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THE SHORT INTEREST MARKET FOR PUBLICLY TRADED REAL ESTATE †‡

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Abstract

This paper evaluates the relation between publicly traded real estate returns and short interest levels. The sample is comprised of NYSE-traded Real Estate Investment Trusts (REITs) covering the period from 1990 through 2005. The data and results offer some surprising findings. First, it may not be widely known that the level of short interest has grown dramatically over the sample period. In fact, in recent years the level of REIT short interest – as measured by median relative short interest - has eclipsed the short interest level of firms in the broader market. Second, while conventional wisdom associates short interest with bearish sentiment, even highly shorted REIT in the sample have positive returns. However, and far more interesting, the spread between low and high short interest portfolios is significantly positive. This finding holds with persistence and across robust risk adjustment schemes. The results may be of particular interest to investors given the recent surge in hedge fund-related real estate investment.

JEL Classification: G14, R33
Key Words: Information, Real Estate, Short Interest

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1. Introduction

The purpose of this paper is to examine the short interest market for publicly traded real estate, specifically REITs. We evaluate the investment performance of highly shorted REITs in contrast to REITs with low relative short interest. There are important reasons for examining the issue of short interest in REITs. First, it is unclear whether the demand for shorting real estate securities (in this case, REITs) reflects investor response to superior information or is generated from actions based on non-informational reasons. Prior research has shown that REIT insiders have a considerable information advantage relative to outside shareholders (see Damodaran and Liu, 1993). This information advantage may be shared and exploited by other property valuation experts.

Second, empirical research has not determined if short selling of REITs outweighs the apparent costs. For instance, the REIT sector is well known for high dividend yields and lower liquidity, as measured by market capitalization, relative to other firms. These characteristics impose costs on short sellers. At the same time, the number of hedge funds reporting a short position in publicly traded real estate has grown significantly in the past decade.[1] The causes and implications of this growth have not been fully documented.

Third, REIT investment managers have been shown to add more value to their mutual funds in down markets than in up markets. This pattern, described by Kallberg, Liu and Trzcinka (2000), suggests that the aggregate demand for REIT short interest may be more relevant than firm-specific demand. Furthermore, property sector considerations may contribute to temporal variations in short interest activity. The extent to which publicly traded real estate offers a derivative market for property speculators and hedgers is an interesting and important area for inquiry. To our knowledge, this is the first work to consider this issue in a rigorous framework with an extensive data set.

[1] See Peter Slatin, "Double Plays: Hedge-funds that invest in real-estate trusts seek the best of two worlds." **Barron's** Monday, April 25, 2006, and Ilana Polyak, "Hedging their bets: Hedge funds increasingly look to REITs, but should investors look at hedge funds?" NAREIT Real Estate Portfolio Magazine, September/October 2004.

The theoretical underpinnings of market efficiency and asset pricing assume that arbitrageurs may engage in short selling at no cost (e.g., Fama, 1970 and Ross, 1976).[2] More recently, some empirical work using proprietary data has argued that the actual cost of shorting limits arbitrage opportunity (D'Avolio, 2002). At the same time, it is generally agreed that short selling requires heterogeneous beliefs among investors. Diamond and Verrecchia (1987) suggest that the high cost of short selling would be a reasonable action taken primarily by those informed investors with negative information and who anticipate significant price declines. Other, less informed investors would interpret an increase in short selling for a security as bad news that may imply that the security is overvalued and should experience lower future returns. The incentive to engage in short selling based on superior information or trading signals may be tempered by the higher dividend yields of REITs that may impose significant cost constraints to investors.

In this study, the empirical analysis attempts to document the returns associated with high levels of short interest for publicly traded real estate. We use monthly short interest data for the period 1990 through 2004 for a sample of NYSE-traded REITs. Our returns are calculated through 2005. The amount of short interest is standardized by shares outstanding and quartile portfolios are formed to show performance, risk sensitivity, time variation and composition by property type. Overall, the results do not support the conventional wisdom that heavily shorted REIT experience subsequent price decreases. Of course, the REIT market has performed well, *sans* risk adjustment, during the analysis period.

The results, however, do show strong support for significant excess returns to a long-short strategy for REITs. Additional analysis considers the sensitivity to real estate fundamentals, time variation in the excess returns, and sector rotation based on property type.

This paper continues as follows. The next section describes the data. The third section presents the empirical analysis. Additional analysis is provided in the fourth section, and the last section offers our conclusions and remarks.

[2] Fama (1970) incorporates costless borrowing in his theory of efficient capital markets while Ross (1976) assumes similar cost structures in his study of arbitrage in asset pricing.

2. Data

2.1 Data Sources

This study examines a sample of REITs, as publicly traded real estate.[3] The data are obtained from two sources. Short interest data from January 1990 through December 2004 are obtained from the NYSE for all NYSE-trade firms. This allows us to draw some observations about the level of short interest for REITs versus all other NYSE firms. The REIT sample, along with real estate security classifications, is drawn from the CRSP/Ziman Real Estate Data Series. We, also, obtain returns, price and shares outstanding data from the CRSP files from January 1990 through December 2005.[4] Finally, some of the risk factors used in the analysis are obtained from Kenneth French's website.

As stated, the monthly short interest data are obtained directly from the NYSE. These data are reported to the markets as of the settlements that take place on the 15th of each month or the first business day prior to that date if it is a holiday. Since settlement takes three business days (five business days until June 7, 1995), the data represent short interest culminating with trading that has occurred three or five business days prior to the 15th of each month.

The short interest sample is matched with the CRSP/Ziman data and limited to ordinary common shares to form an initial REIT sample. Exchanges usually do not report short interest levels for securities that have no short interest in the current and previous month. Consequently, it is particularly important for us to account for missing short interest data. We follow the approach documented in the literature. For REITs with at least one report of non-zero short interest during the examination period, we set all missing short interest levels equal to zero. Likewise, for any REIT with all missing short interest values (i.e., no zero or non-zero values), those firms are excluded from the sample. This procedure is conservative and mitigates the chance of misclassifying observations. The final sample of REITs represents the intersection of these data sources.

[3] The extent to which the data proxy for underlying or direct real property exposure is interesting, albeit beyond the scope of the immediate study.

[4] The return data extend one year longer than the short interest data so that we may examine the returns of portfolios formed on the basis of short interest.

2.2 Sample Characteristics

For cross-sectional comparisons of short interest, it is necessary to standardize the absolute number of shares held short. We use relative short interest (RSI), the number of shares sold short as a percentage of the number of common shares outstanding for each security, as a measure of short interest. This measure of short interest is used in Arnold et al. (2005), Chen and Singal (2003), Dechow et al. (2001), and other recent studies on short sales.

Descriptive characteristics presented in Table 1 provide a comparison between the REIT sample and the universe of NYSE securities. A significant increase in the short interest market for REITs occurs over the sample period. The median RSI increased from 0.025 to 1.714 percent during this period, a level of shorting activity that exceeded the NYSE firms.[5] The number of REITs with non-zero short interest increases rapidly at the beginning of the sample period and reaches 100 percent of the firms at the end of the sample period. Figure 1 presents the time series properties of the median RSI for the REITs used in this study and that of all NYSE firms during the sample period, 1990 - 2004. These trends highlight the growing significance of short sales for all investors, including REIT investors.

Table 2 presents summary statistics of REITs that are ranked into quartiles of relative short interest (RSI). The mean RSI ranges from a low of 0.083% and increases to a high of 2.191% among REITs. Though not reported in Table 2, the average size increases with the level of short interest, and this pattern is consistent with earlier studies, such as D'Avolio (2002) who describes size as a measure for the supply of stock available for shorting. This characteristic also reflects the general liquidity among the firms. The median size of REITs within the lowest RSI quartile is $327 million while the comparable firm in the highest quartile is almost three times larger, $890 million. It is important to note that RSI and size numbers are averages across the full sample period, 1990 – 2004.

[5] Earlier studies have examined the characteristics of financial securities and short selling and have identified consistent traits. For example, research suggests that liquidity constraints impact short selling so that stocks from larger firms usually have higher RSI than securities from smaller entities. Typically, REITs are smaller than highly shorted NYSE stocks, so the shorting activity among REITs runs counter to established trading patterns.

