ELSEVIER

Journal of Financial Markets 6 (2003) 363–387

Journal of FINANCIAL MARKETS

www.elsevier.com/locate/econbase

Intra-industry momentum: the case of REITs ☆

Andy C.W. Chui[a], Sheridan Titman[b], K.C. John Wei[c,*]

[a] *Department of Business Studies, The Hong Kong Polytechnic University, Kowloon, Hong Kong*
[b] *Department of Finance, University of Texas at Austin, Austin, TX 78712-1179, USA*
[c] *Department of Finance, Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong*

Abstract

Real estate investment trusts (REITs) provide a good setting to examine intra-industry momentum. The industry is relatively homogenous and well defined, and the industry experienced structural changes that allow us to test alternative explanations for the observed momentum effect. Specifically, we test predictions that are related to investor overconfidence (based on Daniel, Hirshleifer, and Subrahmanyam (1998)) and the speed of information diffusion (based on Hong and Stein (1999)). The first predicts a stronger momentum effect in REITs during the post-1990 period than during the pre-1990 period due to more valuation uncertainty in the post-1990 period. The second predicts a more pronounced momentum effect in REITs during the pre-1990 period than during the post-1990 period due to the higher speed of information diffusion in the post-1990 period. Our findings tend to support the first prediction. Specifically, while we do not find a momentum effect in REITs during the pre-1990 period, we find a strong and prevalent momentum effect in REITs during the post-1990 period.

☆ The authors appreciate helpful comments from the seminar participants at the Hong Kong University of Science and Technology, the Fifth Asian Real Estate conference in Beijing, PRC, July 27–30, 2000, and the American Real Estate and Urban Economics Association 2002 Meeting in Atlanta. The authors also thank A. Subrahmanyam (the editor) and an anonymous referee for insightful comments and Dr. Virginia Unkefer for the editorial assistance. Andy Chui acknowledges the financial support from the Hong Kong Polytechnic University (G-T095). Sheridan Titman and John Wei acknowledge the financial support from the Research Grants Council of the Hong Kong Special Administration Region, China (HKUST6233/97H).

*Corresponding author. Tel.: +852-2358-7676; fax: +852-2358-1749.

E-mail addresses: bussandy@polyu.edu.hk (A.C.W. Chui), titman@mail.utexas.edu (S. Titman), johnwei@ust.hk (K.C.J. Wei).

1386-4181/03/$ - see front matter
doi:10.1016/S1386-4181(03)00002-8

1. Introduction

During the early 1990s, a substantial number of real estate investment trusts (REITs) went public. Evidence from the CRSP tapes (which include stocks listed on either the NYSE/Amex or Nasdaq) shows that there were only 67 REITs in 1989. However, by 1992, the number grew to 101 and, by 1994, to 226. Along with the increased number of REITs, there were major changes in the REIT industry, which included changes in the strategies, organization and ownership structures of the trusts. For a variety of reasons discussed by Ling and Ryngaert (1997), these changes made REITs substantially more difficult to value in the post-1990 period.[1]

This paper examines the efficiency of the REIT market in the pre- and post-1990s by evaluating the profitability of simple momentum strategies that consisted of buying the REITs that performed well in the recent past and selling those that performed poorly. Studies by Jegadeesh and Titman (1993, 2001) and others have documented that these strategies work well when they are implemented over a large number of diverse stocks. These strategies do not, however, generally work as well when implemented on samples of stocks restricted to a particular industry.[2] Up to now, however, no one has provided a detailed examination of the profitability of momentum strategies in any particular industry.

For a variety of reasons, REITs provide a particularly good industry for evaluating intra-industry momentum. First, REITs can be viewed as a relatively large and homogeneous industry group. In contrast to most industries, it is straightforward to determine which firms belong in the REIT industry. Second, the changes in the REIT industry during the 1990s provide an interesting setting in which to learn about the determinants of the momentum effect. Indeed, we find that return volatility and earnings volatility for REITs are much greater in the 1990s than in the 1980s. As we will discuss in more detail below, the overconfidence theory proposed by Daniel et al. (DHS, 1998) suggests that momentum is likely to be stronger in the later period, when REITs were relatively more difficult to value. However, the information diffusion theory proposed by Hong and Stein (1999), who examine how momentum profits are related to the speed of the diffusion of information, predicts that momentum should be stronger in the earlier period, when analyst coverage was much weaker and information flow was slower.

Consistent with the overconfidence hypothesis, we find that the momentum effect in REITs is small and weak in the pre-1990 period, but it is strong and prevalent during the post-1990 period and that this increase in the momentum profit is unique

[1] There are two exogenous factors that partially explain the changes in the REIT industry over this time period. The first was the financial difficulties of banks and savings and loans in the late 1980s and early 1990s that substantially reduced the amount of debt that was available to finance commercial real estate. The second was 1993 legislation that made it easier for pension funds to hold REITs in their portfolios.

[2] Indeed, Moskowitz and Grinblatt (1999) argue that most of the profits from momentum strategies come from the momentum of industry portfolios rather than from intra-industry momentum. Grundy and Martin (2001) show that when you skip a month between the portfolio formation and initiation dates, industry momentum becomes less important and intra-industry momentum becomes more important. Later in this paper we present evidence that confirms Grundy and Martin's results.

to the REIT industry. These results continue to hold when we adjust returns using a variety of benchmarks based on the Fama–French (1993) three-factor model and the Daniel–Titman (1997) characteristics-based model. In addition, we find that the positive returns of the momentum portfolio are subsequently reversed in two years after the formation date, suggesting that the momentum profits are generated from delayed overreaction (perhaps caused by positive-feedback traders) rather than by underreaction to information.

The remainder of this paper is organized as follows. Section 2 discusses the behavioral theories of momentum profits and describes the development of our empirical hypotheses derived from these theories. Section 3 discusses the data and methodology used in the paper, while Section 4 reports the results on momentum profits implemented within the REIT industry. In Section 5, we investigate whether the momentum effect of REITs is due to delayed overreaction caused by positive-feedback trading by looking at the post-holding period returns of momentum portfolios. Finally, Section 6 concludes the paper.

2. Behavioral theories of momentum

Daniel, Hirshleifer, and Subrahmanyam (DHS, 1998) provide a model in which investor overconfidence can generate the observed momentum effect. As discussed by Daniel and Titman (1999), overconfidence is likely to influence investors relatively more when they analyze fairly vague and subjective information.[3] According to this argument, since REITs are diverse portfolios of real estate investments with stable incomes and limited growth potential, the momentum effect in REITs should be relatively weak.

This reasoning, which is clearly valid in the pre-1990 period, may be less applicable in the post-1990 period. As discussed in Ling and Ryngaert (1997), REITs in the post-1990 period have substantially greater valuation uncertainty than those in the pre-1990 period because of the changes in management style and the evolution of the umbrella partnership REIT (UPREIT) structure.[4] In contrast to the passive investment style that was widely used to manage REITs before 1990, REITs in the post-1990 period are more actively managed and their investments tend to be focused by the product type and the geographic market. These changes in management style make it more difficult for investors to evaluate the value added to a REIT by the

[3] Daniel and Titman (1999) use the book-to-market ratio to measure valuation uncertainty (high book-to-market stocks are more straightforward to value) and find that momentum profits are negatively related to the book-to-market ratios. Trading volume may provide another proxy for the vagueness of the information used in a firm's valuation. As suggested by asymmetric information models (for example, Blume et al., 1994), trading volume can reflect investor disagreement about the true value of a stock. When information is more vague, there is likely to be more disagreement among investors and, therefore, more turnover. Lee and Swaminathan (2000) find that momentum profits are higher for firms with higher turnover.

[4] The UPREIT structure allows the transfer of ownership (from private partnership to public REIT ownership) without triggering a taxable sale.

current management as well as the value of 'growth options' from REIT expansions. The evolution of the UPREIT structure in the 1990s has also made many REITs even more difficult to value. There are two reasons. First, the UPREIT structure introduces a complicated ownership structure that may create more conflicts of interest in the management of UPREIT investments. Second, the UPREIT structure makes the accounting statements of REITs more difficult to analyze (Frank, 1993). Because of these significant changes in the organization, business plans, and ownership structures in REITs, valuing REITs in the post-1990 period involves much more than valuing the underlying properties, which makes this valuation much more subjective than in the pre-1990 period.[5] If the momentum effect is indeed caused by investor overconfidence and overconfidence is negatively related to the extent to which the investment can be objectively valued, then we should find a stronger momentum effect in REITs during the post-1990 period.[6]

The implications of the DHS overconfidence model can be contrasted with those of Hong and Stein's (1999) model. In the Hong-Stein model, the interaction of investors with limited rationality (''newswatchers'' and ''momentum traders'') and the slow diffusion of information generate initial underreaction and subsequent overreaction. Hong et al. (2000) argue that the momentum effect, caused by the slow diffusion of information, should be strongest for the smallest stocks with the least analyst coverage. Since REITs are relatively small firms with relatively low levels of analyst coverage, one might expect to see REITs exhibit more momentum.[7] However, Chan, et al. (1998) document that REITs attracted significantly more institutional investors after 1990 and Gentry, et al. (2003) suggest that analyst coverage on REITs increased a lot after the boom in this industry that began in the early 1990s. In addition, we also find that news coverage of REITs has increased significantly in the post-1990 period. All these findings indicate that information on REITs flowed faster after 1990, indicating that the momentum effect for REITs should be weaker in the post-1990s period according to the Hong-Stein theory.

3. Data and methodology

Our REIT sample and common stock sample are, respectively, constructed from all the REITs (including equity, mortgage, and hybrid)[8] and common stocks traded

[5] For additional discussions on the changes in the REIT industry in the 1990s, see McMahan (1994) and Ross and Klein (1994).

[6] Barberis, et al. (1998) suggest that, because of a conservatism bias, investors are slow in updating their beliefs and may thus underreact to information. Although their paper suggests interesting implications about the momentum effect, we do not think that it suggests anything on the difference in momentum profits of REITs in the pre- and post-1990 periods.

[7] It should also be noted that the average monthly turnover of REITs is much lower than the turnover of common stocks of approximately the same firm size. Lee and Swaminathan (2000) find that turnover is positively related to momentum profits, which suggest that we might expect to observe lower momentum profits for REITs.

