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Daniel Huerta-Sanchez

Diego Escobari
The University of Texas Rio Grande Valley, diego.escobari@utrgv.edu

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Changes in sentiment on REIT industry excess returns and volatility

(*Financial Markets and Portfolio Management*, forthcoming)

Daniel Huerta-Sanchez Diego Escobari

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Abstract

REIT characteristics pose unique risks and benefits to investors who seek liquid diversification and hedging vehicles to complement their portfolios. This paper tests for the asymmetric effect of individual and institutional investor sentiment on REIT industry returns and conditional volatility. We simultaneously model the impact of two markedly different groups of investors on the return generating process of the REIT industry. Our findings suggest that noise trading imposes significant systemic risk on the realization of REIT industry returns. Interestingly, corrections in institutional investor expectations have a larger effect on REIT industry returns and volatility than changes in individual investor expectations. More specifically, bearish shifts in institutional investor expectations of future market conditions have a significantly larger impact on returns and volatility than bullish shifts. Results align with the overreaction to negative information and loss aversion hypotheses.

Keywords: REITs; investor sentiment; noise traders; volatility; GARCH-M
JEL Classification: G02, G11

1. Introduction

Orthodox financial theory posits that noise induced by market participants who make trades on pseudo-signals are not important in the formation of prices given that rational arbitrageurs will maintain prices in check with fundamentals (Fama, 1965). However, empirical evidence of persisting market anomalies challenges the notion that markets are fully efficient and that noise traders play no significant role on prices. Work by De Long, Shleifer, Summers, and Waldmann (1990, DSSW hereafter) provides a theoretical framework that models the impact of noise trading on prices. In the DSSW model, price deviations from fundamental value can persist despite the force of arbitrage given that noise traders are observed to act in concert for prolonged periods and that changes in sentiment are unpredictable. Given the possibility for loss, arbitrageurs' risk aversion will result in a reduction in the position they are willing to take, thus leaving remnants of mispricing. The result is that trading waves based non-fundamental information may introduce a systemic risk on the market that is priced (Lee et al., 2002).

Real Estate Investment Trusts (REITs) are unique securities that offer a hybrid investment between equity and real estate. Investing in REITs allows ownership in professionally-managed real estate portfolios that most financially constrained investors could not have otherwise owned given the illiquid characteristics of the real estate market, the large capital pledges, and the long-term commitment of the typical real estate investment (Chan et al., 2003). As such, REITs are a magnet for both individual and institutional investors who simultaneously seek diversification via indirect commercial real estate ownership and who are concerned with allocating their capital in liquid securities that can be traded without incurring significant transaction costs (Han and Liang, 1995). However, valuing REITs presents unique challenges that are often related to the illiquid nature of their underlying assets. Net asset value

(NAV) is among the predominant methods used to value REITs which involves a comparison between market capitalization and the estimated liquidation value of the properties in their portfolio. Clayton and MacKinnon (2001) document frequent and persistent NAV deviations in REITs that may be often attributed to noise investor trading; they argue that these deviations are related to overly optimistic and pessimistic fluctuations of irrational sentiment.

The purpose of this paper is to test the impact of noise trader risk on REIT industry returns and volatility using the DSSW framework. The DSSW model proposes not only first moment contemporaneous correlations between returns and sentiment changes, but that second moments of returns, measured by their conditional variance, are also affected. The DSSW model expects that if market sentiment is, on average, bullish then noise investors will significantly increase their holdings of risky assets which raises market risk and therefore increases returns. The effect is the opposite when bearish sentiment dominates, when it is expected that noise investors will irrationally reduce (dump) their holdings of risky assets and negatively impact returns (Lee et al., 2002). Moreover, the DSSW framework predicts that the direction and magnitude of changes in noise trader sentiment is also relevant in the formation of prices. That is, the larger the magnitude of the change in sentiment, the larger will be the impact on returns and on the volatility of returns. Moreover, it is expected that bearish shifts in sentiment will have a larger impact on returns and volatility than bullish sentiment changes following the DeBondt and Thaler (1985) overreaction hypothesis.

Using a generalized autoregressive conditional heteroscedasticity (GARCH) in-mean model, we test the impact of changes in sentiment on REIT market returns and volatility. Our paper contributes to the literature by including measures of both individual and institutional investor sentiment in our model to test whether these distinct types of investors introduce noise as a priced risk factor on a diversified portfolio of REITs.

Although the individual investor has been considered the noise trader and the institutional investor the rational arbitrageur, we justify the use of both sentiment measures following Brown and Cliff (2004). They find that bullish (bearish) shifts in institutional investor sentiment create noise and positively (negatively) affect prices, challenging the conventional wisdom that sentiment is primarily an individual investor driven phenomenon that should only affect small stocks. Moreover, institutional investors have been observed to display herding behavior and to rely on peer trading as capital allocation signals under the perception that other institutions may hold superior information (Freybote and Seagraves, 2017). This reliance on external signals that may or may not convey fundamental information is a phenomenon that can be associated with the formation of expectations about market conditions to buy, hold, or sell. In our study we also consider the sharp increase in institutional ownership in the REIT industry in recent years to expect that institutional noise trading is a factor that will significantly impact prices. Figure 1 shows that aggregate percentage of institutional ownership has grown from about 16.43% in 1992Q1 to 66.07% in 2003Q1. In addition, our empirical approach allows for asymmetries in the impact of investor sentiment on REIT industry returns and volatility. We expect that negative shifts in sentiment affect security returns and volatility differently than do positive shifts in sentiment.

[Figure 1, about here]

The empirical results suggest greater influence on REIT returns and volatility from changes in institutional investor sentiment than from individual investor sentiment, even after controlling for institutional ownership. This is consistent with prior investor sentiment literature that argues that rational sentiment will influence the market when arbitrage opportunities arise, that is, institutional investor sentiment is significant in explaining returns (Verma and Soydemir, 2009). Our results also align with Freybote and Seagraves (2017) who find a significant dynamic relationship between sentiment and both securitized and commercial real estate; however, their study focuses on the particular office space property type and concentrates in testing this impact on the first moment of returns which implicitly assumes homoscedastic conditional variance. Our findings extend previous studies that suggest that only individual investor sentiment is significantly and positively related to the formation of REIT prices (see, e.g., Lin et al., 2009). Similar to Lin et al. (2009), we find that the level of institutional ownership is an insignificant factor in explaining REIT returns; however, our results indicate that both individual and institutional investor sentiment affect REIT returns in different ways. Our estimates point to an asymmetric effect in bullish and bearish changes in institutional investor sentiment, whereas no asymmetric effect is observed for changes in individual investor sentiment. As institutional investor sentiment turns bearish, institutions will tend to hold less of the risky assets because of pessimistic future expectations. The negative returns are pushed by expectation-induced sales of REIT stocks. Conversely, bullish shifts in expectations will pressure price upwards since optimistic investors will seek to purchase REITs in the expectation of improvements in future market performance.

When modeling the heteroscedastic shocks, we find strong support showing a positive and statistically significant effect of bearish institutional investor sentiment on excess return volatility, whereas bullish institutional investor sentiment has no statistically significant impact. In the case of individual investor sentiment, both bullish and bearish sentiments positively and significantly impact the risk of holding REITs, as captured by the volatility on excess return. However, the magnitudes for these coefficients are considerably smaller than for institutional investor sentiment. Overall, results favor the De Bondt and Thaler (1985) overreaction hypothesis; coefficients for negative changes in sentiment are consistently larger in magnitude than for positive shifts in sentiment, that is, the overreaction is greater for negative expectations. This is also in line with the notion of investor loss aversion. Our findings also contribute to the behavioral finance and REIT literature by further exploring the sentiment-return relationship and by examining the effect that sentiment has on volatility for this peculiar and highly regulated industry.

The remainder of this paper is organized as follows. Section 2 provides a survey of relevant literature. Section 3 describes the data, while Section 4 presents the econometric framework. Section 5 reports and discusses the empirical results and Section 6 provides a summary of the findings and concludes.

2. Literature Review

After decades of debate, sentiment is now recognized by numerous financial economists to be a significant factor influencing the return generating process of financial securities (see, e.g., Baker and Wurgler 2006; 2007). Conventional theory assumes that investors are all rational profit maximizers who make trades based on fundamental information and that their allocation decisions are not biased by sentiment. However, the behavioral finance approach to modeling returns has proposed various theories and provided empirical evidence that sentiment does contribute to noise that significantly impacts the formation of prices. Black (1986) proposes that prices are not always fully reflective of fundamentals and that noise cannot be excluded from models that attempt to grasp the return and volatility behavior of securities. He refers to noise as factors that cause this deviation which, among other components, largely include irrational trader sentiment. A relevant example of a theoretical framework that incorporates sentiment is DSSW (1990), who model the effect of noise on equity prices. The DSSW model suggests that although arbitrageurs bet against noise trader mispricing, they cannot always drive prices to their fundamental values. This is because noise traders, who trade on noise as if it were information, can drive prices so far away from fundamentals that sophisticated investors will not be willing to bear the risk of betting against them. This phenomenon can be persistent thus making sentiment a risk that is priced.

Empirical evidence that acknowledges on the effect of sentiment on security prices is now common in the financial literature. For instance, widely cited papers, such as Baker and Wurgler (2006, 2007) and Brown and Cliff (2004, 2005), show that sentiment is a risk factor that significantly impacts stock returns. In a recent study, Johnk and Soydemir (2015) provide evidence that sentiment decomposed into rational and irrational components is a significant factor in explaining sector returns using a conditional capital asset pricing model. However, their study focuses on aggregate global industry classification standard (GICS) sectors for the S&P 500 and does not provide an explicit indication of the impact of sentiment on the REIT industry. In the case of REITs, Chan et al. (1990) and Lin et al. (2009) find that proxies for investor sentiment significantly impact REIT returns even after controlling for other risk factors observed to influence REIT prices. Other research also explores the relationship between investor sentiment and the REIT market (Barkman and Ward, 1999; Chiang and Lee, 2010; Das et al., 2014). To the best of our knowledge, our approach is the first to explore a dynamic model that tests for the impact of heterogeneous investor sentiment measures, individual and institutional, when contemporaneously modeling returns and the return volatility of an aggregate securitized real estate portfolio.

