

## **PRICE REVERSAL AND MOMENTUM STRATEGIES**

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This version: May 2002

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We are grateful to Yeung Lewis Chan, Chuan Yang Hwang, Lewis H. K. Tam, Sheridan Titman, K. C. John Wei, seminar participants at Hong Kong Baptist University and PhD student workshop at HKUST for helpful comments and suggestions. Kot also thanks Harry Leung for computing support. All errors are our own.

## PRICE REVERSAL AND MOMENTUM STRATEGIES

### ABSTRACT

This paper investigates the role of price reversal in momentum strategies. We hypothesize that the momentum strategies implemented in the early stage of price reversal (MSES) are more profitable than those implemented in the late stage of price reversal (MSLS). Empirical results shows that while MSES records significant positive returns, the profits to MSLS are not significant. There is a continuation of momentum profits in MSES but a reversal in MSLS. Regression analysis shows that returns in MSES could be captured by the book-to-market factor in the Fama and French three-factor model.

*JEL classification:* G11; G14

*Keywords:* Price reversal, Momentum strategies

## INTRODUCTION

The co-existence of short-term price momentum and long-term price reversals has been widely documented in the literature. DeBondt and Thaler (1987, 1987), Chopra, Lakonishok and Ritter (1992) showed that there are price reversals at horizons of around three to five years, so that contrarian strategies of buying past losers and sell past winners are profitable when implemented based on such time horizons. On the other hand, Jegadeesh and Titman (1993, 2001a), Chan, Jegadeesh, and Lakonishok (1996), Rouwenhorst (1998), Chan, Hameed and Tong (2000), and Grundy and Martin (2001) showed that there are price continuations at horizons of three to twelve months, so that momentum strategies of buying past winners and selling past losers are profitable when implemented based on these time horizons.

It is difficult for any rational pricing models to explain the co-existence of both price momentum at short horizons and price reversals at long horizons. In recent years, behavioral finance models have been proposed to explain the two phenomena simultaneously. Daniel, Hirshleifer, and Subrahmanyam (1998) show that overconfidence leads to negative long-run autocorrelations while biased self-attribution results in positive short-run autocorrelations. Hong and Stein (1999) assume that information diffuses gradually so that prices underreact in the short-run. When momentum traders implement naive momentum strategies based on past price trends, their trades will finally lead to overreaction at long horizons. In the learning model of Barbeis, Shleifer, and Vishny (1998), while actual earnings follow a random walk, individuals believe that earnings either follow a steady growth trend or are mean-reverting.

Despite the co-existence of short-term price momentum and long-term price reversal, except for a few papers, there is not much empirical analysis of the two effects jointly. Jegadeesh and Titman (2001a) showed that while there are profits to momentum-sorted portfolios at the initial stage of implementation, the profits decline over time and are eventually reversed. Their results are consistent with the predictions of some behavioral models (like Daniel et. al., 1998) that delayed reactions will lead to price momentum, which

finally pushes the prices away from the equilibrium values. Another related paper is Lee and Swaminathan (2000) who demonstrate that past trading volume predicts both the magnitude and persistence of future price momentum. They show that the price momentum of low-volume stocks is generally smaller than large-volume stocks. Based on the one-year horizon, the return differential between past winners and past losers is wider for high-volume firms, due mainly to the tendency of low-volume losers to rebound. In the long term, a strategy of buying low-volume winners and selling high-volume losers continues to earn positive returns beyond the first year while a strategy of buying high-volume winners and selling low-volume losers earn negative returns after the first year

In this paper, we provide a further analysis of the interaction of price momentum and price reversal effects. The main hypothesis is that if the short-term price trend occurs subsequent to the price reversal, the price momentum will be stronger and last longer in the future. The reasoning behind the hypothesis is simple. Suppose a stock overshoots the equilibrium value so that it experiences a price reversal. Since a price reversal is triggered only if there is substantial mispricing, the price momentum in the early stage of price reversal will be large in order to push the price back to the equilibrium value. On the other hand, if a stock is in the late stage of a price reversal, since it has experienced the price correction over a long period, it should run out of momentum.

In the empirical analysis we therefore distinguish the momentum stocks in the early stage of price reversal from those in the late stage. First, we follow traditional momentum strategies by sorting the stocks into winners and losers based on past short-term performance. Second, within the short-term winner portfolio and short-term loser portfolio, we further sort stocks into long-term winners and long-term losers based on longer-term performance in the past. For momentum strategies implemented in the early stage or price reversal (MSES), we buy stocks that are of short-term winners but long-term losers and sell stocks that are of short-term losers but long-term winners. For momentum strategies implemented in the late stage of price reversal (MSLS), we buy stocks that are of both short-term and long-term winners and sell stocks that are of both short-term and long-term losers. Our prediction is

that for the price momentum for MSES is bigger than MSLS so that MSES is more profitable.

Our empirical work is different from some other papers that also investigate the joint interaction of momentum strategies and contrarian strategies in several ways. In a recent paper, Balvers and Wu (2002) construct an indicator based on the mean reversion and momentum effects together. By applying the analysis to 18 developed equity markets on a monthly basis, they find that the combined momentum-contrarian strategies outperform both pure momentum and pure mean reversion strategies. However, while our work is based on individual securities in the U.S. market, Balvers and Wu (2002) focus on the aggregate market in 18 developed countries. Our work is also different from Jegadeesh and Titman (2001a). Jegadeesh and Titman (2001a) show how the profits of momentum-sorted portfolio will be reversed when the portfolio enters the contrarian cycle. On the other hand, we explore how the profits of momentum-sorted portfolios will be affected when they are formed at the early stage vs. the late stage of the contrarian cycle.<sup>1</sup>

We find that returns of MSES are significantly positive while returns of MSLS are insignificantly different from zero. The empirical results are insensitive to the choice of holding period and the sample period. Furthermore, unlike Jegadeesh and Titman (2001a) who show that the momentum profits will be reversed after 12 months, the momentum profits of MSES continue to increase in the 60-month holding period. Therefore, the price continuation is much stronger for stocks that are in the early stage of price reversal. We also show that the long-term winner (loser) stocks have lower (higher) book-to-market ratios. Not surprisingly, the returns of the momentum portfolios could be *partially* captured by the book-to-market factor in the Fama and French three-factor model.

The remains of the paper are organized as follows. Section I reviews the previous work on momentum strategies and presents the methodologies for investigating the joint

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<sup>1</sup> Other works examine the profitability of momentum strategies and contrarian strategies *independently*, for example Schiereck, DeBondt, and Weber (1999) examines in the Germany market, and Kato(2002) examine in the Japanese market.

effects of price momentum and price reversal. Section II presents analysis on the momentum profits. Section III provides an assessment of the risk of the momentum strategies. Section IV provides long-term performance and robustness check. This is followed by a conclusion in Section V.

