

Academic Research Monitor

Momentum Investing

Equities

Global
Quantitative

Aspects of momentum investing

In this issue of our regular update on recent academic advances, we focus on momentum strategies (winners versus losers). We explore various recent academic findings including two ways of timing a momentum strategy and therefore safeguarding against imminent drawdowns.

Ten myths about momentum investing – all busted.

Are momentum returns too small and sporadic? Are they mainly concentrated on the short side (losers) and within small cap universes? Does a momentum strategy survive transaction costs and tax costs? Is it too volatile? Is it robust to the definition of the momentum metric? These and a few other questions (ten in total) constitute the myths of momentum investing that the first paper that we review highlights. Importantly enough, the paper goes and refutes them all; one by one.

Momentum crashes are predictable

There is considerable empirical evidence that momentum suffers from few, yet very large, losses (the latest example is during spring 2009). The second paper that we review argues that such crashes can be predicted using a measure of scarcity of capital that is available to sophisticated money managers who engage in momentum trading. When momentum gets overcrowded the likelihood of an imminent crash increases; this is the time to exit. We replicate this timing methodology and find that it adds value to momentum investing across various global regions.

Improving the performance of a momentum strategy using a stop-loss rule

The last paper that we review claims that closing the positions that move against the desired direction (winners that depreciate and losers that appreciate) during the course of the holding month can significantly improve the risk-adjusted returns of a momentum strategy. We implement the strategy and find that although the average returns from using a stop-loss rule within a momentum strategy are higher, this is all due to getting out of momentum during its occasional downturns, but that for most of the time the stop-loss strategy underperforms the naïve approach.

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Introduction

This issue of our Academic Research Monitor explores various aspects of momentum investing.¹ Our focus here is the cross-sectional equity momentum strategy, where stocks are ranked based on their recent past performance (typically past 12 months, skipping the most recent month) and a portfolio that takes long positions on the top/best performers and short positions on the worst is subsequently formed and held for a month before rebalancing takes place.

The momentum strategy has historically delivered very strong performance and the risk-adjusted returns have remained high, even following its discovery by Jegadeesh and Titman (1993, 2001); see Schwert (2003). Recent empirical evidence by Geczy and Samonov (2003) shows that momentum patterns have been statistically and economically strong for more than two centuries (their dataset spans the period between 1801 and 2012), whereas Asness, Moskowitz and Pedersen (2013) argue in favour of the existence of momentum patterns in every market, not just within equity stocks².

The pervasiveness of the phenomena has been so strong that academics are yet to provide a plausible and well accepted explanation, even though the academic research on the topic is thriving. Whether an extrapolation of price trends that is driven by human behavioural biases or compensation for bearing some type of systematic risk, it is impossible to deny the empirical evidence. As a consequence, momentum has been one of the most popular quantitative strategies.

Following the continuous demand for research and insight on the features of momentum investing, we review in this issue of the ARM three recent papers on the topic (see Figure 1). In particular, the first paper highlights ten myths about momentum investing (e.g. that momentum can only be exploited on the short side or that it does not survive transaction costs) and goes on and refutes them all.

The remaining two papers try to improve the performance of momentum by suggesting two different timings mechanisms; the first relates to the amount of capital invested in (and therefore the crowdedness of) the momentum strategy³ and the second employs a simple stop-loss strategy that suggests closing all the positions that move against the desired direction (i.e. winners that fall and losers that appreciate) before the end of the holding month. We empirically test both ideas and evaluate their validity.

Figure 1: Papers on Momentum

"Fact, Fiction and Momentum Investing" <i>Clifford Asness, Andrea Frazzini, Ronen Israel and Tobias Moskowitz</i>	<i>Journal of Portfolio Management, Volume 40, Number 5, 2014</i>
"Momentum Trading, Return Chasing and Predictable Crashes" <i>Benjamin Chabot, Eric Ghysels and Ravi Jagannathan</i>	SSRN working paper, November 2014
"Taming Momentum Crashes: A Simple Stop-Loss Strategy" <i>Yufeng Han, Guofu Zhou and Yingzi Zhu</i>	SSRN working paper, August 2014

Source: UBS

¹ The ARM has featured again in the past academic papers that focus on cross-sectional equity momentum. See the [ARM, 12 July 2013](#).

² See [Harvesting Cross-Asset Value](#) (11 December 2014) for our view on this.

³ See [Where are the crowded trades?](#) (16 January 2015) for our view on this.

Winners versus Losers

Strong across time and across markets

"Fact, Fiction and Momentum Investing"

by Clifford Asness, Andrea Frazzini, Ronen Israel & Tobias Moskowitz

In their manifesto in favour of momentum investing, Clifford Asness, Andrea Frazzini, Ronen Israel and Tobias Moskowitz highlight ten myths about / criticisms of momentum and subsequently refute them. This paper is not a core research paper, but instead it is more of an essay that discusses various features of momentum investing and, at times, draws parallels between it and value investing. Importantly enough, the authors highlight the large diversification benefits from combining value and momentum in the spirit of Asness, Moskowitz and Pedersen (2013).

We subsequently state the ten myths and briefly review the arguments of the authors in their effort to refute them. In order to support their arguments, they conduct some simple empirical experiments using data collected from the Kenneth French's data library (on market, value – HML, size – SMB and momentum – UMD factors from January 1927 to December 2013) or seek support from a list of other recent academic papers that they have written⁴.

