The Profitability of Momentum Strategies

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Momentum strategies based on continuations in stock prices have attracted a wide following among money managers and investors. We evaluated the profitability of price momentum strategies based on past return and earnings momentum strategies based on standardized unexpected earnings and revisions of consensus forecasts. The strategies proved to be profitable for intermediate horizons. Chasing momentum can generate high turnover, however; hence, implementation of momentum strategies requires a focus on managing trading costs. Comparing the strategies yielded evidence that they reflect distinct phenomena and provided information about the sources of profits. The results indicate that the market is slow to incorporate the full impact of information in its valuations.

Does a stock price going up considerably over several months imply anything about its price in the future? A response to this question based on the efficient market hypothesis would be that past price changes do not predict future price changes. But a large and growing body of evidence suggests otherwise.

More precisely, it suggests that what past price movements mean for future price changes depends, in part, on the horizon. For long horizons (three to five years), what goes up apparently comes down and what goes down comes up. Past price movements are subsequently reversed. So, long-term past losers earn higher future returns than long-term past winners. The profits from a strategy based on such long-term movements are very noisy, however, and in many years, the strategy can generate losses. Similar reversals occur over very short horizons (days or weeks), but trading costs make capitalizing on these short-term patterns difficult. What has caught the attention of many investors recently is the predictability of price changes over intermediate horizons (three months to a year). In the medium term, stock prices exhibit momentum (continuation in a price direction). So, for these horizons, what goes up tends to keep rising and vice versa.

Many money managers and stock analysts attempt to exploit this pattern of price momentum. For instance, academic studies have documented 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.[1]

Evaluation of the usefulness of momentum strategies requires that their profitability be measured. In addition, practitioners and academics need to understand why momentum strategies work. In the absence of a reasonable explanation for the profitability of momentum strategies, the pattern of profits observed in the past could be a statistical fluke. If so, then momentum-based strategies are unlikely to be useful in the future. On the other hand, if the pattern is the result of systematic biases in the way investors process information, then the profitability should continue.

We document that significant profits are possible from a simple price momentum strategy of buying past six-month winners and selling past six-month losers.[2] A natural question that arises from this finding is: What drives the price momentum? Past returns, after all, are a reflection of changing fundamentals.

One explanation is that stock returns tend to be high when earnings growth exceeds expectations or when consensus forecasts of future earnings are revised upward (we refer to these conditions together as "earnings momentum"). Studies by Givoly and Lakonishok (1979), Latane and Jones (1979), and Bernard and Thomas (1989), among others, documented that earnings momentum strategies earn significant abnormal returns. Thus, the profits from a price momentum strategy may

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reflect underlying changes in fundamentals that are captured by earnings momentum.

Another explanation is that strategies based on price momentum and earnings momentum may be profitable because they exploit market underreaction to different pieces of information. For instance, earnings momentum strategies may exploit underreaction to information about the short-term prospects of companies that will ultimately be manifested in near-term earnings. Price momentum strategies may exploit slow reaction to a broader set of value-relevant information, including the long-term prospects of companies that have not been fully captured by near-term earnings forecasts or past earnings growth. If both these explanations are true, then a strategy based on past returns and on earnings momentum in combination should lead to higher profits than either strategy individually.

Sample and Methodology

Our sample included all stocks listed on the NYSE, Amex, and Nasdaq. We excluded closed-end funds, real estate investment trusts, American Depositary Receipts, and foreign stocks. We used stock price data from the CRSP database and earnings data from Compustat. Earnings forecast data came from the I/B/E/S database. The sample period for our first set of tests was January 1973 to December 1993, which is the sample period in Chan, Jegadeesh, and Lakonishok (1996). We also provide the out-of-sample performance of the momentum strategies for the 1994–98 sample period.

At the beginning of every month, we computed the price and earnings momentum variables. The variable for the price momentum strategy was a stock's past compound return, extending back six months prior to portfolio formation. In the earnings momentum strategies, we used two measures of earnings news. One was the commonly used standardized unexpected earnings, *SUE*, variable. Foster, Olsen, and Shevlin (1984) examined various time-series models for expected earnings and analyzed how the resulting measures of unanticipated earnings are associated with future returns. They found that a seasonal random walk model performs as well as more complex models, so we used it as our model of expected earnings. The *SUE* for stock i in month t is thus defined as

$$SUE_{i,t} = \frac{e_{i,q} - e_{i,q-4}}{\sigma_{i,t}}, \quad (1)$$

where

$e_{i,q}$ = quarterly earnings per share most recently announced as of month t for stock i

$e_{i,q-4}$ = earnings per share four quarters ago

$\sigma_{i,t}$ = the standard deviation of unexpected earnings, $e_{i,q} - e_{i,q-4}$, over the preceding eight quarters

