairly large positive (negative) mean monthly returns ranging from 5.80

percent to 11.24 percent (-7.93 percent to -5.64 percent). In month t -1, which is the skipped

month, winner stocks' returns decline markedly but stay positive ranging from 1.49 percent to

1.74 percent; by contrast, losers' stock returns reverse from negative to positive ranging from

0.24 percent to 3.49 percent. From months T (when momentum profits are computed) to +5

winner stocks' returns slowly decline over time but remain greater than 1 percent per month. However, in these post-formation months, loser stocks' returns follow a pattern of relatively low and insignificant returns near zero for big- and medium-capitalization stocks but highly significant and positive returns ranging from 2.30 percent to 2.48 percent per month for small stocks. Clearly, small losers exhibit different time series return behavior than other stock groups.

We further investigate small losers' return behavior under different market regimes. To do this we sort the time series average returns of the loser-stock portfolio in the 11-month formation periods into quintiles. We also sort the winner-stock portfolios' formation period returns into quintiles. The low (high) quintile period is associated the lowest (highest) formation period returns, hereafter referred to as bear (bull) markets. Analyses in Table 2 are then repeated using these low (high) market regime time series sorts in Table 3. Winner stock portfolios' performance is not noticeably different between these two market regimes. However, losers stocks have much larger reversals after low (bear market) formation period returns than after high (bull market) returns. In the low regime, small losers have the following returns (in percent) by post-formation month: t-1 = 6.40, T = 5.25, …, t+5 = 6.38. The general pattern of returns is similar for loser stocks in the high regime but the magnitudes of the monthly returns are at least 50 percent lower. Interestingly, substantial return reversal occurs even in the high (bull market) regime for small loser stocks, with returns rebounding from the end of the formation period at t-2 = -2.83 percent to T = 1.77 percent in the momentum profit computation month.

Table 4 focuses on the month T profit results for winner and losers in Table 3. Instead of using low and high past return quintiles for both winners and losers, we divide past formation period average returns over time into low and other quintile categories for only losers. We

provide further details in these results, including the number of months for low and other quintiles, *t*-statistics, and Sharpe ratios for the different size and regime portfolios. Results for winners in Panel A show that mean returns increase as market capitalization decreases (i.e., mean total returns of 1.58 percent, 1.78 percent, and 2.07 percent for big, medium, and small stocks, respectively, that are highly significant at more than the 1 percent level). Also, small stocks have higher mean Sharpe ratios (i.e., 0.92) than medium or big stocks (i.e., 0.79 for both portfolios). Among small- and medium-sized stocks, there is little difference in winners' returns for low versus other past-return quintiles. For big stocks the low regime has a lower return at 1.06 percent (i.e., marginally significant at the 10 percent level) compared to other past-return quintiles at 1.71 percent (highly significant at more than the 1 percent level). These results are likely due to the fact that big stocks are more highly correlated with the general market index than other stocks. Bear markets have lower average market returns than other periods, which lowers big stock returns at such times.

Loser portfolio results are reported in Panel B of Table 4. In general, the month *T* returns for medium and big loser stocks are not significantly different from zero (and Sharpe ratios fluctuate around zero). However, in low and other past-return periods, small loser stocks have highly significant returns at the 1 percent level equal to 5.25 percent and 1.78 percent and Sharpe ratios of 0.99 and 0.64, respectively. Thus, small losers have large positive returns in post-formation months across all market conditions (i.e., low, normal, and high return markets).

Table 5 repeats the analyses in Table 4 but sorts average formation period returns over time into low and other quintiles based on cross-sectional dispersion of loser portfolio returns. We find that, when past returns are very low in a bear market, cross-sectional return dispersion among small losers is low also. Hence, return dispersion of losers in the formation period is

another possible proxy for market regime. This regime approach is confirmed by the close

similarity of results between Table 4 and 5. Notice that small loser stocks have highly

significant average returns equal to 4.82 percent and 1.89 percent in low and other past-return

periods, respectively, which are close to 5.25 percent and 1.78 percent returns in Table 4 for

these stock portfolios using low and other past-return quintiles.

As noted in the introduction, Daniel and Moskowitz (2013) have documented that

momentum crashes are more likely and larger in terms of losses after sharp market downturns

during bear markets. However, they do not breakdown stocks in momentum portfolios by

market capitalization as in the present study. Barroso and Santa-Clara (2015) use intersection

CRSP/COMPUSTAT stocks based on Kenneth French's website[6] to construct their momentum

portfolios but again do not parse stocks by market capitalization. Our results in Tables 3 to 5

that decompose momentum portfolios by market capitalization suggest that small losers explain a

large part of the losses in momentum crashes. More generally, small loser stocks have reversal

behavior in post-formation months that lowers momentum profits.

B. *Momentum Strategies*

Given the documented reversal behavior of small losers, we comparatively evaluate

different momentum strategies, including a hybrid strategy that goes long winners plus long

(rather than short) small losers. We consider three momentum strategies: (1) traditional

momentum that is long (short) value-weighted returns of winner (loser) stocks (denoted WML1);

(2) size-based momentum that is long (short) value-weighted returns of the small, medium, and

big winner (loser) stocks sorted into three separate portfolios, the returns of which are summed to

get winner (loser) profits (WML2); and, (3) a hybrid size-based momentum that is the same as

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[6] See http://mba.tuck.dartmouth.edu/pages/faculty/ken.french.