[8] We choose to include all types of REITs so that we can have a larger sample in the pre-1990 period. Moreover, most of the listed REITs are equity REITs. According to the statistics provided by the

on the NYSE, AMEX, and Nasdaq over the 1982–99 period.[9] To be included in our sample, the securities must have been listed for at least two years. Data on the returns and market capitalizations of REITs and common stocks are collected from the CRSP data file, while data on book values and earnings are collected from the COMPUSTAT data file.[10] We include only ordinary common stocks identified by CRSP in our sample.

To form momentum portfolios, at the end of each month all securities in each of the samples are ranked in ascending order based on the past six-month cumulative returns with dividends. The securities in the bottom 30 percent are assigned to the loser (denoted as "L") portfolio, while those in the top 30 percent are assigned to the winner (denoted as "W") portfolio. These portfolios are value-weighted using the market capitalization of the security at the end of the ranking month as the weight. Each of these portfolios is held for six months. We require that each portfolio contain at least five securities at any point in time during our sampling period.

To reduce the effect of nonsynchronous trading and the bid-ask bounce, following Jegadeesh and Titman (1993), we measure returns on these portfolios one month after the ranking takes place. If a security has any missing returns during the holding period, we replace them with the corresponding value-weighted market returns that are also obtained from CRSP. If the returns on the security are no longer available, we rebalance the portfolio in the month the security is deleted from our database. Excess returns on a security are calculated as the returns on that security minus the risk-free rate, which we assume is equal to the one-month T-bill rate.

To increase the power of our tests, we construct overlapping portfolios. The winner (loser) portfolio is an overlapping portfolio that consists of the "W" ("L") portfolios in the previous six months. The returns on the winner (loser) portfolios are the simple average of the returns on the six "W" ("L") portfolios. For instance, the January return on the winner portfolio is the simple average of the January returns on the "W" portfolios that are constructed from June to November in the previous year. The momentum portfolio we examine is the zero-cost, winner-minus-loser portfolio.

Table 1 reports the summary statistics of the winner and loser portfolios that are constructed from the REIT and common stock samples. The average number of securities in the portfolios formed from REITs is far less than that from common stocks. However, the number of REITs increased by more than three times from the

(*footnote continued*)
NAREIT, while 46% of the listed REITs were equity REITs in the pre-1990 period, 73% of them are equity REITs in the post-1990 period.

[9] Our sample period begins in February 1982, because there are only a few REITs with available returns and market capitalization data before February 1982. The data sample periods used in our analyses start one year after the actual sample periods. We need to use twelve observations on returns to form momentum portfolios.

[10] Our measure of earnings is operating income after depreciation, corresponding to Compustat's annual data item 178.

Table 1
Summary statistics of REITs and common stocks. The sample includes all the REITs and common stocks listed on the NYSE/AMEX/Nasdaq. To be included in our sample, each REIT and common stock must have been listed for at least two years. The winner and loser portfolios are formed monthly. The winner (loser) portfolio is the value-weighted portfolio of thirty percent of the REITs/stocks with the highest (lowest) six-month lagged returns. The 'All' portfolio includes either all REITs or all common stocks. This table reports the average number of stocks assigned to each portfolio every month, along with the minimum number of stocks in each portfolio during our sample periods (reported in parentheses). Also reported are the average market capitalization (in million dollars) and the average book-to-market equity of each portfolio. A portfolio's market capitalization in each month is the value-weighted average of the market capitalization of the REITs/stocks in that portfolio. Similarly, a portfolio's book-to-market ratio is the value-weighted average of the book-to-market equity of the REITs/stocks in that portfolio. The book-to-market equity of each REIT/stock is computed as its book value in year $t-1$ divided by its market capitalization in December of year $t-1$. The book-to-market equity is matched with the market capitalization of the REITs/stocks from July of year t to June of year $t+1$. The average monthly analyst coverage is the value-weighted average of analyst coverage of the REITs/stocks, which are covered by both CRSP and I/B/E/S databases in that portfolio. The data on analyst coverage are from the I/B/E/S and are available on a monthly basis. Analyst coverage in any given month is computed as the number of I/B/E/S analysts who provide earnings estimates for fiscal year $t+1$ in that month

February 1983–June 1999						
	REITs			Common stocks		
	All	Winner	Loser	All	Winner	Loser
Avg. no. of stocks	68	21	21	4,921	1,477	1,477
(Minimum #)	(15)	(5)	(5)	(4,089)	(1,230)	(1,230)
Avg. market cap.	427	436	355	19,792	20,243	8,443
Avg. book-to-market ratio	0.81	0.89	0.91	0.59	0.61	0.58
Avg. analyst coverage	2.33	2.26	2.13	22.40	21.32	18.84
February 1983–December 1989						
Avg. no. of stocks	29	9	9	4,581	1,375	1,375
(Minimum #)	(15)	(5)	(5)	(4,089)	(1,230)	(1,230)
Avg. market cap.	166	166	109	9,906	8,201	5,362
Avg. book-to-market ratio	0.83	0.82	0.89	0.76	0.79	0.72
Avg. analyst coverage	2.17	1.99	2.16	21.76	20.47	18.54
January 1990–June 1999						
Avg. no. of stocks	96	29	29	5,169	1,551	1,551
(Minimum #)	(52)	(16)	(16)	(4,703)	(1,411)	(1,411)
Avg. Market Cap.	616	632	534	26,990	29,010	10,685
Avg. book-to-market ratio	0.79	0.95	0.92	0.47	0.48	0.48
Avg. analyst coverage	2.45	2.46	2.11	22.86	21.96	22.28

pre-1990 period to the post-1990 period. The average market capitalization of REITs is much smaller than that of common stocks and both increased considerably over our sample period. The average number of analysts covering REITs is much smaller than the average number of analysts covering common stocks, but this number has been growing for REITs. For common stocks, the average number of analysts increased from 21.76 in the 1980s to 22.86 in the 1990s, an increase of 5.1 percent.

For REITs, the average number of analysts increased from 2.17 in the 1980s to 2.45 in the 1990s, an increase of 13 percent.[11]

The book-to-market ratio for each security is computed as its most updated book value in the year $t-1$ divided by its market capitalization in December of year $t-1$. These book-to-market ratios are used to rank securities from June in year t to May in year $t+1$. Following Fama and French (1992), we do not include firms in our sample until they have appeared in COMPUSTAT for two years. In addition, firms with negative book-to-market ratios are excluded from our analysis. To minimize the effect caused by firms with extreme book-to-market ratios, firms with book-to-market ratios that are higher than the 0.9975 fractile or lower than the 0.0025 fractile are set equal to the 0.9975 and 0.0025 fractile values, respectively. This procedure has no effect on our inferences. The average book-to-market ratios of the winner and loser portfolios are also shown in Table 1. Over the whole sample period, the REIT portfolios have higher book-to-market ratios than their counterpart common stock portfolios. However, the book-to-market ratios for the REIT portfolios are close to those for the common stock portfolios in the pre-1990 period. In the post-1990 period, the book-to-market ratios for common stocks decrease substantially, while those for REITs increase slightly.

To confirm the argument proposed by Ling and Ryngaert (1997), we begin our analysis by looking at changes in return volatility and earnings volatility, which can be viewed as proxies for changes in valuation uncertainty. If REITs are indeed more difficult to value after 1990, we would expect that both the return volatility and earnings volatility in the post-1990 period (January 1990 to June 1999) should be greater than their counterparts in the pre-1990 period (January 1982 to December 1989). The volatility of returns on a REIT in month t is computed as the standard deviation of its daily returns in that month.[12] To be included in our sample for this test, each REIT is required to have at least forty-eight monthly observations on the volatility of returns in both the pre-1990 and post-1990 periods. As a result, our sample includes only twenty-seven REITs.[13]

Panel A of Table 2 reports the summary statistics on the return volatilities of these REITs. Out of this sample, seventeen REITs had increased return volatilities after 1990 and fifteen of these increases are statistically significant at the five percent level. In contrast, only five had a significant decline in their return volatilities. Furthermore, the average return volatility is also significantly larger in the

[11] The analyst coverage numbers come from *IBES* and do not include all analysts. Based on discussions with individual REIT analysts, we have the impression that these numbers substantially underestimate the extent to which analyst coverage has increased in this industry. Gentry, et al. (2003) also suggest that analyst coverage of REITs increased a lot after 1990.

[12] To compute the standard deviation of daily returns on a REIT in a particular month, this REIT should have observations on daily returns for all the trading days in that month.

[13] There are total of 57 REITs appeared in both sample periods. If we only require each firm to have at least 24 observations on the monthly standard deviations in both sample periods, there are 44 firms. Out of these 44 REITs, 28 have shown increased volatility and most of these increases (20 out of 28) are significant at the 5% significance level. While the average volatility in this sample is 1.836% before 1990, it is 2.388% after 1990. The difference is 0.552% with a t-value of 5.56.

