Momentum Strategies versus Directional Momentum Strategies: A Comparative Study with No-load Mutual Funds

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Abstract

The textbook definition of 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 formation period, the directional momentum strategy applied to stock and/or bond no-load mutual funds proves very profitable for long horizon (ten to twenty years) investors.

I. Introduction

The weak form of the efficient market hypothesis claims that past security price changes do not predict future security prices. Empirical evidence, however, suggests that the relationship, if any, between past security price changes and future security price changes partially depends on the horizon. For three to five year horizons what goes up (down) subsequently goes down (up); similarly for very short horizons of days or weeks. However, for three month to one year horizons stock prices exhibit momentum or continuation in a price direction. In other words, what goes up (down) tends to keep going up (down). As Badrinath and Wafal (2002) document, this pattern of stock price momentum is exploited by institutional investors such as investment advisors and 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, and stocks with strong sell recommendations typically exhibit low price momentum."

The traditional momentum strategy involves ranking each stock in the sample under consideration based on its past compound return (Chan, Jagadeesh & 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. The equally weighted decile of stocks with the highest past performance is called the "winner" portfolio and that with the lowest past performance is called the "loser" portfolio. 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 50 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.

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 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 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 ROR signs, 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. Research by Jegadeesh and Titman (1993), Rouwenhorst (1998) 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 with high (low) returns over the past three months to one year continue to out-(under-) perform stocks with low (high) past returns over the same period.

The momentum effect has been documented using data mainly from domestic and international stock markets. 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.

This 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 over 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 the directional momentum methods, the resulting long-term performance is impressive.

The remainder of the paper is organized as follows. Section II describes the sample, briefly discusses the survivorship bias issue and provides the fund selection rules to be compared and contrasted. Section III 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 IV provides conclusions and suggestions for further research.

II. Sample Construction, Survivorship Bias, and Fund Selection Rules.

Sample Construction

All the data used in our study come from the Morningstar Pricipia Pro CD-ROM. We are interested in developing an investment strategy that is accessible to the small investor. 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 1982.2 and the last one at the end of 2001.3. Table I 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.

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 to 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, we believe that the main results we derive are qualitatively robust. Since extremely successful funds have better survivorship than poorly performing funds, our selections that exhibit favorable directional momentum should minimize this 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

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

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

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

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

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

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

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

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

and

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

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.

III. Temporal Composition and Risk-Adjusted Performance of Traditional and Directional Momentum Strategies

In this section, we examine two 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 and CAPM-evidence. 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 192.2-ending 2001.4. We emphasize that the decision on which fund to invest in is made every quarter based on return information provided by the previous three months.

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.

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.

Graphical Evidence

Figure 3 shows the evolution of wealth at quarterly intervals, from buying $1 at beginning 1982.2 and following either one of the four momentum strategies or investing in the S&P 500 portfolio till the end of 2001.4. Figure 3 provides graphical support for the view that Strategy A, the traditional momentum strategy, produces 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, when the stock market bubble burst, 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 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.

CAPM-Based Evidence

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-alpha. This measure uses the characteristic line to evaluate fund or strategy performance. Let us define the following variables: R is the single mutual fund quarterly rate of return, f is the three-month U.S. Treasury bill rate constructed from one-month bill rates, 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

$$R - f = a + b(M - f) + e$$

R-f (M-f) is also called excess fund (market portfolio) return. If the securities market is mean-variance efficient, then the intercept a (= Jensen-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 less than one.

Table 3 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-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&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-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 directional ones. These differences favor especially strategy B, both in terms of terminal wealth and risk-adjusted performance forms. We believe 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 believe that strategy D will be a credible competitor to strategy B from now on..

IV. 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. However, 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 declining. Under conditions like that the directional momentum strategies perform best by obtaining generous positive alphas and exhibiting lower than one betas. This behavior should make directional momentum strategies very attractive to the small investor.

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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

