

Price momentum components: Evidence from international market Indices

Graham Bornholt^a and Mirela Malin^b

Department of Accounting, Finance and Economics, Griffith Business School, Griffith University, Gold Coast, Queensland, 4222, Australia

This paper shows that splitting the traditional momentum strategy into two components based on past long-term performance produces contrasting strategies. Past long-term returns predict both the magnitude and persistence of momentum. Early-stage momentum profits are larger than the traditional momentum strategy's profits when applied to developed and emerging market indices and do not reverse in the first five years post-formation whereas late-stage momentum profits are weaker and tend to reverse quickly. While we do not rule out other explanations, our evidence is consistent with an explanation based on investor overreaction.

Keywords: early-stage; momentum effect; developed markets; emerging markets; indices

JEL Classification: G14, G15

^aCorresponding author: Graham Bornholt email: g.bornholt @griffith.edu.au; Tel: +61 7 5552 8851; Fax: +61 7 5552 8068

^bEmail: m.malin@griffith.edu.au; Tel: +61 7 5552 7719; Fax: +61 7 5552 8068

1. Introduction

The momentum anomaly has proven to be one of the most pervasive anomalies in financial markets with a vast literature proposing either rational explanations or explanations based on investor overreaction or underreaction. The momentum strategy of Jegadeesh and Titman (1993, 2001) involves buying past strong performers and selling past weak performers, where performance is measured by returns over the last 3-12 months. In a study of US stocks, Chan and Kot (2006) show that past long-term returns can be used to produce more-powerful momentum strategies. The rationale behind their approach is based on the assumption that momentum occurring just after a reversal in long-term returns will be stronger and will persist for longer than will momentum that does not follow such a turning point in the recent past.

This paper tests the Chan and Kot (2006) rationale with international market indices. We split momentum portfolios into two components (early-stage and late-stage) in a fashion similar to Chan and Kot (2006). The early-stage strategy buys short-term winners that are (relatively) long-term losers and sells short-term losers that are (relatively) long-term winners. The late-stage strategy buys short-term winners that are (relatively) long-term winners and sells short-term losers that are (relatively) long-term losers. The examination of these strategies shows that the early-stage momentum strategy outperforms the traditional pure momentum strategy and the late-stage strategies even after risk adjustment. Our results demonstrate that past long-term returns predict both the magnitude and persistence of momentum.

The remainder of the paper is organized as follows: Section 2 describes the data and the methodology used to construct the various single and double sorted momentum strategies. Section 3 presents the main empirical results including post-formation and risk-adjustment results. Section 4 provides some closing comments.

2. Data and methodology

Monthly total returns data are obtained from Datastream for 44 Morgan Stanley Capital International (MSCI) market indices. These returns are calculated from prices with reinvested gross dividends (excluding withholding taxes) converted to US dollar terms and cover the period January 1970 to April 2013, thus the number of observations for each country ranges from 220 to 520. Using

returns measured in US dollars means that the various strategy profits reflect the results that would be available to a US dollar-based investor (Balvers and Wu, 2006).

Table 1 shows the summary statistics for the sample including the monthly mean return and standard deviation for each country. To differentiate the performance of indices in various global settings, the countries are grouped into 18 developed markets (Panel A) to be consistent with other index based studies (Balvers and Wu, 2006) and 26 emerging markets (Panel B) based on MSCI's own classification. The returns for the developed market indices are available from January 1970, while the first emerging market indices' returns start in January 1988.

[Table 1 about here]

In this paper we compare and contrast the traditional momentum strategy with the early-stage and late-stage momentum strategies for both groups of indices. The formation methodology for each strategy is presented in the next sections. In all cases, portfolios are formed for the developed and emerging markets separately using the technique for each.

2.1 Pure Momentum Strategy

For traditional pure momentum strategies, indices are ranked at the beginning of each month based on their past J -month returns ($J = 3, 6, 9, \text{ or } 12$ months). Each month t , those indices with the lowest 25% of past J -month returns are assigned to the short-term loser portfolio S1, while those indices with the largest 25% of past J -month returns are assigned to the short-term winner portfolio S4. Thus each month both S1 and S4 contain four market indices. The arbitrage pure momentum portfolio (S4-S1) buys the short-term winners and sells the short-term losers, which is held for a K -month holding period where $K = 1, 3, 6, 9, \text{ or } 12$ months.

2.2 Early-Stage and Late-Stage Momentum Strategies.

For the early-stage and late-stage strategies, each month the short-term winner and loser portfolios for the widely-studied $J = 6$ pure momentum strategy are split in half based on the relative magnitude of their component indices' long term past $J2$ -month returns ($J2 = 36, 48, \text{ or } 60$ months). Thus the short-term loser portfolio S1 is split into two portfolios each containing two indices each month. Let S1L1 denote the portfolio composed of the two indices in S1 with the lowest past $J2$ -month returns L1, and let S1L2 denote the portfolio with the remaining two indices from S1 that have

relatively large past $J2$ -month returns L2. Similarly, let S4L1 denote the portfolio with the two indices in short-term winner portfolio S4 with the lowest past $J2$ -month returns L1, and let S4L2 denote the portfolio with the remaining two indices in S4 with the highest past $J2$ -month returns L2.

The early-stage momentum strategy buys the short-term winners with relatively poor long-term past returns and sells the short-term losers with relatively good long-term returns (S4L1-S1L2). The late stage momentum strategy buys the short-term winners with relatively good long-term past returns and sells the short-term losers with relatively poor long-term returns (S4L2-S1L1). By construction, early-stage indices appear to have experienced a recent price reversal whereas late-stage indices appear to have experienced price continuation over a long period. Early-stage indices are 'early' in a price reversal whereas late-stage indices are 'late' in a price continuation. Figure 1 presents a graphical representation of the two strategies.

[Figure 1 about here]

An advantage of splitting the short-term winner and loser portfolios into just two sub-portfolios is that our early stage and late stage portfolios together cover all the components of the corresponding pure momentum portfolios. That is, the traditional pure momentum winner (loser) portfolio is just the union of our early stage winner (loser) and the late stage winner (loser) portfolios.

Our investigation is based on the monthly returns for the portfolios that are held over the next K -months ($K = 1, 3, 6, 9$ or 12) and the next five years. Following Jegadeesh and Titman (1993, 2001), for all strategies we employ overlapping portfolios to increase the power of our tests. The monthly return for the K -month holding period is an equal-weighted average of portfolio returns for the strategies from the current month and the previous $K-1$ months. This method means that simple t -statistics can be used to test average monthly returns. When reporting portfolio monthly returns and profitability, we follow Balvers and Wu (2006) and skip one month between the end of the formation period (J or $J2$) and the start of the holding period (K) throughout this paper.

On the other hand, when searching for evidence of price reversals subsequent to portfolio formation we employ post-formation analyses that begin at the end of the formation period and do not use overlapping portfolios. Thus, for example, the Year 1 event time annual return refers to the average 12-month return in the first year following the end of the formation period. Statistical significance in the post-formation analyses is determined using the Newey-West (1987) correction for serial autocorrelation with the appropriate number of lags (11 in this case). To facilitate comparisons

between the single and double strategies, the discussion will focus on strategies with six-month holding periods ($K=6$), with other results shown for robustness purposes.

3. Results

We discuss the empirical results for the pure, early stage and late stage momentum strategies in this section. In Subsection 3.1, we report pure momentum results and confirm consistency with the stylized facts from prior momentum studies. In Subsection 3.2, we report early and late stage momentum profitability while in Subsection 3.3 we look at the long-horizon returns up to 5 years post-formation. Finally in Subsection 3.4, we investigate the extent to which strategy profits can be explained by a risk-adjustment model.

3.1 Pure momentum

Table 2 contains the results from several pure momentum strategies for developed markets (Panel A) and emerging markets (Panel B) for 20 (J,K) combinations. Each month indices are ranked based on their returns over the previous J -months ($J = 3, 6, 9$ or 12). We report results for the bottom 25 percent loser portfolio (S1), the top 25 percent winner portfolio (S4), and the pure momentum strategy S4-S1 that is long S4 and short S1. Columns 4 to 8 report the portfolio equal-weighted average monthly returns in percentages over the next K -months ($K = 1, 3, 6, 9$ or 12).