Based on the DSSW (1990) theoretical model, empirical research has emerged to show the effect of investor sentiment not only on returns, but on higher moments of returns such as conditional variance, a view empirically supported by Brown (1999) and Lin et al. (2002). Glosten et al. (1993) provide evidence that market volatility is, in fact, impacted by shocks to the market and that there is an asymmetric impact on volatility depending on the nature of the shock. Investor sentiment is a key component of these shocks which carry information not reflected by fundamentals. Lee et al. (2002) use a GARCH framework to test for the impact of sentiment on stock market returns and its conditional variance (volatility). They find that volatility is asymmetrically impacted by changes in sentiment, specifically finding that negative sentiment has a greater impact than positive sentiment, and that higher (lower) volatility in prior periods leads to lower (higher) future returns. This linkage between sentiment, returns, and volatility offer an avenue of research on securities with unique traits such as REITs. REITs offer characteristics of both stocks and direct private real estate investments, bringing diversification benefits to investor portfolios which categorize them as a unique asset class for many investors.

The REIT industry serves as a testing ground for many financial theories given the nature of their underlying assets and the strict rules to which REITs must conform, which clearly differentiates them from other equities.[1] A distinctive REIT industry characteristic is the

[1] REIT qualifying rules can be accessed at: https://www.reit.com/investing/reit-basics/what-reit

relatively high levels of institutional ownership recorded in recent years.[2] Figure 1 shows that REIT aggregate institutional ownership has fluctuated between 43% and 66% between 2003 and 2013 and it is currently maintaining historically high levels. It is common wisdom that increased levels of institutional ownership in firms influence management behavior through increased monitoring and, consequently, the formation of stock prices. Institutions can add pressure to prices and price volatility because their trading patterns may serve as signals to other investors that hold the same stock (e.g., herding) or because their large stock holdings and their potential to trade in blocks can substantially affect prices.

The relationship between investor sentiment and REITs has been addressed to some extent in previous literature; however, more research is crucial to establish a pattern of findings that will bring an enhanced understanding of the impact that investor expectations of future market conditions have on the return generating process of this industry. Chan et al. (1990) pioneered the analysis of the relationship of REIT returns and closed-end fund discounts, a commonly used proxy for investor sentiment. They find that the closed-end fund discounts significantly affect REIT returns using a multifactor Arbitrage Pricing model. Lin et al. (2009) builds on Chan et al. (1990) and further investigates the investor sentiment-REIT return relationship. Lin et al. (2009) use as a proxy for individual investor sentiment the change in closed-end fund discounts and control for sophisticated investor influence with the change in REIT institutional ownership. Findings from Lin et al. (2009) suggest that there is a positive and significant relationship between investor sentiment and REIT returns. Their analysis shows that when their proxy of investor sentiment depicts optimism, REIT returns are higher. These

[2] Institutions that invest in REITs include bank trusts, insurance companies, mutual funds/investment advisers, and others (Devos et al., 2012). The group with largest REIT holdings is the mutual funds/investment advisers (38% of ownership on average).

findings are aligned with related research that also suggests a positive relationship between sentiment and stock returns (e.g. Neal and Wheatly, 1998; Lee et al., 2002; Baker and Wurgler, 2007).

Specific results from Lin et al. (2009) suggest that individual investor sentiment impacts REIT returns and that institutional investor ownership does not have a significant impact on REIT prices or mitigates the effect of sentiment on REIT returns. We extend their work by considering the potential effect that institutional investor expectations may have on REIT returns. Previous work shows that after the relaxation of the five-or-fewer rule with the Revenue Reconciliation Act of 1993, the substantial increase in institutional ownership resulted in an increase in REIT prices (Downs, 1998). Chan et al. (2005) explain that the increase in institutional participation in the REIT market after the structural changes occurred in the 1990s have influenced REITs to behave more like other equity for which institutional ownership is significant. This tendency suggests that the rise in institutional ownership should increase the influence of institutional investors' perception of market conditions on REIT price formation.

3. Data

We employ the FTSE NAREIT U.S. Real Estate Index and the FTSE NAREIT U.S. Total Return Index returns from Thomson's DataStream as proxies to construct REIT industry returns. The difference between the two series is that the FTSE NAREIT U.S. Real Estate Index solely tracks prices, while the FTSE NAREIT U.S. Total Return index both tracks prices and takes into account dividend payments. The total return index is relevant since dividends constitute a significant source of income for REIT investors and because investors often hold REITs in their portfolios for the steady dividend stream rather than for stock price appreciation. We provide results using both series to assess the robustness of our results. The FTSE NAREIT Real Estate indices are a free-float adjusted, market capitalization-weighted indices of U.S. Equity REITs. The FTSE NAREIT is a proper sample of the REIT industry since it includes all REITs recognized by the National Association of Real Estate Investment Trusts (NAREIT). Constituents of the Index include all tax-qualified REITs with more than 50 percent of total assets in qualifying real estate assets other than mortgages secured by real property. The sample covers the period from January 1992 to February 2013. The sample begins in 1992 since the REIT industry experienced significant changes in rules and regulations then; in fact, academics refer to the period after 1992 as the "new REIT era" (Pagliari et al., 2005; Oikarinen et al., 2011). After the changes in the REIT market in the early 1990s, it is believed that a notable increase in institutional ownership and in analyst coverage led to a better dispersion of information about these firms. These changes resulted in REIT prices more accurately reflecting market fundamentals and displaying less deviation from their net asset value, making the REIT market more efficient (Oikarinen et al., 2011). We obtain institutional ownership data from Compustat.

We use the Fama and French (1992) factors and the default risk (*DEF*) and term structure premiums (*PREM*) as control variables. Although some academics debate whether the use of the Fama-French factors adequately explain REIT returns, Peterson and Hsieh (1997) address this issue and conclude that equity REIT returns are affected by the market-to-book and size factors as suggested by Fama and French (1992) and by the bond market factors *DEF* and *PREM* (Fama and French, 1993). The Fama-French and bond market risk factors are commonly used in REIT literature as control variables (e.g., Buttimer et al., 2005; Lee et al., 2008; Lin et al., 2009; Ro and Ziobrowski, 2011). The Fama-French factors are obtained from Dr. Kenneth French's website.[3] *DEF* is the default risk premium defined by the difference between Moody's Seasoned Aaa Corporate Bond Yield and the Baa Corporate Bond Yield. *PREM* is the term risk premium constructed as the difference between the 20-year Treasury bond rate and the one-month Treasury bill rate. The *DEF* and *PREM* factors are constructed from data from Thomson's DataStream.

3.1. Investor sentiment

Following previous empirical studies, we employ direct survey-based sentiment indices (e.g. Brown and Cliff, 2004; Liu, 2015; Johnk and Soydemir, 2015) in weekly frequency. Brown and Cliff (2004) find that survey-based sentiments are significantly related to commonly used indirect measures (proxies) of sentiment such as: the number of advancing issues to declining issues, the proportional percent change in margin borrowing, the proportional percent change in short interest, the ratio of specialists' short sales to total short sales, the ratio of odd-lot sales to purchases, the equity put-to-call trading volume, the closed-end fund discount, the net purchases of mutual funds, the proportion of fund assets held in cash, and the initial public offerings first day returns.[4] This suggests that survey measures do a proper job in depicting sentiment. Brown and Cliff (2004) suggest that sentiment does not necessarily impact individual investors and small stock exclusively as has been commonly presented in the literature; their analysis shows that institutional investor sentiment is also a factor that impacts returns and that large stocks are also affected by sentiment.

[3] Accessed on November 29, 2014. http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html

[4] An advantage of utilizing the II and AAII as our proxies for sentiment is the weekly frequency which suits our methodology, whereas many other sentiment proxies are collected in either monthly or quarterly frequency.

As a proxy for institutional investor sentiment, this study employs the Investors Intelligence (II) survey. Investors Intelligence is an organization dedicated to technical analysis and financial research that collects data on institutional investors' perception of the market. The Investors Intelligence survey is built on a compilation of investment advisory newsletters' perception of future market performance. These perceptions are labeled bullish, bearish, or hold depending on the recommendations from the advisors for which three measures are constructed: the percentage of bullish advisors, bearish advisors, and neutral advisors. The institutional sentiment index in this analysis is constructed by calculating the spread between the percentage of bullish investors and bearish investors, commonly referred to as the bull-bear spread (Brown and Cliff, 2004).

To proxy for individual investor sentiment, this study employs data from the American Association of Individual Investors (AAII) market condition survey. The AAII is a nonprofit organization that focuses on education to individual investors about wealth management and investing. This survey is conducted by the AAII selecting a random sample of its members and asking about their perception of market outlooks for the following 6 months. Depending on the responses, the AAII labels each survey as bullish, bearish, or neutral. The individual sentiment index is constructed by calculating the difference between the percentage of bullish responses and bearish responses of the surveys. The AAII index is a bull-bear spread variable that has been used to capture individual investor sentiment (Brown and Cliff, 2004). Both surveys (AAII and II) are collected weekly.

3.2. Descriptive statistics

Table 1 presents the correlations for the variables employed in this study. The correlation between changes in individual investor sentiment ($\Delta AAII$) and changes in institutional investor sentiment (ΔII) is roughly 0.162.[5] This relatively low correlation coefficient can be explained by the fact that both variables appear in first differences, the same transformation we use in the estimations. The relatively low coefficient suggests that our two distinct classes of investors react differently to innovations and new information in the market. In addition, it provides motivation to use both when studying the role of sentiment on returns and volatility. The largest two correlations observed are between the NAREIT excess returns and the FF excess return of the market (0.561), and between the NAREIT excess returns and the HML factor (0.289). This is reasonable given that REITs, despite regulations and rules are, in fact, equity and are expected to have a relatively high correlation with equity market factors. Overall, most of the relatively low pair-wise correlations reported in Table 1 are preliminary evidence that multicollinearity is unlikely to be a concern in the empirical specifications presented in section 4.[6]

[Table 1, about here]

Summary statistics are presented in Table 2. Weekly mean NAREIT excess total returns (0.231%) are larger than excess price returns (0.118%) as expected. Excess total returns reflect not only REIT stock returns but also incorporate dividends which are a substantial source of income for REIT investors. Mean excess REIT total weekly returns are larger than market excess returns (0.134%) for the sample period, supporting claims of REIT over performance with respect to stock market from the National Association of Real Estate Investment Trusts.

[5] All analyses were also performed using levels of investor sentiment. Results using levels rather than changes in sentiment yield qualitatively similar results to the ones reported. For the sake of brevity, we omit these results but are available upon request.