2.3 Portfolio Construction

In order to determine the *ex post* relation between relative short interest and returns, we form calendar time portfolios following the approach used in Jegadeesh and Titman (1993, 2001). We begin by assigning the cross-section of REITs to quartiles based on RSI. This is done each month and we refer to that month where sorting occurs as time zero. Each REIT remains in the portfolio and returns are calculated at the end of the subsequent month, time one. At that point, the sorting can be repeated and the returns can be recalculated for each of the quartile portfolios. We categorize the returns from this monthly portfolio construction as one month holding period returns.

This approach also lends itself to forming longer holding period portfolios. For instance, a REIT assigned to the high quartile can be held in that quartile for any number of months following the initial assignment regardless of subsequent changes or rankings by RSI (see Jegadeesh and Titman, 2001). We calculate the monthly returns from these holding-period portfolios, beginning at time one, over specific periods: 3, 6, and 12 months. We repeat the portfolio formation in time one and form portfolios for subsequent return calculations over the specific period. Effectively, in any given month, a particular quartile portfolio with a K-month holding period will hold all the REITs that are assigned to that RSI quartile during the preceding K-months. For example, in December 2000, the Quartile 4 portfolio with a 6-month holding period would hold all the REITs that were assigned to RSI quartile 4 from May 2000 through November 2000. In January 2001, the REITs that were assigned to the RSI quartile 4 in December 2000 will be added to the portfolio to replace those RSI quartile 4 REITs from May 2000.

3. Empirical Analysis

3.1 Raw Returns

Research has consistently linked short selling with subsequent return behavior. Diamond and Verrecchia (1987) propose that only informed investors with negative information who anticipate significant profits would knowingly engage in costly short selling. Empirical studies such as Desai, et al. (2002), and Asquith, et al. (2005) observe that high short interest forecasts low future returns.

The documented pattern of high short selling associated with lower future returns holds with REITs. Table 3 presents average monthly returns for equally weighted portfolios constructed by RSI quartile. We also subdivide the highest RSI quartile (Quartile 4) to observe the return patterns in the most heavily shorted REITs. After portfolio construction, we calculate the monthly raw returns over different holding periods in the manner presented by Jegadeesh and Titman (2001). We measure the portfolio returns for 1, 3, 6, and 12 month periods. The table also shows the average portfolio returns in the full period and in two subperiods that roughly bisect the overall sample period. All monthly raw returns are significantly different from zero.

One trend that emerges throughout the three sample periods and across the four holding periods is that future returns decline with higher levels of short interest. For example, the monthly portfolio returns for the full sample period with 6-month holding periods decline monotonically from a high of 1.401% in the lowest RSI quartile (Low) to 0.841% in quartile 4 (High) with a continued decline to 0.773% in the most highly shorted REITs, group 4B. Table 3 also reports the significant spread of 0.560% in monthly returns between the highest and lowest quartiles (L-H), which is representative of a significant annualized spread of over 6.7 percent. Additionally, 62.2% of the monthly spreads throughout the sample period are positive, which suggests a persistent positive spread as opposed to a result that is being driven by only a few cases of large positive values.

A second pattern that emerges is that future returns decline with longer holding periods among those portfolios at the tails of the short interest distribution, quartiles 1 and 4. In Panel A among quartile 1, the least shorted REITs, we observe the average raw returns declining monotonically from a high of 1.545% for 1-month holding periods to a low of 1.332% with 12-month holding periods. This trend suggests that the least shorted REITs retain the favorability of the market while returns decline with the increase in the time between portfolio rebalancing. This pattern in returns also holds for the highly shorted REITs in quartile 4 (High) where the returns decline monotonically from 0.937 percent for the portfolios formed monthly to a low of 0.793% for the 12-month holding periods. These findings demonstrate considerable consistency and persistence across degree of short interest and holding periods.

A more descriptive assessment of the monthly raw returns is presented in Figure 2, which provides the cumulative returns by RSI quartile with a six-month holding period. The graph reveals a monotonic decrease in cumulative returns as relative short interest increases among

REITs. The quartile 1 portfolio (L) with the lowest amount of relative short interest provides the greatest cumulative return while the portfolio (H) with the highest relative short interest generates the lowest cumulative return. The quartile 4 REITs are subdivided into 4A and 4B, and the same return-RSI pattern emerges with portfolio 4B earning a lower return than the REITs in 4A that have slightly less shorting activity. The increasing spread in cumulative returns, generated by the REIT portfolios formed by RSI quartile, also suggests that a hedging strategy may be possible. Figure 3 presents the cumulative return payoff of a zero-cost investment strategy that exploits the persistent spread between the lowest and highest RSI quartiles, (L–H). The graph depicts a steadily upward cumulative return pattern through the 1990s until there is a substantial increase in 1997 from approximately 100 percent to slightly under 200 percent in that year. The most dramatic cumulative return increase spans 2001 to the end of our sample period when cumulative returns increase from roughly 200 percent to approximately 750 percent. Interestingly, this latter period also represents a significant increase in short interest activity for the REITsample as well as the broader NYSE market.

3.2 Excess returns with 4 factor risk adjustment

An analysis with raw returns does not control for risk differences across quartile-based portfolios that may account for differences in realized returns. To address this issue we assess the performance of REIT portfolio returns within the context of recognized risk factors, such as those contained in the Fama and French (1993) 3-factor model and the one-year momentum factor presented in Carhart (1997) and Jegadeesh and Titman (2001). An interpretation of such test results using these factors often focuses on risk sensitivity, but Carhart (1997) proposes that this model may be interpreted from a return attribution perspective. This interpretive position emphasizes the coefficients of the factors that may indicate the proportion of return reflecting investment strategies: high versus low beta stocks; small versus large firm stocks; growth versus value stocks; and momentum versus contrarian stocks.

We estimate the performance of the short interest-based portfolios relative to the four factors as

$$\left(R_{j,t} - R_{f,t}\right) = \alpha_j + \beta_m RMRF_t + \beta_s SMB_t + \beta_H HML_t + \beta_{mom} MOM_t + \varepsilon_t \qquad (1)$$

where ($R_{j,t} - R_{f,t}$) is the return on a portfolio in excess of the one-month Treasury bill while RMRF is the excess return of the market. The following three factors, SMB, HML, and MOM reflect zero-investment portfolios representing size, book-to-market, and one-year momentum in returns.

Table 4 presents output reflecting the interaction of REIT portfolio returns and these four factors. We focus on the portfolios with six month holding periods for the balance of the empirical analysis. The longer holding period allows us to draw conclusions about excess returns while reducing the impact of transaction costs. Two main patterns emerge among the test results. One distinctive finding is how the intercept, representing monthly abnormal returns, declines monotonically as relative short interest increases. The portfolio comprised of REITs with the lowest RSI generates the highest abnormal monthly return of 0.458 percent. The level of monthly abnormal returns diminishes monotonically as relative short interest increases. The intercept for the portfolio with the highest RSI is -0.153 percent but is not statistically different from zero. These results show that the common risk factors contained in the four-factor model explain some, though not all, of the monthly returns of REIT portfolios formed on the basis of short interest.

The test results also highlight that all the common market factors in the four-factor model exhibit explanatory power on the monthly excess returns in the highest and lowest quartiles. Yet the sensitivity to these factors varies somewhat across the REIT portfolios in the high and low RSI quartiles. The REIT portfolio representing the most heavily shorted securities appears to have greater sensitivity to these four factors than the REIT portfolio in the lowest RSI quartile.

The possibility of a hedging strategy emerges with an examination of the spread between the REIT portfolios from the highest and lowest RSI quartiles. While the four-factor model demonstrates explanatory power on the monthly returns of the high and low RSI portfolios, the monthly return spread does not exhibit any sensitivity to these common risk factors. The alpha for the 1-4 (L-H) spread is 0.610 percent and is statistically significant. The low R-squared is not to be confused with a regression that lacks explanatory power. On the contrary, the argument can be made that the 61.0 basis point spread between these portfolios – and which indicates a substantial annualized spread of approximately 7.3 percent – is not influenced by the systematic risk factors. At the same time, the lack of explanatory power among the common risk factors also indicates that other factors may be needed to explain the performance of the REIT

portfolios.

