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Momentum, reversal, and the trading behaviors of institutions ☆

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Abstract

We identify two types of momenta in stock returns—one due to returns relative to other stocks and one due to firm-specific abnormal returns, where abnormal is determined by a stock's idiosyncratic return variation. Despite similar performances over the first year, these momentum portfolios perform dramatically differently beyond year one. Relative-return momentum reverses strongly; abnormal-return momentum continues for years. This complexity in return momentum challenges the current theories of momentum. We propose that both momenta are consequences of agency issues in the money management industry and provide empirical support for this economic rationale of momentum in returns. Incentives induce institutions to chase relative returns and to underreact to firm-specific abnormal returns.
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1. Introduction

Momentum in stock returns presents one of the strongest challenges to the efficiency and rationality of financial markets. Why does buying stocks with the highest returns over the prior six to twelve months and shorting stocks with the lowest returns generate robust profits?[1] Thus far, risk-based explanations have had little empirical success. As a consequence, most theories of momentum rely on behavioral and cognitive biases of investors.[2]

We present findings that challenge the most prominent theories of momentum while providing support for a new agency-based rational explanation suggesting that institutions play a role in generating momentum in returns. First, we document that there are two types of momenta—one due to returns *relative* to other stocks and one due to firm-specific *abnormal* returns, where abnormal is determined by a stock's own idiosyncratic return variation. Our motivation for isolating these types of momenta is based on two findings in the literature. One, the profits to the standard relative-return momentum portfolios reverse on average in the long run (two to five years after formation), suggesting an overreaction to relative returns. Two, abnormal returns following corporate events such as earnings surprises, dividend changes, share repurchases, stock splits, and seasoned equity offerings continue for years without reversing, suggesting an underreaction to firm-specific news.[3] Consistent with these other results, the two types of momenta we identify perform dramatically differently after the first year of their holding periods, revealing a complexity to momentum that current theories cannot accommodate. Second, we show that the trading of institutions contributes to both types of momenta in ways that are consistent with their incentives as money managers, thereby supporting an economic rationale for momentum in returns. Agency issues provide a parsimonious and rational theory of momentum that is consistent with our new empirical facts.

To examine the two types of momenta, we construct portfolios based on firm-specific abnormal returns and raw returns independently and then separate the stocks with abnormal-return momentum from the stocks with relative-return momentum. Relative-return-momentum stocks are identified as those in the extreme deciles of prior six-month returns, as introduced by Jegadeesh and Titman (1993). Abnormal-return-momentum stocks are identified as those with firm-specific residual returns more than one standard deviation from zero. Both momentum portfolios generate significant and robust profitability in the first twelve months of their holding periods. We find that relative-return momentum reverses strongly in months thirteen through sixty with average profits around *negative* 40 basis points per month. In contrast, abnormal-return momentum

[1]Following Jegadeesh and Titman's (1993) seminal study, Rouwenhorst (1998, 1999), Griffin et al. (2005), Grundy and Martin (2001), and Schwert (2003) find momentum in stock returns throughout the world, in U.S. returns before 1960, and even in U.S. returns after the publication of Jegadeesh and Titman's (1993) results.

[2]Fama and French (1996), Moskowitz (2003), Cooper et al. (2004), and Liu et al. (2003) find that momentum cannot be captured by various measures of factor risks. Lewellen and Shanken (2002) and Brav and Heaton (2002) note that rational learning under uncertainty can generate momentum, but this theory has yet to be tested. Chan et al. (1996) and Grinblatt and Han (2005) suggest that momentum is due to underreaction to firm-specific news. On the other hand, Daniel et al. (1998), Hong and Stein (1999), and Barberis et al. (1998) suggest that momentum is due to overreaction to firm-specific news.

[3]Lee and Swaminathan (2000) and Jegadeesh and Titman (2001) find long-run reversal for momentum portfolios. A list of studies finding post-event continuation in returns is provided in the appendix of Daniel et al. (1998). In addition, Chan (2003) finds long-run continuation in returns following headline media news.

persists on average for at least four years, generating profits in months thirteen through sixty around *positive* 20 basis points per month. The five-year difference in cumulative returns across the abnormal-return-momentum and relative-return-momentum portfolios is roughly 30%, revealing a stark distinction between abnormal-return and relative-return momenta.

The finding of two types of momenta is important for several reasons. First, we find that the long-run profitability of momentum portfolios depends critically on the type of momentum present. Relative-return momentum reverses and is consistent with overreaction. Abnormal-return momentum persists and is consistent with underreaction. Current theories do not predict these differences. Second, the long-run momentum in abnormal returns extends the empirical evidence of underreaction to firm-specific news beyond the distinct news announcements in corporate events and media headlines. We find that underreaction extends more broadly to include even the firm-specific information captured in returns. Such a pervasive phenomenon deserves further attention and suggests an avenue of research away from event-specific explanations of underreaction.

We continue our analysis by examining how changes in the institutional ownership of stocks relate to our momentum findings. Do institutions overreact to extreme relative returns and underreact to firm-specific abnormal returns? First, we find that institutions buy relative-return winners and sell relative-return losers at rates far above average, but institutions buy abnormal-return winners and sell abnormal-return losers as if they were any other stock. These results suggest that institutions chase relative returns, possibly resulting in an overreaction, but institutions ignore firm-specific abnormal returns, possibly resulting in an underreaction. Second, we examine how changes in institutional ownership affect the profits of each type of momentum portfolio. We find that the relative-return-momentum stocks that institutions most support (i.e., winners they buy the most of and losers they sell the most of) reverse strongly in the long run, while the relative-return-momentum stocks that institutions least support (i.e., winners they buy the least of and losers they sell the least of) do not reverse. This variation in long-run profits is consistent with institutions' overreacting to relative returns. On the other hand, the abnormal-return-momentum stocks that institutions least support display momentum that persists for years, while the abnormal-return-momentum stocks that institutions most support do not. This variation in profits is consistent with institutions' underreacting to firm-specific abnormal returns. In sum, institutions are empirically linked to both types of momenta.

We propose that the incentives of money managers can induce managers to underreact to firm-specific abnormal returns and to overreact to relative returns. Lakonishok et al. (1994), Shleifer and Vishny (1997), and others note that agency issues in delegated money management can have consequences for asset pricing. The general notion is that, on one hand, institutions keep their portfolios near a market index, for reputation and career concerns, which hinders managers from fully exploiting firm-specific information, possibly generating an underreaction to firm-specific news. On the other hand, when institutions do deviate from an index, they tend to tilt toward stocks with higher prior returns because their clientele demands relative returns. Chasing relative returns may generate an overreaction.[4] Our analysis of institutional trading supports these agency explanations

[4]Chan et al. (2002) document that mutual funds tend to cluster near an index but deviate in the direction of stocks with higher prior returns. Gruber (1996), Sirri and Tufano (1998), and Del Guercio and Tkac (2002)

of momentum in returns and dovetails with the recent literature on the limits of arbitrage, surveyed by Barberis and Thaler (2003).

Throughout the paper we consider numerous robustness checks of our findings. With regard to the construction of our abnormal-return-momentum portfolios, we consider single-index and multifactor models of expected returns to estimate abnormal returns as well as several ways of defining abnormal-return winners and losers. With regard to the performance evaluation of our momentum portfolios, we employ several unconditional factor models, conditional versions of the CAPM, estimates of an empirical stochastic discount factor similar to Chen and Knez (1996), and size-and-book-to-market-matched returns. To alleviate concerns that the changes in portfolio composition each month might result in changes in risk that we are not otherwise capturing, we also use the average of the factor loadings from the individual stocks as the proxies for potentially dynamic portfolio loadings. With regard to robustness across stock size, we examine equal-weighted and value-weighted portfolios as well as large-stock subsets. Our findings are robust across all these alternatives and across subperiods.

In Section 2, we define abnormal-return momentum and examine the profits to abnormal-return-momentum portfolios. We highlight the disparate performances of relative-return momentum and abnormal-return momentum in Section 3. In Section 4, we examine the relations between institutional trading, momentum, and long-run reversal. Section 5 presents robustness checks of the momentum and reversal patterns, and Section 6 provides characteristics of the stocks in the various momentum portfolios we construct. We conclude in Section 7.

2. Isolating momentum due to abnormal returns

Our sample is constructed from all stocks traded on the NYSE, AMEX, and NASDAQ from 1960 through 2000. For all portfolios, the first holding period begins January of 1963. We exclude stocks priced below \$5 at the end of the formation periods to reduce microstructure concerns.

2.1. Construction of the abnormal-return momentum portfolios

The momentum first identified by Jegadeesh and Titman (1993) is based on relative raw returns. Stocks with the highest returns are the winners and are held in a long position; stocks with the lowest returns are the losers and are held in a short position. As noted in the introduction, we seek to compare momentum due to relative returns with momentum due to firm-specific abnormal returns (i.e., firm-specific news). To do so, we first must estimate abnormal returns. Using a market-index model, we calculate the firm-specific return of a given stock.