WML2 but the small loser portfolio is added to the long winner size portfolios rather than the loser size portfolios (WML3).[7]

In an attempt to manage crash risk, we consider three different time-weighting approaches: (1) traditional momentum portfolios are formed as a benchmark based on average formation period returns of stocks and month T returns are computed (i.e., time weight $w = 1$ for all t); (2) crash risk is managed by suspending momentum portfolio investment when the average formation period return falls in the lowest quintile of formation period returns (i.e., time weight $w = 0$ for the lowest quintile t and 1 otherwise); and, (3) crash risk is managed by suspending momentum portfolio investment when the cross-sectional dispersion of formation period returns falls in the lowest dispersion quintile of formation period dispersions (i.e., time weight $w = 0$ for the lowest quintile t and 1 otherwise). The latter two approaches seek to mitigate crash risk in the spirit of Barroso and Santa-Clara (2015), but rather than scaling the long-short portfolio by its realized volatility in the formation period, we eliminate momentum investment in the low quintile (bear market) regime.

Table 6 reports the value-weighted return results for these different momentum strategies and crash risk approaches. As shown in Panel A, the traditional momentum portfolio, or WML1, earns a highly significant 1.81 percent per month, with Sharpe ratio of 0.74 and minimum one-month return of -47.78 percent (i.e., the largest one-month drawdown). The managed risk strategies, denoted WML2 and WML3 in Panels B and C, respectively, boost monthly returns to 2.24 percent and 2.27 percent but more importantly increase Sharpe ratios to 1.23 and 1.24 with minimum returns to -21.95 percent and -22.10 percent. Thus, crash risk can be substantially

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[7] In unreported results, we tested another hybrid momentum strategy based on WML1 plus the small loser portfolio but the results were almost identical to WML3. To conserve space, we do not report these results.

reduced by 50 percent or more by simply not investing in momentum portfolios when formation period returns fall in their lowest quintile.

The results for strategy WML2 in Table 6 are typically inferior to those for WML1. However, strategy WML3 clearly dominates WML1. Without any risk management, Panel A shows that monthly returns increase from 1.81 percent for WML1 to 2.09 percent for WML3. Also, the Sharpe ratio increases from 0.74 to 1.20 and minimum return increases from -47.78 percent to -37.37 percent. Hence, including small loser stocks in the long portfolio (WML3) materially improves the traditional momentum return and risk performance.

Referring to Panels B and C in Table 6, crash risk management further improves momentum performance. For example, focusing on WML3 results, eliminating momentum portfolios in months after low quintile formation period returns (dispersion) increases returns to 2.33 (2.41) percent from 2.09 percent. Strikingly, risk management increases Sharpe ratios to 1.82 (1.88) from 1.20 and increases minimum returns to -14.17 (13.72) percent from -37.37 percent. Hence, drawdowns are reduced almost threefold via these simple risk management approaches.

Relevant to our market correlation proposition, Table 7 repeats the analyses in Table 6 but uses correlation-weighted returns rather than value-weighted returns. In Panel A the results for the traditional momentum approach, or WML1, are generally inferior to those using value-weighted returns in Table 6. However, the results for the WML3 strategy that goes long in winners plus small losers are somewhat improved relative to the value-weighted results. Comparing Tables 7 and 6, correlation-weighted (value-weighted) returns are as follows: 2.30 (2.09) percent per month, 1.30 (1.20) Sharpe ratio, and -46.14 (-37.37) percent minimum

monthly return. We infer that weighting stocks on market capitalization yields momentum profits similar to weighting on correlation with the CRSP index.

As discussed in the previous section, as the market correlation of winners and losers increases, we would expect the return spread between these long and short portfolios to become more stable over time. In effect, the correlation between the returns of long and short portfolios increases as market correlation increases. In Table 8 we repeat Table 7, but instead of using market correlation weighted returns, we use correlation weights of each winner (loser) stock with the loser (winner) portfolio. The results are almost identical to those in Table 7. This evidence corroborates our conjecture that market correlation affects the correlation between winners and losers and helps to explain momentum profits.

It is important to observe that value- and correlation-weighted returns outperform equal-weighted returns in traditional portfolios. Table 9 repeats Tables 6 to 8 with equal-weighted returns. The traditional momentum approach in Panel A without risk management, or WML1, now earns only 0.67 percent per month, with a very low Sharpe ratio of 0.29 and high minimum return of -83.70 percent. Momentum profits decline considerably using equal-weighted portfolios due to the fact that small stocks have lower correlation to the market and equal weighting places more emphasis on small stocks, The WML2 strategy performs as badly as WML1 in Panel A. Hence, equal-weighted returns underperform value- and correlation-weighted momentum approaches that go long winners and short losers.

Interestingly, when small loser stocks are added into the long portfolio in WML3, equal-weighted returns outperform the value- and correlation-weighting results. Panel A of Table 9 shows that WML3 has 2.43 percent returns, a 1.44 Sharpe ratio, and a -42.39 percent minimum return. Likewise, applying risk-managed approaches to the WML3 strategy in Panels B and C

yield excellent performance of 2.70 percent and 2.82 percent returns, 2.35 and 2.49 Sharpe ratios, and -15.46 percent and -13.94 percent minimum returns, respectively. Due to the low performance of the WML2 strategy, it is apparent that adding a long position in small loser stocks greatly enhances momentum profits. And, equal-weighting these small loser stocks puts more weight on the very small stocks in this portfolio that have the largest return reversals from bear markets.