The second measure of earnings momentum was the change in analysts' forecasts of earnings. Because analyst estimates are not necessarily revised every month, many of the monthly revisions take the value of zero. To get around this problem, we defined *REV6*, a six-month moving average of past changes in earnings forecasts by analysts, as

$$REV6_{i,t} = \sum_{j=0}^{6} \frac{f_{i,t-j} - f_{i,t-j-1}}{p_{i,t-j-1}}, \quad (2)$$

where $f_{i,t}$ is the consensus (mean) I/B/E/S estimate in month t of firm i's earnings for the current fiscal year. The revisions in estimates for month $t-j$ were scaled by the prior month's stock price ($p_{i,t-j-i}$).[3] Analyst estimates are available on a monthly basis,[4] which dispenses with the need for a model of expected earnings.

Keep in mind that analyst forecasts may not be an entirely clean measure of expected earnings. The estimates issued by analysts may be colored by incentives other than correctly estimating a company's future earnings; the desire to encourage investors to trade and thereby generate brokerage commissions could be one incentive.

Returns to Momentum Strategies: Univariate Analysis

The price momentum and earnings momentum measures are positively correlated with one another. **Table 1** shows that the highest correlation (0.440) was obtained for the two earnings momentum variables. Interestingly, the correlations of past six-month returns, *R6*, with standardized unexpected earnings and with analysts' forecast revisions indicate that past earnings surprises and revisions of expectations about the following year's

Table 1. Correlations between Prior Six-Month Return and Earnings Momentum Variables, 1973–93

	R6[a]	SUE	*REV6*
R6	1.000		
SUE	0.293	1.000	
REV6	0.294	0.440	1.000

[a]*R6* is the stock compound return over the prior six months.

Note: Correlations based on monthly observations pooled across all eligible stocks.

earnings are equally important driving forces for contemporaneous stock returns. The low correlations suggest, however, that the different momentum variables do not reflect the same information. Rather, they capture different aspects of improvement or deterioration in a company's performance.

To evaluate the profitability of strategies based on each momentum variable considered individually, we ranked stocks on the basis of either price momentum or a measure of earnings momentum. To be eligible, a stock needed to have available only data on the variable used in the ranking. The ranked stocks were then assigned to one of 10 decile portfolios, where the breakpoints were based on NYSE stocks. In the earnings momentum strategies, the breakpoints in any given month were based on NYSE companies that reported earnings within the prior three months (which took into account a complete cycle of earnings announcements). All stocks were equally weighted within a given portfolio.

For each momentum strategy, we report buy-and-hold returns in the periods subsequent to portfolio formation. Because returns measured over contiguous intervals may be spuriously related because of bid–ask bounce, we skipped the first five days after portfolio formation before we began to measure returns under the price momentum strategy and, for the sake of comparability, under the earnings momentum strategy. If a stock was delisted after it was included in a portfolio but before the end of the holding period over which returns were being calculated, we replaced its return until the end of the period with the return on a value-weighted market index. To calculate returns in subsequent periods, we rebalanced all the stocks remaining in the original portfolio to equal weights at the end of the period.

Table 2 presents the returns from each individual momentum strategy. In Panel A, Portfolio 1 comprises past losers and Portfolio 10 comprises past winners. As the arbitrage portfolio in the last column shows, in the first six months after portfolio formation, past winners (Portfolio 10) outperformed past losers (Portfolio 1) by 8.8 percentage points (pps). By the end of 12 months, the return difference had widened to 15.4 pps. Much of this difference was driven, however, by the extreme decile portfolios; comparing the returns to decile Portfolios 9 and 2 reveals a smaller difference, 6.3 pps.

Panel B of Table 2 presents the performance of decile portfolios based on standardized unexpected earnings. In the first six months after portfolio formation, the arbitrage portfolio (Portfolio 10 minus Portfolio 1) earned a return of 6.8 pps. Compared with the price momentum strategy reported in Panel A, the superior performance of the *SUE*-based strategy was relatively short-lived: The spread in returns between the extreme portfolios after a year was only slightly higher.