## **I. MOMENTUM STRATEGIES**

### *A. Previous work on Momentum Strategies*

Numerous studies have examined the profitability of momentum strategies.<sup>2</sup> Jegadeesh and Titman (1993) document stock price continuation in the three to twelve months holding period in the U.S. market and show that the momentum strategies (buy past winners and sell past losers) are profitable. In a recent study, Jegadeesh and Titman (2001a) reexamine the momentum strategies with the data in 1990s and show that momentum strategies continue to be profitable. There is also evidence that the momentum strategies are also profitable in non-U.S. equity markets. Rouwenhorst (1998, 1999) implements the momentum strategies in twelve European countries and emerging markets and finds that momentum effect exists in these markets. Chan, Hameed and Tong (2000) show that momentum strategies are profitable using the stock index data in 23 countries. They also show that momentum profits arise mainly from the stock markets rather than the currency markets. Chui, Titman, and Wei (2000) demonstrate that momentum profits exist in eight Asian markets.

A question that arises is whether the momentum is driven by delayed reaction to systematic information or to firm-specific information. Moskowitz and Grinblatt (1999) document momentum effect in industry components of stock returns. Once the industry momentum effect is controlled, momentum strategies are less profitable. On the other hand, Lee and Swaminathan (2000) report that industry adjustment only account for 20 percent of

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<sup>2</sup> Jegadeesh and Titman (2001b) provide a review of momentum strategies..

price momentum effect. Grundy and Martin (2001) show that momentum strategies are more profitable when formulated based on past stock-specific returns rather than the total returns in the past. Chordia and Shivakumar (2002) examine the relative importance of common sources of momentum profits, and show that payoffs of momentum strategies can be explained by a set of lagged macroeconomic variables and such payoffs disappear once stock returns are adjusted for their predictability based on these macroeconomic variables.

A number of studies have investigated the underreaction of prices to new information. Jegadeesh and Titman (1993) and Chan, Jegadeesh, and Lakonishok (1996) provide corroborating evidence by showing that stock prices underreact to news announcement. Hong, Lim, and Stein (2000) show that the underreaction is consistent with the gradual diffusion model of Hong and Stein (1999), where the information diffuses only gradually across the investing public. They find that momentum strategies tend to work better for stocks with low analyst coverage. Lee and Swaminathan (2000) consider the role of trading volume when forming the momentum strategies. They show that past trading volume play the role to link the momentum strategies and contrarian strategies. For example, they report that price momentum effects reverse over the next five years, and high (low) trading volume winners (losers) experience faster reversals.

#### *B. Momentum Strategies in Different Stages of Price Reversal*

To investigate the interaction of price momentum and price reversal effects, we formulate our trading strategies as follows. First, we sort the stocks into winners and losers based on the past short-term performance (from month  $-t$  to month  $-1$ ). Next, within the short-term winner and loser groups, we further sort the stocks into winners and losers based on the long-term performance prior to month  $-t$  (from month  $-T$  to month  $-(t+1)$ ). Therefore, a stock could fall into one of the following categories: (i) short-term winner and long-term winner; (ii) short-term winner and long-term loser; (iii) short-term loser and long-term winner; and (iv) short-term loser and long-term loser. Figure 1 depicts the price paths for these four

scenarios, where panel A is for the stocks in (i) and (ii), and panel B is for the stocks in (iii) and (iv).

We first compare the stocks in (i) and (ii). Since the stock in (ii) is a short-term winner and long-term loser, it experiences the price reversal recently. We define the stock in (ii) to be in an early stage of price reversal. For the stock in (i) that does not experience a price reversal recently, it is defined to be in the *late* stage of price reversal. When the price reversal occurs, it is likely that the price deviates significantly from the equilibrium value. We conjecture that the momentum necessary for the price correction will be large when the stock is in the early stage of price reversal. On the other hand, since the stock in (i) is a winner in both the short-term and long-term, the momentum to push the stock price upward is much smaller. We therefore predict that the stock in (ii) will outperform the stock in (i) after month 0.

We could make a similar prediction for the stocks in (iii) and (iv). Since the stock in (iii) is a short-term loser and long-term winner, it is also in the early stage of price reversal. The momentum gained from the price reversal is therefore bigger than that of the stock in (iv) which does not experience the price reversal lately. Since the stocks are in a downward trend, we predict that the stock in (iii) will decline much faster than and underperform the stock in (iv).

In the implementation, we need to decide on the length of windows in ranking the short-term and long-term performance. Following Jegadeesh and Timan (1993), we rank the short-term performance based on last six-month return. Previous literature shows that momentum strategies are profitable in less than 12 months while contrarian strategies are profitable based on 3-5 year window. Based on the above consideration, we will rank the stocks based on past 60-month performance. First, we sort the stocks into five groups based on the short-term returns from month  $-t$  to month  $-1$ , with  $t$  not bigger than 12. Group 1 is the short-term loser, while group 5 is the short-term winner. Within each group, we further sort stocks into four sub-groups based on the long-term returns from month  $-60$  to month  $-(t+1)$ . Therefore, stocks in four sub-groups have similar short-term performance but

differ in long-term performance. Sub-group 1 is the long-term loser, while sub-group 4 is the long-term winner. Altogether we have twenty portfolios based on two-way dependent sorting.

## II. EMPIRICAL RESULTS

### A. Data

We include all domestic common stocks listed on the New York (NYSE), American (AMEX), and NASDAQ stock markets. Closed-end funds, Real Estate Investment Trusts (REITs), trusts, American Depository Receipts (ADRs), and foreign stocks are excluded on the analysis. Follow Jegadeesh and Titman (2001a), we exclude stocks priced below \$5 at the beginning of the holding period and all stocks with market capitalizations that would place them in the smallest NYSE decile. This is to ensure the results are not driven by small and illiquid stocks or by bid-ask bounce.

### B. Preliminary Results

Following our previous discussion, we sort the securities based on a two-way classification using the returns over the prior 60 months. At the beginning of every month in the sample period, we rank stocks on the basis of their returns over the short-term period from month  $-t$  to month  $-1$  and then group the stocks into 5 portfolios. Within each portfolio, we further sort stocks into 4 sub-portfolios based on their returns over the long-term period prior to month  $-k$  (from month  $-60$  to month  $-(k+1)$ ). Under this procedure each stock is assigned to one of twenty portfolios. We will trace the performance of each portfolio for the six months following the portfolio formation.

Table 1 reports buy-and-hold returns for the twenty portfolios based on various windows for ranking short-term performance (3, 6, 9, and 12 months). The first column indicates the ranking of the portfolios in terms of short-term performance (1 being the worst

and 5 being the best), while the second column indicates the ranking of the sub-portfolios in terms of long-term performance (1 being the worst and 4 being the best). The holding period returns of the portfolios are generally higher if the portfolios perform better recently. For example, using the 12-month ranking period, the returns to the short-term loser portfolios (#1 short-term ranking) after formation vary from 0.75% to 1.33% per month, while the returns to the short-term winner portfolios (#5 short-term rank) vary from 1.67% to 1.86% per month. Similar results are obtained for the other ranking periods as well. These results are consistent with the momentum effect widely documented in the previous literature.<sup>3</sup>

Once we control for past short-term performance, stocks with better past long-term performance will have lower returns in future. Using the 12-month ranking period as an example, among those short-term loser portfolios (#1 short-term ranking), the holding period monthly returns decrease monotonically from the long-term winner portfolio (#4 long-term ranking) to the long-term loser portfolio (#1 long-term ranking), being 0.75%, 1.02%, 1.18%, and 1.33% for the four sub-portfolios, respectively. Therefore, among short-term losers, the stocks that are most likely to continue the bad performance are those that experience price reversal recently (from long-term winners to short-term losers). Likewise, among those short-term winner portfolios (#5 short-term ranking), the holding period returns also decrease monotonically from the long-term winner portfolio (#4 long-term ranking) to the long-term loser portfolio (#1 long-term ranking). Therefore, among short-term winners, the ones that are most likely to continue the good performance are those that experience price reversal recently (from long-term losers to short-term winners). These results are consistent with our hypothesis that the price momentum is the strongest for those stocks that are in the early stage of price reversal.