3.3 Excess returns with 4 factors plus a real estate risk adjustment

The abnormal returns resulting from the four-factor model suggest that REIT asset pricing may require additional risk factors not present in the previous model. REITs have long been thought to offer investors additional benefits of diversification, so we incorporate a real estate factor to the multi-factor analysis. An interpretation of test results with an asset-specific factor may provide intuition about the overall sensitivity of REITs to the different investment strategies reflected in the Carhart's (1997) interpretation of the four-factor model with the additional real estate component.

We estimate the performance of the REIT portfolios relative to five factors as

$$(R_{j,t} - R_{f,t}) = \alpha_j + \beta_m RMRF_t + \beta_S SMB_t + \beta_H HML_t + \beta_{mom} MOM_t + \beta_R RERF_t + \varepsilon_t \qquad (2)$$

where $(R_{j,t} - R_{f,t})$ is the monthly return on a portfolio in excess of the one-month Treasury bill and RMRF is the excess return of the market. The next three factors, SMB, HML, and MOM are as discussed previously. The real estate factor, RERF, is the value-weighted REIT index in excess of the one-month Treasury bill. The index represents all REIT types and is obtained from CRSP/Ziman database. Table 5 reports the results with the four factors employed in the previous section, plus a real estate exposure factor.

The results show that the introduction of the real estate factor resolves the degree of sensitivity that the REIT portfolio returns have with the four common market factors. The measure of abnormal monthly returns, the alpha, continues to decrease monotonically as relative short interest increases. The intercept of the five-factor model is highest in the low-short portfolio at 0.348% and steadily declines across quartiles until it reaches -0.295% in the high-short portfolio. The introduction of the real estate factor diminishes the magnitude of the monthly abnormal returns across all quartiles with the high-short portfolio intercept becoming strongly negative. The larger adjusted R-squared shows that the five-factor model provides a substantially better fit for the data than does the four-factor model.

The five-factor model also reveals significant sensitivity to the real estate factor and explains a significant portion of the excess returns of the REIT portfolios. Sensitivity to the real

estate factor appears to increase as REITs experience higher short interest. The coefficient for the real estate factor is 0.713 in the low-short portfolio and increases monotonically to a high of 0.928 in the portfolio with the greatest amount of shorting activity. The difference in sensitivity to the real estate factor suggests that investors may incorporate this information to increase the efficiency of hedging practices.

The inclusion of the real estate factor produces a substantial decline in the overall sensitivity of the portfolio returns to the four market factors with their smaller coefficients. In most portfolios, the RMRF factor is subsumed by the real estate factor and no longer exhibits explanatory power for the returns. The results also show that the low- and high-short portfolios experience a reversal in sensitivity to the four market factors with the inclusion of the real estate factor. The five-factor output shows that the portfolio formed with greater shorting activity exhibit less sensitivity to the market factors than does the low-short portfolio. The coefficients for the REIT portfolio in quartile 1 are consistently more positive than those of the highly shorted portfolio. Such findings demonstrate that investors should incorporate information from the broader real estate market when assessing trading strategies for REITs.

The output of the five-factor model reveals that the abnormal return to the strategy of longing the low-short portfolio (L) and shorting the high-short portfolio (H) is significantly impacted by the real estate factor. The four factors representing broader market variables exhibit no explanatory power on the spread. The test results show that a 64.4 basis point spread per month, or 7.73% per year, exists between quartiles 1 and 4, and that this abnormal return remains in the presence of an extended model. The continued presence of a spread in abnormal monthly returns between the low- and high-short portfolios suggests a fundamental divergence in future returns occurs with different short selling activity across REITs.

3.4 Time variations in excess returns

Short interest among REITs increased significantly in the latter half of our sample period, which may suggest different interactions between REIT returns and the various factors used in this study. In this section we estimate the performance of the REIT portfolios relative to the five factors in equation (2) and focus on two subperiods that roughly bisect the sample period.

The test results, presented in Table 6, indicate some differences across time in the return behavior and in sensitivity among REITs to the market and real estate factors. The portfolios

formed from low-short REITs do not generate abnormal returns in the earlier subperiod, Panel A, but have large, positive abnormal returns in the second subperiod. While the low-short returns become positive and statistically significant in the second subperiod, the reverse pattern emerges among the highly shorted REITs. The portfolios formed from highly shorted REITs have negative abnormal returns in the first subperiod while the tests do not measure any abnormal return in the second subperiod. Thus, REITs that experience the extremes in shorting activity exhibit some differences in return behavior across time.

Despite the changes in return patterns among the low- and high-short REITs, the spread between these two portfolios remains sizable and significant across the subperiods. The return spread in the first subperiod exhibits no sensitivity to the five factors while only the real estate factor partially impacts the spread in the second subperiod. The consistent return spread across the subperiods indicates that a hedging strategy may have been viable throughout the entire time of this study.

4. Additional Analysis

4.1 Real estate factor sensitivity

The portfolio returns for REITs based on level of short interest are economically and statistically significant. This point is particularly relevant as the spread between low and high short interest portfolio is robust across the sample period. Furthermore, the results in earlier tests (i.e., Table 5) suggest that differences between the low- and high-short portfolios may be best exploited within a hedging strategy. In this section we examine the REITs in the lowest and highest RSI quartiles and test for differences in sensitivity to factors that form common investment strategies: equity market sensitivity risk, small versus large stocks; growth versus value stocks; momentum versus contrarian stocks; and real estate sensitivity risk.

We differentiate the sensitivity of high- and low-short REIT portfolios relative to specific factors in

$$(R_{j,t} - R_{f,t}) = \alpha_j + \beta_m RMRF_t + \beta_S SMB_t + \beta_H HML_t + \beta_M MOM_t + \beta_R RERF_t + \delta\alpha_j + \beta_{\delta m}\delta RMRF_t + \beta_{\delta S}\delta SMB_t + \beta_{\delta H}\delta HML_t + \beta_{\delta M}\delta MOM_t + \beta_{\delta R}\delta RERF_t + \varepsilon_t \quad (3)$$

where the notation is as described earlier, except for the dichotomous variable, δ. Delta assumes

a value of 1 for the high short interest portfolio, Quartile 4, and a value of zero for the low short interest portfolio. Hence, the variable δ–alpha that takes the value of 1 for the highest RSI quartile and captures the differential excess return over the lowest RSI quartile portfolio. The next five variables: δRMRF; δSMB; δHML; δMOM; and δRERF are interactive terms between the RSI quartile dummy variable and the respective factors. We test three versions of this model (referring to each version as Model 1, 2 or 3), to better understand the differential impacts on the high-short REITs. For Model 3, which is the full model shown in equation (3), the coefficient estimates for δRMRF, δSMB, δHML, δMOM are not reported so as to conserve space. Table 7 presents the test results for the entire sample period and the two sub-periods.

The Model 1 results represent the output of the five-factor model in equation (2) with the addition of the RSI dummy variable, δAlpha. In the full period, the five factors exhibit significant explanatory power on the monthly returns of the low- and high-short portfolios, and these findings are consistent with earlier results. The δAlpha variable is negative and significant, which confirms the differences in monthly returns between the REIT portfolios experiencing the least and greatest shorting activity. The monthly abnormal return for the high-short portfolio is the combined value of the Alpha and δAlpha coefficients: 0.307 – 0.560 = -0.253 percent. This return attribute for the most highly shorted securities is consistent with earlier results reported in this study. We form Model 2 by adding the interactive real estate factor dummy, δRERF, to Model 1 of this table. The results from this model highlight the abnormal returns for portfolios at the RSI extremes and the differential interactions with the real estate factor. The Model 2 results show that the highly shorted REIT portfolio generates significantly negative abnormal returns and is also more sensitive than low-short REITs to movements within real estate, as shown by the positive δRERF coefficient. Model 3 represents the full model, equation (3), and the results are similar to those from Models 1 and 2. None of the interactive dummy variables for the initial four factors are significantly different from zero (not report in the table). This suggests that these broad risk factors do not have a differential sensitivity across the highest and lowest short interest portfolios.

The subperiod analysis reveals significant differences across time in the behavior of low- and high-short portfolios of REITs. In the first subperiod, the abnormal returns do not emerge among the low-short REIT portfolios while the high-short REITs, with negative δAlpha, continue to generate negative returns in Models 1 and 2. The results for Model 3 reveal an

absence of any type of abnormal return among the REIT portfolios in this first subperiod. Interestingly, the full model has an insignificant real estate dummy variable, so no apparent differences in sensitivity to real estate factor exist among the low- and high-short portfolios. The lack of significance may be the result of lower power since there are fewer observations in this short sample period.