Table 2
Return volatility before and after 1990: REITs versus other Industries. This table shows the summary statistics on the changes in return volatility (%) in different industries along with the proportion of firms with changes that are significant at the five percent level. The statistics are computed over the pre-1990 period (from January 1982 to December 1989) and the post-1990 period (from January 1990 to June 1999). "*Mean vol*" refers the mean value of return volatilities. The variable "*Change*" is the average monthly returns volatility of a REIT/stock in the post-1990 period minus its counterpart in the pre-1990 period. Common stocks are divided into 18 industries based on their two-digit SIC code. The classification of industries is defined by Moskowitz and Grinblatt (1999), except for the classification of 'Transportation' and 'Retail and Dept. Stores'. 'Railroads' (SIC code 40) and 'Other Transport' (SIC codes 41–47) in Moskowitz and Grinblatt are combined together to form the 'Transportation' industry. 'Dept. Stores' (SIC 53) and 'Retail' (SIC codes 50–52 & 54–59) in Moskowitz and Grinblatt are added together to form the 'Retail & Dept.' industry. Monthly return volatility of a REIT/stock in month t is computed as the standard deviation of its daily returns in that month. To compute the standard deviation, we require each REIT/stock to have observations on daily returns for all the trading days in that month. To be included in our sample of this test, each REIT/stock should have at least forty-eight observations on monthly return volatility in both the pre-1990 period and the post-1990 period. The *t-statistics* are shown in parentheses

Panel A: *REITs*						*Change significance at 5% (in proportion)*	
Industry	*No. of REITs*		*Mean vol Pre-1990*	*Mean vol Post-1990*	*Mean change*	*Median Change*	*Positive*	*Negative*
REITs	27		1.865	2.585	0.720 (2.42)	0.221	0.56	0.19
Panel B: *Other industries*							*Change significance at 5% (in proportion)*	
Industry	*SIC codes*	*No of stocks*	*Mean vol Pre-1990*	*Mean vol Post-1990*	*Mean change*	*Median change*	*Positive*	*Negative*
Mining	10–14	146	3.838	4.699	0.861 (3.41)	0.154	0.41	0.28
Food	20	73	2.334	2.716	0.382 (3.06)	−0.000	0.41	0.30
Apparel	22–23	44	2.620	3.454	0.834 (2.82)	0.182	0.45	0.23
Paper	26	31	1.953	2.082	0.129 (1.49)	0.023	0.42	0.16
Chemical	28	155	2.808	3.420	0.612 (5.44)	0.146	0.42	0.22
Petroleum	29	31	2.463	2.388	−0.075 (−0.29)	−0.317	0.10	0.55
Construction	32	24	2.321	2.856	0.535 (2.58)	0.179	0.46	0.13
Prim. metals	33	43	2.225	3.120	0.896 (3.03)	0.280	0.47	0.21
Fab. metals	34	70	2.667	3.024	0.358 (1.82)	0.037	0.34	0.24
Machinery	35	220	3.029	4.047	1.018 (7.73)	0.518	0.55	0.15
Electrical Eq.	36	213	3.242	4.238	0.996 (9.90)	0.726	0.58	0.14
Transport Eq.	37	63	2.224	2.539	0.315 (2.46)	−0.024	0.33	0.25
Manufacturing	38–39	191	3.176	4.217	1.042 (7.82)	0.477	0.55	0.13
Transportation	40–47	46	2.331	2.688	0.357 (1.76)	0.164	0.39	0.26
Utilities	49	169	1.536	1.645	0.110 (2.03)	−0.074	0.25	0.36
Retail & Dept.	50–59	273	2.695	3.578	0.883 (7.93)	0.368	0.52	0.15
Financial	60–69	483	2.161	2.876	0.715 (9.94)	0.359	0.57	0.16
Other	Other	505	2.850	3.700	0.850 (9.74)	0.338	0.50	0.15
Overall average			2.582	3.183	0.601	0.196	0.43	0.23
			(20.53)	(16.71)	(7.32)	(3.38)		

post-1990 period than in the pre-1990 period with a value of the difference of 0.734 percent (t-value = 2.44).

We use the coefficient of variation (CV) of earnings to measure the earnings volatilities of REITs.[14] To be included in this test, each REIT must have data on earnings for at least four consecutive years in both the pre-1990 and post-1990 periods. There are thirty-four REITs that satisfy this requirement. Panel A of Table 3 reports that 24 out of the 34 had increased earnings volatility after 1990 and twelve have an *F-ratio* that is significant at the ten percent level. The *F-ratio* is computed as the standard deviation of earnings in the pre-1990 period divided by its counterpart in the post-1990 period.

We find that the average earnings volatility is much larger in the post-1990 period than in the pre-1990 period with a change in volatility of 0.731 (t-value = 3.19).[15] In addition, none of the REITs in this sample had a significant drop in its earnings volatility. In sum, our evidence on both return volatility and earnings volatility is consistent with the idea that REITs became more difficult to evaluate after 1990.

For comparison purposes we also investigate the change in valuation uncertainty after 1990 in other industries. Specifically, all common stocks in our sample are classified into eighteen industries based on their two-digit SIC code. Our classification of industries is similar to the classification used by Moskowitz and Grinblatt (1999).[16] We use the procedures that we apply to REITs to compute return volatility and earnings volatility for firms in each of these industries.

The results in Panel B of Table 2 shows that for most industries return volatilities are in fact larger in the post-1990 period than in the pre-1990 period. The average change of return volatility across these eighteen industries is 0.601 (t-value = 7.32), which is very significant but is a substantially smaller percentage increase than what we observed for REITs. Furthermore, the average proportion of firms that have increased return volatility in these industries (0.43) is less than that what we observed for the REITs (0.56).

The results in Panel B of Table 3 reveals that the evidence of increased earnings volatility, found in our REIT sample, in much less prevalent in other industries. Specifically, earnings volatility increases in only eight out of the eighteen industries in the post-1990 period and only one of these changes is significant. The average change

[14] To avoid extreme *CVs*, firms with CV that are higher than the 0.9975 fractile or lower than the 0.0025 fractile are set equal to the 0.9975 and 0.0025 fractile values, respectively. This procedure has no effect on our inferences.

[15] We also use the standard deviation to measure the earnings volatility. The results are similar to those reported here. In particular, while the average standard deviation is 4.599 in the pre-1990 period, it is 15.713 in the post-1990 period with the difference to be significantly positive. To save space, the results on standard deviation are not reported here.

[16] Except for the 'Transportation' and 'Retail and Dept. Stores' industries, the classification of other industries is the same as the one used by Moskowitz and Grinblatt (M&G, 1999). To ensure that there are enough stocks in each industry momentum portfolio, we combine the 'Railroad' and the 'Other Transport' industries in M&G to form the 'Transportation' industry in this study. 'Dept. stores' and 'Retail' in M&G are combined together to form the 'Retail & Dept. Stores' industry in this study. Furthermore, REITs are excluded from the Financial industry. We find similar results, however, if we use the exact classification of M&G.

Table 3
Earnings volatility before and after 1990: REITs versus other Industries. This table shows the summary statistics on the changes in earnings volatility in different industries. The statistics are computed over the pre-1990 period (from January 1982 to December 1989) and the post-1990 period (from January 1990 to June 1999). "*Mean vol*" refers the mean value of return volatilities. The variable "*Change*" is the average earnings volatility of a REIT/stock in the post-1990 period minus its counterpart in the pre-1990 period. Common stocks are divided into 18 industries based on their two-digit SIC code. The classification of industries is described in Table 2. Volatility of earnings is measured by the coefficient of variation of earnings reported at the fiscal year end of each REIT/stock. To calculate the earnings volatility, each REIT/stock should have at least four consecutive observations on earnings in each sample period. Also shown in this table is the proportion of firms with their *F-ratios* (standard deviation of earnings before 1990 divided by the standard deviation of earnings after 1990) that are significant at the ten percent level in each industry. The *t-statistics* are shown in parentheses

Panel A: REITs						*Change significance at 10% (in proportion)*	
Industry	*No. of REITs*	*Mean vol Pre-1990*	*Mean vol Post-1990*	*Mean change*	*Median change*	*Positive*	*Negative*
REITs	34	0.500	1.231	0.731 (3.19)	0.299	0.35	0

Panel B: Other industries						*Change significance at 10% (in proportion)*	
Industry	*No. of stocks*	*Mean vol Pre-1990*	*Mean vol Post-1990*	*Mean change*	*Median change*	*Positive*	*Negative*
Mining	133	6.314	2.811	−3.503 (−1.92)	−0.092	0.26	0
Food	78	0.906	0.701	−0.205 (−1.50)	−0.097	0.15	0
Apparel	48	1.477	6.259	4.782 (1.10)	−0.034	0.06	0
Paper	32	0.616	1.055	0.440 (0.85)	−0.171	0.09	0
Chemical	167	3.677	1.826	−1.851 (−1.00)	−0.008	0.31	0
Petroleum	26	5.171	2.106	−3.064 (−1.05)	0.024	0.04	0
Construction	25	1.149	1.191	0.042 (0.10)	0.031	0.12	0
Prim. metals	42	2.371	2.736	0.365 (0.23)	−0.137	0.05	0
Fab. metals	70	1.512	0.881	−0.631 (−1.59)	−0.063	0.21	0
Machinery	232	6.021	5.924	−0.097 (−0.04)	−0.063	0.22	0
Electrical Eq.	219	4.479	1.711	−2.769 (−2.36)	−0.040	0.32	0
Transport Eq.	68	3.194	2.249	−0.945 (−0.39)	−0.060	0.21	0
Manufacturing	205	2.132	3.136	1.005 (1.25)	−0.029	0.26	0
Transportation	55	1.133	1.437	0.304 (0.52)	−0.033	0.24	0
Utilities	143	0.888	0.895	0.007 (0.02)	0.000	0.22	0
Retail & Dept.	293	1.629	3.658	2.029 (1.82)	0.033	0.25	0
Financial	310	1.973	1.126	−0.847 (−1.19)	−0.021	0.34	0
Other	580	2.951	2.156	−0.795 (−1.10)	0.034	0.30	0
Overall Average		2.644 (6.22)	2.325 (6.14)	−0.318 (−0.71)	−0.040 (−2.95)	0.20	0

Table 4
Change of public information on REITs. This table shows the summary statistics on the average number of news items published in the *Wall Street Journal* (WSJ) per year for a sample of REITs. The average number of news items per year is computed as the average number of news items per month multiplied by twelve. To be included in our sample, the REIT should be covered in CRSP for at least four years before and after 1990. Owing to data availability on *WSJ* articles covered in *ABI/INFORM*, our search for news items on REITs begins in January 1986 and ends in June 1999. The search is conducted by using the company names as the keywords. Each REIT may have different sample periods because they may be deleted from CRSP prior to June 1999. The variable "*Change*" is the average number of news stories per year of a REIT in the post-1990 period minus its counterpart in the pre-1990 period. Also reported is the number of changes that are significant at the ten percent level. The *t-statistic* is in the parenthesis

No. of observations: 37

	Mean	*Median*	*Minimum*	*Maximum*	*Change significance at 10%*	
Pre-1990	1.304	0.250	0	7.5		
Post-1990	2.337	1.263	0	15.038	*Positive*	*Negative*
Change	1.033	0.316	−5.408	7.538	12	3
t-value	(2.85)					

in earnings volatility across these industries is negative and insignificant and, on average, only twenty percent of the firms in these industries have shown significantly greater earnings volatility after 1990. These findings indicate that the change in earnings volatility in REITs after 1990 is much larger than the corresponding changes in other industries. Summarizing the above, our findings suggest that REITs exhibit a larger change in valuation uncertainty after 1990 than firms in other industries.