We also compare the profitability of the momentum strategies implemented in the early stage of price reversal and in the late stage of price reversal. The momentum strategies

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<sup>3</sup> The difference between the monthly returns to winner portfolio and loser portfolio is generally smaller than the one percent figure reported in Jegadeesh and Titman (1993, 2001a). It, however, has to be noted that while Jegadeesh and Titman sort the stocks into 10 deciles, we group the stocks into 5 portfolios in the first sorting.

implemented in the early stage of price reversal (MSES) involves buying stocks that are short-term winners but long-term losers, and selling stocks that are short-term losers but long-term winners. In contrast, the momentum strategies implemented in the late stage of price reversal (MSLS) involves buying stocks that are winners in both the short term and long term, and selling stocks that are losers in both the short term and long term. The returns of the momentum strategies are computed as the difference between the returns of the long and short portfolios. As shown in Table 1 the monthly returns of MSES vary from 0.64% for the 3-month ranking period to 1.37% for the 9-month ranking period and are highly significant. In contrast, the monthly returns of MSLS are much smaller and generally statistically insignificant. This shows that the momentum profits are reduced significantly if the momentum stocks are from the late stage of price reversal.

To examine whether the results are sensitive to the choice of holding periods, we also compute the returns of momentum strategies for different holding periods (3, 6, 9, 12 months). Panels B and C of Table 2 reports the monthly returns of MSLS and MSES for different combinations of ranking and holding periods. For comparison, Table 2 also reports the returns of the simple (one-way sorting) momentum strategies (Panel A). The simple momentum strategies are to sort the stocks into five portfolios based on past short-term performance. The returns of simple momentum strategies are computed as the difference between returns of the winner portfolio and loser portfolio.

Results indicate that regardless of the ranking and holding periods, the returns of MSES are the highest, followed by simple momentum strategies, and the returns of MSLS are the lowest. In fact, the returns of MSLS are insignificantly different from zero for different combinations of the ranking and holding periods, confirming that there is little price momentum for stocks that are in the late stage of price reversal. Overall, our results support the hypothesis that the price momentum varies in different stages of price reversal. A momentum strategy that can take advantage of the information about the price reversal will improve the profitability.

### *C. Characteristics of Stocks in Momentum Strategies*

Previous results demonstrate that momentum profits could be greatly improved by considering the long-term performance in the past. A natural question is whether the past long-term performance is related to some other stock characteristics. We therefore select one representative strategy for further investigation. The strategy that we choose is based on the 6-month short-term performance (month -6 to month -1) and long-term performance from month -60 to month -7. We choose this strategy because Jegadeesh and Titman (1993, 2001a) analyze the simple momentum strategies mainly based on past six-month returns.

Table 3 reports average statistics for the twenty portfolios formed based on the two-way sorting procedure described earlier. By construction, past short-term returns increase monotonically from short-term losers to short-term winners. Once the short-term performance is controlled, there is still a great disparity of long-term performance from long-term losers to long-term winners. The monthly turnover ratio is the ratio of the number of shares traded each month relative to the number of shares outstanding at the end of the month. The turnover ratio seems to bear a U-shaped relationship with the past long-term performance, being higher for long-term winners and long-term losers. Our momentum strategies are therefore not the same as those considered in Lee and Swaminathan (2000), who show that the strategy of buying low-volume winners and selling high-volume losers is more profitable than the strategy of buying high-volume winners and selling low-volume. For our strategies, the winners that we long and the losers that we short in both the MSES and MSLS have higher trading volume. Therefore, contrary to Lee and Swaminathan (2000), the difference in the profitability of MSES and MSLS is not due to the trading volume effect.

Table 3 shows that there is a strong linkage between the past long-term performance and the book-to-market equity ratio. Once the short-term performance is controlled, the book-to-market ratio increases from long-term winners to long-term losers. This shows that after the stock prices have declined for a long period, the book-to-market ratio becomes higher. A related question is whether the profitability of our MSES is related to

book-to-market effect. Finally, there is also a consistent pattern that the firm size is smaller for the long-term losers. We therefore also need to investigate whether the size effect could account for the profitability of MSES.

### **III. RISK ASSESSMENT**

In the previous section, we find that the profits of momentum strategies are significantly different between the early stage and late stage of price reversal cycle. One natural question is whether the risks of these two strategies are also significantly different from each other. We will examine this issue in this section. First, we investigate the return distribution of the two strategies. Second, we will examine whether the momentum profits could be explained by the Fama and French three-factor pricing model. Again, we focus on the strategies sorted first based on past six-month returns, and then based on return performance from month -60 to month -7.

#### *A. Distribution of Returns*

Table 4 reports return distribution of the long portfolio, short portfolio, and the arbitrage portfolio (long portfolio – short portfolio) for MSES and MSLS. The mean returns of the winner portfolios are 1.95% and 1.62% per month for MSES and MSLS, while the mean returns of the loser portfolios are 0.81% and 1.26% per month, respectively. Therefore, both the winner and loser portfolios are responsible for the superior performance of MSES over MSLS. For the arbitrage portfolio, the mean return of MSES is 1.13% per month while the mean return of MSLS is 0.35% per month. The median returns of the two strategies are 0.95% and 0.59% per month, respectively, suggesting that the difference in mean returns between the two strategies is not due to outlier observations. It is also noted that MSES has lower standard deviation and kurtosis and is less negatively skewed than MSLS. Therefore, MSES is less risky than MSLS regardless of which risk measures we use.

## B. Fama and French (1996) three-factor Model

In this section, we test whether the three-factor model of Fama and French (1996) could explain the returns of our momentum strategies. According to Fama and French, the three factors could explain most of the pricing anomalies except the momentum effect, including the contrarian effect. Since our momentum strategies are based on the interaction of contrarian effect and momentum effect, it is interesting to see whether the returns could be subsumed by the three factors.

We therefore estimate the Fama and French three-factor asset-pricing model for the twenty portfolios formed on the two-way sorting procedure:

$$R_{i,t} - R_{f,t} = \alpha_i + b_i(R_{M,t} - R_{f,t}) + s_iSMB_t + h_iHML_t + \varepsilon_{i,t}$$

where  $R_{i,t}$  is the return on portfolio  $i$  at month  $t$ ,  $R_{f,t}$  is the risk-free rate at month  $t$ ,  $R_{M,t}$  is the return on market portfolio at time  $t$ ,  $SMB_t$  is the return on size portfolio (small firm minus big firm) at month  $t$ , and  $HML_t$  is the return on book-to-market portfolio (high book-to-market firms minus low book-to-market firms) at month  $t$ <sup>4</sup>.