[6] Because some of the correlations appear to be relatively large, for example, the pair-wise correlation between *Def* and *Prem* (0.382), we additionally run various OLS regressions, similar to the specifications we will use in the empirical section (e.g., equation 1), to calculate the Variance Inflation Factors (VIF). We found no evidence that multicollinearity could be a concern as all VIF were below 10.

[Table 2, about here]

Changes in institutional investor sentiment (ΔII) appear less volatile than changes in individual investor sentiment ($\Delta AAII$). This is consistent with Figure 2, which presents the time series graphs of both of these measures. The standard deviation for $\Delta AAII$ (14.762%) is substantially larger than for ΔII (4.616%). Moreover, the minimum (-58.000) and maximum (51.000) values for $\Delta AAII$ are considerably larger in magnitude than the minimum and maximum for ΔII (-17.500 and 18.100, respectively). The ranges in these figures are consistent with the observed differences in unconditional volatilities of sentiment, captured by the unconditional standard deviations of $\Delta AAII$ and ΔII as presented in Table 2. The relatively low average weekly changes in sentiment indicate that negative and positive shifts in sentiment are offsetting each other over time.

[Figure 2, about here]

To test for the asymmetric impact of changes in sentiment on returns, we employ an interaction term between the absolute value of changes in sentiment and the dummy variable D_t that at time t takes the value of 1 if changes in sentiment are positive and 0 if changes in sentiment are negative. This dummy variable is multiplied by the magnitude of the change in sentiment since previous research finds that in addition to the direction of the correction in sentiment, the magnitude of shifts in sentiment has a significant impact on the formation of conditional volatility of returns and expected returns (Lee et al., 2002). The observed means of

D_t*|Δ$AAII|_t$ and $(1- D_t)$*|Δ$AAII|_t$ are 5.713 and 5.699, which are considerably larger than the means of D_t*|Δ$II|_t$ and $(1- D_t)$*|Δ$II|_t$, calculated at 1.777 and 1.765. This, again, suggests a greater volatility in individual investor sentiment with respect to institutional sentiment. Table 3 presents the frequency table for changes in both individual and institutional investor sentiment. Overall there are more positive than negative Δ*II* and Δ*AAII*; however, the difference is minor.

[Table 3, about here]

4. Methodology

4.1. Modeling excess returns and asymmetric effects

We now turn to describe the empirical model to capture how excess returns are affected by sentiment. A central element in this model is to be able to allow for asymmetric effects in the mean as well as in the variance equations. To achieve this, we isolate negative changes in sentiment from positive ones, in addition to accounting for the magnitude of these changes. This will be consistent with Lee et al. (2002), who find that the size of the fluctuations in investor sentiment influence returns. In particular, the mean equation that describes the asymmetric effect of changes in sentiment on REIT returns has the following form:

$$(REIT - Rf)_t = \beta_0 + \beta_1 D_t|\Delta Sent_t| + \beta_2 (1 - D_t) |\Delta Sent_t| + \sum_{i=1}^{N} \gamma_i X_{it} + \varepsilon_t \quad (1)$$

where $(REIT\text{-}Rf)_t$ are the FTSE NAREIT U.S. Real Estate Index excess returns at time *t*, and $\Delta Sent_t$ is the change in sentiment for the measures of institutional and individual sentiment. Moreover, D_t is a dummy variable that takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative, while X_t is a vector of control variables that we explained in detail below. ε_t is the remainder stochastic term. We are interested in estimating the vector of coefficients $(\beta_0, \beta_1, \gamma_i')$.

From equation (1) we observe that the interaction term between the dummy D_t and the absolute value of $\Delta Sent_t$ along with the interaction term between $1 - D_t$ and absolute value of $\Delta Sent_t$ are expected to capture the asymmetric effect. In particular β_1 reflects the impact that positive changes in sentiment have on REIT industry returns whereas β_2 reflects the impact of negative changes in sentiment. The changes in sentiment for individual and institutional investors are included in the model separately and simultaneously to assess whether there are any overriding effects among the sentiments of these two types of investors in the model.

For the vector of observed control variables X_t we employ the Fama and French (1992) three stock market factors as well as the default risk (Def_t) and term structure variables ($Term_t$) as proposed by Peterson and Hsieh (1997). $(Rm\text{-}Rf)_t$ is the excess return on the market portfolio constructed as the value-weighted returns on all NYSE, AMEX, and NASDAQ stocks minus the one-month Treasury bill rate. SMB_t (small minus big) is the average return on the three small portfolios minus the average on the three big portfolios for all stocks based on market capitalization. HML_t (high minus low) is the average return on the two value portfolios minus the average return on the two growth portfolios for all stocks based on the book-to-market ratio. Def_t is the default risk premium defined by the difference between Moody's Seasoned Aaa Corporate Bond Yield and the Baa Corporate Bond Yield. $Prem_t$ is the term risk premium constructed as difference between the 20-year Treasury bond rate and the one-month Treasury bill rate. We expect X_t to explain a large portion variability in REIT returns (see, e.g., Buttimer et al., 2005; Lee et al., 2008; Lin et al., 2009; Ro and Ziobrowski, 2011).

In addition to modeling the mean equation of excess return, we are interested in modeling the conditional variance as this is a measure of the risk of holding REITs. An important element before modeling the conditional variance is to test the null hypothesis of homoscedastic errors in equation (1). Homoscedastic errors imply a constant risk model. If the null of homoscedasticity is rejected, then OLS in equation (1) is still unbiased, but it is no longer efficient. More importantly, rejecting the null means that risk of holding REITs might be modeled as a function of some covariates. In particular, we want to model the risk to be a function of investor sentiment.

To test for heteroscedastic errors, we use a variation of the Breusch-Pagan test. The first step is to estimate equation (1) using OLS to obtain an estimate of the error terms. Because the estimation includes a constant term, by construction the error terms in equation (1) have an expected value of zero. This means that we can use the error terms squared to approximate its variance. Our Breusch-Pagan test then uses the squared of the predicted error terms in equation (1) and regresses them on the same set of independent variables. That is, we estimate the following auxiliary regression:

$$\hat{\varepsilon}_t^2 = \delta_0 + \delta_1 D_t|\Delta Sent_t| + \delta_2 (1 - D_t) |\Delta Sent_t| + \sum_{i=1}^{N} \theta_i X_{it} + \varphi_t \qquad (2)$$

Under homoscedastic errors equation (2) should not be able to explain $\hat{\varepsilon}_t^2$. Hence the null hypothesis of homoscedasticity is a test of whether all the slope coefficients in (2) are jointly equal to zero, i.e., $H_0: \delta_1 = \delta_2 = \theta_1 = \theta_2 = \cdots = \theta_N = 0$. Using the R-squared we can either base the test on an F-statistic or multiply the R-squared times the sample size to have an LM (Lagrange Multiplier) statistic that follows a chi-squared distribution. Rejection of the null in favor of the alternative of heteroscedastic errors is evidence of ARCH errors.

[Table 4, about here]

[Table 5, about here]

[Table 6, about here]

Tables 4, 5, and 6 present the OLS regression results from the estimation of equation (1) for various specifications of the definition of sentiment and the set of regressors in X_t. In addition to reporting the R-squared, at the bottom of each of these tables we report the Breusch-Pagan LM test statistics as well as their corresponding p-values. We find that for the institutional investors sentiment in Table 4 there is strong evidence of ARCH errors across all models. For the individual investor sentiment reported in Tables 5 there is strong evidence of ARCH errors in models 3 and 4, while some evidence (p-value<0.1) for model 1. When combining measures of sentiment, we observe in Table 6 that there is strong evidence in three of the models. Overall, we find that at at least 1% significance level there are ARCH errors in 8 of the 12 models, while at at least 10% significance level in 11 of the 12 models.[7] OLS for these models are not efficient so we additionally allow for an ARCH error structure estimated via maximum-likelihood (Escobari and Lee, 2013).

4.2. Asymmetric effects of sentiment on returns and volatility

To model the impact of changes in sentiment on REIT returns and volatility, we augment the estimation of equation (1) with a second equation that models the dynamics of the

[7] At a 10% level we fail to reject homoscedasticity only in model 2, Table 5.

conditional volatility. The idea is to use maximum likelihood to jointly estimate equation (1) and one of the following specifications for the variance equation:

$$h_t = \varphi_1 + \varphi_2\varepsilon_{t-1}^2 + \varphi_3\varepsilon_{t-1}^2 I_{t-1} + \varphi_4 h_{t-1} + \varphi_5 D_t\,|\Delta Sent_t| + \varphi_6(1-D_t)\,|\Delta Sent_t| + \omega_t \qquad (3)$$

$$\log(h_t) = \alpha_1 + \alpha_2\left(\varepsilon_{t-1}/\sqrt{h_{t-1}}\right) + \alpha_3\left|\varepsilon_{t-1}/\sqrt{h_{t-1}}\right| + \alpha_4\log(h_{t-1}) + \varphi_5 D_t\,|\Delta Sent_t| + \varphi_6(1-D_t)\,|\Delta Sent_t| + \omega_t \qquad (4)$$

The link between the mean and the variance equation is that the stochastic error term ε_t in the mean equation is assumed to follow a normal distribution, $\varepsilon_t \sim N(0, h_t)$, with h_t being the conditional variance modeled with either equation (3) or (4). The benefit of a joint estimation of the mean and variance equations is to additionally allow us to test for asymmetric effects of sentiment on the conditional volatility of excess returns. While the null hypothesis $\beta_1 = \beta_2$ helps in assessing asymmetries in the mean equation, the null hypothesis $\varphi_5 = \varphi_6$ allows to test for asymmetries in the variance equation. Rejection of the null of $\varphi_5 = \varphi_6$ implies that positive and negative changes in sentiment have a differentiated effect on stock volatility (i.e., the risk of holding REITs).

In the threshold-GARCH conditional variance presented in equation (3), ε_{t-1}^2 are lagged shocks from the mean equation and I_{t-1} is a dummy variable that takes the value of 1 if $\varepsilon_{t-1} < 0$, zero otherwise. The coefficient φ_3 is expected to capture asymmetries on how the conditional volatility is impacted differently by positive and negative shocks (Nelson, 1991; Glosten et al., 1993). For negative shocks the magnitude of the effect is captured by φ_2, while positive shocks have an effect of $\varphi_2 + \varphi_3$. Glosten et al. (1993) find that the magnitude of the impact of bad news is greater than for good news on market volatility, therefore φ_3 is expected to be negative since positive shocks have been observed to cause a downward revision in conditional variance.

