The Relation between Momentum and Drift: Industry-Level Evidence from Equity Real Estate Investment Trusts (REITs)

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1. Abstract

We examine the industry-level relation between the two dominant asset pricing anomalies, the continuation of past price movements (momentum) and the incomplete reaction to earnings news (post-earnings-announcement drift). With the former having long been established in REIT returns, and the latter having only recently been documented, we show that the two returns phenomena are highly related in both the cross-section and time-series of industry-level returns, and the relation is negative. Additionally, the payoff to a REIT drift strategy largely dominates the payoff to a REIT momentum strategy in terms of greater economic magnitude and statistical significance.

2. Introduction

The short term continuation of returns (momentum) is the phenomenon where stocks which have performed well in the recent past tend to continue to perform well, while stocks which have performed poorly in the recent past tend to continue to perform poorly (Jegadeesh and Titman 1993, 2001). The delayed reaction to earnings announcements (post-earnings-announcement drift) describes the occurrence where the returns to stocks with positive unexpected earnings announcements tend to continue to drift up, while the returns to stocks with negative unexpected earnings announcements tend to continue to drift down (Ball and Brown 1968, Foster, Olsen and Shevlin 1984, Bernard and Thomas 1989, 1990). While various other market aberrations have surfaced over time, most have been dismissed as the result of inaccurate modeling or the byproduct of flawed empirical methods (Schwert 2003). In contrast, the returns patterns associated with momentum and the post-earnings-announcement drift (or, simply, the drift) continue "above suspicion" as the two primary anomalies to market efficiency (Fama 1998).

While momentum and drift have long been considered to be two distinct, separate anomalies, they may be closely linked. Sorting stocks on past returns (to form momentum portfolios) and earnings surprises (to form drift portfolios), Chan, Jegadeesh and Lakonishok (1996) show that returns to each trading strategy can be partially predicted by the other. By extension, Chordia and Shivakumar (2006) investigate the interrelatedness of momentum and the systematic component of the drift. That is, using a broad cross-section of typical equities[1], they eliminate firm- and industry-specific information through diversified drift portfolios and find the predictive ability of a momentum trading strategy to be subsumed by the systematic, or macro-level, component of the drift. However, it is not known whether this relation holds when controlling for systematic effects by using a sample of firms within the same industry who are likely to react similarly to changes in macroeconomic variables (Mueller and Pauley 1995).

We extend the work of Chordia and Shivakumar (2006) and examine the relation between momentum and the post-earnings-announcement drift at the industry-level using a sample of equity real estate investment trusts (REITs). Equity REITs are a relatively homogeneous industry group where, in contrast to most industries, membership determination is fairly straightforward (Chui, Titman and Wei 2003a). Furthermore, using a single industry, and REITs in particular, reduces the potentially confounding effects that can arise due to differences in risk, transparency, and growth potential (Hartzell, Kallberg and Liu 2008).[2]

REITs are also unique in that the underlying real estate assets have characteristics that are particularly conducive to momentum and drift. Namely, real estate exhibits strong autocorrelation in both returns (Case and Shiller 1989) and rental growth (An, Deng, Fisher and Hu 2012). Returns autocorrelation creates a favorable environment for momentum. Correspondingly, momentum has received substantial attention in the REIT literature (Graff and Young 1997, Stevenson 2002, Chui, Titman and Wei 2003a, 2003b, Hung and Glascock 2008, Derwall, Huij, Brounen and Marquering 2009, Hung and Glascock 2010, Goebel, Harrison, Mercer and Whitby 2012, among others). Whereas the earnings surprise at the heart of the post-earnings-announcement drift, which is essentially earnings growth, is closely tied to rental growth. For commercial real estate, returns are largely determined by rental growth. However, in contrast to the extensive attention given to REIT momentum, we are only aware of one study of REIT drift (Price, Gatzlaff and Sirmans 2012).[3]

Empirically, the pricing anomalies appear to be more pronounced in REIT returns than in the broad cross-section of typical industrial firms. Chui, Titman and Wei (2003a, 2003b) demonstrate greater momentum profitability with REITs when compared to the same strategy applied to a cross-section of non-REIT equities. Similarly, Price, Gatzlaff and Sirmans (2012) show greater drift profitability with REITs when compared to non-REITs. Additionally, these three studies, along with Hung and Glascock (2008), also find the magnitude of the returns to the respective strategies to increase for REITs following the early 1990s. This represents a departure from the pattern of either constant or decreasing anomaly magnitude in the broad cross-section examined in most studies (Chui, Titman and Wei 2003a, Chordia, Goyal, Sadka, Sadka and Shivakumar 2009, among others). Thus, there are at least three features wherein REITs provide a good forum to investigate the potential link between momentum and the post-earnings-announcement drift, while controlling for systematic effects. First, the relatively homogeneous nature of the industry controls for the potential differential reactions to systematic effects observed in the broad cross-section of industrial firms. Second, real estate returns and rental income growth display strong serial correlation, asset characteristics which are favorable to the manifestation of momentum and drift, respectively. Third, the within-industry presence of the two anomalies appears to be strong and prevalent, having increased over time, which stands in contrast to the apparent decrease for non-REITs.

Utilizing empirical techniques in the spirit of Chan, Jegadeesh, and Lakonishock (hereafter CJL) (1996) and Chordia and Shivakumar (hereafter CS) (2006), we confirm the presence of momentum and drift in REITs and find that the two anomalies are related at the industry-level. Portfolio sorts reveal an average momentum return of 4.68% on an annualized basis and an average drift return of 8.04%, annualized, over the January 1993 to March 2010 period. Two-way portfolio sorting and firm-level cross-sectional regressions show that both anomalies can partially explain the other. However, we find that REIT drift is substantially stronger than REIT momentum in terms of both economic magnitude and statistical significance, even after controlling for the effects of the other. Furthermore, equity REIT momentum is dominated by the post-earnings-announcement drift in time-series regression techniques. This result holds when controlling for the excess returns of individual property sectors. That is, tests reveal an asymmetrically inverse relation where a momentum strategy appears to generate a negative payoff when controlling for drift, while controlling for momentum has only a minimal downward effect on the positive returns to a drift strategy.

Overall, this study makes several contributions to the literature. First, we add to the general understanding of the nature of the two anomalies by controlling for systematic effects. The strong industry-level relation demonstrates that the link between momentum and drift is far more than just the systematic connection suggested by CS (2006). Rather, the industry-level results point future research toward including non-systematic components in search of an explanation for the existence of the two anomalies. Second, we bridge the two separate streams of research dealing with REIT momentum and REIT drift by empirically demonstrating a strong connection between the two. Third, while REIT momentum has received greater attention in the literature than REIT drift, we show REIT drift to be the dominant strategy on both a univariate and risk-adjusted basis. Given the empirical strength and economic magnitude of the drift, when compared to momentum, and the potential that momentum may be rooted in the market's inability to fully impound earnings information, the REIT literature may be able to better understand both anomalies by turning its attention towards the under-studied REIT drift anomaly.

The remainder of the paper proceeds as follows. In the next section, we discuss the relevant literature and develop hypotheses. The third section describes the data. The fourth section presents our analysis and results. The final section concludes.

