The Asymmetric Conditional Beta-Return Relations of REITs

John L. Glascock[1]

University of Connecticut

Ran Lu-Andrews[2]

University of Connecticut

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Abstract

The traditional modern portfolio model posits that return is a function of beta—the stock's sensitivity to market movements. However, much research suggests that on an empirical basis this expectation does not hold. Pettengill, Sundaram and Mathur (1995) [PSM] suggest that the problem is that expected risk-return relationships are positive, but actual outcomes can vary. Thus we implement the PSM procedure to determine if we can obtain better explanatory ability for REIT returns relative to beta. Using PSM's suggested technique, we find evidence that REIT stocks with higher betas have more positive returns when the realized market returns exceed risk-free rates and more negative returns when the realized market returns fall below risk-free rates. Furthermore, we form REIT portfolios based on betas and find that similar results hold for portfolio level: REIT portfolios with higher betas have more positive returns when the realized market returns exceed risk-free rates and more negative returns when the realized market returns fall below risk-free rates.

We also examine beta relative to up and downside risk as suggested in Harlow and Rao (1989) [HR]. By using HR conditional beta approach, we find that REIT investors seem to view losses differently than gains. Our study is to determine if we can validate the positive risk-return trade-off predicted by CAPM and to show that a significant and positive systematic beta-return relation exists in both static and conditional CAPM model settings. We believe that our research effort is the first to incorporate both static beta estimation and asymmetric beta estimation to show a significantly positive risk-return trade-off in the industry of real estate investment trusts. Using HR generalized Mean-Lower Partial Moment Asset Pricing Model, we confirm that REIT stocks with higher downside betas have higher average returns, but upside betas are insignificant in the beta-return relation for REITs. We find similar results for portfolio level as well. These results on the downside and upside betas are consistent with the findings on real estate market index returns in Cheng (2005).

JEL Codes: G00, G12, C10, C30

Keywords: REIT, Conditional Beta, Asymmetric Risk, Risk-return trade-off, CAPM

[1] Real Estate Center, School of Business, University of Connecticut, 2100 Hillside Rd, Storrs, CT 06269. Email: john.glascock@business.uconn.edu

[2] Corresponding author. Real Estate Center, School of Business, University of Connecticut, 2100 Hillside Rd, Storrs, CT 06269. Email: ran.lu-andrews@business.uconn.edu

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1. Introduction

According to the traditional Capital Asset Pricing Model (CAPM), an asset's expected excess return is proportional to the expected market risk premium. This proportion is named "beta" to represent an asset's sensitivity to market movements. A positive risk-return trade-off is predicted by the CAPM. Since the birth of CAPM and modern portfolio theory, numerous studies have focused on testing this predicted positive risk-return trade-off. Empirical tests utilize average realized returns of a market index to proxy for the expected market return and average realized asset returns (usually an equity or fixed-income security) to proxy for the expected asset returns. The return predictability of beta has been challenged from various empirical studies (e.g. Roll (1977) and Fama and French (1992, 1996, 2015)).

Starting from early 1990s, studies on betas of REIT stocks have gained more and more attention due to the diversification purpose of portfolio management of investors. In our research, we examine the beta-return relation of REIT stocks from two different perspectives: static unconditional betas as suggested in traditional CAPM framework with modification outline as in Pettengill, Sundaram and Mathur (1995) [PSM] and conditional betas in the downside risk framework as suggested in Harlow and Rao (1989).

Time-varying betas of REIT stocks have been well documented. Glascock (1991) shows that betas of REIT stocks vary with market conditions. Sagalyn (1990) and Goldstein and Nelling (1999) find that REIT stocks have higher betas in declining markets than in rising markets. Chatrath, Liang and McIntosh (2000) and Chiang, Lee and Wisen (2004) attempt to provide explanations to this so-called "asymmetric REIT-beta puzzle". Yet, these researches only focus on the documentation of the time variation of betas among REIT stocks and do not further the investigation of REIT return predictability of betas. Our study intends to validate the positive risk-return trade-off predicted by CAPM and shows evidence that a significant and positive systematic beta-return relation exists in both static and conditional CAPM model settings.

In the static CAPM model setting, we follow the method proposed by Pettengill *et al* (1995). They remind us that using realized returns to proxy for expected returns could produce a bias in the return estimate. In the traditional static CAPM settings, the expected market risk premium is a non-negative number. Therefore, the model predicts a positive risk-return trade-off. However, negative realized market risk premium is observed frequently in the data. Thus, when realized market index returns fall below risk-free rates, we should expect an inverse relation between beta and returns. They show evidence that there is a significant systematic relation between betas and returns: when the market risk premium is positive, the relation is positive; when the market risk premium is negative, the relation is negative. Isakov (1999) applies a similar approach on Swiss stock market and finds a strong relation between betas and returns.