Table 2. After-Formation Returns for Portfolios Based on Past Return Momentum and Earnings Momentum: One-Way Classification, 1973–93 Data

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	10 – 1 (pps)
A. Return: Classification based on prior six-month return											
Past six months	–30.8	–12.6	–5.5	0.0	5.0	9.9	15.3	21.9	31.9	69.6	100.4
Six months APF	6.1	8.6	9.3	9.6	10.2	10.4	10.5	11.1	12.0	14.9	8.8
First year APF	14.3	18.5	19.8	20.8	21.4	22.2	22.3	23.5	24.8	29.7	15.4
Second year APF	20.5	20.1	20.5	20.6	20.8	20.8	20.4	20.8	20.7	19.9	–0.6
Third year APF	19.4	19.6	19.7	19.6	19.9	20.2	20.5	20.1	20.8	20.6	1.2
B. Return: Classification based on standardized unexpected earnings											
Past six months	–5.2	–0.4	2.7	6.2	9.9	12.7	14.9	16.6	18.6	22.6	27.8
Six months APF	5.1	6.3	8.1	9.1	10.5	11.4	11.4	11.5	11.9	11.9	6.8
First year APF	13.8	16.0	19.3	20.5	22.5	23.2	22.7	22.6	22.5	21.3	7.5
Second year APF	16.9	18.3	19.4	21.2	21.8	21.5	21.8	21.1	20.4	18.0	1.1
Third year APF	18.5	18.9	20.4	21.6	20.8	21.1	21.1	20.8	19.7	17.9	–0.6
C. Return: Classification based on analyst forecast revisions											
Past six months	–6.6	0.2	3.2	5.8	8.3	9.9	11.6	15.6	19.1	24.8	31.4
Six months APF	4.6	7.0	7.2	7.9	8.3	8.2	8.7	10.6	11.6	12.3	7.7
First year APF	13.2	15.9	16.4	17.1	17.7	17.4	17.7	20.3	21.6	22.9	9.7
Second year APF	15.9	18.0	17.8	18.7	18.0	17.1	17.8	17.5	18.8	21.4	5.5
Third year	17.7	18.2	17.4	17.3	18.6	17.9	17.6	18.9	19.4	20.2	2.5

APF = after portfolio formation.

Underlying the efficient market hypothesis is the notion that if any predictable patterns exist in returns, investors will quickly act to exploit them, until the source of predictability is eliminated. Investment rules based on *SUE* have a long history, however (dating back at least to Jones and Litzenberger 1970 and Latane and Jones 1979), and we found profits to a *SUE*-based strategy for a sample period that is largely outside the sample periods in the earlier studies.

Finally, we examined predictability based on analyst forecast revisions. The general perception is that analysts' forecasts tend to be overly optimistic. Such optimism may reflect the incentives that analysts face. That is, analysts' estimates may be overly favorable to encourage investors to buy a stock and thereby generate brokerage income. In addition, potential buyers (all the clients of the brokerage firm) outnumber potential sellers (who are, given the difficulty of short selling, limited to current holders of the stock); hence, an analyst is less likely to benefit from issuing a negative recommendation than a positive one. Also, an unfavorable forecast may strain relations between company managers and the analyst and jeopardize other interactions between the company and the analyst's brokerage firm (such as underwriting and investment banking).

Although these considerations may impart a bias to analysts' forecasts, an upward or downward revision in the consensus estimate may still convey important information. Panel C of Table 2 presents the returns for decile portfolios based on the *REV6* variable. The difference in returns between the extreme decile portfolios for the first six months is only marginally larger than the return spread based on *SUE*. The spread over a 12-month period is larger than the corresponding difference based on SUE but significantly smaller than the spread based on price momentum.

One hypothesis is that the profitability of momentum strategies stems from overreaction induced by positive-feedback trading of the sort discussed by DeLong, Shleifer, Summers, and Waldmann (1990). This view suggests that "trend chasers" reinforce movements in stock prices, even in the absence of fundamental information, so the returns for past winners and losers are (at least partly) temporary in nature. Under this explanation, past winners and losers will subsequently experience reversals in their stock prices.

To test the positive-feedback-trading hypothesis, we examined the performance of the decile portfolios in the second and third years after portfolio formation. Contrary to the predictions of this hypothesis, Panel A of Table 2 shows that the high-momentum portfolios and low-momentum portfolios earned about the same return over the two- and three-year holding periods. For instance, for the price momentum strategy, the loser portfolio outperformed the winner portfolio by only 0.6 pps in the second year and the winner portfolio earned only marginally higher returns in the third year.

To summarize, sorting stocks on the basis of past returns yields large differences in subsequent returns. Sorting on past earnings momentum (measured either by *SUE* or analyst forecast revisions) also gives rise to large spreads in future returns. The spreads in returns associated with the earnings momentum strategies tend to be smaller, however, and persist over a shorter period than the spreads associated with the price momentum strategy. Our evidence is consistent with the idea that the market does not promptly incorporate the news in past prices or earnings. The adjustment is gradual, so prices exhibit predictable drifts. These drifts last for up to a year, and no reversals occur after that period.

