Directional Momentum Strategies With No-load Mutual Funds

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ABSTRACT

A typical textbook definition of the weak form efficient market hypothesis suggests that past security price changes do not predict future price changes. But a large body of empirical evidence claims that over horizons of three months to a year stock prices exhibit momentum, that is, continuation in a price direction. This pattern of stock price momentum is exploited by some mutual funds that typically buy past stock winners and sell past stock losers. In this paper, we show that if momentum is modified to take into consideration price patterns within the period of selection/formation, the directional momentum strategy applied to stock and/or bond no-load mutual funds proves very profitable for long term (fifteen to twenty years) investors.

INTRODUCTION

The weak form of the efficient market hypothesis claims that past security price changes, or returns, do not predict future security price changes or returns and thus technical analysis is useless. Yet, empirical evidence suggests that the relationship, if any, between past and future security price changes partially depends on the investment horizon length. Let us define formation period as the period over which momentum is observed and upon which selection is dependent and holding period as the investment horizon. DeBondt and Thaler (1985) suggest that for formation/holding periods of three to five years, what goes up (down) subsequently goes down (up). The same evidence of significant changes in return direction was observed by Jegadeesh (1990) and Lehmann (1990) for very short horizons of days or weeks. On the other hand Jegadeesh and Titman (1993, 2001) and Chan, Jegadeesh, and Lakonishok (1996) among others, find that for three month to one year formation/holding periods stock prices exhibit momentum or continuation in price direction. In other words, what goes up (down) tends to subsequently keep going up (down). As Badrinath and Wahal (2002) document, the pattern of no change in return direction or stock price momentum is exploited by institutional investors such as investment advisors, mutual funds, pension funds and banks. More specifically, Chan, Jegadeesh and Lakonishok (1999, p. 80) state that "mutual funds typically buy past winners and sell past losers. In addition, stocks with strong buy recommendations from analysts typically exhibit high price momentum." Carhart (1997, pp. 57-58), however, suggests that "funds that earn higher one-year returns do so not because fund managers successfully follow momentum strategies, but because some mutual funds just happen by chance to hold relatively larger positions in last year's winning stocks."

The traditional momentum strategy involves ranking each stock in the sample under consideration based on its past compound return (Chan, Jegadeesh, and Lakonishok (1999, p. 81)) or its past average return (Rouwenhorst (1998, p. 271)). For example, at the end of each quarter all stocks are ranked into, say, deciles based on their past 3-month average or compound return. Both the winner decile portfolio of stocks with the highest past performance and the loser decile portfolio that contains stocks with the lowest past performance receive either the same weight or alternatively a market-cap weight. The momentum variable thus obtained reflects the aggregation of individual securities in the decile portfolio and is justified by the noise in the data. However, to replace, say 100 stocks of likely different degrees of momentum by their average and thus implicitly assume that all stocks in the decile portfolio are homogeneous in momentum increases the odds of missing economically relevant information. Further, ranking stocks based on their past 3-month return does not consider their intra 3-month return behavior that may differentially affect

investors' expectations. These expectations are influenced by the finding of Kahneman and Tversky (1982) in the field of cognitive psychology, which suggests that investors tend to overweight recent information and underweight more remote information.

Let us illustrate the above arguments graphically. Since the investor considers winner portfolios only, we assume that the return of the 3-month formation period is positive. Let the sequence of intra-quarter monthly security prices be P_0, P_1, P_2, P_3 , where $P_0(P_3)$ is the beginning (end) of quarter price. Figure 1 considers all possible patterns of monthly returns that produce the same quarterly return. Intuitively, patterns 3, 4, and 7 do not reflect the momentum idea in terms of trend continuation or projection. Thus, although all 7 price patterns have the same 3-month positive return, investors are likely to prefer patterns 1 and 5, rather than, say, 4 and 7, since they better reflect the idea of momentum. Figure 1 was produced considering patterns of price changes only. However, in addition to the rate of return (ROR) sign, momentum investors are likely to find price acceleration over time a desirable characteristic.

Figure 2 considers both monthly ROR sign and change of returns within pattern 1. In terms of price acceleration sub-pattern (a) is likely more desirable than the other 3 sub-patterns and the momentum investor will expect on average higher subsequent returns from securities exhibiting this sub-pattern than from the others.

In this paper we analyze the momentum effect with no-load mutual funds over the 20-year period 1982 to 2001. As noted previously, research by Jegadeesh and Titman (1993), Rouwenhorst (1998), Griffin, Ji, and Martin (2005), and many others documents that average stock returns are positively related to past performance over medium term (3 to 12 month) horizons. In other words, U.S. and European stocks as well as stocks of many emerging markets and some Asian markets exhibit the momentum effect.

Although Chordia and Shivakumar (2002) claim that momentum strategies' returns show strong robustness and are not due to data mining, Hameed and Kusnadi (2002) show that when these traditional strategies are applied to Pacific Rim stock markets, they lack evidence of profitability. Similarly, Hon and Tonks (2003), when examining traditional momentum trading strategies in the UK stock market over the period 1955-96, find that they are not profitable over the 1955-76 period. Finally, Griffin, Ji, and Martin (2005) report that even in the U.S., momentum strategies lost money from December 1990 until November 1993. Although momentum is an empirical fact, the causes of this phenomenon are still debated.

Jacobs (2000) argues that option-replication strategies are a potential cause of price momentum. That is, investors trying to replicate a protective put that offers upside gains with a floor against downside losses, buy stocks as prices increase and sell stocks as their prices decrease, thus generating price momentum.

Jegadeesh and Titman (2001), trying to find and compare explanations for the stock momentum phenomenon, examined whether overreaction pushes prices of winners (losers) above (below) their long-term values. They conclude that overreaction provides at best a partial explanation.

Johnson (2002), in defending rationality against investor irrationality, heterogeneous information or market frictions, advances the hypothesis that stochastic growth rates may account for some or all of the momentum anomaly. His model offers clearly defined quantitative predictions about risk and return in terms of familiar and observable characteristics of individual firms or portfolios. His model, however, cannot explain the success of momentum-based strategies with other asset categories. For example, Hottinga et al (2001), working with individual bond strategies found that the bond momentum variable outperforms, in a statistically significant sense, a bond benchmark. Further, Okunev and White (2003) use successfully momentum-based strategies in the foreign exchange market.

Finally, Griffin, Ji, and Martin (2003), using a large international data set covering forty countries, tested the hypothesis that macroeconomic risk variables such as expected and unexpected changes in inflation, term spread, and changes in industrial production can explain momentum profits internationally, and find no relationship. Another potential cause is market inefficiency because of analyst/investor behavior. Chan, Jegadeesh, and Lakonishok (1996), working with U.S. stock market data, conclude that stock price momentum is partly a result of slow incorporation of

new information into stock prices—the underreaction effect. More recently, Van Dijk and Huibers (2002), working with stocks from 15 European countries, confirm the underreaction effect.