[Table 2 about here]

The developed markets results in Panel A of Table 2 show significant momentum profits for all (J,K) combinations with the exception of ($J = 3, K = 1$) and ($J = 12, K = 12$). For example, with a six-month formation and holding period ($J = K = 6$) past winners achieve an average return of 1.46% per month whereas past losers achieve only 0.78% month. The difference between S4 and S1 of 0.68% per month is significant (t -stat 4.10).

The emerging market results in Panel B of Table 2 are very different. Out of all possible formation/holding combinations only the strategy based on $J = K = 6$ months earns significant profits of 0.77% per month (t -stat 2.0). The reason is that in the emerging markets, both winner (S4) and loser (S1) portfolios achieve significant monthly returns, with some cases like ($J = 3, K = 1$) and ($J = 12, K = 12$) for example, the loser portfolios outperforms the winner portfolios.

3.2 Early-stage and late-stage momentum

One aim of this paper is to investigate whether momentum is a composite effect. In particular we examine whether consideration of the past long-term performance of momentum winner and loser portfolios allow us to produce enhanced momentum strategies with markedly different performances. By selecting short-term winner (loser) indices whose past performance indicate they were losers (winners) over the last 5 years, we concentrate only on those indices that will continue to be winners (losers) over both the short and long-term. These short-term winner (loser) indices are *early* in their long-term reversal stage. Thus we combine the continuation of the momentum effect with the reversal feature of the contrarian effect to create an enhanced momentum strategy. It is expected that the early-stage strategy will outperform the pure momentum strategy, while the late-stage strategy which contains the residual portfolios will underperform the pure momentum strategy. (see Figure 1)

For the early-stage and late-stage strategies, each month the short-term winner and loser portfolios of the pure momentum strategy are split in half based on the relative magnitude of their component indices' long-term past J_2 -month returns ($J_2 = 36, 48, \text{ or } 60$ months). The early-stage strategy (S4L1-S1L2) buys short-term winners with relatively poor long-term performances (S4L1) and sells the short-term losers with relatively good long-term performances (S1L2). The late stage strategy (S4L2-S1L1) buys the short-term winners with relatively good long-term performances (S4L2) and sells the short-term losers with relatively long-term poor performances (S1L1). The results for these strategies for both developed and emerging markets are reported in Tables 3 and 4. To conserve space, only combinations based on past $J = 6$ months' formation periods and for $J_2 = 36, 48, \text{ or } 60$ months are presented.

[Tables 3 and 4 about here]

Table 3 presents the results of the early-stage momentum for the developed markets (Panel A) and the emerging markets (Panel B) showing positive average monthly returns for all K holding periods. In particular, for both developed and emerging indices, the early-stage strategy with six month holding period produces the highest returns for the S4L1-S1L2 strategies. For example, the early-stage $J/J_2 = 6/60$ and $K = 6$ strategy applied to the developed markets earns a return of 0.78% per month (t -stat 3.77) and 0.87% per month (t -stat 1.99) for the emerging markets. These returns are larger than the corresponding pure momentum base case S4-S1 return of 0.68% per month (t -stat

3.62) for the developed markets and 0.77% per month (t -stat 2.00) for the emerging markets reported in Table 2.

In contrast, as expected, most of the developed markets late-stage momentum strategy results presented columns 4 to 8 of Panel A of Table 4 are insignificant. The only statistically significant returns for the late-stage S4L2-S1L1 portfolio comes from the three strategies based on $K = 6$ months holding period and $J1/J2 = 6/60$ with $K = 9$ months holding period. The results for the emerging markets in Panel B of Table 4 show insignificant returns for all formation J and holding K periods, with 8 out of the 15 late-stage strategies showing negative returns. The reason of these mixed results is that the late-stage strategy is constructed using the residual portfolios from the early-stage strategy which causes the loser portfolio S1L1 to earn high returns as well, especially for the emerging markets. Nevertheless, comparing the two Tables 3 and 4 we observe that each early-stage strategy profit is larger than the corresponding late-stage profit for both groups of indices.

3.3 Long-horizon returns

Annual event time returns for each portfolio are reported in columns 9 to 13 of Table 2 (pure momentum), Table 3 (early-stage) and Table 4 (late-stage) with the associated t -statistics calculated using the Newey-West (1987) correction for autocorrelation up to 11 lags. Year 1, Year 2, Year 3, Year 4, and Year 5 refer to the annual returns of each strategy in the five 12-month periods following the formation date.

For the developed markets in Panel A of Table 2 the momentum strategy portfolio S4-S1 produces returns of between 4.35% and 5.67% for Year 1 which are all significant. In contrast, the S4-S1 returns for Years 2 to 5 are universally negative for all J formation periods. Although none of these losses are significant, the sum of the Years 2 to 5 losses in each case either offsets or almost offsets the corresponding gains from Year 1. These results are consistent with the evidence from a number of prior momentum studies that indicate that the price movements generating momentum profits frequently reverse. Similar to the developed markets results, the emerging markets in Panel B of Table 2 show positive but insignificant momentum returns for Year 1 with the exception of $J = 12$ strategy which is negative. The difference is that for emerging markets the returns of the momentum strategy 3 years after the formation period are positive as well.

The early-stage and late-stage strategy annual event time returns for the developed markets (Panel A) and emerging markets (Panel B) presented in Table 3 and 4 are based on short-term performance over the previous six months ($J = 6$), and long-term performance over the past $J2 = 36, 48, \text{ and } 60$ months. The Year 1 early-stage returns in Table 3 are significant at the 1% level for the developed markets with positive but insignificant returns continuing in Year 2 and Year 3 for the $J1/J2 = 6/60$ case. The emerging markets post-holding returns are positive on 12 out of 15 combination with only the $J1/J2 = 6/60$ case being statistically significant. On the other hand, none of the late-stage strategy annual event time returns are significant, with the majority of S4L2-S1L1 portfolios earning negative returns. These results suggest that early-stage momentum and late-stage momentum have dramatically different post-formation evidence of reversal of returns.

To better illustrate the long-term behavior of the strategies' profits for the developed markets, Figure 2 presents the post-formation cumulative returns of the pure momentum S4-S1 (for the $J = 6$ case), early-stage S4L1-S1L2 and late-stage S4L2-S1L1 strategies (for the $J1/J2 = 6/60$ case) using non-overlapping portfolios ($K = 1$) for the 60 months following the end of the formation period.

[Figure 2 about here]

Over the 1970 to 2013 sample period, the pure momentum results display an impressive reversal of returns in the second through fifth years. Cumulative returns increase monotonically until they reach 5.50% at the end of Month 10. By the end of Month 60 the cumulative pure momentum profits have reduced to 1.22%. The early stage momentum cumulative returns increase monotonically to 6.15% at the end of Month 10, then after a small dip to 5.60% the returns reach 8.76% by the end of month 40. The strategy experience a small reversal for 10 months to 6.46% after which the profits bounce back to 7.74% by the end of Month 60. The lack of complete post-formation return reversal in the case of the early stage strategy is consistent with investor overreaction. If early stage momentum profits are due to the reversal of a past overreaction that took place in the 60-month formation period then early stage momentum returns should not reverse in the post-formation period. The late-stage cumulative returns in Figure 2 follows closely the pattern of the pure momentum strategy profits, although at lower returns.

[Figure 3 about here]

Figure 3 displays the corresponding graphs for the emerging markets case showing similar patterns in the profits of the three strategies although with higher differences in the cumulative returns.

For example the early-stage profits reach 19.10% by month 44, leveling to 14.72% by the end of month 60, while the late-stage strategy follows a dramatic reversal reaching -29.33% by the end of month 60.

It is easy to see why this reversal of late-stage returns is also consistent with investor overreaction. Recall that the late-stage momentum strategy buys short-term winners with relatively good long-term past returns and sells short-term losers with relatively poor long-term returns. By construction, late-stage indices have experienced price continuation over a long period. If investor overreaction is the cause of the late-stage strategy's holding period profitability then we would expect its holding period returns to be reversed eventually. The over-reversal of late stage returns displayed in Figures 2 and 3 suggests that some degree of overreaction may have already set in by the end of the formation period. Figure 3 in Jegadeesh and Titman (2001) displays a similar pattern for pure momentum in their study based on US stocks. While they were concerned about the implications of this pattern for behavioral theories, such a pattern can be consistent with investor overreaction. Consistency with investor overreaction is determined by the early-stage momentum and late-stage momentum evidence.