Regression results are reported in Table 5. Consistent with Fama and French (1996), the momentum profits cannot be explained by the three-factor model. While the intercepts of short-term losers are significantly negative, the intercepts of short-term winners are significantly positive. On the other hand, the return differentials between long-term winners and long-term losers could be explained by the three factors. The sensitivities of the portfolio to the book-to-market factor decrease with past long-term performance. The long-term losers have negative beta sensitivities to the book-to-market factor while the long-term winners have positive beta sensitivities. This result should not be surprising. According to Table 3, the past long-term performance of the portfolio is negatively correlated

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<sup>4</sup> The data for  $SMB_t$  and  $HML_t$  are downloaded from the website of Fama and French.

with the book-to-market ratio. This explains why the long-term winners (losers) have negative (positive) factor loadings on book-to-market factor. After controlling for Fama and French three factors, the intercepts of long-term losers and long-term winners are not that much different from each others. For example, among the short-term losers, the intercepts of long-term losers and long-term winners are  $-0.43\%$  and  $-0.31\%$ , respectively. Overall, these results are consistent with Fama and French (1996) that contrarian profits could be captured by their three-factor model. Since our momentum strategies are based on the interaction of momentum and contrarian effects, it is not surprising that part of the returns could be explained by the three-factor model. In the bottom of Table 5, we also report the results for the momentum strategies implemented in early and late stage of price reversal. The intercepts of the two strategies are fairly close to each other.

#### **IV. Long-Term Performance and Robustness Check**

##### *A. Long-term Performance*

As documented by Jegadeesh and Titman (2001a), the profits of momentum strategies will typically be reversed after 12 months. We therefore investigate the long-term performance of MSES and MSLS. We will track the average monthly returns in each of the 60 months following the portfolio formation date.

Table 6 reports the returns of MSES and MSLS during the 60-month holding period. The returns of MSES are significantly positive in each of the first eleven months. Although the returns become smaller after the first year or turn negative in a few months, there is still a trend for MSES to generate positive returns in the remaining holding period. On the other hand, the returns of MSLS are much smaller and are positive only in the first eight months. In the remaining holding period, the returns are mostly negative and significantly different from zero.

Figure 2 plots the cumulative returns over the 60-month holding periods. While the

momentum profits of MSLS get reversed after eight months and turn negative after 14 months, the momentum profits of MSES continue to increase throughout the holding period. Our results could be contrasted with those in Jegadeesh and Titman (2001a) that the performance of simple momentum strategies in the 13 to 60 months following portfolio month is negative. Jegadeesh and Titman interpret their results as supporting the delayed overreaction hypothesis in Daniel et. al. (1998) where there is price reversal after a prolonged momentum period. While the results for MSLS are consistent with the hypothesis that the price momentum gets reversed, the results for MSES suggest that the price momentum will be continued if the stocks are in the early stage of price reversal.

Figure 3 displays the long-term performance of winners and losers in early and late stage of momentum strategies. For the short-term 12-month returns, results are consistent with our predictions in Figure 1. Early stage winner and loser, i.e., the stock price experienced reversal recently, have stronger momentum effect than those in the late stage. For the long-term 60-month returns, consist with DeBondt and Thaler (1985) who report that contrarian profits are mainly due to long-term winner (past long-term loser). For the long-term loser (past long-term winner), regardless of the short-term performance, the long-term returns are more flat after 12-month.

#### *B. Seasonality in MESE and MSLS*

Debondt and Thaler (1985, 1987) show that the contrarian profits are especially stronger in January, but Jegadeesh and Titman (1993, 2001a) report that their momentum strategies are not profitable in January. We therefore examine whether our results exhibit seasonal effects. In particular, we compare the average returns for January and the other eleven months (February – December) in the holding period. Results are shown in Table 7. The results for January are similar to the rest of the year. In January, the returns are generally higher for long-term losers than for long-term winners.<sup>5</sup> The returns of the momentum

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<sup>5</sup> Our results also consist with recently papers by Hvidkjaer (2000) and Grinblatt and Moskowitz (2002). Hvidkjaer (2000) documents strong evidence of tax loss trading: first, holding period buy pressure for past winners is evenly distributed among the calendar year, next, the sell pressure for past losers exhibits pronounced seasonality. Grinblatt and Moskowitz (2002) also reports that momentum

strategies are also higher for MSES than for MSLS in January. Therefore, our results are not simply due to seasonality effect.

### *C. Profitability of MSES and MSLS in Sub-period*

We also check the robustness of the results by examining the performance of momentum strategies in different sub-periods. We partition the whole sample period into several sub-periods: 1970-1974, 1975-1979, 1980-1984, 1985-1989 and 1990-1997. Results are reported in Table 8. Except for the 1985-1989 sub-period that includes the 1987 market crash, the returns of MSES are much higher than that of MSLS in the other sub-periods.

## **V. CONCLUSIONS**

This paper combines both the short-term and long-term performance of stocks in forming the momentum strategies. We hypothesize that stocks in the early stage of price reversal (short-term losers but long-term winners or short-term winners but long-term losers) will have bigger momentum in continuing the recent price trend. The momentum strategies implemented in the early stage of price reversal (MSES) will be more profitable than the strategies implemented in the late stage of price reversal (MSLS).

The empirical results are consistent with our predictions. We find that returns of MSES are significantly positive while returns of MSLS are not significantly different from zero. The results are robust to the choice of the ranking and holding periods. We find that past long-term performance is negatively correlated with the book-to-market ratio. As a result, the book-to-market factor in the Fama and French three-factor model is able to explain the differential returns of the two strategies. Contrary to Jegadeesh and Titman (2001a), profits of momentum strategies will not necessarily be reversed after 12 months. In our

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and reversal effects are strongly affected by a turn-of-the-year seasonal, the tax environment and month of the year are both matter.

analysis, while returns of MSLS might get reversed after 8 months, returns of MSES will continue in the whole 60-month holding period.

Overall, our results suggest that we could improve the profits of momentum strategies if we also consider the past long-term performance. The evidence is consistent with the behavioral finance model that the part of the price momentum originates from the price reversal to correct for the overreaction.