Return to Momentum Strategies: Two-Way Analysis

The evidence in the previous section indicates that each of the momentum strategies we considered is by itself useful in predicting stock returns 6 to 12 months into the future. Because these variables tend to move together, however, the findings may reflect not three separate effects but different manifestations of a single effect. If only one of the three momentum variables is the direct source of return predictability, then it should subsume the other variables.

We addressed this issue with predictability tests based on two-way classifications. At the beginning of each month, we sorted the securities in the sample on the basis of their past six-month returns and assigned them to one of three equal-sized portfolios. Independently, we sorted and grouped stocks into three equal-sized portfolios on the basis of the most recent earnings surprise. In this procedure, each stock was assigned to one of nine portfolios.

Panel A of **Table 3** reports the results when portfolios were based on rankings by past six-month returns and standardized unexpected earnings. The most important observation is that past realizations of six-month returns and *SUE* predicted continued drifts in prices in the subsequent period. In particular, the two-way sort generated large differences in returns between stocks that were jointly ranked highest and stocks jointly ranked lowest. For example, the highest ranked portfolio outperformed the lowest ranked portfolio by 8.1 pps in the first six months and 11.5 pps in the first year.

Table 3. After-Formation Returns for Portfolios Classified by Past Return Momentum and Earnings Momentum: Two-Way Classification, 1973–93 Data

A. Standardized unexpected earnings and prior six-month return									
SUE:	1 (Low)	2	3	1	2	3	1	2	3 (High)
R6:	1 (Low)	1	1	2	2	2	3	3	3 (High)
Return									
First six months	5.5	9.4	8.5	7.6	10.6	11.3	7.4	11.8	13.6
First year	14.2	19.0	15.7	18.3	22.4	21.6	19.0	25.3	25.7
B. Revisions in analyst forecasts and prior six-month return									
REV6:	1 (Low)	2	3	1	2	3	1	2	3 (High)
R6:	1 (Low)	1	1	2	2	2	3	3	3 (High)
Return									
First six months	4.2	6.3	8.5	7.7	8.8	11.2	9.3	10.3	13.0
First year	11.3	13.4	15.2	18.0	18.6	21.4	21.4	21.5	24.6
C. Revisions in analyst forecasts and standardized unexpected earnings									
REV6:	1 (Low)	2	3	1	2	3	1	2	3 (High)
SUE:	1 (Low)	1	1	2	2	2	3	3	3 (High)
Return									
First six months	5.1	6.5	9.3	8.4	9.3	11.1	9.3	9.6	12.1
First year	13.7	15.3	19.0	18.4	19.6	22.4	18.5	18.7	22.0

Each variable (*R6* and *SUE*) contributed some incremental predictive power for future returns. In Panel A, when prior returns were held fixed, stocks with high *SUE*s earned 4.3 pps more, on average, than stocks with low *SUE*s in the first six months following portfolio formation.[5] In comparison, the returns on stocks with high and low past prior returns but similar levels of *SUE* differed on average by only 3.1 pps. In the first six months, the marginal contribution of *SUE* was larger than that of past returns. When we considered the returns over the first year after portfolio formation, however, the picture completely changed. The marginal contribution of *SUE* was only 3.8 pps, compared with a contribution of 7 pps for past returns.

A similar picture emerges from the two-way classification by past six-month returns and analyst forecast revisions (Panel B of Table 3). The marginal contribution of analyst revisions in the first six months was 3.8 pps, compared with 4.5 pps for past returns. Although the marginal contribution of analyst revisions remained at about the same level 12 months after portfolio formation, the marginal contribution of past returns increased to 9.2 pps.

Given the similar patterns of predictability based on *SUE* and based on analyst revisions (from Table 2), we decided to examine whether these two variables capture the same phenomenon. Panel C presents the results of two-way portfolios sorted on the basis of standardized unexpected earnings and analyst revisions. We found that both *SUE* and *REV6* make individual contributions to return predictability, and their level of contribution is about the same. The marginal contributions of *SUE* were 3.4 pps and 3.7 pps for 6 and 12 months, respectively, after portfolio formation. The corresponding contributions of analyst revisions were 3.2 pps and 4.3 pps.

None of the momentum variables studied here subsumes any of the others. Instead, they each exploit underreaction to different pieces of information. As in Table 2, however, the results shown in Table 3 contain signs that the component of superior performance associated with earnings variables is more short-lived than the component associated with prior returns.