3.4 Risk-adjusted returns

To assess whether strategy profits are simply a reward for bearing risk, we employ the same international two-factor model used by Balvers and Wu (2006) to risk-adjust raw returns. The two-factor model contains a market factor and a value minus growth factor (VMG) as follows:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_{p,wld}(R_{wld,t} - R_{f,t}) + \nu_{p,vmg} VMG_t + \varepsilon_t, \quad (1)$$

where the dependent variable $R_{p,t} - R_{f,t}$ is the monthly excess return of a portfolio of interest (whether it's the long, short or the arbitrage portfolio of a strategy), $R_{p,t}$ represents the monthly US dollar return of portfolio p at time t and $R_{f,t}$ the monthly risk free rate at time t represented by the one-month US T-bill return. The independent variables or factors for the two models are as follows: $R_{wld,t} - R_{f,t}$ corresponds to the excess return on the MSCI World market portfolio at time t and VMG_t or Value minus Growth is the return on the MSCI World Value Index minus the return on the MSCI World Growth Index at time t . The monthly values of the MSCI world market index and the MSCI world value and growth indices were obtained from Datastream. The monthly returns for the Ibbotson and

Associates one-month T-bill risk free rate were downloaded from Kenneth French's website.² The two-factor model risk adjustment covers the period from January 1975 to April 2013 since the value and growth indices' price history starts in 1975. The coefficients β_p and v_p are the regression loadings corresponding to the factors of the model, while the intercept α_p (or simply alpha) represents the risk-adjusted abnormal return of the portfolio over the estimation period. The t -values corresponding to the regression coefficients are corrected for heteroskedasticity using White's (1980) test.

Table 5 reports the regression coefficients for the long, short and long-short portfolios and their associated t -values for the pure momentum case with $J = 6$ and for the early-stage and late-stage cases with $J1/J2 = 6/60$ based on six month holding periods ($K = 6$). For comparison purposes, the table also reports the corresponding unadjusted (raw) average monthly returns for these strategies taken from Tables 2, 3 and 4.

[Table 5 about here]

Consider first the developed markets results in Section 1 of Table 5. The risk-adjusted return of the arbitrage S4-S1 pure momentum strategy is a significant 0.571% per month (t -stat 3.13), while the early-stage S4L1-S1L2 alpha is 0.793% per month (t -stat 3.66) and slightly bigger than the unadjusted 0.78% monthly return. For completeness we have presented the risk-adjusted return of the S4L2-L1L1 late-stage strategy as well at 0.464% per month (t -stat 2.03).

Similar to the developed markets, the emerging markets results in Section 2 of Table 5 show significant alphas for the pure momentum S4-S1 strategy at 0.787% per month (t -stat 2.03). The early-stage S4L1-S1L2 risk-adjusted return is 0.929% per month (t -stat 2.14) and larger than the unadjusted raw return of 0.87% per month while the late-stage strategy produces insignificant alphas.

Overall, Table 5 shows that the returns of the early-stage strategy outperform the pure momentum and the late-stage strategies' returns and that the two-factor model does not diminish the magnitude of the abnormal returns. Another important feature of the results in Table 5 is that, in every case, the long side of every strategy has a significant alpha indicating that for international market indices it is the short-term winners that are driving the abnormal momentum profits.

²http://www.mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library

4. Concluding remarks

Our results at the market index level are consistent with Chan and Kot's (2006) study of US stocks. Past long-term returns predict the magnitude and the persistence of momentum. Our early-stage strategy produces a significant alpha of 0.929% per month whereas the late-stage strategy has an insignificant alpha of 0.162% per month.

The standard interpretation of momentum evidence is that pure momentum profits must eventually reverse if investor overreaction explains the momentum effect. We argue that this interpretation is incorrect. That is, we argue that consistency with overreaction does not require the eventual reversal of momentum profits. If long-term overreaction is present then momentum in the early stages of the subsequent price reversals may continue for a considerable period of time without the necessity of reversing. In contrast, the other component of pure momentum (late-stage momentum) is long short-term winners with relatively good long-term past returns and short short-term losers with relatively poor long-term returns. Investor overreaction would predict that late-stage profits would reverse in the near future as a turning point in these securities long-term performances is approaching. In short, investor overreaction can produce the observed results with early-stage momentum returns that do not reverse in the post-holding period and late stage momentum returns that quickly reverse. These opposite patterns for the two components of pure momentum mean that consistency with overreaction does not require that pure momentum profits eventually reverse.

Although all the evidence in our study is consistent with investor overreaction, we cannot exclude rational explanations or even investor underreaction from playing a role in momentum. In particular, the notions of investor overreaction and underreaction seem intertwined. Would not a slow reversal from a past overreaction be a form of investor underreaction?

References

- Balvers, R. J., & Wu, Y. (2006). Momentum and Mean Reversion Across National Equity Markets. *Journal of Empirical Finance*, 13, 24-48.
- Chan, K., & Kot, H. W. (2006). Can Contrarian Strategies Improve Momentum Profits? *Journal of Investment Management*, 4(1), 70-89.
- Jegadeesh, N., & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *Journal of Finance*, 48(1), 65-91.
- Jegadeesh, N., & Titman, S. (2001). Profitability of Momentum Strategies: An Evaluation fo Alternative Explanations. *Journal of Finance*, 56(2), 699-720.
- Newey, W. K., & West, K. D. (1987). A Simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix. *Econometrica*, 55, 703-708.
- White, H. (1980). A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity. *Econometrica*, 48, 817-838.

Table 1
Summary Statistics of Stock Index Returns

| Panel A: Developed Countries | | | | | |
|-------------------------------------|---------------|-------------|----------------|---------------|-------------|
| Country | Mean % | SD % | Country | Mean % | SD % |
| Australia | 1.05 | 7.04 | Japan | 0.95 | 6.20 |
| Austria | 0.92 | 6.84 | Netherlands | 1.12 | 5.63 |
| Belgium | 1.11 | 5.97 | Norway | 1.24 | 7.97 |
| Canada | 0.96 | 5.74 | Singapore | 1.28 | 8.31 |
| Denmark | 1.21 | 5.72 | Spain | 0.96 | 6.86 |
| France | 1.03 | 6.61 | Sweden | 1.35 | 7.06 |
| Germany | 1.01 | 6.43 | Switzerland | 1.08 | 5.34 |
| Hong Kong | 1.69 | 10.15 | UK | 1.02 | 6.41 |
| Italy | 0.71 | 7.49 | US | 0.89 | 4.49 |
| AVERAGE | | | | 1.09 | 6.68 |
| Panel B: Emerging Countries | | | | | |
| Country | Mean % | SD % | Country | Mean % | SD % |
| Argentina | 2.14 | 15.52 | Malaysia | 1.07 | 8.21 |
| Brazil | 2.51 | 14.67 | Mexico | 2.00 | 9.01 |
| Chile | 1.64 | 7.11 | Morocco | 0.95 | 5.52 |
| China | 0.51 | 10.34 | Pakistan | 1.14 | 10.79 |
| Colombia | 1.74 | 9.07 | Peru | 1.77 | 9.32 |
| Czech Republic | 1.26 | 8.44 | Philippines | 1.15 | 9.04 |
| Egypt | 1.60 | 9.70 | Poland | 1.92 | 14.02 |
| Hungary | 1.54 | 11.15 | Russia | 2.33 | 15.82 |
| India | 1.13 | 8.95 | South Africa | 1.25 | 7.90 |
| Indonesia | 1.92 | 14.21 | Sri Lanka | 1.10 | 10.47 |
| Israel | 0.69 | 6.97 | Taiwan | 1.04 | 10.42 |
| Jordan | 0.39 | 5.29 | Thailand | 1.36 | 10.89 |
| Korea | 1.15 | 10.89 | Turkey | 2.23 | 16.36 |
| AVERAGE | | | | 1.44 | 10.39 |

This table provides descriptive statistics for the return data of the 18 MSCI developed market and 26 MSCI emerging market indices from their first available months (January 1970 for the developed markets and January 1988 at the earliest for the emerging markets) until April 2013, obtained from Datastream. The mean refers to the average monthly returns and SD refers to the standard deviation of monthly returns.