As a robustness check of the risk management strategies, we re-ran the market-correlation-weighted momentum returns in Table 7. Instead of using the full sample period to define low past loser returns or return dispersion (i.e., bear markets), we use the first 180 months (or 1965/01 to 1979/12) to determine the lowest 20th percent of losers' formation period returns (or standard deviation). Momentum trading is suspended in month T during such bear months. Because the results in Table 10 are similar to those in Table 7 using the full sample period to define bear markets, we infer that look-ahead bias is not an issue with our full sample findings.

C. Momentum After Dropping the Small Stock Tercile

To better understand the role of correlation in momentum portfolios, we re-ran Tables 6 to 9 after dropping the bottom tercile defined earlier as small stocks within winner and loser portfolios. Again, small stocks have relatively low correlation with the market due to their higher idiosyncratic volatility than larger stocks. Three main results emerge from Tables 11 to 14. First, for momentum portfolios comprised of big- and medium-capitalization stocks, equal-weighted results are almost identical to those for the value-weighted approach. Second, the results for WML1 and WML2 in Tables 11 to 14 are very similar, in contrast to earlier results in Tables 6 to 9 in which WML2 consistently underperforms WML1 by a large margin. Third, and last, most momentum profits can be attributed to the big- and medium-capitalization stocks.

Comparing the value-weighted results for WML1 and WML2 using all stocks in Table 6, which yield 1.81 percent and 1.06 percent per month, respectively, these strategies in Table 11 excluding small stocks earn 1.85 percent and 1.79 percent per month. Thus, small stocks do not enhance momentum profits on average. We interpret this evidence to mean that correlation between big and medium stocks and the overall market helps to explain the lion's share of momentum profits, not value weighting by stock market capitalization per se which does not improve upon equal weighting returns. Finally, in view of the results in Tables 6 to 9, adding small stocks to momentum portfolios increases idiosyncratic risk and can lower performance, especially small loser stocks which are typically smaller in market capitalization than small winner stocks (see Table 1). However, due to their common reversal pattern, adding small loser stocks to the long winner portfolio can significantly increase momentum profits, increase Sharpe ratios, and reduces crash risk.

IV. Conclusion

This paper proposed that market correlation plays an important role in momentum profits. Momentum is believed to be entirely anomalous and therefore unrelated to market risk associated with the general market index. We posit that winner and loser portfolios' returns are more likely to maintain a spread and earn momentum profits if they are correlated with the market portfolio than if they were uncorrelated. Empirical analyses of U.S. stocks indicate that traditional momentum portfolios based on value-weighted stock returns earn almost three times the monthly returns of equal-weighted returns. This outsized value-weighted performance is due to the fact that large capitalization stocks have higher correlation to the overall market than small capitalization stocks. Upon weighting returns by winner and loser stocks' correlations with CRSP index returns, momentum profits are approximately doubled compared to equal-weighted

returns. When we drop the bottom tercile of stocks by market capitalization (viz., small stocks) from momentum portfolios, the performance of equal-, value- and correlation-weighted approaches are almost identical. Also, excluding small stocks provides value-weighted momentum profits that are approximately the same as those for all stocks, which means that most momentum profits can be attributed to big- and medium-capitalization stocks.

We further documented the consistent tendency of small losers to reverse returns in post-formation months. Reversals are symptomatic of idiosyncratic behavior due to lower correlation with general market movements than other stocks. When we add small losers to long positions in winner stocks, momentum profits are substantially increased. Indeed, using equal-weighted returns, monthly returns are boosted by about one-third compared to the traditional value-weighted approach. This hybrid momentum/reversal strategy has not been documented in previous literature.

Lastly, in the spirit of Barroso and Santa-Clara (2015), we found that momentum crash risk can be substantially mitigated by suspending portfolio formation in bear market periods with historically either low returns or low dispersion among loser stocks in the formation period. Using these managed-risk approaches, minimum returns of momentum strategies after large market downturns can be increased by as much as fourfold compared to traditional value-weighted momentum returns. Of course, mitigating drawdown risk of momentum strategies to reasonable levels is important in investors in the real world concerned about large negative volatility. Many investment managers cannot accept large drawdowns due to client demands to control such potential losses.

In sum, we conclude that momentum profits for common stocks are explained in large part by correlation between big- and medium-capitalization winner and loser stocks' returns and

general market movements. By implication, it is not surprising that (as noted in the introduction) momentum has been widely observed across different asset classes, including bonds, commodities, forward and futures contracts, real estate, etc. Market risk related to market correlation is systematic and should affect the entire financial market. Momentum research is recommended on the role of correlation in other asset classes, including low correlation assets.

References

Barberis, M., A. Shleifer, and R. Vishny, 1998, A model of investor sentiment, *Journal of Financial Economics* 49, 307–343.

Barroso, P., and P. Santa-Clara, 2015, Momentum has its moments, *Journal of Financial Economics* 111–120.

Chordia, T., and L. Shivakumar, 2002, Momentum, business cycle, and time-varying expected returns, *Journal of Finance* 57, 985–1019.

Conrad, J., and G. Kaul, 1998, An anatomy of trading strategies, *Review of Financial Studies* 11, 489–519.

Cooper, M. J., R. C. Gutierrez Jr., and A. Hameed, 2004, Market states and momentum, *Journal of Finance* 59, 1345–1365.

Daniel, K., and T. Moskowitz, 2013, Momentum crashes, Working paper, Columbia Business School and Booth School of Business, University of Chicago.

Daniel, K., D. Hirshleifer, and A. Subrahmanyam, 1998, Investor psychology and security market under- and overreactions, *Journal of Finance* 53, 1839–1885.