1. *Momentum returns are too "small and sporadic".*

Evaluating the performance of the market and the three other factors (value, size and momentum) across three different sample periods (see the margin notes on the right), momentum consistently beats size and value in terms of both average return and Sharpe ratio. Importantly, momentum exhibits the largest proportion of positive 1-year rolling returns across all sample period (indicatively 81% for the full sample, 1927 – 2013). Looking at 5-year rolling returns momentum seems to go side by side with value (88% for momentum against 89% for value for the full sample), whereas a combination of the two beats both with a proportion of positive returns reaching 92%.

Bottom-line: momentum, the authors claim, is neither small nor sporadic.

2. *Momentum cannot be captured by long-only investors as "momentum can only be exploited on the short side".*

Evaluating the performance of winners and losers separately, the authors find that the respective alphas (with respect to the market, so we look at market-adjusted returns) contribute equally to the overall alpha of the momentum strategy. In fact, winners appear to contribute slightly more (51.8% to 57.8% of the momentum return, depending on the sample period, comes from the long side).

Bottom-line: the long side of momentum is equally profitable as its short side.

3. *Momentum is much stronger among small cap stocks than large caps.*

In a somewhat less convincing piece of evidence, the authors show that momentum strategies are successful (in terms of positivity and statistical significance of average returns) in both small and large cap universes, but the average returns are almost 50% lower in the large cap universe. The authors

Sample periods:

- **1927-2013: full sample**
- **1963-2013: Fama and French, (1992, 1993) start their sample period in 1963**
- **1991-2013: True out-of-sample momentum period; Jegadeesh and Titman (1993) end their sample period in 1990**

⁴ These papers are Asness and Frazzini, 2013, Asness, Ilmanen, Israel and Moskowitz 2013, Asness, Moskowitz and Pedersen, 2013, Frazzini, Israel and Moskowitz, 2013, Frazzini, Israel, Moskowitz and Novy-Marx, 2013 and Israel and Moskowitz, 2013.

try to strengthen their arguments by contrasting the evidence with value investing, where at least for the most recent period (1991 – 2013), value is only statistically and economically strong within a small cap universe.

Bottom-line: momentum, unlike value, exhibits more robust return patterns among large versus small stocks.

4. *Momentum does not survive, or is seriously limited by, trading costs.*

There is no doubt that momentum generates higher turnover than other trading strategies, like value. However, using evidence from Frazzini, Israel and Moskowitz (2013), the authors claim that the transaction costs of a momentum strategy are relatively small and therefore the strategy survives even after accounting for these costs. The main argument is that an institutional investor would optimise momentum rebalancing (by slicing up orders into smaller trades, allowing for some tracking error with respect to the theoretical style portfolio etc.) in a way to significantly reduce transaction costs. The authors claim that the actual costs paid by a large institutional investor can be even ten times smaller than the costs of a momentum strategy that are calculated using aggregated transaction-level data.

Bottom-line: rebalancing momentum in an optimised way can significantly reduce the respective transaction costs.

5. *Momentum does not work for a taxable investor.*

This type of criticism relates again to the high turnover feature of momentum and the claim is that momentum investing bears high taxes. However, the authors argue that higher turnover does not necessarily mean high taxes. Comparing momentum with value, the authors use evidence from Israel and Moskowitz (2013) and other recent academic papers and argue that the two strategies have similar taxes, even though the turnover of momentum might be even up to six times that of value. Briefly, this is because momentum is, by construction, tax advantageous (holding on to winners and selling losers, hence avoiding short-term capital gains and realising short-term capital losses), whereas value is highly exposed to dividend income, which is tax inefficient. Constructing tax-optimised versions of momentum is therefore much easier than doing so for value, hence bridging the gap between the two even further.

Bottom-line: the tax burden of momentum is similar to that of value, even if it has significantly higher turnover.

6. *Momentum is best used with screens rather than as a direct factor.*

This myth relates to the claim that momentum, as an investment vehicle, might not be useful, but instead it can be of significant value when used as a screen (e.g. avoid taking long positions on stocks with negative momentum). The authors argue that this claim is just counterintuitive; as they cynically say "you can't be a little bit pregnant". It's either momentum at its wholeness or nothing at all. Invalidating momentum, while using momentum screens to highlight good and bad subsets of the universe of stocks appears odd.

Bottom-line: momentum is strong; both as a factor and as a screen. It cannot be just one or the other.

7. *One should be particularly worried about momentum's return disappearing.*

There exists empirical evidence that various return premia have attenuated, before eventually disappearing, in the period following their initial documentation in the academic literature (e.g. see the overview by Schwert, 2003). Return premia caused by behavioural biases can disappear if they are arbitrated away; whereas return premia that constitute compensation for bearing some type of systematic risk can disappear if the tastes for risk change or the price of the risk itself changes. The authors claim that neither effect has been true for the case for momentum (which is still debated whether it's a behavioural or a risk-based story). Empirical evidence shows strong momentum returns even after its discovery by Jegadeesh and Titman (1993) and no significant indication that it has been arbitrated away. Importantly enough, even if momentum had a zero return, the authors show that the strategy would still expand the opportunity set of an investor due to its great diversification benefits when combined with a value strategy.

Bottom-line: there are no signs that momentum has been arbitrated away in these first 20 years since its original discovery.