Table 2
Profitability of the Pure Momentum Strategy

| Panel A: Developed Markets | | | | | | | | | | | | |
|-----------------------------------|-----------|---------------------|------------------------|------------------|----------------|------------------|------------------|---------------------------|------------------|------------------|------------------|------------------|
| <i>J</i> | Portfolio | Formation Return | Holding Period Returns | | | | | Annual Event Time Returns | | | | |
| | | | K = 1 | K = 3 | K = 6 | K = 9 | K = 12 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
| 3 | S1 | 0.94 | 0.97 (3.67) | 0.94 (3.80) | 0.91 (3.83) | 0.88 (3.77) | 0.94 (4.04) | 12.16 (4.46) | 15.44 (5.35) | 14.51 (4.66) | 13.79 (4.93) | 15.46 (5.04) |
| | S4 | 1.14 | 1.29 (5.26) | 1.27 (5.18) | 1.31 (5.49) | 1.36 (5.77) | 1.27 (5.35) | 17.83 (5.34) | 13.27 (4.18) | 13.41 (4.71) | 12.86 (4.31) | 14.81 (5.07) |
| | S4-S1 | | 0.32 (1.47) | 0.33 (1.72) | 0.40 (2.50) | 0.48 (3.46) | 0.33 (2.55) | 5.67 (3.76) | -2.17 (-1.39) | -1.10 (-0.72) | -0.93 (-0.88) | -0.65 (-0.53) |
| 6 | S1 | 0.92 | 0.93 (3.58) | 0.87 (3.50) | 0.78 (3.22) | 0.80 (3.33) | 0.88 (3.67) | 11.56 (3.00) | 14.81 (5.28) | 14.25 (4.51) | 14.73 (5.21) | 15.92 (4.70) |
| | S4 | 1.23 | 1.44 (5.59) | 1.46 (5.72) | 1.46 (5.86) | 1.37 (5.50) | 1.23 (5.00) | 17.20 (5.18) | 13.94 (4.21) | 13.19 (4.66) | 12.69 (4.16) | 15.28 (4.82) |
| | S4-S1 | | 0.51 (2.22) | 0.59 (2.84) | 0.68 (3.62) | 0.57 (3.27) | 0.35 (2.20) | 5.64 (3.31) | -0.87 (-0.40) | -1.06 (-0.64) | -2.04 (-1.48) | -0.63 (-0.42) |
| 9 | S1 | 0.92 | 0.79 (3.02) | 0.75 (2.98) | 0.76 (3.06) | 0.83 (3.41) | 0.93 (3.82) | 11.72 (4.24) | 15.22 (5.26) | 14.24 (4.45) | 15.34 (5.35) | 16.22 (4.63) |
| | S4 | 1.33 | 1.48 (5.74) | 1.50 (5.86) | 1.40 (5.51) | 1.31 (5.23) | 1.22 (4.92) | 17.22 (4.98) | 13.63 (3.99) | 12.52 (4.30) | 13.17 (4.13) | 15.65 (4.97) |
| | S4-S1 | | 0.69 (3.08) | 0.75 (3.51) | 0.64 (3.12) | 0.48 (2.54) | 0.30 (1.66) | 5.50 (2.48) | -1.59 (-0.68) | -1.72 (-0.91) | -2.17 (-1.37) | -0.57 (-0.34) |
| 12 | S1 | 0.92 | 0.72 (2.70) | 0.78 (3.02) | 0.84 (3.31) | 0.90 (3.55) | 0.95 (3.81) | 12.02 (4.30) | 14.77 (4.98) | 14.22 (4.32) | 15.69 (5.37) | 15.91 (4.54) |
| | S4 | 1.42 | 1.44 (5.48) | 1.38 (5.26) | 1.30 (5.07) | 1.23 (4.86) | 1.17 (4.65) | 16.37 (4.64) | 13.31 (3.80) | 12.18 (4.14) | 13.80 (4.29) | 14.92 (4.84) |
| | S4-S1 | | 0.72 (3.02) | 0.60 (2.61) | 0.46 (2.16) | 0.34 (1.66) | 0.22 (1.13) | 4.35 (1.76) | -1.45 (-0.58) | -2.04 (-1.07) | -1.89 (-1.16) | -0.99 (-0.54) |
| Panel B: Emerging Markets | | | | | | | | | | | | |
| <i>J</i> | Portfolio | Formation Return | Holding Period Returns | | | | | Annual Event Time Returns | | | | |
| | | | K = 1 | K = 3 | K = 6 | K = 9 | K = 12 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
| 3 | S1 | 0.87 | 1.68 (3.45) | 1.60 (3.64) | 1.41 (3.35) | 1.41 (3.35) | 1.54 (3.74) | 20.68 (3.55) | 24.21 (4.20) | 16.65 (3.10) | 18.39 (3.42) | 18.02 (3.15) |
| | S4 | 1.26 | 1.45 (2.93) | 1.50 (3.36) | 1.75 (4.25) | 1.78 (4.44) | 1.62 (4.00) | 24.50 (4.01) | 16.57 (3.19) | 19.90 (3.78) | 17.72 (3.16) | 14.28 (2.64) |
| | S4-S1 | | -0.23 (-0.43) | -0.10 (-0.23) | 0.34 (1.06) | 0.37 (1.35) | 0.09 (0.36) | 3.82 (1.01) | -7.65 (-2.17) | 3.25 (1.56) | -0.67 (-0.39) | -3.74 (-1.68) |
| 6 | S1 | 0.85 | 1.23 (2.59) | 1.31 (2.91) | 1.18 (2.72) | 1.29 (3.00) | 1.40 (3.32) | 20.03 (3.00) | 22.23 (4.31) | 16.53 (3.17) | 19.47 (3.55) | 18.60 (3.29) |
| | S4 | 1.42 | 1.98 (4.48) | 1.95 (4.53) | 1.95 (4.74) | 1.78 (4.30) | 1.60 (3.88) | 24.31 (3.95) | 15.27 (3.07) | 20.24 (3.82) | 15.54 (2.75) | 14.77 (2.74) |
| | S4-S1 | | 0.74 (1.50) | 0.64 (1.39) | 0.77 (2.00) | 0.49 (1.40) | 0.19 (0.61) | 4.28 (0.99) | -6.97 (-2.36) | 3.71 (1.54) | -3.93 (-1.82) | -3.82 (-1.71) |
| 9 | S1 | 0.83 | 1.31 (2.72) | 1.28 (2.68) | 1.32 (2.90) | 1.39 (3.15) | 1.43 (3.35) | 22.19 (3.29) | 21.18 (4.09) | 15.71 (2.93) | 20.08 (3.60) | 17.55 (3.11) |
| | S4 | 1.59 | 1.89 (4.20) | 1.94 (4.45) | 1.86 (4.30) | 1.71 (3.94) | 1.36 (3.35) | 24.53 (3.57) | 17.30 (3.38) | 21.65 (3.90) | 15.04 (2.61) | 14.47 (2.67) |
| | S4-S1 | | 0.58 (1.16) | 0.66 (1.37) | 0.54 (1.22) | 0.31 (0.78) | -0.08 (-0.23) | 2.34 (0.38) | -3.88 (-1.29) | 5.94 (2.07) | -5.04 (-2.11) | -3.08 (-1.44) |
| 12 | S1 | 0.82 | 1.53 (3.14) | 1.55 (3.30) | 1.51 (3.33) | 1.48 (3.36) | 1.52 (3.49) | 23.51 (3.49) | 20.06 (3.71) | 16.69 (3.00) | 20.48 (3.66) | 15.86 (2.92) |
| | S4 | 1.76 | 1.96 (3.90) | 1.81 (3.90) | 1.62 (3.62) | 1.35 (3.24) | 1.27 (3.11) | 21.21 (3.23) | 17.98 (3.55) | 19.22 (3.73) | 14.07 (2.38) | 13.02 (2.43) |
| | S4-S1 | | 0.43 (0.77) | 0.26 (0.53) | 0.11 (0.25) | -0.13 (-0.35) | -0.25 (-0.74) | -2.31 (-0.36) | -2.09 (-0.67) | 2.53 (1.09) | -6.41 (-2.34) | -2.84 (-1.13) |