One possible explanation for the larger return spreads associated with price momentum than with earnings momentum is as follows. Our earnings momentum strategies were based on the performance of near-term income—the surprises in quarterly earnings or changes in analysts' forecasts of earnings for the current fiscal year. In contrast, when we selected stocks on the basis of high or low prior returns, we isolated cases in which the market made very large revisions in its expectations for the company's future outlook. The stocks in the highest ranked portfolio in our price momentum strategy rose in price by roughly 70 percent, on average, and the stocks in the lowest ranked portfolio fell in price by about 30 percent, on average, over the previous six months (see Table 2). Changes of this magnitude are unlikely to have arisen solely from quarter-to-quarter news in earnings. The corresponding past six-month returns of the portfolio ranked highest (lowest) by analyst revisions, for example, was about 25 percent (–7 percent). Because the reappraisal of market beliefs for the price momentum portfolios was larger and given that the market's adjustment was not immediate, perhaps it is not

surprising that the spread in future returns was larger for the price momentum strategy.

Similarly, the difference in the persistence of the two strategies has some intuitive basis. The uncertainty underlying the short-horizon measures of profitability used in the earnings momentum strategies is resolved relatively quickly. Prior returns, in contrast, reflect a broad set of market expectations not limited to near-term profitability. On this basis, we conjecture that for the price momentum strategy, it may take longer for the new information to be played out in stock prices.

Momentum for Large-Cap Stocks

We applied the momentum strategies to a sample of large-cap stocks to alleviate potential problems with small-cap stocks. Transaction costs tend to be high for small-cap stocks because they tend to be thinly traded and trade at low prices.[6] It would thus be easier to implement a momentum strategy with the large-cap stocks than with all stocks.

The sample in **Table 4** comprises stocks with market capitalizations as of the portfolio formation date exceeding the median market value of NYSE stocks. To minimize repetition, we report results only for returns in the first year following portfolio formation. Even for this set of large companies, which are more widely followed than small companies and for which timely information should be most readily available, the evidence is still that the market adjusts only gradually to the information in past returns or past earnings news. Notably, the one-way sorts in Panel A of Table 4 continue to deliver sizable differences in returns. This statement is particularly true when stocks are ranked by prior return; for this ranking, the spread in future one-year returns is 14 pps, which is almost as large as the spread for the entire sample in Table 2 (15.4 pps). A large difference in returns also shows up when the sorting was based on past analyst revisions. The one-year spread in this case of 7.6 pps can be compared with 9.7 pps for the entire sample in Table 2. When past standardized unexpected earnings is the ranking variable, the one-year spread is 4.6 pps smaller than the corresponding spread based on the entire sample.

Panel B of Table 4 shows returns for portfolios based on two-way sorts of the large-cap stocks. Compared with the entire sample, the large-cap stock sample displays smaller differences in returns between the highest ranked and lowest ranked portfolios. Nonetheless, the spreads remain large. Although sorting by prior return conditional on past earnings news gives rise to larger differences in subsequent returns, earnings momentum variables still have some marginal explanatory power. For example, the average one-year spread across prior return ranks with the rank by *SUE* held fixed is 5.7 pps. The average spread associated with *SUE* conditional on prior return is 2.1 pps. Perhaps earnings news has less impact on the returns of large companies than on other companies because numerous additional sources of information are available that deal with the outlook for large-cap companies.

Further Evidence of Biased Expectations

The evidence in the previous sections indicates that the effect of the good news that drives up the prices of winners during the ranking period spills over for the next 12 months and vice versa for losers. A natural explanation for this evidence is that the market underreacts to information. This section provides more direct evidence of such a bias in

Table 4. Returns for Momentum Portfolios Formed from a Sample of Large-Cap Companies, 1973–93 Data

A. Mean return in first after-formation year from one-way classification

Ranking Criterion	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	10 – 1 (pps)
R6	8.6	14.5	15.6	17.0	176.0	17.6	18.2	18.8	20.2	22.6	14.0
SUE	14.7	14.7	16.8	17.1	18.3	18.7	18.3	19.0	19.2	17.6	2.9
REV6	13.4	15.4	16.3	16.2	16.3	17.4	17.7	18.1	19.1	21.0	7.6

B. Mean return in first after-formation year from two-way classification

SUE rank:	1(Low)	2	3	1	2	3	1	2	3 (High)		
R6 rank:	1(Low)	1	1	2	2	2	3	3	3 (High)		
SUE and *R6*	13.3	15.4	13.6	16.2	18.0	18.6	17.5	20.9	21.0		
REV6 and *R6*	12.8	13.9	13.1	16.4	17.5	19.0	20.0	19.1	21.3		

Note: The sample included all stocks from the larger sample with beginning-of-month market value of equity above the median market capitalization of NYSE issues.

market expectations by examining stock-price reactions to earnings announcements in the holding period and by investigating how analysts change their earnings estimates.