Our paper differs from earlier work in two ways. We do not work with stocks only, but with no-load mutual funds of all categories and we also consider not only past 3-month performance but also the intra-quarterly directional changes as previously outlined. We find that for the three-month horizons the profitability of the traditional momentum investment strategy using our universe of mutual funds is mediocre. However, when we select mutual funds based on directional momentum methods, the resulting long-term performance is enhanced.

The remainder of the paper is organized as follows. Section 2 describes the sample, briefly discusses the survivorship bias issue and provides the fund selection rules to be compared and contrasted. Section 3 documents the sub-par risk-adjusted profitability of 3-month traditional momentum. Further, it shows that the directional momentum strategies, i.e., strategies that exploit intra-formation period price patterns can be very profitable. Section 4 provides conclusions and suggestions for further research.

SAMPLE CONSTRUCTION, SURVIVORSHIP BIAS, AND FUND SELECTION RULES

Sample Construction

All the data used in our study come from the *Morningstar Principia Pro CD-ROM*. We are interested in developing an investment strategy that is accessible to the small investor and is as simple as possible. For this reason we limit the universe of mutual funds to no-load mutual funds for which the minimum initial investment is less than or equal to \$5,000. Due to the nature of our study, a no-load mutual fund has to have at least a 3-month history to be included in the universe of mutual funds. The first universe of no-load funds is formed at the beginning of 1982.Q2 and the last one at the end of 2001.Q3. We assume that the momentum trading strategy is implemented at the end of the 3-month formation period and held for 3 months. Other authors wait a certain period of time before implementing a trading strategy. Korajczyk and Sadka (2004, p. 1042) call this waiting period a “skip” period. Jegadeesh and Titman (1993) use in their analysis a no skip period and a skip period of one week, and many other momentum researchers such as Fama and French (1996), Grundy and Martin (2001) and Korajczyk and Sadka (2004) use one-month skip period. In our paper we use no skip period but even if the transfer of funds from a mutual fund to another mutual fund takes a few days, we believe that the conclusions we reach will not be materially affected since the phenomenon under study evolves slowly.

Table 1 shows the size of the universe of no-load funds at each month over the 1982 to 2001 sample period, that meets the above criteria. It shows that the number of no-load mutual funds has increased twenty-fold, from 119 funds in January of 1982 to 2,353 funds in December 2001 and this increase has been monotonic.

In order to make the momentum variable prominent and reduce the effect of other priced and idiosyncratic factors, researchers work with sizeable stock universes. For example, Jegadeesh and Titman (1993, 2001), Grundy and Martin (2001), and Moskowitz and Grinblatt (1999) used the U.S. CRSP database, which, as of end of 2004, included 7000 stocks. On the other hand, momentum researchers who work with portfolios of securities such as market and industry indices and funds, use small universes. For example, Richards (1997) considered 16 MSCI market indices, Chan, Hameed, and Tong (2000) worked with 23 DataStream market indices, and O’Neal’s (2000) universe contained 31 U.S. Sector Fidelity funds. Since we do not work with stocks but with mutual funds that are portfolios of securities, we need portfolios of one to several mutual funds only in order to economically exploit the momentum in returns present in aggregate securities. In this paper we opt for simplicity and select and evaluate single-fund portfolios on a quarterly basis.

Survivorship Bias

The Morningstar data include only funds that survive. As Malkiel (1995) shows, this condition can bias performance results upward. Further, as Blake, Elton, and Gruber (1993) note, since bond funds exhibit lower performance variability, the survivorship bias is less important for bond funds than for stock funds. Although our

sample is not free of survivorship-bias among the losers, we believe that the main results we derive are qualitatively robust. Since successful funds are by definition survivors, our selections that exhibit favorable directional momentum should be exempt from survivorship bias.

Fund Selection Rules

A. The traditional momentum strategy (Strategy A)

At the end of each quarter, we rank the available universe of no-load funds from top to bottom based on each fund's past quarterly compound return and select the fund that has the maximum value. Mathematically, the traditional momentum strategy can be expressed as select the fund with

$$\max(1 + R_{t-1})(1 + R_{t-2})(1 + R_{t-3})$$

s.t.

$$R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$$

where R_{t-i} ($i=1,2,3$) is the rate of return on a fund, i months before the decision and implementation time t .

B. The directional momentum strategy with price acceleration (Strategy B). This strategy can be mathematically expressed as, choose the fund that

$$\max(1 + R_{t-1})(1 + R_{t-2})(1 + R_{t-3})$$

s.t.

$$R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$$

and

$$(1 + R_{t-2}) / (1 + R_{t-3}) > 1, (1 + R_{t-1}) / (1 + R_{t-2}) > 1$$

The above inequality ratios imply that, if available, the chosen fund's price accelerates over the last three months before investment is made.

C. The directional momentum strategy with recent price acceleration (Strategy C)

In this case we assume that the investor believes more recent returns convey more information than less recent ones. Mathematically, this strategy is expressed as follows:

Select the mutual fund that

$$\max(1 + R_{t-1})(1 + R_{t-2})(1 + R_{t-3})$$

s.t.

$$R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$$

and

$$(1 + R_{t-1}) / (1 + R_{t-2}) > 1$$

This strategy assumes that the directional momentum investor pays more attention to R_{t-1} and R_{t-2} than to R_{t-3} and, hence, wants to select the fund that exhibits price acceleration over the two most recent months.

- D. The directional momentum strategy with increasing price acceleration (Strategy D). This strategy is the most difficult to implement and is expressed as follows. Select the mutual fund, if available, that

$$\max(1 + R_{t-1})(1 + R_{t-2})(1 + R_{t-3})$$

s.t.

$$R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$$

and

$$(1 + R_{t-2}) / (1 + R_{t-3}) > 1$$

and

$$(1 + R_{t-1}) / (1 + R_{t-2}) > (1 + R_{t-2}) / (1 + R_{t-3})$$

Unlike with Rule B, Rule D demands that the fund that meets the above constraints exhibit increasing price acceleration over the quarterly formation period.

For all strategies other than the traditional momentum Strategy A, when no no-load mutual fund under consideration meets all the constraints of a directional momentum strategy, then the investment is placed in U.S. Treasury bills.

TEMPORAL COMPOSITION AND RISK-ADJUSTED PERFORMANCE OF TRADITIONAL AND DIRECTIONAL MOMENTUM STRATEGIES

In this section we examine three pieces of evidence on the returns from applying the traditional and three directional momentum strategies on the same universes of no-load mutual funds: graphical evidence, terminal wealth evidence that does not consider the riskiness of each strategy, and risk-adjusted evidence relying on Jensen's alpha and the Sharpe Ratio measures of performance. Further, we compare and contrast the above metrics of performance against those of the S&P 500 Stock Index. In Table 2, we report the name of the fund and its subsequent realized quarterly return from following each of the above-mentioned strategies over the period beginning 1982.Q2-ending 2001.Q4. We emphasize that the decision on which fund to invest in is made every quarter based on return information provided by the previous 3-month formation period.