This table presents the average monthly returns in percentages of the short, long and arbitrage portfolios of the pure momentum strategy for the developed markets (Panel A) and emerging markets (Panel B). Portfolios are constructed as follows: each month t , indices are ranked based on the compound return based on past $J=3, 6, 9$ and 12 formation months. The top 25 of indices are those with the highest past return and grouped in the winner $S4$ portfolio and the bottom 25 are indices with the lowest past returns and grouped in the loser $S1$ portfolio. These portfolios are equally weighted. The strategy $S4-S1$ goes long the winner portfolio and short the loser portfolio to be held for $K=1, 3, 6, 9$ and 12 months. *Formation Return* represents the average compound monthly return in percentages over the formation period J . The annual returns (*Year 1, Year 2, Year 3, Year 4* and *Year 5*) are computed as the average compounded returns in percentages for the first five years following the formation date. The t -statistics for the K monthly returns are simple t -statistics, whereas for the annual returns are calculated using Newey-West (1987) autocorrelation correction estimates up to 11 lags. The t -statistics are presented in parenthesis.

Table 3
Profitability of the Early Stage Momentum Strategy

| Panel A: Developed Markets | | | | | | | | | | | | | |
|----------------------------|---------------------------|-----------|------------------------|------------------------|--------|--------|--------|---------------------------|---------------------------|--------|---------|---------|---------|
| J1 | J2 | Portfolio | Holding Period Returns | | | | | Annual Event Time Returns | | | | | |
| | | | K = 1 | K = 3 | K = 6 | K = 9 | K = 12 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 | |
| 6 | 36 | S1L2 | 0.88 | 0.79 | 0.70 | 0.75 | 0.85 | 10.61 | 13.21 | 15.40 | 17.24 | 16.25 | |
| | | | (3.05) | (2.87) | (2.64) | (2.84) | (3.26) | (3.00) | (4.72) | (4.32) | (5.24) | (4.46) | |
| | | S4L1 | 1.59 | 1.45 | 1.45 | 1.36 | 1.28 | 17.00 | 15.32 | 14.21 | 13.95 | 16.92 | |
| | | | | (5.93) | (5.55) | (5.67) | (5.28) | (5.02) | (4.83) | (4.54) | (4.93) | (4.19) | (4.68) |
| | | | S4L1-S1L2 | 0.71 | 0.66 | 0.75 | 0.61 | 0.43 | 6.40 | 2.11 | -1.19 | -3.29 | 0.67 |
| | | | | (2.76) | (3.01) | (3.75) | (3.27) | (2.48) | (3.22) | (1.01) | (-0.52) | (-2.20) | (0.27) |
| | 48 | S1L2 | 0.99 | 0.87 | 0.72 | 0.85 | 0.94 | 10.75 | 13.96 | 15.70 | 16.21 | 16.40 | |
| | | | (3.31) | (3.11) | (2.62) | (3.14) | (3.51) | (3.58) | (4.97) | (4.54) | (5.57) | (4.36) | |
| | | | S4L1 | 1.40 | 1.51 | 1.54 | 1.48 | 1.34 | 17.51 | 16.68 | 15.45 | 14.40 | 15.59 |
| | | | | (5.02) | (5.60) | (5.90) | (5.71) | (5.21) | (5.12) | (4.74) | (5.34) | (4.13) | (4.47) |
| | | | S4L1-S1L2 | 0.42 | 0.64 | 0.82 | 0.64 | 0.40 | 6.76 | 2.73 | -0.25 | -1.81 | -0.81 |
| | | | | (1.51) | (2.73) | (4.07) | (3.40) | (2.25) | (3.70) | (1.15) | (-0.12) | (-1.22) | (-0.45) |
| 60 | | S1L2 | 0.96 | 0.79 | 0.65 | 0.69 | 0.79 | 10.19 | 14.25 | 15.41 | 15.41 | 15.30 | |
| | | | (3.40) | (2.93) | (2.46) | (2.66) | (3.04) | (3.45) | (4.74) | (4.54) | (4.96) | (4.08) | |
| | | | S4L1 | 1.40 | 1.47 | 1.43 | 1.33 | 1.22 | 16.18 | 16.73 | 15.91 | 14.75 | 16.22 |
| | | | | (4.94) | (5.40) | (5.49) | (5.15) | (4.76) | (5.25) | (4.48) | (5.24) | (4.28) | (4.52) |
| | | | S4L1-S1L2 | 0.44 | 0.68 | 0.78 | 0.64 | 0.43 | 5.99 | 2.48 | 0.50 | -0.66 | 0.92 |
| | | | | (1.65) | (2.94) | (3.77) | (3.38) | (2.38) | (3.26) | (1.03) | (0.26) | (-0.42) | (0.57) |
| | Panel B: Emerging Markets | | | | | | | | | | | | |
| | J1 | J2 | Portfolio | Holding Period Returns | | | | | Annual Event Time Returns | | | | |
| | | | | K = 1 | K = 3 | K = 6 | K = 9 | K = 12 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
| 6 | 36 | S1L2 | 0.82 | 0.86 | 0.76 | 1.11 | 1.16 | 0.77 | 0.76 | 0.79 | 0.82 | 0.78 | |
| | | | (1.53) | (1.65) | (1.54) | (2.33) | (2.51) | (3.00) | (1.40) | (1.50) | (1.56) | (1.54) | |
| | | S4L1 | 1.10 | 1.28 | 1.41 | 1.35 | 1.27 | 1.00 | 1.07 | 1.08 | 1.22 | 1.13 | |
| | | | | (2.20) | (2.67) | (3.04) | (3.01) | (2.94) | (2.05) | (2.29) | (2.34) | (2.63) | (2.46) |
| | | | S4L1-S1L2 | 0.27 | 0.43 | 0.66 | 0.24 | 0.11 | 0.24 | 0.31 | 0.29 | 0.40 | 0.35 |
| | | | | (0.48) | (0.80) | (1.38) | (0.57) | (0.30) | (0.37) | (0.55) | (0.54) | (0.76) | (0.70) |
| | 48 | S1L2 | 0.73 | 0.93 | 0.82 | 1.04 | 1.20 | 14.70 | 16.62 | 14.85 | 15.44 | 18.71 | |
| | | | (1.35) | (1.80) | (1.68) | (2.18) | (2.49) | (2.32) | (2.94) | (2.33) | (2.35) | (2.68) | |
| | | | S4L1 | 1.49 | 1.44 | 1.61 | 1.56 | 1.51 | 20.85 | 20.57 | 18.28 | 13.90 | 17.43 |
| | | | | (2.92) | (2.92) | (3.53) | (3.55) | (3.55) | (3.21) | (3.23) | (3.06) | (2.23) | (2.48) |
| | | | S4L1-S1L2 | 0.76 | 0.51 | 0.80 | 0.53 | 0.32 | 6.15 | 3.94 | 3.43 | -1.54 | -1.28 |
| | | | | (1.30) | (0.99) | (1.92) | (1.41) | (0.96) | (1.33) | (1.11) | (0.91) | (-0.61) | (-0.31) |
| 60 | | S1L2 | 0.78 | 0.90 | 0.77 | 0.88 | 0.89 | 13.43 | 16.37 | 15.19 | 15.81 | 17.90 | |
| | | | (1.40) | (1.70) | (1.52) | (1.74) | (1.80) | (2.20) | (2.61) | (2.40) | (2.32) | (2.43) | |
| | | | S4L1 | 1.48 | 1.60 | 1.64 | 1.55 | 1.42 | 21.53 | 16.55 | 19.14 | 13.68 | 19.88 |
| | | | | (3.02) | (3.31) | (3.56) | (3.47) | (3.26) | (3.21) | (2.63) | (3.13) | (2.11) | (2.69) |
| | | | S4L1-S1L2 | 0.71 | 0.70 | 0.87 | 0.67 | 0.53 | 8.10 | 0.18 | 3.95 | -2.13 | 1.97 |
| | | | | (1.27) | (1.41) | (1.99) | (1.68) | (1.47) | (1.76) | (0.04) | (1.29) | (-0.82) | (0.53) |