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 (%)
1982.1	Stein Roe Managed Municipals	4.62	T. Rowe Price New Income	3.49	Strong Balanced	4.18	T-Bill	3.23
1982.2	Gintel	9.46	T-Bill	2.52	Strong Large Cap Growth	6.31	T-Bill	2.52
1982.3	U.S. Global Inv Gold Shares	54.77	Spectra N	24.62	Spectra N	24.62	State Farm Interim	6.90
1982.4	U.S. Global Inv Gold Shares	-4.96	T-Bill	2.09	Salomon Bros Opportunity	16.83	T-Bill	2.09
1983.1	FMI Common Stock	13.94	Strong Large Cap Growth	18.55	Sit Mid Cap Growth	21.67	Strong Large Cap Growth	18.55
1983.2	American Cent Ultra Inv	-7.65	Fidelity Independence	-3.94	American Cent Ultra Inv	-7.65	T-Bill	2.38
1983.3	Japan S	10.41	SAFECO Dividend Income	2.34	Stratton Monthly Div REIT	-4.54	SAFECO Dividend Income	2.34
1983.4	Greenspring	3.91	Japan S	15.35	Japan S	15.35	Japan S	15.35
1984.1	Bailard, Biehl Intl Equity	-13.13	T-Bill	2.56	Bailard, Biehl Intl Equity	-13.13	T-Bill	2.56
1984.2	Nicholas II	10.94	Strong Large Cap Growth	4.37	Strong Balanced	2.74	T-Bill	2.69
1984.3	Armstrong Associates	-13.24	Fidelity Capital & Income	3.96	HighMark Bond Fid	7.47	T-Bill	2.33
1984.4	Century Shares Trust	14.91	Copley	5.59	Century Shares Trust	14.91	SAFECO CA Tax-Free Inc	4.79
1985.1	Fidelity OTC	9.78	USAA Cornerstone Strategy	3.10	Scudder Large Co Val S	6.47	Stratton Monthly Div REIT	12.39
1985.2	American Cent Targt 2010 Inv	-5.41	Stratton Monthly Div REIT	-6.49	American Cent Targt '10	-5.41	T-Bill	1.83
1985.3	Bailard, Biehl Intl Equity	20.98	Bailard, Biehl Intl Equity	20.98	Bailard, Biehl Intl Equity	20.98	Bailard, Biehl Intl Equity	20.98
1985.4	American Cent Targt 2005 Inv	45.49	American Cent Targt '05 Inv	45.49	American Cent Targt '05	45.49	Bailard, Biehl Intl Equity	29.20
1986.1	American Cent Targt 2010 Inv	-5.96	Fidelity Overseas	7.59	Fidelity Overseas	7.59	Fidelity Growth & Income	6.86
1986.2	Strong Opportunity Inv	-11.64	Strong Opportunity Inv	-11.64	Strong Opportunity Inv	-11.64	Strong Opportunity Inv	-11.64
1986.3	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
1986.4	American Cent Targt 2010 Inv	0.61	T-Bill	1.42	American Cent Targt '10	0.61	T-Bill	1.42
1987.1	U.S. Global Inv Gold Shares	-11.36	U.S. Global Inv Gold Shares	-11.36	U.S. Global Inv Gold Shrs	-11.36	U.S. Global Inv Gold Shrs	-11.36
1987.2	Nomura Pacific Basin	7.36	Berwyn	6.81	Fidelity Europe	13.37	Berwyn	6.81
1987.3	USAA Gold	-37.37	T-Bill	1.55	Fidelity Europe	-25.33	T-Bill	1.55
1987.4	American Cent Targt 2015 Inv	4.77	Babson Tax-Free Income	2.75	American Cent Targt '15	4.77	T-Bill	1.48
1988.1	Stonebridge Aggressive Grth	-14.23	Mosaic Mid-Cap Growth	-1.07	Mosaic Mid-Cap Growth	-1.07	Mosaic Mid-Cap Growth	-1.07
1988.2	Vanguard Windsor	1.92	Vanguard Windsor	1.92	Vanguard Windsor	1.92	Vanguard Windsor	1.92
1988.3	Westcore Flexible Income	-3.07	FAM Value	3.47	FAM Value	3.47	FAM Value	3.47
1988.4	American Cent Targt 2015 Inv	-0.73	RSI Retrmnt STInvmt	2.18	Scudder Global S	9.84	T-Bill	2.21
1989.1	American Cent Ultra Inv	10.43	T-Bill	2.19	Scudder Large Co Val S	9.11	T-Bill	2.19
1989.2	American Cent Targt 2015 Inv	-4.23	American Cent Targt '15 Inv	-4.23	American Cent Targt '15	-4.23	Strong Discovery	7.73
1989.3	INVESCO Health Sciences Inv	5.90	T-Bill	1.97	American Cent Giftrust Inv	-4.03	T-Bill	1.97
1989.4	U.S. Global Inv Gold Shares	-12.24	Fidelity Utilities	-4.92	Fidelity Utilities	-4.92	Stein Roe High-Yield Muni	0.50
1990.1	Stonebridge Aggressive Grth	8.23	Merrill Lynch Sen Float Rt	2.36	Stonebridge Aggr. Grth	8.23	T-Bill	2.01
1990.2	American Cent Targt 2020 Inv	-13.34	Fidelity Capital & Income	-2.92	Fidelity Capital & Income	-2.92	Gabelli Mathers	0.84
1990.3	USAA Gold	-13.23	Scudder Medium-Term T/F S	2.16	USAA Gold	-13.23	Scudder Medium-Term T/F	2.16
1990.4	Fidelity Adv Eqty Grth Instl	37.10	Spectra N	35.29	Spectra N	35.29	State Farm Interim	1.88
1991.1	American Heritage	-0.90	JP Morgan US Sm Co Sel	-8.53	American Cent Ultra Inv	-6.19	UMB Scout Small Cap	2.99
1991.2	U.S. Global Inv Gold Shares	-15.41	Vanguard Precious Metals	-3.81	Vanguard Precious Metals	-3.81	Vanguard Precious Metals	-3.81
1991.3	INVESCO Financial Svcs Inv	4.15	Bailard, Biehl Bond Opp	5.32	Stonebridge Aggressive	15.45	Bailard, Biehl Bond Opp	5.32