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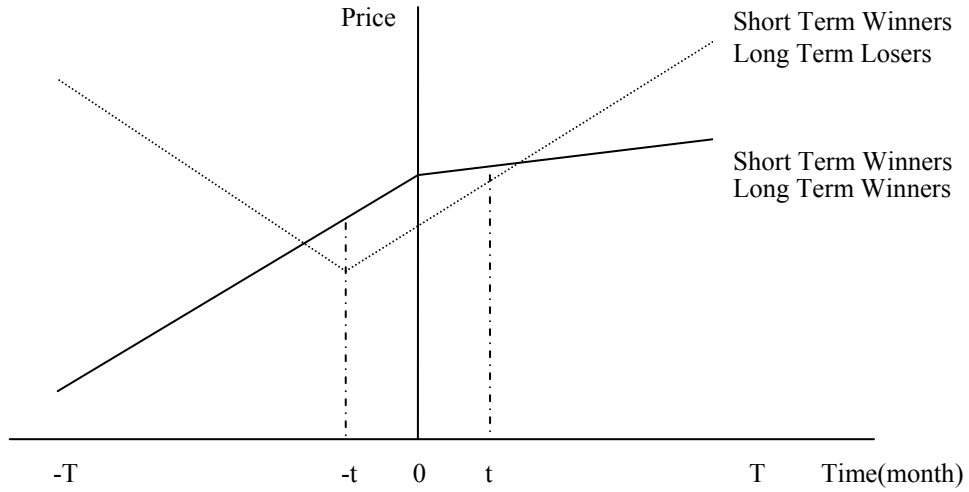
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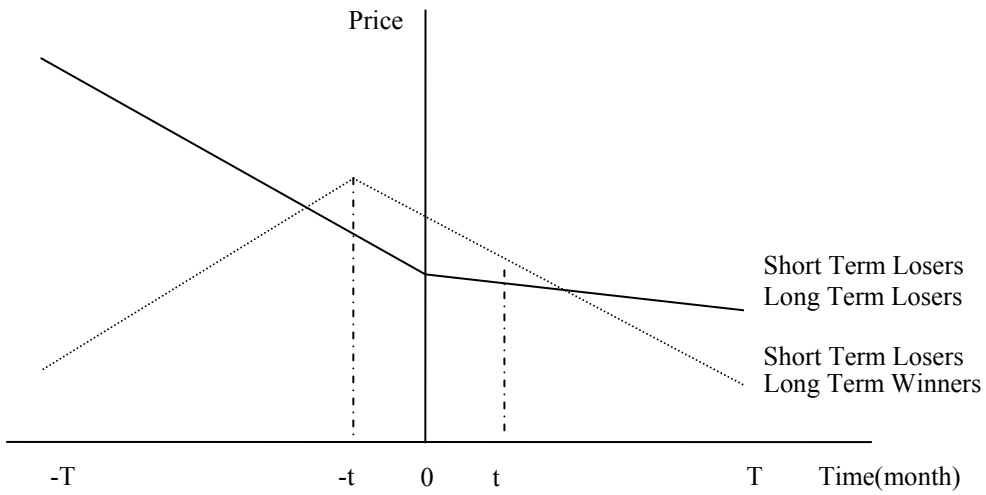
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**Figure 1: Price Reversal and Momentum Strategies.** The figure illustrates the price reversal and momentum strategies. Panel A illustrates the case of winners in momentum strategies. Panel B illustrates the case of losers in momentum strategies.

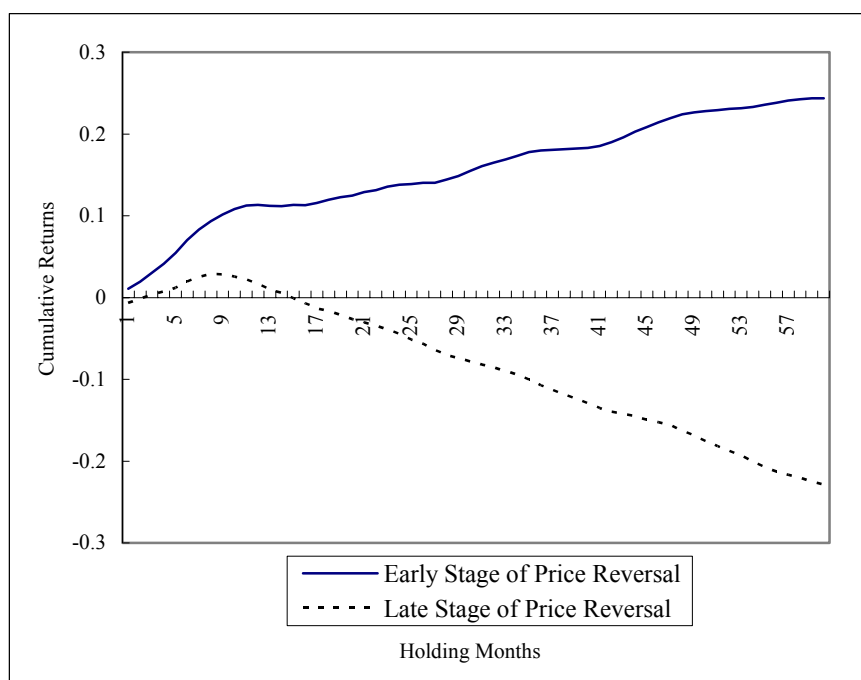
Panel A Short Term Winners



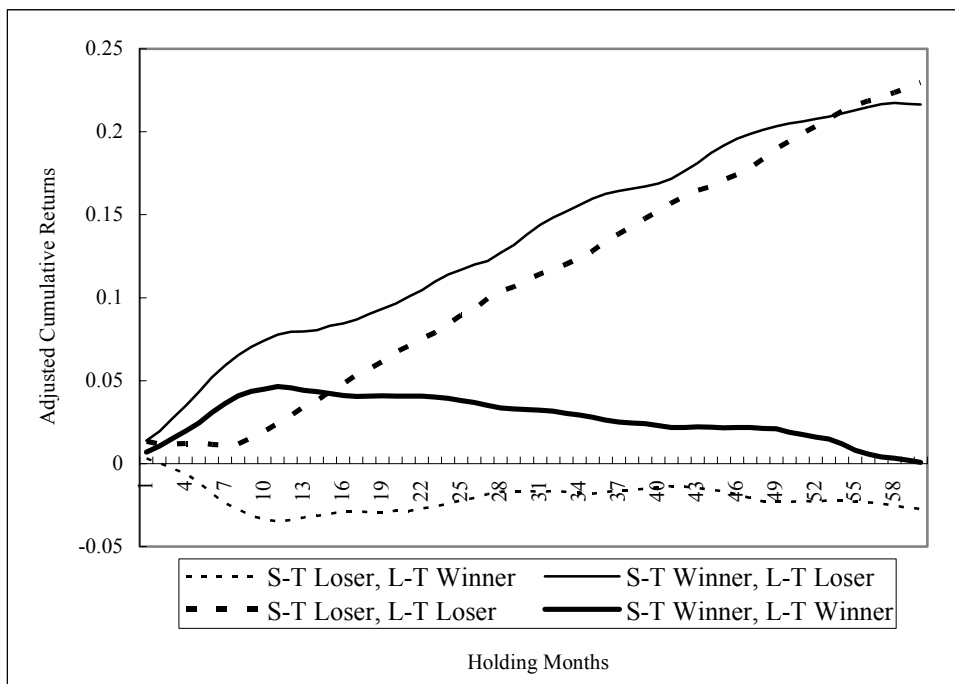
Panel B Short Term Losers



**Figure 2: Long-term Performance of Momentum Strategies Implemented in Early and Late Stage of Price Reversal.** This table reports long-term performance of average monthly returns of momentum strategies in early stage and late stage of price reversal. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. The time gap is 1 month between ranking period and holding period.



**Figure 3: Winners and Losers' Long-term Performance in Momentum Strategies Implemented in Early and Late Stage of Price Reversal.** This table reports adjusted cumulative long-term performance of average monthly returns of momentum strategies in early stage and late stage of price reversal for winners and losers. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Reported cumulative returns are adjusted by *value*-weighed NYSE/AMEX/NASDAQ index. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. The time gap is 1 month between ranking period and holding period.