This table presents the average monthly returns in percentages of the short, long and arbitrage portfolios of the *early* stage momentum strategy for the developed markets (Panel A) and emerging markets (Panel B). Portfolios are based on the 6 month formation period contrarian strategy $J1 = 6$. The formation of these portfolios is explained in Table 2. Within the short-term winner *S4* portfolio and the short-term loser *S1* portfolio, indices are further classified into two portfolios each where the top 50 of indices have best long-term performance *L2* and the bottom 50 of indices have the worst long-term performance *L1* over the past formation months $J2 = 36, 48, 60$. The resulting four portfolios are: short-term winners that have worst long-term performance *S4L1* and worst long-term performance *S4L2*, and short-term losers that have worst long-term performance *S1L1* and best long-term performance *S1L2*. The *early* stage momentum strategy *S4L1-S1L2* is held for $K=1, 3, 6, 9$ and 12 months. The annual returns (*Year 1, Year 2, Year 3, Year 4* and *Year 5*) are computed as the average compounded returns in percentages for the first five years following the formation date. The t -statistics for the K monthly returns are simple t -statistics, whereas for the annual returns are calculated using Newey-West (1987) autocorrelation correction estimates up to 11 lags. The t -statistics are presented in parenthesis.

Table 4
Strategy Profitability of the Late Stage Momentum Strategy

| Panel A: Developed Markets | | | | | | | | | | | | |
|----------------------------|------|-----------|------------------------|----------------|----------------|----------------|----------------|---------------------------|------------------|------------------|------------------|------------------|
| J1 | J2 | Portfolio | Holding Period Returns | | | | | Annual Event Time Returns | | | | |
| | | | K = 1 | K = 3 | K = 6 | K = 9 | K = 12 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
| 6 | 36 | S1L1 | 0.91 (2.96) | 0.83 (2.96) | 0.71 (2.63) | 0.76 (2.85) | 0.86 (3.32) | 10.57 (3.00) | 16.11 (5.24) | 14.84 (4.58) | 14.30 (5.11) | 16.89 (4.40) |
| | | S4L2 | 0.99 (3.16) | 1.08 (3.74) | 1.15 (4.27) | 1.11 (4.25) | 1.05 (4.10) | 13.37 (4.09) | 12.59 (3.71) | 13.19 (4.52) | 12.51 (3.93) | 14.54 (4.25) |
| | | S4L2-S1L1 | 0.08 (0.26) | 0.25 (0.93) | 0.44 (1.85) | 0.35 (1.62) | 0.19 (0.95) | 2.80 (1.12) | -3.53 (-1.16) | -1.65 (-0.82) | -1.79 (-0.94) | -2.34 (-0.99) |
| 48 | S1L1 | S1L1 | 0.85 (2.80) | 0.87 (3.06) | 0.84 (3.12) | 0.94 (3.62) | 1.01 (4.02) | 12.15 (4.25) | 15.38 (4.86) | 14.36 (4.18) | 15.95 (4.86) | 16.30 (4.26) |
| | | S4L2 | 1.22 (4.20) | 1.18 (4.22) | 1.24 (4.60) | 1.24 (4.70) | 1.16 (4.41) | 14.98 (4.71) | 12.09 (3.62) | 12.11 (3.98) | 12.85 (4.19) | 15.99 (4.48) |
| | | S4L2-S1L1 | 0.36 (1.28) | 0.31 (1.20) | 0.40 (1.71) | 0.30 (1.39) | 0.15 (0.72) | 2.83 (1.15) | -3.28 (-1.15) | -2.25 (-1.02) | -3.10 (-1.57) | -0.31 (-0.15) |
| 60 | S1L1 | S1L1 | 0.92 (3.18) | 0.97 (3.55) | 0.91 (3.52) | 0.98 (3.91) | 1.00 (4.10) | 12.82 (4.21) | 14.79 (4.89) | 15.22 (4.24) | 16.23 (4.99) | 16.32 (4.18) |
| | | S4L2 | 1.32 (4.44) | 1.29 (4.49) | 1.40 (4.98) | 1.39 (5.00) | 1.26 (4.56) | 17.26 (4.67) | 12.67 (3.88) | 12.73 (4.25) | 12.91 (3.99) | 15.48 (4.12) |
| | | S4L2-S1L1 | 0.39 (1.41) | 0.32 (1.29) | 0.49 (2.13) | 0.41 (1.94) | 0.25 (1.27) | 4.45 (1.61) | -2.13 (-0.80) | -2.49 (-1.07) | -3.32 (-2.05) | -0.84 (-0.42) |

| Panel B: Emerging Markets | | | | | | | | | | | | |
|---------------------------|------|-----------|------------------------|------------------|----------------|------------------|------------------|---------------------------|-------------------|-----------------|------------------|------------------|
| J1 | J2 | Portfolio | Holding Period Returns | | | | | Annual Event Time Returns | | | | |
| | | | K = 1 | K = 3 | K = 6 | K = 9 | K = 12 | Year 1 | Year 2 | Year 3 | Year 4 | Year 5 |
| 6 | 36 | S1L1 | 1.67 (2.99) | 1.66 (3.31) | 1.37 (2.80) | 1.34 (2.80) | 1.52 (3.24) | 20.65 (3.00) | 22.52 (3.82) | 15.59 (2.55) | 20.76 (3.54) | 14.32 (2.53) |
| | | S4L2 | 2.30 (4.57) | 2.02 (4.43) | 1.87 (4.15) | 1.51 (3.39) | 1.32 (3.00) | 21.65 (3.37) | 13.11 (2.27) | 17.87 (3.20) | 12.11 (1.86) | 14.57 (2.39) |
| | | S4L2-S1L1 | 0.63 (1.02) | 0.37 (0.71) | 0.50 (1.04) | 0.16 (0.37) | -0.21 (-0.51) | 1.00 (0.18) | -9.41 (-2.88) | 2.27 (0.62) | -8.65 (-2.95) | 0.26 (0.11) |
| 48 | S1L1 | S1L1 | 1.59 (2.80) | 1.71 (3.29) | 1.43 (2.83) | 1.52 (3.09) | 1.63 (3.40) | 22.12 (3.44) | 23.36 (3.78) | 14.22 (2.30) | 20.16 (3.18) | 15.87 (2.57) |
| | | S4L2 | 1.60 (3.38) | 1.63 (3.68) | 1.52 (3.42) | 1.32 (2.94) | 1.18 (2.61) | 16.52 (2.73) | 12.36 (2.13) | 16.75 (2.76) | 15.26 (2.35) | 13.11 (2.15) |
| | | S4L2-S1L1 | 0.01 (0.02) | -0.09 (-0.17) | 0.09 (0.20) | -0.20 (-0.46) | -0.45 (-1.16) | -5.60 (-1.08) | -11.00 (-2.65) | 2.53 (0.70) | -4.91 (-1.49) | -2.76 (-1.13) |
| 60 | S1L1 | S1L1 | 1.75 (3.10) | 1.70 (3.22) | 1.35 (2.65) | 1.39 (2.79) | 1.47 (3.01) | 23.35 (3.20) | 20.29 (3.32) | 15.61 (2.40) | 20.68 (3.00) | 17.23 (2.80) |
| | | S4L2 | 1.62 (3.20) | 1.66 (3.49) | 1.53 (3.20) | 1.24 (2.56) | 0.95 (2.00) | 16.73 (2.61) | 12.23 (2.02) | 18.61 (3.00) | 16.47 (2.37) | 12.17 (1.99) |
| | | S4L2-S1L1 | -0.13 (-0.22) | -0.04 (-0.07) | 0.18 (0.40) | -0.15 (-0.35) | -0.51 (-1.32) | -6.62 (-1.19) | -8.06 (-2.14) | 3.00 (0.94) | -4.21 (-1.19) | -5.05 (-2.36) |

This table presents the average monthly returns in percentages of the short, long and arbitrage portfolios of the *early* stage momentum strategy. Portfolios are based on the 6 month formation period contrarian strategy $J1 = 6$. The formation of these portfolios is explained in Table 2. Within the short-term winner *S4* portfolio and the short-term loser *S1* portfolio, indices are further classified into two portfolios each where the top 50 of indices have best long-term performance *L2* and the bottom 50 of indices have the worst long-term performance *L1* over the past formation months $J2 = 36, 48, 60$. The resulting four portfolios are: short-term winners that have worst long-term performance *S4L1* and worst long-term performance *S4L2*, and short-term losers that have worst long-term performance *S1L1* and best long-term performance *S1L2*. The *late* stage momentum strategy *S2L2-S1L1* is held for $K=1, 3, 6, 9$ and 12 months. The annual returns (*Year 1, Year 2, Year 3, Year 4* and *Year 5*) are computed as the average compounded returns in percentages for the first five years following the formation date. The *t*-statistics for the K monthly returns are simple *t*-statistics, whereas for the annual returns are calculated using Newey-West (1987) autocorrelation correction estimates up to 11 lags. The *t*-statistics are presented in parenthesis.