3. Literature Review and Hypothesis Development

The empirical manifestation of momentum and the post-earnings-announcement drift continue to puzzle researchers within the context of standard asset pricing models and the underlying assumption of market efficiency. If the anomalies were well understood, then associated abnormal returns should be quickly equilibrated away through active trading (Schwert 2003). To some extent, the trends regarding the persistence of these two anomalies are fairly different for non-REIT stocks in general and REITs in particular.

Jegadeesh and Titman (2001) find momentum profitability to be remarkably similar in the 1990-1998 period when compared to the earlier sample of 1965-1989 from Jegadeesh and Titman (1993). Furthermore, numerous studies demonstrate that institutions actively trade on momentum (Sias 2007).[4] However, Chui, Titman and Wei (2003a) document a decline in non-REIT momentum when comparing the returns of the 1980s to the 1990s. Additionally, when disaggregating momentum returns by industry, the momentum effect in REITs is shown to be small and weak in the 1980s and strong and prevalent in the 1990s. It is noteworthy that the authors demonstrate this increase in momentum profitability to be unique to the REIT industry. Hung and Glascock (2008) also find that momentum returns are higher after the industry structural changes of the early 1990s. The increased momentum profitability is curious because the latter period takes place after the phenomenon became known, and we would expect its discovery to contribute to its reduction (Below, Kiely and McIntosh 1996).

Some studies find that the magnitude of the post-earnings-announcement drift has generally declined over time for non-REIT stocks (Campbell, Ramadorai and Schwartz 2009, Chordia, Goyal, Sadka, Sadka and Shivakumar 2009). However, the anomaly remains robust over four decades following its discovery, even though the strategy is actively pursued by institutional traders (Ke and Ramalingegowda 2005, Campbell, Ramadorai and Schwartz 2009). Price, Gatzlaff, and Sirmans (2012) show non-REIT drift to be fairly constant over the 1980s, 1990s, and 2000s. More importantly, they find that REIT drift magnitude increases with each successive decade.[5]

The increased manifestation of momentum and drift in the REIT industry, while non-REIT returns associated with the same anomalies are either holding steady or declining, suggests that there may be a common component to them which is not driven by a differential reaction to systematic effects. This is in contrast to CS (2006). They argue a systematic connection between momentum and drift that is rooted in stocks differential reaction to macroeconomic variables, specifically the inflation illusion. The inflation illusion hypothesis (Modigliani and Cohn 1979, CS 2005) suggests that equity investors fail to fully anticipate the effect of inflation on earnings growth. Consequently, cross-sectional misvaluation results if earnings growth varies across stocks in response to inflation. When earnings growth is positively (negatively) related to inflation, the stock will be undervalued (overvalued). The systematic component of post-earnings-announcement drift, which CS (2006) show subsumes momentum, is then empirically manifested in the correction of the misvaluation over the intermediate horizon (CS 2005, 2006).

Sadka (2006) contends that systematic variations in liquidity provide a link between momentum and the post-earnings-announcement drift. More explicitly, market-wide variations in liquidity are shown to be priced within the context of momentum and drift portfolio returns. Using the unique features of a REIT sample allows us to eliminate the potential differential effects of macro-level variables such as inflation and systematic liquidity since firms within this relatively homogeneous, well defined industry should react fairly similarly to changes in these variables.[6]

This enables us to extend the work of CS (2006) by testing for a link between momentum and drift which is not systematic in nature.

Consequently, this leads to the following primary null hypothesis.

H1: Momentum and drift are not related at the industry-level.

If the null is rejected and the two anomalies are shown to be related, then we are led to examine two competing secondary hypotheses in an effort to better understand the nature of the link.[7] At the industry-level, if momentum returns are due to the intermediate horizon returns attributable to earnings news, then a momentum strategy will not be profitable after controlling for the post-earnings-announcement drift.

H2a: REIT momentum is captured by REIT drift.

Alternately, if drift returns are due to the intermediate horizon returns attributable to momentum, then a post-earnings-announcement drift strategy will not be profitable after controlling for momentum, at the industry-level.

H2b: REIT drift is captured by REIT momentum.

4. Data

Our sample consists of the publicly traded equity REIT universe identified by the National Association of Real Estate Investment Trusts (NAREIT) from January 1993 through March 2010. We utilize the list of equity REITs provided in Feng, Price and Sirmans (2011) for 1993–2009 and add 2010 adjustments using the NAREIT Index constituents list posted on the NAREIT website.[8] By definition, all tax-qualified equity REITs that are publicly traded on one of the three major exchanges (NYSE, AMEX, and NASDAQ) are included as constituents. All data for the equity REITs in this study are from commonly used sources. Monthly returns and firm size data are from CRSP. Quarterly earnings and book value of equity data come from Compustat. Monthly Fama and French (1993) factor data for MKT, SMB, and HML are from Ken French's Data Library.[9] The transaction based returns series for individual property types are from the MIT Center for Real Estate.[10]

Sample descriptive statistics are presented in Exhibit 1, Panel A. Firm size, which is calculated as the number of shares outstanding in a given month multiplied by the monthly share price, is shown in millions. The mean market capitalization of $1.2 billion and median of $464 million reflects a positively skewed firm size distribution. That is, most REITs in the sample are smaller firms, while a handful of companies fall within the large firm category. The 31,806 firm-month observations indicate an average of 154 firms in each of the 207 months in the sample period. Qtr. EPS represents the quarterly earnings per share, which data provides the basis for calculating drift. With a mean and median of 21 cents per share, earnings appear to be normally distributed. Mo. Returns signifies monthly returns, which are used to determine momentum. The sample monthly returns of 1%, on average, also appear to be normally distributed.

5. Analysis and Results

Our empirical analysis employs characteristic portfolio sorts and factor models. Daniel and Titman (1997, 1998) advocate using portfolio sorts to examine the interrelated nature between returns patterns and various characteristics (which, in our case, is another returns pattern). They contend that portfolio sorts enable direct tests of returns patterns because they do not assume the characteristic of interest to be a risk factor which depends on the covariance structure of returns. However, factor models have the advantage of explicitly accounting for returns premiums associated with exposure to a particular aspect of risk (Fama and French 1993, Carhart 1997). Thus, by utilizing both portfolio sorts and factor models we are able to examine the potential industry-level relation between momentum and drift without explicitly assuming either a characteristic story or a risk story.[11]

Our initial analysis involves examining future returns by forming drift and momentum portfolios.[12] We do so by sorting on each firm's past earnings surprise and returns characteristics. Following CJL (1996) and CS (2006), we use a seasonal random walk measure of unexpected earnings (SUE) to capture the drift in future returns, and use past six month returns (MOM) to capture momentum in future returns. The SUE for each firm *i* in month *t* is calculated as:

$$SUE_{i,t} = \frac{E_{i,q} - E_{i,q-4}}{\sigma_{i,t}} \tag{1}$$

where $E_{i,q}$ is the most recent quarterly earnings per share, $E_{i,q-4}$ is earnings per share four quarters ago, and $\sigma_{i,t}$ is the standard deviation of unexpected earnings ($E_{i,q} - E_{i,q-4}$) over the prior eight quarters.[13] For MOM, we compound the monthly returns for each firm *i* over months *t-6* through *t-1* as:

$$MOM_{i,t} = [\prod_{t-6}^{t-1}(1 + r_{i,t})]^{1/6} - 1 \tag{2}$$

where $r_{i,t}$ is the monthly return for firm *i* in a given month *t*.[14] Descriptive statistics for both SUE and MOM are provided in Exhibit 1, Panel B. Like the underlying earnings and returns data used in their calculation, SUE and MOM are fairly normally distributed with means (medians) of 0.03 (0.00) and 0.01 (0.01), respectively. We note that the two variables are not directly comparable due to differences in scale and what they measure. However, we are interested in comparing the returns that accrue to firms that are sorted on these two characteristics.