Perusal of Table 2 shows that the selections cover the whole spectrum of asset categories: small and large capitalization funds, growth and value funds, gold and precious metals funds, Treasury and municipal and international bond funds, utility and Euro stock index funds, etc. Further, most names appear in the sample only once. Industry groups and market segments tend to rotate in terms of popularity and performance. So a group that does well now will likely not do as well in the future. Further, as the universe of securities/funds increases over time the competition for first place becomes tougher and the chance of reappearance of the same fund on top declines.

In general, the greater the number of constraints in the fund selection rule, the greater the chances that the rule will not find a suitable fund and thus the investment money will be placed in T-bills. This was the case with strategy B and especially strategy D.

Graphical Evidence

Figure 3 shows the evolution of wealth at quarterly intervals, from buying \$1 at beginning 1982.Q2 and following either one of the four momentum strategies or investing in the S&P 500 portfolio till the end of 2001.Q4. Figure 3 provides graphical support for the view that Strategy A, the traditional momentum strategy, produces long-term poor performance relative to the other directional momentum strategies. The same Figure 3 also shows that the buy-and-hold strategy of investing in the S&P 500 portfolio obtains better (worse) performance results than the traditional (any directional) momentum strategy. Finally, it appears that only in the last few years before the stock market bubble burst in March 2000, did the directional momentum strategies clearly exhibit superior performance relative to that of the S&P 500 portfolio or the traditional momentum strategy.

Figures 4 and 5 consider the wealth behavior of the strategies under consideration over the two ten-year subperiods, 1982-1991 and 1992-2001, respectively. Over the first subperiod, strategy A, the traditional momentum strategy, produces progressively inferior wealth performance relative to the other four strategies that behave like a herd. Over the second ten-year subperiod, strategy B is the clear winner, with strategies D and C in second and third place, and the traditional momentum strategy A competing with the buy-and-hold strategy of holding the S&P 500 portfolio for last place.

Figures 6, 7, 8, and 9 revisit the comparative wealth behavior of the strategies under consideration at five-year intervals. Over the 1982-1986 period all strategies behave similarly, over the next five-year period, however, the buy and hold strategy is dominant and the traditional momentum strategy takes last place. The behavior of the strategies is similar during the 1992-1996 period (Figure 8) but there is a differentiation in terminal wealth performance over the last five-year subperiod (Figure 9). All three directional momentum strategies vastly outperform the traditional momentum and the buy and hold strategies, which perform similarly.

In generating the above figures we used five-year, ten-year and twenty-year intervals to reflect the view of average, long-term and very long-term horizon investors. The general impression one obtains from perusing the above figures is that the momentum strategies show more terminal wealth variability than the buy-and-hold strategy of investing in the S&P 500 portfolio.

Terminal Wealth Evidence

Figure 3 compares the performance over time of the traditional and patterned momentum strategies relative to the S&P 500 portfolio. Table 3 quantifies the comparative wealth behavior of the strategies under consideration over various intervals. Using wealth accumulated from an initial investment of \$1 and the geometric mean returns, Table 3 presents results for each of the four strategies and the S&P 500 for the full 79-quarter period and all the subperiods examined, namely the first 39 quarters and the last 40 quarters, the first 19 quarters, the second 20 quarters, the third 20 quarters and the final 20 quarters. As expected, the strategies that are consistent with directional momentum (Strategies B, C, and D) outperform the traditional momentum strategy and the S&P 500 for most of the periods considered, whereas the traditional momentum strategy (Strategy A) only marginally outperforms the S&P 500 in two out of the 4 5-yr subperiods and in the latter ten year subperiod and never outperforms more than one directional momentum strategy. Finally, in the full 79 quarter period, the compound annual return for the directional momentum Strategy B is an impressive 29.69% whereas the compound annual return for the traditional strategy is only 8.83% and the S&P 500 compound annual return is only 15.88%. Since, like Hendricks, Patel and Zeckhauser (1993), our sample is restricted to no-load funds, transactions costs associated with investing in and switching between such funds are close to zero.

Risk-Adjusted Performance Evidence

Returns of a strategy must be adjusted for risk before they can be compared meaningfully to other strategies or to a benchmark. Methods of risk-adjusted performance, based on mean-variance criteria, are the Jensen's alpha and the Sharpe Ratio.

Jensen's alpha

In examining the performance of the traditional momentum strategy relative to the directional ones, we use the S&P 500 portfolio as the benchmark. In terms of measure of performance, we utilize the Jensen's alpha first. This measure uses the characteristic line to evaluate fund or strategy performance. Let us define the following variables: R_p is the single mutual fund quarterly rate of return, R_f is the three-month U.S. Treasury bill rate constructed from one-month bill rates, R_m is the S&P 500 portfolio rate of return, and e is the residual rate of return. Then the characteristic line used to evaluate performance is

$$R_p - R_f = a + b(R_m - R_f) + e$$

$R_p - R_f$ ($R_m - R_f$) is also called excess fund (market portfolio) return. If the securities market is mean-variance efficient, then the intercept a (= Jensen's alpha) is statistically insignificant. If, however, the performance of a strategy is superior (inferior), then $a > 0$ ($a < 0$). The slope b is also called beta or systematic risk and is the measure of risk that matters to a well-diversified investor. We know that diversification into bonds, foreign stocks and precious metals produces significant reductions in systematic risk. Since the temporal composition of the momentum strategies is very heterogeneous, we expect the beta of the momentum strategies measured over different estimation periods to be mainly less than one.

Table 4 reports the results from applying the above characteristic line on the traditional momentum strategy (Panel A) and on the directional momentum strategies (Panels B, C, and D) over different estimation periods. Looking at Panel A, we see that only over the 1992-2001 period and over the 1997-2001 period was the Jensen's alpha positive, but statistically insignificant. However, the systematic risk of this strategy, with the exception of the 1987-1991 period, was greater than one.

As for directional momentum strategies, it appears that strategies B and D provide similar results whereas strategy C provides somewhat less impressive results. The most successful directional momentum strategies (B and D) have betas mainly less than one, whereas strategy C's betas are around one.

It appears that there is an inverse relationship between a momentum strategy's beta and its Jensen measure of performance, alpha. Further, the higher the R^2 of a strategy, the greater its systematic risk and the lower its Jensen's alpha.

With the exception of the most recent years, the 1982-2001 period was associated with primarily rising equity prices. If one considers both graphical and CAPM-based statistical evidence, it appears that there are differences between the traditional standard momentum strategies and the directional ones. These differences favor especially strategy B, both in terms of terminal wealth and risk-adjusted performance. We speculate that strategy D would have outperformed strategy B if the universe of no-load funds had been in the thousands throughout the 1982-2001 period. We therefore speculate that strategy D will be a credible competitor to strategy B from now on.