In the conditional CAPM model setting, we adopt the downside beta framework as in Bawa and Lindenberg (1977) and Harlow and Rao (1989). Downside risk framework is a world in which investors treat downside losses and upside gains differently (see Roy (1952)). Bawa and Lindenberg (1977) suggest that it is necessary to have an extension of the traditional CAPM that recognizes the asymmetric risk treatment, and a natural extension is to have two betas: downside betas and upside betas. Downside betas measure the sensitivity of stocks to the market during market downturns; upside betas measure the sensitivity during market upturns. Harlow and Rao (1989) present a generalized Mean-Lower Partial Moment Asset Pricing Model, in which they specify the estimations of downside beta and upside beta. Cheng (2005), using the model suggested by Harlow and Rao

(1989), explicitly demonstrates the relations between asymmetric risk measures and real estate returns. He shows that downside beta is positively correlated with real estate returns (as measured by NCREIF property index returns) in both time series and cross section. Ang, Chen and Xing (2006), following Bawa and Lindenberg (1977), examine the risk premiums for asymmetric measures in the factor loadings. They estimate a downside risk premium in the cross section, and show that stocks with higher downside betas have higher average returns.

To the best of our knowledge, our research effort is the first to incorporate both static beta estimation and asymmetric beta estimation to show a significantly positive risk-return trade-off in the industry of real estate investment trusts (SIC code=6798). Using monthly stock data from 1992 to 2014 and a methodology specified in PSM (1995), we show evidence that REIT stocks with higher betas have more positive returns when the realized market returns exceed risk-free rates and more negative returns when the realized market returns fall below risk-free rates. Furthermore, we form REIT portfolios based on betas and find that similar results hold for portfolio level: REIT portfolios with higher betas have more positive returns when the realized market returns exceed risk-free rates and more negative returns when the realized market returns fall below risk-free rates.

Following the downside beta estimation proposed by Harlow and Rao (1989) for the same sample period, we find that REIT stocks with higher downside betas have higher average returns, but upside betas are insignificant in the beta-return relation for REITs. We find similar results for portfolio level as well. These results on the downside and upside betas are consistent with the findings on real estate market index returns in Cheng (2005).

The rest of the article is organized as follows. Section 2 reviews related literature on beta-return relation. Section 3 explains the data sample and methodology used in our study. Section 4 presents the empirical results. Section 5 concludes.

2. Related Literature

Traditional CAPM (Sharpe-Lintner-Black (SLB) model) is a one-period static (unconditional) model. Empirical tests using average realized stock returns and market index returns initially supported the traditional CAPM model [see Fama and MacBeth (1973)]. However, as more researchers conducted empirical tests, more challenging results have been found. Many later studies reject the model's empirical validity (see, for example, Roll (1977), and Fama and French (1992, 1996)). Fama and French (2004) give a comprehensive review of the literature on CAPM.

Fama (1991) says that "in spite of the evidence against the SLB model, market professionals (and academics) still think about risk in terms of market β. And, like academics, practitioners retain the market line (from the risk free rate through the market portfolio) of the Sharpe-Lintner model as a representation of the tradeoff of expected return for risk available from passive portfolios." Numerous researches, then, attempt to improve empirical methodologies used in the validation of CAPM or focus on various theoretical frameworks to relax the assumptions in the unconditional CAPM world.

Pettengill *et al* (1995) effectively point out that the impact of using realized returns to proxy for expected returns should be profoundly recognized in the empirical test methodologies. In the traditional static CAPM settings, the expected market risk premium is a non-negative number. Therefore, the model predicts a positive risk-return trade-off. However, negative realized market risk premium is observed frequently in the data. Thus, when realized market index returns fall below risk-free rates, we should expect an inverse relation between beta and returns. They show evidence that there is a significant systematic relation between betas and returns: when the market risk premium is positive, the relation is positive; when the market risk premium is negative, the relation is negative. Isakov (1999) applies a similar approach on Swiss stock market and finds a strong relation between betas and returns.