De Bondt, W. F. M., and R. Thaler, 1985, Does the stock market overreact?, *Journal of Finance* 40, 793–805.

[DeBondt, W. F. M., and R. Thaler, 1987, Further evidence of stock market overreaction and seasonality, *Journal of Finance* 42, 557–581.

Fama, E. F., and K. R. French, 1996, Multifactor explanations of asset pricing anomalies, *Journal of Finance* 51, 55–84.

Fama, E. F., and K. R. French, 2008, Dissecting anomalies, *Journal of Finance* 63, 1653–1678.

George, T. J., and C.-Y. Hwang, 2004, The 52-week high and momentum investing, *Journal of Finance* 59, 2145–2176.

Grinblatt, M., and B. Han, 2005, Prospect theory, mental accounting and momentum, *Journal of Financial Economics* 78, 311–339.

Gutierrez, R. C., and E. K. Kelly, 2008, The long-lasting momentum in weekly returns, *Journal of Finance* 63, 415–447.

Hong, H., and J. C. Stein, 1999, A unified theory of underreaction, momentum trading, and overreaction in asset markets, *Journal of Finance* 54, 2143–2184.

Jegadeesh N., 1990, Evidence of predictable behavior of security returns, *Journal of Finance* 45, 881–898.

Jegadeesh, N., and S. Titman, 2001, Profitability of momentum strategies: An evaluation of alternative explanations *Journal of Finance* 56, 699–720.

Johnson, T. C., 2002, Rational momentum effects, *Journal of Finance* 57, 585–608.

Kim, H., and S. M. Choi, 2013, Momentum effect as part of a market equilibrium, *Journal of Financial and Quantitative Analysis* 49, 107–130.

Lehman, B. N., 1990, Fads, martingales, and market efficiency, *Quarterly Journal of Economics* 105, 1–28.

Lewellen, J., 2002, Momentum and autocorrelation in stock returns, *Review of Financial Studies* 15, 533–563.

Lintner, J., 1965, The valuation of risk assets and the selection of risky investments in stock portfolios and capital budgets, *Review of Economics and Statistics* 47, 13–37.

Liu, L. X., and L. Zhang, 2008, Momentum profits, factor pricing, and macroeconomic risk, *Review of Financial Studies* 21, 2417–2448.

Lo, A. W., and A. C. MacKinlay, 1990, When are contrarian profits due to stock market overreaction?, *Review of Financial Studies* 3, 175–205.

Moskowitz, T. J., and M. Grinblatt, 1999, Do industries explain momentum?, *Journal of Finance* 54, 1249–1290.

Moskowitz, T. J., Y. H. Ooi, and L. H. Pedersen, 2012, Time series momentum, Journal of Financial Economics 104, 228–250.

Mossin, J., 1966, Equilibrium in a capital asset market, *Econometrica* 34, 768–783.

Pollet, J. M., and M. Wilson, Average correlation and stock market returns, Journal of Financial Economics 96, 364–380.

Rouwenhorst, K. G., 1998, International momentum strategies, *Journal of Finance* 53, 267–284.

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

Sharpe, W. F., 1964, Capital asset prices: A theory of market equilibrium under conditions of risk, *Journal of Finance* 19, 425–442.

Table 1. Mean Correlation, Market Capitalization, and Returns of Quintile Winner and Loser Stock Portfolios Formed from All CRSP Stocks After Sorting by the Correlation of Their Monthly Returns with CRSP Index Returns in the Sample Period 1965 to 2013

Correlation Quintile	Winners			Losers		
	Correlation	Market Capitalization	Return	Correlation	Market Capitalization	Return
1 (Low)	0.005	$218	1.78%	-0.044	$33	2.10%
2	0.151	$336	1.90%	0.069	$53	1.85%
3	0.248	$495	1.80%	0.145	$101	1.59%
4	0.348	$916	1.80%	0.229	$193	0.91%
5 (High)	0.495	$2,576	1.91%	0.375	$361	0.20%

This table presents the average correlation and average market capitalization (and associated standard deviations) of CRSP stocks in winner (top decile) and loser (bottom decile) portfolios sorted into quintiles based on their correlation of monthly returns with value-weighted CRSP index returns from January 1965 to December 2013.

Table 2. Short-Term Reversal of Momentum Portfolios by Market Capitalization

Month	Winners			Losers		
	Big	Medium	Small	Big	Medium	Small
t-2	5.80%	7.87%	11.24%	-7.93%	-7.37%	-5.64%
	(20.35)	(22.6)	(26.46)	(-18.93)	(-18.43)	(-13.58)
t-1	1.49%	1.74%	1.67%	0.24%	1.07%	3.49%
	(5.30)	(5.48)	(5.39)	(0.56)	(2.27)	(6.79)
T	1.58%	1.78%	2.07%	-0.26%	0.04%	2.47%
	(5.52)	(5.53)	(6.47)	(-0.65)	(0.08)	(5.00)
t+1	1.50%	1.68%	1.84%	-0.28%	0.09%	2.30%
	(5.16)	(5.21)	(5.77)	(-0.71)	(0.20)	(4.76)
t+2	1.38%	1.49%	1.58%	-0.05%	0.15%	2.48%
	(4.67)	(4.59)	(4.89)	(-0.14)	(0.35)	(5.18)
t+3	1.40%	1.34%	1.45%	0.04%	0.20%	2.45%
	(4.66)	(4.17)	(4.54)	(0.10)	(0.48)	(5.16)
t+4	1.34%	1.32%	1.28%	0.29%	0.35%	2.38%
	(4.58)	(4.12)	(4.00)	(0.78)	(0.84)	(5.03)
t+5	1.22%	1.21%	1.13%	0.41%	0.41%	2.43%
	(4.18)	(3.86)	(3.52)	(1.14)	(1.01)	(5.22)