8. *Momentum is too volatile to rely on.*

By "too volatile", this myth refers mainly to the few but very detrimental episodes that momentum has experienced over the last century. Without much thought, spring 2009 comes first to everyone's mind. To find another drawdown as big as that, one has to go back to the aftermath of the Great Depression in the summer of 1932. These dramatic drawdowns (and mainly the most recent, exactly because it's so recent) have stigmatised momentum investing. The reason for these drawdowns is the time-varying conditional exposure of the strategy to the market. Though unconditionally uncorrelated with the overall market (beta-neutral), the momentum strategy bears a large negative beta following prolonged market downturns (as winners are low-beta stocks and losers are high-beta stocks). An adverse upswing of the market is enough to significantly hurt the momentum portfolio; exactly what happened in 1932 and 2009. The authors do acknowledge the existence of such episodes, but suggest using a constant-volatility overlay on the momentum strategy in order to reduce the exposure to it in periods of high volatility and therefore safeguard against an imminent drawdown. Daniel and Moskowitz (2014) and Barroso and Santa-Clara (2014) study specifically the mechanics of this suggestion; both papers have been reviewed in our [Academic Research Monitor](#) published on July 12, 2013. As an alternative to volatility-target the momentum strategy, the authors of the paper that we review suggest of course its combination with a value strategy.

Bottom-line: as any other strategy, momentum has its bad moments. Volatility-targeting it or combining it with value can significantly improve its performance.

9. *Different measures of momentum can give different results over a given period!*

This is a relatively strange claim and supports that different measures of momentum (e.g. 12-month, 6-month, skipping the last month) can lead to different results over a certain period. We don't seem to find how reasonable

a statement that is, as it's largely expected to get different results for different measures. Along the same lines, the authors argue that any quant style has various definitions (take value for instance; investors use a handful of ranking criteria like the dividend yield, the earnings yield, the book-to-price ratio and many others) that could not agree over a certain short-term period. The essence of robustness, however, lies on the stable and long-term performance. And it is true that independent of the definition of momentum (within reason) all different measures exhibit relatively similar results.

Bottom-line: momentum patterns are robust to the definition of momentum.

10. There is no theory behind momentum

It is true that the academic literature has not yet reached a well-accepted explanation of the strong momentum patterns. Behavioural and risk-based explanations both are plausible scenarios for the source of momentum. The authors abstain from taking sides and generally seem to support that momentum is an outcome of a combination between compensation for fundamental risk and an exposition of human cognitive biases. However, whether momentum patterns are due to some behavioural bias (under-reaction, overconfidence etc.) or constitute compensation for bearing some sort of undiversifiable risk, the empirical evidence is beyond any doubt. Momentum portfolios generate large risk-adjusted return for more than two centuries (Geczy and Samanov, 2013). The explanation of the large returns is still debatable but the data is undeniable. As the authors say "*we discovered the world wasn't flat before we understood and agreed why*".

Bottom-line: momentum patterns lack a convincing explanation; however the empirical evidence is strong and beyond any doubt.

"Momentum Trading, Return Chasing and Predictable Crashes"

by Benjamin Chabot, Eric Ghysels and Ravi Jagannathan

There is undeniable empirical evidence that momentum is a strategy that earns abnormally high risk-adjusted returns, but it is however dramatically hurt by few, yet very large, losses (Daniel and Moskowitz, 2014, Barroso and Santa-Clara, 2015). Benjamin Chabot, Eric Ghysels and Ravi Jagannathan confirm the above empirical patterns by studying the profitability of a momentum strategy not just during the standard CRSP era in the US (1927 to 2012), but also during the Victorian era in London (1866 to 1907), using a unique hand-collected dataset.

Across both sample periods, a simple momentum strategy (winners/top decile versus losers/bottom decile) achieves a Sharpe ratio close to 0.50. The average return of the strategy as well as its Fama and French (1993) alpha⁵ is twice as big for the CRSP era compared to the Victorian era (alpha of 1.01% against 0.52% on a monthly basis), but given that the volatility of the strategy is proportionally equally larger during the CRSP era results to very similar risk-adjusted momentum returns for both periods. These findings, the authors claim, highlight the pervasiveness of momentum patterns across historical periods and regions.

The next empirical exercise that the authors conduct relates to the identification of momentum crashes, i.e. those few, yet large negative returns that can dramatically hurt the long-term performance of the momentum strategy. Using a dating algorithm⁶ that identifies momentum bull and bear markets, they find that bear markets of at least 5% (10%) occurred on average every 15-16 (28-29) months during the CRSP era and every 25-26 (70-71) months during the Victorian era with cumulative momentum losses of 13.6% (20.6%) and 10.2% (15.8%) respectively for the two distinct periods. These drawdowns are rather harsh to be ignored and objective of the authors is to explore their origin.

In that respect, they hypothesise that these crashes are the result of sudden and forced liquidation of leveraged momentum investors. Their thinking process goes as follows: for momentum patterns to exist in the first place, and in the absence of a well-accepted (behavioural or risk-based) explanation, investors should –by some mechanism– be incapable of completely arbitraging them away. Capital and leverage constraints could actively prevent skilled investors from exploiting the momentum patterns in full (and therefore make them disappear). In an effort to increase their exposure to momentum, skilled investors would either employ leverage or solicit capital from less skilled investors. Arguably, attracting such "blind" capital is easier in periods when momentum performs well. As a consequence, following periods of good momentum returns, the strategy is expected to become more crowded, which raises the likelihood of a crash due to sudden deleverage. In the event of a crash, return-chasing "blind" capital would be allocated to other successful strategies and not to momentum, which then explains the existence of momentum cycles (in and out of their bull and bear periods).

Following the above rationale, and if momentum patterns with their sporadic crashes are the results of such "limits-to-arbitrage", the authors claim that the

Momentum profits are strong across two distinct datasets:

- Victorian era (London): 1866 – 1907
- CRSP era (US): 1927 – 2012

Momentum strategies suffer from rare but large losses

Limits-to-arbitrage

⁵ The authors construct a size and a dividend yield factor for the Victorian era in order to proxy for the Fama and French (1993) SMB and HML factors.