For each stock i and each month t, we estimate Eq. (1) over the previous five years: $[t-60, t-1]$, requiring at least 24 monthly observations during that window.

$$r_{it} - r_{ft} = \alpha_i + \beta_i(r_{Mt} - r_{ft}) + \varepsilon_{it}, \tag{1}$$

(*footnote continued*)
examine capital flows into mutual funds and find that fund investors chase relative returns in addition to, or possibly in lieu of, risk-adjusted (firm-specific) returns.

where r_{it} is the return on stock i in month t, r_{ft} is the one-month T-bill rate in month t, r_{Mt} is the return on the CRSP value-weighted index in month t, α_i and β_i are parameters to be estimated, and ε_{it} is the residual return for stock i in month t. Afterwards, we calculate the firm-specific abnormal return of the stock in month t based on the estimated parameters.

$$\hat{\varepsilon}_{it} = r_{it} - r_{ft} - \hat{\alpha}_i - \hat{\beta}_i(r_{Mt} - r_{ft}). \tag{2}$$

For each stock and each month, this procedure identifies two quantities, the residual return of the stock in month t, $\hat{\varepsilon}_{it}$, and the estimated variance of the residual over the prior five years, $\hat{\sigma}^2_{\varepsilon it}$. Note that the alpha from the estimation period serves as a general control for misspecification in the model of expected returns. We have also estimated residuals using the Fama and French (1993) three-factor model, using a two-factor model comprised of the market portfolio and the appropriate industry portfolio for stock i from the 48 industry portfolios of Fama and French (1997), and using a sixty-month moving average of an individual stock's return.[5] The findings are unchanged.

We identify abnormal-return winners and losers over the J-month formation period $[t-J, t-1]$ by first cumulating the monthly residual returns of each stock over the J months and also cumulating the variances of the monthly residuals over the J months. The parameters of (1) and the stock-specific return variances are updated each month over the J-month formation period. Stock i is a J-month winner during months $[t-J, t-1]$ if its cumulative residual return over the period is greater than or equal to the square root of its cumulative variance. Stock i is a J-month loser during months $[t-J, t-1]$ if its cumulative residual return over the period is less than or equal to the negative square root of its cumulative variance. Standardizing the residual return yields an improved measure of the extent to which a given firm-specific return shock is actually news, as opposed to noise, thereby facilitating a better interpretation of the residual as firm-specific information. We use the one-standard-deviation threshold to maintain a sufficient number of stocks per month in subsequent analyses, but we have also implemented the strategies based on one-and-a-half and two standard deviations, and all findings remain unchanged. In short, abnormal-return momentum behaves consistently no matter how we measure it.

Following the above procedure, we identify two groups of stocks, abnormal-return winners and abnormal-return losers, and we hold them for K months, $[t+1, t+K]$; we refer to these months as the holding period. We skip a month between the formation period and the holding period to mitigate the negative serial correlation due to bid-ask bounce. Following Jegadeesh and Titman (1993), we employ a calendar-time method to increase the power of the tests but to avoid the pitfalls induced by overlapping returns. In any particular calendar month, we identify K portfolios of winner and loser stocks respectively. Each of the K portfolios represents a different vintage of the J-month strategy which is currently open in that month. The return in a given calendar month is the equally-weighted return of the component stocks across the K portfolios. This produces a time-series of monthly returns to the respective winner and loser portfolios for the holding period $[t+1, t+K]$. Afterwards, we subtract the return of the loser portfolio each month from the return of the winner portfolio. The resulting profits represent a zero-cost trading strategy which is long in the winners and short in the losers.

[5]We thank Kenneth French for providing these data on his website. The definitions of the industries are provided on the website as well.

Our measure of firm-specific abnormal return differs from raw return by a function of α_i, σ_{ε_i}, and β_i, though β_i is not expected to generate any cross-sectional differences. For those readers who are already wondering about the relative extent to which α_i and σ_{ε_i} drive the forthcoming results, we can state that both measures contribute to our findings, with α_i playing the larger role. In addition, we can confirm that our results are qualitatively similar if we do not standardize the residual return and instead define abnormal-return winners and losers using a cross-sectional decile sort of residual returns. Measuring expected returns with α_i estimated over only the prior 12 months or with α_i set to zero also generates qualitatively similar results to those reported in later sections.

2.2. Performance evaluation

We consider various formation and holding periods for the abnormal-return momentum portfolios (and the relative-return momentum portfolios defined later). To evaluate performance during the holding period, we follow the calendar-time procedure of Jegadeesh and Titman (1993) which is also the long-run procedure recommended for the event-study literature by Fama (1998) and Mitchell and Stafford (2001). Since there is no clear consensus on what model of expected returns is best, though, we consider a wide variety. In the tables, we report three performance metrics: raw returns, CAPM alphas, and Fama and French (1993) three-factor alphas. We also evaluate portfolio performance using a conditional CAPM, a conditional CAPM with human capital, and several estimates of the stochastic discount factor of Chen and Knez (1996). The findings are unchanged and are not provided for the sake of brevity. These alternative models of expected returns are detailed in Sections A.1, A.2, and A.3 of the Appendix.

Mitchell and Stafford (2001) raise additional concerns regarding long-run performance evaluation. Following their suggestions, we address potential concerns. First, we control for the inability of the Fama-French three-factor model to fully explain average returns across size and book-to-market categories (for example, small value stocks) by subtracting the returns to matching size/book-to-market stocks from the returns of the selected momentum stocks. Second, the factor loadings of the momentum portfolio might change over time as the composition of the portfolio changes. We allow for this by using average factor loadings of the individual stocks comprising each portfolio as proxies for the portfolio's loadings. Third, we consider value-weighted portfolios as well as equal-weighted portfolios. The inferences about abnormal profit spreads between winner and loser stocks documented in the upcoming tables are unaffected by the comprehensive set of performance-evaluation procedures we consider, and are not provided for brevity's sake. Different procedures, however, can affect inferences on whether the winners or the losers are primarily responsible for the abnormal return spread between the two sets of stocks. Details of the matching technique and of the factor-loadings procedure are provided in Sections A.4 and A.5 of the Appendix. In short, our findings for abnormal-return momentum and for relative-return momentum are remarkably robust.

2.3. Momentum profits of abnormal-return portfolios

We begin our examination by documenting the performances of portfolios of stocks experiencing firm-specific abnormal returns (denoted as "ABN") for $J = 6$ and $J = 12$. Table 1 displays the performances of these portfolios during three holding periods

Table 1
Abnormal-return momentum

For each stock i and each month t, we estimate Eq. (1) over the previous five years: $[t-60, t-1]$, requiring at least 24 monthly observations. We obtain the residual return of the stock using Eq. (2). To identify abnormal performance over the J-month formation period $[t-J, t-1]$, we first cumulate the residual monthly returns of each stock over the J months and cumulate the variances of the monthly residuals over the J months. Winner (loser) stocks over months $[t-J, t-1]$ are identified when the cumulative residual return over the period is greater (less) than or equal to the square root (negative square root) of its cumulative variance. We report below the performances of the equally-weighted calendar-time portfolios during the holding periods $[t+1, t+K]$ for $K = 6, 12$, and $[t+13, t+K]$ for $K = 60$. Panels A and B give the mean performances for the 6-month and 12-month formation periods ($J = 6, 12$), respectively, over the 1963:01 to 2000:12 period, with the t-statistics in parentheses. The columns correspond to the three performance metrics and three holding-period windows.

	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
Panel A: Formation period $[-6,-1]$									
Winners − Losers	1.14	0.84	0.03	1.11	0.80	0.03	1.20	0.94	0.09
	(8.01)	(6.87)	(0.65)	(7.80)	(6.59)	(0.59)	(8.66)	(7.97)	(1.87)
Winners	1.26	1.09	0.77	0.66	0.49	0.21	0.53	0.36	−0.01
	(4.75)	(4.14)	(3.13)	(5.20)	(4.07)	(1.92)	(8.29)	(6.52)	(−0.29)
Losers	0.13	0.25	0.74	−0.45	−0.32	0.18	−0.67	−0.57	−0.11
	(0.50)	(1.00)	(2.96)	(−3.58)	(−2.55)	(1.52)	(−6.96)	(−6.55)	(−1.78)
Panel B: Formation period $[-12,-1]$									
Winners − Losers	1.08	0.72	−0.01	1.03	0.68	−0.02	1.22	0.88	−0.06
	(6.63)	(4.99)	(−0.24)	(6.34)	(4.66)	(−0.31)	(7.85)	(6.43)	(−1.01)
Winners	1.24	1.04	0.74	0.62	0.42	0.17	0.55	0.35	−0.04
	(4.51)	(3.84)	(2.99)	(4.67)	(3.35)	(1.60)	(7.16)	(4.99)	(−0.77)
Losers	0.16	0.32	0.75	−0.41	−0.25	0.19	−0.67	−0.53	−0.10
	(0.63)	(1.24)	(3.00)	(−3.13)	(−1.93)	(1.59)	(−6.68)	(−5.77)	(−1.65)

$[t+1, t+6]$, $[t+1, t+12]$, and $[t+13, t+60]$. In month $t+1$, each of the abnormal-return portfolios contains on average more than 800 stocks, over 400 in the winner and loser component portfolios respectively, which is roughly 15% of the stock universe selected for each side of the portfolio in a given month.[6] Including such a large number of stocks in the portfolios reduces the power of our tests and decreases our ability to find abnormal profits to these strategies since the selected stocks are also components of the factor-mimicking portfolios used for performance evaluation.

Over the 1963:01 to 2000:12 period, the 6-month ABN portfolio, reported in Panel A, generates significant monthly profits between 0.80% and 1.20% per month during the first six and twelve months of the holding period across the three measures of performance. Profits are higher in the first six months. The CAPM alphas and the Fama-French alphas indicate that both sides of the portfolio contribute to the momentum profits. The results for the 12-month ABN portfolio in Panel B are similar.

[6]The two-standard-deviation filter is much more restrictive. Requiring that each calendar month have at least 10 stocks in the portfolios results in roughly 100 stocks on average in the winner portfolios and 70 stocks on average in the loser portfolios using the two-standard-deviation filter. So, roughly three percent of the stock universe is on either side of the portfolio when using the two-standard-deviation filter.