Roy (1952) suggests that investors care differently about downside losses than they care about upside gains. Hence, it is intuitive to consider that investors perceive risk differently due to different market conditions and price movements. Bawa and Lindenberg (1977) introduce an extension of the traditional CAPM which takes into account the asymmetric perception of risk. They suggest the specification of downside beta and upside beta. Harlow and Rao (1989) introduce a Mean-Lower Partial Moment Asset Pricing model and evaluate downside beta and upside beta relative to the regular beta in traditional CAPM. Ang and Chen (2002) document asymmetric correlations between U.S. stocks and the aggregate U.S. market. Correlations are much greater for downside moves, especially for extreme downside moves, than for upside moves. Ang, Chen and Xing (2006) demonstrate that stocks with higher downside betas have higher average returns. Cheng (2005) finds that downside beta is positively related to commercial real estate portfolio returns (measured by NCREIF property index returns).

Following the intertemporal framework proposed by Merton (1973), many researches allow conditional betas to be time-varying. Among recent studies, Bollerslev, Engle, and Wooldridge (1988), Bali (2008) and Bali and Engle (2010) find a significantly positive relation between returns and condition betas in a time-series fashion. Bali, Engle, and Tang (2013) find a positive risk-return trade-off in the cross-section of stock returns by using dynamic conditional betas. Gonzalez, Nave, and Rubio (2012) find that conditional beta estimation under mixed data sampling generate better out-of-sample performance relative to OLS betas.

Starting from early 1990s, studies on betas of REIT stocks have gained more and more attention due to the diversification purpose of portfolio management of investors. A large number of studies focus on the correlation between REIT stocks and the general stock markets. Gyourko and Linneman (1988) and Hang and Liang (1995) find a strong positive correlation between REITs and common stocks. Myer and Webb (1993) show that REITs co-move with stock indices. Time-varying betas have been well documented in REIT literature. Glascock (1991) shows that betas of REIT stocks vary with market conditions. Sagalyn (1990) and Goldstein and Nelling (1999) find that REIT stocks have higher betas in declining markets than in rising markets. Chatrath *et al* (2000) and Chiang *et al* (2004) attempt to provide explanations to this so-called "asymmetric REIT-beta puzzle". Some studies note that the correlation between REITs and the general markets have been weakening, suggesting a possible sign that maturing REITs are more close to represent the performance of underlying real estate assets (see Ghosh, Miles and Sirmans (1996) and Chatrath and Liang (1999)).

Mostly recently, Case, Yang and Yildirim (2012) document dynamic correlations between REIT and stock returns using dynamic conditional correlation model with generalized autoregressive conditional heteroskedasticity (DCC-GARCH). They find that REIT-stock correlation were high prior to 1991, decreasing from the end of 1991 to 2001, and then increasing steadily after September 2001. Yet, all these researches only focus on the documentation of the time variation of betas among REIT stocks and did not further the investigation of REIT return predictability of betas.

3. Data and Methodology

3.1. Data

In this research, we use the monthly stock data from CRSP for the sample period of January 1992 to December 2014. REIT stocks are identified using SIC code of 6798. We obtain monthly CRSP equal-weighted market index returns as a proxy for the realized market returns. We also employ monthly three-month Treasury bill rate as a proxy for risk-free rate.

3.2.Methodology

In our research, we examine the beta-return relation of REIT stocks from two different perspectives: static unconditional betas as suggested in traditional CAPM framework with modification outline as in Pettengill, Sundaram and Mathur (1995), and conditional betas in the downside risk framework as suggested in Bawa and Lindenberg (1977) and recommended by Ang, Chen and Xing (2006). In both perspectives, we apply similar approach as in Fama and MacBeth (1973) to explore the relation between betas and returns.

3.2.1. Perspective 1: static CAPM beta estimation

Previous tests which use realized returns to estimate betas usually take the following form:

$$\left(R_{it} - r_f\right) = \widehat{\beta_i} \times \left(R_{mt} - r_f\right) + \varepsilon_{it}, \tag{1}$$

followed by the test for a positive beta-return relation,

$$R_{it} = \widehat{\gamma_0} + \widehat{\gamma_1} \times \beta_i + \epsilon_t. \tag{2}$$

Where R_{it} is the realized REIT return, r_f is the risk-free rate, and R_{mt} is the realized market return. If $R_{mt} - r_f < 0$, then$\widehat{\beta_i} \times \left(R_{mt} - r_f\right) < 0$. In this case, the predicted asset return includes a negative risk premium which is proportionate to beta. Thus, we should expect an inverse relation between beta and return when the realized returns fall below risk-free rate. Therefore, to better estimate the beta-return relation, we adopt the modification suggested by Pettengill, Sundaram, and Mathur (1995).