In the exponential-GARCH conditional variance presented in equation (4), $\varepsilon_{t-1}/\sqrt{h_{t-1}}$ are standardized lagged shocks. This model allows for leverage effects. If the standardized lagged shocks are positive, the effect of the shocks on the conditional variance is $\alpha_2 + \alpha_3$, but if the shocks are negative the effect is $-\alpha_2 + \alpha_3$. The lagged elements h_{t-1} in equation (3) and log(h_{t-1}) in equation (4) are realizations of the conditional variance to account for autocorrelation in volatility.

The interpretation of the asymmetries in the mean equation follow equation (1). It is expected that investors will react differently to the magnitudes of the shifts in bullish and bearish sentiment (Lee et al., 2002), which would be consistent with DSSW (1990), who predict that the direction and magnitude of changes in sentiment are relevant in asset pricing. Note that when $\Delta Sent_t > 0$, the impact on volatility will be captured by the coefficient φ_5, and if $\Delta Sent_t < 0$ the impact on volatility will be captured by φ_6. Individual and institutional investor sentiments are included in the model independently and simultaneously for a thorough analysis.

5. Empirical Results

5.1. REIT returns and volatility, and institutional investor sentiment

Table 7 presents the empirical results for the GARCH specifications in equations (1) and (3). Model 1 includes the results for the equation that only includes positive and negative changes in institutional investor sentiment (ΔII) in the mean and conditional variance equations. There are no relevant differences between results for REIT price returns and total returns. The estimates show that both positive and negative changes in institutional investor sentiment have a statistically significant impact on REIT returns. Moreover, they have a differentiated effect with the difference between the coefficients being statistically significant as the χ^2 associated with the null of $\beta_1 = \beta_2$ is 17.23 for REIT price returns. This implies a rejection of the null at the 1% level. For REIT total returns the statistics associated with the test is χ^2 =16.39, implying a rejection of the null at the 1% level.

[Table 7, about here]

The signs of the coefficients are as expected; there is a positive relationship between positive changes in institutional investor sentiment and REIT excess returns, whereas there is a negative relationship between negative changes in investor sentiment and REIT excess returns. In support of the DeBondt and Thaler (1985) overreaction and loss aversion conjectures, the magnitude of the negative changes in institutional investor sentiment coefficient is larger in magnitude than that for the coefficient for positive changes.

The coefficients on the control variables *Rm-Rf*, *SMB* and *HML* are all positive and statistically significant at the 1% level, indicating that the Fama-French equity factors have an important role when explaining REIT returns. REITs tend to respond to the same factors that explain the variation in returns of other stocks in the market. On the other hand, the *Def* and *Prem* bond factors appear statistically insignificant in the results; previous research argues that because of the unique dividend policy in the REIT industry, these resemble to some extent the behavior of fixed-income securities (Lee and Stevenson, 2005). However, our results provide no evidence to support this conjecture.

The conditional variance equations in both specifications of Model 1 in Table 7 show that, with the exception of the coefficient on $D_t\ |\Delta II_t|$, the estimated GARCH coefficients are all statistically significant. In particular, the estimates show that innovations have an asymmetric effect on conditional volatility. Positive shocks cause higher upward revisions in volatility than negative shocks. In addition, volatility at *t-1* significantly impacts concurrent conditional volatility with a relatively high point estimate, indicating a high persistence in volatility dynamics. Both positive and negative shifts in sentiment appear to positively contribute to volatility; however, the difference between the magnitudes of the coefficients for positive and negative changes in institutional investor sentiment are not statistically significant. Note that the 0.313 estimate on the variance equation in column one shows that negative shifts in institutional investor sentiment impact the conditional variance significantly. On the other hand, the 0.039 estimate on the same column shows that positive changes in sentiment have a statistically insignificant effect. These results are again, consistent with the overreaction hypothesis which posits that negative sentiment contributes to volatility more than positive sentiment. All residuals follow a white noise process as suggested by significant Portmanteau *Q*-statistics reported in the last line of Table 7.

5.2. REIT returns and volatility, and individual investor sentiment

Model 2 in Table 7 shows the results from the joint estimation of equations (1) and (3), when the measure of sentiment is individual investor sentiment (*AAII*). The first column of Model 2, reports the estimates when excess REIT price returns is the dependent variable. Under this specification, positive changes in individual investor sentiment are observed to have a positive and statistically significant impact on excess returns (10% significance level), whereas, negative shifts have no statistically significant effect. These results are consistent with a bandwagon effect, even though the impact on returns is relatively small. As reported at the bottom of the table, there is a statistically significant difference between the coefficient for positive and negative $\Delta AAII$ (χ^2 = 6.50, significant at the 5% level). This is indicative that returns are impacted asymmetrically by bullish and bearish sentiment, result consistent with our previous specifications that used institutional investor sentiment. Also in line with the results from Model 1, the slope coefficients on the control variables *Rm-Rf*, *SMB*, and *HML* are all positive and statistically significant, yet, coefficients for bond factors *Def* and *Prem* are not statistically different from zero.

The estimates of the conditional variance equation in Model 2 (Table 7) for REIT price returns show that the GARCH terms all have the expected signs and are consistent with results from Model 1. Bearish individual investor sentiment has a positive and statistically significant effect on conditional volatility, yet, bullish individual investor sentiment has no statistically significant effect. These findings are consistent with the overreaction hypothesis in which negative shifts in sentiment are associated with greater increased volatility than for positive changes in sentiment.

When we examine the results for REIT total returns in the second specification of Model 2, we can observe slight differences compared to REIT price returns. For instance, in the mean equation, although there is a statistically significant difference between the coefficients for positive and negative $\Delta AAII$ (χ^2 =4.96, significant at the 5% level), neither coefficient is significantly different from zero. These results imply that changes in sentiment from individual (small) investors are not relevant to REIT returns. Nevertheless, both positive and negative $\Delta AAII$ positively contribute to REIT total return volatility. This signals that although small investors do not have a significant impact on returns, their trading introduces increased risk in this market. The coefficient for negative $\Delta AAII$ is larger in magnitude than for positive $\Delta AAII$ providing evidence to support the overreaction conjecture in the conditional variance equation of Model 2. More than likely, risk derived from irrational trading contributes to REIT return over-performance with respect to the overall stock market.

5.3. REIT returns and volatility, jointly including individual and institutional sentiments

Model 3 in Table 7 presents the results for the compressive model that includes institutional (ΔII) and individual sentiment ($\Delta AAII$) simultaneously. This model is useful to study whether results are robust when sentiments from these two markedly different types of investors are jointly included in the model specification. The results for REIT price returns and for total returns are identical in essence. The estimates for the mean equation in both specifications show that ΔII has a statistically significant while $\Delta AAII$ does not contribute significantly to changes in REIT returns. One might argue that increases in institutional ownership in REITs in recent years can explain these results. Consistent with Figure 1, Devos et al. (2012) explain that institutional ownership holdings have been increasing. Moreover, institutions generally have larger capital than individuals and often have the capacity to trade in blocks large enough to influence REIT prices. To test if institutional ownership plays a role in our results, Table 8 presents the estimates for the comprehensive model with institutional ownership as an additional variable in the mean and the variance equations. We find that after controlling for institutional ownership, the results are quantitatively the same.

[Table 8, about here]

When examining the asymmetric impact of sentiment on REIT returns, we observe from Table 7 that the effect for positive shifts on institutional sentiment is statistically different than for negative shifts (χ^2 =15.99, significant at the 1% level), denoting an asymmetric impact between bearish and bullish institutional investor sentiment on excess returns. Moreover, the magnitude for bearish episodes is larger than for bullish episodes, providing further support for the overreaction hypothesis. In the case of individual sentiment, no asymmetry is observed.

In the conditional variance equations, the results are consistent with Models 1 and 2 in both Tables 7 and 8. Negative changes in institutional investor sentiment contribute to upward revisions in volatility, whereas positive changes in sentiment are not significant when explaining volatility. In effect, a statistically significant difference among coefficients for positive and negative shifts in institutional investor sentiment (ΔII) suggests an asymmetric impact on the conditional variance (in Table 7, χ^2 =3.13, significant at the 10% level for REIT price returns and χ^2 =3.26, significant at the 10% level for REIT total returns). In contrast, there is no statistically significant difference between the coefficients for positive and negative individual sentiment, $\Delta AAII$. However, for both price and total returns, the coefficients for negative $\Delta AAII$ are larger in magnitude than for negative changes, which provide additional support for the overreaction hypothesis. Positive $\Delta AAII$, however, appear to only significantly positively (10% significance level) impact volatility in REIT total excess returns. Residuals follow a white noise process as suggested by significant Portmanteau *Q*-statistics reported in the bottom of Tables 7.

[Table 9, about here]

Table 9 presents an additional robustness check on the specification of the variance equation by reporting the joint estimation of equations (1) and (4). The results for the mean equation are nearly the same as the ones reported in Tables 7 and 8. Moreover, for the variance equation the exponential-GARCH models present strong support to the hypothesis of differentiated effects between negative versus positive shifts in institutional investor sentiment. The same is true for the individual sentiment, as illustrated in the estimates from Model 2. Overall, when comparing Tables 7, 8 and 9, we see that the results on the effect of sentiment of

REIT return and volatility are robust to the selection of a threshold-GARCH or an exponential-GARCH.[8]

6. Conclusion

Advances in behavioral finance suggest that security prices not only reflect economic fundamentals but are also influenced by noise factors such as investor perception and trading patterns. Theoretical models imply that investor sentiment is a significant factor in explaining returns and volatility and that noise traders can deviate prices from fundamental values substantially and, in some cases, persistently. This paper contributes to the REIT and investor sentiment literature in the following distinct ways. We initially extend the work of Lin et al. (2009) by making a distinction between two markedly different categories of investors: rational institutional investors and small individual investors. These two groups of investors are observed to form distinct expectations, and we assess whether these differences impact returns and volatility differently. To test for the impact of individual and institutional investor sentiment on REIT returns, we employ a GARCH framework following the DSSW noise trader model to simultaneously characterize the dynamics of returns and conditional variance. We also test whether there is an asymmetric impact between positive and negative changes in investor sentiment on REIT returns and volatility.