These abnormal-return momentum findings are similar to the relative-return momentum results of Jegadeesh and Titman (1993) and others. There is a notable difference, however, between abnormal-return momentum identified here and relative-return momentum examined in prior studies. Jegadeesh and Titman (2001) and Lee and Swaminathan (2000) find that the profits to a six-month relative-return-momentum strategy reverse significantly from two to five years following portfolio formation.[7] Panels A and B of Table 1 show that the profits to the 6-month and 12-month abnormal-return portfolios do not reverse by any metric in the long-run holding period of two to five years.

The lack of reversal in abnormal-return momentum suggests that abnormal returns are a source of information for future returns that is separate from relative returns. Examining only the first year of the holding periods masks the distinction between abnormal and relative returns. We fully clarify this distinction in the next section by separating abnormal-return-momentum stocks from relative-return-momentum stocks.

3. Long-run differences between abnormal-return and relative-return momentum

To compare the performances of the abnormal-return-momentum and relative-return-momentum strategies, we must identify the relative-return winners and losers. Following Jegadeesh and Titman (1993), in each month t, we rank all stocks into deciles based on their compounded returns over the formation period $[t-J, t-1]$. We refer to the top-decile stocks as winners and to the bottom-decile stocks as losers, and we hold them for K months, $[t+1, t+K]$. Again, we employ a calendar-time method and also skip one month between the formation period and the testing period. The relative-return (denoted as "REL") momentum portfolios are constructed as long positions in the winning stocks and short positions in the losing stocks.

We then identify three subset portfolios of momentum stocks. The "REL-only" portfolio is comprised of the subset of the relative-return portfolio that does not also experience a firm-specific abnormal return during the formation period (i.e., does not experience a standardized residual greater than or equal to one in absolute value). The "ABN-only" portfolio is comprised of the subset of the stocks in the abnormal-return-momentum portfolio from the previous section which are not also in the top or bottom deciles of lagged returns during the formation period.[8] Finally, we identify the "REL∩ABN" portfolio which is the intersection of the stocks in the relative-return-momentum portfolio with the stocks in the abnormal-return-momentum portfolio. For the sake of brevity, we report only the results for the 6-month formation periods. The 12-month results are very similar. On average, the number of stocks in the REL-only, ABN-only, and REL∩ABN portfolios in month $t+1$ is about 150, 440, and 400 respectively, with an equal split between the winner and loser sides for each portfolio.

Table 2 presents the mean profits for the three subset 6-month portfolios (REL-only, ABN-only, and REL∩ABN). The REL-only portfolio generates greater profits on average than the ABN-only portfolio in the first six months, but this difference is statistically

[7]These reversal findings are for the full sample. Jegadeesh and Titman (2001) and Lee and Swaminathan (2000) find that reversal depends on risk adjustments, stock size, subperiods, and trading volume.

[8]There is a handful of stocks throughout the entire sample period that can be classified as "conflicting"—a relative-return winner (loser) with a negative (positive) abnormal return. For example, 35 conflicting stocks are discovered from 1963 to 2000 in the 6-month-formation-period results. We disregard these stocks.

Table 2
Subsets of 6-month momentum portfolios

Following the procedure described in Table 1, we identify the abnormal-return winners and losers over the formation months $[t-6, t-1]$. We then identify the relative-return winners and losers as the stocks in the highest (lowest) decile of raw returns over the formation period $[t-6, t-1]$. We then identify the "REL-only" portfolio which is comprised of the subset of the relative-return winners and losers that are not also abnormal-return winners or losers during the formation period. The "ABN-only" portfolio is comprised of the subset of the abnormal-return winners and losers that are not also in the top or bottom decile of lagged raw returns during the formation period. Finally, we identify the "REL∩ABN" portfolio which is the intersection of the stocks in the relative-return momentum portfolio with the stocks in the abnormal-return–momentum portfolio. The subset portfolios are each long in winners and short in losers. We report below the performances of the equally-weighted calendar-time portfolios during the holding periods $[t+1, t+K]$ for $K = 6$, 12 and $[t+13, t+K]$ for $K = 60$. Below are the mean performances for the 6-month portfolios, respectively, with the t-statistics in parentheses. The columns correspond to the three performance metrics and three holding-period windows.

Winners – losers	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
REL-only	1.00	0.48	−0.40	0.97	0.43	−0.43	1.29	0.78	−0.24
	(4.78)	(2.65)	(−4.14)	(4.60)	(2.40)	(−4.43)	(6.35)	(4.66)	(−3.03)
ABN-only	0.70	0.60	0.19	0.70	0.59	0.20	0.66	0.57	0.18
	(6.51)	(6.59)	(3.73)	(6.44)	(6.47)	(3.92)	(6.27)	(6.35)	(3.48)
REL∩ABN	1.52	1.06	−0.14	1.49	1.01	−0.15	1.72	1.28	−0.01
	(7.36)	(6.04)	(−1.92)	(7.16)	(5.75)	(−2.16)	(8.48)	(7.68)	(−0.22)

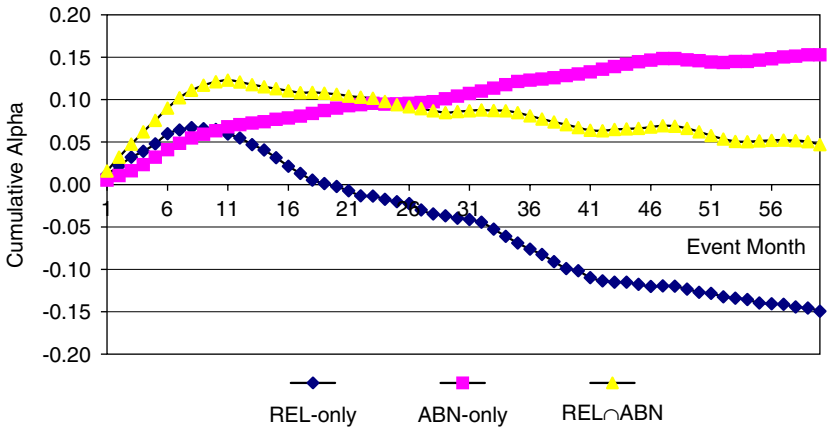

Fig. 1. Cumulative CAPM alphas of the 6-month subset portfolios. The cumulative performances from the CAPM are plotted for the 6-month subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2) for the 60 months following formation of the portfolios.

significant only using the Fama-French alphas (t-statistic of 3.1, not in tables). We see also that the REL-only profits dissipate more quickly than the ABN-only profits as evidenced by the large decline in REL-only monthly profits from $[t+1, t+6]$ to $[t+1, t+12]$. What

is most revealing, however, are the striking differences in the long-run performances of these portfolios. The REL-only portfolio reverses dramatically during months 13 to 60 by all performance measures (−0.24 to −0.43%) while the ABN-only portfolio generates significant profits during months 13–60 using all three performance measures (0.18 to 0.20%).

So, once we control for the overlap between the relative-return and abnormal-return portfolios, we find that these two seemingly similar strategies behave dramatically differently. Fig. 1 plots the cumulative CAPM alphas for the subset portfolios based on a 6-month formation period.[9] The plots of the cumulative mean raw returns and of the cumulative Fama-French alphas are similar. The REL-only portfolio reverses sharply after the first year, while the ABN-only profits drift upward for four years before becoming flat. On average after 60 months, the REL-only portfolio generates a cumulative abnormal return of −15% while the ABN-only portfolio generates +15%. The gulf between their long-run performances is astounding given that both portfolios are momentum strategies that generate relatively similar levels of momentum profits in the short-run.

We also see in Fig. 1 that the short-run momentum profits of the REL∩ABN portfolio are markedly higher than the short-run profits of the other two portfolios, and the long-run performance of the REL∩ABN portfolio falls between the performances of the other two subsets. These findings for the REL∩ABN portfolio are detailed in Table 2. The profits of the 6-month REL∩ABN portfolio during the first twelve months significantly exceed the profits for both the REL-only and ABN-only groups using the raw, CAPM, and Fama-French performance metrics by at least 0.41% per month with a t-statistic of at least 3.1 (not in table). This is likely because the formation-period residuals of the REL∩ABN stocks are much larger than the residuals of the other two groups; in other words, the formation-period news is larger. The mean residual of the 6-month REL∩ABN winners (losers) is 57% (−45%) while those of the REL-only and ABN-only winners (losers) are 25% (−26%) and 26% (−25%), respectively.[10] The profits of the REL∩ABN portfolio either reverse mildly or not at all in months 13–60, depending on which performance measure is used.

Overall, we find that stocks experiencing firm-specific abnormal returns continue to perform well for several years, once the influence of relative returns is removed. Conversely, the stocks in the relative-return extremes that are without firm-specific abnormal returns display dramatic long-run reversal in returns.[11]

Additionally, Table 3 shows that both sides of the subset 6-month portfolios (winners and losers) contribute to the short-run momentum profits of the REL-only, ABN-only, and REL∩ABN winners-minus-losers portfolios. Which side contributes more to the

[9]To produce Fig. 1, we estimate the alphas and betas for each holding-period month in a separate regression, which means that the profits and losses are robust when allowing the factor loadings to vary month-by-month through event time.

[10]The average standard deviation of the residuals to the 6-month REL∩ABN winners (losers) is 30% (28%), to the REL-only winners (losers) is 41% (37%), and to the ABN-only winners (losers) is 19% (19%).

[11]Abnormal-return momentum is not simply momentum in less extreme relative returns. Additional tests confirm this. First, the less extreme REL-only portfolio long in decile 9 of the cross section of prior returns and short in decile 2, but not containing abnormal-return winners or losers, displays long-run reversal across all three performance metrics (between −0.25% and −0.11% per month in $[t+13, t+60]$). Second, the ABN-only portfolio excluding stocks in the cross-sectional deciles 10, 9, 2, and 1 displays long-run momentum across all three metrics (between 0.23% and 0.31% per month in $[t+13, t+60]$).