⁶ See Lunde and Timmermann (2004).

duration of momentum cycles could be predicted by a measure of scarcity of capital that is available to skilled momentum investors. The more capital there is, the more crowded the momentum strategy is and the more likely an imminent crash becomes.

Using an appropriately designed hazard model (see the paper for further details), the authors find that high past momentum returns increase significantly the probability of a bear momentum market in both CRSP and Victorian eras, in line with their hypothesis. The effects are incomparably stronger when past momentum returns reside in the top deciles of the historical momentum return distribution.

Interestingly enough, the dependence of the probability of a momentum bear market on the past market performance and on the level of the risk-free rate is different between the two periods and is directly related to the market mechanics and idiosyncrasies of each period.

In particular, during the CRSP era, high past stock market performance would decrease the relative attractiveness of momentum investing, hence keeping some of the blind capital away from it and therefore render the strategy less crowded and consequently less likely to crash. No statistically significant effects are documented for the risk-free rate during this period. Instead, during the Victorian era, when there was no delegated asset management activity, investors could only increase exposure to momentum through leverage, which implies margin borrowing and collateral. High stock market performance would increase collateral values and would therefore make leverage easier and the momentum strategy more crowded, hence increasing the likelihood of an eminent crash. Conversely, high levels of risk-free rate would render leverage more expensive and therefore the momentum strategy less crowded, hence reducing the likelihood of an imminent crash.

The above analysis has one key message: momentum crashes are predictable. As a consequence, a momentum investor can define a certain threshold of transition-to-a-bear-market probability and exit the momentum strategy when this is exceeded.⁷ Given that past momentum performance is a strong predictor of future crashes, the authors provide a simple illustration of a timing mechanism that instructs switching from momentum to cash when the most recent 12-month momentum market relative return is above some high percentile of its past 36-month return distribution. The raw momentum strategy during the CRSP era (starting in 1930 due to the 36-month initial window) delivers a Sharpe ratio of 0.44, which increases to 0.65 if the threshold is set at the 75th percentile. In the next section, we evaluate the performance of this simple timing rule when applied to different regions.

The last part of the analysis in the paper investigates the conditions under which a momentum strategy gets progressively crowded, which, in turn, increases the likelihood of a crash, even if this crash can be predicted in real-time. In other words the authors wonder why a sophisticated investor decides to remain invested in momentum when the probability of a crash is high. Using a stylised model (see the paper for further details), the authors show that following periods of high

Strong momentum profits increase the likelihood of a future crash

Momentum crashes are predictable

Why would a sophisticated money manager remain invested in momentum when the probability of a crash is high?

⁷ This finding is completely in line with the results of our very recent research paper ["Where are the crowded trades?"](#) (16 January 2015). In this report, we show that a measure of crowdedness can be used to time the entry to and subsequent exit from a momentum strategy.

momentum profits, sophisticated money managers that have invested in momentum are compensated with incentive fees above the high-water mark and also attract capital from return-chasing investors (exactly because they have performed well recently). These effects incentivise money managers to remain invested in a crowded momentum strategy, even after periods of very good performance when the likelihood of an imminent crash has significantly increased. Using both the stylised model as well as a broader simulated model, the authors show that sophisticated managers can indeed rationally crowd into momentum strategies even in periods of elevated risk. The reason is the combination of the risk-shifting convex nature of incentive fees with the return-chasing behaviour of investors. They particularly show that aggressive managers that only exit momentum after the strategy exceeds a very high threshold of past return outperform managers who use more conservative thresholds.

Evaluating the performance of the timing mechanism

From an active portfolio management point of view, one of the most interesting findings of this paper is that momentum crashes are predictable and that a simple timing mechanism can safeguard against imminent momentum crashes. The idea is to compare the more recent 12-month performance of the momentum strategy to that of the overall market. If the momentum strategy outperforms significantly (for this to happen, some certain threshold of the distribution of the difference in the return series must be exceeded), then it would look too attractive for "blind" capital and therefore the likelihood of a crash would increase. Exiting momentum at this point in time is the simple timing rule that the authors suggest.

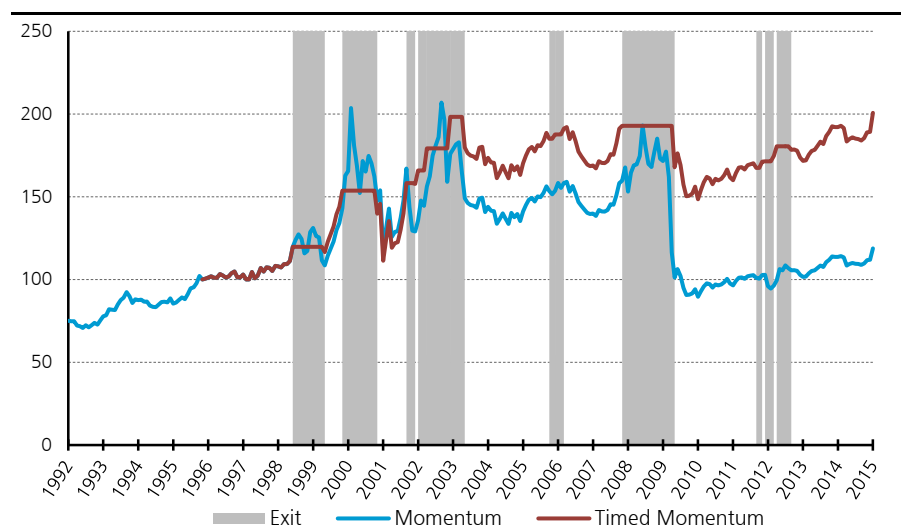
Does the timing mechanism work in other regions?