Overall, our results indicate that investor sentiment is a significant factor in explaining REIT returns and volatility. This is in line with the results in Lin et al. (2009). However, we find that institutional investor sentiment has a larger impact on REIT returns and volatility compared to individual investor sentiment. These results hold even after controlling for the increase in

[8] The negative and statistically significant point estimate on $\varepsilon_{t-1}/\sqrt{h_{t-1}}$ is consistent with in previous findings (Lee et al, 1992); negative shocks cause higher upward revisions in volatility than positive shocks.

aggregate institutional ownership in REITs in recent years. These results may be attributed to institutional real estate investor herding behavior as suggested by Freybote and Seagraves (2017). Additionally, results suggest an asymmetric impact between bearish and bullish institutional investor sentiment on both REIT industry excess returns and volatility, whereas no statistically significant difference is recorded between bearish and bullish individual investor sentiment on REIT industry returns and volatility. As institutional investors have negative future market expectations, that is, sentiment turns bearish; institutions will tend to hold less of the REIT portfolio. The negative returns are induced by negative expectation sales of REITs. Conversely, optimistic institutional investors purchase REITs and pressure their prices upward in the expectation of improvements in future market performance. Overall, results are aligned with the overreaction and loss aversion hypotheses; coefficients for institutional bearish sentiment are consistently larger in magnitude than for institutional bullish sentiment.

Findings from this study provide further evidence on the importance of investor sentiment in explaining returns and volatility. Despite REIT regulations, the nature of their assets, and the perceived insignificant deviations from NAV, our results show that investor sentiment plays an important role in the return generating of this industry. Overall, results provide support to the discipline of behavioral finance and leave open an avenue for research on the REIT-sentiment relationship.

Appendix

Table 1A presents various specifications following a version of equation (1) to analyze how the pricing of the Fama-French factors are affected by sentiment. We create six interaction variables using all the combinations between each of the three Fama-French factors and our two measures of sentiment. All models reported in the table use excess NAREIT price returns to construct the dependent variable.[9]

Models 1 and 2 show that sentiment increases the role of *Rm-Rf* on excess returns (higher measured of sentiment increase the positive effect of *Rm-Rf* on excess returns). The magnitude of the effect is relatively important. Based on the point estimates in Model 1, a one standard deviation increase in institutional investor sentiment increases the marginal effect of *Rm-Rf* on excess returns by about 0.148.

The estimates presented in Models 3 and 4 show that the interaction terms are not statistically significant. Our interpretation is that our measures of sentiment have no role on how *SMB* affects excess returns.

The positive and statistically significant slope coefficients on the interaction terms on Models 5 and 6 show that sentiment positively affects the pricing of *HML*. For example, based on the point estimates of Model 5, a one standard deviation increase in the institutional investor sentiment increases the marginal effect of *HML* on excess returns by 0.388. We view this change as relatively large.

[9] Alternative specification using excess NAREIT total returns provided qualitatively the same results.

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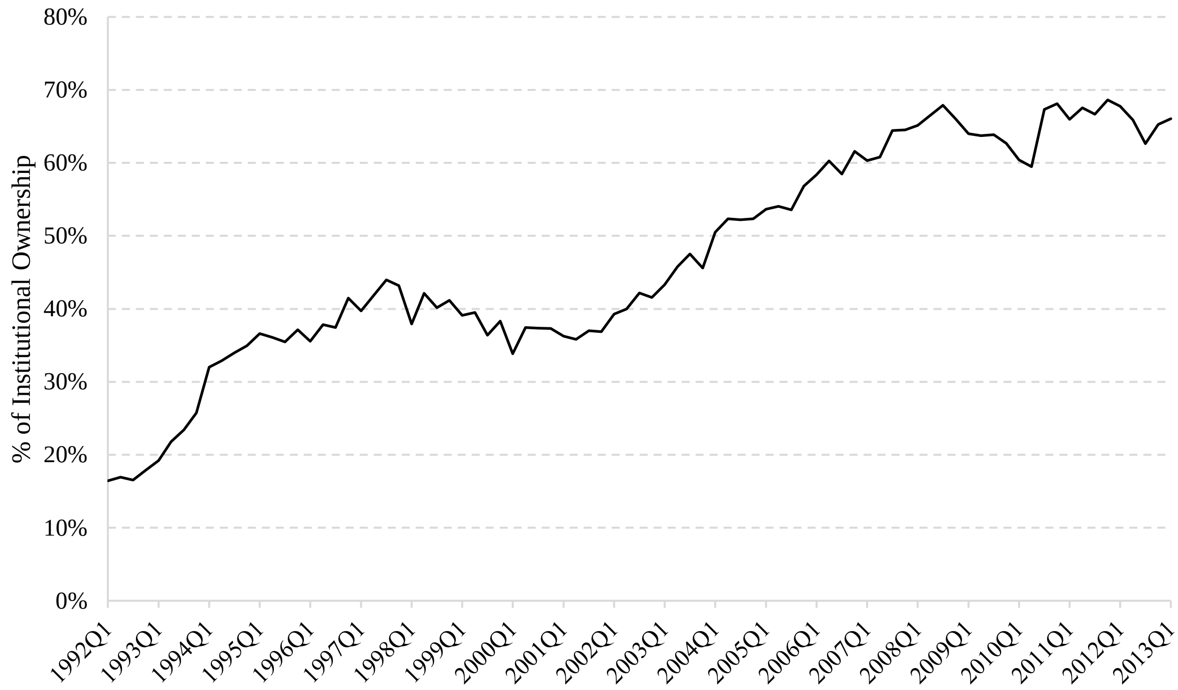
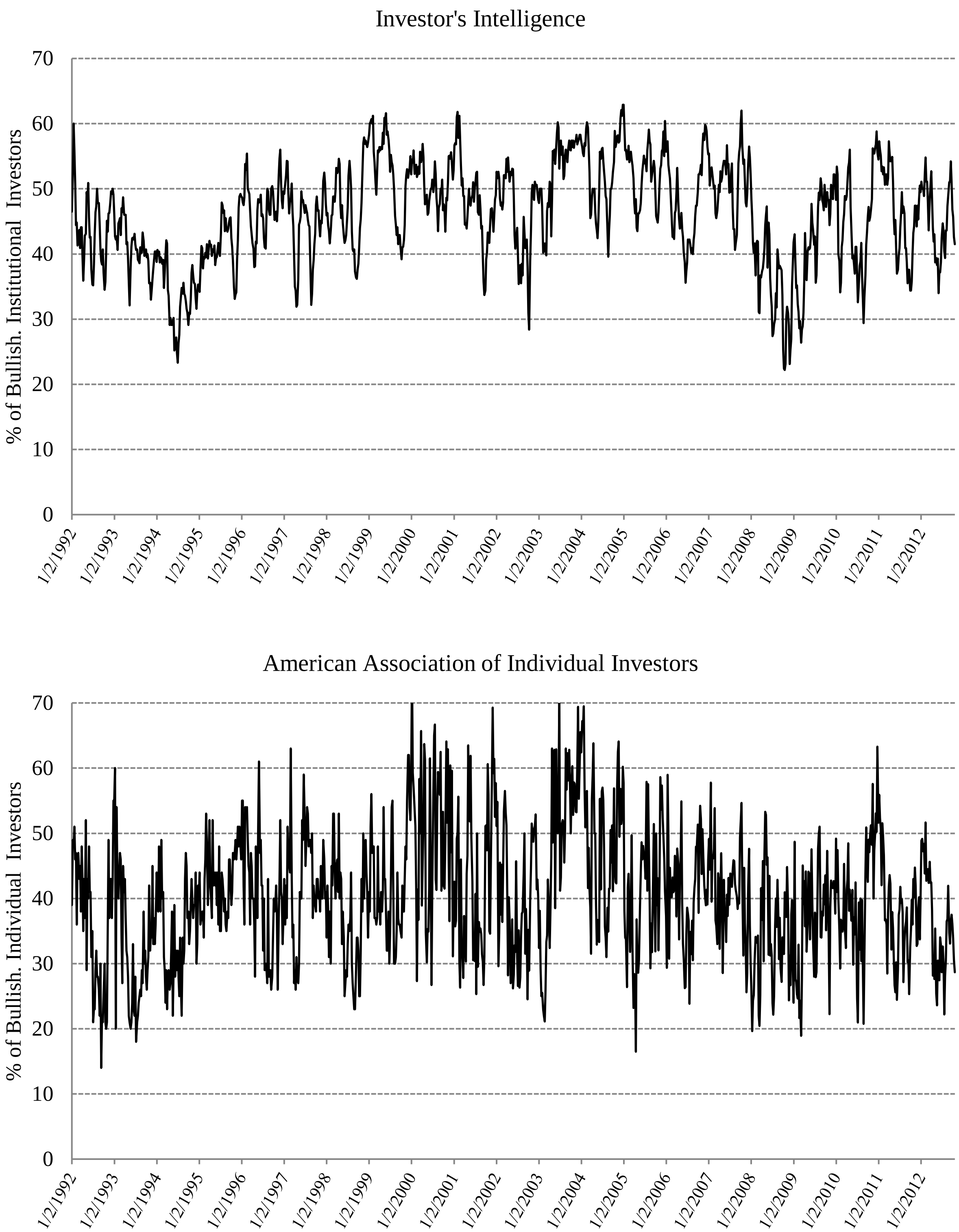
Figure 1. Percentage of Aggregate REIT Institutional Ownership (1992-2013).



Notes: This figure shows the percentage of aggregate REIT institutional ownership from 1992Q1 to 2013Q1. Data is obtained from Compustat.

Figure 2. Bullish individual and institutional investor sentiment (1992-2013).



Notes: This figure shows the weekly percentage of bullish surveys for institutional (Investors Intelligence) and individual (American Association of Individual Investors) investors from January 1992 to January 2012.