First, we use 36-month rolling window to estimate beta from traditional CAPM framework (as in Equation (1)) on individual REIT firm level. Second, betas estimated using data from *t-36* to *t-*

1 are assigned to time *t*. Third, we test for a systematic relation between beta and returns, using the methodology outline as follows (see, Pettengill, Sundaram, and Mathur (1995)).

$$R_{it} = \widehat{\gamma_{0t}} + \widehat{\gamma_{1t}} \times \delta \times \beta_i + \widehat{\gamma_{2t}} \times (1-\delta) \times \beta_i + \epsilon_{it} \qquad (3)$$

Where δ=1 if $\left(R_{mt} - r_f\right) \geq 0$, and 0 otherwise. γ_{1t} is estimated for periods with non-negative market risk premium, and γ_{2t} is estimated for periods with negative market risk premium. We expect that $\gamma_{1t} > 0$ and $\gamma_{2t} < 0$ to show that there is a significant positive risk-return trade-off as predicated by traditional CAPM framework. In addition, we conduct the test on subsample periods.

3.2.2. Perspective 2: conditional beta in downside risk framework

Bawa and Lindenberg (1977) introduce a measure of downside risk: downside beta:

$$\beta^- = \frac{cov(r_i, r_m | r_m < \mu_m)}{var(r_m | r_m < \mu_m)} \qquad (4)$$

Where r_i is security *i*'s excess return, r_m is the market excess return, μ_m is the average market excess return. Harlow and Rao (1989) make an extension to traditional CAPM and present a generalized Mean-Lower Partial Moment Asset Pricing Model (MLPM):

$$R_i = \alpha_i + \beta_i^+ R_M^+ + \beta_I^- R_M^- + \gamma_i D^+ + \varepsilon_i \qquad (5)$$

Where R_i is asset *i*'s return, R_M^+ is the market return if it exceeds a target return, and 0 otherwise, R_M^- is the market return if it falls below a target return, and 0 otherwise. D^+ is a dummy variable that equals to 1 if the market is in upturns and 0 otherwise.

Our research methodology follows the approach by Harlow and Rao (1989). First, we use 36-month rolling window to estimate downside beta and upside beta from Equation (5) on individual REIT firm level. Second, downside betas and upside betas estimated using data from *t-36* to *t-1* are assigned to time *t*. Third, we test for a systematic relation between beta and returns, using the methodology as in Fama and MacBeth (1973).

$$R_i = \theta_{0t} + \theta_{1t}^{+}\times\beta_i^{+} + \theta_{2t}^{-}\times\beta_i^{-} + \tau_{it} \qquad (6)$$

β_i^{+} and β_i^{-} measure the asymmetric sensitivity of an asset to different market conditions. If an investor is downside risk averse, β_i^{-} will demand a positive risk premium. That is, assets with higher downside betas command higher returns. If an investor prefers upside potentials, β_i^{+} will demand a negative risk premium. That is, assets with higher upside betas command lower returns. Thus, we expect that $\theta_{1t}^{+} < 0$ and $\theta_{2t}^{-} > 0$. We also perform the test methodology to subsample periods.

4. Empirical Test Results

4.1. Perspective 1: static beta estimation

First, we use rolling-window regression to estimate individual REIT beta in Equation (1) for the period of 1992 to 2014. We choose 36-month window for the rolling regressions[3]. Summary statistics of the estimated betas and returns are presented in Table 1. On average, REIT beta is lower than 1, which is consistent with previous findings that REIT stocks have defensive nature. Second, we assign estimated individual REIT betas (using data from *t-36* to *t-1*) to each REIT at time *t*. For example, REIT betas as of January 1995 will be using regression window from January 1992 to December 1994. The third step is to test the beta-return relation in cross section. In this step, we test the cross-sectional beta-return relation separately from Equation (2) and Equation (3).

[Insert Table 1 here]

[3] We also use 60-month rolling regression window. The results are similar.

Table 2 shows the results with regular betas with traditional CAPM as in Equation (2). Overall, for the full sample period of 1995 to 2012[4], the regular beta of REITs is significantly positively related to REIT returns. However, when we look into the results from subsample periods, the beta-return relation is not quite consistent as predicted by traditional CAPM. Beta-return relations from subsample periods 2007-2014 are significantly positive as expected. Beta-return relations from subsample periods 1995-1997 and 2001-2003 are insignificant. The risk premiums on betas for the subsample periods 1998-2000 and 2004-2006 are significantly negative, which is the opposite of what traditional CAPM expects. From Table 2, we can clearly see that the beta-return relation is highly dependent on the sample periods.

[Insert Table 2 here]

To restore the expected positive risk-return trade-off as predicted by CAPM, Pettengill, Sundaram and Mathur (1995) suggest a modified method to estimate the beta-return relation. The method is described in Equation (3). Table 3 presents the results estimated from Equation (3).