We empirically investigate the performance of this timing rule. In particular, following the paper, at the end of every month we compare the 12-month cumulative momentum return, $R_{t-12 \rightarrow t}^{Mom}$ against the respective 12-month cumulative market return $R_{t-12 \rightarrow t}^{Mkt}$. If the spread $R_{t-12 \rightarrow t}^{Mom} - R_{t-12 \rightarrow t}^{Mkt}$ exceeds the 75th percentile of its past 36-month distribution, then we exit momentum and assume a zero return for the following month. In the paper, the authors invest in the risk-free rate when they exit from momentum, but we prefer setting the return of these months equal to zero in order to focus specifically on the benefit of the timing mechanism to safeguard against future momentum drawdowns and avoid biasing upwards the average return of the timing strategy due to risk-free rate proceeds.

For our empirical analysis we use the Dow Jones universe and construct our momentum portfolios by first splitting the stocks across three size baskets (small, medium and high) and then, ranking them within these baskets by their past 12-month return after skipping the most recent month. Market cap weighted portfolios of the top third of stocks (winners) are formed across each size band and the return of the overall winner portfolio is the simple average of the winner portfolios of the three size bands.⁸ The construction of the losers portfolio follows the same rationale. The dataset goes from January 1992 to December 2014. Given that we need a distribution of 12-month cumulative returns over 36 months results in an overall 4-year initial period before the first results are available. Along these lines, our back-test starts in January 1996.

⁸ The construction of the UMD factor, which is used for the empirical analysis of the paper that we reviewed above and is available at the website of Kenneth French follows a similar methodology. The main differences are (a) the number of size baskets; they use two, we use three, (b) the type of extreme portfolios; they use deciles, we use thirds and (c) the universe; they use CRSP, we use Dow Jones. The correlation of our momentum portfolio with the UMD factor is 96%, over the period January 1992 to November 2014.

Figure 2: Timing Momentum in US



Source: UBS Quantitative Research. The figure presents the cumulative returns of the standard 12-month momentum strategy and the timed version of it. The plots have been scaled accordingly so that both start at 100 in December 1995.

Figure 2 presents cumulative returns for the simple price momentum strategy and its timed counterpart based on the above methodology. The grey bands highlight the periods when the timed strategy is not invested in momentum. It is obvious that the timed version of momentum achieves in improving the performance of the strategy over this most recent period mainly because it avoids the turbulent periods of 2000, 2002-2003 and most importantly "switches off" during the dramatic loss of spring 2009. Figure 3 reports various summary statistics that indeed highlight how effective the timing mechanism is. The Sharpe ratio of the strategy increases by more than twofold and most importantly the Calmar ratio, which measures the ratio of the annualised geometric returns over the maximum drawdown increases from a mere 0.02 up to 0.14.

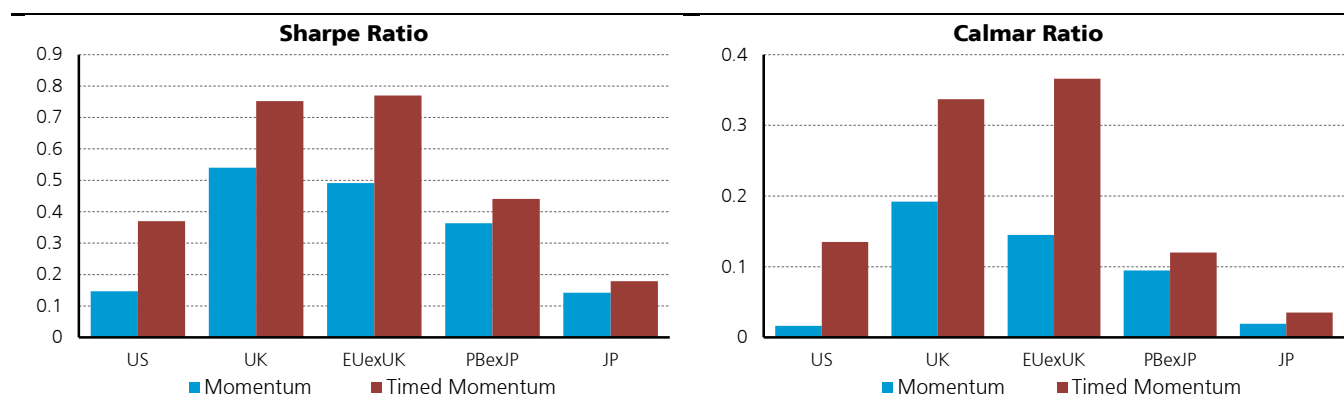
In order to evaluate the performance of the timing mechanism across other regions, we turn our attention to the UK, Europe ex. UK, Pacific Basin ex. Japan and Japan. The analysis is conducted from the perspective of a US investor (i.e. return series are in USD). Figure 4 presents the change in Sharpe and Calmar ratios for all regions (including the US for reference) and Figure 5 presents the cumulative returns of the strategies for each region.