Table 1. Correlation table

	Excess REIT Price Ret	*Excess REIT Total Ret*	ΔII	$\Delta AAII$	*Positive Dummy* |ΔII|*	*Negative Dummy* |ΔII|*	*Positive Dummy* |ΔAAII|*	*Negative Dummy* |ΔAAII|*	*Rm-Rf*	*SMB*	*HML*	*Def*	*Prem*
Excess REIT Price Ret	1.000												
Excess REIT Total Ret	0.999	1.000											
ΔII	0.262	0.261	1.000										
$\Delta AAII$	0.152	0.152	0.162	1.000									
Positive Dummy |ΔII|*	0.221	0.220	0.842	0.133	1.000								
Negative Dummy |ΔII|*	-0.221	-0.220	-0.840	-0.140	-0.415	1.000							
Positive Dummy |ΔAAII|*	0.132	0.132	0.137	0.846	0.131	-0.099	1.000						
Negative Dummy |ΔAAII|*	-0.126	-0.126	-0.138	-0.850	-0.095	0.138	-0.437	1.000					
Rm-Rf	0.561	0.562	0.319	0.142	0.254	-0.283	0.103	-0.138	1.000				
SMB	0.157	0.158	0.138	0.083	0.081	-0.150	0.085	-0.056	0.139	1.000			
HML	0.289	0.289	-0.012	0.009	-0.023	-0.003	0.045	0.029	-0.132	-0.223	1.000		
Def	-0.017	-0.018	0.046	0.008	0.138	0.060	0.061	0.047	-0.017	0.026	-0.037	1.000	
Prem	0.023	0.022	0.006	0.009	0.049	0.039	0.003	-0.013	0.006	0.073	-0.026	0.382	1.000

This table shows the correlation matrix for the variables employed. Excess NAREIT Price Returns are the weekly REIT industry price returns minus the risk-free rate. Excess NAREIT Total Returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. ΔII and $\Delta AAII$ are changes in institutional and individual investor sentiment, respectively. D_t is a dummy variable that at time t takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. *Rm-Rf*, *SMB* and *HML* are the Fama-French equity factors while *Def* and *Prem* are the Fama-French bond factors

Table 2. Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Excess NAREIT Price Returns	1108	0.118	3.136	-32.461	35.106
Excess NAREIT Total Returns	1108	0.231	3.140	-32.424	35.159
ΔII	1110	0.013	4.616	-17.500	18.100
$\Delta AAII$	1111	0.014	14.762	-58.000	51.000
$D^* \lvert\Delta II\rvert$	1110	1.777	2.753	0.000	18.100
$(1- D)^* \lvert\Delta II\rvert$	1110	1.765	2.729	0.000	17.500
$D^* \lvert\Delta AAII\rvert$	1111	5.713	8.672	0.000	51.000
$(1-D)^* \lvert\Delta AAII\rvert$	1111	5.699	8.806	0.000	58.000
Rm-Rf	1109	0.134	2.437	-18.000	12.610
SMB	1109	0.036	1.327	-9.370	6.440
HML	1109	0.081	1.399	-7.000	9.790
Prem	1011	2.326	1.342	-0.270	4.540
Def	1112	0.963	0.440	0.500	3.460

This table provides summary statistics for all variables employed in the econometric analysis. Frequency of observations is weekly. Excess NAREIT price returns are the REIT industry price returns minus the risk-free rate. Excess NAREIT total returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. ΔII and $\Delta AAII$ are changes in institutional and individual investor sentiment, respectively. D_t is a dummy variable that at time t takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. The interaction between D_t and the absolute value of the change in investor sentiment at time t ($|\Delta Sent_t|$) is constructed to capture whether positive changes in sentiment impact REIT industry returns differently than negative changes in sentiment. *Rm-Rf*, *SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors.

Table 3. Frequency table: Changes in institutional and individual investor sentiment

	Frequency	**Percent**
Positive ΔII	573	51.71%
Negative ΔII	537	48.29%
Total $\Delta \boldsymbol{II}$	**1,110**	**100%**
Positive $\Delta AAII$	566	50.99%
Negative $\Delta AAII$	545	49.01%
Total $\Delta \boldsymbol{AAII}$	**1,111**	**100%**

This table reports weekly frequencies for positive and negative changes in institutional investor sentiment (ΔII) and positive and negative changes in individual investor sentiment ($\Delta AAII$) for the sample period from January 1992 to January 2013.

Table 4. Regression results. Changes in institutional investor sentiment on FTSE NAREIT price and total excess returns.

	Model 1		Model 2		Model 3		Model 4	
	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns
Intercept	0.092	0.204	-0.189	-0.077	0.160	0.280	-0.230	-0.111
	(0.65)	(1.44)	(-1.75)	(-0.72)	(0.60)	(1.05)	(-1.15)	(-0.56)
$D_t * \|\Delta II\|_t$	0.183***	0.183***	0.076***	0.076***	0.193***	0.193***	0.085***	0.084***
	(5.03)	(5.01)	(2.73)	(2.71)	(4.75)	(4.75)	(2.74)	(2.73)
$(1- D_t) * \|\Delta II\|_t$	-0.170***	-0.170***	-0.006	-0.006	-0.183***	-0.182***	-0.006	-0.004
	(-4.62)	(-4.61)	(-0.22)	(-0.19)	(-4.52)	(-4.50)	(-0.18)	(-0.13)
$Rm\text{-}Rf_t$			0.733***	0.736***			0.738***	0.741***
			(24.36)	(24.47)			(23.43)	(23.52)
SMB_t			0.386***	0.389***			0.381***	0.385***
			(7.14)	(7.21)			(6.68)	(6.75)
HML_t			0.875***	0.877***			0.921***	0.924***
			(17.19)	(17.23)			(16.98)	(17.03)
Def_t					-0.315	-0.323	-0.095	-0.102
					(-1.32)	(-1.36)	(-0.53)	(-0.57)
$Prem_t$					0.092	0.091	0.048	0.046
					(1.15)	(1.14)	(0.80)	(0.77)
N	1108	1108	1108	1108	1009	1009	1009	1009
R^2	0.067	0.067	0.468	0.470	0.071	0.071	0.478	0.480
Adj. R^2	0.066	0.066	0.466	0.468	0.067	0.067	0.475	0.476
F-Statistic	39.95	39.82	194.20	195.57	19.13	19.13	131.16	132.02
Breusch-Pagan (LM)	12.07***	11.97***	14.44**	14.25**	134.21***	134.41***	195.95***	197.14***
B-P p-value	0.002	0.003	0.013	0.014	0.000	0.000	0.000	0.000

This table presents the results for the linear model in equation (1) which only includes changes in institutional investor sentiment (ΔII):

$$(\boldsymbol{REIT - Rf})_t = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\, \boldsymbol{D_t} |\Delta \boldsymbol{Sent_t}| + \boldsymbol{\beta_2}\, (\boldsymbol{1 - D_t})\, |\Delta \boldsymbol{Sent_t}| + \sum_{i=1}^{N} \boldsymbol{\gamma_i X_{it}} + \boldsymbol{\varepsilon_t}$$

The Portmanteau *Q*-statistic tests for white noise in the residuals. The Breusch-Pagan test is to test for heteroscedasticity in a linear regression model. The null hypothesis in the Breusch-Pagan test is that coefficients from equation (2) are conjunctively equal to zero ($H_0\colon \delta_2 = \theta_1 = \theta_2 = \cdots = \theta_N = 0$). We compute the F-statistic for the joint significance of all variables and LM (Lagrange Multiplier) statistic based on the R^2 obtained from equation (2). Rejection of the null hypothesis indicates heteroscedastic errors. Excess NAREIT total returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. ΔII are changes in institutional sentiment. D_t is a dummy variable that at time t takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. The interaction between D_t and the absolute value of the change in investor sentiment at time t is constructed to capture whether positive changes in sentiment impact REIT industry returns differently than negative changes in sentiment. *Rm-Rf, SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors.T-statistic in parentheses. ***, ** and * represent 1%, 5% and 10% significance level respectively.

Table 5. Regression results. Changes in individual investor sentiment on FTSE NAREIT price and total excess returns.

	Model 1		Model 2		Model 3		Model 4	
	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns
Intercept	0.069	0.183	-0.066	0.048	0.082	0.200	-0.128	-0.010
	(0.47)	(1.24)	(-0.60)	(0.44)	(0.29)	(0.71)	(-0.62)	(-0.05)
$D_t * \lvert \Delta AAII \rvert_t$	0.035***	0.035***	0.011	0.011	0.037***	0.037***	0.009	0.009
	(2.96)	(2.94)	(1.24)	(1.20)	(2.81)	(2.82)	(0.92)	(0.93)
$(1- D_t) * \lvert \Delta AAII \rvert_t$	-0.027**	-0.027**	-0.011	-0.011	-0.030**	-0.030**	-0.014	-0.014
	(-2.29)	(-2.29)	(-1.29)	(-1.29)	(-2.35)	(-2.32)	(-1.47)	(-1.43)
$Rm\text{-}Rf_t$			0.748***	0.751***			0.753***	0.755***
			(25.85)	(25.96)			(24.87)	(24.96)
SMB_t			0.388***	0.391***			0.383***	0.386***
			(7.21)	(7.27)			(6.73)	(6.79)
HML_t			0.875***	0.877***			0.922***	0.924***
			(17.14)	(17.19)			(16.93)	(16.98)
Def_t					-0.225	-0.234	-0.020	-0.028
					(-0.93)	(-0.97)	(-0.11)	(-0.16)
$Prem_t$					0.082	0.081	0.044	0.043
					(1.00)	(0.99)	(0.74)	(0.72)
N	1108	1108	1108	1108	1009	1009	1009	1009
R^2	0.022	0.021	0.467	0.468	0.025	0.024	0.476	0.478
Adj. R^2	0.020	0.020	0.464	0.466	0.021	0.021	0.473	0.474
F-Statistic	12.11	12.01	192.82	194.19	6.31	6.26	130.06	130.92
Portmanteau Q-stat	195.82***	199.99***	161.38***	164.17***	187.72***	191.77***	158.47***	161.56***
Breusch-Pagan (LM)	5.76*	5.78*	7.73	7.64	151.72***	151.99***	198.91***	200.18***
B-P p-value	0.056	0.056	0.172	0.177	0.000	0.000	0.000	0.000

This table presents the results for the linear model in equation (1) which only includes changes in individual investor sentiment ($\Delta AAII$):

$$(\boldsymbol{REIT - Rf})_{\boldsymbol{t}} = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\, \boldsymbol{D_t} |\Delta \boldsymbol{Sent_t}| + \boldsymbol{\beta_2}\, (\boldsymbol{1 - D_t})\, |\Delta \boldsymbol{Sent_t}| + \sum_{i=1}^{N} \boldsymbol{\gamma_i X_{it}} + \boldsymbol{\varepsilon_t}$$

The Portmanteau *Q*-statistic tests for white noise in the residuals. The Breusch-Pagan test is to test for heteroscedasticity in a linear regression model. The null hypothesis in the Breusch-Pagan test is that coefficients from equation (2) are conjunctively equal to zero ($H_0\colon \delta_2 = \theta_1 = \theta_2 = \cdots = \theta_N = 0$). We compute the F-statistic for the joint significance of all variables and LM (Lagrange Multiplier) statistic based on the R^2 obtained from equation 2. Rejection of the null hypothesis indicates heteroscedastic errors. Excess NAREIT total returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. $\Delta AAII$ are changes in individual investor sentiment. D_t is a dummy variable that at time *t* takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. The interaction between D_t and the absolute value of the change in investor sentiment at time *t* is constructed to capture whether positive changes in sentiment impact REIT industry returns differently than negative changes in sentiment. *Rm-Rf, SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors.T-statistic in parentheses. ***, ** and * represent 1%, 5% and 10% significance level respectively.