For both drift and momentum, two separate methods are used to calculate the future post-portfolio-formation returns. The first method follows CS (2006), which employs a rolling technique where each month's return for months *t* through *t+5* is a function of the past six ranking strategies, with only the weights of 1/6 of the securities changing each month, and the rest being carried over from the previous month. We then take the average of the six monthly returns. The second method follows CJL (1996), where we compute buy-and-hold returns for the six-month holding period subsequent to portfolio formation, with no monthly rebalancing, and divide by six.

Using SUE and MOM, we independently sort all equity REITs into equal-weighted quintile portfolios and report average monthly post-portfolio-formation returns in Exhibit 2. The average monthly drift (momentum) is simply the difference between the average monthly return to the high and low SUE (MOM) quintile portfolios. The drift of 0.70% per month (8.40% annualized) using the CS method, and 0.67% per month (8.04% annualized) using the CJL method, is both statistically and economically significant. Momentum returns are not significantly different than zero using the CS method, but are a highly significant 0.39% per month (4.68% annualized) following CJL. These results, in combination with the evidence in other studies (e.g. Chui, Titman and Wei 2003a, 2003b, Price, Gatzlaff and Sirmans 2012), suggest that each strategy is useful in predicting future REIT returns. However, while both anomalies are present on a univariate basis, there is a stronger manifestation of the drift when compared to momentum.

We next consider the two anomalies in a multivariate setting to examine whether they are connected at the industry-level. We utilize two-way portfolio sorts using the post-portfolio-formation returns methods of CS (2006) and CJL (1996) in Exhibit 3. To accomplish this, all equity REITs are independently sorted by SUE and MOM into terciles, creating 9 equally-weighted portfolios. Average monthly portfolio returns, computed following CS, are reported in Exhibit 3, Panel A. The mean monthly portfolio return of 1.50% for the equity REITs which fall within the highest terciles for both SUE and MOM is significantly different than the corresponding return of 0.54% for the portfolio comprised of firms within the lowest terciles of both SUE and MOM. The combined effect of drift and momentum at (1.50 – 0.54 =) 0.96% per month is similar to the individual effects shown in Exhibit 2, although of greater magnitude than each anomaly individually.[15]

When holding the SUE dimension of the sort constant and comparing mean returns differences between the high and low rankings of MOM, we do not find differences that are statistically significant at the 5% level or better. Although the 0.66% portfolio difference in the lowest SUE tercile, with a t-statistic of 1.79, has a p-value of 0.076. Moreover, the portfolio differences decrease monotonically as SUE increases. When we hold MOM constant, we find highly significant differences between portfolios with high and low SUE rankings across all three MOM terciles. Interestingly, while the drift strategy appears to dominate momentum, the future returns to the SUE portfolios decrease monotonically as the level of MOM increases. Mean SUE returns differences decrease by roughly half with each higher MOM tercile, moving from 1.05% for the lowest MOM tercile, to 0.50% for the middle MOM tercile, and 0.30% for the highest MOM tercile.

In Exhibit 3, Panel B, we use the CJL (1996) method to calculate the future returns and find consistent results in the portfolio difference testing. The monthly difference of 0.94% between firms in the highest terciles for both SUE and MOM (1.49%) and the lowest terciles for both SUE and MOM (0.55%) is only slightly lower than we find in Exhibit 3. When holding either SUE or MOM constant, we see the same pattern of monotonic decreases in portfolio returns differences with increases in the ranking of the other dimension. We also see highly significant SUE differences across all three MOM levels, where the magnitudes are nearly identical to those in Panel A. However, unlike Panel A, when holding SUE constant at the lowest level in Panel B, the difference of 0.64% between high and low MOM terciles is highly significant. Overall, the negative relation in Exhibit 3 suggests a link between drift and momentum at the industry-level.

At the firm-level, we use Fama and MacBeth (1973) cross-sectional regressions to determine whether SUE and MOM are priced. Each month, we regress excess buy-and-hold returns on Size, SUE, and MOM. The time series of estimated coefficients reflect their respective prices of risk and the corresponding test statistics. Following CJL (1996), we include firm size as a catch-all variable for other influences on the cross-section of returns. The results are presented in Exhibit 4. When SUE and MOM are included as explanatory variables individually, both are positive and significant, suggesting that higher levels of unexpected earnings and past returns are related to higher returns over the subsequent six-month period. In other words, both drift and momentum are present in the cross-section of equity REIT returns at the firm-level. When SUE and MOM are included in the regressions together, each retains its significance. The magnitude and significance of SUE is virtually unchanged, while the magnitude of the MOM coefficient is reduced by roughly 34% and its significance is slightly reduced as well, although it remains strong. Both SUE and MOM are at least partially priced by market participants in the cross-section of returns.

We next examine the time-series relation between drift and momentum in the spirit of CS (2006). Unlike CS (2006), which examines the systematic portions of drift and momentum, using an equity REIT sample allows us to isolate the industry-level components of the two strategies. The time-series tests are implemented by establishing the presence of one anomaly on a risk adjusted basis using Fama and French (1993) three-factor model alphas, and then extending the model to include a factor which controls for the effects of the other anomaly. To capture the effects of momentum, we create a long-short investment portfolio using the difference between returns to equity REITs in the highest and lowest MOM quintiles. We refer to the long-short portfolio returns factor as WML, to signify winners minus losers.[16] For drift, we create similar long-short portfolio returns by taking the difference between returns to equity REITs in the highest and lowest SUE quintiles. We call this factor PMN to denote positive minus negative. The base case and augmented three-factor model specifications estimated over the entire sample period are as follows:

$$RET_{p,t} = \alpha_p + \beta_{1,p} MKT_t + \beta_{2,p} SMB_t + \beta_{3,p} HML_t + \varepsilon_{p,t} \tag{3}$$

$$RET_{p,t} = \alpha_p + \beta_{1,p} MKT_t + \beta_{2,p} SMB_t + \beta_{3,p} HML_t + \beta_{4,p} FACTOR_t + \varepsilon_{p,t} \tag{4}$$

where $RET_{p,t}$ is the excess return for portfolio *p* in month *t*, MKT_t is the excess market return in month *t*, SMB_t and HML_t are the Fama and French (1993) size and book-to-market factors in month *t*, respectively, and $FACTOR_t$ represents the augmentation using either WML or PMN in month *t*.