Table 3
Decomposition of 6-month subset momentum portfolios into winners and losers

For the 6-month formation period, we form three subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2). Reported below are the performances of the equally-weighted winner and loser portfolios during the holding periods $[t+1, t+K]$ for $K = 6$, 12, and $[t+13, t+K]$ for $K = 60$. Panels A, B, and C give the mean performances for the respective subsets, with the t-statistics in parentheses. The columns correspond to the three performance metrics and three holding-period windows.

	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
Panel A: REL-only									
Winners	1.14	0.83	0.56	0.41	0.10	−0.14	0.53	0.21	−0.20
	(3.27)	(2.47)	(1.79)	(2.03)	(0.55)	(−0.88)	(4.29)	(2.17)	(−2.54)
Losers	0.14	0.36	0.96	−0.56	−0.34	0.30	−0.76	−0.57	0.04
	(0.40)	(1.03)	(2.89)	(−2.52)	(−1.55)	(1.43)	(−5.51)	(−4.48)	(0.43)
Panel B: ABN-only									
Winners	1.07	1.02	0.85	0.56	0.50	0.35	0.30	0.25	0.05
	(4.73)	(4.55)	(3.88)	(5.29)	(5.11)	(3.56)	(5.79)	(5.47)	(1.02)
Losers	0.37	0.42	0.66	−0.15	−0.09	0.16	−0.36	−0.32	−0.12
	(1.63)	(1.88)	(2.99)	(−1.41)	(−0.91)	(1.61)	(−4.18)	(−4.03)	(−2.10)
Panel C: REL∩ABN									
Winners	1.42	1.14	0.68	0.73	0.45	0.05	0.74	0.46	−0.10
	(4.41)	(3.61)	(2.40)	(4.08)	(2.71)	(0.35)	(6.90)	(5.06)	(−1.63)
Losers	−0.10	0.08	0.82	−0.76	−0.56	0.20	−0.98	−0.82	−0.09
	(−0.34)	(0.26)	(2.82)	(−4.52)	(−3.46)	(1.26)	(−7.72)	(−7.44)	(−1.12)

long-run reversal of profits of the REL-only winners-minus-losers portfolio and to the long-run momentum of the ABN-only winners-minus-losers portfolio is less clear and can depend upon which metric is used. For example, the CAPM alphas indicate that the long-run momentum of the ABN-only winners-minus-losers portfolio is mostly due to the continued positive performance of the winners while the Fama-French alphas indicate that the momentum is due predominantly to the continued negative performance of the losers.

Thus far, we find that momentum from firm-specific abnormal returns persists for several years and does not reverse. In contrast, momentum from relative returns reverses strongly in the long run. The long-run findings reveal that abnormal-return momentum and relative-return momentum are separate phenomena. Abnormal-return momentum is consistent with underreaction. Relative-return momentum is consistent with overreaction. These findings are robust and are unaltered when employing other definitions of abnormal-return winners and losers (different expected-return models and different filters) and when employing other metrics of performance evaluation (as detailed in the Appendix). As shown later in Section 5, the disparate long-run performances of abnormal-return and relative-return momenta are also present in subperiods and in large-cap stocks.

As an additional robustness check, we also employ cross-sectional regressions, in lieu of the preceding portfolio methods, to disentangle the information regarding future returns contained in REL from the information contained in ABN. To avoid the statistical concerns that would arise from overlapping the returns on the left-hand side of the

regression and to allow us to simultaneously examine both short-run and long-run effects of REL and ABN, we regress the cross-section of returns in month $t+1$ on various lags of REL and ABN. For example, to examine the relation between REL and returns over the subsequent six months, we regress $r_{i,t+1}$ on the mean of the six values of REL for stock i sampled at $t-1$, $t-2,\ldots,t-6$. This procedure is a regression analogue of the calendar-time portfolio procedure we use above. Averaging the six past values of REL and using this average to explain future returns is analogous to equally weighting the six vintages of REL portfolios that are "open" in calendar month $t+1$. For each stock, the mean of its REL over months $[t-1,t-6]$ is labeled $\text{REL}^{\text{short}}$. We define REL^{long} as the mean value of REL over months $[t-13,t-60]$. $\text{ABN}^{\text{short}}$ and ABN^{long} are both formed similarly.

We do not require a stock to have nonmissing values of REL and ABN for each month in the $[t-1,t-6]$ and $[t-13,t-60]$ windows; we use any available data. This makes the regression analysis comparable to the previous portfolio analysis in that no survivorship bias is imparted to the tests; the cross-sectional regressions consider any short-run and any long-run information that is available for stock i. In addition, we do not impose a price filter, as we did in the portfolio-based tests (since the notion of a single formation month no longer exists).

We also include book-to-market equity and size in the cross-sectional regressions as additional controls. BM is the ratio of the book value of equity (from Compustat reported for fiscal year-end in year $t-1$) to the market value of equity (from CRSP in December of year $t-1$), and is used to explain returns in year t. Size is the market value of equity from CRSP in June of year t and is used to explain returns from July of year t through June of year $t+1$.

For each month from January 1963 to December 2000, we obtain the cross-sectional regression coefficients of the six explanatory variables. The time-series of each respective coefficient is used to test the hypothesis that the mean of the coefficient is zero. We employ Gallant's (1987) standard errors which are robust to serial autocorrelation and to heteroskedasticity.[12] The respective means of the coefficients (multiplied by 100) and their associated t-statistics are as follows.

$\text{REL}^{\text{short}}$	REL^{long}	$\text{ABN}^{\text{short}}$	ABN^{long}	log(BM)	log(size)
0.68	−1.05	0.24	0.14	0.29	−0.09
(1.76)	(−3.42)	(3.49)	(1.89)	(3.09)	(−1.71)

These results mirror our prior findings. Relative returns and firm-specific abnormal returns generate separate sparks for short-run momentum in returns. More importantly, relative returns reverse strongly in years two through five while firm-specific abnormal returns continue to drift.

In the next section, we turn our attention to the possibility that institutional investors might contribute to the above return patterns. Specifically, we suggest that institutions underreact to firm-specific abnormal returns and overreact to relative returns.

[12]We use the AR(1) specification suggested by Andrews (1991) to estimate the optimal bandwidth; then, as he also suggests, we examine alternative bandwidths centered about the optimal bandwidth. The findings are robust across alternative bandwidths.

4. Institutional trading and momentum

Delegated money managers have incentives that can lead them to underreact to firm-specific news and to overreact to relative returns. Assuming institutional investors are the marginal traders, their incentives can result in the return patterns that we find in the prior section. On one hand, managers have incentives to keep their fund portfolios close to an index. Chan et al. (2002) document that mutual fund portfolios tend to cluster around a broad index, i.e., to closet index. The desire to remain near an index can hinder a manager from fully exploiting any firm-specific information he might have, since generating positive alpha requires him to tilt his portfolio toward individual stocks. This behavior can result in an underreaction to firm-specific news. There are various incentives for managers to keep their portfolios near an index. Scharfstein and Stein (1990) note reputation concerns. In addition, Shleifer and Vishny (1997) recognize that arbitrage can be riskier for money managers when the principals have short horizons. Consistent with both of these notions, Del Guercio and Tkac (2002) find that pension funds with high tracking error relative to the S&P 500 index are punished with fund outflows, documenting the downside of deviating from an index benchmark. Admati and Pfleiderer (1997) and Dybvig et al. (2004), among others, show that benchmark-adjusted compensation structures can lead to reduced managerial effort. For any of these reasons, money managers might stay close to an index, thus possibly generating an underreaction to firm-specific news.

On the other hand, Chan et al. (2002) document that when mutual funds do deviate from an index, they tilt toward stocks with higher prior returns. This behavior presumably reflects the preferences of their investing clientele to chase relative returns. For example, Gruber (1996), Sirri and Tufano (1998), and Del Guercio and Tkac (2002) find that mutual-fund flows chase prior relative returns in addition to, and possibly in lieu of, risk-adjusted returns. Funds with the best recent performance based on relative returns receive the largest inflows. Our conjecture is that money managers give their clients what they want—higher relative returns. By chasing relative returns, institutions possibly generate an overreaction.[13]

The upshot of all this is that agency issues in money management can provide a rational explanation for institutions' underreacting to firm-specific news (abnormal returns) and overreacting to relative returns. Although the empirical evidence we have highlighted to support our framework is for mutual and pension funds, we believe the same forces are likely to apply to money managers in general.

To test our hypotheses, we first examine the stock holdings of institutional money managers to see if managers pursue relative returns while relatively ignoring firm-specific abnormal returns. We then test if the abnormal-return momentum stocks that institutions pursue the least are the stocks whose momentum is greatest and does not reverse, consistent with underreactions to firm-specific news. We also examine if the relative-return

[13]Interestingly, Evans (2004) provides evidence that investors' (naive) demand for relative returns affects more than just the asset-selection decisions of money managers. He finds that the more externally relevant decisions of mutual funds, namely the choices of which incubated funds to bring to market and which funds to terminate, are based upon relative returns. In contrast, the more internally relevant decisions such as manager promotion or demotion are based upon risk-adjusted returns. The second finding recognizes the sophistication of institutions; it also indicates a possible mitigating effect for a portfolio manager's pursuit of relative returns since internal monitoring relies on alpha. However, Farnsworth and Taylor (2004) provide survey evidence that the majority of a fund manager's compensation is linked to the profitability of the firm rather than to investment performance.

Table 4
Changes in institutional holdings within subset momentum portfolios

For the 6-month formation period, we form three subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2). For 1980 through 2000, Panel A reports the mean change in institutional ownership for the winner and loser stocks in each of the subset portfolios during various event-time windows. Panel B gives the *t*-statistics for testing whether the mean changes in institutional ownership are equal across the respective pairs. The *t*-statistics are robust to serial correlation and heteroskedasticity.