Table 6. Regression results. ΔII and $\Delta AAII$ on REIT returns

	Model 1		Model 2		Model 3		Model 4	
	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns
Intercept	0.045	0.159	-0.180	-0.066	0.126	0.244	-0.197	-0.080
	(0.25)	(0.90)	(-1.34)	(-0.49)	(0.44)	(0.86)	(-0.92)	(-0.37)
D_t* $\|\Delta II\|_t$	0.172***	0.172***	0.073***	0.073***	0.181***	0.181***	0.081***	0.081***
	(4.75)	(4.74)	(2.62)	(2.60)	(4.45)	(4.45)	(2.62)	(2.61)
$(1- D_t)$* $\|\Delta II\|_t$	-0.158***	-0.158***	-0.002	-0.002	-0.170***	-0.169***	-0.001	0.000
	(-4.31)	(-4.31)	(-0.08)	(-0.06)	(-4.19)	(-4.17)	(-0.03)	(0.01)
D_t* $\|\Delta AAII\|_t$	0.028**	0.027**	0.009	0.009	0.028**	0.029**	0.007	0.007
	(2.37)	(2.35)	(1.02	(-1.24)	(2.23)	(2.24)	(0.71)	(0.72)
$(1-D_t)$* $\|\Delta AAII\|_t$	-0.020*	-0.020*	-0.011	-0.011	-0.021*	-0.021*	-0.013	-0.013
	(-1.72)	(-1.72)	(-1.24)	(-1.24)	(-1.68)	(-1.65)	(-1.38)	(-1.35)
$Rm\text{-}Rf_t$			0.728***	0.731***			0.732***	0.735***
			(24.11)	(24.21)			(23.14)	(23.24)
SMB_t			0.379***	0.382***			0.376***	0.380***
			(7.00)	(7.06)			(6.57)	(6.64)
HML_t			0.871***	0.873***			0.919***	0.921***
			(17.07)	(17.12)			(16.89)	(16.93)
Def_t					-0.321	-0.330	-0.088	-0.097
					(-1.35)	(-1.39)	(-0.49)	(-0.54)
$Prem_t$					0.091	0.090	0.046	0.045
					(1.14)	(1.13)	(0.77)	(0.75)
N	1108	1108	1108	1108	1009	1009	1009	1009
R^2	0.080	0.079	0.471	0.472	0.083	0.083	0.481	0.482
Adj. R^2	0.076	0.076	0.467	0.469	0.078	0.077	0.476	0.477
F-Statistic	23.84	23.73	139.65	140.59	15.16	15.07	102.67	103.30
Portmanteau Q-stat	196.51***	200.99***	156.37***	159.73***	186.65***	190.76***	153.06***	156.62***
Breusch-Pagan (LM)	15.97***	15.89***	17.87**	17.70**	136.59***	136.83***	197.97***	199.17***
B-P p-value	0.003	0.003	0.013	0.013	0.000	0.000	0.000	0.000

This table presents the results for the linear model in equation (1) which includes changes in institutional (ΔII) and individual ($\Delta AAII$) investor sentiment simultaneously:

$$(\boldsymbol{REIT} - \boldsymbol{Rf})_t = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\, \boldsymbol{D_t}|\Delta \boldsymbol{Sent_t}| + \boldsymbol{\beta_2}\,(\mathbf{1} - \boldsymbol{D_t})\,|\Delta \boldsymbol{Sent_t}| + \sum_{i=1}^{N} \boldsymbol{\gamma_i X_{it}} + \boldsymbol{\varepsilon_t}$$

The Portmanteau *Q*-statistic tests for white noise in the residuals. The Breusch-Pagan test is to test for heteroscedasticity in a linear regression model. The null hypothesis in the Breusch-Pagan test is that coefficients from equation (2) are conjunctively equal to zero (H_0: $\delta_2 = \theta_1 = \theta_2 = \cdots = \theta_N = 0$). We compute the F-statistic for the joint significance of all variables and LM (Lagrange Multiplier) statistic based on the R^2 obtained from equation 2. Rejection of the null hypothesis indicates heteroscedastic errors. Excess NAREIT total returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. ΔII and $\Delta AAII$ are changes in institutional and individual investor sentiment, respectively. D_t is a dummy variable that at time t takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. The interaction between D_t and the absolute value of the change in investor sentiment at time t is constructed to capture whether positive changes in sentiment impact REIT industry returns differently than negative changes in sentiment. *Rm-Rf*, *SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors. T-statistic in parentheses. ***, ** and * represent 1%, 5% and 10% significance level respectively.

Table 7. GARCH results. ΔII and $\Delta AAII$ on REIT returns and volatility

	Model 1		Model 2		Model 3	
	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns
Intercept	-0.178	-0.006	-0.381**	-0.202	-0.241	-0.066
$D_t\ \|\Delta II_t\|$	0.056**	0.055**			0.056**	0.055**
$(1-D_t)\ \|\Delta II_t\|$	-0.059**	-0.056**			-0.059**	-0.056**
$D_t\ \|\Delta AAII_t\|$			0.012*	0.009	0.008	0.007
$(1-D_t)\ \|\Delta AAII_t\|$			-0.008	-0.009	-0.002	-0.002
$Rm\text{-}Rf_t$	0.539***	0.543***	0.574***	0.584***	0.534***	0.540***
SMB_t	0.318***	0.330***	0.311***	0.324***	0.304***	0.317***
HML_t	0.537***	0.540***	0.551***	0.569***	0.523***	0.528***
Def_t	0.212	0.139	0.357*	0.297	0.220	0.155
$Prem_t$	-0.006	-0.005	0.011	0.012	0.005	0.006
φ_1	-2.520***	-2.583***	-1.946***	-2.356***	-2.611***	-2.702***
ε_{t-1}^2	0.175***	0.177***	0.227***	0.225***	0.190***	0.192***
$\varepsilon_{t-1}^2 I_{t-1}$	-0.101***	-0.101***	-0.138***	-0.138***	-0.119***	-0.119***
h_{t-1}	0.820***	0.820***	0.799***	0.801***	0.798***	0.797***
$D_t\ \|\Delta II_t\|$	0.039	0.051			0.086	0.099
$(1-D_t)\ \|\Delta II_t\|$	0.313***	0.319***			0.285***	0.289***
$D_t\ \|\Delta AAII_t\|$			-0.086	0.046***	0.025	0.031
$(1-D_t)\ \|\Delta AAII_t\|$			0.066***	0.069***	0.037**	0.040**
Log-likelihood	-2072.50	-2070.33	-2087.02	-2085.26	-2070.41	-2068.25
Wald χ^2	690.18***	703.03***	621.97***	631.00***	620.15***	629.05***
N	1009	1009	1009	1009	1009	1009
χ^2 Diff. +/- ΔII (Mean eq.)	17.23***	16.39***			15.99***	15.23***
χ^2 Diff. +/- ΔAAII (Mean eq.)			6.50**	4.96**	1.63	1.26
χ^2 Diff. +/- ΔII (Cond. Var.)	1.76	1.84			3.13*	3.26*
χ^2 Diff. +/- ΔAAII (Cond. Var.)			0.72	1.12	0.19	0.12
Portmanteau Q-stat	166.17***	171.91***	163.35***	168.56***	165.07***	170.72***

This table reports the results for the GARCH model which includes changes in individual ($\Delta AAII$) and institutional investor sentiment (ΔII) simultaneously described by equations (3) and (4):

$(\boldsymbol{REIT-Rf})_t = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\, \boldsymbol{D_t}|\boldsymbol{\Delta Sent_t}| + \boldsymbol{\beta_2}\,(\boldsymbol{1-D_t})\,|\boldsymbol{\Delta Sent_t}| + \sum_{i=1}^{N}\boldsymbol{\gamma_i X_{it}} + \boldsymbol{\varepsilon_t}$ (1)

$\boldsymbol{h_t} = \boldsymbol{\varphi_1} + \boldsymbol{\varphi_2\varepsilon_{t-1}^2} + \boldsymbol{\varphi_3\varepsilon_{t-1}^2 I_{t-1}} + \boldsymbol{\varphi_4 h_{t-1}} + \boldsymbol{\varphi_5 D_t}\,|\boldsymbol{\Delta Sent_t}| + \boldsymbol{\varphi_6}(\boldsymbol{1-D_t})\,|\boldsymbol{\Delta Sent_t}| + \boldsymbol{\omega_t}$ (3)

Each model has two columns that show results for excess NAREIT price returns and excess NAREIT total returns, respectively. The Portmanteau *Q*-statistic tests for white noise in the residuals. Excess NAREIT total returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. ΔII and $\Delta AAII$ are changes in institutional and individual investor sentiment, respectively. D_t is a dummy variable that at time *t* takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. The interaction between D_t and the absolute value of the change in investor sentiment at time *t* is constructed to capture whether positive changes in sentiment impact REIT industry returns differently than negative changes in sentiment. *Rm-Rf*, *SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors. ***, ** and * represent 1%, 5% and 10% significance level respectively

Table 8. GARCH results, controlling for Institutional Ownership.