Exhibit 5, Panel A, presents the results of regressing excess SUE portfolio returns on the Fama and French (1993) three-factor model using the SUE quintile portfolios from Exhibit 2, where post-portfolio-formation returns are computed after the manner of CS (2006) in columns 1 through 5. The intercept coefficients, which represent risk adjusted alphas, increase monotonically from the low SUE portfolio to the high SUE portfolio, indicating the presence of the post-earnings-announcement drift on a risk adjusted basis. A high (0.60%) minus low (-0.21%) zero-investment portfolio produces a return of (0.60 - -0.21 =) 0.81% per month. We check this result with a long-short portfolio returns regression, where we long the firms in the highest SUE quintile and short the firms in the lowest SUE quintile, and report the time-series results in column 6. We also repeat the long-short portfolio analysis using buy-and-hold returns in column 7. In each case, the presence of risk adjusted drift is confirmed.

In Panel B, we extend the three-factor model to include WML and check to see if the momentum factor causes the risk adjusted drift to disappear. The significant loadings on the WML factor in columns 1 through 5 show momentum's negative relation with excess returns within each of the SUE portfolios. However, in isolation the significant WML loadings do not directly speak to an effect on drift because drift is a long-short anomaly which can only be observed across columns 1 through 5. In examining the intercept coefficients, we find that the alphas continue to increase as we move from low (0.07%) to high (0.73%) SUE portfolios after including WML, and that the ordering is monotonic. Moreover, a zero-investment portfolio still produces a robust (0.73 – 0.07 =) 0.66% monthly return, which is confirmed with positive and significant alphas in columns 6 and 7. While accounting for momentum does provide partial explanatory power for the drift, as evident by the slight reduction in alphas in columns 6 and 7 from Panel A to Panel B, the reduction to drift payoffs is only modest.

The results of regressing excess MOM portfolio returns on the Fama and French (1993) three-factor model are shown in Panel C. Like the SUE regressions, the MOM quintile portfolios' post-portfolio-formation returns shown in columns 1 through 5 are calculated following CS (2006). The monotonic increase in the alphas across the quintile portfolios suggests the presence of momentum on a risk adjusted basis. The zero-investment momentum return to a strategy long the high (0.63%) MOM portfolio and short the low (0.05%) MOM portfolio yields a monthly return of (0.63 – 0.05 =) 0.58%. The significance of momentum at the 10% level is confirmed in columns 6 and 7 with two-tailed t-statistics of 1.74 (p-value of 0.084) and 1.95 (p-value of 0.053), respectively. However, given that the presence of positive returns to a momentum trading strategy is a one-tailed hypothesis, the corresponding p-values are, in effect, 0.042 and 0.027.

In Panel D, we check to see if the drift factor causes risk adjusted momentum to disappear. Once PMN is included in columns 1 through 5, the monotonic ordering of the alphas disappears. The statistical significance of each intercept in columns 1 through 5 does not indicate the presence of momentum within each individual portfolio because, in isolation, the dependent variables in these regressions assume a long strategy only; whereas the momentum anomaly is a long-short phenomenon. To the contrary, the significant positive alphas in the lower MOM portfolios suggest the weakness of momentum and the dominance of the drift. The intercepts of the high (0.86%) and low (0.86%) MOM portfolios are identical, leading to zero-investment momentum returns that are nonexistent at (0.86 – 0.86 =) 0.00% per month. This is confirmed in the long-short regressions in columns 6 and 7 where the alphas are not significantly different from zero.[17] Thus, the drift factor largely captures the influence of past returns on future returns at the industry-level in time-series tests. This is particularly noteworthy given that Fama and French (1996) demonstrate that the three-factor model alone is unable to explain momentum. Moreover, Carhart (1997) shows that market-wide momentum, which they also denote as WML, is a priced risk factor in the context of the standard three-factor model. Our finding that an industry-level drift factor captures industry-level momentum on a risk adjusted basis suggests that the two anomalies are not only related, but that the empirically observed effect of past returns on future returns may only be a manifestation of the market's inability to fully impound unexpected earnings into stock prices.[18]

To further ensure industry-level sample homogeneity, we repeat the time-series regressions from equations (3) and (4) and add controls for specific property sectors. We include excess returns to each of the four major asset types (Apartment, Industrial, Office, Retail) as explanatory variables to account for any potential differences (e.g. liquidity or leverage) between REITs that fill their portfolios with high concentrations in one particular asset type.[19] Like with the analysis in Exhibit 5, the focus here is on the alphas and whether the inclusion of a factor that proxies for one anomaly can cause the long-short profitability to the other anomaly to disappear; only with the addition of asset type specific controls for robustness. The results are shown in Exhibit 6 where we see that drift (Panel A) and momentum (Panel C) are still present with monotonically increasing alphas across the quintile portfolios after controlling for property types.[20] In Panel B, we find that positive and significant excess returns to a drift strategy still hold once WML is included. However, in Panel D the momentum strategy actually produces negative returns once PMN is incorporated, although not in a statistically significant way.

6. Conclusion

Various anomalies to market efficiency tend to surface over time. However, Fama (1998) demonstrates that two anomalies remain remarkably robust to improvements in empirical techniques, changes in sample periods, and myriad attempts to explain them. This study examines the link between these two primary anomalies, the short term continuation of returns (momentum) and the incomplete reaction to unexpected earnings announcements (post-earnings-announcement drift), at the industry-level.

The manifestation of momentum in REIT returns is well established and has been shown to have increased in the most recent two decades when compared to prior decades (e.g. Chui, Titman and Wei 2003a, 2003b, Hung and Glascock 2008). More recently, Price, Gatzlaff and Sirmans (2012) document drift in REIT returns and show that it too has increased in recent decades. This unique aspect of equity REITs provides an excellent forum in which to further investigate a potential industry-level link between momentum and drift.

Prior work in this area has been systematic in nature. Chan, Jegadeesh and Lakonishock (1996) find a link between momentum and drift in the broader markets. This work is extended by Chordia and Shivakumar (2005, 2006) and Sadka (2006) who collectively contend that any such link is likely attributable to the differential effects of macroeconomic variables, such as inflation or systematic liquidity, on the broad cross-section of firms. The REIT sample allows us to determine whether a link exists after controlling for systematic effects. REITs allow us to substantially reduce the potential differential effects of macro-level variables since firms within this comparatively homogeneous, well defined industry, should react fairly similarly to changes in these variables. Moreover, we are able to readily control for asset type focus to further reduce potential differences across property sectors.

We find a link between momentum and drift which is not systematic in nature. We empirically show that the two anomalies are negatively related, where the returns attributable to one tend to increase as the level of the other decreases. In general, we demonstrate that the market's incomplete reaction to REIT earnings information has a more pronounced effect on future returns than the information contained in past REIT returns. Moreover, time-series analysis reveals that the post-earnings-announcement drift strategy dominates the payoffs to a momentum strategy at the industry-level on a risk adjusted basis. Taken together, our results provide evidence that a connection between the two primary anomalies to market efficiency is not merely a manifestation of markedly different reactions to systematic effects by a broad cross-section of firms.

7. Endnotes

[1] REITs are specifically excluded from the samples of Chan, Jegadeesh and Lakonishock (1996) and Chordia and Shivakumar (2006).