Figure 3: Performance Statistics

	Momentum	Timed Momentum
Geom. Ret (%)	0.93	3.73
Volatility (%)	18.88	11.89
Max. DD (%)	56.73	27.57
Sharpe Ratio	0.15	0.37
Calmar Ratio	0.02	0.14

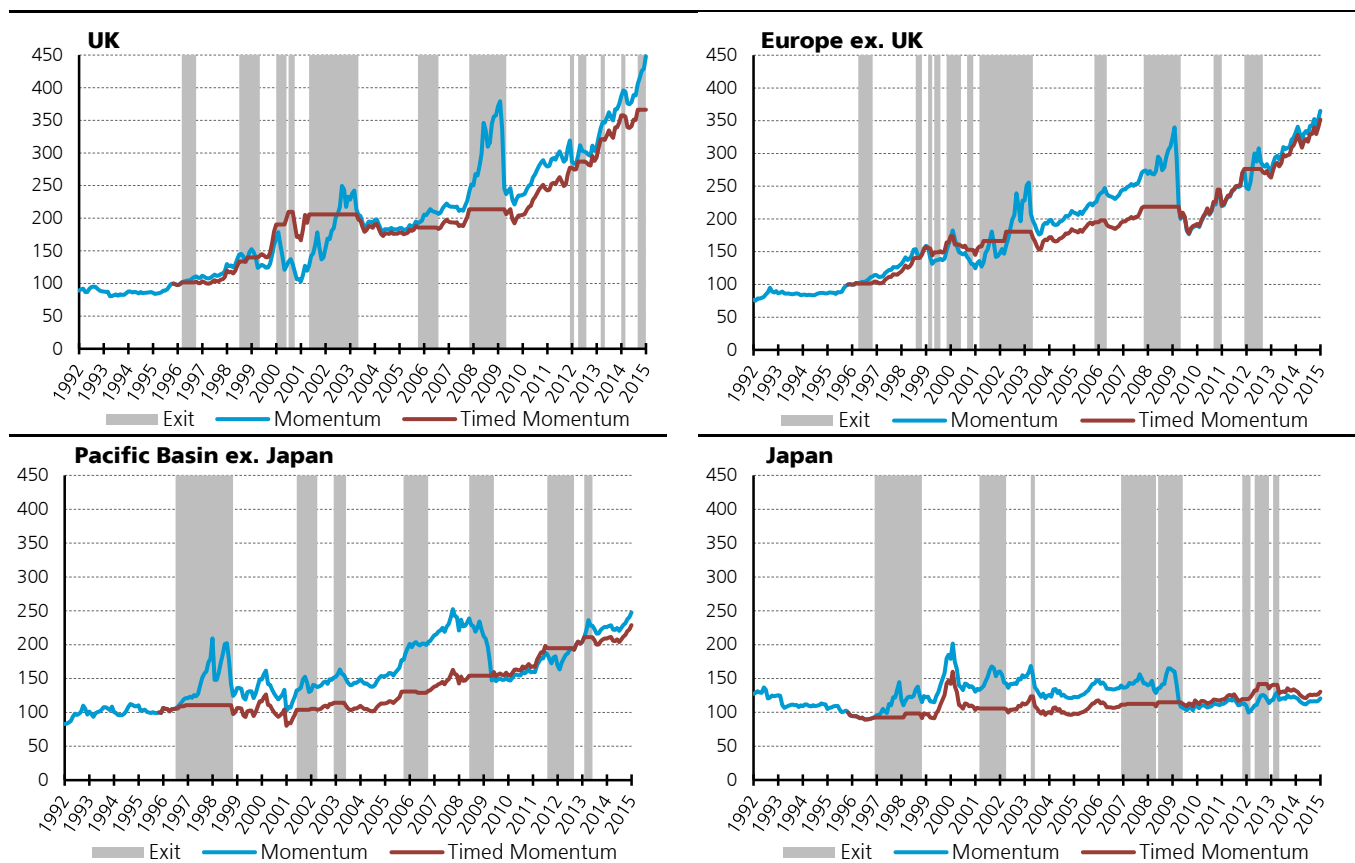
Source: UBS Quantitative Research. The figure presents various annualised (when applicable) performance statistics for the standard momentum strategy and a timed version of it. The Calmar ratio is defined as the ratio of the annualised geometric returns and the maximum drawdown. The sample period is from January 1996 to December 2014.

Figure 4: Risk-adjusted Performance Ratios in Global Regions



Source: UBS Quantitative Research. The figure reports the Sharpe ratio and the Calmar ratio for five different regions (US, UK, Europe ex. UK, Pacific Basin ex. Japan and Japan) for the standard momentum strategy and a timed version of it. The Calmar ratio is defined as the ratio of the annualised geometric returns and the maximum drawdown. The sample period is from January 1996 to December 2014.

Figure 5: Timing Momentum in Global Regions



Source: UBS Quantitative Research. The figure presents the cumulative returns for four different regions (UK, Europe ex. UK, Pacific Basin ex. Japan and Japan) for the standard 12-month momentum strategy and the timed version of it. The plots have been scaled accordingly so that both start at 100 in December 1995.

The evidence across the various global regions is not as strong as it is in the US (at least in term of cumulative returns), but it is very obvious that the timed strategy reduces significantly the high volatility of the simple momentum strategy and successfully manages to safeguard against various aggressive losses (the largest of which is of course during spring 2009). This is confirmed by the relatively larger Sharpe ratios and, most importantly (as we explain in the next paragraphs) Calmar ratios of the timed strategies in Figure 4.

At this point it is worth commenting that the Sharpe ratio might not be the appropriate measure to evaluate the performance of strategies that have a timing "in-or-out" mechanism, as during the "out" months, a zero return is recorded in the data series and this can bias both the average arithmetic return and the volatility of the strategy, i.e. the two components of the Sharpe ratio. Having acknowledged this concern in the applicability of the Sharpe ratio, we believe that the Calmar ratio is a more appropriate statistic to use. The Calmar ratio is defined as the ratio between the annualised geometric returns and the maximum drawdown of a strategy. Neither the geometric returns, nor the maximum drawdown of a strategy are affected by the "switching off" mechanism, hence it allows for comparisons between "always-on" and "in-or-out" strategies.