This table presents the monthly value-weighted returns of momentum- and size-sorted portfolios for CRSP stocks from January 1965 to December 2013. Stocks are first sorted by formation period returns in months $t = -12$ to -2 and classified into deciles with the top (bottom) decile classified as winners (losers). Stocks are further sorted by size tercile groups based on market capitalization at the beginning of holding period. Momentum profits are computed in month T, which skips one month after the formation period $t = -12$ to -2. In parenthesis t statistics of mean portfolio returns are shown.

Table 3. Short-Term Reversal of Momentum Portfolios by Formation Period Returns and Market Capitalization

Month	Winners						Losers					
	Low Past Returns			High Past Returns			Low Past Returns			High Past Returns		
	Big	Medium	Small	Big	Medium	Small	Big	Medium	Small	Big	Medium	Small
t-2	2.95%	5.20%	7.77%	8.22%	11.16%	16.29%	-14.22%	-11.80%	-9.03%	-3.09%	-3.59%	-2.83%
	(5.56)	(7.70)	(9.44)	(9.76)	(10.67)	(12.96)	(-9.86)	(-8.69)	(-6.44)	(-7.52)	(-7.02)	(-5.28)
t-1	0.65%	0.81%	0.26%	0.60%	1.60%	1.86%	1.26%	3.51%	6.40%	0.55%	1.30%	2.77%
	(1.26)	(1.38)	(0.44)	(0.70)	(1.52)	(1.88)	(0.72)	(1.97)	(3.47)	(1.21)	(2.23)	(4.26)
T	1.22%	1.40%	1.40%	0.78%	1.40%	1.91%	0.98%	1.96%	5.25%	0.31%	0.36%	1.77%
	(2.26)	(2.32)	(2.10)	(0.84)	(1.30)	(1.87)	(0.65)	(1.25)	(3.09)	(0.68)	(0.59)	(2.53)
t+1	1.18%	1.55%	1.56%	0.85%	1.55%	1.81%	0.32%	1.64%	4.14%	-0.10%	0.45%	1.76%
	(2.12)	(2.35)	(2.20)	(0.95)	(1.54)	(1.84)	(0.22)	(1.08)	(2.57)	(-0.20)	(0.71)	(2.40)
t+2	1.16%	1.47%	1.40%	1.04%	1.58%	1.99%	0.88%	1.82%	4.70%	-0.35%	0.22%	1.41%
	(2.00)	(2.21)	(1.98)	(1.18)	(1.59)	(2.00)	(0.69)	(1.24)	(2.97)	(-0.73)	(0.32)	(1.81)
t+3	0.86%	0.78%	1.33%	0.30%	0.58%	0.63%	-0.11%	1.06%	3.95%	0.31%	0.64%	1.96%
	(1.57)	(1.23)	(1.94)	(0.32)	(0.58)	(0.63)	(-0.08)	(0.78)	(2.84)	(0.66)	(1.08)	(2.77)
t+4	0.87%	1.12%	1.28%	-0.22%	0.35%	0.30%	0.00%	1.28%	4.15%	0.31%	0.97%	1.83%
	(1.68)	(1.73)	(1.85)	(-0.25)	(0.36)	(0.30)	(0.00)	(0.97)	(2.88)	(0.58)	(1.45)	(2.27)
t+5	0.98%	1.24%	1.40%	0.52%	0.79%	0.39%	1.65%	3.33%	6.38%	0.32%	1.13%	2.39%
	(1.87)	(1.90)	(1.97)	(0.61)	(0.90)	(0.41)	(1.32)	(2.39)	(4.13)	(0.63)	(1.70)	(3.07)

This table presents the monthly value-weighted returns of momentum and size-sorted portfolios for CRSP stocks from January 1965 to December 2013. Stocks are first sorted by formation period returns in months $t = -12$ to -2 and classified into deciles with the top (bottom) decile classified as winners (losers). Winner stocks are further divided into high and low quintiles based on historical formation period returns in the sample period, which is repeated for loser stocks. Lastly, stocks are sorted by size tercile groups based on market capitalization at the beginning of holding period. Momentum profits are computed in month T, which skips one month after the formation period $t = -12$ to -2. In parenthesis t statistics of mean portfolio returns are shown.

Table 4. Historical Returns of Momentum Portfolios by Market Capitalization: Comparison of Bear Markets Coinciding with Low Formation Period Returns of Loser Stocks Versus Other Periods

Panel A. Winner Stocks

Variable	Big			Medium			Small		
	Low	Others	Total	Low	Others	Total	Low	Others	Total
No. of months	117	471	588	117	471	588	117	471	588
Mean	1.06%	1.71%	1.58%	1.86%	1.76%	1.78%	2.18%	2.04%	2.07%
t value	1.68	5.32	5.52	2.79	4.80	5.53	3.48	5.55	6.47
Sharpe ratio	0.54	0.85	0.79	0.89	0.77	0.79	1.12	0.89	0.92