[2] To further add to the industry-specific nature of the analysis and increase the homogeneity of the REIT sample, we also control for property type in robustness tests since firms within the REIT industry have become more focused on single property types over time (Chiang 2010).

[3] Price, Gatzlaff and Sirmans (2012) focus exclusively on documenting the existence of the post-earnings-announcement drift in REITs. Their analysis does not consider REIT momentum in itself, nor does it examine any potential connections between the two anomalies.

[4] Without accounting for differences in empirical methods, the empirical results of past studies regarding institutional momentum trading initially appear mixed. Several papers find evidence of institutional momentum trading. Others find weak evidence of momentum trading. And others do not find evidence of momentum trading (See Sias 2007 for a complete listing). Sias (2007) reconciles the methodological differences across studies and finds their results to be remarkably uniform in providing strong evidence that aggregate institutional demand is positively related to lagged returns.

[5] Although interesting, the precise cause(s) of increased momentum and drift in the modern REIT era when compared earlier times is beyond the scope, and not critical to the development, of our study. What is important is that prior studies document the prevailing strength of each anomaly in the REIT setting.

[6] The relation between REITs and inflation has received substantial attention in the literature. Most studies (see Simpson, Ramchander and Webb (2007) for an extensive listing) find either a negative or insignificant relation, although Glascock, Lu and So (2002) suggest that the relation is merely a manifestation of the effects of monetary policies. With respect to monetary policy, Anderson, Boney and Guirguis (2012) find a uniformly negative short run relation between unexpected monetary shocks and REIT index returns across seven specialized areas (e.g. Residential, Health, Retail, Industrial, etc.). Chou and Chen (2013) find that REITs react differently to monetary policy than the general stock market. Yunus (2012) finds securitized real estate returns react to shocks to various macroeconomic variables in the same direction across countries and Chatrath, Christie-David and Ramchander (2012) show the relation between REIT returns and macroeconomic news to be distinct from the relation between

returns and firm-specific news. Nonetheless, the direction of these relations is not important for our purposes. What matters is that the industry reacts relatively uniformly to macroeconomic variables, as these studies imply.

[7] Secondary hypotheses are not stated in standard null form.

[8] http://www.reit.com

[9] http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[10] http://web.mit.edu/cre/research/credl/tbi.html

[11] Much of the extant REIT momentum literature relies on factor models. Goebel, Harrison, Mercer and Whitby (2012) provide a good discussion of the relative merits and criticisms of factor models and portfolio sorts, but rely exclusively on the latter in their analysis of REIT momentum. Price, Gatzlaff and Sirmans (2012) incorporate factor models and portfolio sorts in their examination of REIT drift.

[12] We primarily rely on quintile (for univariate sorts) and tercile (for two-dimensional sorts) portfolios throughout the analysis due to the relatively small number of equity REITs at any given point in time. We check our results using decile (for univariate sorts) and quintile (for two-dimensional sorts) portfolios and the results are qualitatively similar.

[13] Consequently, the remaining analysis utilizes portfolio returns from January 1995 through March 2010.

[14] Following CJL (1996) and CS (2006) we compound past returns from month *t-6* through month *t-1*. Our results are robust to using *t-7* through *t-2* as well.

[15] The returns difference magnitudes for the tercile sorts are going to naturally be more muted than the differences shown in Panels C and D, of 1.44% and 1.66%, respectively. As such, the differences in Panels A and B are not directly comparable with the differences reported in Exhibit 2. Whereas the magnitude of the differences shown in Panels C and D are much more comparable with those in Exhibit 2 (subject to observation count concerns as noted above).

[16] This is the same notation as in the Carhart (1997) four-factor model. However, while the Carhart WML factor is a broad measure which incorporates nearly all publicly traded firms, our WML factor is REIT-specific.

[17] This result holds in one-tailed tests as well.

[18] This is consistent with Capozza and Israelsen (2007) who find that REIT momentum varies with firm characteristics like leverage, size and focus in a manner which suggests much of the variation may depend on the information environment rather than just price history.

[19] In unreported results, we examine SUE and MOM across the characteristics of liquidity and leverage and find significant cross sectional differences. This suggests that a firm-level characteristics or asset type comparison study may be an interesting area of further inquiry. However, for the present study we include property types as control measures to reduce potential cross-sectional dispersion and see if our results hold.

[20] The two-tailed t-stat for the alpha in Panel C, column 7, of 1.72 has a corresponding p-value of 0.0863. The p-value for a one-tailed test is 0.0432.

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Exhibit 1

Descriptive Statistics.

Panel A	Mean	Min	P25	P50	P75	Max	Std.Dev.	N
Size	1,192.559	0.497	167.525	463.862	1,278.831	29,145.594	2,168.838	31,806
Qtr. EPS	0.212	-21.370	0.060	0.210	0.350	43.590	0.906	30,326
Mo. Returns	0.013	-0.826	-0.027	0.011	0.051	4.600	0.102	32,524
Panel B								
SUE	0.030	-19.956	-0.538	0.000	0.597	17.997	2.106	24,763
MOM	0.012	-0.371	-0.003	0.013	0.028	0.674	0.040	30,777

Notes: This exhibit provides descriptive statistics (mean, minimum, 25th percentile, median, 75th percentile, standard deviation, and number of monthly observations with sufficient data). Size represents firm market capitalization, in millions, calculated as the share price multiplied by the number of shares outstanding. Qtr. EPS represents the quarterly earnings per share, computed as quarterly net income divided by the number of shares outstanding at the end of the quarter. Mo. Returns is the monthly returns, in decimal format. SUE denotes standardized unexpected earnings, calculated as the four quarter lagged difference in the most recent earnings per share scaled by the standard deviation of unexpected earnings over the past eight quarters. MOM is a firm's compound return over the prior six months, in decimal format.

Exhibit 2

Monthly portfolio returns, following CS (2006) and CJL (1996), by SUE and MOM quintiles.

SUE Quintiles	Monthly Portfolio Return, CS	Monthly Portfolio Return, CJL	MOM Quintiles	Monthly Portfolio Return, CS	Monthly Portfolio Return, CJL
1 (Low)	0.85%	0.80%	1 (Low)	1.01%	1.01%
2	0.96%	0.95%	2	1.10%	1.07%
3	1.25%	1.24%	3	1.14%	1.11%
4	1.43%	1.39%	4	1.24%	1.24%
5 (High)	1.55%	1.47%	5 (High)	1.43%	1.40%
[5 – 1]	0.70%	0.67%		0.42%	0.39%
t-statistic	(4.15)*	(9.80)*		(1.19)	(2.19)*

Notes: This exhibit shows average monthly portfolio returns when firms are sorted into quintile portfolios by SUE and MOM. SUE represents standardized unexpected earnings, calculated as the four quarter lagged difference in the most recent earnings per share scaled by the standard deviation of unexpected earnings over the past eight quarters. MOM represents momentum, computed as a firm's compound return over the past six-months. In each month, t, portfolios are formed based on their SUE and MOM ranking in month t-1. Average monthly portfolio returns are then computed separately using two different methods, following CS (2006) and CJL (1996). With CS, each month's return is a combination of the past six ranking strategies, with 1/6 of the securities changing each month, and the rest being carried over from the previous month. CJL portfolio returns follow a simple buy-and-hold strategy where portfolios are held for the following six months, with no monthly re-balancing. For the SUE quintiles there are roughly 135 firms in each portfolio each month, for the MOM quintiles there are approximately 168 firm-month observations in each portfolio, on average. t-statistics are in parentheses. * denotes statistical significance with a p-value less than 5%.