To conclude, we should comment that the timing mechanism that is proposed by the paper that we reviewed does seem to have some value. Over-crowdedness of the momentum strategy appears to increase the likelihood of an imminent drawdown and using a measure of the attractiveness of the strategy (e.g. how better it has performed relative to the market) can significantly smooth out medium-term volatility spikes that tend to come along with large losses.

"Taming Momentum Crashes: A Simple Stop-Loss Strategy"

by Yufeng Han, Guofu Zhou and Yingzi Zhu

In many papers by both academics and practitioners the approach followed is to rank stocks by some factor at the end of the month and then buy the "good" ones, perhaps also shorting the "bad" ones and then hold these positions for a month before rebalancing. Yufeng Han, Guofu Zhou and Yingzi Zhu introduce a simple idea into the testing of a momentum strategy: just because a stock is chosen to be part of the momentum portfolio at the beginning of a month, doesn't mean we have to hold it until the end of the month.

The way they implement this is via a simple stop-loss rule – if a stock moves by 10% in the wrong direction (so if a stock in the "winners" portfolio falls by 10% or more or a stock in the "losers" portfolio appreciates by 10%) they close the position until the end of the month. We give more details of their exact calculations when we reproduce their results below.

The momentum strategy that they study involves ranking stocks based on their past returns from 7 months ago to 1 month ago, and then holding the position for 1 month. They also look at the strategy ranking on the returns from 13 months to 1 month ago. As with most academic papers their universe is the set of domestic common stocks from CRSP with their data starting in 1926⁹. They rank on their momentum indicator and then calculate the equal weighted returns to the top and bottom decile portfolios.

The obvious question is what is the effect of implementing a stop loss rule within this momentum strategy?

Figure 6 below gives the main results of the paper. The Sharpe ratio of the original momentum strategy (winners-losers) is 0.166, coming from a return of 1.01% and a standard deviation of 6.07%. Adding in a stop-loss at 10% more than doubles the Sharpe ratio to 0.370 with the return increasing to 1.73% and the volatility falling to 4.67%. For a long only investor using a 10% stop-loss has little effect on the return – it marginally increases from 1.20% to 1.24%. The volatility of the long only portfolio does however fall from 7.82% to 6.14%. We will investigate the relative returns and tracking error when we present our results.

Changing the level of the stop loss to 5% produces even better results, with the Sharpe ratio going up to 0.556. This also pushes up the return to the Winners portfolio to 1.46% and again lowers the volatility.

While this increase in average returns is helpful, the effect in the so called "crash periods" is even more dramatic. There are three "crash periods" (from Daniel and Moskowitz (2014): July and August 1932, April and May 1933, and March and April 2009). The authors' naïve momentum strategy has returns of -70.24%, -54.06% and -39.52% in these three periods. The strategy including a 10% stop-loss has returns of 10.91%, 16.16% and -11.82%: in two out of the three periods this strategy manages to make a profit.

⁹ They exclude the smallest size decile using the NYSE breakpoints and stocks with a price less than \$5 at the end of each month.

Figure 6: Performance of Momentum Strategies that employ Stop-Loss rules

	Avg Ret(%)	Std Dev (%)	SRatio	Skewness	Kurtosis	Minimum(%)	Maximum(%)
Panel A: Market and Original Momentum							
Market	0.62 (3.62)	5.45	0.114	0.17	7.31	-28.98	37.77
Losers	0.2 (0.71)	8.88	0.023	1.18	10.07	-39.43	66.1
Winners	1.2 (4.93)	7.82	0.153	-0.28	3.66	-33.06	44.86
Winners-Losers	1.01 (5.31)	6.07	0.166	-1.18	14.47	-49.79	45.11
Panel B: Stop Loss at 10%							
Losers	-0.49 (-2.68)	5.9	-0.083	-1.37	4.26	-39.19	12.73
Winners	1.24 (6.44)	6.14	0.202	0.74	3.4	-12.91	42.08
Winners-Losers	1.73 (11.87)	4.67	0.37	1.86	12.79	-11.34	43.43
Panel C: Stop Loss at 5%							
Losers	-0.93 (-6.38)	4.68	-0.199	-1.97	7.01	-35.59	8.28
Winners	1.46 (9.49)	4.92	0.297	1.51	7.27	-8.58	40.01
Winners-Losers	2.39 (17.81)	4.3	0.556	2.26	14.28	-9.01	40.41
Panel D: Stop Loss at 15%							
Losers	-0.21 (-1.02)	6.66	-0.032	-0.95	3.05	-39.06	17.04
Winners	1.02 (4.79)	6.83	0.149	0.29	2.46	-16.86	42.78
Winners-Losers	1.23 (8.14)	4.86	0.253	1.4	11.36	-13.77	44.23

Source: "Taming Momentum Crashes: A Simple Stop-Loss Strategy" by Y. Han, G. Zhou and Y. Zhu; Table 1, reproduced with permission. The table presents summary statistics of the monthly returns on the original momentum portfolios (Losers, Winners, and Winners-Losers) with those on the corresponding stop-loss momentum portfolios. The original momentum portfolios are formed using the last six month cumulative returns from t-7 to t-2. Three levels of top loss rules are used (5%, 10% and 15%). The summary statistics reported are average excess returns (Avg Ret), standard deviation (Std Dev), Sharpe ratio (SRatio), Skewness, Kurtosis, minimum and maximum returns. Newey and West (1987) robust t-statistics are in parentheses. The sample period is from January, 1926 to December, 2011.