[Insert Table 3 here]

We create a dummy variable, δ, that is equal to 1 if the realized market returns are above or equal to the risk-free rate (measured by three-month Treasury bill rate), and 0 otherwise. Table 1 shows the average of δ, which suggest that, during the full sample period of January 1995 to December 2014, about 39.79% of the time the realized market risk premium is non-negative and 60.21% of the time the market risk premium was actually negative. Equation (3) implies that the expected risk premium on beta should be positive during market upturns (i.e. when the realized

[4] Because we use 36-month rolling window to estimate beta, the full sample period for the main results starts from 1995.

market returns are above risk-free rate), and the expected risk premium on beta should be negative during market downturns (i.e. when the realized market returns are below the risk-free rate).

Results from Table 3 confirm the expectations. We find that, throughout the whole sample period, the risk premium on regular beta estimated by traditional CAPM is highly positive during upturns and highly negative during market downturns. These results suggest that REIT stocks with higher betas are more sensitive to the market movements than ones with lower betas. When the market goes up, REIT stocks with higher betas go up more than ones with lower betas; when the market goes down, REIT stocks with higher betas go down more than ones with lower betas. This is consistent with the prediction by traditional CAPM that there is a positive risk-return trade-off. Apart from the subsample period of 1995 to 1997, all the other subsample periods show highly significantly coefficients on the betas as expected.

Moreover, we sort REIT stocks into five quintiles based on the regular betas estimated from Equation (2). Then we calculate the equal-weighted portfolio returns and repeat the rolling-window regression analysis of beta-return relation on portfolio level. Table 4 exhibit the results from Equation (3) on REIT portfolio level.

[Insert Table 4 here]

Panel A in Table 4 shows the summary statistics of REIT portfolios on beta and returns. Panel B shows the beta-return relation in REIT stocks on portfolio level. We can see that the results on the portfolio level are consistent with the REIT stock level results. We find that, throughout the whole sample period, the risk premium on regular beta estimated by traditional CAPM is highly positive during upturns and highly negative during market downturns. These results suggest that REIT portfolios with higher betas are more sensitive to the market movements than ones with lower betas.

When the market goes up, higher-beta REIT portfolios tend to go up more than ones with lower betas; when the market goes down, higher-beta REIT portfolios tend to go down more than ones with lower betas. This is consistent with the prediction by traditional CAPM that there is a positive risk-return trade-off.

4.2. Perspective 2: conditional beta estimation in downside risk framework

In this section, we intend to test the downside risk of REIT stocks. We estimate upside and downside betas following the method proposed by Harlow and Rao (1989). First, we use rolling-window (36 months) regression to estimate individual REIT beta in Equation (5) for the period of 1992 to 2012. A dummy variable is created to be equal to 1 if the market return exceeds the risk-free rate and 0 otherwise. Table 5 shows the summary statistics of upside beta (β^+), downside beta (β^-) and the dummy variable. On average, both upside beta (β^+) and downside beta (β^-) are below 1. However, we have larger dispersions among both betas than the regular beta estimated in earlier section from Table 1.

[Insert Table 5 here]

Second, we assign estimated individual REIT upside betas and downside betas (using data from *t-36* to *t-1*) to each REIT at time *t*. For example, REIT betas as of January 1995 will be using regression window from January 1992 to December 1994. Third, we test the beta-return relation in cross section. In this step, we test the cross-sectional beta-return relation indicated from Equation (6).

[Insert Table 6 here]

Table 6 presents the regression results from Equation (6). As we discussed earlier, we expect the risk premium on upside beta to be negative if investors prefer upside potentials of an asset, and the risk premium on downside beta to be positive if investors are downside risk averse. The results support our expectations. Throughout the whole sample period of 1995 to 2014[5], the risk premium on downside beta (β^{-}) is significantly positive. This suggests that REIT investors are downside risk averse and demand a higher risk premium for REIT stocks with higher downside betas. However, the risk premium on upside beta (β^{+}) is negative but insignificant. One possible explanation could be that investors view REIT stocks as defensive stocks, and they asymmetrically care more about the downside risk than upside potentials. The subsample period analysis yield similar results even though three subsample periods (1998-2000, 2001-2003, 2004-2006, and 2013-2014) exhibit insignificant or opposite results. This could be a result from the high-growth in commercial real estate markets during that time period of 1998 to 2006. Also, we find that for subsample periods 2010-2014, the risk premium on upside beta (coefficient on β^{+}) is significantly positive. The results indicate that, in the post-crisis recovery period after 2009, real estate investors care about upside growth potential as well as downside risk. Overall, we find supporting evidence that asymmetric risk matters to REIT stocks.