Table 5
Risk-Adjusted Pure Momentum, Early-Stage and Late-Stage Momentum Profits

| Section 1: Developed Markets | | | | | |
|------------------------------|------------|--------------------|--------------------|--------------------|--------------------|
| Panel A: Pure Momentum | | | | | |
| Portfolio | Raw Return | Two-Factor Model | | | Adj R ² |
| | | α | β | v | |
| S1 | 0.78 | -0.159 (-1.148) | 1.069 (22.699) | 0.298 (4.049) | 69.8 |
| S4 | 1.46 | 0.413 (2.845) | 1.062 (21.900) | 0.098 (1.271) | 71.0 |
| S4-S1 | 0.68 | 0.571 (3.130) | -0.007 (-0.104) | -0.200 (-2.135) | 0.5 |
| Panel B: Early-Stage | | | | | |
| S1L2 | 0.65 | -0.322 (-2.089) | 1.088 (27.509) | 0.197 (2.278) | 66.9 |
| S4L1 | 1.43 | 0.472 (2.885) | 1.057 (17.730) | 0.228 (2.336) | 65.7 |
| S4L1-S1L2 | 0.78 | 0.793 (3.664) | -0.031 (-0.419) | 0.030 (0.237) | -0.3 |
| Panel C: Late-Stage | | | | | |
| S1L1 | 0.91 | -0.026 (-0.152) | 0.982 (20.369) | 0.411 (4.987) | 57.4 |
| S4L2 | 1.40 | 0.438 (2.420) | 1.098 (21.107) | -0.012 (-0.108) | 61.8 |
| S4L2-S1L1 | 0.49 | 0.464 (2.029) | 0.116 (1.866) | -0.423 (-3.456) | 3.8 |
| Section 2: Emerging Markets | | | | | |
| Panel A: Pure Momentum | | | | | |
| Portfolio | Raw Return | Two-Factor Model | | | Adj R ² |
| | | α | β | v | |
| S1 | 1.18 | 0.530 (1.480) | 0.968 (10.262) | 0.267 (1.390) | 33.1 |
| S4 | 1.95 | 1.317 (3.819) | 0.921 (10.792) | 0.106 (0.636) | 33.6 |
| S4-S1 | 0.77 | 0.787 (2.032) | -0.046 (-0.525) | -0.161 (-0.917) | -0.4 |
| Panel B: Early-Stage | | | | | |
| S1L2 | 0.77 | 0.013 (0.033) | 1.169 (12.274) | 0.162 (0.843) | 42.9 |
| S4L1 | 1.64 | 0.942 (2.615) | 1.033 (12.850) | 0.106 (0.493) | 41.0 |
| S4L1-S1L2 | 0.87 | 0.929 (2.144) | -0.137 (-1.325) | -0.056 (-0.237) | 0.0 |
| Panel C: Late-Stage | | | | | |
| S1L1 | 1.35 | 0.628 (1.546) | 1.076 (11.514) | 0.178 (0.760) | 36.6 |
| S4L2 | 1.53 | 0.790 (2.165) | 1.116 (11.624) | -0.115 (-0.658) | 45.3 |
| S4L2-S1L1 | 0.18 | 0.162 (0.367) | 0.040 (0.384) | -0.292 (-1.205) | 0.1 |

This table presents the two-factor regression results for the monthly returns of the momentum portfolios with $J = 6$ and $K = 6$ and the early-stage and late-stage portfolios with $J/J2 = 6/60$ and $K = 6$. For the pure momentum strategy, S4 is the portfolio of short-term winners and S1 is the portfolio of short-term losers (as described in Table 2). For the early-stage strategy, S1L2 is the portfolio of short-term losers that have the best long-term performance, and S4L1 is the portfolio of short-term winners that have the worst long-term performance. For the late-stage strategy, S1L1 is the portfolio of short-term losers that have the worst long-term performance and S4L2 is the portfolio of short-term winners with the best long-term performance (as described in Tables 3 and 4). The two-factor regression is as follows:

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{wt} - R_{ft}) + v_p VMG_t + \varepsilon_{pt}$$

where $R_{wt} - R_{ft}$ is the excess return on the MSCI World Market portfolio and VMG_t is the value growth factor represented by the return on the MSCI World Value Index minus the return on the MSCI World Growth Index. *Raw Return* is the unadjusted monthly percent return for the respective portfolio. The *t*-statistics presented in parentheses are corrected for heteroskedasticity using White's (1980) test.

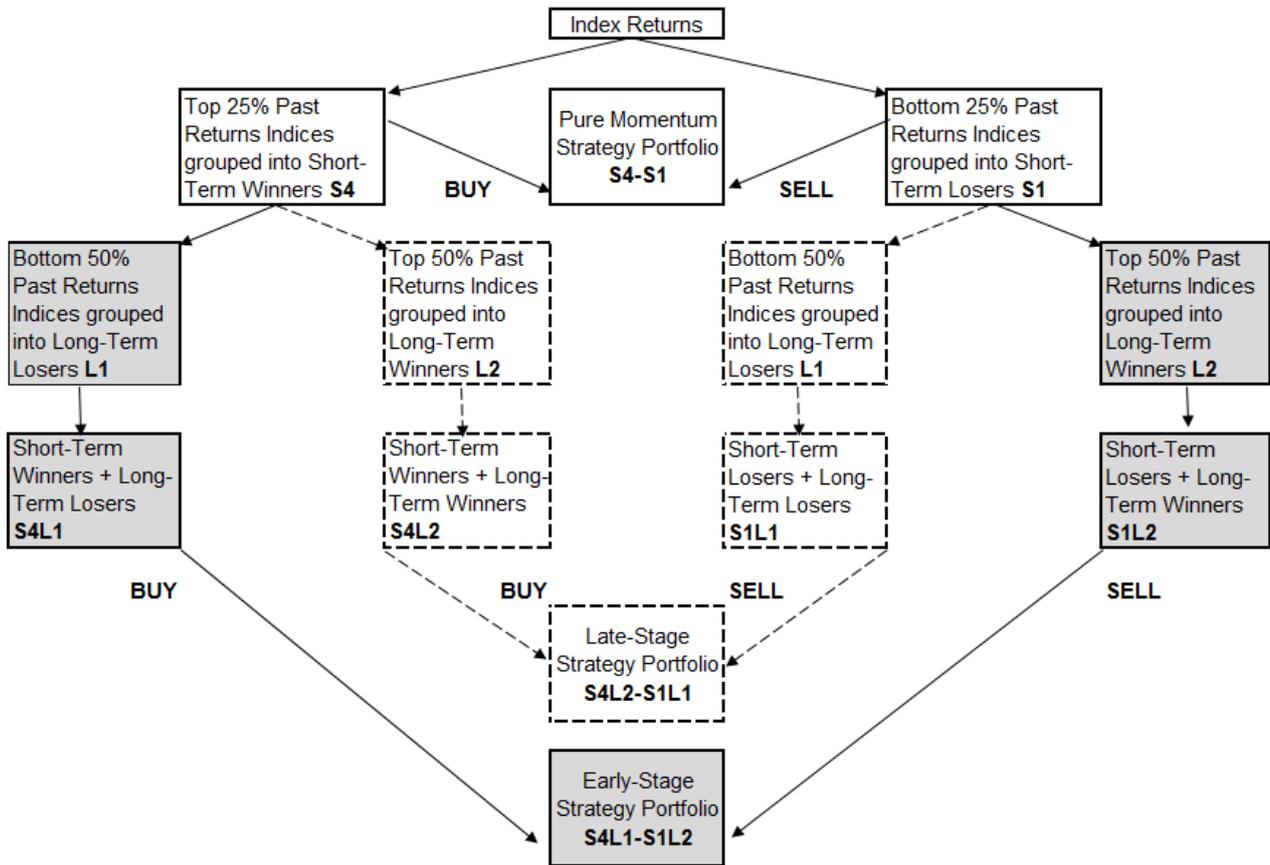


Figure 1
Graphical representation of the pure momentum, early-stage and late-stage strategies.