We next investigate if more information on REITs were generated after 1990. We look at the change in the amount of public information on REITs before and after 1990. We use the number of articles on a particular REIT that appeared in the *Wall Street Journal* as a proxy for public information on a particular REIT. The sample period for this test is from January 1986 to June 1999.[17] To be included in our sample for this test, each REIT must be covered by CRSP for at least four years in the pre-1990 and the post-1990 periods. Table 4 reports the summary statistics on the average number of news items per year for thirty-seven REITs in each sample period. We find that twenty-four of the REITs enjoyed more news coverage after 1990. While twelve REITs had a significant increase in news coverage, three REITs experienced a significant decline in news coverage. On average, while there was only about one news article per REIT per year in the pre-1990 period, the news coverage per REIT per year increased to two articles in the post-1990 period, an increase of 100 percent (t-value = 2.85).[18] Given the fact that the *Wall Street Journal* coverage did not significantly expand from 1980s to 1990s, it is very unlikely that the average

[17] Our search is conducted through the *ABI/INFORM* using company names as the keywords. *ABI/INFORM* began to cover *WSJ* articles in April 1985. However, we cannot find any articles related to REITs before 1986. To hedge against any possible data error, we start our search in January 1986.

[18] We obtain similar findings, if REIT is used as the keyword to search for the news related to all REITs.

news coverage per firm per year for firms in other industries increased after 1990. As a result, the increase in news coverage after 1990 is likely to be relatively unique to the REIT industry.

4. Momentum profits

4.1. Raw returns of the momentum strategy in the REIT and other industries

To begin our analysis of momentum strategies, we compute the excess returns on our winner and loser portfolios over the whole sample period as well as in the pre-1990 and post-1990 periods. Figs. 1–3 plot the cumulative returns on the momentum portfolios in these sample periods. Fig. 1 shows that momentum profits on REITs are much larger in the post-1990 period than in the pre-1990 period. Over the whole sample period, the momentum strategy is more profitable for REITs than for common stocks. The cumulative profits on the REIT momentum portfolio and the common stock momentum portfolio over the whole sample period are 400 percent and 150 percent, respectively.[19] However, Figs. 2 and 3 suggest that the momentum strategy on REITs is profitable only in the post-1990 period.[20] We observe from Fig. 2 that, during the pre-1990 period, momentum profits are larger for common stocks than for REITs. In the pre-1990 period, the cumulative profit on common stocks is about 45 percent while it is about 20 percent on REITs. This picture changes completely in the post-1990 period. As shown in Fig. 3, the cumulative profit on REITs is 320 percent, which is almost 4.4 times larger than the 60 percent profit realized for common stocks.

The average monthly momentum profits show the same pattern. Table 5 presents the results. We find a strong momentum effect for common stocks over the 1983–1999 period, confirming the results reported in the previous literature. Over the same period, the difference between the returns of winner and loser REIT portfolios is 0.89 percent per month, which is much larger than the 0.49 percent generated from a sample of common stocks. The momentum strategies generate a profit of 0.48 percent per month during the pre-1990 period on our sample of common stocks, but only 0.30 percent per month on our sample of REITs. In contrast, during the post-1990 period, the momentum strategies generate a profit of 1.33 percent per month

[19] Since the momentum portfolio is a zero-cost portfolio, the computation of the returns may not be meaningful. However, it is still useful to compare the returns across different portfolios when a meaningful measure is used. Here, we measure the momentum profit as the excess returns derived from investing one dollar in risk-free assets and one dollar in the winner portfolio and shorting one dollar in the loser portfolio.

[20] In the rest of the paper, we use 1990 as the cutoff point to test the DHS prediction versus the Hong-Stein prediction based on our understanding of the changes in the REIT industry. The exact time for the changes is, however, very difficult to determine. To see whether the cutoff point that we choose is reasonable, we use a switching regression to let the data determine the structural change in momentum for REITs. The result indicates that the structural change occurs in September 1989, which is very close to December 1989, which is the date we use.

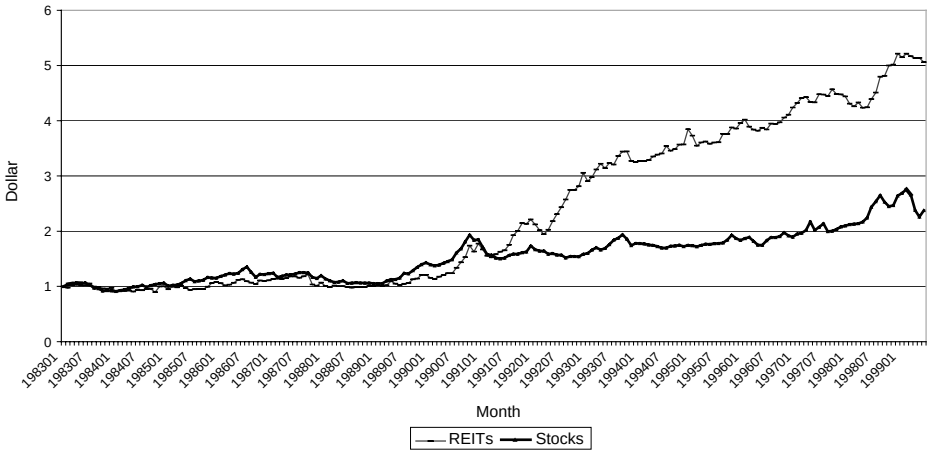

Fig 1. Cumulative momentum profits, February 1983–June 1989.

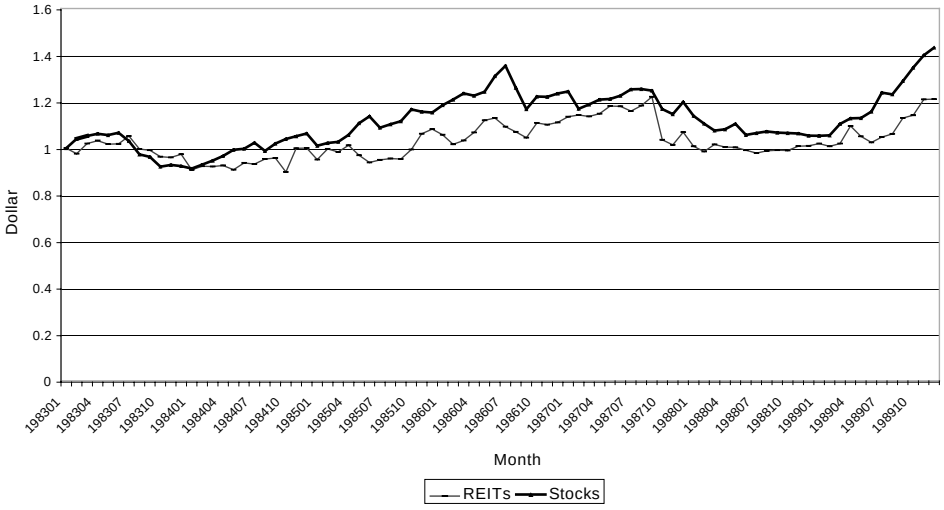

Fig. 2. Cumulative momentum profits, February 1983–December 1989.

for REITs, but only 0.50 percent per month for common stocks.[21] The difference between the momentum profits in the pre-1990 and post-1990 periods for REITs is

[21] The momentum profit for common stocks in the post-1990 period is lower and statistically less significant than the momentum profit reported in Jegadeesh and Titman (2001). The difference is caused by the fact that they are using top and bottom 10 percent past returns to classify winner and loser portfolios. In the current study, the winner and loser portfolios include the stocks from the top and bottom 30 percent. The same reason explains why the momentum profit in common stocks is insignificant in the pre-1990 period. Using Jegadeesh and Titman's (2001) classification, we find a momentum profit of 1.61 percent per month in the pre-1990 period, and it is 1.32 percent per month in the post-1990 period. Both are highly significant.

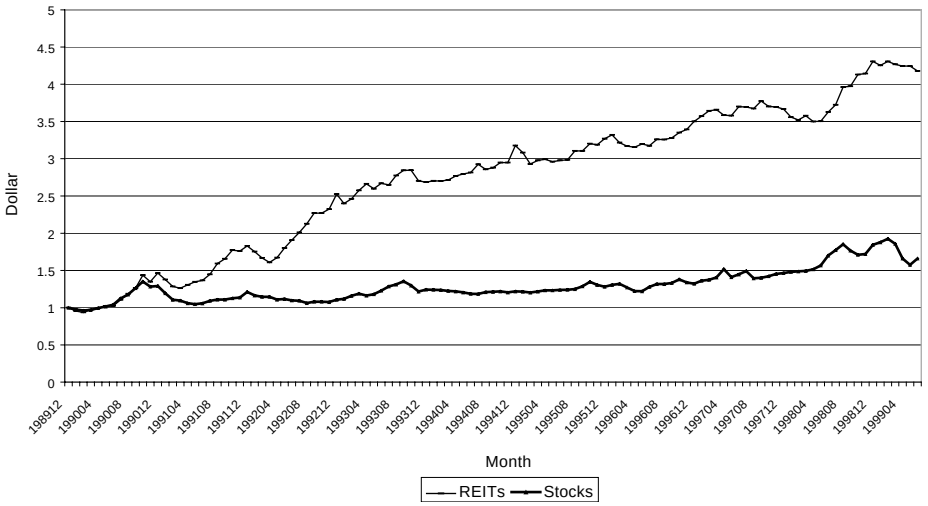

Fig. 3. Cumulative momentum profits, January 1990–June 1999.

about 1 percent per month with a *t-statistics* of 1.97, while the momentum profits for common stock is not significantly different in the two time periods. It should be noted that in the post-1990 period the loser REIT portfolio actually has a negative excess return, while the winner REIT portfolio realizes a very significant positive excess return.[22]

4.2. Momentum in other industries

To investigate whether the increase in momentum profits in the later period is unique to the REIT industry, we examine the changes in momentum profits after 1990 in other industries. Using the methodology discussed above, we form momentum portfolios in each of the eighteen industries. Table 6 reports the average monthly returns on these momentum portfolios in each sample period and the changes in momentum profits after 1990 in each industry. An *F-test* of whether the average momentum profits differ across industries is not rejected, suggesting that there is not reliable variation in the momentum effects across industries. In addition, none of these industries shows significantly larger momentum profits after 1990. An *F-test* of whether all these changes are equal to zero is not rejected. Our finding indicates that the dramatic increase in the momentum profits during the post-1990 period is a unique phenomenon of the REIT industry.