5. Conclusion

In this research effort, we examine the beta-return relation among REIT stocks. We test the beta-return relation from two different angles: first, we examine the relation based on the method proposed by Pettengill *et al* (1995). We split the sample into up and down market periods. We find that during market upturns the risk premium on unconditional betas is positive; while during market downturns, the risk premium on beta is negative. This suggests that there is a positive risk-return trade-off as predicted by traditional CAPM.

Second angle to investigate this beta-return relation is developed based on the downside risk framework as in Bawa and Lindenberg (1977) and Harlow and Rao (1989). We estimate upside and downside betas for REIT stocks, and show that REIT stocks with higher downside betas exhibit

[5] Because we use 36-month rolling window to estimate beta, the full sample period for the main results starts from 1995.

higher returns. We also find results that REIT upside betas are not significantly associated with REIT returns. These results are consistent with the findings in Cheng (2005), Ang *et al* (2006) and Case *et al* (2012). We find evidence that as REIT stock market deepens, it co-varies with the general stock market more and that beta is alive and well for REIT firms. The work also suggests that investors of REIT stocks are more concerned with downside risk associated with the securities.

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Table 1: Summary of Statistics

This table presents the summary of descriptive statistics of beta, delta, and returns for the sample period of January 1992 to December 2014. The estimated unconditional beta from traditional CAPM, using Equation (1):

$$(R_{it} - r_f) = \widehat{\beta_i} \times (R_{mt} - r_f) + \varepsilon_{it}, \tag{1}$$

Excess market return is the CRSP equal-weighted index return net of risk-free rate. Excess REIT return is the monthly REIT stock return net of risk-free rate. Three-month Treasury bill rate is used as a proxy for risk-free rate. We use 36-month rolling window to estimate beta from traditional CAPM framework (as in Equation (1)) on individual REIT firm level. Second, betas estimated using data from *t-36* to *t-1* are assigned to time *t*. The dummy variable, δ, is equal to 1 if excess market return is non-negative and 0 otherwise.

	β	δ	Excess Market Return	Excess REIT return
N	37695	37695	37695	37695
MIN	-4.1617	0	-0.2454	-0.9535
MAX	8.4777	1	0.1912	3.4337
MEAN	0.6324	0.3979	-0.0141	-0.0131
STD	0.6078	0.4895	0.05994	0.1112

Table 2: Unconditional Beta-Return Relation

This table shows the unconditional beta-return relation estimated from Equation (2) using Fama-MacBeth (1973) methodology.

$$R_{it} = \widehat{\gamma_0} + \widehat{\gamma_1} \times \beta_i + \epsilon_t. \qquad (2)$$

A positive coefficient on β is expected to show a positive risk-return trade-off. Tests are also performed for various subsample periods. Estimated unconditional betas are estimated in Table 1.

		Coefficient (t-value)	P-Value
Full Sample (1995-2014)	Intercept	-0.0230 (-27.91)	<.0001
	Beta	0.0156 (16.64)	<.0001
Subsample 1 (1995-1997)	Intercept	-0.0316 (-20.46)	<.0001
	Beta	0.0003 (0.11)	0.9099
Subsample 2 (1998-2000)	Intercept	-0.0450 (-24.76)	<.0001
	Beta	-0.0145 (-3.75)	0.0002
Subsample 3 (2001-2003)	Intercept	-0.0005 (-0.32)	0.7490
	Beta	0.0054 (1.52)	0.1276
Subsample 4 (2004-2006)	Intercept	-0.0098 (-6.49)	<.0001
	Beta	-0.0107 (-4.66)	<.0001
Subsample 5 (2007-2009)	Intercept	-0.0498 (-10.92)	<.0001
	Beta	0.0245 (6.11)	<.0001
Subsample 6 (2010-2012)	Intercept	0.0045 (1.85)	0.0646
	Beta	0.0102 (5.74)	<.0001
Subsample 7 (2013-2014)	Intercept	0.0074 (3.38)	0.0007
	Beta	0.0082 (3.74)	<.0001

Table 3: Beta-return Relation Conditional on Market Conditions

This table presents results on beta-return relation conditional on market conditions. We test for a systematic relation between beta and returns, using the methodology outline as follows (see, Pettengill, Sundaram, and Mathur (1995)).

$$R_{it} = \widehat{\gamma_{0t}} + \widehat{\gamma_{1t}} \times \delta \times \beta_i + \widehat{\gamma_{2t}} \times (1-\delta) \times \beta_i + \epsilon_{it} \quad (3)$$

Where δ=1 if $(R_{mt} - r_f) \geq 0$, and 0 otherwise. γ_{1t} is estimated for periods with non-negative market risk premium, and γ_{2t} is estimated for periods with negative market risk premium. We expect that $\gamma_{1t} > 0$ and $\gamma_{2t} < 0$ to show that there is a significant positive risk-return trade-off as predicated by traditional CAPM framework. In addition, we conduct the test on subsample periods.