					Grth			
1991.4	American Cent Vista Inv	-7.41	Credit Suisse Gl F/I Comm	-4.06	Stein Roe Capital Opport	-5.06	Credit Suisse Gl F/I Co mm	-4.06
1992.1	American Heritage	-6.67	Permanent Port Treasury Bill	0.81	Fidelity Capital & Income	4.47	Permanent Port Treas. Bill	0.81
1992.2	T. Rowe Price New Asia	-6.19	American Cent Intl Bond Inv	7.18	American Cent Intl Bnd Inv	7.18	Scudder High-Yield T/F S	2.68
1992.3	American Cent Giftrust Inv	28.82	Tbill	0.79	American Cent Targt '05	0.43	T-Bill	0.79
1992.4	PBHG Growth	3.14	PBHG Growth	3.14	PBHG Growth	3.14	Alpine Intl Real Estate Y	13.59
1993.1	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
1993.2	U.S. Global Inv Gold Shares	-11.24	American Cent Targt '15 Inv	13.11	American Cent Targt '15	13.11	American Cent Targt '15	13.11
1993.3	PBHG Emerging Growth	4.80	PBHG Growth	4.16	PBHG Growth	4.16	Muhlenkamp	-1.66
1993.4	Mosaic Foresight	-15.46	Excelsior Latin America	-4.52	Mosaic Foresight	-15.46	Excelsior Latin America	-4.52
1994.1	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
1994.2	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
1994.3	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
1994.4	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
1995.1	Wasatch Ultra Growth	18.10	Wasatch Ultra Growth	18.10	Wasatch Ultra Growth	18.10	American Cent Intl Bd Inv	2.66
1995.2	Alger Small Cap Retirement	23.23	Fidelity Aggressive Growth	15.99	Alger Small Cap Retire	23.23	Fidelity Aggressive Growth	15.99
1995.3	PBHG Select Equity	6.64	Galaxy II Utility Index Ret	7.75	PBHG Select Equity	6.64	Galaxy II Utility Index Ret	7.75
1995.4	Dreyfus Aggressive Growth	40.97	Dreyfus Premier Strat Val A	15.29	Dreyfus Prem Strat Val A	15.29	Bruce	-12.64
1996.1	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
1996.2	Vontobel Eastern Euro Equity	5.62	Excelsior Intl Equity Instl	-1.41	Vontobel Eastern Euro Eq	5.62	Evergreen Util & Telecom I	-4.50
1996.3	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
1996.4	CGM Realty	4.27	CGM Realty	4.27	CGM Realty	4.27	CGM Realty	4.27
1997.1	American Heritage	20.48	Vanguard Euro Stock Idx	9.57	Oakmark International I	8.28	Vanguard Euro Stock Idx	9.57
1997.2	Munder Micro-Cap Equity K	40.72	Excelsior Latin America	6.95	Excelsior Latin America	6.95	UAM Anal Enhan. Eq Ins	12.07
1997.3	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
1997.4	American Cent Utilities Inv	11.96	Galaxy II Utility Index Ret	5.65	Galaxy II Utility Index Ret	5.65	Bruce	1.59
1998.1	Matthews Korea	-36.51	Prudential Europe Growth Z	7.88	Kinetics Internet	38.69	First Eagle International Y	2.90
1998.2	Kinetics Internet	-9.79	Wash-Hoisington US Treas	8.75	UAM Analytic Defens Eq I	-6.19	USAA Income Strategy	-1.63
1998.3	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
1998.4	Matthews Korea	9.31	Berkshire Focus	27.80	Matthews Korea	9.31	T. Rowe Price Sci & Tech	12.61
1999.1	Kinetics Internet	10.35	Matthews Japan	35.18	Matthews Japan	35.18	Matthews Japan	35.18
1999.2	Matthews Korea	-15.46	Neuberger Berman Millenn Tr	5.77	Matthews Korea	-15.46	Neuberger Berman Mill. Tr	5.77
1999.3	Turner Technology I	86.42	Berger Information Tech Inst	97.78	T. Rowe Price Japan	23.93	Berger Info Tech Inst	97.78
1999.4	Westcore Small Cap Growth	26.62	PBHG Select Equity	35.98	PBHG Select Equity	35.98	PBHG Select Equity	35.98
2000.1	Deutsche European Eq Invm	-3.93	American Eagle Capital App	28.24	American Eagle Cap App	28.24	American Eagle Cap App	28.24
2000.2	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
2000.3	ProFunds Ultra Utilities Inv	2.41	Exeter Life Sciences A	18.02	Exeter Life Sciences A	18.02	Fairholme Fund, The	13.69
2000.4	CGM Focus	5.25	Boston Partners Lg/Sht Eq Iv	15.60	Vontobel U.S. Value	-4.41	Bost Partners Lg/Sht Eq Iv	15.60
2001.1	Ameristock Focused V alue	21.60	Nuveen High Yield Muni Bd R	3.73	Buffalo High-Yield	2.54	Nuveen Hi Yield Muni Bd	3.73
2001.2	Turner New Enterprise	-47.02	Stratton Monthly Div REIT	-6.66	Wasatch Ultra Growth	-18.20	Goldman Sachs RE Svc	-6.11
2001.3	Comstock Capital Value R	-14.96	Comstock Capital Value R	-14.96	Comstock Capital Value R	-14.96	Huntington Mort Secs Tr	0.58
2001.4	Stein Roe Managed Municipals	4.62	T-Bill	2.52	Strong Balanced	4.18	T-Bill	3.23

Table 3

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

$$R - f = a + b(M - f) + e$$

All returns are quarterly and measured in percentages. M is the S&P 500 Portfolio, 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 desscribes 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 Beginning	End	n	a	b	t(a)	t(b)	R^2	s(e)
1982.2	2001.4	79	-0.76	1.28	-0.37	5.03***	0.24	17.64
1982.2	1991.4	39	-3.44	1.35	-1.59	5.44***	0.43	12.80
1992.1	2001.4	40	1.78	1.23	0.50	2.64**	0.13	21.40
1982.2	1986.4	19	-1.29	1.86	-0.41	4.77**	0.55	12.32
1987.1	1991.4	20	-6.33	0.99	-2.36**	3.48***	0.37	11.62
1992.1	1996.4	20	-0.01	2.02	-0.00	2.04*	0.14	15.26
1997.1	2001.4	20	1.71	1.12	0.28	1.81	0.11	26.91

Panel B

Estimation Period Beginning	End	n	a	b	t(a)	t(b)	R^2	s(e)
1982.2	2001.4	79	4.77	0.54	2.61***	2.44**	0.06	15.44
1982.2	1991.4	39	0.81	0.65	0.48	3.34***	0.21	10.09
1992.1	2001.4	40	8.52	0.45	2.74***	1.11	0.01	18.87
1982.2	1986.4	19	1.56	1.19	0.64	3.88*	0.44	9.66
1987.1	1991.4	20	-0.81	0.30	-0.39	1.37	0.04	8.96
1992.1	1996.4	20	3.04	0.98	0.98	1.36	0.04	11.11
1997.1	2001.4	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							
1982.2	2001.4	79	2.54	0.80	1.67*	4.32***	0.18	12.87
1982.2	1991.4	39	-0.22	1.05	-0.12	5.11***	0.40	10.64
1992.1	2001.4	40	5.16	0.51	2.17**	1.64	0.04	14.43
1982.2	1986.4	19	1.14	1.49	0.48	5.00***	0.57	9.41
1987.1	1991.4	20	-2.24	0.75	-0.91	2.89***	0.28	10.65
1992.1	1996.4	20	1.42	1.47	0.44	1.96*	0.13	16.57
1997.1	2001.4	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							
1982.2	2001.4	79	4.07	0.38	2.39**	1.85*	0.03	14.39
1982.2	1991.4	39	1.22	0.31	1.04	2.31**	0.10	6.88
1992.1	2001.4	40	6.77	0.52	2.18**	1.27	0.02	16.79
1982.2	1986.4	19	2.12	0.71	1.09	2.92***	0.30	7.67
1987.1	1991.4	20	-0.31	0.04	-0.34	0.41	-0.05	3.95
1992.1	1996.4	20	1.79	0.54	0.52	0.68	-0.03	12.22
1997.1	2001.4	20	11.64	0.56	2.20**	1.03	0.00	23.27