[22] We also look into the excess returns on our momentum portfolios in January, in February to November, and in December. We find that the stronger momentum profits on REITs during the post-1990 period is not driven by the seasonal pattern in momentum profits. We also find that our result is not driven by the lead-lag effect. These findings are not reported here to save space.

Table 5
Momentum profits for REITs versus common stocks. This table reports the average monthly excess returns (in percent) on momentum portfolios. These portfolios are formed using the momentum formation technique of Jegadeesh and Titman (1993). The winner (the top 30 percent) and loser (the bottom 30 percent) portfolios are formed monthly based on the six-month lagged returns and held for six months. These portfolios are value-weighted and the returns are measured one month after the portfolio formation. The one-month *T-bill* rate is used as the risk free rate and the *t-statistics* are in parentheses

		February 1983–June 1999	*Pre-1990: February 1983–December 1989*	*Post-1990: January 1990–June 1999*	*Post-1990 Minus Pre-1990*
REITs	*Winner* (*W*)	0.83 (3.07)	0.54 (1.26)	1.03 (2.99)	0.49 (0.90)
	Loser (*L*)	−0.06 (−0.21)	0.25 (0.63)	−0.29 (−0.63)	−0.54 (−0.84)
	W−L	0.89 (3.43)	0.30 (0.74)	1.33 (3.92)	1.03 (1.97)
Common stocks	*Winner* (*W*)	1.08 (3.24)	0.85 (1.52)	1.24 (3.06)	0.39 (0.57)
	Loser (*L*)	0.58 (1.56)	0.38 (0.68)	0.73 (1.46)	0.35 (0.47)
	W−L	0.49 (2.13)	0.48 (1.45)	0.50 (1.57)	0.02 (0.05)
W_{REITs} *minus* W_{stocks}		−0.25 (−0.88)	−0.31 (−0.76)	−0.21 (−0.52)	0.10 (0.19)
L_{REITs} *minus* L_{stocks}		−0.64 (−2.02)	−0.13 (−0.25)	−1.02 (−2.50)	−0.89 (−1.38)
$(W-L)_{REITs}$ *minus* $(W-L)_{stocks}$		0.40 (1.46)	−0.18 (−0.43)	0.83 (2.31)	1.01 (1.83)

We employ the same technique as Moskowitz and Grinblatt (1999) to form industry-neutral portfolios. An industry-neutral portfolio is a value-weighted portfolio that buys the winners and shorts the losers from each of the eighteen industries. Since these winners and losers are found in the same industry, the returns on the industry-neutral portfolio reflect intra-industry momentum. If we measure the returns on the industry-neutral portfolio immediately after portfolio formation, as in Moskowitz and Grinblatt (1999), we find, as they do, that the industry neutral portfolio produces insignificant momentum profits. However, if we measure returns on the industry-neutral portfolio one month after portfolio formation, as Grundy and Martin (2001) do, we find that the average momentum profits on this portfolio are significant over the whole sample period as well as over the period after 1990, but the profits are not significant in the pre-1990 period. However, in contrast to our results on the REIT sample, the difference between the pre- and post-1990 momentum profits are not significantly different.

In sum, although the overall momentum effect for common stocks is essentially unchanged in these two time periods, the momentum effect for REITs is substantially stronger in the post-1990 period.[23] This finding is unique to the REIT industry and is consistent with Daniel et al. (1998) overconfidence theory that suggests that momentum is stronger when the relevant valuation information is more subjective.

[23] The difference between the momentum profits in the pre-1990 and post-1990 periods is about 1 percent per month with a *t-statistics* of 1.97.

Table 6
Change in momentum profits for common stocks by industry. This table reports the average monthly excess returns (in percent) on momentum portfolios formed in each industry. Common stocks are divided into 18 industries based on their two-digit SIC code. The classification of industries is described in Table 2. Returns on the momentum portfolios are measured one month after the portfolio formation. The formation of the momentum portfolios is described in Table 4. The average number of stocks in each industry every month is reported, along with the minimum number of stocks in each industry at any point in our sample period (inside the parentheses in this column). We also report the Gibbons et al. (1989) *F-statistic* for if the average momentum profits in different sample periods and the changes in momentum profits after 1990 are significantly different from zero, as well as an *F-statistic* that tests whether they are equal across industries. The industry-neutral portfolio is a value-weighted portfolio that buys all the winners and shorts all the losers from these industries. The last two rows of this table show the momentum profits on the industry-neutral portfolios when returns on these portfolios are measured immediately after their formations. The *t-statistics* are in parentheses

			Momentum profits (%)			
Industry	*SIC codes*	*No. of Stocks*	*Whole Period*	*Pre-1990*	*Post-1990*	*Post minus Pre 1990*
Mining	10–14	279	0.720	1.133	0.420	−0.713
		(195)	(1.78)	(2.04)	(0.74)	(−0.87)
Food	20	104	0.295	0.541	0.117	−0.424
		(86)	(1.09)	(1.49)	(0.30)	(−0.77)
Apparel	22–23	85	0.527	0.747	0.366	−0.381
		(68)	(1.58)	(1.53)	(0.81)	(−0.56)
Paper	26	45	−0.136	−0.318	−0.003	0.314
		(38)	(−0.53)	(−1.02)	(−0.01)	(0.61)
Chemical	28	258	0.380	0.176	0.529	0.353
		(145)	(1.15)	(0.51)	(1.03)	(0.53)
Petroleum	29	28	−0.012	0.237	−0.194	−0.431
		(23)	(−0.04)	(0.57)	(−0.49)	(−0.73)
Construction	32	40	0.150	0.775	−0.305	−1.080
		(30)	(0.35)	(1.50)	(−0.48)	(−1.24)
Prim. metals	33	69	0.071	−0.240	0.298	0.538
		(57)	(0.21)	(−0.44)	(0.71)	(0.80)
Fab. metals	34	112	0.359	0.663	0.138	−0.524
		(79)	(1.37)	(1.70)	(0.39)	(−0.99)
Machinery	35	341	0.525	0.366	0.640	0.274
		(243)	(1.52)	(0.92)	(1.23)	(0.39)
Electrical Eq.	36	383	0.496	0.392	0.571	0.180
		(257)	(1.43)	(0.89)	(1.12)	(0.26)
Transport Eq.	37	87	0.623	0.742	0.536	−0.206
		(76)	(2.07)	(1.83)	(1.25)	(−0.34)
Manufacturing	38–39	319	0.832	0.656	0.959	0.303
		(203)	(2.38)	(1.51)	(1.86)	(0.43)
Transportation	40–47	100	0.358	−0.103	0.694	0.797
		(74)	(1.36)	(−0.27)	(1.96)	(1.50)
Utilities	49	203	0.190	0.102	0.254	0.152
		(180)	(1.01)	(0.33)	(1.09)	(0.40)
Retail & Dept. Stores	50–59	510	1.006	0.587	1.311	0.724
		(361)	(3.70)	(1.89)	(3.20)	(1.32)
Financial	60-69	858	0.445	0.519	0.391	−0.128
		(407)	(1.96)	(1.70)	(1.23)	(−0.28)
Other	other	1,051	0.571	0.695	0.480	−0.215
		(809)	(2.02)	(1.63)	(1.27)	(−0.38)
F-statistic (*all* = 0)			1.3285	1.2753	0.9604	0.9134
(*p*-value)			(0.175)	(0.234)	(0.511)	(0.563)

Table 6 (*continued*)

			Momentum profits (%)			
Industry	*SIC codes*	*No. of Stocks*	*Whole Period*	*Pre-1990*	*Post-1990*	*Post minus Pre 1990*
F-statistic (all the same)			1.2000	1.3546	0.9107	0.9632
(*p*-value)			(0.268)	(0.189)	(0.560)	(0.502)
One month skipped			0.368	0.197	0.492	0.295
Industry Neutral (*t-statistic*)			(2.22)	(0.92)	(2.05)	(0.88)
No gap			0.217	0.118	0.290	0.172
Industry Neutral (*t*-statistic)			(1.29)	(0.55)	(1.17)	(0.50)

4.3. Risk-adjusted returns of the momentum strategy

Although several researchers have concluded that momentum profits cannot be explained by traditional risk factors, up to now, no researcher has looked closely at intra-industry momentum. Hence, it is important to examine the extent to which our results could have been generated by risk. Perhaps the returns on the REIT momentum portfolios are higher during the post-1990 period because the portfolios are riskier during this period.

We consider the Fama and French (FF, 1993) three-factor model here.[24] The FF model includes a market factor (*Mkt*), a size factor (*SMB*), and a book-to-market factor (*HML*), which we construct following Fama and French's (1993) procedures. Specifically, all stocks listed on the NYSE/AMEX/Nasdaq are allocated to two size-sorted groups (small and big). A stock is regarded as "small," when its end-of-June market capitalization in year t is below the median market capitalization of all NYSE stocks. Otherwise, the stock is classified as "big." All stocks are independently sorted into three book-to-market groups (bottom 30 percent, medium 40 percent, and top 30 percent) based on the breakpoints determined by the book-to-market ratios of all NYSE stocks at the end of December in year $t-1$.

Six portfolios are formed based on the intersections of the two size-sorted groups and the three book-to-market sorted groups. Value-weighted monthly returns on these portfolios are calculated from July of year t to the following June. *SMB* (small minus big) is the difference between the equally weighted average return on the three small size-sorted portfolios and that on the three big size-sorted portfolios. *HML* (high minus low) is the difference between the equally weighted average return on the two low book-to-market-sorted portfolios and that on the two high book-to-market-sorted portfolios. The market factor is measured as the returns on the value-weighted market index minus the risk-free rate. We measure the risks of a portfolio as the sensitivities to these three factors as indicated in the following regression betas:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i,Mkt} Mkt_t + \beta_{i,SMB} SMB_t + \beta_{i,HML} HML_t + e_{it}, \quad (1)$$

[24] Peterson and Hsieh (1997) suggest that returns on equity and mortgage REITs are significantly related to these three risk factors.

where R_{it} is the return on portfolio i, Mkt_t is the return on the market portfolio minus the risk-free rate, SMB_t is the return on the SMB portfolio, and HML_t is the return on the HML portfolio.