Evaluating the performance of the stop-loss rule

We investigate the performance of this approach using our own momentum factor. We use a slightly more conservative approach to calculating the stopped return than is used in the paper but we do not believe that this makes a significant difference to the results.

The authors' approach is as follows. They take the price at which one opens a trade, P_0 , as the closing price at the end of the previous month. On each trading day before the end of the next month they calculate the return

$$R_t^X = \frac{P_t^X - P_0}{P_0}, X \in \{O, C\}$$

where X stands for the open or closing price on the day. If the opening return is less than -10% (assuming we are long) then the authors assume the position is closed at the open. If the opening return is above -10% but the closing return is below -10% (i.e. we fall through -10% during the day) they assume that the stock is sold for an exact 10% loss. The proceeds are invested in the risk-free asset until the end of the month.

Our implementation is simpler than this. We only use the closing return and we close the position at the close – so if the stock has fallen by (say) 12% the position is closed at a 12% loss rather than assuming that it could be closed at 10%. We also just hold cash (i.e. a zero percent return) rather than getting the risk-free rate after the position has been closed.

For our replication we calculate the total returns to a 6-month momentum strategy (7 months to 1 month ago) in the US using the Dow Jones World Index as our universe¹⁰. As in the paper we use the top and bottom deciles, equal weighted and rebalanced monthly. Figure 7 summarises the results. Note that the first line of the table shows the arithmetic averages; the second line geometric.

The authors' stop loss rule

Our stop loss rule

Figure 7: Returns to a 6-month momentum strategy in the US

	Losers	Winners	Winners - Losers	Market
Arith average monthly return	0.90%	1.36%	0.45%	1.08%
Annualized Geom Avg Return	4.26%	14.37%	-1.78%	11.39%
Annualized Std Dev	37.20%	23.80%	25.14%	20.21%
Annualized Sharpe (Rf=0%)	0.11	0.60	-0.07	0.56

Source: UBS Quantitative Research. The back test was run using the US part of the Dow Jones World Index, creating decile portfolios using 6 month price momentum. The returns are total returns in USD terms. The market and the decile portfolios are all equal weighted.

We ran the back test including the stop loss, and obtained the results in Figure 8. As with the paper we find that the return to the loser portfolio is lower whereas the winner portfolio in our case also has a lower performance. This leads to a much better geometric average performance for the winners-losers portfolio.

Figure 8: Returns to a 6mth momentum strategy in the US with a 10% stop loss

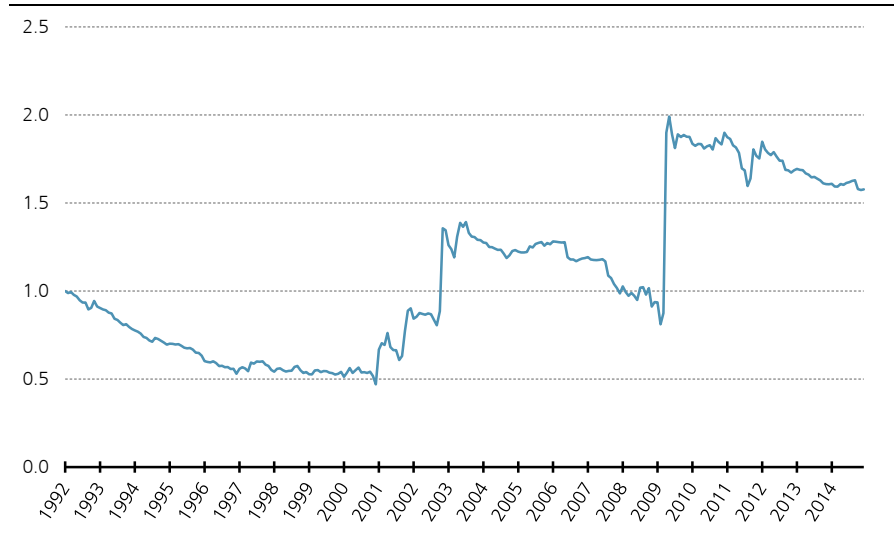
	Losers	Winners	Winners - Losers
Arith average monthly return	0.62%	0.83%	0.21%
Annualized Geom Avg Return	4.28%	7.72%	0.13%
Annualized Std Dev	22.85%	18.26%	22.14%
Annualized Sharpe (Rf=0%)	0.19	0.42	0.01

Source: UBS Quantitative Research

¹⁰ At the end of December 2014 the US part of this had 1261 constituents.

Unfortunately there is a fly in the ointment – although the statistics above seem to suggest that the strategy has some merit, Figure 9 shows the ratio of the cumulative performance of the stop loss strategy over the performance of the normal momentum strategy.

Figure 9: Relative performance of the winners – losers strategies



Source: UBS Quantitative Research

The stop loss strategy underperforms almost all the time, just gaining performance during the very bad periods for momentum especially at the end of 2002 and in 2009.

The reason that this could be happening is captured in the paper *The Long-Lasting Momentum in Weekly Returns* by Gutierrez and Kelley (2008). In that paper they study the returns to a winners-losers portfolio created by ranking on one week returns. They find that in the first week after creation this portfolio loses 69 basis points on average – i.e. there is a very short term reversal effect¹¹. It seems likely that by closing out stocks which have had a large move we are not allowing the portfolio to benefit from this short term reversal effect. But when we get extreme moves in the market (such as in 2009) the stop loss works, and this gain is enough to outweigh the normal drag on performance from missing the price reversals.

Missing out on short-term reversals

We conclude that although this strategy helps during momentum crashes its day to day performance is a costly way to obtain a hedge against the occasional downturns in momentum.

¹¹ They also find that after week four this reverses and becomes a continuation effect.

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