Table 5 presents the abnormal returns (measured as raw return less the contemporaneous equal-weighted market return) for the variously constructed portfolios over a four-day window surrounding the announcement of quarterly earnings. The evidence in Table 5 indicates that the market continues to be surprised at the two quarterly earnings announcements following portfolio formation, particularly for the extreme decile portfolios.[7] In particular, for the price momentum strategy (Panel A), the abnormal return around the first subsequent announcement is higher by 2.6 pps for winners than for losers. At the second announcement following portfolio formation, the abnormal return is again larger for winner stocks, by 1 pps. To put this finding in perspective, note that the spread in returns between Portfolios 10 and 1 (see Table 2) was 8.8 pps in the first six months after portfolio formation. The combined difference of 3.6 pps in abnormal returns around the subsequent two announcements of quarterly earnings thus accounts for 41 percent of this spread. After two quarters, there is not much difference between the portfolios' abnormal returns around earnings announcements.

Next, consider the second part of Panel A—the behavior of analysts' revisions at earnings forecasts. The revisions for all the portfolios were mostly negative because analysts' forecasts initially tend to be overly optimistic and to be adjusted downward over time. In the period following portfolio formation, revisions for the loser portfolio were relatively unfavorable whereas those for the winner portfolio were relatively favorable. The adjustments in forecasts are especially protracted for the loser portfolio; a large downward monthly revision (averaging 2.1 percent relative to the stock price at the beginning of the month) occurred in the first six months after portfolio formation. The average monthly revision from 7–12 months afterward is still large (1.8 percent).

Klein (1990) also found that analysts remain overly optimistic in their forecasts for companies that have experienced poor stock-price performance. One conjecture is that it may not be in an analyst's best interest to be the first messenger with bad news (a negative forecast) because doing so might antagonize corporate managers. Analysts may prefer to remain optimistic and wait for additional confirmatory evidence of poor earnings before slowly modifying their estimates.

Panels B and C of Table 5 present returns around earnings announcements and future analyst revisions for the portfolios formed on standardized unexpected earnings and past analyst revisions. The results here are very similar to the findings for the price momentum portfolios. Again, the market was pleasantly surprised around earnings announcements for the winners up to two quarters after portfolio formation and vice versa for the losers. Meanwhile, analysts gradually revised downward their earnings forecasts for all companies. The downward revision is more pronounced for past losers.

All in all, the association between prior returns and prior earnings news, as well as the sluggishness in the market's response to past earnings surprises, provides further evidence that the market is slow in fully responding to new information.

Recent Evidence

So far, following Chan et al. (1996), we have reported the tests for companies in the 1973–93 sample period. Now, we turn to our investigations of whether the main findings hold outside that period.

Table 6 reports 12-month returns for the 1994–98 period for decile portfolios formed by ranking on each momentum variable individually. The portfolio formation procedure was the same as for the portfolios reported in Table 2. As Table 6 shows, when we formed portfolios based on price momentum (Panel A), the past winner portfolios outperformed the past loser portfolios by an average of 7.74 pps a year.[8]

Panels B and C report that the portfolios with high earnings momentum outperformed those with low earnings momentum, on average, in this sample period. In particular, the difference for the extreme portfolios based on consensus forecast revisions (Panel C) is notable; it averaged 9.96 pps a year.

To summarize, although this more recent sample period is short, the results provide reassurance that the profitability of momentum strategies is not a statistical fluke. But the recent evidence poses a puzzle: Why do these predictable patterns in returns still exist, despite the wide interest and following that momentum strategies have attracted? The issue is an interesting one that needs to be addressed in future research.

Conclusions

Strategies based on past returns and earnings momentum yield significant profits over a 6–12 month horizon. For example, in our study, sorting stocks by prior six-month return yielded return spreads of 8.8 pps over the subsequent six months. Similarly, ranking stocks by past earnings growth or a moving average of past revisions in consensus forecasts of earnings produced spreads of around 7 pps over the next six months. One caveat to bear in

Table 5. Earnings Announcement Returns and Analyst Forecast Revisions after Portfolio Formation, 1973–93 Data