			Panel A: Market Upturns			Panel B: Market Downturns		
	Intercept	t-statistics	γ1	t-statistics	p-value	γ2	t-statistics	p-value
Full Sample (1995-2014)	-0.0180	-22.81	0.0503	47.69	<.0001	-0.0270	-23.92	<.0001
Subsample 1 (1995-1997)	-0.0316	-20.46	0.0023	0.40	0.6897	-0.00003	-0.01	0.9893
Subsample 2 (1998-2000)	-0.0452	-24.92	0.0121	2.03	0.0419	-0.0225	-5.51	<.0001
Subsample 3 (2001-2003)	-0.0007	-0.49	0.0486	11.00	<.0001	-0.0444	-9.47	<.0001
Subsample 4 (2004-2006)	-0.0108	-7.39	0.0392	12.09	<.0001	-0.0247	-10.66	<.0001
Subsample 5 (2007-2009)	-0.0213	-4.98	0.0764	18.96	<.0001	-0.0561	-12.58	<.0001
Subsample 6 (2010-2012)	0.0045	1.94	0.0331	18.07	<.0001	-0.0217	-10.93	<.0001
Subsample 7 (2013-2014)	0.0090	4.21	0.0182	8.18	<.0001	-0.0187	-6.73	<.0001

Table 4: Beta-Return Relation on Portfolio Level

This table shows the beta-return relation on REIT portfolio level. We sort REIT stocks into five quintiles based on the regular betas estimated from Equation (2). Then we calculate the equal-weighted portfolio returns and repeat the rolling-window (36 months) regression analysis of beta-return relation on portfolio level.

Panel A: Summary Statistics on Portfolio Level				
	Portfolio β	δ	Excess Market Return	Excess Portfolio Return
N	1020	1020	1020	1020
MIN	0.0794	0	-0.2454	-0.3893
MAX	2.1058	1	0.1912	0.5447
MEAN	0.6786	0.4265	-0.0117	-0.0112
STD	0.4493	0.4948	0.0625	0.0685

Panel B: Beta-Return Trade-off on Portfolio Level					
	Unconditional		Conditional		
Portfolio	Intercept	Beta	Intercept	γ1	γ2
1	-0.0204***	0.0119	-0.0158***	0.0598***	-0.0426***
	(-2.82)	(0.88)	(-2.63)	(4.84)	(-3.37)
2	-0.0317***	0.0364***	-0.0256***	0.0737***	-0.0157
	(-4.13)	(2.97)	(-3.91)	(6.57)	(-1.31)
3	-0.0303***	0.0307**	-0.0206***	0.0671***	-0.0298**
	(-3.50)	(2.56)	(-2.85)	(6.33)	(-2.55)
4	-0.0373***	0.0395***	-0.0239***	0.0669***	-0.0223*
	(-4.02)	(3.68)	(-2.98)	(6.97)	(-1.95)
5	-0.0542***	0.0433***	-0.0318***	0.0666***	-0.0241**
	(-4.13)	(3.86)	(-2.85)	(6.92)	(-2.07)

Table 5: Summary of Statistics

This table presents a summary of descriptive statistics on variables estimated from the generalized lower-partial moment asset pricing model proposed by Harlow and Rao (1989):

$$R_i = \alpha_i + \beta_i^+ R_M^+ + \beta_I^- R_M^- + \gamma_i D^+ + \varepsilon_i \qquad (5)$$

Where $R_i$is asset i's return, $R_M^+$is the market return if it exceeds a target return, and 0 otherwise, R_M^- is the market return if it falls below a target return, and 0 otherwise. $D^+$is a dummy variable that equals to 1 if the market is in upturns and 0 otherwise. $\beta^+$is upside beta, which measures the REIT stocks' upside sensitivity; $\beta^-$is downside beta, which measures the REIT stocks' downside risk.