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

Figure 1

Possible intra-quarter monthly return patterns based on their ROR signs only (P_t/P_{t-1})

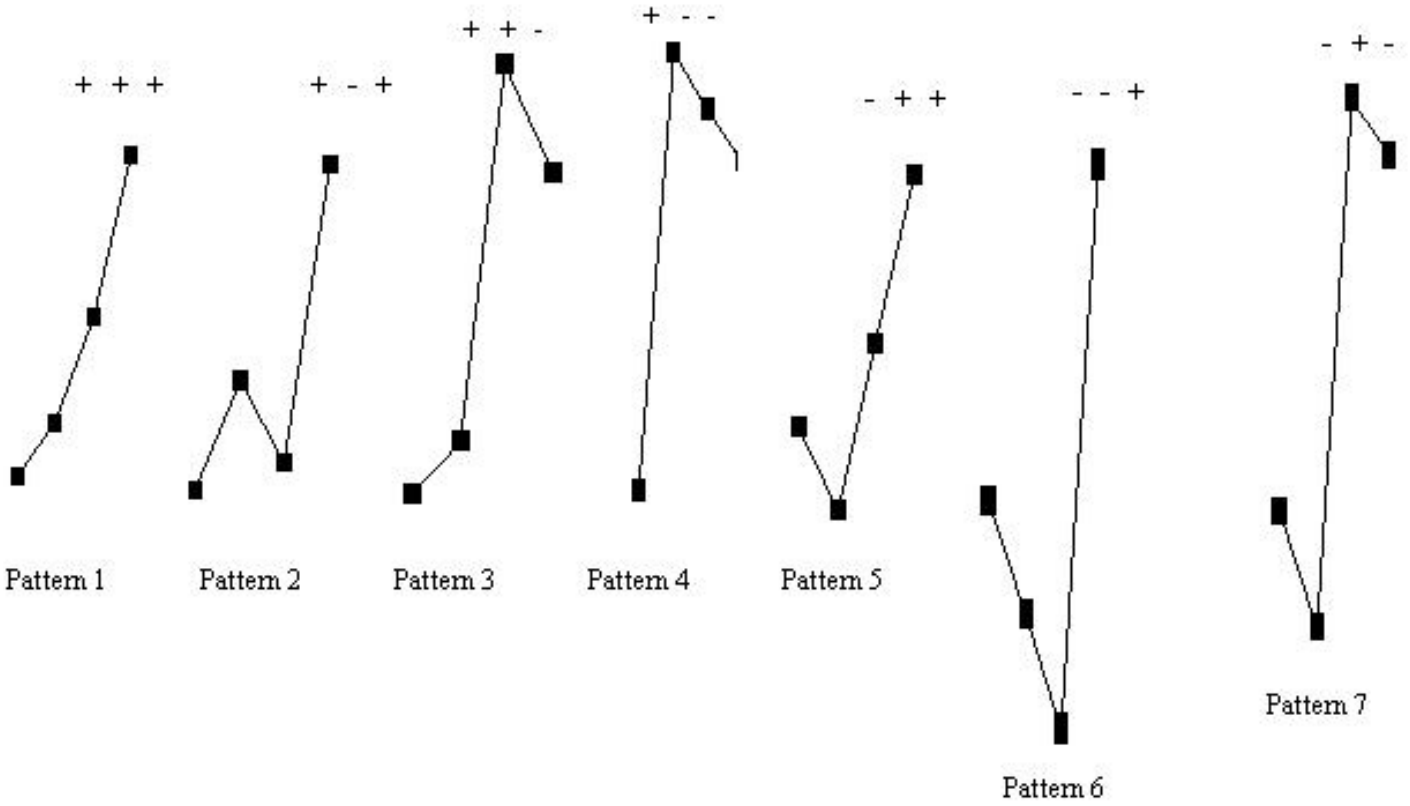
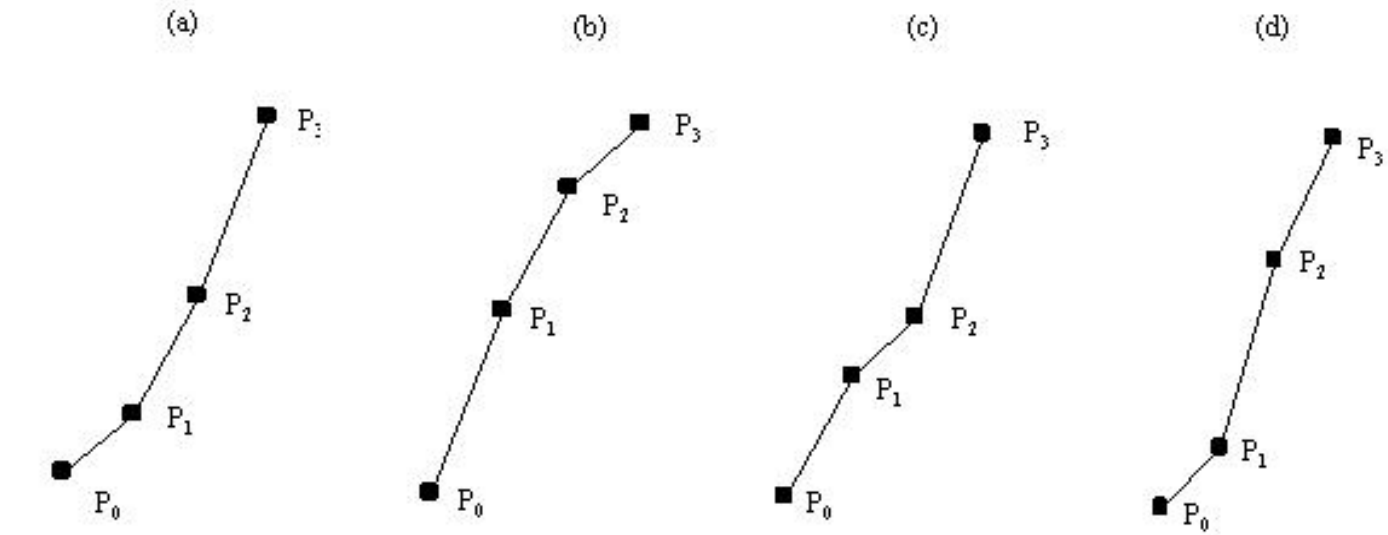


Figure 2.