The Sharpe Ratio

The Sharpe Ratio is defined as

$$S = \frac{\overline{R_p - R_f}}{\sigma_R}$$

Where $\overline{R_p - R_f}$ is the average portfolio excess return over the estimation period, and σ_R is the associated standard deviation of portfolio returns. The Sharpe Ratio relates excess returns to total risk. Since a single security or a concentrated portfolio contains a substantial proportion of unsystematic risk that can be eliminated through diversification, its Sharpe Ratio penalizes performance because total risk is much greater than its systematic risk

component. Further, the pressure of price momentum violates the random walk hypothesis (RWH) with the consequence that the riskiness of the momentum strategies is higher than if each return period were serially independent (Scowcroft and Sefton (2005)). If the portfolio represents the investor's entire investment fund then the Sharpe Ratio is the relevant measure of performance to compare against a benchmark such as the S&P 500 Index or another specific portfolio.

Table 5 reports the Sharpe measure of risk adjusted performance and its components for all momentum strategies and the benchmark S&P 500 Index. Let us consider the standard deviation, σ , first. Strategies A and C are consistently more volatile than the S&P 500 Index, or the Market, whereas strategies B and D have one and two instances of lower volatility, respectively. As for the volatility range, strategy D has the highest range, strategy B exhibits the second highest range, strategy A is third, followed by the Market and finally strategy C with the narrowest range. Ranges are 19.46%, 14.89%, 13.91%, 6.91% and 4.25% respectively. Both maximum and minimum volatilities belong to the 5-yr subperiods. As for the average excess returns, $\overline{R_p - R_f}$, the Market's values are all positive and show little variation; with a range from 1.79% to 3.40% or only 1.6%. Next in terms of range is strategy C with a range from -0.48% to 7.38% or 7.86%, followed by the traditional strategy A with a range from -4.01% to 5.19% or 9.20%. Strategy D is next with a range from -0.22% to 12.64% or 12.86% and strategy B shows the widest range from -0.10% to 13.48% or 13.58%. As with σ , the fluctuations in $\overline{R_p - R_f}$ are more pronounced with 5-year investment horizons.

As for the Sharpe measure, the S&P 500 Index shows little variation and the same can be said for strategy C while Strategies A, B and D exhibit higher Sharpe Ratio variations. Sharpe Ratio ranges are .52, .47, .58, .57, and .60, respectively. All momentum strategies, unlike the S&P 500 Index, produce negative numbers during the same 5-year subperiod.

Inspection of Table 5 shows that over the most recent 10 years and over the entire 20 year period all directional momentum strategies did at least as well as the Market, whereas the traditional momentum strategy's Sharpe-based performance was consistently sub-par. In the most recent 5-year period the volatility of the market was high with $\sigma_m = 9.90\%$ and the same happened to the momentum strategies. It appears that when the volatility of a strategy during a subperiod is low, it is associated with low $\overline{R_p - R_f}$ and low Sharpe Index value, and conversely there is a tendency for the directional strategies to increase their $\overline{R_p - R_f}$ performance with increased volatility.

The performance results from Table 5 suggest that one cannot confidently project past performance into the future. Bodie, Kane and Marcus (1999, Ch. 24) suggest that a performance measure is relevant when the selected portfolio is held for a considerable period of time and no changes in portfolio composition are made during that period. Our momentum strategies, however, dictate drastic periodic changes in portfolio composition and this reality may contribute to the instability in the traditional measures of momentum-based portfolio performance. In general, the appropriate measure of portfolio performance depends critically on whether the portfolio is the entire investment fund [and in this case the Sharpe measure is appropriate] or only a portion of the investor's overall invested wealth [in this case the Jensen's alpha measure is appropriate]. Although the above two performance measures provide dissimilar rankings, they share some similarities. As Leland (1999, p. 28) points out, "A portfolio with a Sharpe ratio greater than the market's will have a positive alpha, but the converse does not necessarily hold."

Inspection of Tables 4 and 5 reveals a new investment reality. Conventional wisdom suggests that individual securities and concentrated portfolios often outperform the market over short periods of time; however, seldom do they outperform the market average over long periods. Our results provide evidence contrary to the conventional wisdom. In this paper we have introduced the concept of patterned/directional momentum and applied its simplest version to no-load mutual funds with satisfactory results, thus providing evidence inconsistent with the widespread belief among academics that all forms of technical analysis are useless.

CONCLUSIONS AND RECOMMENDATIONS

In this paper we show that when the traditional momentum strategy is applied to no-load mutual funds, the results are mediocre. We also show that when a more nuanced definition of recent return performance that discriminates among alternative price growth patterns is used, it can enhance the profitability of the momentum effect. This finding has implications for the published momentum literature. Since this literature does not consider the intra-formation period return behavior that differentially influences investors' expectations, one can argue that its claims of risk-adjusted superior performance for these strategies are conservative and that if these studies are replicated with portfolios formed on a measure of directional momentum, the results will be better still.

A major finding of this paper is that directional momentum strategies perform best when the stock market is turbulent and prices are not declining. Under such conditions the directional momentum strategies perform best by obtaining generous positive alphas and exhibiting lower than one betas. This behavior should make directional momentum strategies attractive to the small investor.

Recommendations For Further Study

No rational pricing model has been as yet able to explain the traditional momentum effect away. Our paper introduces and tests a more powerful version of it, the directional/patterned momentum effect in its simplest and most feasible way. Our choice of the 3-month formation/performance period to be tested on affordable no-load funds favors small to medium wealth investors. The empirical literature, however, has concentrated on 6-month formation/performance periods. Interesting topics for future research would be to extend our model to more complex configurations.

Table 1
Month-By Month Universe Size Of No-Load Mutual Funds Over The 20-Year Period January 1982-December 2001