The second subperiod results, shown in Panel B, are similar to those of the full sample period. The low-short portfolios have positive abnormal returns while the highly shorted REITs generate negative abnormal returns for Models 2 and 3. The high-short portfolios also demonstrate greater sensitivity to the real estate factor.

Overall, these tests show the differential influence of risk factors between the highest and lowest short interest portfolios. The most important result is the significant differential effect of the real estate exposure factor. The results show that high short interest REITs are significantly more sensitive to real estate market risk as proxied for by this factor. One implication is that an investor, with a bearish outlook for the real estate market as a whole, could take a hedge position by shorting REITs with high real estate sensitivity and going long those REITs with low real estate market sensitivity. Should the investor's outlook come to fruition, the short position should under-perform the long position. Thus, investors may achieve trading objectives more effectively by shorting the highest RSI firms since they have greater exposure to movements in the real estate industry.

4.2 Time Variation in Excess Returns

Tests of the abnormal return spread between the low- and high-short portfolios (L-H) find the monthly returns to be significant in both the four- and five-factor models. The coefficients for the intercept presented in Tables 4 and 5 provide a summary measure. Some investors may find it helpful to observe the pattern of monthly abnormal returns for the L–H spread across the sample period. Figure 4 presents a chart of the rolling 48-month alphas for the monthly return spread of the lowest and highest RSI quartiles (L–H). Both alphas show volatility across time, but the graph demonstrates that the monthly abnormal returns for the L–H spread remains positive and on the order of 50 basis points per month throughout the sample period.

Here, too, the holding period is 6 months. Some of the variation in the alphas, for each quartile and the spread, is due to estimation error. However, a comparison between this proxy

for excess returns and a graph of the spread from the raw returns (not shown here) is remarkably consistent. As might be expected, the spread after risk adjustment is even greater than the raw return spread. One might interpret this in a number of way, however, given the fact that the highly shorted portfolio is more sensitive to the real estate factor it is plausible that the risk-adjusted spread is higher than the raw spread. It is also plausible that investors would use this information in selecting those securities that would be employed in a hedging strategy.

4.3 Property Sector Variation across Time

We also consider the potential for sector differences in short interest based on property type. It is well understood that the underlying economics across property types is different and, in some cases, may be exacerbated by institutional issues such as leasing terms. Furthermore, property markets move in different temporal cycles. While the current study does not consider a full disaggregated analysis along the property type dimension, there is intuition to be gleaned from analyzing the available data on property types.

Figure 5 shows the number of firms by property type that comprise Quartile 4, the quartile of highly shorted REITs. One justification for examining this quartile can be obtained from Diamond and Verrecchia (1987); specifically, if short positions are costly, Quartile 4 represents the "smart money" (i.e., informed) short traders. Figure 5 shows the number of firms, by select property types, stacking each category on top of the next. As this is one of four quartiles, approximately one-fourth of the full sample in 2004 (or one-fourth of 166 firms) is shown at the end of the sample period. As stated previously, the figure draws attention to those property types which are most widely recognized by institutional investors and for which the sector economics may be more ready associated with underlying property market fundamentals. The emphasis is given to the REIT property sectors for Apartments, Industrial, Office and larger Retail, as defined by regional malls and shopping centers. The volatility in firm composition may suggest several trading strategies. For instance, during the first sub-period that we consider (1990 – 1997), over half and in some cases nearly all of the firms in Quartile 4 are from outside these core property types. In other words, the highly shorted firms may be more idiosyncratic or speculative shorts. In the latter part of the sample, the number of Apartment REITs that are shorted remains relatively high in comparison, while the short interest in Office and Retails sectors seems somewhat countercyclical.

Focusing still on Quartile 4, Figure 6 shows the full economic weight of the short interest by select property sectors. Specifically, Figure 6 shows the total value (US $ millions) of short interest. Here, the figure is comprised of a the single high RSI quartile, but represents approximately one-half of the total value of short interest. The total value of short interest for all quartiles in our sample at the end of the examination period is $8.3 billion. The recent dollar growth in short positions across the property types suggests that some investors – whether they be speculators or hedgers, space-markets or capital- markets participants – perceive opportunity in the short interest market for publicly traded real estate.

5. Conclusion

The short interest market for publicly traded real estate, in this case REITs, has grown considerably over the past decade. The purpose of this paper is to examine the risk and return characteristics associated with this market. Using monthly short interest data for the period 1990 through 2004, we form quartile portfolios based on the level of relative short interest (i.e., short interest standardized by shares outstanding). The empirical analysis examines the raw and risk adjusted returns of the portfolios and tests for significance. The risk adjustment process employs a four factor model and the same model augmented with a real estate factor. In both cases, the spread between low and high quartile portfolios is significant suggesting the potential for a long-short hedging strategy with real estate securities. Additional analysis examines finer elements of a long-short strategy. Specifically, we find that highly shorted REITs have a greater sensitivity to a real estate factor. Such a finding is consistent with an efficient market neutral strategy. Finally, we find considerable volatility across time in highly shorted property types. Although we do not formally test this phenomenon, it is consistent with a sector-based or pairs-trading strategy.

Although the market for short interest has grown considerably on a relative scale, it is still modest in an absolute sense. At the end of our sample period, the total market value of short interest for publicly traded real estate was approximately $8.3 billion or 2.6% of REIT equity market capitalization. For comparison sake, the total market capitalization for US REITs is approximately $320 billion. The NCREIF property capitalization is approximately $230 billion and the market capitalization of Google, at this time, is in excess of $150 billion. The total notional value of the first derivatives transaction tied to the NCREIF index – swapping office for

apartment exposure – was $10 million. Finally, the real estate hedge fund GEM Realty Capital of Chicago – which is closed to new investors – totals $500 million in assets. In closing, the economic significance of the publicly traded real estate short interest market may be appropriately sized.

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Table 1 - Sample Short Interest Characteristics

Year	Number of REITs in Sample	Number of REITs with non-zero Short Interest	Relative Short Interests			
			Sample Firms		NYSE Firms	
			Mean	Median	Mean	Median
1990	50	34	0.260	0.025	1.423	0.432
1991	52	40	0.251	0.035	1.206	0.372
1992	58	42	0.350	0.034	1.225	0.456
1993	98	91	0.4.8	0.129	1.212	0.397
1994	137	126	0.458	0.114	1.219	0.387
1995	142	135	0.249	0.061	1.351	0.411
1996	151	145	0.490	0.141	1.605	0.491
1997	166	162	0.780	0.191	2.657	0.618
1998	169	160	0.827	0.247	2.466	0.620
1999	160	151	0.635	0.307	2.132	0.538
2000	151	142	0.720	0.278	2.627	0.633
2001	143	140	0.981	0.546	3.180	0.980
2002	140	139	1.375	0.929	2.812	1.188
2003	142	142	1.946	1.131	3.088	1.307
2004	166	166	2.415	1.714	2.898	1.454

The REIT sample represents the intersection between NYSE REITs from the CRSP/Ziman database and short interest data obtained directly from the NYSE. The NYSE Firms data represent all NYSE firms. Relative Short Interest (RSI) is the number of shares held short expressed as a percentage of the number of common shares outstanding for each security. The sample period spans 1990 through 2004. In this table, all values are determined as of December for the year reported.

Table 2 – Relative Short Interest by RSI Quartile

		Quartile 1 (Low)	Quartile 2	Quartile 3	Quartile 4 (High)
Relative Short Interest (%)	Mean	0.083	0.258	0.545	2.191
	Median	0.089	0.254	0.526	1.462

Each month, the mean and median of the Relative Short Interest (RSI) for each RSI quartile are calculated. The averages of these time-series monthly mean and median statistics are reported in the table. The differences between the highest and lowest quartiles for RSI are statistically significant.