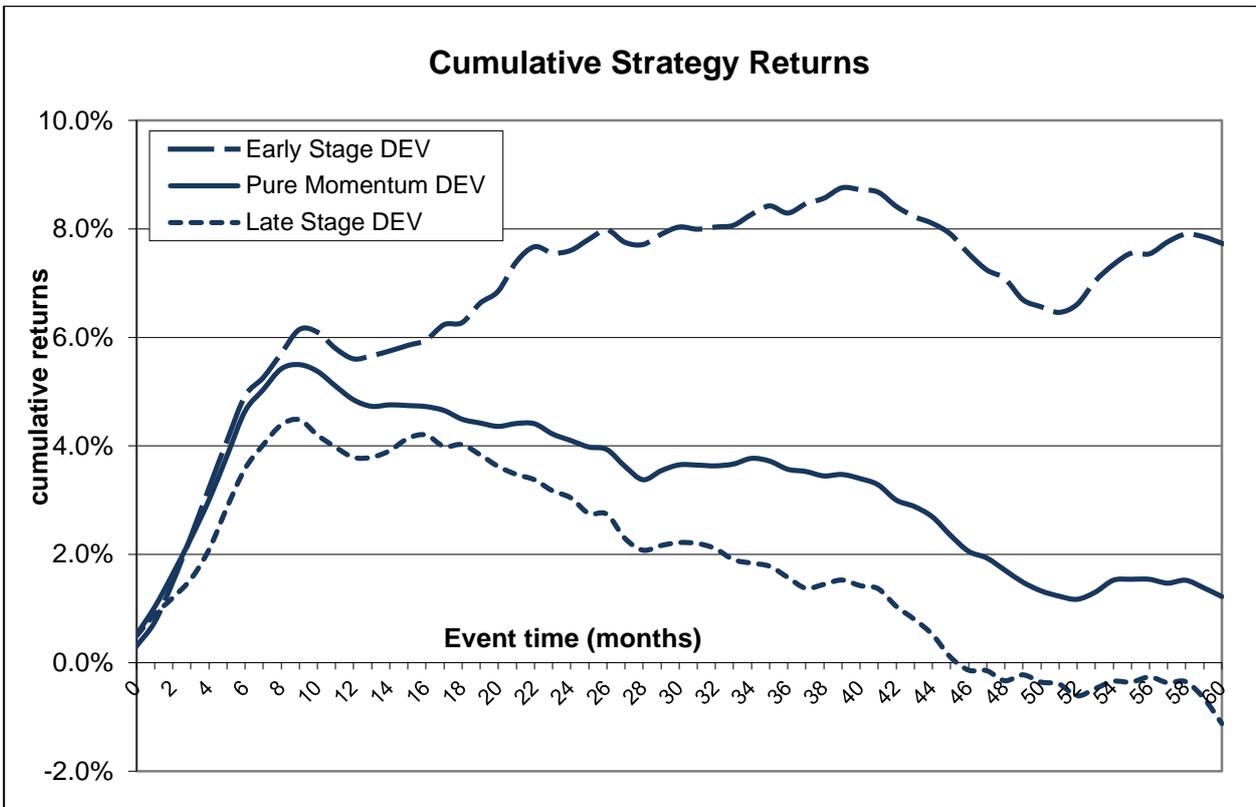


Figure 2 Cumulative Returns of Strategies: Developed Markets
 The graph presents the cumulative returns of the early-stage portfolio S4L1-S1L2 and the late-stage portfolio S4L2-S1L1 (with $J/J2 = 6/60$) and the cumulative returns of the pure momentum portfolio S4-S1 (with $J = 6$) using non-overlapping portfolios ($K = 1$) for the 60 months following the end of the formation period.

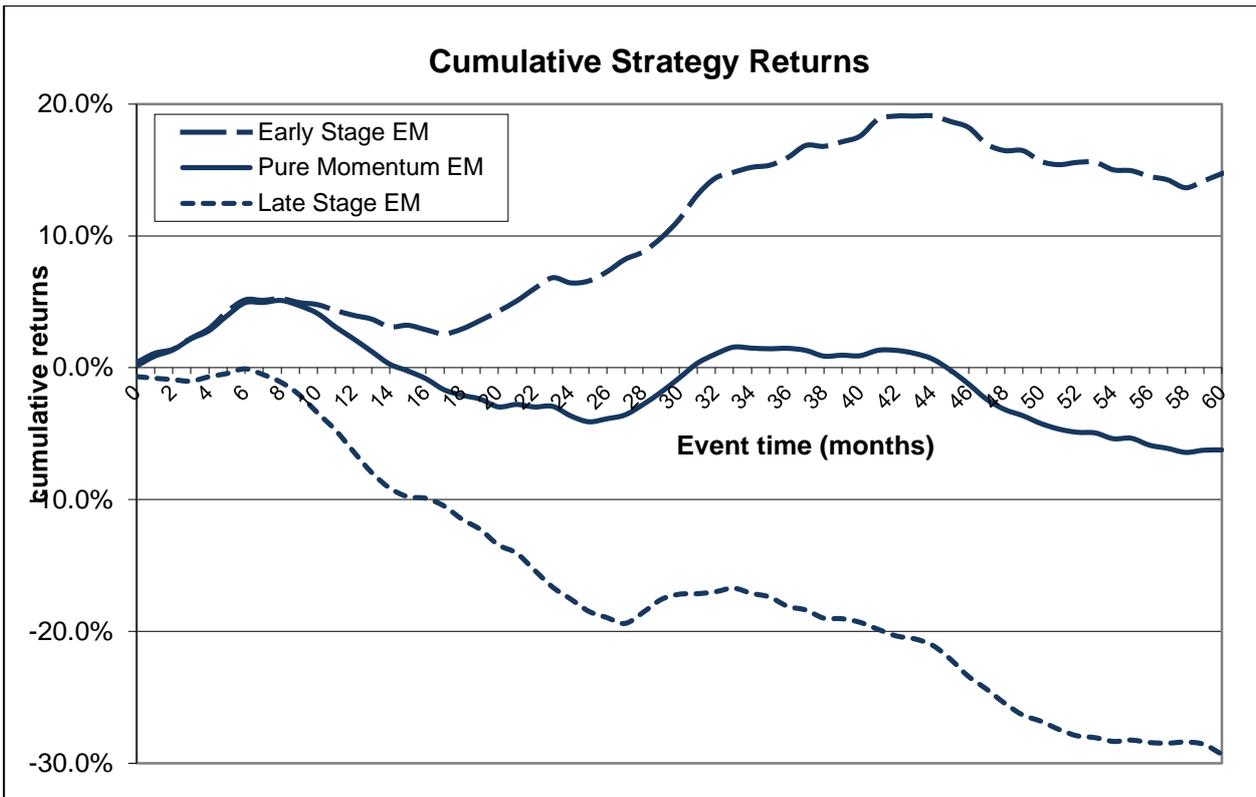


Figure 3 Cumulative Returns of Strategies: Emerging Markets
 The graph presents the cumulative returns of the early-stage portfolio S4L1-S1L2 and the late-stage portfolio S4L2-S1L1 (with $J/J2 = 6/60$) and the cumulative returns of the pure momentum portfolio S4-S1 (with $J = 6$) using non-overlapping portfolios ($K = 1$) for the 60 months following the end of the formation period.