Month	# funds	Month	# funds	Month	#funds	Month	#funds	Month	# funds
Jan-82	119	Jan-86	240	Jan-90	407	Jan-94	772	Jan-98	1535
Feb-82	119	Feb-86	241	Feb-90	407	Feb-94	777	Feb-98	1544
Mar-82	119	Mar-86	242	Mar-90	408	Mar-94	798	Mar-98	1565
Apr-82	122	Apr-86	243	Apr-90	410	Apr-94	818	Apr-98	1589
May-82	122	May-86	246	May-90	410	May-94	823	May-98	1594
Jun-82	122	Jun-86	249	Jun-90	414	Jun-94	836	Jun-98	1604
Jul-82	122	Jul-86	253	Jul-90	420	Jul-94	746	Jul-98	1619
Aug-82	122	Aug-86	257	Aug-90	421	Aug-94	762	Aug-98	1625
Sep-82	122	Sep-86	259	Sep-90	423	Sep-94	768	Sep-98	1635
Oct-82	124	Oct-86	264	Oct-90	428	Oct-94	900	Oct-98	1651
Nov-82	125	Nov-86	267	Nov-90	433	Nov-94	913	Nov-98	1657
Dec-82	128	Dec-86	273	Dec-90	436	Dec-94	918	Dec-98	1668
Jan-83	137	Jan-87	286	Jan-91	447	Jan-95	948	Jan-99	1720
Feb-83	138	Feb-87	290	Feb-91	453	Feb-95	955	Feb-99	1725
Mar-83	139	Mar-87	291	Mar-91	456	Mar-95	963	Mar-99	1746
Apr-83	141	Apr-87	297	Apr-91	459	Apr-95	975	Apr-99	1761
May-83	143	May-87	301	May-91	462	May-95	979	May-99	1788
Jun-83	144	Jun-87	307	Jun-91	469	Jun-95	986	Jun-99	1804
Jul-83	145	Jul-87	308	Jul-91	472	Jul-95	1007	Jul-99	1818
Aug-83	151	Aug-87	312	Aug-91	476	Aug-95	1011	Aug-99	1833
Sep-83	152	Sep-87	316	Sep-91	478	Sep-95	1021	Sep-99	1845
Oct-83	155	Oct-87	323	Oct-91	481	Oct-95	1040	Oct-99	1871
Nov-83	158	Nov-87	324	Nov-91	484	Nov-95	1054	Nov-99	1877
Dec-83	163	Dec-87	326	Dec-91	486	Dec-95	1064	Dec-99	1880
Jan-84	166	Jan-88	336	Jan-92	497	Jan-96	1076	Jan-00	1910
Feb-84	171	Feb-88	338	Feb-92	501	Feb-96	1083	Feb-00	1915
Mar-84	176	Mar-88	340	Mar-92	505	Mar-96	1111	Mar-00	1927
Apr-84	179	Apr-88	343	Apr-92	511	Apr-96	1124	Apr-00	1948
May-84	182	May-88	346	May-92	518	May-96	1141	May-00	1973
Jun-84	190	Jun-88	350	Jun-92	526	Jun-96	1150	Jun-00	1986
Jul-84	191	Jul-88	351	Jul-92	539	Jul-96	1165	Jul-00	2023
Aug-84	192	Aug-88	353	Aug-92	546	Aug-96	1179	Aug-00	2033
Sep-84	194	Sep-88	355	Sep-92	561	Sep-96	1189	Sep-00	2064
Oct-84	195	Oct-88	361	Oct-92	571	Oct-96	1222	Oct-00	2100
Nov-84	197	Nov-88	365	Nov-92	579	Nov-96	1245	Nov-00	2113
Dec-84	199	Dec-88	370	Dec-92	592	Dec-96	1268	Dec-00	2123
Jan-85	205	Jan-89	374	Jan-93	623	Jan-97	1300	Jan-01	2247
Feb-85	207	Feb-89	376	Feb-93	635	Feb-97	1319	Feb-01	2259
Mar-85	208	Mar-89	377	Mar-93	640	Mar-97	1338	Mar-01	2297
Apr-85	211	Apr-89	378	Apr-93	649	Apr-97	1364	Apr-01	2301
May-85	212	May-89	378	May-93	661	May-97	1386	May-01	2318
Jun-85	212	Jun-89	381	Jun-93	671	Jun-97	1395	Jun-01	2327
Jul-85	216	Jul-89	387	Jul-93	683	Jul-97	1417	Jul-01	2336
Aug-85	218	Aug-89	390	Aug-93	690	Aug-97	1429	Aug-01	2338
Sep-85	218	Sep-89	392	Sep-93	701	Sep-97	1457	Sep-01	2347
Oct-85	226	Oct-89	395	Oct-93	716	Oct-97	1472	Oct-01	2348
Nov-85	229	Nov-89	397	Nov-93	726	Nov-97	1486	Nov-01	2349
Dec-85	233	Dec-89	400	Dec-93	746	Dec-97	1501	Dec-01	2353

Table 2

Mutual Funds Selected And Holding Period Returns For The Following Period

Selection Quarter	Strategy A Fund Name	Quarterly Return (%)	Strategy B Fund Name	Quarterly Return (%)	Strategy C Fund Name	Quarterly Return (%)	Strategy D Fund Name	Quarterly Return (%)
1982:Q1	Stein Roe Managed Municipals	4.62	T. Rowe Price New Income	3.49	Strong Balanced	4.18	T-Bill	3.23
1982:Q2	Gintel	9.46	T-Bill	2.52	Strong Large Cap Growth	6.31	T-Bill	2.52
1982:Q3	U.S. Global Inv Gold Shares	54.77	Spectra N	24.62	Spectra N	24.62	State Farm Interim	6.90
1982:Q4	U.S. Global Inv Gold Shares	-4.96	T-Bill	2.09	Salomon Bros Opportunity	16.83	T-Bill	2.09
1983:Q1	FMI Common Stock	13.94	Strong Large Cap Growth	18.55	Sit Mid Cap Growth	21.67	Strong Large Cap Growth	18.55
1983:Q2	American Cent Ultra Inv	-7.65	Fidelity Independence	-3.94	American Cent Ultra Inv	-7.65	T-Bill	2.38
1983:Q3	Japan S	10.41	SAFECO Dividend Income	2.34	Stratton Monthly Div REIT	-4.54	SAFECO Dividend Income	2.34
1983:Q4	Greenspring	3.91	Japan S	15.35	Japan S	15.35	Japan S	15.35
1984:Q1	Bailard, Biethl Intl Equity	-13.13	T-Bill	2.56	Bailard, Biethl Intl Equity	-13.13	T-Bill	2.56
1984:Q2	Nicholas II	10.94	Strong Large Cap Growth	4.37	Strong Balanced	2.74	T-Bill	2.69
1984:Q3	Armstrong Associates	-13.24	Fidelity Capital & Income	3.96	HighMark Bond Fid	7.47	T-Bill	2.33
1984:Q4	Century Shares Trust	14.91	Copley	5.59	Century Shares Trust	14.91	SAFECO CA Tax-Free Inc	4.79
1985:Q1	Fidelity OTIC	9.78	USAA Cornerstone Strategy	3.10	Scudder Large Co Val S	6.47	Stratton Monthly Div REIT	12.39
1985:Q2	American Cent Target 2010 Inv	-5.41	Stratton Monthly Div REIT	-6.49	American Cent Target '10	-5.41	T-Bill	1.83
1985:Q3	Bailard, Biethl Intl Equity	20.98	Bailard, Biethl Intl Equity	20.98	Bailard, Biethl Intl Equity	20.98	Bailard, Biethl Intl Equity	20.98
1985:Q4	American Cent Target 2005 Inv	45.49	American Cent Target '05 Inv	45.49	American Cent Target '05	45.49	Bailard, Biethl Intl Equity	29.20
1986:Q1	American Cent Target 2010 Inv	-5.96	Fidelity Overseas	7.59	Fidelity Overseas	7.59	Fidelity Growth & Income	6.86
1986:Q2	Strong Opportunity Inv	-11.64	Strong Opportunity Inv	-11.64	Strong Opportunity Inv	-11.64	Strong Opportunity Inv	-11.64
1986:Q3	U.S. Global Inv Gold Shares	-0.65	U.S. Global Inv World Gold	6.40	U.S. Global Inv World Gold	6.40	T-Bill	1.37
1986:Q4	American Cent Target 2010 Inv	0.61	T-Bill	1.42	American Cent Target '10	0.61	T-Bill	1.42
1987:Q1	U.S. Global Inv Gold Shares	-11.36	U.S. Global Inv Gold Shares	-11.36	U.S. Global Inv Gold Shares	-11.36	U.S. Global Inv Gold Shares	-11.36
1987:Q2	Nomura Pacific Basin	7.36	Berwyn	6.81	Fidelity Europe	13.37	Berwyn	6.81
1987:Q3	USAA Gold	-37.37	T-Bill	1.55	Fidelity Europe	-25.33	T-Bill	1.55
1987:Q4	American Cent Target 2015 Inv	4.77	Babson Tax-Free Income	2.75	American Cent Target '15	4.77	T-Bill	1.48
1988:Q1	Stonebridge Aggressive Grth	-14.23	Mosaic Mid-Cap Growth	-1.07	Mosaic Mid-Cap Growth	-1.07	Mosaic Mid-Cap Growth	-1.07
1988:Q2	Vanguard Windsor	1.92	Vanguard Windsor	1.92	Vanguard Windsor	1.92	Vanguard Windsor	1.92
1988:Q3	Westcore Flexible Income	-3.07	FAM Value	3.47	FAM Value	3.47	FAM Value	3.47
1988:Q4	American Cent Target 2015 Inv	-0.73	RSI Returnt ST Invmt	2.18	Scudder Global S	9.84	T-Bill	2.21
1989:Q1	American Cent Ultra Inv	10.43	T-Bill	2.19	Scudder Large Co Val S	9.11	T-Bill	2.19
1989:Q2	American Cent Target 2015 Inv	-4.23	American Cent Target '15 Inv	-4.23	American Cent Target '15	-4.23	Strong Discovery	7.73
1989:Q3	INVESCO Health Sciences Inv	5.90	T-Bill	1.97	American Cent Gifttrust Inv	-4.03	T-Bill	1.97
1989:Q4	U.S. Global Inv Gold Shares	-12.24	Fidelity Utilities	-4.92	Fidelity Utilities	-4.92	Stein Roe High-Yield Muni	0.50
1990:Q1	Stonebridge Aggressive Grth	8.23	Merrill Lynch Sen Float Rt	2.36	Stonebridge Aggr. Grth	8.23	T-Bill	2.01
1990:Q2	American Cent Target 2020 Inv	-13.34	Fidelity Capital & Income	-2.92	Fidelity Capital & Income	-2.92	Gabelli Mathers	0.84
1990:Q3	USAA Gold	-13.23	Scudder Medium-Term T/F S	2.16	USAA Gold	-13.23	Scudder Medium-Term T/F	2.16
1990:Q4	Fidelity Adv Eqty Grth Instl	37.10	Spectra N	35.29	Spectra N	35.29	State Farm Interim	1.88
1991:Q1	American Heritage	-0.90	JP Morgan US Sm Co Sel	-8.53	American Cent Ultra Inv	-6.19	UMB Scout Small Cap	2.99
1991:Q2	U.S. Global Inv Gold Shares	-15.41	Vanguard Precious Metals	-3.81	Vanguard Precious Metals	-3.81	Vanguard Precious Metals	-3.81
1991:Q3	INVESCO Financial Svcs Inv	4.15	Bailard, Biethl Bond Opp	5.32	Stonebridge Aggressive	15.45	Bailard, Biethl Bond Opp	5.32
1991:Q4	American Cent Vista Inv	-7.41	Credit Suisse GI F/I Comm	-4.06	Stein Roe Capital Opport	-5.06	Credit Suisse GI F/I Comm	-4.06