Panel B. Loser Stocks

Variable	Big			Medium			Small		
	Low	Others	Total	Low	Others	Total	Low	Others	Total
No. of months	117	471	588	117	471	588	117	471	588
Mean	0.98%	-0.57%	-0.26%	1.96%	-0.44%	0.04%	5.25%	1.78%	2.47%
t value	0.65	-1.72	-0.65	1.25	-1.16	0.08	3.09	4.00	5.00
Sharpe ratio	0.21	-0.27	-0.09	0.40	-0.19	0.01	0.99	0.64	0.71

This table presents the monthly value-weighted returns of momentum- and size-sorted portfolios for CRSP stocks from January 1965 to December 2013. Stocks are first sorted by formation period returns in months $t = -12$ to -2 and classified into deciles with the top (bottom) decile classified as winners (losers). Stocks are further sorted by size tercile groups based on market capitalization at the beginning of holding period. Lastly, results are shown for the aforementioned portfolios when formation period returns of loser stocks are in their lowest quintile in the sample period. The column "Others" represents the historical period when formation period returns of losers do not belong to their lowest quintile.

Table 5. Historical Returns of Momentum Portfolios by Market Capitalization: Comparison of Bear Markets Coinciding with Low Cross-Sectional Dispersion of Returns in the Formation Period of Loser Stocks Versus Other Periods

Panel A. Winner Stocks

Variable	Big			Medium			Small		
	Low	Others	Total	Low	Others	Total	Low	Others	Total
No. of months	117	471	588	117	471	588	117	471	588
Mean	0.61%	1.82%	1.58%	1.39%	1.87%	1.78%	1.66%	2.17%	2.07%
t value	1.11	5.53	5.52	2.14	5.10	5.53	2.41	6.01	6.47
Sharpe ratio	0.35	0.88	0.79	0.69	0.81	0.79	0.77	0.96	0.92

Panel B. Loser Stocks

Variable	Big			Medium			Small		
	Low	Others	Total	Low	Others	Total	Low	Others	Total
No. of months	117	471	588	117	471	588	117	471	588
Mean	0.55%	-0.46%	-0.26%	2.08%	-0.47%	0.04%	4.82%	1.89%	2.47%
t value	0.36	-1.39	-0.65	1.25	-1.32	0.08	2.69	4.45	5.00
Sharpe ratio	0.12	-0.22	-0.09	0.40	-0.21	0.01	0.86	0.71	0.71

This table presents the monthly value-weighted returns of momentum- and size-sorted portfolios for CRSP stocks from January 1965 to December 2013. Stocks are first sorted by formation period returns in months $t = -12$ to -2 and classified into deciles with the top (bottom) decile classified as winners (losers). Stocks are further sorted by size tercile groups based on market capitalization at the beginning of holding period. Lastly, results are shown for the aforementioned portfolios when formation period cross-sectional dispersion of loser stocks' returns are in their lowest quintile in the sample period. The column "Others" represents the historical period when formation period returns of losers do not belong to their lowest quintile.

Table 6. Value-Weighted Momentum Returns for
Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2	WML3
No. of months	588	588	588
Mean	1.81%	1.06%	2.09%
t value	5.16	3.31	8.38
Sharpe ratio	0.74	0.47	1.20
Minimum	-47.78%	-75.20%	-37.37%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2	WML3
No. of months	471	471	471
Mean	2.24%	1.58%	2.33%
t value	7.68	6.44	11.41
Sharpe ratio	1.23	1.03	1.82
Minimum	-21.95%	-28.62%	-14.17%

Panel C. Risk Management: Suspend Formation When Past Loser Return Dispersion Is Low

No. of months	471	471	471
Mean	2.27%	1.64%	2.41%
t value	7.75	7.05	11.79
Sharpe ratio	1.24	1.12	1.88
Minimum	-22.10%	-20.63%	-13.72%

This table presents the value-weighted monthly returns of three different momentum strategies and three risk management approaches for CRSP stock returns from January 1965 to December 2013. We use an 11-month formation period t = -12 to -2, skip one month, and measure returns in the next month. The traditional momentum strategy, or WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by adding the long returns of big, medium, and small winners and subtracting the short returns of big, medium, and small loser. A hybrid size-based strategy, or WML3, is the similar as WML2 but adds the returns of small losers to the big, medium, and small winner portfolios and subtracts the short returns of the big and medium portfolios. Panel A shows results with no risk management. Panels B and C allow risk management by means of suspending momentum portfolio formation during bear market times of either loser stocks' past returns or past return dispersion, respectively.

Table 7. Market-Correlation-Weighted Momentum Returns for
Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2	WML3
No. of months	588	588	588
Mean	1.31%	0.73%	2.30%
t value	3.86	2.12	9.11
Sharpe ratio	0.55	0.30	1.30
Minimum	-79.23%	-86.97%	-46.14%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2	WML3
No. of months	471	471	471
Mean	1.85%	1.35%	2.54%
t value	7.31	5.15	13.13
Sharpe ratio	1.17	0.82	2.10
Minimum	-28.76%	-30.33%	-15.39%

Panel C. Risk Management: Suspend Formation When Past Loser Return Dispersion Is Low

	WML1	WML2	WML3
No. of months	471	471	471
Mean	1.93%	1.40%	2.66%
t value	8.01	5.59	13.92
Sharpe ratio	1.28	0.89	2.22
Minimum	-21.05%	-28.14%	-10.28%

This table presents the market-correlation-weighted monthly returns of three different momentum strategies and three risk management approaches for CRSP stock returns from January 1965 to December 2013. Correlation to the CRSP index returns of each winner and loser stock is used in this weighted return scheme. We use an 11-month formation period t = -12 to -2, skip one month, and measure returns in the next month. The traditional momentum strategy, or WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by adding the long returns of big, medium, and small winners and subtracting the short returns of big, medium, and small loser. A hybrid size-based strategy, or WML3, is the similar as WML2 but adds the returns of small losers to the big, medium, and small winner portfolios and subtracts the short returns of the big and medium portfolios. Panel A shows results with no risk management. Panels B and C allow risk management by means of suspending momentum portfolio formation during bear market times of either loser stocks' past returns or past return dispersion, respectively.