Possible intra-quarter monthly return sub-patterns, within Pattern #1 in Figure 1, that consider both ROR sign and size



Sub-pattern: Price increase acceleration

Subpatter: Price increase deceleration

Sub-pattern: Mixed price increase

Sub-pattern: Alternate form of Mixed price increase

Figure 3
Terminal Value of $1 Invested for the Full 20-year Period

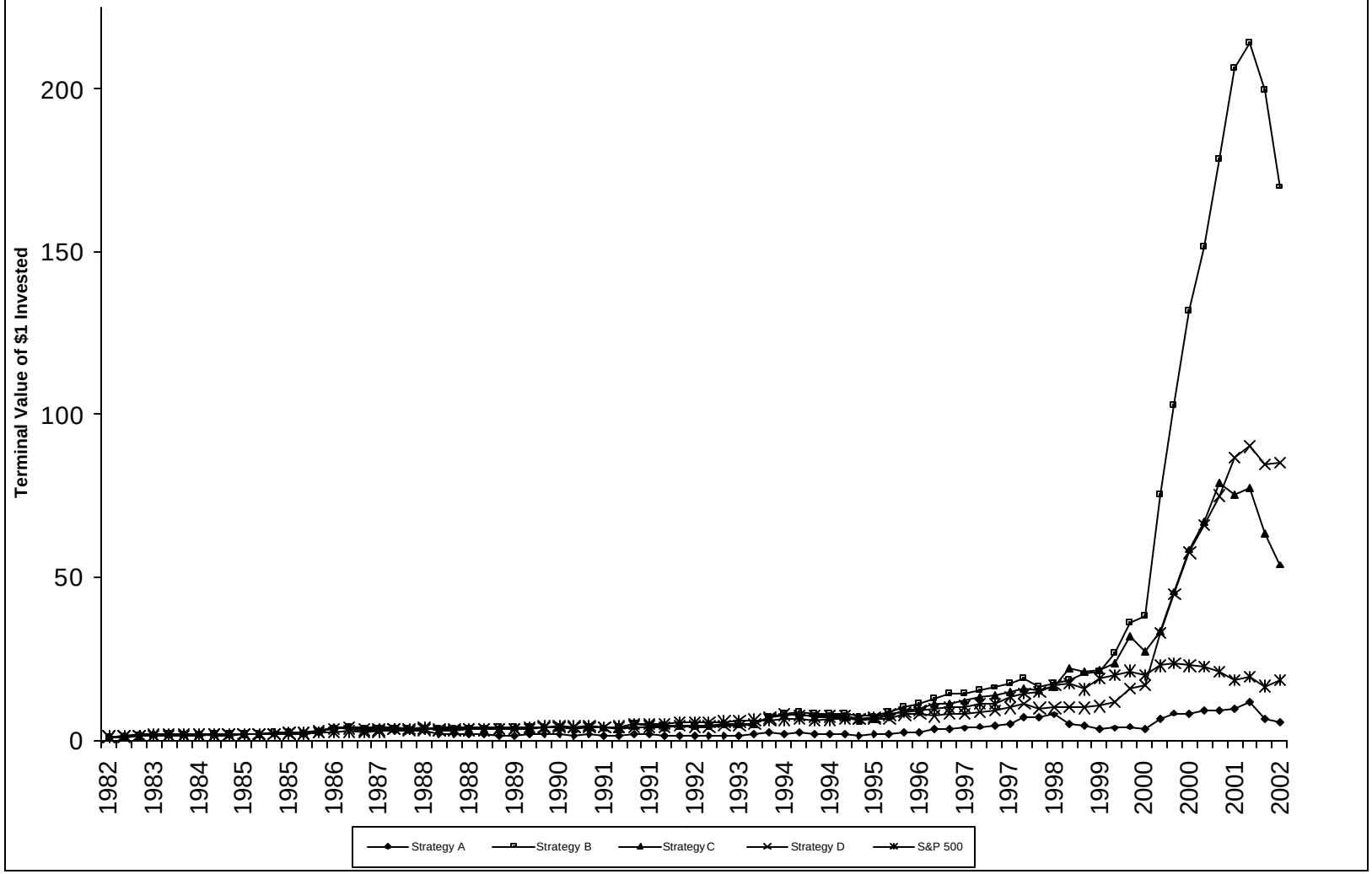


Figure 4
Terminal Value of $1 Invested for the First 39 Quarters 1982-1991

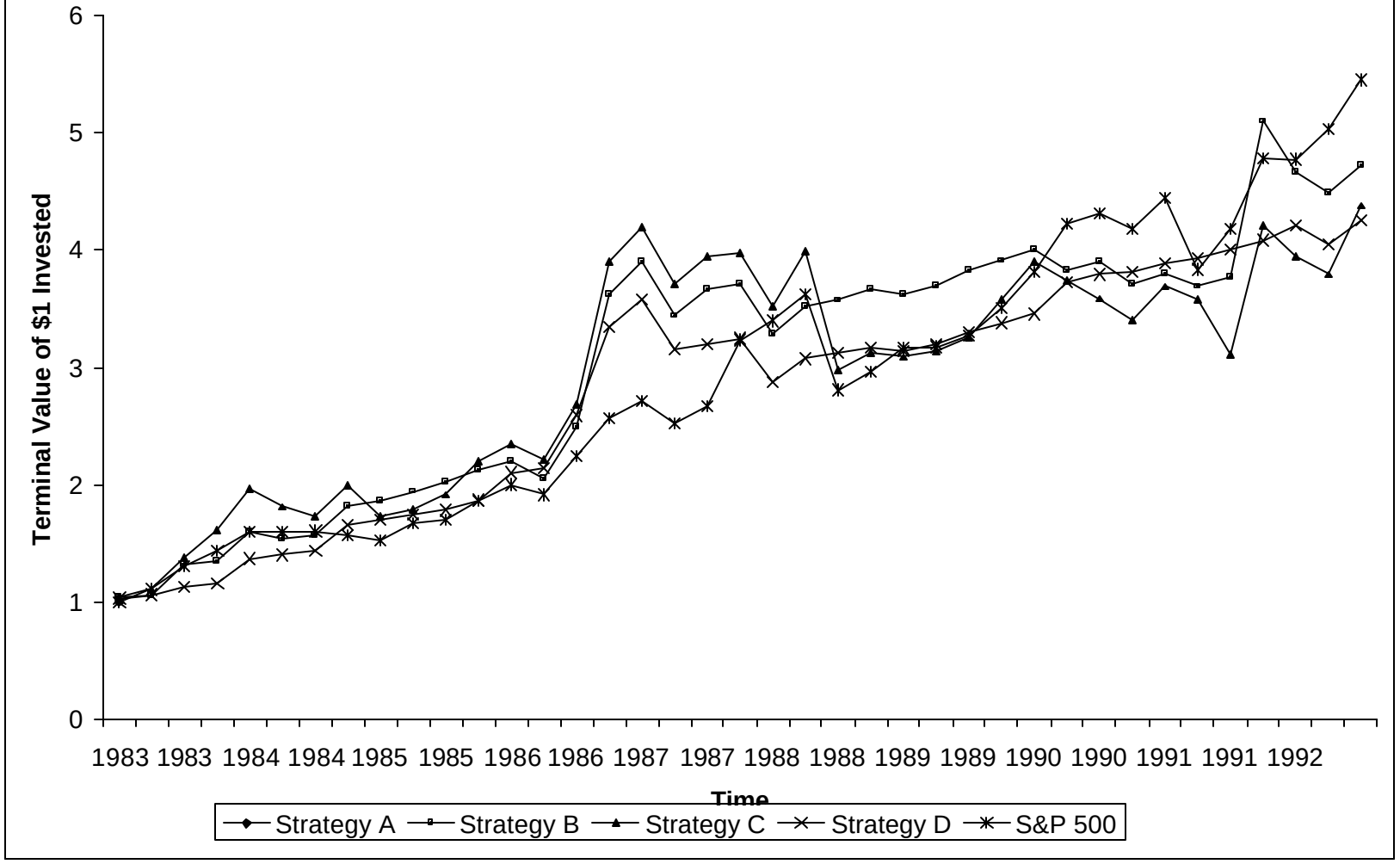


Figure 5