	Winners				Losers			
	Months [−6, −1]	Months [1, 6]	Months [1, 12]	Months [13, 60]	Months [−6, −1]	Months [1, 6]	Months [1, 12]	Months [13, 60]
Panel A: Changes in institutional ownership								
REL-only	0.79	0.39	0.29	0.13	−0.13	−0.02	0.03	0.12
ABN-only	0.16	0.15	0.13	0.07	0.05	0.05	0.06	0.08
REL∩ABN	0.51	0.37	0.28	0.12	−0.32	−0.11	−0.03	0.12
Panel B: t-statistics testing for the differences								
(REL-only) − (ABN-only)	4.29	8.50	7.04	1.90	−5.10	−4.58	−2.61	2.09
(ABN-only) − (REL ∩ ABN)	−2.89	−4.77	−4.84	−2.92	5.36	9.98	7.72	−2.32
(REL ∩ ABN) − (REL-only)	−8.02	−0.63	−0.21	−0.74	−6.03	−4.73	−4.15	0.89

momentum stocks that institutions pursue the most are the stocks whose momentum reverses most strongly in the long run, consistent with overreactions to relative-return performance. These tests are discussed in the next section.

4.1. Changes in institutional holdings of momentum stocks

We begin our investigation of the trading behaviors of delegated money managers by examining the changes in the stock holdings of institutional investors. The 13F data on institutional stock holdings are obtained from CDA/Spectrum which provides quarterly snapshots of the equity holdings of all major institutional money managers, such as mutual funds, pension funds, banks, investment advisors, and insurance companies. A 1978 amendment to the Securities and Exchange Act of 1934 requires all institutions with more than $100 million under discretionary management to report their equity portfolio holdings each calendar quarter to the SEC on form 13F. Our quarterly institutional data are for the period 1980–2000. We define institutional ownership as the percentage of the number of shares outstanding.

Table 4 shows the net buying patterns of institutions in the stocks comprising the relative-return-only and abnormal-return-only momentum portfolios. We investigate institutional ownership changes over the formation period $[t-6, t-1]$ and the three holding periods $[t+1, t+6]$, $[t+1, t+12]$, and $[t+13, t+60]$. Since the institutional holdings data are quarterly but the momentum portfolios are formed monthly, we make the assumption that the changes in ownership in quarter q are spread evenly across the three months of that quarter. The unconditional mean monthly change in institutional ownership averaged first across all stocks in a given month and then across all months in the 1980–2000 period is 0.15%, which reflects the increase in institutional ownership over this time. Using 0.15% as a reference point, we see in Table 4 that institutional buying of

the REL-only and REL∩ABN winners is far above average in the six-month formation period and in the first twelve months of the holding period. Institutions are net buyers of the relative-return winners over $[t-6, t-1]$ and $[t+1, t+12]$ at a rate which is at least double the 0.15% mean rate across all stocks. Accordingly, institutional buying of the REL-only and REL∩ABN losers is far below average, and is actually negative over $[t-6, t-1]$ and $[t+1, t+6]$. These differences between the relative-return winners and losers and the market-wide averages are statistically significant (not in tables) and are consistent with prior studies that document the tendency of institutions to chase prior relative returns.[14]

The more novel finding is that institutions are buying the ABN-only winners and selling the ABN-only losers substantially less than the relative-return-momentum stocks. Panel B provides the *t*-statistics comparing the mean changes in institutional ownership across the momentum subsets. Since we detect serial correlation in these differences, we employ standard errors that are robust to serial autocorrelation and to heteroskedasticity (Gallant (1987)).[15] Given that 0.15% is the average change in institutional ownership per month across all stocks, we can see that institutions treat the ABN-only stocks much like any other stocks despite the momentum profits these stocks generate. Institutions are buying the ABN-only winners in the six-month formation period and in the first twelve months of the holding period nearly exactly at the 0.15% average rate for all stocks. Hence, institutions are ignoring firm-specific abnormal returns.

Note also that institutions are buying fewer REL∩ABN winners than REL-only winners over $[t-6, t-1]$ despite the fact that the REL∩ABN winners generate greater profits in the future, as shown in Table 3. Institutional trading seems more related to a stock's characteristic of being a relative-return extreme than to the future alpha a stock generates.

In short, Table 4 shows that institutions tend to aggressively pursue relative returns and to ignore firm-specific abnormal returns. Hence, institutions might be overreacting to relative returns and underreacting to abnormal returns. We provide further evidence that institutions contribute to both types of momenta in the next section by examining the relations between institutional trading and momentum profits.[16]

4.2. *Profits to stocks that institutions most and least support*

For the momentum in the ABN-only stocks to be due to an underreaction by institutions to firm-specific returns in $[t-6, t-1]$, the ABN-only stocks that institutions least support during the formation period, i.e., winners they buy least and losers they sell least, should display the strongest momentum in the holding periods. In other words, the

[14]Sias (2004) confirms this finding using quarterly holdings data and provides a reference list of prior studies. In addition, Griffin et al. (2005) provide high-frequency evidence.

[15]We use the AR(1) specification suggested by Andrews (1991) to estimate the optimal bandwidth; then, as he also suggests, we examine alternative bandwidths centered about the optimal bandwidth. The results are robust across alternative bandwidths.

[16]It is interesting to note that institutions seemingly ignore the strong reversal in returns for the REL-only stocks over months $[t+13, t+60]$ and continue to relatively ignore the return continuation for the ABN-only stocks over this subsequent period. As a side note, institutions' participation in the presumed long-run corrections occurring over $[t+13, t+60]$ is not necessary to support the overreaction or the underreaction hypothesis. First, no one needs to participate in the correction since prices can adjust to news without trading (i.e., dealers adjust their quotes in response to news). Second, if institutions contribute to the mispricing, why should they necessarily be expected to contribute to the correction?

ABN-only stocks that institutions ignore most should experience the greatest momentum profits as the market corrects the underreaction.

For overreaction by institutions to explain the REL-only return pattern of short-run momentum and long-run reversal, we should find evidence that overreaction in the formation period continues into the early part of the holding period. If institutions are overreacting in the formation period, the REL-only stocks that institutions most support during $[t-6, t-1]$, i.e., winners they buy most and losers they sell most, should reverse most strongly in the long run over $[t+13, t+60]$, as the overreaction is corrected. If institutions continue to overreact in the early part of the holding period, the REL-only stocks that institutions most support during $[t+1, t+6]$ should reverse most strongly in the long run over $[t+13, t+60]$.

Table 5 provides the profits for the respective most-supported and least-supported subsets of the ABN-only and REL-only portfolios. In Panels A and B respectively, the winner stocks in the ABN-only and REL-only portfolios are sorted into thirds based on the changes in institutional ownership over $[t-6, t-1]$. The loser stocks are also sorted

Table 5
Profits to momentum portfolios most supported and least supported by institutions

For the 6-month formation period, we form three subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2). For 1980–2000, we further divide the REL-only and ABN-only portfolios into portfolios that are most-supported and least-supported by institutions. The stocks in the REL-only and ABN-only portfolios are sorted separately into thirds based on changes in institutional ownership over the formation period $[t-6, t-1]$. The most-supported portfolios are formed by taking long positions in the winner stocks in the highest third of institutional changes and taking short positions in the loser stocks in the lowest third of institutional changes. The least-supported portfolios are formed by taking long positions in the winner stocks in the lowest third of institutional changes and taking short positions in the loser stocks in the highest third of institutional changes. Panel A gives the mean performances for the most-supported and least-supported ABN-only stocks, with the *t*-statistics in parentheses. Panel B provides the same for REL-only stocks. Panel C provides the mean performances for the most-supported and least-supported REL-only stocks defining institutional support over the holding period $[t+1, t+6]$, instead of over the formation period $[t-6, t-1]$.

Winners – losers	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
Panel A: ABN-only, support defined over $[t-6, t-1]$									
Most supported	0.50	0.32	0.07	0.44	0.28	0.10	0.58	0.43	0.11
	(2.56)	(2.07)	(1.05)	(2.23)	(1.78)	(1.54)	(3.05)	(2.81)	(1.54)
Least supported	0.59	0.53	0.19	0.67	0.60	0.31	0.66	0.62	0.31
	(3.70)	(3.94)	(2.40)	(4.21)	(4.49)	(4.76)	(4.27)	(4.67)	(4.59)
Panel B: REL-only, support defined over $[t-6, t-1]$									
Most supported	1.41	0.76	−0.33	1.17	0.51	−0.47	1.67	0.98	−0.36
	(4.07)	(2.53)	(−2.12)	(3.45)	(1.76)	(−3.21)	(5.15)	(3.67)	(−2.58)
Least supported	1.32	0.53	−0.12	1.30	0.50	−0.12	1.47	0.68	−0.11
	(5.42)	(2.53)	(−0.73)	(5.26)	(2.32)	(−0.71)	(5.83)	(3.12)	(−0.71)
Panel C: REL-only, support defined over $[t+1, t+6]$									
Most supported	4.88	2.70	−0.42	4.60	2.40	−0.56	5.07	2.86	−0.45
	(12.80)	(7.95)	(−2.24)	(12.21)	(7.33)	(−3.03)	(14.34)	(9.18)	(−2.63)
Least supported	−2.59	−1.55	−0.12	−2.63	−1.62	−0.13	−2.38	−1.39	−0.09
	(−8.98)	(−7.06)	(−0.82)	(−8.98)	(−7.32)	(−0.90)	(−8.12)	(−6.21)	(−0.60)

into thirds. In Panel C, the REL-only stocks are sorted according to changes in institutional ownership over $[t+1, t+6]$. The most-supported portfolio is defined as long in the winner stocks in the upper third of changes in institutional ownership and short in the loser stocks in the bottom third. The least-supported portfolio is defined as long in the winner stocks in the lower third of changes in institutional ownership and short in the loser stocks in the upper third. That is, the most-supported stocks are those that institutions trade most strongly in the direction of formation-period returns, i.e., momentum strategies. The least-supported stocks are those that institutions trade the least in the direction of formation-period returns, which in fact are contrarian strategies on average.