	β^+	β^-	D+
N	37695	37695	37695
MIN	-288.574	-118.935	0
MAX	116.283	46.587	1
MEAN	0.5639	0.7160	0.3979
STD	7.9886	1.3732	0.4895

Table 6: Asymmetric Beta-Return Relations

This table shows the asymmetric beta-return relation of REIT stocks. Upside beta and downside beta are estimated using 36-month rolling window indicated in Equation (5). Then we estimate Equation (6) to show the risk premiums on asymmetric betas to show asymmetric beta-return relations.

$$R_i = \theta_{0t} + \theta_{1t}^{+} \times \beta_i^{+} + \theta_{2t}^{-} \times \beta_i^{-} + \tau_{it} \qquad (6)$$

Where β_i^{+} and β_i^{-} measure the asymmetric sensitivity of an asset to different market conditions. If an investor is downside risk averse, β_i^{-} will demand a positive risk premium. That is, assets with higher downside betas command higher returns. If an investor prefers upside potentials, β_i^{+} will demand a negative risk premium. That is, assets with higher upside betas command lower returns. Thus, we expect that $\theta_{1t}^{+} < 0$ and $\theta_{2t}^{-} > 0$. We also perform the test methodology to subsample periods.

	Model 1		Model 2		Model 3		Model 4	
Full Sample (1995-2014)	Intercept	-0.0230*** (-27.91)	Intercept	-0.0131*** (-22.75)	Intercept	-0.0160*** (-24.83)	Intercept	-0.0160*** (-24.73)
	β	0.0156*** (16.64)	β^{+}	-0.0001 (-1.00)	β^{-}	0.0041*** (9.77)	β^{+}	-0.0001 (-1.24)
							β^{-}	0.0041*** (9.80)
Subsample 1 (1995-1997)	Intercept	-0.0316*** (-20.46)	Intercept	-0.0315*** (-26.14)	Intercept	-0.0330*** (-22.80)	Intercept	-0.0330*** (-22.78)
	β	0.0003 (0.11)	β^{+}	0.0000 (0.23)	β^{-}	0.0035* (1.84)	β^{+}	0.00002 (0.38)
							β^{-}	0.0036* (1.87)
Subsample 2 (1998-2000)	Intercept	-0.0450*** (-24.76)	Intercept	-0.0496*** (-40.53)	Intercept	-0.0476*** (-29.61)	Intercept	-0.0472*** (-29.04)
	β	-0.0145*** (-3.75)	β^{+}	-0.0004* (-1.87)	β^{-}	-0.0064** (-2.33)	β^{+}	-0.0004* (-1.73)
							β^{-}	-0.0062** (-2.23)
Subsample 3 (2001-2003)	Intercept	-0.0005 (-0.32)	Intercept	0.0003 (0.19)	Intercept	0.0004 (0.26)	Intercept	0.0002 (0.11)
	β	0.0054 (1.52)	β^{+}	0.0018 (1.57)	β^{-}	0.0014 (0.60)	β^{+}	0.0017 (1.46)
							β^{-}	0.0004 (0.17)
Subsample 4 (2004-2006)	Intercept	-0.0098*** (-6.49)	Intercept	-0.0153*** (-16.53)	Intercept	-0.0144*** (-11.92)	Intercept	-0.0143*** (-11.69)
	β	-0.0107*** (-4.66)	β^{+}	-0.0009 (-0.85)	β^{-}	-0.0016 (-1.44)	β^{+}	-0.0007 (-0.66)
							β^{-}	-0.0015 (-1.34)

Subsample 5 (2007-2009)	Intercept	-0.0498*** (-10.92)	Intercept	-0.0252*** (-9.99)	Intercept	-0.0532*** (-12.44)	Intercept	-0.0535*** (-12.52)
	β	0.0245*** (6.11)	β^{+}	-0.0011*** (-3.00)	β^{-}	0.0288*** (7.68)	β^{+}	-0.0015*** (-4.10)
							β^{-}	0.0309*** (8.18)
Subsample 6 (2010-2012)	Intercept	0.0045* (1.85)	Intercept	0.0117*** (6.39)	Intercept	0.0103*** (5.08)	Intercept	0.0085*** (3.96)
	β	0.0102*** (5.74)	β^{+}	0.0036*** (3.75)	β^{-}	0.0051*** (3.93)	β^{+}	0.0026** (2.51)
							β^{-}	0.0038*** (2.78)
Subsample 7 (2013-2014)	Intercept	0.0074*** (3.38)	Intercept	0.0086*** (5.22)	Intercept	0.0135*** (10.98)	Intercept	0.0081*** (4.84)
	β	0.0082*** (3.74)	β^{+}	0.0072*** (4.82)	β^{-}	0.0006* (1.85)	β^{+}	0.0070*** (4.70)
							β^{-}	0.0005 (1.52)