Table 8. Winner and Loser Stocks' Correlation-Weighted Momentum Returns for
Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2	WML3
No. of months	588	588	588
Mean	1.30%	0.72%	2.32%
t value	3.93	2.14	9.33
Sharpe ratio	0.56	0.31	1.33
Minimum	-76.34%	-84.47%	-46.12%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2	WML3
No. of months	471	471	471
Mean	1.82%	1.34%	2.57%
t value	7.42	5.22	13.61
Sharpe ratio	1.18	0.83	2.17
Minimum	-28.96%	-29.94%	-15.37%

Panel C. Risk Management: Suspend Formation When Past Loser Return Dispersion Is Low

	WML1	WML2	WML3
No. of months	471	471	471
Mean	1.90%	1.38%	2.68%
t value	8.19	5.71	14.42
Sharpe ratio	1.31	0.91	2.30
Minimum	-18.24%	-23.42%	-9.80%

This table presents the winner and loser stocks' correlation-weighted monthly returns of three different momentum strategies and three risk management approaches for CRSP stock returns from January 1965 to December 2013. Correlation of each winner (loser) to the loser (winner) portfolio) is used in this weighted return scheme. We use an 11-month formation period $t = -12$ to -2, skip one month, and measure returns in the next month. The traditional momentum strategy, or WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by adding the long returns of big, medium, and small winners and subtracting the short returns of big, medium, and small loser. A hybrid size-based strategy, or WML3, is the similar as WML2 but adds the returns of small losers to the big, medium, and small winner portfolios and subtracts the short returns of the big and medium portfolios. Panel A shows results with no risk management. Panels B and C allow risk management by means of suspending momentum portfolio formation during bear market times of either loser stocks' past returns or past return dispersion, respectively.

Table 9. Equal-Weighted Momentum Returns for
Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2	WML3
No. of months	588	588	588
Mean	0.67%	0.63%	2.43%
t value	2.03	1.90	10.06
Sharpe ratio	0.29	0.27	1.44
Minimum	-83.70%	-84.88%	-42.39%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2	WML3
No. of months	471	471	471
Mean	1.28%	1.25%	2.70%
t value	5.15	5.01	14.7
Sharpe ratio	0.82	0.80	2.35
Minimum	-31.37%	-31.45%	-15.46%

Panel C. Risk Management: Suspend Formation When Past Loser Return Dispersion Is Low

	WML1	WML2	WML3
No. of months	471	471	471
Mean	1.34%	1.31%	2.82%
t value	5.75	5.59	15.61
Sharpe ratio	0.92	0.89	2.49
Minimum	-27.69%	-28.25%	-13.94%

This table presents the equal-weighted monthly returns of three different momentum strategies and three risk management approaches for CRSP stock returns from January 1965 to December 2013. We use an 11-month formation period t = -12 to -2, skip one month, and measure returns in the next month. The traditional momentum strategy, or WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by adding the long returns of big, medium, and small winners and subtracting the short returns of big, medium, and small loser. A hybrid size-based strategy, or WML3, is the similar as WML2 but adds the returns of small losers to the big, medium, and small winner portfolios and subtracts the short returns of the big and medium portfolios. Panel A shows results with no risk management. Panels B and C allow risk management by means of suspending momentum portfolio formation during bear market times of either loser stocks' past returns or past return dispersion, respectively.

Table 10. Robustness Test of Market-Correlation-Weighted
Momentum Returns for Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2	WML3
No. of months	408	408	408
Mean	1.18%	0.48%	2.48%
t value	2.66	1.07	7.43
Sharpe ratio	0.46	0.18	1.27
Minimum	-79.23%	-86.97%	-46.14%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2	WML3
No. of months	267	267	267
Mean	1.76%	1.16%	2.58%
t value	5.10	3.25	9.70
Sharpe ratio	1.08	0.69	2.06
Minimum	-21.05%	-28.14%	-10.28%

Panel C. Risk Management: Suspend Formation When Past Loser Return Dispersion Is Low

	WML1	WML2	WML3
No. of months	321	321	321
Mean	2.04%	1.42%	2.95%
t value	6.40	4.31	11.76
Sharpe ratio	1.24	0.83	2.27
Minimum	-21.05%	-28.14%	-10.28%

This table repeats Table 7 using the first 180 months (1965/01-1979/12) to determine the lowest 20th percentage point of losers' median return (or standard deviation). If the last month losers' median return (or standard deviation) is less than 20th percentage point, we suspend momentum trading in month *T*. One month is sequentially added and the risk management procedure repeated until the end of the sample period is reached (2013/12). The returns of this trading strategies begin 1980/01.