Panel A of Table 5 shows that the least-supported ABN-only stocks generate the most momentum profits. The differences in profits over $[t+1, t+12]$ between the least-supported and the most-supported ABN-only stocks are significant with t-statistics at least 1.70 across the three profit metrics (not in the tables). The long-run profit differences over $[t+13,\ t+60]$ are also significant. In fact, the least-supported ABN-only stocks display momentum for years while the most-supported stocks do not. These findings suggest that institutions in aggregate contribute to momentum in the ABN-only stocks by underreacting to firm-specific news.

The profits to the REL-only stocks that are most-supported and least-supported over the formation period $[t-6, t-1]$ are shown in Panel B of Table 5. The most-supported REL-only stocks reverse most strongly in the long-run over $[t+13, t+60]$. In fact, the reversals in the most-supported stocks are quite strong and are at least 0.33% per month across the three metrics. However, the REL-only stocks with the least institutional support do not reverse. In addition, the profit differences across the most-supported and least-supported REL-only stocks are significant in the CAPM alphas, not provided in the tables. These REL-only results are consistent with institutions overreacting to the REL-only stocks during the formation period.

Panel C of Table 5 is consistent with institutions' continuing their overreactions into the first six months of the holding period. The REL-only stocks that institutions most support over $[t+1, t+6]$ display the greatest reversals over the long-run of at least 0.42% per month across all performance metrics over $[t+13, t+60]$. The profit differences across the most-supported and least-supported portfolios are significant using the CAPM and Fama-French models, and are not reported in the tables. And once again, the least-supported REL-only stocks do not reverse in the long-run. The findings in Panels B and C suggest that the aggressive pursuit of relative-return winners by institutions and the aggressive avoidance of relative-return losers, as shown in Table 4, generate a prolonged overreaction in the REL-only stocks.

As a side note, the profits in Panel C of Table 5 for the $[t+1, t+6]$ and $[t+1, t+12]$ holding periods are extreme because changes in institutional ownership are highly correlated contemporaneously with returns. By ranking on changes in institutional ownership over the holding periods, we are de facto ranking on returns over the same period. The profit differences across the most-supported and least-supported stocks are positive in the first twelve months and are consistent with momentum on average for the REL-only portfolio in the short-run.

In sum, Table 5 supports both the notion that the tendency of institutions to pursue relative returns contributes to overreactions and the notion that the tendency of institutions to ignore firm-specific abnormal returns contributes to underreactions. Institutions appear to play a role

in explaining the performances of relative-return–momentum portfolios and of abnormal-return–momentum portfolios, respectively.

5. Subperiods, large stocks, and January seasonals

We examine the strength of the abnormal-return–momentum and relative-return-momentum patterns within the 1963–1981 and 1982–2000 subperiods and within the subset of large stocks. Jegadeesh and Titman (2001) find that the long-run performance of relative-return–momentum portfolios varies across roughly these same subperiods and across stock size. We also examine the performances of the various momentum portfolios in January and non-January. Prior studies find strong losses in the profits to relative-return–momentum portfolios in January even in the first twelve months of the holding period and attribute this brief reversal at least in part to tax effects (Grinblatt and Moskowitz, 2004). To the extent that January losses to momentum portfolios are due to taxes, abnormal-return-only momentum portfolios should not display the January effect that the relative- return–momentum portfolios display, since taxes are based on raw returns.

5.1. Subperiods and large-stock results

Panels A and B of Table 6 show the profits to the REL-only and the ABN-only portfolios in the 1963–1981 and 1982–2000 subperiods. In each subperiod, the returns of the REL-only stocks reverse in the long-run, while the returns of the ABN-only stocks do not. Panel C of Table 6 shows that the long-lasting continuations in abnormal returns are also present in large stocks, defined as stocks whose market value is above the median for NYSE stocks. The long-run reversal of relative-return–momentum is also robust in large stocks according to the raw-return and CAPM metrics, but not according to the Fama-French model. In sum, the momentum and reversal patterns we find in the full sample are robust across the subperiods and within large-cap stocks.

5.2. January seasonality

Table 7 shows that the REL-only and REL∩ABN portfolios incur large losses in January regardless of the holding-period horizon, a well-documented result for relative-return strategies (though the losses are insignificant in the REL∩ABN portfolio due to the large variability in profits). The ABN-only strategy, however, shows no evidence of reversal in January, and in fact, generates large profits in January in the first twelve months of the holding period. Return reversal in January is only an attribute of the relative-return portfolios.

The lack of even a January reversal for the ABN-only strategy is roughly consistent with a tax-loss selling hypothesis for January effects. Taxes are paid according to raw returns, not abnormal returns. Since the ABN-only loser stocks, by definition, are not among the worst stocks according to raw returns, these stocks are not the most advantageous to sell for realizing a capital loss. Tables 8 and 9 report the January and non-January performances of the subset portfolios for the winner and loser sides of the portfolios respectively. They indicate that the January losses of the REL-only portfolio are due to the

Table 6
Momentum profits in subperiods and in large stocks for the 6-month formation period

For the 6-month formation period, we form the REL-only and ABN-only subset portfolios (described in Table 2). Reported below are the performances of the equally-weighted calendar-time portfolios which are long the respective winners and short the respective losers during the holding periods $[t+1, t+K]$ for $K = 6, 12$, and $[t+13, t+K]$ for $K = 60$. Panels A, B, and C give the mean performances, with t-statistics in parentheses. Panels A and B report the profits for the subperiods 1963:01–1981:12 and 1982:01–2000:12, respectively. Panel C reports the profits to the subset portfolios formed from the set of stocks whose market capitalization is greater than the median market capitalization on the NYSE in month $t-1$. The columns correspond to the three performance metrics and the three holding-period windows.

Winners − losers	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
Panel A: 1963:01–1981:12									
REL-only	0.69	0.34	−0.55	0.70	0.34	−0.55	1.12	0.82	−0.20
	(2.10)	(1.20)	(−3.71)	(2.13)	(1.22)	(−3.69)	(3.57)	(3.25)	(−1.80)
ABN-only	0.79	0.70	0.29	0.79	0.70	0.29	0.61	0.56	0.25
	(5.28)	(5.44)	(3.50)	(5.29)	(5.40)	(3.42)	(4.23)	(4.41)	(2.95)
Panel B: 1982:01–2000:12									
REL-only	1.31	0.62	−0.25	1.18	0.46	−0.34	1.49	0.77	−0.29
	(5.06)	(2.73)	(−2.03)	(4.53)	(2.07)	(−2.78)	(5.89)	(3.54)	(−2.61)
ABN-only	0.63	0.50	0.08	0.61	0.49	0.14	0.68	0.59	0.14
	(3.97)	(3.88)	(1.48)	(3.77)	(3.71)	(2.64)	(4.51)	(4.66)	(2.67)
Panel C: Large stocks only									
REL-only	0.66	0.34	−0.28	0.60	0.26	−0.36	1.06	0.76	−0.08
	(2.69)	(1.61)	(−2.74)	(2.43)	(1.24)	(−3.57)	(4.63)	(4.18)	(−1.01)
ABN-only	0.41	0.37	0.12	0.42	0.38	0.15	0.37	0.36	0.13
	(3.28)	(3.62)	(2.07)	(3.33)	(3.60)	(2.69)	(2.95)	(3.43)	(2.27)

extremely good performances of the losers, consistent with a rebound following tax-loss selling.

However, Table 7 demonstrates that there is more to the January performances than just tax-loss selling. The profits for the ABN-only portfolio in the first twelve months of the holding period are greater in January than in non-January, with t-statistics of at least 2.0 for the raw and CAPM metrics (not in the tables). Hence, abnormal-return momentum has its own January effect, opposite that of the relative-return momentum. In sum, there exist large profit differences in January across relative-return-momentum and abnormal-return-momentum portfolios, part of which is consistent with taxation effects.[17]

[17]Although we have not pursued this further, the increased profits in January to the ABN-only portfolio might be consistent with institutions' being responsible for a portion of these turn-of-the-year effects. If the incentives of money managers to chase relative returns is highest right before the turn of the year and lowest right after, the incentives of institutions might also be capable of explaining the January reversal in relative-return momentum (due to the release of price pressure from chasing relative returns at the end of the year) and the increased January profitability of abnormal-return momentum (due to institutions' tilting their portfolios toward positive-alpha stocks in January in response to within-firm incentives—see footnote 13).

Table 7
January seasonality in the profits to the subset momentum portfolios for the 6-month formation period

For the 6-month formation period, we form three subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2). Reported below are the performances of the equally-weighted calendar-time portfolios which are long the respective winners and short the respective losers during the holding periods $[t+1, t+K]$ for $K = 6$, 12, and $[t+13, t+K]$ for $K = 60$. Panels A, B, and C give the January and non-January mean performances for the three subsets respectively, with t-statistics in parentheses. The columns correspond to the three performance metrics and three holding-period windows.