Exhibit 3

Two-way monthly portfolio returns, following CS (2006) and CJL (1996), by SUE and MOM.

Panel A: Mean Returns using CS for 9 Portfolios

SUE Ranking	MOM Ranking 1	2	3	[3 – 1]	t-statistic
1	0.54%	0.89%	1.20%	0.66%	(1.79)
2	1.19%	1.20%	1.30%	0.11%	(0.34)
3	1.59%	1.39%	1.50%	-0.09%	(-0.29)
[3 – 1]	1.05%	0.50%	0.30%		
t-statistic	(4.02)*	(5.29)*	(2.14)*		
[3,3 – 1,1]	0.96%				
t-statistic	(2.46)*				

Panel B: Mean Returns using CJL for 9 Portfolios

SUE Ranking	MOM Ranking 1	2	3	[3 – 1]	t-statistic
1	0.55%	0.88%	1.19%	0.64%	(3.82)*
2	1.20%	1.19%	1.28%	0.08%	(0.54)
3	1.54%	1.36%	1.49%	-0.05%	(-0.39)
[3 – 1]	0.99%	0.48%	0.30%		
t-statistic	(8.68)*	(7.07)*	(3.45)*		
[3,3 – 1,1]	0.94%				
t-statistic	(6.15)*				

Exhibit 3 continued

Panel C: Mean Returns using CS for 25 Portfolios							
	MOM Ranking						
SUE Ranking	1	2	3	4	5	[5 – 1]	t-statistic
1	0.23%	0.79%	1.12%	1.03%	1.56%	1.33%	(2.29)*
2	0.82%	0.86%	1.01%	1.01%	0.89%	0.07%	(0.27)
3	1.06%	1.11%	1.15%	1.43%	1.78%	0.72%	(1.24)
4	1.61%	1.36%	1.36%	1.71%	1.36%	-0.25%	(-0.40)
5	2.08%	1.87%	1.25%	1.44%	1.67%	-0.41%	(-0.84)
[5 – 1]	1.85%	1.08%	0.13%	0.41%	0.11%		
t-statistic	(3.98)*	(1.07)	(3.24)*	(3.26)*	(0.81)		
[5,5 – 1,1]	1.44%						
t-statistic	(3.26)*						

Panel D: Mean Returns using CJL for 25 Portfolios							
	MOM Ranking						
SUE Ranking	1	2	3	4	5	[5 – 1]	t-statistic
1	-0.14%	0.45%	0.68%	0.88%	1.07%	1.21%	(4.59)*
2	0.58%	0.66%	0.83%	0.80%	0.71%	0.13%	(0.66)
3	0.75%	0.90%	0.97%	1.26%	1.35%	0.60%	(2.61)*
4	1.10%	1.17%	1.14%	1.31%	1.27%	0.17%	(0.65)
5	1.68%	1.31%	1.11%	1.32%	1.46%	-0.22%	(-0.76)
[5 – 1]	1.82%	0.86%	0.43%	0.44%	0.39%		
t-statistic	(7.96)*	(4.68)*	(3.73)*	(4.02)*	(2.37)*		
[5,5 – 1,1]	1.60%						
t-statistic	(6.72)*						

Notes: This table provides average monthly portfolio returns using two-way, independent tercile sorts (Panels A and B) and quintile sorts (Panels C and D) on SUE and MOM. SUE represents standardized unexpected earnings, calculated as the four quarter lagged difference in the most recent earnings per share scaled by the standard deviation of unexpected earnings over the past eight quarters. MOM represents momentum, computed as a firm's compound return over the past six-months. The 3 x 3 (5 x 5) sorting produces 9 (25) equally-weighted portfolios where each of the portfolios contains roughly 15 (5) returns observations for each month of the sample period, on average. Average monthly portfolio returns are computed following the rebalancing strategy of CS (2006) in Panels A and C, where each month's return is a combination of the past six ranking strategies, with 1/6th of the securities changing each month, and the rest being carried over from the previous month. Average monthly portfolio returns following the buy-and-hold strategy of CJL (1996) are shown in Panels B and D. t-statistics for the mean differences between portfolios are in parentheses. * denotes statistical significance with a p-value less than 5%.

Exhibit 4

Cross-sectional regressions of returns on SUE and MOM.

	Returns	t-statistic	Returns	t-statistic	Returns	t-statistic
Intercept	0.0134	(45.70)*	0.0128	(46.77)*	0.0132	(44.20)*
Size	-1.0914	(-9.66)*	-1.0990	(-10.21)*	-1.1000	(-9.72)*
SUE	0.0008	(6.65)*			0.0008	(6.50)*
MOM			0.0235	(3.92)*	0.0156	(2.34)*

Notes: Fama and MacBeth (1973) cross-sectional regressions are estimated each month from January 1995 to March 2010. On average, there are 135 firm observations in each of the 183 months of the sample period. Equity REIT firm-level returns are regressed on size, SUE, and MOM. Returns are calculated as six-month buy-and-hold returns following the strategy of CJL (1996). Size represents firm market capitalization, calculated as the share price multiplied by the number of shares outstanding, in thousands. SUE denotes standardized unexpected earnings, calculated as the four quarter lagged difference in the most recent earnings per share scaled by the standard deviation of unexpected earnings over the past eight quarters. MOM is a firm's compound return over the prior six months. t-statistics are in parentheses. * indicates statistical significance with a p-value less than 5%.

Exhibit 5

Time-series regressions of excess portfolio returns on the Fama and French (1993) three-factor model, with PMN and WML.

	1 (Low)	2	3	4	5 (High)	[5 – 1] CS	[5 – 1] CJL
Panel A: SUE portfolios – three-factor model							
Intercept	-0.21	0.05	0.34	0.54	0.60	0.81	0.66
	(-0.66)	(0.17)	(1.25)	(2.12)*	(2.43)*	(4.87)*	(9.55)*
MKT	0.87	0.80	0.80	0.79	0.75	-0.12	-0.01
	(12.15)*	(12.40)*	(13.47)*	(14.22)*	(13.90)*	(-3.22)*	(-0.87)
SMB	0.64	0.56	0.55	0.53	0.52	-0.12	0.03
	(6.98)*	(6.67)*	(7.01)*	(7.27)*	(7.48)*	(-2.59)*	(0.12)
HML	1.09	0.98	0.98	0.94	0.95	-0.14	0.02
	(11.05)*	(10.98)*	(11.82)*	(12.16)*	(12.70)*	(-2.83)*	(0.28)
Adj-R^2	0.5841	0.5860	0.6223	0.6432	0.6439	0.0905	0.0029
Panel B: SUE portfolios – three-factor model and WML							
Intercept	0.07	0.35	0.54	0.71	0.73	0.66	0.61
	(0.23)	(1.38)	(2.11)*	(2.90)*	(3.04)*	(4.33)*	(9.36)*
MKT	0.72	0.63	0.70	0.70	0.68	-0.04	-0.01
	(10.35)*	(11.13)*	(11.96)*	(12.70)*	(12.19)*	(-1.11)	(-0.94)
SMB	0.62	0.54	0.53	0.51	0.51	-0.11	0.02
	(7.32)*	(7.58)*	(7.36)*	(7.52)*	(7.53)*	(-2.53)*	(1.23)
HML	0.95	0.83	0.89	0.86	0.88	-0.08	0.01
	(10.29)*	(10.91)*	(11.31)*	(11.58)*	(11.87)*	(-1.51)	(0.52)
WML	-0.37	-0.45	-0.30	-0.25	-0.18	0.20	0.13
	(-6.09)*	(-8.77)*	(-5.72)*	(-4.97)*	(-3.58)*	(6.33)*	(5.47)*
Adj-R^2	0.6536	0.7073	0.6781	0.6841	0.6659	0.2525	0.1379