Table 11. Value-Weighted Momentum Returns Excluding Small Stocks
for Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management		
Variable	WML1	WML2
No. of months	588	588
Mean	1.85%	1.79%
t value	5.24	5.40
Sharpe ratio	0.75	0.77
Minimum	-47.19%	-63.93%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low		
Variable	WML1	WML2
No. of months	471	471
Mean	2.28%	2.24%
t value	7.73	8.48
Sharpe ratio	1.23	1.35
Minimum	-22.03%	-26.71%

Panel C. Risk Management: Suspend Formation When Past Loser Return Dispersion Is Low		
No. of months	471	471
Mean	2.30%	2.31%
t value	7.78	9.10
Sharpe ratio	1.24	1.45
Minimum	-22.11%	-17.29%

This table presents the value-weighted monthly returns of three different momentum strategies and three risk management approaches for CRSP stock returns from January 1965 to December 2013. Stocks in the small market capitalization tercile are excluded from these strategies. We use an 11-month formation period t = -12 to -2, skip one month, and measure returns in the next month. The traditional momentum strategy, or WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by adding the long returns of big and medium winners and subtracting the short returns of big and medium losers. Panel A shows results with no risk management. Panels B and C allow risk management by means of suspending momentum portfolio formation during bear market times of either loser stocks' past returns or past return dispersion, respectively.

Table 12. Market-Correlation-Weighted Momentum Returns Excluding Small Stocks
for Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2
No. of months	588	588
Mean	1.83%	1.77%
t value	5.34	5.11
Sharpe ratio	0.76	0.73
Minimum	-71.77%	-75.15%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2
No. of months	471	471
Mean	2.32%	2.26%
t value	9.02	8.62
Sharpe ratio	1.44	1.38
Minimum	-27.46%	-28.25%

Panel C. Risk Management: Suspend Portfolio When Past Loser Return Dispersion Is Low

Variable	WML1	WML2
No. of months	471	471
Mean	2.42%	2.36%
t value	9.77	9.42
Sharpe ratio	1.56	1.50
Minimum	-15.84%	-21.10%

This table presents the market-correlation-weighted monthly returns of three different
momentum strategies and three risk management approaches for CRSP stock returns from
January 1965 to December 2013. Correlation to the CRSP index returns of each winner and
loser stock is used in this weighted return scheme. Stocks in the small market capitalization
tercile are excluded from these strategies. We use an 11-month formation period t = -12 to -2,
skip one month, and measure returns in the next month. The traditional momentum strategy, or
WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by
adding the long returns of big and medium winners and subtracting the short returns of big and
medium losers. Panel A shows results with no risk management. Panels B and C allow risk
management by means of suspending momentum portfolio formation during bear market times
of either loser stocks' past returns or past return dispersion, respectively.

Table 13. Winner and Loser Stocks' Correlation-Weighted Momentum Returns
Excluding Small Stocks for Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2
No. of months	588	588
Mean	1.83%	1.76%
t value	5.47	5.21
Sharpe ratio	0.78	0.74
Minimum	-70.12%	-73.88%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2
No. of months	471	471
Mean	2.32%	2.25%
t value	9.22	8.84
Sharpe ratio	1.47	1.41
Minimum	-27.72%	-28.22%

Panel C. Risk Management: Suspend Portfolio When Past Loser Return Dispersion Is Low

Variable	WML1	WML2
No. of months	471	471
Mean	2.41%	2.36%
t value	10.04	9.70
Sharpe ratio	1.60	1.55
Minimum	-15.78%	-19.19%

This table presents the winner and loser stocks' correlation-weighted monthly returns of three different momentum strategies and three risk management approaches for CRSP stock returns from January 1965 to December 2013. Correlation of each winner (loser) to the loser (winner) portfolio) is used in this weighted return scheme. Stocks in the small market capitalization tercile are excluded from these strategies. We use an 11-month formation period t = -12 to -2, skip one month, and measure returns in the next month. The traditional momentum strategy, or WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by adding the long returns of big and medium winners and subtracting the short returns of big and medium losers. Panel A shows results with no risk management. Panels B and C allow risk management by means of suspending momentum portfolio formation during bear market times of either loser stocks' past returns or past return dispersion, respectively.

Table 14. Equal-Weighted Momentum Returns Excluding Small Stocks
for Alternative Portfolio and Risk Management Strategies

Panel A. No Risk Management

Variable	WML1	WML2
No. of months	588	588
Mean	1.81%	1.81%
t value	5.43	5.43
Sharpe ratio	0.78	0.78
Minimum	-72.97%	-72.81%

Panel B. Risk Management: Suspend Portfolio When Past Loser Returns Are Low

Variable	WML1	WML2
No. of months	471	471
Mean	2.31%	2.31%
t value	9.07	9.07
Sharpe ratio	1.45	1.45
Minimum	-28.75%	-28.78%

Panel C. Risk Management: Suspend Formation When Past Loser Return Dispersion Is Low

Variable	WML1	WML2
No. of months	471	471
Mean	2.42%	2.42%
t value	9.97	9.96
Sharpe ratio	1.59	1.59
Minimum	-20.27%	-20.41%

This table presents the equal-weighted monthly returns of three different momentum strategies and three risk management approaches for CRSP stock returns from January 1965 to December 2013. Stocks in the small market capitalization tercile are excluded from these strategies. We use an 11-month formation period t = -12 to -2, skip one month, and measure returns in the next month. The traditional momentum strategy, or WML1, goes long winners and short losers. A size-based strategy, or WML2, is constructed by adding the long returns of big and medium winners and subtracting the short returns of big and medium losers. Panel A shows results with no risk management. Panels B and C allow risk management by means of suspending momentum portfolio formation during bear market times of either loser stocks' past returns or past return dispersion, respectively.