**Table 1. Holding period returns of Momentum Strategies.** This table reports average monthly returns of twenty portfolios based on two-way dependent sorting momentum strategies applied to common stocks in NYSE/AMEX/NASDAQ from 1965-1997. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups stocks based on their short-term returns from Month -K to Month -1 (with K equals to 3, 6, 9, and 12). We then sort stocks into 4 sub-portfolios based on their long-term returns prior to Month -K (from Month -60 to Month -(K+1)). Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Holding Period is fixed to 6 months. There is a time gap of 1 month between ranking period and holding period.

Past short-term Performance	Past long-term Performance	Ranking Period			
		3 months	6 months	9 months	12 months
(Loser)1	4	0.0102	0.0082	0.0066	0.0075
1	3	0.0125	0.0107	0.0098	0.0102
1	2	0.0126	0.0119	0.0117	0.0118
1	1	0.0136	0.0127	0.0128	0.0133
2	4	0.0137	0.0124	0.0116	0.0121
2	3	0.0147	0.0137	0.0133	0.0129
2	2	0.0143	0.0138	0.0133	0.0138
2	1	0.0151	0.0150	0.0144	0.0145
3	4	0.0144	0.0134	0.0134	0.0133
3	3	0.0149	0.0143	0.0139	0.0143
3	2	0.0140	0.0141	0.0142	0.0142
3	1	0.0149	0.0152	0.0147	0.0151
4	4	0.0146	0.0143	0.0144	0.0143
4	3	0.0146	0.0148	0.0155	0.0153
4	2	0.0138	0.0144	0.0151	0.0152
4	1	0.0146	0.0154	0.0164	0.0162
5	4	0.0144	0.0163	0.0173	0.0167
5	3	0.0151	0.0169	0.0174	0.0172
5	2	0.0153	0.0169	0.0176	0.0172
(Winner)5	1	0.0166	0.0195	0.0203	0.0186
Early stage momentum strategies		0.0064	0.0114	0.0137	0.0111
T-statistic		3.69	5.88	6.78	5.37
Late stage momentum strategies		0.0008	0.0035	0.0044	0.0034
T-statistic		0.38	1.52	1.84	1.41

**Table 2. Incremental Profitability of Momentum Strategies in Early Stage and Late Stage of Price Reversal.** This table reports the incremental profitability from Jegadeesh and Titman (1993) momentum strategies to momentum strategies in early stage (MSES) and late stage (MSLS) of price reversal. Panel A reports the average monthly profits from Jegadeesh and Titman (1993) 5 portfolio momentum strategies. Panel B and Panel C reports the average monthly profits in MSES and MSLS respectively. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups stocks based on their short-term returns from Month -K to Month -1 (with K equals to 3, 6, 9, and 12). We then sort stocks into 4 sub-portfolios based on their long-term returns prior to Month -K (from Month -60 to Month -(K+1)). Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. The time gap is 1 month between ranking period and holding period.

Holding Periods	Ranking Periods			
	3 months	6 months	9 months	12 months
Panel A: 5 Portfolio Momentum Strategies (one sorting)				
3 months	0.0048 3.29	0.0073 4.20	0.0098 5.26	0.0089 4.64
6 months	0.0051 3.99	0.0084 5.25	0.0092 5.23	0.0077 4.27
9 months	0.0061 5.38	0.0078 5.27	0.0076 4.57	0.0064 3.70
12 months	0.0056 4.63	0.0059 4.27	0.0058 3.71	0.0046 2.87
Panel B: Early Stage Momentum Strategies (two sorting)				
3 months	0.0069 3.61	0.0104 4.99	0.0154 7.27	0.0140 6.51
6 months	0.0064 3.69	0.0114 5.88	0.0137 6.78	0.0111 5.37
9 months	0.0087 5.47	0.0117 6.71	0.0121 6.46	0.0097 5.01
12 months	0.0083 5.95	0.0100 6.51	0.0098 5.84	0.0077 4.32
Panel C: Late Stage Momentum Strategies (two sorting)				
3 months	-0.0005 -0.20	0.0006 0.23	0.0022 0.91	0.0024 0.97
6 months	0.0009 0.38	0.0036 1.52	0.0045 1.84	0.0034 1.41
9 months	0.0018 0.86	0.0036 1.59	0.0035 1.50	0.0024 0.97
12 months	0.0008 0.39	0.0016 0.71	0.0013 0.57	0.0005 0.24

**Table 3 Characteristics in Momentum Portfolios.** This table reports mean and median value of portfolio (equal-weighted) characteristics in the last lagged month of two-way dependent sorting momentum strategies. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Holding Period is fixed to 6 months. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. Corresponding annual data of accounting variable from COMPUSTAT. The time gap is 1 month between ranking period and holding period.

“Past Short Term Return” presents the returns from month -6 to month -1. “Past Long Term Return” presents the returns from month -60 to month -7. “Trading Volume” presents the average monthly turnover from month -6 to month -1, where monthly turnover is the ratio of the number of shares traded each month to the number of shares outstanding. “Market Cap” presents the average of market capitalization of stocks in millions US dollar. “B/M Ratio” presents the book-to-market equity ratio.

Table 3

Past Short Term Performance	Past Long Term Performance	Mean					Median				
		Past Short Term Return	Past Long Term Return	Trading Volume	Market Cap	B/M Ratio	Past Short Term Return	Past Long Term Return	Trading Volume	Market Cap	B/M Ratio
1 (Loser)	4 (winner)	-0.1985	4.3899	0.0948	796	0.62	-0.1791	2.9950	0.0558	194	0.47
1	3	-0.1725	1.2904	0.0633	983	0.80	-0.1561	1.1463	0.0396	225	0.68
1	2	-0.1676	0.5358	0.0569	889	0.95	-0.1526	0.4701	0.0378	220	0.82
1	1 (loser)	-0.1793	-0.1192	0.0607	519	1.16	-0.1667	-0.1591	0.0425	160	0.93
2	4	-0.0208	3.1390	0.0575	1255	0.68	-0.0183	2.2669	0.0359	274	0.57
2	3	-0.0194	1.0762	0.0403	1588	0.88	-0.0161	1.0438	0.0278	348	0.79
2	2	-0.0196	0.5161	0.0404	1363	1.00	-0.0166	0.5157	0.0287	329	0.89
2	1	-0.0203	-0.0627	0.0467	763	1.16	-0.0182	-0.0728	0.0337	205	0.96
3	4	0.0749	2.9326	0.0541	1565	0.70	0.0724	2.2443	0.0347	314	0.59
3	3	0.0745	1.0519	0.0376	1810	0.90	0.0721	1.0334	0.0270	390	0.82
3	2	0.0741	0.5306	0.0382	1640	1.01	0.0720	0.5359	0.0276	365	0.90
3	1	0.0745	-0.0392	0.0456	904	1.18	0.0722	-0.0399	0.0332	218	0.98
4	4	0.1813	3.1185	0.0598	1532	0.69	0.1716	2.3893	0.0388	323	0.57
4	3	0.1791	1.0885	0.0422	1907	0.91	0.1687	1.0740	0.0298	372	0.81
4	2	0.1787	0.5335	0.0425	1760	1.04	0.1681	0.5362	0.0308	356	0.92
4	1	0.1809	-0.0461	0.0507	976	1.22	0.1717	-0.0566	0.0366	219	1.00
5	4	0.4580	4.0199	0.0956	1100	0.66	0.3858	2.9615	0.0568	253	0.51
5	3	0.4328	1.2209	0.0715	1362	0.90	0.3636	1.2066	0.0445	253	0.77
5	2	0.4376	0.4864	0.0702	1179	1.08	0.3652	0.4673	0.0455	227	0.92
5 (Winner)	1	0.5125	-0.1767	0.0803	631	1.33	0.4030	-0.2227	0.0545	160	1.06