Terminal Value of $1 Invested for the Last 40 Quarters 1992-2001

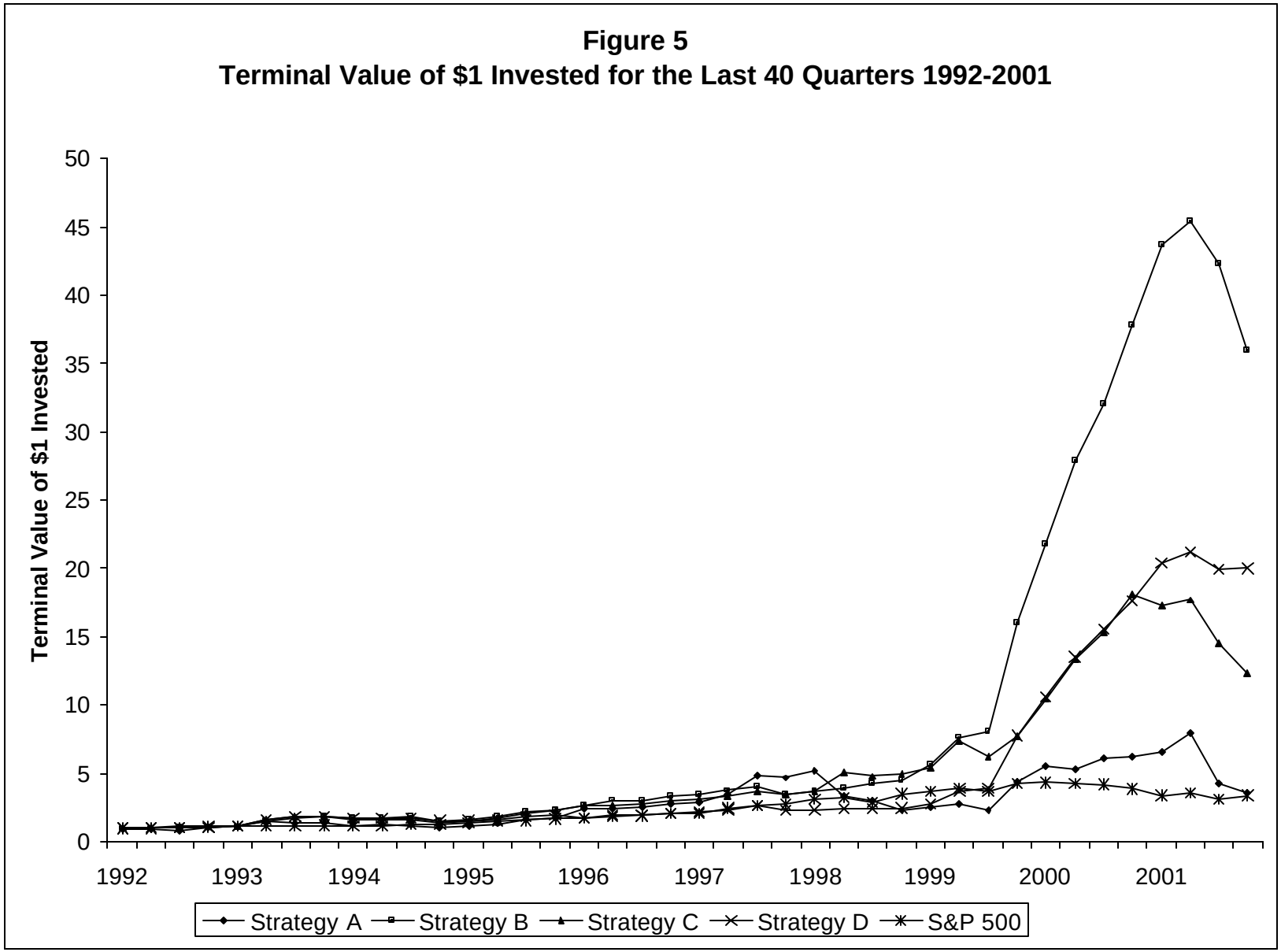


Figure 6
Terminal Value of $1 Invested for the First 19 Quarters 1982 -1986

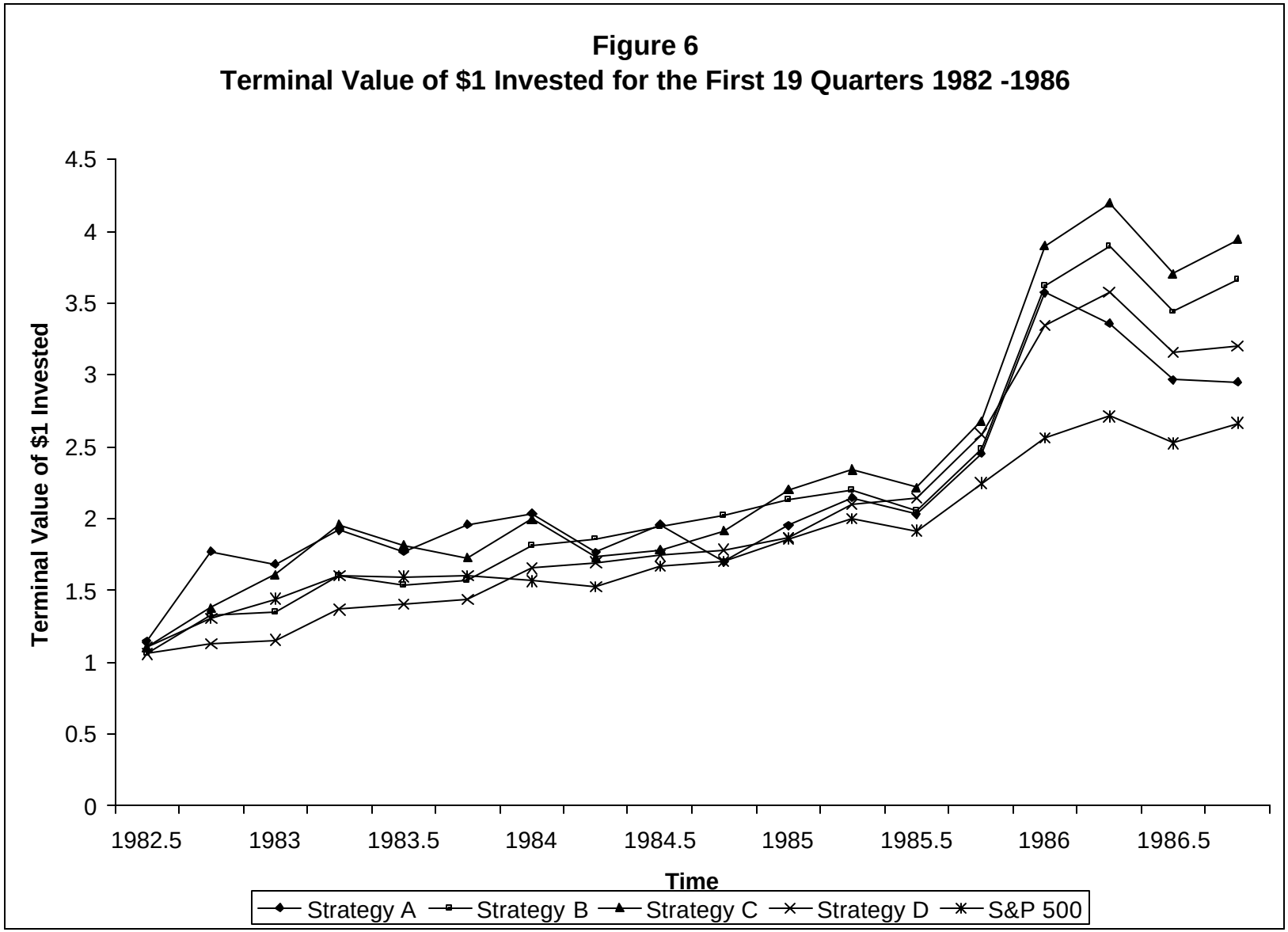


Figure 7
Terminal Value of $1 Invested for the Second 20 Quarters 1987-1991