Exhibit 5 continued

	1 (Low)	2	3	4	5 (High)	[5 – 1] CS	[5 – 1] CJL
Panel C: MOM portfolios – three-factor model							
Intercept	0.05	0.20	0.32	0.45	0.63	0.58	0.36
	(0.13)	(0.64)	(1.32)	(2.00)*	(2.61)*	(1.74)	(1.95)
MKT	1.00	0.84	0.72	0.66	0.67	-0.33	-0.00
	(12.34)*	(12.41)*	(13.39)*	(13.32)*	(12.57)*	(-4.42)*	(-0.07)
SMB	0.59	0.56	0.50	0.50	0.56	-0.03	0.06
	(5.46)*	(6.19)*	(6.94)*	(7.54)*	(7.81)*	(-0.34)	(1.07)
HML	1.11	1.02	0.90	0.83	0.81	-0.30	0.09
	(9.73)*	(10.71)*	(11.84)*	(11.89)*	(10.76)*	(-2.88)*	(1.52)
Adj-R^2	0.5359	0.5571	0.6018	0.6062	0.5828	0.0946	-0.0014
Panel D: MOM portfolios – three-factor model and PMN							
Intercept	0.86	0.90	0.74	0.75	0.86	0.01	-0.31
	(2.39)*	(2.94)*	(2.86)*	(3.03)*	(3.25)*	(0.02)	(-1.38)
MKT	0.92	0.76	0.67	0.63	0.63	-0.29	0.01
	(12.09)*	(11.72)*	(12.18)*	(11.96)*	(11.22)*	(-3.89)*	(0.35)
SMB	0.47	0.46	0.45	0.47	0.51	0.04	0.03
	(4.80)*	(5.57)*	(6.34)*	(6.96)*	(7.05)*	(0.45)	(0.59)
HML	1.01	0.94	0.85	0.80	0.78	-0.23	0.07
	(9.72)*	(10.51)*	(11.28)*	(11.13)*	(10.12)*	(-2.28)*	(1.28)
PMN	-1.22	-1.00	-0.62	-0.43	-0.30	0.92	1.09
	(-8.09)*	(-7.73)*	(-5.64)*	(-4.14)*	(-2.67)*	(6.33)*	(5.47)*
Adj-R^2	0.6748	0.6753	0.6644	0.6435	0.6066	0.2870	0.1353

Notes: This table reports the results of time-series regressions over 183 months (January 1995 through March 2010) of excess portfolio returns on the Fama and French (1993) three-factor model, and on a four-factor model that also includes either WML or PMN as an additional factor. Monthly portfolio returns are computed following CS (2006) in columns 1 through 6, and CJL (1996) in column 7. With CS, each month's return is a combination of the past six ranking strategies, with 1/6 of the securities changing each month, and the rest being carried over from the previous month. CJL portfolio returns follow a simple buy-and-hold strategy where portfolios are held for the following six months, with no monthly re-balancing. WML, denoting past returns winners minus losers, is defined as the returns difference to firms within the highest and lowest momentum quintiles. PMN, denoting positive minus negative most recent earnings surprises, is calculated as the returns difference to firms within the highest and lowest SUE quintiles. SUE denotes standardized unexpected earnings, calculated as the four quarter lagged difference in the most recent earnings per share scaled by the standard deviation of unexpected earnings over the past eight quarters. In panels A and B, the portfolios are sorted into quintiles by the most recent SUE. In panels C and D, the portfolios are sorted into quintiles based on past six-month returns (MOM). t-statistics are in parentheses. * indicates statistical significance with a p-value less than 5%.

Exhibit 6

Time-series regressions of excess portfolio returns on the Fama and French (1993) three-factor model and property sector controls, with PMN and WML.

	1 (Low)	2	3	4	5 (High)	[5 – 1] CS	[5 – 1] CJL
Panel A: SUE portfolios – sector augmented three-factor model							
Intercept	-0.12	0.17	0.41	0.61	0.65	0.77	0.64
	(-0.31)	(0.53)	(1.40)	(2.22)*	(2.46)*	(4.39)*	(9.02)*
MKT	0.88	0.80	0.80	0.80	0.74	-0.14	-0.02
	(13.20)*	(12.08)*	(13.07)*	(13.90)*	(13.35)*	(-3.80)*	(-1.14)
SMB	0.64	0.55	0.54	0.52	0.50	-0.13	0.04
	(7.23)*	(6.41)*	(6.71)*	(6.99)*	(7.11)*	(-2.85)*	(1.80)
HML	1.09	0.97	0.97	0.94	0.93	-0.16	0.02
	(11.32)*	(10.68)*	(11.49)*	(11.88)*	(12.27)*	(-3.18)*	(1.17)
Apartment	0.24	0.08	0.15	0.12	0.14	-0.09	-0.41
	(0.23)	(0.09)	(0.17)	(0.15)	(0.18)	(-0.18)	(-1.91)
Industrial	-0.33	0.50	0.47	0.03	1.04	1.38	0.27
	(-0.30)	(0.49)	(0.50)	(0.04)	(1.25)	(2.47)*	(1.15)
Office	-0.17	-0.78	-0.80	-0.50	-1.17	-1.00	0.20
	(-0.18)	(-0.89)	(-0.99)	(-0.66)	(-1.63)	(-2.08)*	(1.01)
Retail	0.12	-0.00	0.06	0.22	-0.10	-0.22	-0.03
	(0.19)	(-0.00)	(0.10)	(0.43)	(-0.20)	(-0.68)	(-0.19)
Adj-R^2	0.5768	0.5805	0.6167	0.6381	0.6419	0.1167	0.0167