**Table 4 Return Distribution of Momentum Strategies in Early Stage and Late Stage of Price Reversal.** This table reports the statistics of winners, losers and arbitrage portfolio (winners-losers) in momentum strategies. The second and third columns report the statistics for average monthly profits in early and late stage of momentum strategies respectively. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Holding Period is fixed to 6 months. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. The time gap is 1 month between ranking period and holding period.

	Early Stage Momentum Strategies	Late Stage Momentum Strategies
Panel A: Winner		
<i>Moments</i>		
Mean	0.0195	0.0162
Standard Deviation	0.0616	0.0610
Skewness	-0.9534	-0.6116
Kurtosis	4.7473	2.2801
<i>Quantiles</i>		
75%	0.0595	0.0558
50% (Median)	0.0255	0.0186
25%	-0.0151	-0.0219
Panel B: Loser		
<i>Moments</i>		
Mean	0.0081	0.0127
Standard Deviation	0.0654	0.0642
Skewness	-0.0245	0.2997
Kurtosis	1.6367	3.9576
<i>Quantiles</i>		
75%	0.0466	0.0450
50% (Median)	0.0066	0.01113
25%	-0.0301	-0.0265
Panel C: Winner - Loser		
<i>Moments</i>		
Mean	0.0113	0.0035
Standard Deviation	0.0348	0.0421
Skewness	-0.7226	-1.1744
Kurtosis	3.1602	6.1374
<i>Quantiles</i>		
75%	0.0309	0.0272
50% (Median)	0.0095	0.0059
25%	-0.0064	-0.0172

**Table 5 Fama-French 3-Factor Regressions on Momentum Portfolios.** This table presents Fama-French 3-factor regressions on portfolios of momentum strategies.

$$R_{i,t} - R_{f,t} = \alpha_i + b_i(R_{M,t} - R_{f,t}) + s_iSMB_t + h_iHML_t + \varepsilon_{i,t}$$

where  $R_{i,t}$  is the return on portfolio  $i$  at month  $t$ ,  $R_{f,t}$  is the risk-free rate at month  $t$ ,  $R_{M,t}$  is the return on market portfolio at time  $t$ ,  $SMB_t$  is the return on size portfolio (small firm minus big firm) at month  $t$ , and  $HML_t$  is the return on book-to-market portfolio (high book-to-market firms minus low book-to-market firms) at month  $t$ . Three factors data are download from French website. In the table we report the intercept and coefficients of three factors. We also report the t-statistic under the value. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Holding Period is fixed to 6 months. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997..

Past Short Term Performance	Past Long Term Performance	Intercept	$R_M - R_f$	SMB	HML	$R^2$
(Loser)1	4	-0.0043 -3.53	1.1499 38.24	0.6723 15.24	-0.2103 -4.29	0.90
1	3	-0.0023 -2.00	1.0196 36.89	0.6218 15.34	0.1073 2.38	0.88
1	2	-0.0023 -1.91	1.0466 36.24	0.7178 16.95	0.3235 6.86	0.87
1	1	-0.0031 -2.56	1.1388 38.41	0.9808 22.55	0.5002 10.34	0.89
2	4	0.0003 0.37	1.0371 56.23	0.4738 17.52	-0.0775 -2.57	0.94
2	3	0.0008 1.03	0.9513 52.94	0.4099 15.56	0.2579 8.8	0.93
2	2	0.0002 0.22	0.9628 49.03	0.4764 16.54	0.3895 12.16	0.92
2	1	0.0001 0.08	1.0539 50.53	0.7458 24.38	0.4758 13.98	0.93
3	4	0.0016 2.56	1.0181 64.69	0.3845 16.66	-0.1077 -4.19	0.95
3	3	0.0011 1.74	0.9510 60.15	0.3527 15.21	0.3136 12.15	0.94
3	2	0.0004 0.71	0.9718 62.38	0.3755 16.43	0.3941 15.5	0.94
3	1	0.0003 0.38	1.0533 58.85	0.6583 25.08	0.4923 16.86	0.94

Table 5 continued

Past Short Term Performance	Past Long Term Performance	Intercept	$R_M - R_f$	SMB	HML	$R^2$
4	4	0.0027 3.74	1.0051 57.04	0.4000 15.48	-0.1359 -4.73	0.94
4	3	0.0021 3.26	0.9661 60.69	0.2918 12.5	0.2160 8.32	0.94
4	2	0.0008 1.23	0.9836 62.81	0.3539 15.41	0.3796 14.86	0.94
4	1	0.0004 0.50	1.0841 61.41	0.6369 24.6	0.4806 16.68	0.95
5	4	0.0053 4.68	1.0455 37.59	0.5451 13.36	-0.3785 -8.34	0.90
5	3	0.0045 4.43	1.0330 41.51	0.4322 11.84	0.0037 0.09	0.89
5	2	0.0035 3.56	1.0585 43.89	0.5156 14.58	0.1779 4.52	0.90
(Winner)5	1	0.0048 4.29	1.1495 42.1	0.7629 19.05	0.2969 6.66	0.90
Early stage momentum strategies		0.0035	0.0064	0.0895	0.5078	0.14
T-statistic		1.88	0.14	1.34	6.81	
Late stage momentum strategies		0.0028	-0.0866	-0.0435	-0.8784	0.33
T-statistic		1.41	-1.77	-6.08	-11.02	

**Table 6 Long-term Performance of Momentum Strategies in Early Stage and Late Stage.** This table reports average monthly returns of momentum strategies in early stage and late stage of price reversal in 60-month holding period. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. The time gap is 1 month between ranking period and holding period.