Table 3 – Monthly Portfolio Returns based on Relative Short Interest Quartiles
Mean Monthly Raw Returns

	Quartiles							
Holding Period	1 (Low)	2	3	4 (High)	4A	4B	1-4 (L-H)	Percent Positive
Panel A: 1990-2004 (full period)								
1 mos	1.545	1.309	0.893	0.937	1.060	0.818	0.608 [a]	57.8% [b]
3 mos	1.403	1.315	0.994	0.880	0.938	0.828	0.524 [a]	61.0% [a]
6 mos	1.401	1.376	1.130	0.841	0.912	0.773	0.560 [a]	62.2% [a]
12 mos	1.332	1.336	1.154	0.793	0.896	0.693	0.539 [a]	58.1% [b]
Panel B: 1990-1997 (subperiod 1)								
1 mos	1.644	1.466	0.805	0.976	1.241	0.715	0.668 [c]	54.7%
3 mos	1.496	1.459	0.998	0.893	1.033	0.764	0.604 [c]	56.8%
6 mos	1.430	1.442	1.147	0.724	0.820	0.635	0.706 [b]	60.0% [c]
12 mos	1.368	1.414	1.214	0.697	0.816	0.582	0.671 [b]	55.8%
Panel C: 1998-2004 (subperiod 2)								
1 mos	1.433	1.136	0.991	0.892	0.858	0.932	0.541 [b]	61.2% [b]
3 mos	1.302	1.157	0.990	0.865	0.835	0.897	0.437 [c]	65.5% [a]
6 mos	1.370	1.307	1.112	0.964	1.010	0.918	0.407 [c]	64.4% [a]
12 mos	1.297	1.260	1.096	0.888	0.975	0.803	0.409 [b]	60.4% [b]

Equally weighted portfolios are constructed within quartiles based on Relative Short Interest (RSI). The monthly mean statistics are made for the raw returns within each RSI quartile. The time series averages of these monthly data are reported. In addition, the highest RSI quartile is divided into two parts, 4A and 4B. The portfolios are constructed monthly based upon RSI quartiles with the calculation of the subsequent monthly returns for the respective holding periods (1, 3, 6, and 12 months). The difference between the lowest (L) and highest (H) RSI quartiles, 1 and 4, represents the spread in monthly returns between the extreme RSI quartiles. Significance levels from p-values are expressed as: [a] for 1%, [b] for 5%, and [c] for 10%.

Table 4 – Risk Adjusted Portfolio Returns based on Relative Short Interest Quartiles 1990-2004, Six month holding period

$$\left(R_{j,t} - R_{f,t}\right) = \alpha_j + \beta_m RMRF_t + \beta_s SMB_t + \beta_H HML_t + \beta_{mom} MOM_t + \varepsilon_t$$

Coefficients of Four-Factor Model						
Portfolio	Alpha	RMRF	SMB	HML	MOM	Adj R-sq
1 (Low)	0.458	0.509	0.583	0.700	-0.103	0.447
	(0.06)	(0.00)	(0.00)	(0.00)	(0.03)	
2	0.466	0.501	0.447	0.594	-0.059	0.417
	(0.04)	(0.00)	(0.00)	(0.00)	(0.18)	
3	0.235	0.469	0.531	0.660	-0.100	0.407
	(0.33)	(0.00)	(0.00)	(0.00)	(0.04)	
4 (High)	-0.153	0.581	0.614	0.761	-0.129	0.447
	(0.57)	(0.00)	(0.00)	(0.00)	(0.02)	
1-4 Spread	0.610	-0.072	-0.031	-0.061	0.026	-0.004
	(0.00)	(0.17)	(0.57)	(0.37)	(0.51)	

REITs are sorted into Relative Short Interest (RSI) quartiles to form equally weighted portfolios each month. Quartile 1 portfolio represents those REITs having the lowest amount of short interest while Quartile 4 comprises the securities having the most short interest. The Fama and French (1993) three factors are RMRF, SMB, and HML that represent the market proxy and factor-mimicking portfolios for size and book-to-market. MOM represents a one-year return momentum factor. The Alpha is the intercept for the model, while P-values are in parentheses.

Table 5 – Risk and Real Estate Adjusted Portfolio Returns based on Relative Short Interest Quartiles
1990-2004, Six month holding period

$$(R_{j,t} - R_{f,t}) = \alpha_j + \beta_m RMRF_t + \beta_S SMB_t + \beta_H HML_t + \beta_{mom} MOM_t + \beta_R RERF_t + \varepsilon_t$$

	Coefficients of Five-Factor Model						
Portfolio	Alpha	RMRF	SMB	HML	MOM	RERF	Adj R-sq
1 (Low)	0.348	0.121	0.302	0.253	-0.068	0.713	0.699
	(0.05)	(0.03)	(0.00)	(0.00)	(0.05)	(0.00)	
2	0.333	0.029	0.106	0.051	-0.017	0.866	0.889
	(0.00)	(0.34)	(0.00)	(0.19)	(0.38)	(0.00)	
3	0.102	-0.004	0.189	0.116	-0.058	0.868	0.811
	(0.45)	(0.93)	(0.00)	(0.03)	(0.03)	(0.00)	
4 (High)	-0.295	0.076	0.249	0.179	-0.084	0.928	0.799
	(0.07)	(0.14)	(0.00)	(0.01)	(0.01)	(0.00)	
1-4 Spread	0.644	0.046	0.054	0.074	0.015	-0.216	0.053
	(0.00)	(0.46)	(0.36)	(0.34)	(0.69)	(0.00)	

REITs are sorted into Relative Short Interest (RSI) quartiles to form equally weighted portfolios each month. The Fama and French (1993) three factors are RMRF, SMB, and HML that represent the market proxy and factor-mimicking portfolios for size and book-to-market. MOM represents a one-year return momentum factor. The real estate factor, RERF, is the return in excess of a one-month Treasury of a value-weighted REIT index representing the universe of REITs. The Alpha is the intercept for the model, while P-values are in parentheses.

Table 6 – Time Variation of Risk and Real Estate Adjusted Portfolio Returns based on Relative Short Interest Quartiles
Six month holding period

$$(R_{j,t} - R_{f,t}) = \alpha_j + \beta_m RMRF_t + \beta_S SMB_t + \beta_H HML_t + \beta_{mom} MOM_t + \beta_R RERF_t + \varepsilon_t$$

	Coefficients of Five-Factor Model						
Portfolio	Alpha	RMRF	SMB	HML	MOM	RERF	Adj R-sq
Panel A: 1990-1997 (subperiod 1)							
1 (Low)	0.071	0.230	0.461	0.478	-0.054	0.821	0.718
	(0.79)	(0.02)	(0.00)	(0.00)	(0.57)	(0.00)	
2	0.172	0.078	0.104	0.129	0.084	0.840	0.849
	(0.25)	(0.15)	(0.08)	(0.05)	(0.11)	(0.00)	
3	-0.004	0.060	0.378	0.330	-0.059	0.821	0.719
	(0.99)	(0.50)	(0.00)	(0.00)	(0.49)	(0.00)	
4 (High)	-0.505	0.160	0.408	0.297	-0.219	0.993	0.731
	(0.08)	(0.13)	(0.00)	(0.02)	(0.03)	(0.00)	
1-4 Spread	0.575	0.070	0.053	0.180	0.165	-0.172	0.000
	(0.09)	(0.57)	(0.70)	(0.23)	(0.17)	(0.17)	
Panel B: 1998-2004 (subperiod 2)							
1 (Low)	0.537	0.043	0.228	0.136	-0.081	0.642	0.725
	(0.02)	(0.49)	(0.00)	(0.09)	(0.02)	(0.00)	
2	0.392	-0.010	0.125	0.017	-0.046	0.874	0.920
	(0.00)	(0.79)	(0.00)	(0.72)	(0.03)	(0.00)	
3	0.206	-0.044	0.074	-0.021	-0.035	0.918	0.922
	(0.11)	(0.24)	(0.04)	(0.66)	(0.09)	(0.00)	
4 (High)	-0.019	0.039	0.136	0.092	-0.049	0.897	0.931
	(0.87)	(0.26)	(0.00)	(0.04)	(0.01)	(0.00)	
1-4 Spread	0.557	0.004	0.092	0.045	-0.032	-0.254	0.181
	(0.01)	(0.95)	(0.10)	(0.55)	(0.34)	(0.00)	

REITs are sorted into Relative Short Interest (RSI) quartiles to form equally weighted portfolios each month. The Fama and French (1993) three factors are RMRF, SMB, and HML that represent the market proxy and factor-mimicking portfolios for size and book-to-market. MOM represents a one-year return momentum factor. The real estate factor, RERF, is the return in excess of a one-month Treasury of a value-weighted REIT index representing all REITs. The Alpha is the intercept for the model, while P-values are in parentheses.