Winners – losers	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
Panel A: REL-only									
Non-January	1.45	0.94	−0.16	1.41	0.89	−0.19	1.57	1.06	−0.12
	(7.02)	(5.45)	(−1.73)	(6.84)	(5.20)	(−2.06)	(7.78)	(6.50)	(−1.58)
January	−3.94	−4.62	−3.11	−4.10	−4.83	−3.23	−2.76	−3.30	−1.97
	(−5.76)	(−8.06)	(−9.93)	(−5.97)	(−8.44)	(−10.37)	(−3.89)	(−5.75)	(−7.13)
Panel B: ABN-only									
Non-January	0.63	0.54	0.19	0.63	0.54	0.20	0.64	0.55	0.19
	(5.63)	(5.74)	(3.65)	(5.60)	(5.67)	(3.81)	(5.94)	(5.99)	(3.64)
January	1.49	1.22	0.14	1.49	1.20	0.17	0.91	0.83	−0.02
	(3.99)	(3.88)	(0.79)	(3.96)	(3.80)	(0.98)	(2.38)	(2.54)	(−0.10)
Panel C: REL∩ABN									
Non-January	1.73	1.28	0.00	1.70	1.24	−0.02	1.87	1.42	0.06
	(8.09)	(7.13)	(−0.03)	(7.93)	(6.90)	(−0.28)	(9.05)	(8.40)	(0.84)
January	−0.76	−1.39	−1.64	−0.90	−1.58	−1.71	−0.47	−0.76	−1.04
	(−1.07)	(−2.33)	(−6.95)	(−1.26)	(−2.65)	(−7.25)	(−0.64)	(−1.28)	(−4.45)

6. Characteristics of the subset portfolios

For completeness, we provide additional characteristics of the stocks comprising the REL-only, ABN-only, and REL∩ABN portfolios. Table 10 gives the means of the characteristics at the end of the formation period (month $t-1$) for the stocks comprising the portfolios. The measures are:

- *size* = market value of equity from month $t-1$,
- BM = book-to-market equity where book value for fiscal year-end in calendar year $y-1$ is divided by market value from CRSP in December of year $y-1$ and used for all formation periods ending in year y,
- R&D = research and development expenditures for fiscal year-end in calendar year $y-1$ divided by total assets in the same fiscal year and used for all formation periods ending in year y,
- r = return over the six-month formation period,
- ε = cumulative residual return from the single-index model of equation (2) over the six-month formation period,
- σ_ε = standard deviation of six-month residuals at the end of the formation period measured over the prior sixty months,

Table 8
January seasonality in the profits to the subset momentum portfolios for the 6-month formation period: the winners

For the 6-month formation period, we form three subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2). Reported below are the performances of the equally-weighted calendar-time portfolios which are only long the respective winners during the holding periods $[t+1, t+K]$ for $K = 6$, 12, and $[t+13, t+K]$ for $K = 60$. Panels A, B, and C give the January and non-January mean performances for the three subsets respectively, with the t-statistics in parentheses. The columns correspond to the three performance metrics and three holding-period windows.

Winners	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
Panel A: REL-only									
Non-January	0.88	0.57	0.14	0.31	0.01	−0.41	0.54	0.22	−0.31
	(2.43)	(1.63)	(0.44)	(1.48)	(0.01)	(−2.67)	(4.25)	(2.18)	(−3.97)
January	4.02	3.71	5.29	1.54	1.22	3.05	0.38	0.09	1.41
	(3.35)	(3.19)	(4.93)	(2.21)	(1.96)	(5.92)	(0.85)	(0.26)	(5.14)
Panel B: ABN-only									
Non-January	0.79	0.74	0.59	0.40	0.34	0.20	0.30	0.25	0.06
	(3.42)	(3.23)	(2.62)	(3.73)	(3.46)	(1.95)	(5.70)	(5.28)	(1.00)
January	4.12	4.06	3.81	2.39	2.32	2.2	0.25	0.27	0.05
	(5.35)	(5.34)	(5.05)	(6.78)	(7.08)	(6.56)	(1.31)	(1.67)	(0.24)
Panel C: REL∩ABN									
Non-January	1.16	0.86	0.29	0.63	0.32	−0.21	0.77	0.47	−0.18
	(3.47)	(2.63)	(1.00)	(3.35)	(1.88)	(−1.55)	(6.98)	(4.96)	(−2.94)
January	4.23	4.22	5.10	1.97	1.90	3.06	0.32	0.40	1.09
	(3.87)	(3.91)	(5.24)	(3.16)	(3.34)	(6.71)	(0.81)	(1.20)	(4.98)

- *VOL* =mean monthly trading volume per share outstanding over the six-month formation period for NYSE stocks only.[18]

Table 10 also provides the mean decile ranks of the characteristics for the stocks in the subset portfolios. For size and turnover, we use the NYSE breakpoints; for all other variables we use the NYSE-AMEX-NASDAQ breakpoints.

We see that the ABN-only stocks (winners and losers) tend to be larger than the REL-only and REL∩ABN stocks; they tend to have lower R&D, and lower turnover.[19] No clear pattern emerges for BM across the subset portfolios. Note that the return characteristics are as expected given our definitions of REL-only and ABN-only. The raw returns of

[18]Volume cannot be directly compared across the NYSE and NASDAQ markets because of the double counting of inter-dealer trades on NASDAQ. The turnover characteristics are qualitatively the same, though, for NASDAQ stocks.

[19]The lower volume for the ABN-only stocks persists across formation and later holding periods as well as across Decembers and Januarys. The turnover in these portfolios implies that we are identifying a return effect that is different from the patterns found by Lee and Swaminathan (2000). The REL-only portfolio is typically comprised of high-volume stocks, while the ABN-only portfolio is typically comprised of medium-volume stocks. The "late" portfolio of Lee and Swaminathan, which reverses, combines high-volume winners with low-volume losers. Their "early" strategy, which does not reverse, combines low-volume winners with high-volume losers.

Table 9
January seasonality in the profits to the subset momentum portfolios for the 6-month formation period: the losers

For the 6-month formation period, we form three subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2). Reported below are the performances of the equally-weighted calendar-time portfolios which are only long the respective losers during the holding periods $[t+1, t+K]$ for $K = 6$, 12, and $[t+13, t+K]$ for $K = 60$. Panels A, B, and C give the January and non-January mean performances for the three subsets respectively, with t-statistics in parentheses. The columns correspond to the three performance metrics and three holding-period windows.

Losers	Mean return			CAPM alpha			Fama-French alpha		
	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60	Months 1–6	Months 1–12	Months 13–60
Panel A: REL-only									
Non-January	−0.57	−0.37	0.31	−1.10	−0.89	−0.22	−1.03	−0.84	−0.18
	(−1.63)	(−1.09)	(0.91)	(−5.18)	(−4.36)	(−1.10)	(−7.83)	(−7.09)	(−2.02)
January	7.96	8.33	8.40	5.64	6.05	6.28	3.14	3.40	3.38
	(6.88)	(7.38)	(7.58)	(7.96)	(8.87)	(9.49)	(6.81)	(8.12)	(10.6)
Panel B: ABN-only									
Non-January	0.16	0.20	0.40	−0.24	−0.20	−0.01	−0.34	−0.31	−0.14
	(0.69)	(0.86)	(1.75)	(−2.23)	(−1.91)	(−0.04)	(−3.83)	(−3.73)	(−2.25)
January	2.64	2.85	3.67	0.91	1.12	2.03	−0.66	−0.55	0.07
	(3.42)	(3.73)	(4.81)	(2.55)	(3.26)	(6.20)	(−2.12)	(−1.91)	(0.30)
Panel C: REL∩ABN									
Non-January	−0.57	−0.43	0.29	−1.07	−0.92	−0.19	−1.10	−0.96	−0.24
	(−1.85)	(−1.42)	(1.01)	(−6.46)	(−5.77)	(−1.26)	(−8.58)	(−8.68)	(−3.20)
January	5.05	5.62	6.74	2.86	3.48	4.77	0.78	1.16	2.12
	(4.92)	(5.64)	(6.93)	(5.18)	(6.59)	(9.34)	(1.73)	(2.99)	(8.10)

ABN-only stocks are, by definition, less extreme cross-sectionally, but interestingly, the residual returns of ABN-only and REL-only stocks are equivalent. ABN-only stocks have smaller standard deviations of residuals (and returns).

The finding that the ABN-only stocks tilt away from the smallest stocks is interesting. First, many return anomalies tend to concentrate in the smallest stocks, perhaps because of greater information asymmetries and/or greater microstructural issues. Second, the likelihood of realizing the holding-period returns of the abnormal-return-only portfolio should be greater than that for the relative-return portfolios, since trading costs typically decrease with stock size.[20]

7. Conclusion

We find that momentum in stock returns is more complex than previously recognized. Both firm-specific abnormal returns and relative returns contribute separately to momentum. These two types of momenta display starkly different long-run performances. Abnormal-return–momentum persists for years without reversing and is consistent with underreaction. Relative-return momentum reverses strongly after one year and is

[20]Korajczyk and Sadka (2002) and Lesmond et al. (2004) estimate the trading costs to various momentum strategies.

Table 10
Characteristics of the stocks comprising the subset momentum portfolios for a 6-month formation period

Mean levels of the following measures are reported for the stocks comprising the three subset portfolios, REL-only, ABN-only, and REL∩ABN (described in Table 2). For the six-month formation period ending in month $t-1$ of year y, size is market capitalization in month $t-1$ in millions of dollars; BM is the book-to-market equity ratio with book value from year $t-1$ and market value from December of year $y-1$; R&D is research and development expenditures over total assets from year $t-1$; and INST is institutional ownership at the most recent calendar quarter-end. r is the six-month return, ε is the cumulative six-month residual return from equation (2), and VOL is mean monthly trading volume per share for NYSE stocks only during the formation period. σ_ε is the standard deviation of six-month residual returns measured over the prior sixty months. All stocks are also sorted each month into deciles according to each one of the above characteristics. For size and volume, we use the NYSE breakpoints; for all other measures, we use the NYSE-AMEX-NASDAQ breakpoints. The mean decile of each measure that the component stocks belong to at the end of the formation period is reported. Panels A and B give the mean characteristics for the winners, and Panels C and D give the mean characteristics for the losers.