Holding Month	Early stage	T-statistic	Late stage	T-statistic
1	0.0108	4.81	-0.0066	-2.26
2	0.0085	3.79	0.0054	2.13
3	0.0111	5.10	0.0045	1.83
4	0.0106	5.08	0.0042	1.73
5	0.0135	6.39	0.0042	1.77
6	0.0154	7.62	0.0074	3.22
7	0.0130	6.45	0.0059	2.57
8	0.0100	5.13	0.0037	1.57
9	0.0085	4.51	-0.0007	-0.29
10	0.0064	3.51	-0.0027	-1.07
11	0.0044	2.35	-0.0035	-1.43
12	0.0010	0.54	-0.0054	-2.20
13	-0.0014	-0.77	-0.0068	-2.77
14	-0.0002	-0.11	-0.0044	-1.79
15	0.0017	1.00	-0.0067	-2.86
16	-0.0004	-0.23	-0.0063	-2.67
17	0.0025	1.49	-0.006	-2.56
18	0.0040	2.20	-0.0038	-1.68
19	0.0034	1.78	-0.0043	-2.07
20	0.0022	1.17	-0.006	-2.71
21	0.0045	2.47	-0.0039	-1.81
22	0.0024	1.31	-0.0037	-1.75
23	0.0042	2.34	-0.0052	-2.41
24	0.0027	1.41	-0.0062	-2.94

Table 6 continued

Holding Month	Early stage	T-statistic	Late stage	T-statistic
25	0.0009	0.49	-0.0071	-3.30
26	0.0016	0.85	-0.0053	-2.60
27	0.0014	0.76	-0.0084	-4.37
28	0.0025	1.36	-0.0063	-3.25
29	0.0044	2.47	-0.0035	-1.90
30	0.0069	3.88	-0.0046	-2.45
31	0.0065	3.71	-0.0044	-2.30
32	0.0046	2.53	-0.0037	-1.97
33	0.0042	2.20	-0.0046	-2.21
34	0.0045	2.35	-0.0049	-2.41
35	0.0051	2.62	-0.0065	-3.24
36	0.0021	1.08	-0.0078	-4.04
37	0.0008	0.42	-0.0066	-3.56
38	0.0009	0.45	-0.0058	-3.22
39	0.0005	0.27	-0.0055	-3.17
40	0.0009	0.52	-0.0062	-3.35
41	0.0025	1.44	-0.0066	-3.45
42	0.0056	3.11	-0.0047	-2.56
43	0.0063	3.45	-0.0031	-1.61
44	0.0078	4.44	-0.003	-1.60
45	0.0065	3.98	-0.0048	-2.53
46	0.0065	3.61	-0.0035	-1.95
47	0.0056	3.14	-0.0045	-2.57
48	0.0053	3.08	-0.007	-3.87
49	0.0027	1.59	-0.0072	-4.26
50	0.0019	1.02	-0.0078	-4.32
51	0.0011	0.55	-0.0071	-3.79
52	0.0018	0.95	-0.0066	-3.64
53	0.0009	0.50	-0.0065	-3.45
54	0.0020	1.12	-0.0088	-4.50
55	0.0031	1.77	-0.0081	-4.42
56	0.0027	1.53	-0.0062	-3.48
57	0.0029	1.70	-0.0045	-2.70
58	0.0019	1.16	-0.0045	-2.62
59	0.0014	0.77	-0.005	-3.01
60	0.0000	0.00	-0.0046	-2.69

**Table 7 Seasonality of Momentum Strategies.** This table reports average monthly returns in January, December, February-November and February-December in the momentum strategies separately. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Holding Period is fixed to 6 months. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. The time gap is 1 month between ranking period and holding period. T-statistic provides for arbitrage profits.

Past Short Term Performance	Past Long Term Performance	January	December	February - November	February - December
(Loser)1	4	0.0380	0.0172	0.0043	0.0054
1	3	0.0435	0.0204	0.0065	0.0077
1	2	0.0552	0.0158	0.0072	0.0080
1	1	0.0729	0.0174	0.0062	0.0072
2	4	0.0319	0.0224	0.0094	0.0106
2	3	0.0383	0.0224	0.0104	0.0115
2	2	0.0460	0.0215	0.0098	0.0109
2	1	0.0606	0.0210	0.0098	0.0108
3	4	0.0280	0.0252	0.0107	0.0121
3	3	0.0376	0.0253	0.0108	0.0121
3	2	0.0427	0.0241	0.0102	0.0114
3	1	0.0579	0.0245	0.0099	0.0113
4	4	0.0279	0.0271	0.0116	0.0130
4	3	0.0333	0.0266	0.0118	0.0131
4	2	0.0392	0.0265	0.0107	0.0121
4	1	0.0544	0.0263	0.0103	0.0118
5	4	0.0253	0.0297	0.0140	0.0154
5	3	0.0313	0.0297	0.0141	0.0155
5	2	0.0406	0.0299	0.0132	0.0147
(Winner)5	1	0.0585	0.0323	0.0143	0.0160
Early stage momentum strategies		0.0205	0.0151	0.0100	0.0106
T-statistic		2.86	3.01	4.70	5.26
Late stage momentum strategies		-0.0476	0.0123	0.0077	0.0081
T-statistic		-3.64	1.76	3.58	3.95

**Table 8 Profitability of Momentum Strategies in Sub-periods.** This table reports average monthly returns of the momentum strategies in sub-periods. We rank the stocks into 20 portfolios based on the last 60-month performance. At the beginning of every month, we first sort stocks into 5 groups based on their short-term returns from month -6 to month -1, then we further sort each group into 4 sub-portfolios based on their long-term returns from month -60 to month -7. Momentum strategies implemented in the early stage of price reversal is to buy short-term winner but long-term loser and to sell short-term loser but long-term winner. Momentum strategies implemented in the late stage of price reversal is to buy winner in both the short-term and long-term and sell loser in both the losers. Holding Period is fixed to 6 months. Monthly data of all common stocks in NYSE/AMEX/NASDAQ are from 1965-1997. The time gap is 1 month between ranking period and holding period. T-statistic provides for arbitrage profits.

Past Short-term Performance	Past Long-term Performance	1970-1974	1975-1979	1980-1984	1985-1989	1990-1997
(Loser)1	4	-0.0073	0.0178	0.0080	0.0119	0.0089
1	3	-0.0015	0.0215	0.0094	0.0134	0.0102
1	2	-0.0009	0.0241	0.0133	0.0121	0.0107
1	1	-0.0006	0.0283	0.0133	0.0048	0.0154
2	4	-0.0005	0.0189	0.0146	0.0155	0.0124
2	3	0.0015	0.0215	0.0162	0.0158	0.0129
2	2	0.0017	0.0224	0.0164	0.0142	0.0136
2	1	0.0019	0.0280	0.0163	0.0116	0.0156
3	4	-0.0004	0.0189	0.0160	0.0178	0.0136
3	3	0.0016	0.0194	0.0184	0.0168	0.0141
3	2	0.0020	0.0212	0.0174	0.0155	0.0136
3	1	0.0017	0.0263	0.0180	0.0128	0.0157
4	4	0.0016	0.0204	0.0169	0.0180	0.0137
4	3	0.0039	0.0200	0.0185	0.0168	0.0144
4	2	-0.0001	0.0226	0.0177	0.0156	0.0149
4	1	0.0007	0.0275	0.0183	0.0132	0.0157
5	4	0.0037	0.0231	0.0193	0.0182	0.0162
5	3	0.0045	0.0262	0.0189	0.0165	0.0172
5	2	0.0016	0.0259	0.0207	0.0161	0.0182
(Winner)5	1	0.0037	0.0313	0.0217	0.0179	0.0209
Early stage momentum strategies		0.0110	0.0134	0.0137	0.0060	0.0120
T-statistic		1.53	3.19	3.31	1.81	3.97
Late stage momentum strategies		0.0043	-0.0052	0.0059	0.0133	0.0008
T-statistic		0.58	-0.88	1.09	2.80	0.24