Panel A of Table 7 reports the sensitivities of our portfolios to the FF three factors. Similar to common stocks, the Mkt betas for winner and loser portfolios generated from the REIT sample are virtually equal, and the losers are more sensitive than the winners to the SMB factor. Both the winners and losers generated from the REITs sample are influenced more by the HML factor than are the winners and losers from common stocks, but the difference in HML loadings between winners and losers are about the same for REITs and common stocks. The factor loadings are relatively stable over the two time periods, however, the REIT losers have significantly higher factor loadings in the second subperiod.

The risk-adjusted returns, i.e., the regression intercepts in Eq. (1), are presented in Panel B of Table 7. The results indicate that the risk-adjusted returns on the REIT momentum portfolio are quite similar to the raw returns presented in Table 5. In particular, the risk-adjusted returns in the post-1990 period are almost five times larger than they are in the pre-1990 period.

4.4. Characteristic-adjusted returns of momentum strategies

Evidence presented by Daniel and Titman (1997) and Daniel et al. (2001) suggests that stock characteristics may provide a better benchmark than factor sensitivities for measuring excess returns. To investigate whether our findings are driven by differences in firm characteristics between winners and losers, we compute *Size* and book-to-market (BM) characteristic-adjusted returns, defined as

$$R_{it}^{CH} = R_{it} - R_t^{CH_{i,t-1}}, \tag{2}$$

where R_{it} and $R_t^{CH_{i,t-1}}$ are, respectively, the return on security i and the returns on a *Size-BM* matched portfolio in month t.

These characteristics-matched portfolios are formed using Daniel and Titman's (1997) procedure. At the end of each June, all securities in our samples, including both REITs and common stocks, are sorted into five groups based on their market capitalization at the end of the month. Securities in each *Size*-sorted group are further divided into five BM groups based on their book-to-market ratios. All the breakpoints are determined from NYSE securities only. Value-weighted monthly returns on these twenty-five *Size-BM* sorted portfolios are calculated from the July of year t to the June of the next year. One should notice that, by construction, $R_t^{CH_{i,t-1}}$ is the ex-ante return on security i, which is predicted by its firm characteristics. Therefore, R_{it}^{CH} is the ex-ante characteristics-adjusted return on security i. We use these characteristics-adjusted returns to measure the value-weighted returns on our winner and loser portfolios one month after portfolio formation based on the past six months of returns, but we still use the raw returns to classify the securities into our winner and loser portfolios.

The results from Table 8 indicate that adjusting for firm characteristics does not significantly affect our previous results. Over the entire sample period, the

Table 7
Momentum profits and the Fama-French three factor sensitivities. Excess returns on the relative strength portfolios are regressed on the Fama-French (FF) three factors. These factors are the market factor (*Mkt*), the size factor (*SMB*), and the book-to-market factor (*HML*). The winner (loser) portfolio is the value-weighted portfolio of thirty percent of the common stocks or the REITs with the highest (lowest) six-month returns. These portfolios are held for six months and the returns on these portfolios are measured one month after the portfolio formation. The momentum portfolios are formed from these winner and loser portfolios using the method presented by Jegadeesh and Titman (1993). The FF Alphas and the FF factor sensitivities are, respectively, the intercept and the slope coefficients in the Fama-French three-factor model time-series regressions. The *t-statistics* are in parentheses

Panel A: FF factor sensitivities

	REITs			Common stocks		
	Mkt	*SMB*	*HML*	*Mkt*	*SMB*	*HML*
February 1983–June 1999						
Winner (W)	0.63	0.43	0.57	1.05	−0.03	−0.10
	(12.46)	(5.63)	(5.96)	(53.65)	(−0.91)	(−2.83)
Loser (L)	0.58	0.64	0.77	1.05	0.49	0.12
	(9.08)	(6.62)	(6.39)	(24.95)	(7.75)	(1.55)
W minus L	0.05	−0.21	−0.20	−0.00	−0.52	−0.23
	(0.70)	(−2.04)	(−1.58)	(−0.07)	(−6.08)	(−2.13)
February 1983–December 1989						
Winner (W)	0.61	0.48	0.36	1.04	0.00	−0.12
	(8.62)	(3.56)	(2.26)	(39.21)	(0.02)	(−1.98)
Loser (L)	0.38	0.30	0.48	0.97	0.31	0.12
	(4.54)	(1.91)	(2.59)	(17.01)	(2.91)	(0.95)
W minus L	0.23	0.17	−0.13	0.08	−0.31	−0.24
	(2.50)	(1.00)	(−0.62)	(0.98)	(−2.11)	(−1.37)
January 1990–June 1999						
Winner (W)	0.64	0.41	0.71	1.06	−0.04	−0.09
	(8.87)	(4.40)	(5.94)	(36.40)	(−1.08)	(−1.88)
Loser (L)	0.79	0.79	0.94	1.15	0.58	0.14
	(8.72)	(6.75)	(6.20)	(19.21)	(7.46)	(1.38)
W minus L	−0.15	−0.38	−0.23	−0.10	−0.62	−0.23
	(−1.64)	(−3.17)	(−1.45)	(−1.22)	(−5.91)	(−1.69)

Panel B: FF alphas

	February 1983–June 1999			February 1983–December 1989			January 1990–June 1999		
	REITs (R)	Stocks (S)	R–S	REITs (R)	Stocks (S)	R–S	REITs (R)	Stocks (S)	R–S
Winner	0.16	0.15	0.01	−0.01	0.10	−0.11	0.37	0.18	0.19
(W)	(0.81)	(1.87)	(0.09)	(−0.03)	(0.86)	(−0.34)	(1.43)	(1.72)	(0.66)
Loser	−0.70	−0.30	−0.40	−0.26	−0.36	0.11	−1.06	−0.32	−0.73
(L)	(−2.73)	(−1.75)	(−1.53)	(−0.68)	(−1.42)	(0.26)	(−3.18)	(−1.47)	(−2.14)
W–L	0.86	0.44	0.42	0.25	0.47	−0.21	1.43	0.50	0.93
	(3.15)	(1.95)	(1.48)	(0.60)	(1.33)	(−0.50)	(4.20)	(1.70)	(2.47)

momentum strategies still yield significant profits in both the REIT and common stock samples. However, these profits are smaller than those obtained from the raw returns. The momentum strategies produce significantly higher characteristics-adjusted returns for REITs during the post-1990 period than during the pre-1990

Table 8
Characteristics-adjusted returns for the momentum portfolios The formation of the momentum portfolios is described in Table 4. The lagged returns are always the raw returns. The returns (in percent) in the holding period, however, are adjusted for firm size and book-to-market equity. All firms in our sample, including both *REITs* and common stocks, are allocated into twenty-five portfolios sorted by their firm size and book-to-market equity. These characteristic-based portfolios are formed using the methodology presented by Daniel and Titman (1997). The break points are computed from the stocks listed on the NYSE only. The characteristics-adjusted returns are computed as $R_{it}^{CH} = R_{it} - R_t^{CH_{i,t-1}}$,where R_{it} is the returns on security i and $R_t^{CH_{i,t-1}}$ is the return on the characteristic-matched (i.e., size and BM) portfolio. The characteristic-adjusted returns on the momentum portfolios are measured one month after the portfolio formation. The *t-statistics* are in parentheses

		Winner (W)	Loser (L)	W−L
February 1983 to	REITs	−0.02 (−0.06)	−0.77 (−2.60)	0.75 (2.76)
June 1999	Stocks	0.12 (1.73)	−0.27 (−1.98)	0.39 (2.08)
			Difference =	0.36 (1.31)
February 1983 to	REITs	−0.04 (−0.09)	−0.43 (−0.83)	0.39 (0.86)
June 1989	Stocks	0.05 (0.52)	−0.36 (−1.83)	0.42 (1.47)
			Difference =	−0.03 (−0.07)
January 1990 to	REITs	−0.00 (−0.00)	−1.02 (−2.93)	1.02 (3.01)
June 1999	Stocks	0.17 (1.80)	−0.20 (−1.08)	0.38 (1.48)
			Difference =	0.64 (1.85)

period. Furthermore, in the post-1990 period, the characteristics-adjusted returns are larger for the REIT momentum portfolio than in the common stock momentum portfolio. The difference is significant but smaller than that obtained from the raw returns.[25]

5. Post-holding period returns of the momentum portfolios

The behavioral theories that we discussed earlier suggest that the momentum effects are due to delayed overreaction caused by positive-feedback trading. These theories indicate that we should observe return reversals in the post-holding period. Table 9 and Figs. 4–6 present the post-holding returns on momentum portfolios formed from common stocks and REITs in the different sample periods. Consistent with the previous findings, the average returns of both the REIT and common stock momentum portfolios, one year after portfolio formation, are positive and significant in all the sample periods. Over the entire sample period, the average monthly post-holding returns on all the momentum portfolios are insignificant after month ten and the average monthly cumulative returns on all momentum portfolios exhibit return reversals after month 24. Fig. 4 shows the details on the cumulative

[25] Similar to the results using the raw returns, the momentum effect has a strong seasonal pattern in REITs and common stocks, even when we use characteristics-adjusted returns. This seasonal pattern, however, does not affect our major findings.