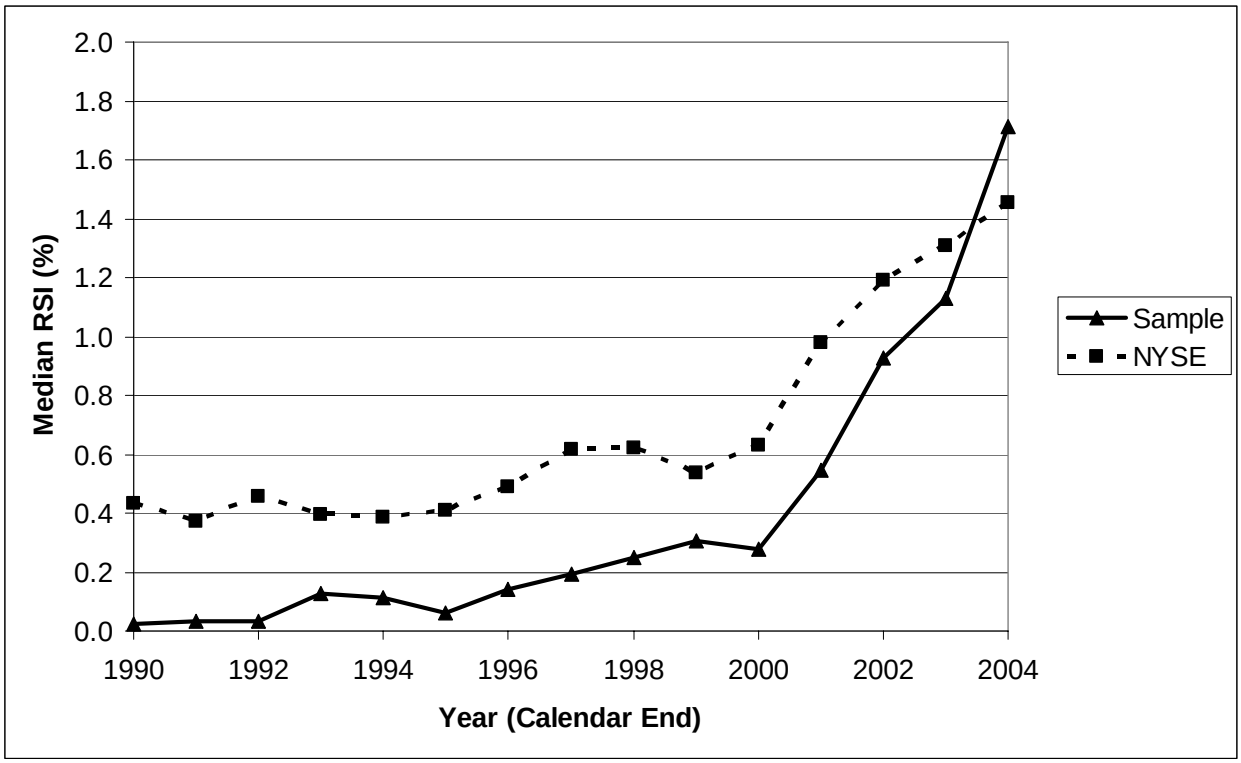
Table 7 – Differential Sensitivity between Low- and High-short Portfolios
Six month holding period

$$(R_{j,t} - R_{f,t}) = \alpha_j + \beta_m RMRF_t + \beta_S SMB_t + \beta_H HML_t + \beta_M MOM_t + \beta_R RERF_t$$
$$+ \delta\alpha_j + \beta_{\delta m}\delta RMRF_t + \beta_{\delta S}\delta SMB_t + \beta_{\delta H}\delta HML_t + \beta_{\delta M}\delta MOM_t + \beta_{\delta R}\delta RERF_t + \varepsilon_t$$

	Coefficients of Factors								
Model	Alpha	RMRF	SMB	HML	MOM	RERF	δAlpha	δRERF	Adj R-sq
Panel A: 1990-2004 (full period)									
1	0.307	0.099	0.276	0.216	-0.076	0.820	-0.560		0.731
	(0.06)	(0.01)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)		
2	0.375	0.099	0.276	0.216	-0.076	0.731	-0.697	0.178	0.756
	(0.02)	(0.01)	(0.00)	(0.00)	(0.04)	(0.00)	(0.00)	(0.00)	
3	0.348	0.121	0.302	0.253	-0.068	0.713	-0.644	0.216	0.736
(partial)	(0.04)	(0.02)	(0.00)	(0.00)	(0.04)	(0.00)	(0.01)	(0.01)	
Panel B: 1990-1997 (subperiod 1)									
1	0.136	0.195	0.434	0.387	-0.136	0.907	-0.706		0.727
	(0.60)	(0.01)	(0.00)	(0.00)	(0.05)	(0.00)	(0.04)		
2	0.186	0.195	0.434	0.387	-0.136	0.845	-0.806	0.124	0.728
	(0.48)	(0.01)	(0.00)	(0.00)	(0.05)	(0.00)	(0.02)	(0.24)	
3	0.071	0.230	0.461	0.478	-0.054	0.821	-0.575	0.172	0.726
(partial)	(0.80)	(0.03)	(0.00)	(0.00)	(0.58)	(0.00)	(0.15)	(0.24)	
Panel C: 1998-2004 (subperiod 2)									
1	0.462	0.041	0.182	0.114	-0.065	0.769	-0.407		0.837
	(0.01)	(0.26)	(0.00)	(0.02)	(0.00)	(0.00)	(0.10)		
2	0.539	0.041	0.182	0.114	-0.065	0.663	-0.561	0.213	0.848
	(0.00)	(0.24)	(0.00)	(0.01)	(0.00)	(0.00)	(0.02)	(0.00)	
3	0.537	0.043	0.228	0.136	-0.081	0.642	-0.557	0.254	0.847
(partial)	(0.00)	(0.39)	(0.00)	(0.04)	(0.01)	(0.00)	(0.03)	(0.00)	

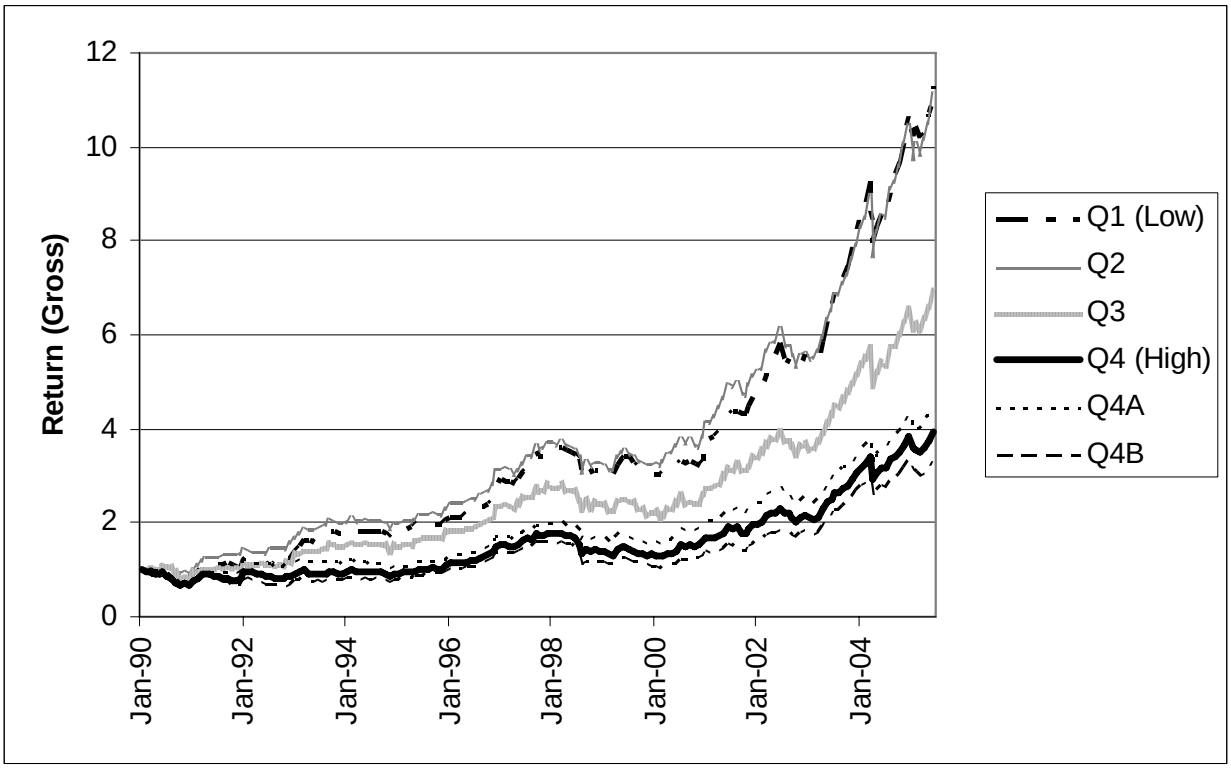
This Table compares the highest and lowest RSI quartile portfolios. The Fama and French (1993) three factors are RMRF, SMB, and HML that represent the market proxy and factor-mimicking portfolios for size and book-to-market. MOM represents a one-year return momentum factor. The real estate factor, RERF, is the return in excess of a one-month Treasury of a value-weighted REIT index representing the all REITs. The Alpha is the intercept for the model. The dichotomous variable δ takes the value of 1 for the highest quartile portfolio and 0 for the lowest RSI quartile portfolio. The interactive intercept term measures the difference in average monthly abnormal returns between these two extreme quartile portfolios. The next five variables: δRMRF; δSMB; δHML; δMOM; and δRERF are interactive terms between the dichotomous variable and the respective factors. Models 1 and 2 are as shown. A partial version of Model 3, the full model, is shown to conserve space. P-values are in parentheses.