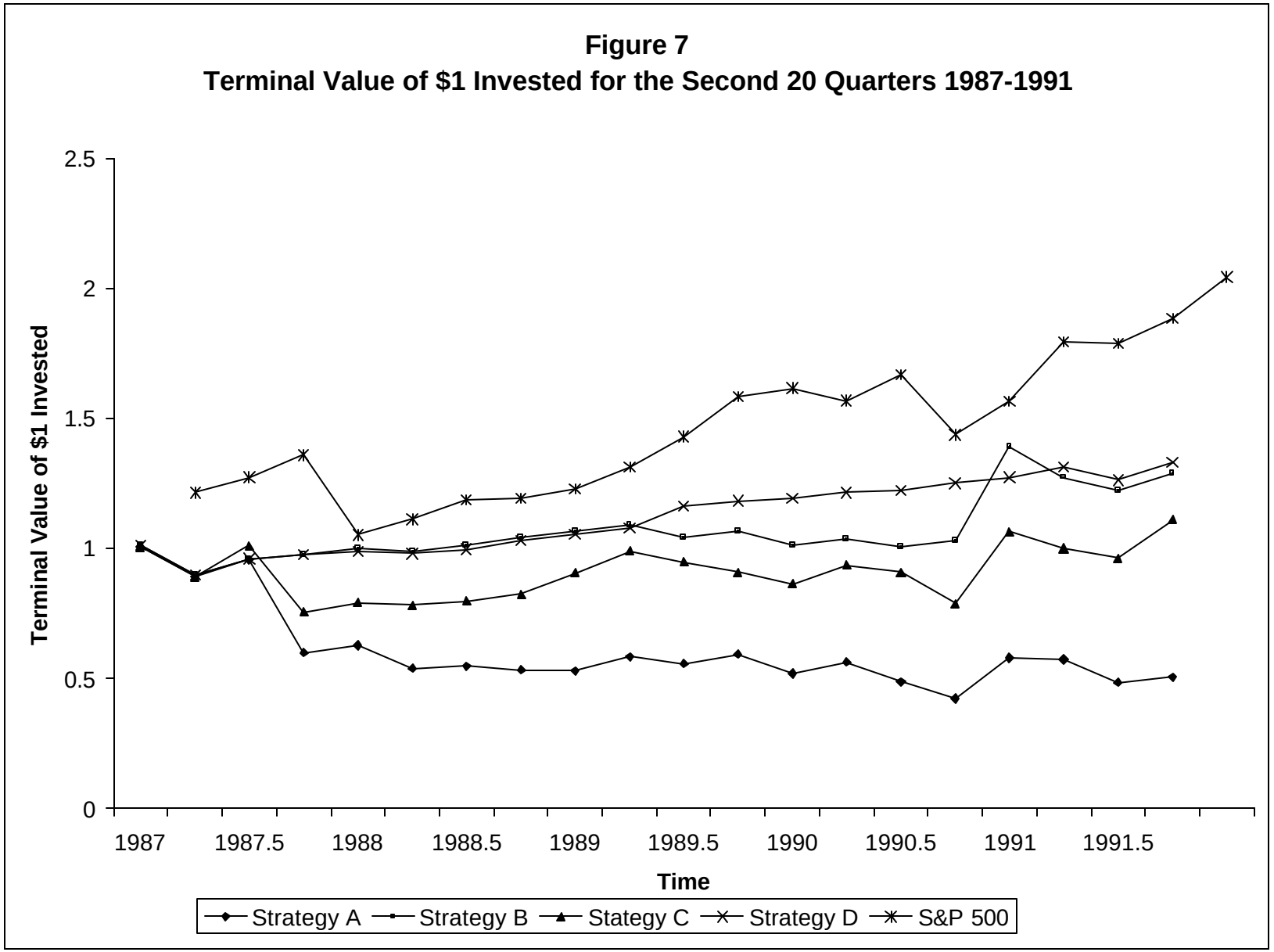


Figure 8
Terminal Value of $1 Invested during the Third 20 Quarters 1992-1996

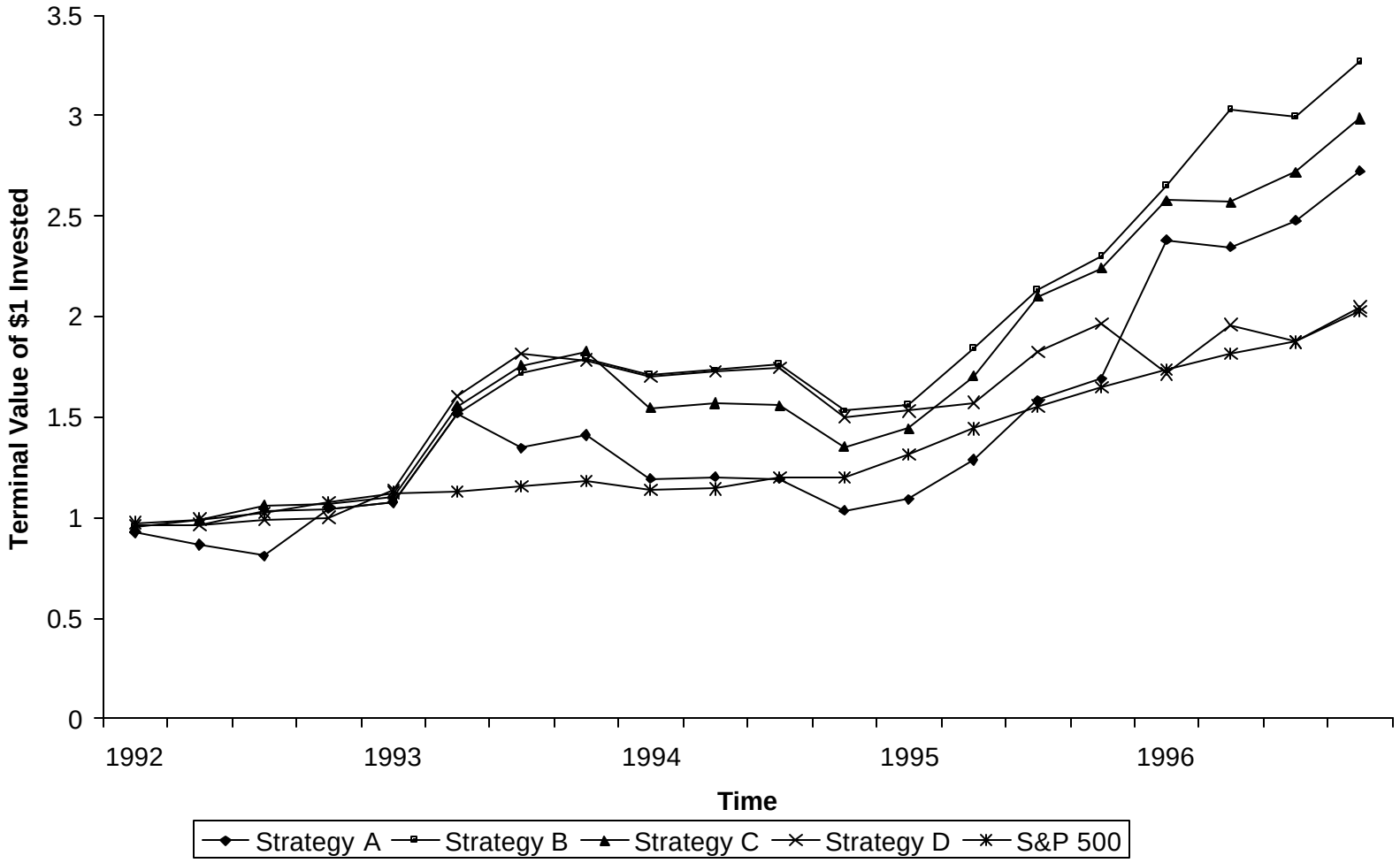


Figure 9
Terminal Value of $1 Invested for the Final 20 Quarters 1997-2001