Table 9
Post-holding period returns of momentum portfolios. The momentum portfolios are formed based on 6-month lagged returns. The formation procedures of the momentum portfolios are the same as those described in Table 4, except that the holding periods range from one month to 60 months. This table also reports the average monthly momentum returns one year, two years, three years, four years, and five years after portfolio formation. Autocorrelation-consistent estimates of standard errors are used to compute the *t*-statistics (shown in parentheses) for the cumulative returns and average returns by year

	Monthly returns			Cumulative returns		
Month	*REITs* (*R*)	*Stocks* (*S*)	*R minus S*	*REITs* (*R*)	*Stocks* (*S*)	*R minus S*
Panel A: 1983–1999						
1	0.38 (1.09)	0.03 (0.13)	0.35 (0.95)	0.38 (1.09)	0.03 (0.13)	0.35 (0.95)
2	0.68 (1.97)	0.13 (0.51)	0.54 (1.46)	1.06 (1.53)	0.17 (0.34)	0.89 (0.94)
3	0.78 (2.39)	0.38 (1.52)	0.40 (1.19)	1.84 (1.57)	0.55 (0.75)	1.29 (1.04)
4	1.04 (3.26)	0.49 (1.92)	0.55 (1.66)	2.88 (2.04)	1.03 (1.16)	1.85 (1.25)
5	1.09 (3.30)	0.80 (3.06)	0.30 (0.87)	3.98 (2.51)	1.83 (1.65)	2.14 (1.31)
6	1.31 (3.91)	1.01 (3.95)	0.30 (0.88)	5.29 (3.04)	2.84 (2.34)	2.45 (1.44)
7	1.04 (3.03)	0.99 (3.94)	0.06 (0.15)	6.33 (3.19)	3.83 (2.61)	2.50 (1.37)
8	0.94 (2.95)	0.89 (3.64)	0.05 (0.15)	7.27 (3.15)	4.72 (3.00)	2.55 (1.25)
9	0.64 (1.87)	0.52 (2.14)	0.12 (0.32)	7.91 (3.17)	5.24 (3.61)	2.67 (1.19)
10	0.68 (1.99)	0.43 (1.75)	0.25 (0.72)	8.59 (3.22)	5.68 (3.50)	2.92 (1.14)
11	0.48 (1.36)	0.22 (0.84)	0.27 (0.72)	9.08 (3.13)	5.89 (3.48)	3.18 (1.11)
12	0.36 (1.01)	−0.02 (−0.09)	0.39 (1.00)	9.44 (3.37)	5.87 (3.27)	3.57 (1.10)
24	−0.42 (−1.14)	−0.75 (−2.60)	0.33 (0.84)	10.61 (2.59)	4.12 (1.18)	6.49 (1.17)
36	−0.37 (−1.06)	−0.24 (−0.90)	−0.13 (−0.31)	6.19 (2.01)	2.92 (0.81)	3.26 (0.51)
48	0.37 (0.81)	−0.22 (−0.91)	0.59 (1.20)	4.89 (1.06)	2.23 (0.55)	2.66 (0.36)
60	0.03 (0.05)	−0.20 (−0.90)	0.23 (0.39)	3.58 (0.67)	1.53 (0.38)	2.05 (0.25)

Average monthly momentum returns by year

Holding Period	*Months 1–12*	*Months 13–24*	*Months 25–36*	*Months 37–48*	*Months 49–60*	*Months 13–60*
REITs (*R*)	0.79 (3.37)	−0.05 (−0.32)	−0.37 (−2.57)	−0.11 (−0.48)	−0.12 (−0.55)	−0.16 (−1.37)
Stocks (*S*)	0.49 (3.27)	−0.08 (−0.61)	−0.10 (−0.64)	−0.06 (−0.57)	−0.05 (−0.57)	−0.07 (−1.37)
R *minus* S	0.30 (1.13)	0.03 (0.18)	−0.27 (−2.41)	−0.05 (−0.21)	−0.07 (−0.31)	−0.09 (−0.68)
Panel B: 1983–1989						
1	−0.63 (−1.25)	0.41 (1.21)	−1.05 (−1.93)	−0.63 (−1.25)	0.41 (1.21)	−1.05 (−1.93)
2	−0.11 (−0.21)	0.48 (1.31)	−0.59 (−1.05)	−0.75 (−0.93)	0.89 (1.41)	−1.64 (−3.67)
3	0.30 (0.57)	0.39 (1.09)	−0.09 (−0.18)	−0.45 (−0.44)	1.28 (1.56)	−1.73 (−2.71)
4	0.52 (1.13)	0.27 (0.76)	0.24 (0.50)	0.06 (0.06)	1.55 (1.39)	−1.49 (−1.64)
5	0.75 (1.48)	0.45 (1.20)	0.31 (0.62)	0.82 (0.70)	2.00 (1.38)	−1.18 (−1.03)
6	1.07 (2.12)	0.71 (1.86)	0.36 (0.73)	1.88 (1.48)	2.71 (1.67)	−0.82 (−0.66)
7	0.80 (1.51)	0.70 (1.83)	0.11 (0.19)	2.69 (2.03)	3.41 (1.87)	−0.72 (−0.48)
8	0.87 (1.81)	1.00 (2.73)	−0.13 (−0.25)	3.56 (2.19)	4.41 (2.18)	−0.85 (−0.49)
9	0.67 (1.35)	1.01 (2.58)	−0.35 (−0.25)	4.23 (2.69)	5.42 (2.38)	−1.20 (−0.61)
10	0.85 (1.66)	0.99 (2.55)	−0.14 (−0.25)	5.07 (2.34)	6.41 (2.50)	−1.34 (−0.59)
11	0.89 (1.55)	0.68 (1.80)	0.22 (0.85)	5.97 (2.80)	7.08 (2.55)	−1.12 (−0.46)
12	0.71 (1.36)	0.21 (0.55)	0.50 (0.85)	6.67 (2.82)	7.30 (2.47)	−0.62 (−0.24)
24	−0.21 (−0.43)	−0.68 (−1.65)	0.47 (0.87)	6.33 (1.86)	9.01 (2.08)	−2.68 (−0.79)
36	−0.53 (−1.10)	−0.18 (−0.43)	−0.36 (−0.59)	2.67 (0.68)	10.29 (3.52)	−7.61 (−2.05)
48	0.58 (0.96)	−0.59 (−1.63)	1.17 (1.73)	−1.27 (−0.21)	9.92 (2.55)	−11.19 (−1.92)
60	0.88 (1.38)	−0.33 (−1.05)	1.21 (1.61)	−1.17 (−0.17)	7.99 (2.03)	−9.16 (−0.98)

Average monthly cumulative returns by year

Holding Period	*Months 1–12*	*Months 13–24*	*Months 25–36*	*Months 37–48*	*Months 49–60*	*Months 13–60*
REITs (*R*)	0.56 (2.82)	−0.03 (−0.18)	−0.30 (−1.78)	−0.33 (−1.34)	0.01 (0.03)	−0.16 (−0.99)
Stocks (*S*)	0.61 (2.47)	0.14 (1.00)	0.11 (0.65)	−0.03 (−0.22)	−0.16 (−1.34)	0.01 (0.23)
R minus S	−0.05 (−0.24)	−0.17 (−0.98)	−0.41 (−2.66)	−0.30 (−1.00)	0.17 (0.58)	−0.18 (−1.28)

Table 9 (*continued*)

	Monthly returns			Cumulative returns		
Month	*REITs* (*R*)	*Stocks* (*S*)	*R minus S*	*REITs* (*R*)	*Stocks* (*S*)	*R minus S*
Panel C: 1990–1999						
1	1.30 (2.76)	−0.30 (−0.78)	1.60 (3.37)	1.30 (2.76)	−0.30 (−0.78)	1.60 (3.37)
2	1.38 (3.15)	−0.18 (−0.46)	1.56 (3.31)	2.68 (2.46)	−0.48 (−0.66)	3.16 (2.43)
3	1.22 (3.02)	0.38 (1.05)	0.84 (1.88)	3.90 (2.60)	−0.10 (−0.09)	4.00 (2.24)
4	1.51 (3.42)	0.68 (1.90)	0.83 (1.81)	5.41 (2.91)	0.57 (0.41)	4.84 (2.24)
5	1.39 (3.25)	1.11 (3.07)	0.29 (0.60)	6.80 (3.20)	1.68 (1.09)	5.12 (2.10)
6	1.53 (3.40)	1.28 (3.74)	0.25 (0.53)	8.34 (3.47)	2.96 (1.81)	5.37 (2.08)
7	1.26 (2.81)	1.25 (3.78)	0.01 (0.02)	9.59 (3.49)	4.21 (2.48)	5.38 (1.91)
8	1.01 (2.34)	0.79 (2.41)	0.22 (0.50)	10.60 (3.23)	5.00 (2.94)	5.60 (1.76)
9	0.62 (1.28)	0.09 (0.29)	0.53 (1.15)	11.22 (4.60)	5.09 (3.12)	6.13 (1.79)
10	0.53 (1.14)	−0.06 (−0.20)	0.59 (1.40)	11.75 (4.23)	5.02 (3.19)	6.72 (1.72)
11	0.12 (0.27)	−0.20 (−0.57)	0.32 (0.67)	11.86 (3.85)	4.83 (3.01)	7.04 (1.57)
12	0.06 (0.11)	−0.24 (−0.63)	0.29 (0.56)	11.92 (3.40)	4.59 (2.98)	7.33 (1.40)
24	−0.67 (−1.71)	−0.55 (−1.84)	−0.12 (−0.28)	16.74 (3.51)	−2.90 (−0.84)	19.64 (2.15)
36	−0.44 (−1.00)	−0.42 (−1.27)	−0.02 (−0.03)	11.22 (2.39)	−7.63 (−1.33)	18.85 (1.79)
48	0.08 (0.13)	0.26 (1.01)	−0.18 (−0.28)	13.72 (2.17)	−8.80 (−1.49)	22.52 (2.20)
60	−1.22 (−1.53)	−0.01 (−0.04)	−1.21 (−1.39)	10.51 (1.59)	−7.89 (−1.30)	18.39 (1.75)
Average monthly cumulative returns by year						
Holding Period	*Months 1–12*	*Months 13–24*	*Months 25–36*	*Months 37–48*	*Months 49–60*	*Months 13–60*
REITs (*R*)	0.99 (3.40)	−0.07 (−0.30)	−0.46 (−3.53)	0.21 (0.64)	−0.30 (−0.91)	−0.16 (−1.13)
Stocks (*S*)	0.38 (2.98)	−0.40 (−2.30)	−0.39 (−1.90)	−0.10 (−0.93)	0.12 (1.82)	−0.20 (−2.04)
R minus S	0.61 (1.80)	0.33 (1.07)	−0.07 (−0.44)	0.31 (0.97)	−0.42 (−1.17)	0.05 (0.33)