Figure 1 – Median RSI for Sample and NYSE Firms, 1990 - 2004



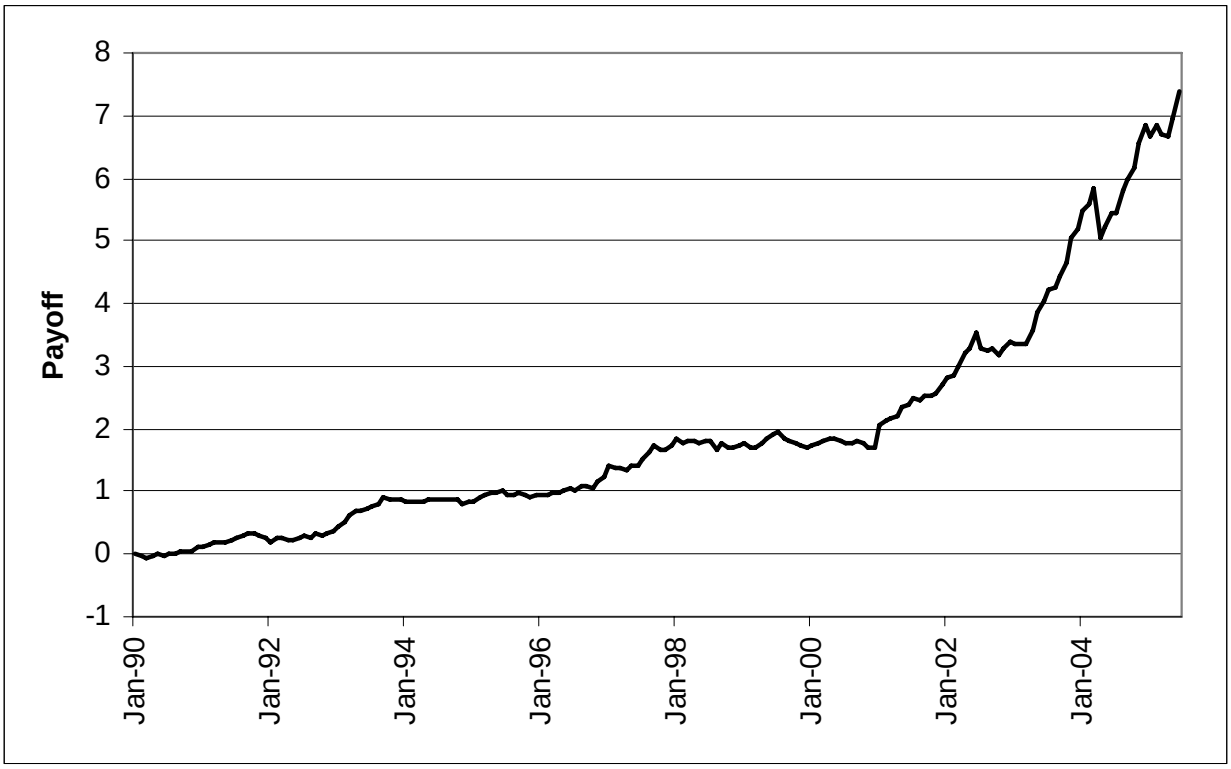
The solid line labeled "Sample" represents the entire sample of REITs used in this study. "NYSE" is all NYSE-traded firms and their median short interest during the sample period, 1990 - 2004. RSI is the number of shares shorted divided by the shares outstanding for individual firms.

Figure 2 – Cumulative Return by Relative Short Interest Quartile
Six month holding period



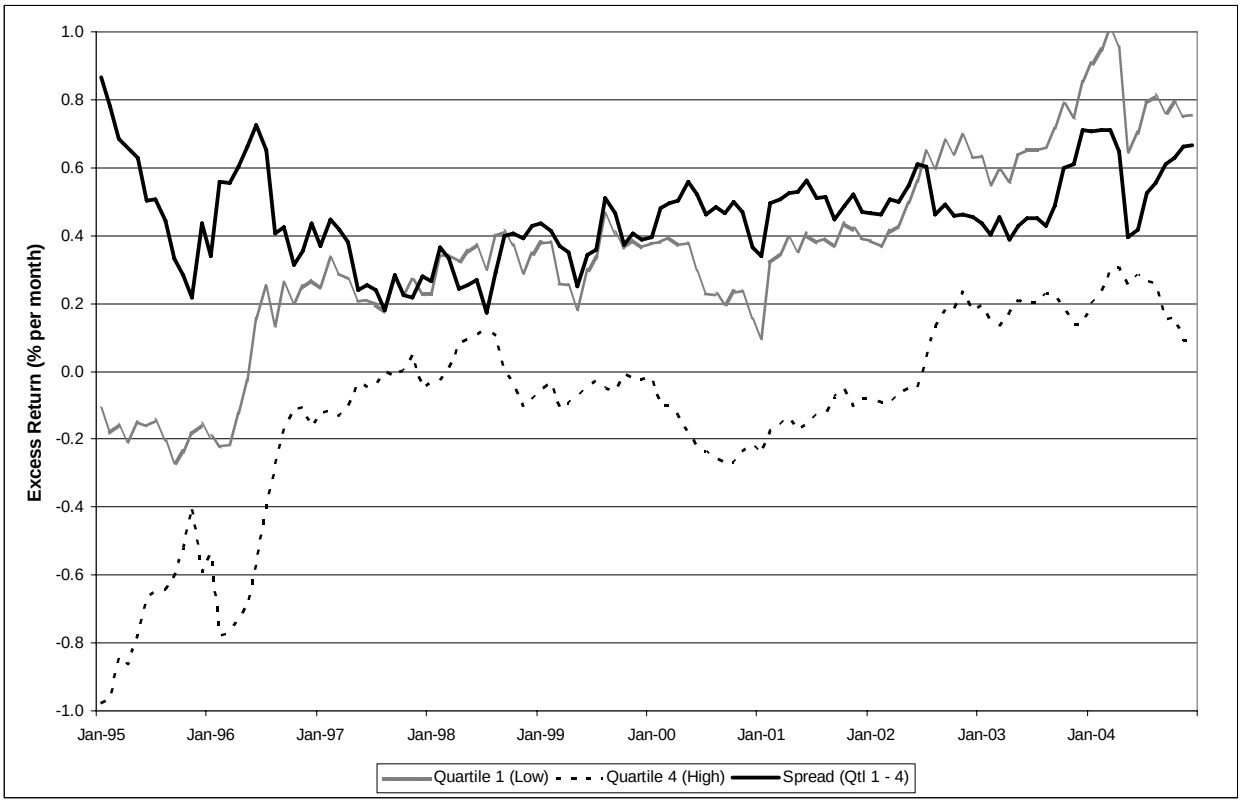
This figure shows the cumulative effect of a unit 1 investment in each of the quartile-based portfolios at the beginning of the sample period.