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)
A. Classification based on prior six-month return										
	Abnormal Return around Earnings Announcements[a]									
First announcement APF	–1.1	–0.4	–0.1	0.0	0.2	0.3	0.4	0.6	0.9	1.5
Second announcement APF	–0.2	0.0	0.0	0.1	0.1	0.3	0.3	0.3	0.5	0.8
Third announcement APF	0.2	0.1	0.2	0.1	0.2	0.1	0.3	0.3	0.3	0.5
Fourth announcement APF	0.3	0.1	0.2	0.1	0.1	0.0	0.1	0.2	0.1	0.1
	Revisions in Analyst Forecasts[b]									
Average over 6 months APF	–2.138	–0.578	–0.368	–0.282	–0.220	–0.152	–0.117	–0.068	–0.041	0.004
Average for months 7–12 APF	–1.843	–0.555	–0.378	–0.318	–0.248	–0.206	–0.191	–0.165	–0.153	–0.180
B. Classification based on standardized unexpected earnings										
	Abnormal Return around Earnings Announcements									
First announcement APF	–1.2	–0.8	–0.5	–0.1	0.3	0.5	0.7	0.8	1.1	1.2
Second announcement APF	–0.3	–0.2	0.1	0.1	0.4	0.4	0.4	0.3	0.3	0.5
Third announcement APF	0.2	0.1	0.3	0.3	0.2	0.3	0.2	0.1	0.1	0.1
Fourth announcement APF	0.3	0.5	0.2	0.1	0.2	0.1	–0.1	–0.1	0.0	–0.2
	Revisions in Analyst Forecasts									
Average over 6 months APF	–1.480	–0.866	–0.647	–0.453	–0.325	–0.198	–0.119	–0.095	–0.054	0.005
Average for months 7–12 APF	–1.160	–0.817	–0.659	–0.352	–0.352	–0.247	–0.296	–0.232	–0.199	–0.155
C. Classification based on past analyst forecast revisions										
	Abnormal Return around Earnings Announcements									
First announcement APF	–0.6	–0.4	–0.2	–0.1	–0.1	0.0	0.2	0.3	0.5	0.9
Second announcement APF	–0.2	0.0	0.0	0.0	–0.1	0.2	0.2	0.1	0.3	0.4
Third announcement APF	0.3	0.0	0.0	0.3	0.0	0.0	0.0	0.3	0.0	0.0
Fourth announcement APF	0.2	0.2	0.1	0.0	–0.2	0.1	0.0	0.0	0.0	–0.1
	Revisions in Analyst Forecasts									
Average over 6 months APF	–2.027	–0.529	–0.323	–0.231	–0.158	–0.158	–0.116	–0.057	–0.037	–0.321
Average for months 7–12 APF	–1.994	–0.516	–0.320	–0.237	–0.190	–0.181	–0.153	–0.135	–0.156	–0.332

[a]Abnormal returns around earnings announcement dates are relative to the equally weighted market index and are cumulated from two days before to one day after the date of earnings announcement.

[b]Averages of percentage revisions relative to the beginning-of-month stock price in monthly median I/B/E/S estimates of current fiscal year earnings per share are reported.

Table 6. Profitability of Momentum Strategies, 1994–98 Data

	1 (Low)	2	3	4	5	6	7	8	9	10 (High)	10 – 1 (pps)
A. Classification based on prior six-month return											
1994	–12.00	–6.10	0.40	2.10	0.50	–0.90	–1.80	3.10	–4.50	–6.40	5.60
1995	35.70	27.40	32.30	35.00	32.30	32.20	30.30	36.70	35.30	42.10	6.40
1996	11.90	15.60	17.90	20.20	27.90	22.50	22.00	21.90	20.40	15.30	3.40
1997	7.20	05.70	14.80	20.80	26.60	32.80	35.60	37.30	37.50	23.80	16.60
1998	–2.30	–4.40	–7.00	–3.30	–0.40	0.00	04.50	0.10	–0.80	04.40	6.70
1994–98 average	8.10	7.64	11.68	14.96	17.38	17.32	18.12	19.82	17.58	15.84	7.74
B. Classification based on standardized unexpected earnings											
1994	–2.30	–2.40	–6.80	–1.00	–4.60	–1.20	–0.10	–3.30	0.90	–2.00	0.30
1995	36.70	25.40	27.80	31.00	33.40	27.50	36.10	36.90	38.60	40.60	3.90
1996	16.30	17.90	19.20	16.30	21.90	19.60	23.10	22.70	24.70	18.40	2.10
1997	25.50	21.70	23.50	22.80	24.10	24.50	25.20	28.40	29.60	28.10	2.60
1998	–3.20	–5.20	–1.30	04.40	–0.60	5.00	–0.10	–0.60	0.00	–6.20	–3.00
1994–98 average	14.60	11.48	12.48	14.70	14.84	15.08	16.84	16.82	18.76	15.78	1.18
C. Classification based on analyst forecast revisions											
1994	0.50	1.90	–7.10	–1.00	–5.50	–3.10	–7.60	–8.10	–3.80	–7.70	–8.20
1995	34.40	19.30	28.80	32.60	25.20	19.10	27.80	29.70	40.20	56.90	22.50
1996	15.50	16.20	18.60	22.40	16.00	12.10	21.00	15.70	25.40	30.20	14.70
1997	5.80	18.50	15.30	21.10	23.60	24.70	36.60	28.50	29.70	21.20	15.40
1998	–5.60	–15.00	–3.80	–1.90	10.60	12.40	03.20	0.40	–0.30	–0.20	5.40
1994–98 average	10.20	8.18	10.36	14.64	13.98	13.04	16.20	13.24	18.24	20.08	9.96

mind, however, is that trading is by no means a free activity. Chasing momentum can generate high turnover, so much of the potential profit from momentum strategies may be dissipated by transaction costs.