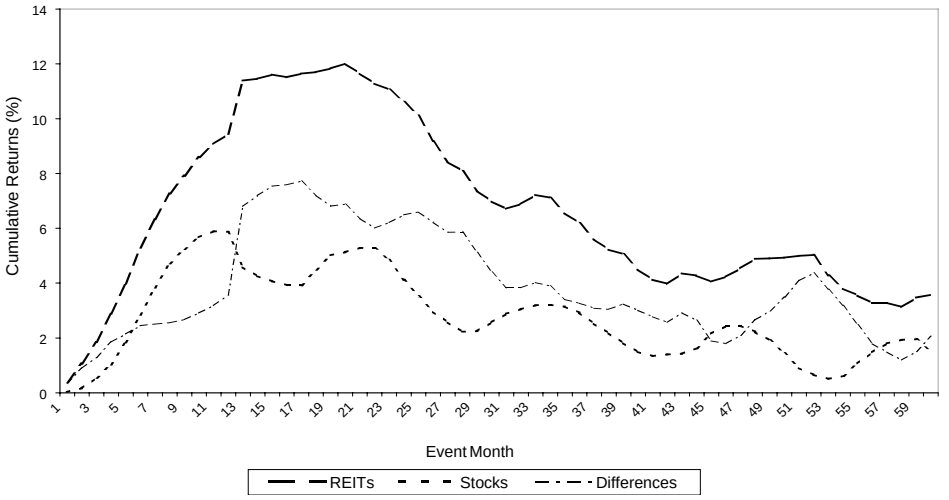

Fig. 4. Cumulative momentum profits, 1983–1999.

returns, which indicate that the cumulative returns on all the momentum portfolios decrease monotonically after month 24. Consistent with our previous findings, the cumulative returns on the REIT momentum portfolios are always larger than those

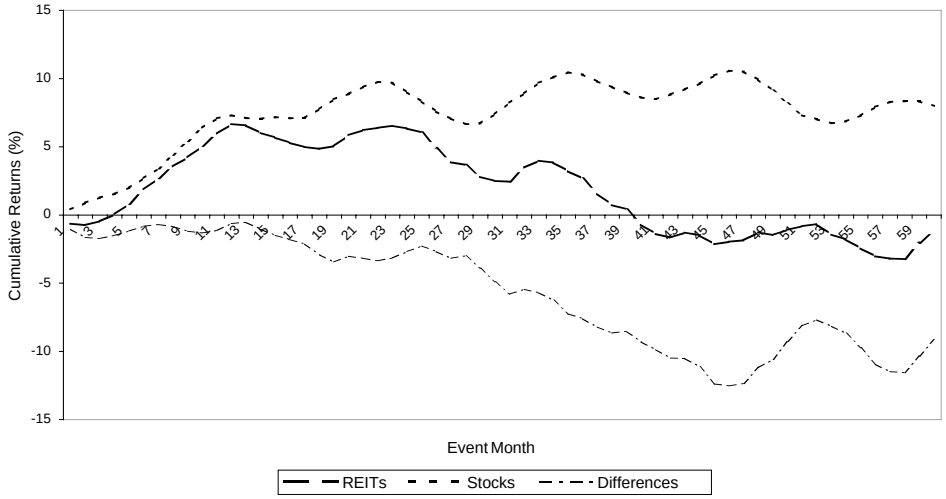

Fig. 5. Cumulative momentum profits, 1983–1990.

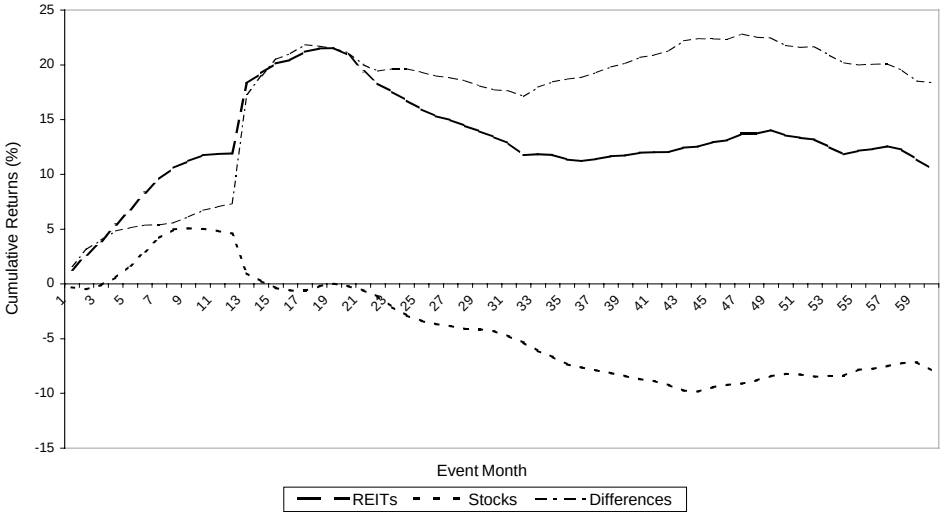

Fig. 6. Cumulative momentum profits, 1990–1999.

on the momentum portfolios formed with common stocks. Starting in month 13, the returns of both the REIT and common stock momentum portfolios are negative on average. Similar findings are also obtained for the post-1990 period (see Panel C of Table 8 and Fig. 6). Consistent with previous findings presented by Jegadeesh and Titman (2001) and Lee and Swaminathan (2000), our results for the REITs and common stocks provide support for the delayed overreaction explanation suggested by Daniel et al. (1998) and Hong and Stein (1999).

6. Conclusions

There are now several papers that have examined the cross-sectional determinants of momentum profits. This paper explores a particular industry, REITs, in detail and examines how the profitability of momentum strategies changes over time. REITs provide a very good industry for examining within-industry momentum for two reasons. First, it is one of the few industries that include sufficient observations to estimate momentum returns. Second, there was a change in the structure of the industry around 1990 that allows us to test some hypotheses about the determinants of momentum profits. Before 1990, it was straightforward to value a REIT. However, due to significant changes in the organization, business plans, and ownership structures after 1990, REITs became much more difficult to value (i.e., Ling and Ryngaert (1997) and our own evidence). We argue that the overconfidence model proposed by Daniel, et al. (1998) suggests that momentum should be greater in the later time period when valuations require investors to make more judgments that can potentially be biased by their overconfidence. However, since there is substantially more information about the REITs in the 1990s (i.e., analyst coverage and newspaper coverage), the diffusion of information model proposed by Hong and Stein (1999) predicts the opposite.

Our empirical results indicate that the momentum strategy generates a profit of 0.89 percent per month from the REIT sample during the 1983–1999 sample period. The magnitude of these returns exceeds the profit of 0.49 percent obtained from common stocks over the same period. The momentum effect for REITs is shown to be relatively small before 1990, but it is quite large after 1990 with a profit of 1.33 percent per month. This increase in momentum profits after 1990 is not found in other industries and is consistent with Daniel et al. (1998) overconfidence model. The post-holding period return-reversal evidence provides further support for this theory.[26]

Since the magnitude of the post-1990 momentum effect is quite large, we performed a number of tests to examine the extent to which it can be explained by risk or other characteristics of REITs. As we show, the momentum returns cannot be explained by factor risks, as measured by the Fama and French (1993) factors, or by firm characteristics such as market capitalizations and book-to-market ratios. In addition, since REITs trade less frequently than common stocks, we would expect that they should exhibit less rather than more momentum, given the evidence in Lee and Swaminathan (2000). These results are somewhat puzzling and may warrant further analysis.

References

Barberis, N., Shleifer, A., Vishny, R., 1998. A model of investor sentiment. Journal of Financial Economics 49, 307–343.

[26] It should be noticed that, however, the Hong and Stein model also predicts a long-run reversal of momentum profits.

Blume, L., Easley, D., O'Hara, M., 1994. Market statistics and technical analysis: the role of volume. Journal of Finance 49, 153–181.

Chan, S.H., Leung, W.K., Wang, K., 1998. Institutional investment in REITS: evidence and implications. Journal of Real Estate Research 16, 357–374.

Daniel, K.D., Titman, S., 1997. Evidence on the characteristics of cross-sectional variance in common stock returns. Journal of Finance 52, 1681–1714.

Daniel, K.D., Titman, S., 1999. Market efficiency in an irrational world. Financial Analysts Journal, November/December, 28–40.

Daniel, K.D., Hirshleifer, D., Subrahmanyam, A., 1998. Investor psychology and security market under- and overreactions. Journal of Finance 53, 1839–1885.

Daniel, K.D., Titman, S., John Wei, K.C., 2001. Explaining the cross-section of stock returns in Japan: factors or characteristics? Journal of Finance 56, 743–766.

Fama, E.F., French, K.R., 1992. The cross-section of expected stock returns. Journal of Finance 47, 427–465.

Fama, E.F., French, K.R., 1993. Common risk factors in the returns on stocks and bonds. Journal of Financial Economics 33, 3–56.

Frank, R.A., 1993. The umbrella partnership REIT: keys to the real estate kingdom? The REIT Report, Winter, 16–18.

Gentry, W.M., Kemsley, D., Mayer, C.J., 2003. Dividend taxes and share prices: evidence from real estate investment trusts. Journal of Finance 58, 261–282.

Gibbons, M., Ross, S., Shanken, J., 1989. A test of the efficiency of a given portfolio. Econometrica 57, 1121–1152.

Grundy, B.D., Martin, J.S., 2001. Understanding the nature of the risks and the source of the rewards to momentum investing. Review of Financial Studies 14, 29–78.

Hong, H., Stein, J.C., 1999. A unified theory of underreaction, momentum trading and overreaction in asset markets. Journal of Finance 54, 2143–2184.

Hong, H., Lim, T., Stein, J.C., 2000. Bad news travels slowly: size, analyst coverage, and the profitability of momentum strategies. Journal of Finance 55, 265–295.

Jegadeesh, N., Titman, S., 1993. Returns to buying winners and selling losers: implications for stock market efficiency. Journal of Finance 48, 65–91.

Jegadeesh, N., Titman, S., 2001. Profitability of momentum strategies: an evaluation of alternative explanations. Journal of Finance 56, 699–720.

Lee, C.M.C., Swaminathan, B., 2000. Price momentum and trading volume. Journal of Finance 55, 2017–2069.

Ling, D.C., Ryngaert, M., 1997. Valuation uncertainty, institutional involvement, and the underpricing of IPOS: the case of REITS. Journal of Financial Economics 43, 433–456.

McMahan, J., 1994, The long view—A perspective on the REIT market, Real Estate Issues, August, 1–4.

Moskowitz, T.J., Grinblatt, M., 1999. Do industries explain momentum? Journal of Finance 54, 1249–1290.

Peterson, J.D., Hsieh, C.-H., 1997. Do common risk factors in the returns on stocks and bonds explain returns on REITS? Real Estate Economics 25, 321–346.

Ross, S., Klein, R., 1994. Real estate investment trusts for the 1990s. Real Estate Finance Journal, Summer, 37–44.