Figure 3 - Cumulative Payoff for a Zero-cost Investment Strategy
Six month holding period



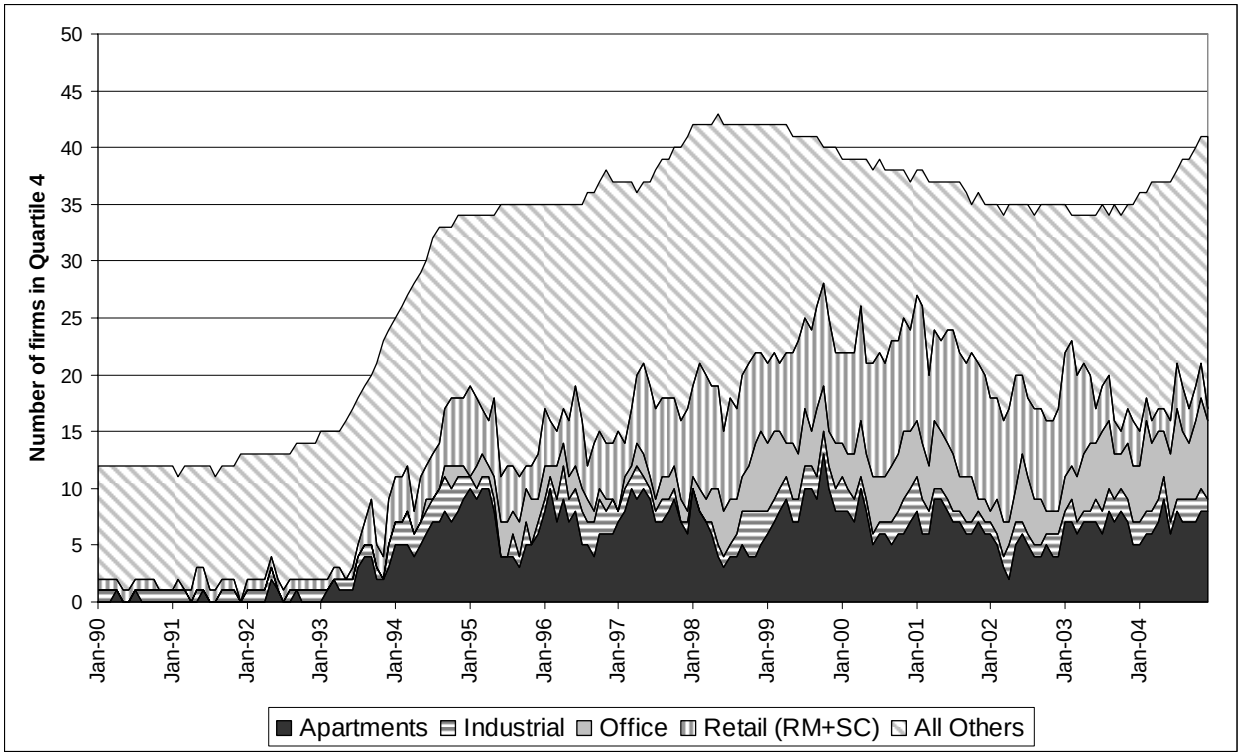
This figure shows the cumulative payoff for a zero-cost investment strategy which holds long Quartile 1 (Low RSI firms) and shorts Quartile 4 (high RSI firms) as of the beginning of the sample period.

Figure 4 - Abnormal Returns based on 48-month rolling alphas and a 5-Factor Model Six month holding period



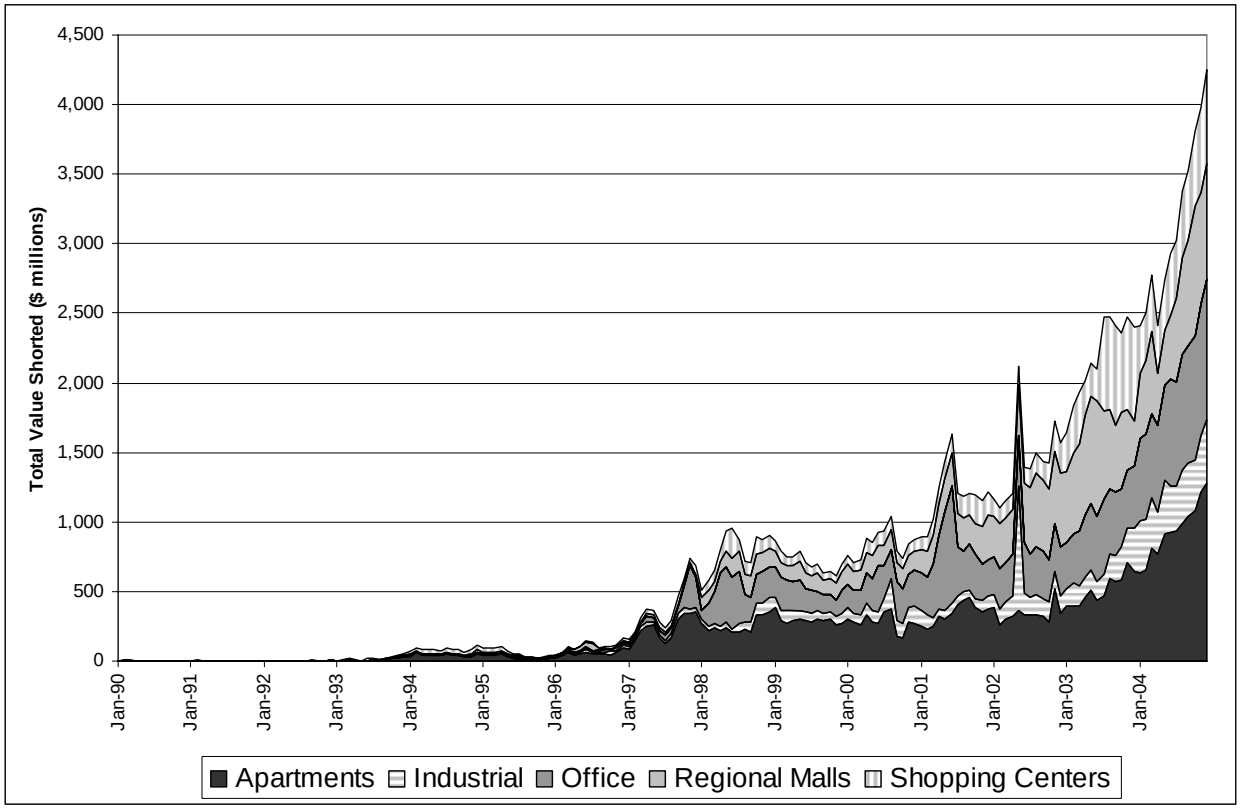
This figure shows the time variation in excess returns for the 5-factor model. The excess return or alpha is estimated over a 48-month rolling window. The heaviest solid line shows the spread between the portfolios for Quartile 1 (Low RSI firms) and Quartile 4 (high RSI firms).

Figure 5 - Property Types of Quartile 4; Number of Firms in Quartile 4 by select Property Types across time.



This figure shows the number of firms, by select property types, in Quartile 4 (High RSI). This figure is the cumulative number of firms; meaning that approximately one-fourth of the full sample in 2004 (or one-fourth of 166 firms) is shown at the end of the sample period. The figure draws attention to those property types which are most widely recognized by institutional investors and for which the sector economics may be more ready associated with underlying property market fundamentals.

Figure 6 – Total Value Shorted in Quartile 4 by Select Property Types across time.



This figure shows the total value (US $ millions) of short interest for select property types. This figure is comprised of the highest RSI quartile and represents approximately one-half of the total value of short interest at the end of the sample period. The figure draws attention to those property types which are most widely recognized by institutional investors and for which the sector economics may be more ready associated with underlying property market fundamentals.