The source of these momentum profits may be the tendency of at least some investors to chase past trends. These investors may rush to buy past winners and dump past losers, resulting in temporary price drifts for these stocks. The implication of this hypothesis is that momentum profits are subsequently reversed. We found, however, that the winner and loser portfolios have about equal returns in the second and third years after formation of the momentum-based portfolios. Therefore, momentum profits are not driven by trend chasers.

In evaluating the profitability of trading strategies when the momentum variables were jointly considered, we found that, although all three momentum variables tended to move together, each of them made an incremental contribution in predicting future returns. For instance, our two-way analysis revealed that the marginal contribution of price momentum to future six-month returns is about 4.5 pps and the contribution of analyst forecast revisions is about 3.8 pps. The price momentum effect, however, tended to be longer-lived than the earnings momentum effect, and it made a relatively larger contribution over a 12-month holding period. The reason may be that returns respond to information related to both long-term and short-term profitability of companies whereas the information in the earnings variables is inherently short term in nature.

These results indicate that the market is slow to incorporate in its valuations the full impact of information. To examine this issue further, we focused on the market's reaction when earnings are released after portfolio formation. A substantial portion of the momentum effect is indeed concentrated around subsequent earnings announcements. For example, about 41 percent of the superior performance in the first six months of the price momentum strategy in our study occurred around the announcement dates of earnings. Generally, therefore, if the market is surprised by good or bad earnings news, then (on average) the market continues to be surprised in the same direction, at least over the next two subsequent announcements.

Another piece of evidence compatible with the sluggish response of market participants is the long time it takes analysts to adjust their forecasts. This inertia in revising forecasts may not be helping the market to assimilate new information in a timely fashion. Analysts are especially slow in revising their estimates in the case of companies with the worst performance. The cause may be the incentives analysts have to maintain good relations with corporate managers.

The evidence we presented is in clear violation of the concept of market efficiency. The foundation of market efficiency is the assumption that investors have unbiased expectations. Behavioral psychologists have found that their subjects typically exhibit a "conservatism" bias, however, in the way they process information. This bias leads people to hold on to their prior beliefs for too long without updating them fully in the face of new information. As Barberis, Shleifer, and Vishny (1998) argued, such behavioral biases may be the underlying source of persistent market underreaction.

Notes

1. See, for example, Grinblatt and Titman (1989), Chen, Jegadeesh, and Wermers (forthcoming 2000), and Womack (1996).
2. Previous studies that examined this issue include Jegadeesh and Titman (1993) and Chan, Jegadeesh, and Lakonishok (1996). The latter paper contains an in-depth examination of the issues addressed here. Rouwenhorst (1998) provided confirmatory evidence based on European stocks.
3. Scaling the revisions by the stock price penalizes stocks with high P/Es. To circumvent this possibility, we also scaled revisions by book value per share. We also experimented with using the percentage change in the median I/B/E/S estimate and using the difference between the number of upward and downward revisions as a proportion of the number of estimates for the measure of analyst revisions and found our results to be robust to these alternative measures.
4. In the context of an implementable investment strategy, all stocks were candidates for inclusion in our price momentum or earnings momentum portfolios in a given month. The strategy based on analyst revisions automatically fulfilled this requirement because consensus estimates are available monthly. The portfolios based on standardized unexpected earnings, however, did pick up an earnings variable, which may be somewhat out-of-date for those companies that did not announce earnings in the month of portfolio formation. This situation may have led to an understatement of the returns to the *SUE* strategy, but in any event, we were able to compare the results from the price momentum and from the earnings momentum strategies directly.
5. In each of the three categories of prior return, we took the difference in returns between Portfolios 3 and 1 when stocks were ranked by *SUE*. The reported number is the simple mean of the three differences.
6. In the last period of portfolio formation, only two stocks in the large-cap sample (out of about 1,000 eligible stocks) had prices below $5.
7. We found the average abnormal return around announcement dates to be positive, which is consistent with the findings of Chari, Jagannathan, and Ofer (1988).
8. Jegadeesh and Titman (1999) also reported that momentum strategies were profitable in the 1990s.

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