1992 Q1	American Heritage	-6.67	Permanent Port Treasury Bill	0.81	Fidelity Capital & Income	4.47	Permanent Port Treas. Bill	0.81
1992 Q2	T. Rowe Price New Asia	-6.19	American Cent Intl Bond Inv	7.18	American Cent Intl Bond Inv	7.18	Scudder High-Yield T/F S	2.68
1992 Q3	American Cent Gifttrust Inv	28.82	TbIll	0.79	American Cent Target '05	0.43	T-Bill	0.79
1992 Q4	PBHG Growth	3.14	PBHG Growth	3.14	PBHG Growth	3.14	Alpine Intl Real Estate Y	13.59
1993 Q1	U.S. Global Inv Gold Shares	41.01	U.S. Global Inv Gold Shares	41.01	U.S. Global Inv Gold Shrs	41.01	U.S. Global Inv Gold Shrs	41.01
1993 Q2	U.S. Global Inv Gold Shares	-11.24	American Cent Target '15 Inv	13.11	American Cent Target '15	13.11	American Cent Target '15	13.11
1993 Q3	PBHG Emerging Growth	4.80	PBHG Growth	4.16	PBHG Growth	4.16	Mutlenkamp	-1.66
1993 Q4	Mosaic Foresight	-15.46	Excelsior Latin America	-4.52	Mosaic Foresight	-15.46	Excelsior Latin America	-4.52
1994 Q1	CMC International Stock	0.70	Van Kampen Prime Rate Inc.	1.46	Van Kampen Prime Rt Inc	1.46	Van Kampen Prime Rt Inc	1.46
1994 Q2	State St Res Glb Resource S	-0.67	Van Kampen Prime Rate Inc.	1.66	State St Res Glb Res S	-0.67	T-Bill	1.16
1994 Q3	U.S. Global Inv Gold Shares	-13.17	U.S. Global Inv Gold Shares	-13.17	U.S. Global Inv Gold Shrs	-13.17	USAA Gold	-14.01
1994 Q4	Pin Oak Aggressive Stock	5.01	Merrill Lynch Sen Float Rt	1.88	Turner Midcap Value	6.64	Merrill Lynch Sen Float Rt	1.88
1995 Q1	Wasatch Ultra Growth	18.10	Wasatch Ultra Growth	18.10	Wasatch Ultra Growth	18.10	American Cent Intl Bd Inv	2.66
1995 Q2	Alger Small Cap Retirement	23.23	Fidelity Aggressive Growth	15.99	PBHG Select Equity	23.23	Fidelity Aggressive Growth	15.99
1995 Q3	PBHG Select Equity	6.64	Galaxy II Utility Index Ret	7.75	PBHG Select Equity	6.64	Galaxy II Utility Index Ret	7.75
1995 Q4	Dreyfus Aggressive Growth	40.97	Excelsior Premier Strat Val A	15.29	Dreyfus Prem Strat Val A	15.29	Bruce	-12.64
1996 Q1	INVESCO Gold Inv	-1.50	State St Res Glb Resource S	14.32	U.S. Global Inv World Gold	-0.33	State St Res Glb Resource	14.32
1996 Q2	Vontobel Eastern Euro Equity	5.62	Excelsior Intl Equity Instl	-1.41	Vontobel Eastern Euro Eq	5.62	Evergreen Util & Telecom I	-4.50
1996 Q3	HSBC Investor Equity Y	9.89	Fidelity Adv Emerg Mkts Inst	9.33	HSBC Investor Equity Y	9.89	Fidel Adv Emerg Mkts Inst	9.33
1996 Q4	CGM Realty	4.27	CGM Realty	4.27	CGM Realty	4.27	CGM Realty	4.27
1997 Q1	American Heritage	20.48	Vanguard Euro Stock Idx	9.57	Oakmark International I	8.28	Vanguard Euro Stock Idx	9.57
1997 Q2	Munder Micro-Cap Equity K	40.72	Excelsior Latin America	6.95	Excelsior Latin America	6.95	UAM Anal Enhanc. Eq Ins	12.07
1997 Q3	Munder Micro-Cap Equity K	-3.73	Perritt Micro Cap Opport	-13.79	Munder Micro-Cap Eq K	-3.73	Fremont U.S. Micro-Cap	-12.90
1997 Q4	American Cent Utilities Inv	11.96	Galaxy II Utility Index Ret	5.65	Galaxy II Utility Index Ret	5.65	Bruce	1.59
1998 Q1	Mathews Korea	-36.51	Prudential Europe Growth Z	7.88	Kinetics Internet	38.69	First Eagle International Y	2.90
1998 Q2	Kinetics Internet	-9.79	Wash-Hoisington US Treas	8.75	UAM Analytic Defens Eq I	-6.19	USAA Income Strategy	-1.63
1998 Q3	Comstock Capital Value R	-23.17	American Cent Intl Bond Inv	3.64	American Cent Intl Bd Inv	3.64	American Cent Intl Bd Inv	3.64
1998 Q4	Mathews Korea	9.31	Berkshire Focus	27.80	Mathews Korea	9.31	T. Rowe Price Sci & Tech	12.61
1999 Q1	Kinetics Internet	10.35	Mathews Japan	35.18	Mathews Japan	35.18	Mathews Japan	35.18
1999 Q2	Mathews Korea	-15.46	Neuberger berman millenn Tr	5.77	Mathews Korea	-15.46	Neuberger Berman Mill. Tr	5.77
1999 Q3	Turner Technology I	86.42	Berger Information Tech Inst	97.78	T. Rowe Price Japan	23.93	Berger Info Tech Inst	97.78
1999 Q4	Westcore Small Cap Growth	26.62	PBHG Select Equity	35.98	PBHG Select Equity	35.98	PBHG Select Equity	35.98
2000 Q1	Deutsche European Eq Invn	-3.93	American Eagle Capital App	28.24	American Eagle Cap App	28.24	American Eagle Cap App	28.24
2000 Q2	American Eagle Capital App	14.47	Alpine U.S. Real Estate Eq Y	14.84	American Eagle Cap App	14.47	Alpine U.S. R E Eq Y	14.84
2000 Q3	ProFunds Ultra Utilities Inv	2.41	Exceter Life Sciences A	18.02	Exceter Life Sciences A	18.02	Fairholme Fund, The	13.69
2000 Q4	CGM Focus	5.25	Boston Partners Lg/Shr Eq Iv	15.60	Vontobel U.S. Value	-4.41	Bost Partners Lg/Shr Eq Iv	15.60
2001 Q1	Ameristock Focused Value	21.60	Nuveen high yield muni Bd R	3.73	Buffalo High-Yield	2.54	Nuveen Ht Yield Muni Bd	3.73
2001 Q2	Turner New Enterprise	-47.02	Stratton Monthly Div REIT	-6.66	Wasatch Ultra Growth	-18.20	Goldman Sachs RE Svc	-6.11
2001 Q3	Comstock Capital Value R	-14.96	Comstock Capital Value R	-14.96	Comstock Capital Value R	-14.96	Huntington Mort Sess Tr	0.58
	The number of times T-bills were selected as the investment	0		9		0		19