Exhibit 6 continued

	1 (Low)	2	3	4	5 (High)	[5 – 1] CS	[5 – 1] CJL
Panel B: SUE portfolios – sector augmented three-factor model and WML							
Intercept	-0.02	0.28	0.49	0.67	0.70	0.71	0.60
	(-0.06)	(1.03)	(1.78)	(2.59)*	(2.73)*	(4.52)*	(8.94)*
MKT	0.71	0.62	0.69	0.70	0.66	-0.05	-0.01
	(9.78)*	(10.60)*	(11.41)*	(12.25)*	(11.37)*	(-1.42)	(-1.02)
SMB	0.61	0.53	0.52	0.51	0.49	-0.12	0.03
	(7.07)*	(7.31)*	(7.07)*	(7.25)*	(7.13)*	(-2.79)*	(1.48)
HML	0.94	0.83	0.87	0.86	0.86	-0.08	0.01
	(9.91)*	(10.59)*	(10.97)*	(11.30)*	(11.33)*	(-1.75)	(0.70)
WML	-0.40	-0.46	-0.31	-0.25	-0.19	0.21	0.12
	(-6.12)*	(-8.66)*	(-5.68)*	(-4.88)*	(-3.65)*	(6.48)*	(5.14)*
Apartment	0.72	0.35	0.33	0.27	0.37	-0.35	-0.33
	(0.76)	(0.45)	(0.41)	(0.35)	(0.50)	(-0.75)	(-1.63)
Industrial	-0.89	0.10	0.20	-0.19	0.78	1.67	0.09
	(-0.88)	(0.11)	(0.24)	(-0.23)	(0.96)	(3.32)*	(0.41)
Office	0.08	-0.44	-0.57	-0.31	-1.05	-1.13	0.24
	(0.09)	(-0.59)	(-0.76)	(-0.44)	(-1.51)	(-2.61)*	(1.29)
Retail	0.29	0.10	0.13	0.27	-0.02	-0.31	0.02
	(0.49)	(0.21)	(0.25)	(0.58)	(-0.04)	(-1.06)	(0.15)
Adj-R^2	0.6495	0.7033	0.6737	0.6791	0.6653	0.2836	0.1378

Exhibit 6 continued

	1 (Low)	2	3	4	5 (High)	[5 – 1] CS	[5 – 1] CJL
Panel C: MOM portfolios – sector augmented three-factor model							
Intercept	0.24	0.35	0.40	0.49	0.51	0.27	0.35
	(0.61)	(1.07)	(1.53)	(2.03)*	(1.99)*	(0.76)	(1.72)
MKT	1.01	0.85	0.73	0.66	0.67	-0.34	-0.02
	(12.17)*	(12.20)*	(12.98)*	(12.88)*	(12.34)*	(-4.57)*	(-0.57)
SMB	0.57	0.55	0.49	0.49	0.54	-0.03	0.06
	(5.20)*	(5.96)*	(6.66)*	(7.25)*	(7.57)*	(-0.30)	(1.12)
HML	1.11	1.03	0.90	0.83	0.81	-0.30	0.09
	(9.59)*	(10.57)*	(11.59)*	(11.61)*	(10.75)*	(-2.87)*	(1.43)
Apartment	0.15	0.12	-0.13	-0.01	0.12	-0.03	-0.76
	(0.16)	(0.15)	(-0.21)	(-0.02)	(0.19)	(-0.04)	(-1.50)
Industrial	1.12	0.41	0.76	0.65	0.45	-0.67	1.51
	(0.88)	(0.39)	(0.89)	(0.83)	(0.55)	(-0.58)	(2.29)*
Office	-1.63	-0.81	-0.79	-0.84	-0.60	1.04	-0.30
	(-1.55)	(-0.91)	(-1.11)	(-1.29)	(-0.87)	(1.09)	(-0.55)
Retail	-0.08	-0.03	-0.03	0.10	0.17	0.25	-0.35
	(-0.11)	(-0.04)	(-0.05)	(0.23)	(0.37)	(0.39)	(-0.94)
Adj-R^2	0.5402	0.5573	0.5993	0.6059	0.5942	0.1171	0.0214

Exhibit 6 continued

	1 (Low)	2	3	4	5 (High)	[5 – 1] CS	[5 – 1] CJL
Panel D: MOM portfolios – sector augmented three-factor model and PMN							
Intercept	1.19	1.11	0.85	0.79	0.74	-0.45	-0.33
	(3.22)*	(3.46)*	(3.10)*	(3.02)*	(2.67)*	(-1.29)	(-1.40)
MKT	0.90	0.75	0.65	0.60	0.60	-0.30	-0.01
	(11.64)*	(11.17)*	(11.42)*	(11.14)*	(10.38)*	(-4.07)*	(-0.13)
SMB	0.43	0.44	0.43	0.44	0.48	0.05	0.03
	(4.43)*	(5.24)*	(5.95)*	(6.50)*	(6.61)*	(0.55)	(0.54)
HML	0.97	0.91	0.83	0.77	0.75	-0.23	0.06
	(9.38)*	(10.11)*	(10.77)*	(10.57)*	(9.60)*	(-2.30)*	(1.09)
PMN	-1.29	-1.04	-0.66	-0.47	-0.36	0.93	1.04
	(-8.51)*	(-7.90)*	(-5.93)*	(-4.46)*	(-3.15)*	(6.48)*	(5.14)*
Apartment	-0.57	-0.40	-0.22	0.01	0.74	1.31	-0.25
	(-0.55)	(-0.44)	(-0.30)	(0.02)	(0.95)	(1.33)	(-0.42)
Industrial	3.28	2.11	1.74	1.24	0.60	-2.68	1.18
	(2.90)*	(2.14)*	(2.07)*	(1.55)	(0.71)	(-2.49)*	(1.82)
Office	-2.67	-1.64	-1.34	-1.20	-1.11	1.56	-0.52
	(-2.75)*	(-1.94)	(-1.86)	(-1.75)	(-1.53)	(1.69)	(-0.96)
Retail	-0.54	-0.39	-0.30	-0.06	0.07	0.62	-0.33
	(-0.85)	(-0.69)	(-0.63)	(-0.14)	(0.15)	(1.02)	(-0.91)
Adj-R^2	0.6894	0.6796	0.6662	0.6438	0.6089	0.3417	0.1396

Notes: This table reports the results of time-series regressions over 183 months (January 1995 through March 2010) of excess portfolio returns on the Fama and French (1993) three-factor model augmented with property sector excess returns, and on a four-factor model that also includes either WML or PMN as an additional factor. Monthly portfolio returns are computed following CS (2006) in columns 1 through 6, and CJL (1996) in column 7. With CS, each month's return is a combination of the past six ranking strategies, with 1/6 of the securities changing each month, and the rest being carried over from the previous month. CJL portfolio returns follow a simple buy-and-hold strategy where portfolios are held for the following six months, with no monthly re-balancing. Property sector excess returns are derived from the MIT transactions based indices. WML, denoting past returns winners minus losers, is defined as the returns difference to firms within the highest and lowest momentum quintiles. PMN, denoting positive minus negative most recent earnings surprises, is calculated as the returns difference to firms within the highest and lowest SUE quintiles. SUE denotes standardized unexpected earnings, calculated as the four quarter lagged difference in the most recent earnings per share scaled by the standard deviation of unexpected earnings over the past eight quarters. In panels A and B, the portfolios are sorted into quintiles by the most recent SUE. In panels C and D, the portfolios are sorted into quintiles based on past six-month returns (MOM). t-statistics are in parentheses. * indicates statistical significance with a p-value less than 5%.