	Model 1		Model 2	
	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns
Intercept	-0.395	-0.149	-0.507*	-0.257
$D_t\ \lvert\Delta II_t\rvert$	0.058**	0.056**	0.055**	0.055**
$(1-D_t)\ \lvert\Delta II_t\rvert$	-0.060**	-0.055**	-0.059**	-0.055**
$D_t\ \lvert\Delta AAII_t\rvert$			0.008	0.006
$(1-D_t)\ \lvert\Delta AAII_t\rvert$			-0.001	-0.002
$Rm\text{-}Rf_t$	0.529***	0.533***	0.527***	0.534***
SMB_t	0.317***	0.329***	0.302***	0.316***
HML_t	0.539***	0.541***	0.524***	0.530***
Def_t	-0.023	-0.003	0.056	-0.052
$Prem_t$	-0.001	-0.004	0.018	0.014
$I.O._t$	0.834	0.550	1.011*	0.746
φ_1	-3.307***	-3.431***	-3.639	-3.777***
ε_{t-1}^2	0.183***	0.184***	0.205***	0.206***
$\varepsilon_{t-1}^2 I_{t-1}$	-0.118***	-0.115***	-0.144***	-0.142***
h_{t-1}	0.794***	0.793***	0.757***	0.756***
$D_t\ \lvert\Delta II_t\rvert$	0.040	0.054	0.077	0.086
$(1-D_t)\ \lvert\Delta II_t\rvert$	0.256***	0.260***	0.217***	0.219***
$D_t\ \lvert\Delta AAII_t\rvert$			0.047***	0.050***
$(1-D_t)\ \lvert\Delta AAII_t\rvert$			0.046***	0.047***
$I.O._t$	2.834***	2.981***	3.039***	3.194***
Log-likelihood	-2064.62	-2062.98	-2059.69	-2057.88
Wald χ^2	654.21***	652.87***	609.71***	607.06***
N	1009	1009	1009	1009
χ^2 Diff. +/- ΔII (Mean eq.)	17.14***	16.34***	16.53***	15.81***
χ^2 Diff. +/- ΔII (Cond. Var.)	2.75*	2.80*	3.82**	3.59*
Portmanteau Q-stat	168.70***	173.52***	168.29***	172.96***

This table reports the results for the GARCH model which includes changes in individual (Δ*AAII*) and institutional investor sentiment (Δ*II*) simultaneously described by equations (3) and (4):

$$(\boldsymbol{REIT-Rf})_t = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\, \boldsymbol{D_t}\lvert\Delta \boldsymbol{Sent_t}\rvert + \boldsymbol{\beta_2}\,(\boldsymbol{1-D_t})\,\lvert\Delta \boldsymbol{Sent_t}\rvert + \sum_{i=1}^{N}\boldsymbol{\gamma_i X_{it}} + \boldsymbol{\varepsilon_t} \quad (1)$$

$$\boldsymbol{h_t} = \boldsymbol{\varphi_1} + \boldsymbol{\varphi_2\varepsilon_{t-1}^2} + \boldsymbol{\varphi_3\varepsilon_{t-1}^2 I_{t-1}} + \boldsymbol{\varphi_4 h_{t-1}} + \boldsymbol{\varphi_5 D_t}\,\lvert\Delta \boldsymbol{Sent_t}\rvert + \boldsymbol{\varphi_6}(\boldsymbol{1-D_t})\,\lvert\Delta \boldsymbol{Sent_t}\rvert + \boldsymbol{\omega_t} \quad (3)$$

Each model has two columns that show results for excess NAREIT price returns and excess NAREIT total returns, respectively. The Portmanteau *Q*-statistic tests for white noise in the residuals. Excess NAREIT total returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. Δ*II* and Δ*AAII* are changes in institutional and individual investor sentiment, respectively. D_t is a dummy variable that at time *t* takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. The interaction between D_t and the absolute value of the change in investor sentiment at time *t* is constructed to capture whether positive changes in sentiment impact REIT industry returns differently than negative changes in sentiment. *Rm-Rf, SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors. $I.O._t$ is the percentage of aggregate institutional ownership at time *t.* ***, ** and * represent 1%, 5% and 10% significance level respectively.

Table 9. Exponential-GARCH results.

	Model 1		Model 2	
	Excess NAREIT Price Returns	Excess NAREIT Total Returns	Excess NAREIT Price Returns	Excess NAREIT Total Returns
Intercept	-0.235	-0.040	-0.287*	-0.100
$D_t\ \lvert\Delta II_t\rvert$	0.055**	0.051**	0.055**	0.052**
$(1-D_t)\ \lvert\Delta II_t\rvert$	-0.050**	-0.049**	-0.054**	-0.048**
$D_t\ \lvert\Delta AAII_t\rvert$			0.012*	0.011
$(1-D_t)\ \lvert\Delta AAII_t\rvert$			-0.000	-0.001
$Rm\text{-}Rf_t$	0.550***	0.553***	0.538***	0.545***
SMB_t	0.326***	0.339***	0.308***	0.321***
HML_t	0.548***	0.560***	0.505***	0.512***
Def_t	-0.213	-0.117	0.207	-0.098
$Prem_t$	-0.022	-0.023	0.029	0.036
α_1	-0.014	-0.017	-0.049*	-0.052*
$\varepsilon_{t-1}/\sqrt{h_{t-1}}$	-0.045***	-0.046***	-0.049**	-0.052***
$\lvert\varepsilon_{t-1}/\sqrt{h_{t-1}}\rvert$	0.210***	0.206***	0.251***	0.241***
$\log(h_{t-1})$	0.963***	0.963***	0.947***	0.947***
$D_t\ \lvert\Delta II_t\rvert$	0.003	0.004	0.013	0.014
$(1-D_t)\ \lvert\Delta II_t\rvert$	0.036***	0.037***	0.036***	0.036***
$D_t\ \lvert\Delta AAII_t\rvert$			-0.003	-0.003
$(1-D_t)\ \lvert\Delta AAII_t\rvert$			0.009***	0.010***
Log-likelihood	-2074.03	-2071.86	-2069.28	-2067.04
Wald χ^2	711.20***	749.80***	630.75***	657.73***
N	1009	1009	1009	1009
χ^2 Diff. +/- ΔII (Mean eq.)	16.23***	14.26***	16.87***	14.34***
χ^2 Diff. +/- ΔII (Cond. Var.)	17.48***	16.92***	7.21***	6.93*
Portmanteau Q-stat	165.93***	172.17***	165.05***	171.60***

This table reports the results for the GARCH model which includes changes in individual (Δ*AAII*) and institutional investor sentiment (Δ*II*) simultaneously described by equations (3) and (4):

$$(\boldsymbol{REIT-Rf})_t = \boldsymbol{\beta_0} + \boldsymbol{\beta_1}\, \boldsymbol{D_t}\lvert\Delta \boldsymbol{Sent_t}\rvert + \boldsymbol{\beta_2}\,(\mathbf{1}-\boldsymbol{D_t})\,\lvert\Delta \boldsymbol{Sent_t}\rvert + \sum_{i=1}^{N}\boldsymbol{\gamma_i X_{it}} + \boldsymbol{\varepsilon_t} \quad (1)$$

$$\log(\boldsymbol{h_t}) = \boldsymbol{\alpha_1} + \boldsymbol{\alpha_2}\left(\boldsymbol{\varepsilon_{t-1}}/\sqrt{\boldsymbol{h_{t-1}}}\right) + \boldsymbol{\alpha_3}\left\lvert\boldsymbol{\varepsilon_{t-1}}/\sqrt{\boldsymbol{h_{t-1}}}\right\rvert + \boldsymbol{\alpha_4}\log(\boldsymbol{h_{t-1}}) + \boldsymbol{\varphi_5 D_t}\,\lvert\Delta \boldsymbol{Sent_t}\rvert + \boldsymbol{\varphi_6}(\mathbf{1}-\boldsymbol{D_t})\,\lvert\Delta \boldsymbol{Sent_t}\rvert + \boldsymbol{\omega_t} \quad (3)$$

Each model has two columns that show results for excess NAREIT price returns and excess NAREIT total returns, respectively. The Portmanteau *Q*-statistic tests for white noise in the residuals. Excess NAREIT total returns are the REIT industry total returns minus the risk-free rate, total returns account for dividend payments. Δ*II* and Δ*AAII* are changes in institutional and individual investor sentiment, respectively. D_t is a dummy variable that at time *t* takes the value of 1 if the change in sentiment is positive and 0 if the change in sentiment is negative. The interaction between D_t and the absolute value of the change in investor sentiment at time *t* is constructed to capture whether positive changes in sentiment impact REIT industry returns differently than negative changes in sentiment. *Rm-Rf, SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors. $I.O._t$ is the percentage of aggregate institutional ownership at time *t.* ***, ** and * represent 1%, 5% and 10% significance level respectively.

Table 1A. Sentiment and the pricing of the Fama-French factors

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	$\lvert\Delta II_t\rvert$	$\lvert\Delta AAII_t\rvert$	$\lvert\Delta II_t\rvert$	$\lvert\Delta AAII_t\rvert$	$\lvert\Delta II_t\rvert$	$\lvert\Delta AAII_t\rvert$
Intercept	-0.159	-0.112	-0.233	-0.128	-0.214	-0.158
$\lvert\Delta II_t\rvert$	0.043*		0.039		0.044*	
$\lvert\Delta AAII_t\rvert$		-0.002		-0.003		-0.007
Rm-Rf$_t$	0.616***	0.615***	0.760***	0.763***	0.743***	0.750***
(*Rm-Rf$_t$*) $\lvert\Delta II_t\rvert$	0.032***					
(*Rm-Rf$_t$*) $\lvert\Delta AAII_t\rvert$		0.012***				
SMB_t	0.382***	0.393***	0.338***	0.349***	0.387***	0.408***
SMB_t $\lvert\Delta II_t\rvert$			0.017			
SMB_t $\lvert\Delta AAII_t\rvert$				0.003		
HML_t	0.894***	0.904***	0.927***	0.932***	0.599***	0.718***
HML_t $\lvert\Delta II_t\rvert$					0.084***	
HML_t $\lvert\Delta AAII_t\rvert$						0.015***
Def_t	-0.168	0.004	-0.082	-0.018	-0.148	0.0239
$Prem_t$	0.048	0.031	0.045	0.045	0.062	0.057
N	1009	1009	1009	1009	1009	1009
R^2	0.482	0.482	0.475	0.474	0.488	0.479
Adj. R^2	0.479	0.478	0.472	0.470	0.484	0.476
F-Statistic	133.31	132.81	129.50	128.81	136.30	131.53

This table presents the results for a version of the linear model in equation (1). All the specifications use excess NAREIT price returns to construct the dependent variable. ΔII and $\Delta AAII$ are changes in institutional and individual investor sentiment, respectively. *Rm-Rf*, *SMB* and *HML* are the Fama-French equity factors and *Def* and *Prem* are the Fama-French bond factors. ***, ** and * represent 1%, 5% and 10% significance level respectively.