Table 3
Terminal Wealth (TW) And Geometric Mean Returns (GM)
For All Four Strategies And The S&P 500

Panel A. Full Period and Half Period Results		Full 20 Years		1 st 10 Years		Last 10 Years			
Strategy	Description	TW	GM	TW	GM	TW	GM		
A	Traditional momentum strategy	\$5.32	8.83%	\$1.49	4.17%	\$3.57	13.57%		
B	Maximize the quarterly formation period compound return subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$ and $\frac{(1 + R_{t-1})}{(1 + R_{t-2})} > 1 \text{ and } \frac{(1 + R_{t-2})}{(1 + R_{t-3})} > 1,$	\$169.87	29.69%	\$4.72	17.25%	\$35.98	43.09%		
C	Maximize the quarterly formation period compound return subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$ and $(1 + R_{t-1}) > (1 + R_{t-2}) > 1$	\$53.88	22.37%	\$4.38	16.36%	\$12.31	23.1%		
D	Maximize the quarterly formation period compound return subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$, $\frac{(1 + R_{t-2})}{(1 + R_{t-3})} > 1 \text{ and } \frac{(1 + R_{t-1})}{(1 + R_{t-2})} > \frac{(1 + R_{t-2})}{(1 + R_{t-3})}$	\$85.09	25.23%	\$4.26	16.03%	\$19.99	34.92%		
S&P 500	Return on the Index	\$18.37	15.88%	\$5.46	19.07%	\$3.37	12.92%		
Panel B. Results for Each 5-Year Period		1 st 5-Year Period		2 nd 5-Year Period		3 rd 5-Year Period		Last 5-Year Period	
Strategy	Description	TW	GM	TW	GM	TW	GM	TW	GM
A	Traditional momentum strategy	\$2.95	25.58%	\$0.51	-12.60%	\$2.73	22.25%	\$1.31	5.55%
B	Please see Panel A	\$3.66	31.41%	\$1.29	5.22%	\$3.27	26.74%	\$11.00	61.54%
C	Please see Panel A	\$3.94	33.47%	\$1.11	2.11%	\$2.99	24.49%	\$4.12	32.73%
D	Please see Panel A	\$3.20	27.75%	\$1.33	5.87%	\$2.05	15.44%	\$9.76	57.72%
S&P 500	Return on the Index	\$2.66	22.87%	\$2.04	15.33%	\$2.03	15.21%	\$1.66	10.67%

Table 4
CAPM Regressions to Explain Quarterly Excess Returns on Standard and Directional Momentum Strategies

$$R_p - R_f = a + b(R_m - R_f) + e$$

All returns are quarterly and measured in percentages. R_m is the S&P 500 Portfolio, R_f is the three-month U.S. Treasury bill rate constructed from one month bill rates and R is the single mutual fund portfolio return to be explained.

Panel A describes regressions where the mutual fund is selected based on traditional momentum methodology. $t(a)$ ($t(b)$) is the t-value of the intercept (slope coefficient). The regression R^2 and residual standard error $s(e)$ are adjusted for degrees of freedom. Finally n is the number of quarterly returns in the estimation period.

Panel B summarizes sets of regressions where the mutual fund is selected so that it maximizes the quarterly formation period compound return subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$ and $(1+R_{t-1})/(1+R_{t-2}) > 1$ and $(1+R_{t-2})/(1+R_{t-3}) > 1$, where $R_{t-1}, R_{t-2}, R_{t-3}$ are monthly rates of return over the quarterly formation period.