	Size	BM	R&D	r	ε	σ_ε	VOL
Winners							
Panel A: Mean values							
REL-only	594	0.61	0.07	0.57	0.25	0.41	0.07
ABN-only	1378	1.03	0.03	0.29	0.26	0.19	0.04
REL∩ABN	628	0.94	0.05	0.83	0.57	0.30	0.07
Panel B: Mean decile ranks							
REL-only	3.36	3.78	6.18	9.94	8.80	7.73	7.33
ABN-only	4.61	6.21	5.25	8.50	8.89	3.32	5.34
REL∩ABN	3.54	5.52	5.71	9.97	9.82	5.98	7.21
Losers							
Panel C: Mean values							
REL-only	118	0.89	0.07	−0.24	−0.26	0.37	0.06
ABN-only	1590	0.65	0.03	−0.10	−0.25	0.19	0.04
REL∩ABN	451	0.74	0.04	−0.30	−0.45	0.28	0.06
Panel D: Mean decile ranks							
REL-only	2.26	5.21	6.32	1.64	2.37	7.34	6.71
ABN-only	5.22	4.39	5.14	3.22	2.36	3.32	4.92
REL∩ABN	3.54	4.58	5.57	1.39	1.34	5.61	6.63

consistent with overreaction. These findings are robust across alternative performance metrics, across alternative measures of abnormal returns, across subperiods, and within large-cap stocks.

We offer an agency-based explanation of our stock-return findings that provides an economic rationale for momentum in returns. Moreover, the agency explanation that we propose for these newly identified complexities in return momentum is parsimonious in that the single underlying source of momentum is the agency relation between money managers and their clients. Delegated money managers have incentives to chase relative returns yielding an overreaction and to ignore firm-specific news yielding an underreaction. The trading behaviors of institutions confirm these tendencies. We find that institutions aggressively buy stocks with the highest prior returns and avoid stocks with the lowest prior returns. We also find that the long-run reversal of relative-return momentum occurs only for winner stocks that institutions buy the most and for loser stocks that institutions sell the most. These findings suggest that institutions overreact to relative returns. On the other hand, institutions trade stocks with high and low firm-specific abnormal returns as if these stocks were any other

stocks. Moreover, abnormal-return momentum persists for years only for the winner stocks that institutions buy the least and for the loser stocks that institutions sell the least. These findings suggest that institutions underreact to abnormal returns (firm-specific news). In short, institutions seem to contribute to both types of the momenta we identify.

In addition, the persistence of abnormal-return momentum contributes to the growing evidence that the market underreacts to firm-specific news. Prior studies find evidence of underreaction to corporate events and to headline news. The finding that the market also underreacts to the general firm-specific information in returns reinforces and extends the prior evidence. Underreaction to firm-specific news is a pervasive phenomenon. Our agency explanation for momentum also serves as an economic rationale for the specific underreactions found in prior studies.

Finally, our institutional results complement the recent literature on the limits of arbitrage, surveyed in Barberis and Thaler (2003). As such, they offer possible explanations for the notorious inability of institutions to beat the market.[21] Our finding that institutions appear to underreact to firm-specific news is consistent with the VAR results of Cohen et al. (2002). The subtle difference is that we suggest that institutions contribute to underreaction while they suggest that institutions fail to fully exploit the underreaction. Our results on overreaction, however, provide a sharper contrast to recent studies. This is the first finding of a negative relation between institutional trading and long-run returns that we are aware of. This finding suggests that institutional trading possibly destabilizes prices, driving them away from fundamental values. In contrast, recent studies by Wermers (1999) and Sias (2004), among others, find only a positive correlation between institutional trading and future returns. However, these studies limit their analysis to just twelve months after they measure institutional trading. We find return reversals in months 13–60.

Appendix

We describe here the other metrics and procedures we employ to evaluate the performances of the portfolios. The findings are robust across all of these variations. Abnormal-return momentum persists for several years and does not reverse; relative-return momentum reverses strongly in the long-run.

A.1. Stochastic discount factor

Assuming that the law of one price holds, there exists a stochastic discount factor (SDF) that satisfies the following pricing equation:

$$\mathrm{E}(mx) = 1, \tag{A.1}$$

where x is a future payoff (expressed as a gross return). Assuming that there exists a riskless (unobservable) asset, Hansen and Jagannathan (1991) show how an estimator of m can be retrieved from a basis set of traded assets. The estimate is obtained by finding the $N \times 1$ vector $\mathbf{c}$ such that

$$\mathrm{E}(\mathbf{x}\mathbf{x}'\mathbf{c}) = \mathbf{1}_N, \tag{A.2}$$

[21] Berk and Green (2004) and Wermers (2000) suggest other possible and complementary reasons.

where $\mathbf{x}$ is the $N \times 1$ vector of payoffs for the basis assets and $\hat{m} = \mathbf{x}'\mathbf{c}$ is the estimate of the SDF.

Since the portfolios we examine are winner-minus-loser portfolios, the SDF should price the profits to zero.

$$\mathrm{E}(mr^{W-L}) = 0, \tag{A.3}$$

where r^{W-L} is the payoff to the winner portfolio minus the payoff to the loser portfolio. Following Chen and Knez (1996), we can estimate the pricing error, or alpha, using the mean of the time-series of the discounted payoffs, which should be zero. The advantage of this method is that it does not rely on any specific model of the pricing kernel. The pricing kernel is obtained directly from return data on the basis assets.

We employ four sets of assets to serve as the basis sets, and thus form four estimates of the SDF. From Kenneth French's website we obtain value-weighted and equal-weighted returns to sets of 12 and 30 industry portfolios, respectively.[22] The equal-weighted portfolios reflect more of the performance of smaller stocks and increasing the number of industry portfolios reflects more of the non-systematic components of stock returns. Following the advice of Dahlquist and Soderlind (1999) and Farnsworth et al. (2002), we add the one-month T-bill rate to the set of basis assets to better estimate the mean of m.

A.2. Conditional CAPM

Jagannathan and Wang (1996, hereafter JW) and Lettau and Ludvigson (2001a, hereafter LL) find that allowing betas to change as a function of the state of the market improves the ability of the CAPM to explain the cross section of stock returns. Following LL, we employ *cay* as the conditioning variable.[23] The variable *cay* is the log consumption-wealth ratio and is shown by Lettau and Ludvigson (2001b) to predict stock returns.[24] The form of the CAPM we estimate is

$$r_t^{W-L} = \alpha + \beta_1(r_{Mt} - r_{ft}) + \beta_2(cay)(r_{Mt} - r_{ft}) + \varepsilon_t. \tag{A.4}$$

The macro data are quarterly. The findings in this specification, and in the following with human capital, are the same when using quarterly frequency for the momentum portfolios' profits or when using monthly frequency and updating the macro variables every third month.

A.3. Conditional CAPM with human capital

JW and LL find that adding the return on human capital to the CAPM improves the conditional CAPM's ability to explain the cross section of stock returns even further. So we consider a conditional CAPM with the market portfolio expanded to include human capital. We use the growth rate in per capita labor income as the proxy for the return on

[22]Professor French's website is at http://mba.tuck.dartmouth.edu/pages/faculty/ken.french. We thank him for generously providing these data. The definitions of the industries are provided on the website.

[23]We thank Martin Lettau for generously providing the *cay* data as well as the labor income data on his website at http://pages.stern.nyu.edu/~mlettau.

[24]Brennan and Xia (2005) and Lee (2002) argue that the estimates of *cay* provided by Lettau and Ludvigson are biased. Lee re-estimates the series and finds that *cay* is unable to predict future returns. Lettau and Ludvigson (2005) respond to the criticisms.

human capital as JW and LL do. The model is then

$$r_t^{W-L} = \alpha + \beta_1(r_{Mt} - r_{ft}) + \beta_2(cay)(r_{Mt} - r_{ft}) + \beta_3\Delta y + \beta_4(cay)\Delta y + \varepsilon_t, \quad \text{(A.5)}$$

where Δy is the change in the log of labor income.

A.4. Size and book-to-market matches

For each month in the holding period, we subtract from the returns of our selected momentum stocks the returns of a matching size/book-to-market portfolio. The portfolios are formed by first sorting all stocks into quintiles using market values of equity at the end of the prior month. These five portfolios are then sorted further into quintiles using the book-to-market ratios of equity, where book value is from the fiscal-year end of the prior calendar year and market value is from December of the prior calendar year. The size breakpoints are determined using only NYSE stocks; the book-to-market breakpoints are determined using all stocks. The calendar-time series of adjusted returns are then evaluated using mean raw returns and Fama-French alphas. We also examine 10×10 matching portfolios and find similar results.

A.5. Using individual-stock factor loadings to construct proxies for portfolio loadings

Since the composition of stocks in these momentum portfolios is changing through time, the factor loadings of the portfolios might also be changing through time. Estimating time-invariant factor loadings, as we do in the reported tables, might lead to poor estimates of performance. This source of potential time variation is different from the time variation that we consider in the conditional CAPM models. To allow for the possibility that changes in portfolio composition will lead to changes in factor loadings, we follow the suggestion of Mitchell and Stafford (2001) and Grundy and Martin (2001) to use the loadings of the individual stocks comprising the portfolios each month to construct proxies for portfolio loadings. We estimate each stock's CAPM and Fama-French factor loadings in months $[t+1, t+60]$, requiring at least twenty-four months of available data. (The look-ahead bias this imposes does not affect our empirical findings.) To estimate the portfolio factor loadings each calendar month, we average the factor loadings of the individual stocks that are in each portfolio that calendar month.

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