Panel C summarizes a set of regressions where the mutual fund is selected so that the compound return over the quarterly formation period is maximized subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$ and $(1+R_{t-1}) > (1+R_{t-2}) > 1$.

Panel D summarizes a set of regressions where the mutual fund is selected so that the compound return over the quarterly formation period is maximized subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$, $(1+R_{t-2})/(1+R_{t-3}) > 1$ and $(1+R_{t-1})/(1+R_{t-2}) > (1+R_{t-2})/(1+R_{t-3})$.

Panel A							
Estimation Period	n	a	b	t(a)	t(b)	R ²	s(e)
Beginning End							
1982.Q2 2001.Q4	79	-0.76	1.28	-0.37	5.03***	0.24	17.64
1982.Q2 1991.Q4	39	-3.44	1.35	-1.59	5.44***	0.43	12.80
1992.Q1 2001.Q4	40	1.78	1.23	0.50	2.64**	0.13	21.40
1982.Q2 1986.Q4	19	-1.29	1.86	-0.41	4.77**	0.55	12.32
1987.Q1 1991.Q4	20	-6.33	0.99	-2.36**	3.48***	0.37	11.62
1992.Q1 1996.Q4	20	-0.01	2.02	-0.00	2.04*	0.14	15.26
1997.Q1 2001.Q4	20	1.71	1.12	0.28	1.81	0.11	26.91
Panel B							
Estimation Period	n	a	b	t(a)	t(b)	R ²	s(e)
Beginning End							
1982.Q2 2001.Q4	79	4.77	0.54	2.61***	2.44**	0.06	15.44
1982.Q2 1991.Q4	39	0.81	0.65	0.48	3.34***	0.21	10.09
1992.Q1 2001.Q4	40	8.52	0.45	2.74***	1.11	0.01	18.87
1982.Q2 1986.Q4	19	1.56	1.19	0.64	3.88*	0.44	9.66
1987.Q1 1991.Q4	20	-0.81	0.30	-0.39	1.37	0.04	8.96
1992.Q1 1996.Q4	20	3.04	0.98	0.98	1.36	0.04	11.11
1997.Q1 2001.Q4	20	12.72	0.42	2.31**	0.76	-0.02	24.21
Panel C							
Estimation Period	n	a	b	t(a)	t(b)	R ²	s(e)
Beginning End							
1982.Q2 2001.Q4	79	2.54	0.80	1.67*	4.32***	0.18	12.87
1982.Q2 1991.Q4	39	-0.22	1.05	-0.12	5.11***	0.40	10.64
1992.Q1 2001.Q4	40	5.16	0.51	2.17**	1.64	0.04	14.43
1982.Q2 1986.Q4	19	1.14	1.49	0.48	5.00***	0.57	9.41
1987.Q1 1991.Q4	20	-2.24	0.75	-0.91	2.89***	0.28	10.65
1992.Q1 1996.Q4	20	1.42	1.47	0.44	1.96*	0.13	16.57
1997.Q1 2001.Q4	20	6.65	0.40	1.72	1.03	0.00	16.99
Panel D							
Estimation Period	n	a	b	t(a)	t(b)	R ²	s(e)
Beginning End							
1982.Q2 2001.Q4	79	4.07	0.38	2.39**	1.85*	0.03	14.39
1982.Q2 1991.Q4	39	1.22	0.31	1.04	2.31**	0.10	6.88
1992.Q1 2001.Q4	40	6.77	0.52	2.18**	1.27	0.02	16.79
1982.Q2 1986.Q4	19	2.12	0.71	1.09	2.92***	0.30	7.67
1987.Q1 1991.Q4	20	-0.31	0.04	-0.34	0.41	-0.05	3.95
1992.Q1 1996.Q4	20	1.79	0.54	0.52	0.68	-0.03	12.22
1997.Q1 2001.Q4	20	11.64	0.56	2.20**	1.03	0.00	23.27

Note: (***, **, *) Denotes significance at the (1%, 5%, 10%) level

Table 5
Standard Deviations, Average Portfolio Excess Returns, And Sharpe Ratios Over Various Subperiods
For All Strategies And The Market

	Strategy A			Strategy B			Strategy C			Strategy D			Market		
	σ_p	$\overline{R_p - R_f}$	Sharpe Ratio	σ_p	$\overline{R_p - R_f}$	Sharpe Ratio	σ_p	$\overline{R_p - R_f}$	Sharpe Ratio	σ_p	$\overline{R_p - R_f}$	Sharpe Ratio	σ_p	$\overline{R_p - R_f}$	Sharpe Ratio
Time Period	%	%		%	%		%	%		%	%		%	%	
1 st 19 Quarters	18.30	5.05	.28	12.83	5.60	.44	14.30	6.21	.43	9.10	4.54	.50	7.38	3.40	.46
2 nd 20 Quarters	14.65	-4.01	-.27	9.14	-0.10	-.01	12.53	-0.48	-.04	3.92	-0.22	-.06	9.35	2.34	.25
3 rd 20 Quarters	16.51	5.19	.31	11.34	5.55	.49	12.40	5.19	.42	11.97	3.17	.26	3.69	2.57	.70
Last 20 Quarters	28.56	3.73	.13	24.03	13.48	.56	17.15	7.38	.43	23.38	12.64	.54	9.90	1.79	.18
First 39 Quarters	17.00	0.40	.02	11.37	2.67	.24	13.72	2.78	.20	7.33	2.10	.29	8.37	2.86	.34
Last 40 Quarters	23.03	4.57	.20	18.99	9.51	.50	14.82	6.28	.42	18.97	7.90	.42	7.38	2.18	.30
Full 79 Quarters	20.22	2.46	.12	15.89	6.14	.39	14.26	4.55	.32	14.58	5.04	.35	7.87	2.52	.32
Strategy A	Traditional momentum strategy														
Strategy B	Maximize the quarterly formation period compound return subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$ and $\frac{(1+R_{t-1})}{(1+R_{t-2})} > 1$ and $\frac{(1+R_{t-2})}{(1+R_{t-3})} > 1$,														
Strategy C	Maximize the quarterly formation period compound return subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$ and $(1+R_{t-1}) > (1+R_{t-2}) > 1$														
Strategy D	Maximize the quarterly formation period compound return subject to $R_{t-1} > 0, R_{t-2} > 0, R_{t-3} > 0$, $\frac{(1+R_{t-2})}{(1+R_{t-3})} > 1$ and $\frac{(1+R_{t-1})}{(1+R_{t-2})} > \frac{(1+R_{t-2})}{(1+R_{t-3})}$														

Figure 1
Possible Intra-Quarter Monthly Return Patterns Based On Their ROR Signs Only (P_t/P_{t-1})

Figure 2
Possible Intra-Quarter Monthly Return Sub-Patterns, Within Pattern #1 In Figure 1,
That Consider Both Price Change And Price Acceleration/Deceleration

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